



## System Planning and Engineering

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### Note

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

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This chapter describes the basic planning and engineering information required to configure an ONS 15454 for deployment.

The following topics are covered in this chapter:

- [Shelf Configurations, page 7-1](#)
- [Shelf Assembly Configuration Rules, page 7-13](#)
- [Power and Grounding, page 7-34](#)
- [Alarm and Control Connections, page 7-39](#)
- [Cabling, page 7-49](#)
- [Synchronization, page 7-75](#)
- [Card Protection Configurations, page 7-91](#)
- [In-Service Low-Density to High-Density Upgrades, page 7-104](#)
- [GBICs and SFPs, page 7-105](#)



### Note

The terms ONS 15454, shelf, and node shall mean a single ONS 15454 assembly shelf in this chapter.

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## Shelf Configurations

The ONS 15454 is a flexible platform that can be deployed in three types of configurations; multiservice provisioning platform (MSPP), multiservice transport platform (MSTP) or Hybrid. Each of these configurations requires a minimum set of components to operate the system. The following tables outline the minimum required components necessary to operate an ONS 15454 node.

## MSPP Configurations

Cisco ONS 15454 MSPP configurations provide efficient multiservice aggregation (multiplexing) to SONET transport. [Table 7-1](#) outlines the minimum components needed to build a functional MSPP node.

**Table 7-1** Minimum MSPP Node Configuration

Component	Terminal Node	Linear ADM Node	Two-Fiber Ring Node	Four-Fiber Ring Node
Shelf Assembly	1	1	1	1
Fan Tray Assembly	1	1	1	1
Air Filter	1	1	1	1
Timing, Communications, Control (TCC+/TCC2/TCC2P) Card	2	2	2	2
Cross-connect Card	2	2	2	2
Optical Card	2	4	2	4
System Software License	1	1	1	1

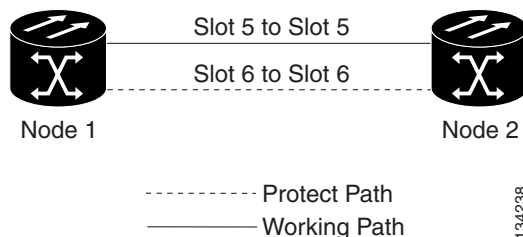
An ONS 15454 MSPP node can be activated with only the above equipment. You will then need to select appropriate service interfaces, which can include optical cards, electrical cards (with appropriate electrical interface adapter [EIA] panels), Ethernet cards, and storage access networking (SAN) cards to meet the particular deployment application.

## Point-to-Point Nodes

Point-to-point or 1+1 protected extensions are often used to interconnect SONET subnetworks. Examples include interconnection of two access networks and interconnection between interoffice rings. ONS 15454 nodes can be configured to provide 1+1 protected transport directly to end users when the fiber topology warrants point-to-point connection rather than ring connection.

[Figure 7-1](#) shows two ONS 15454 nodes in a point-to-point configuration. Working traffic flows from Slot 5/Node 1 to Slot 5/Node 2. You create the protect path by placing Slot 6/Node 1 in 1+1 protection with Slot 6/Node 2.

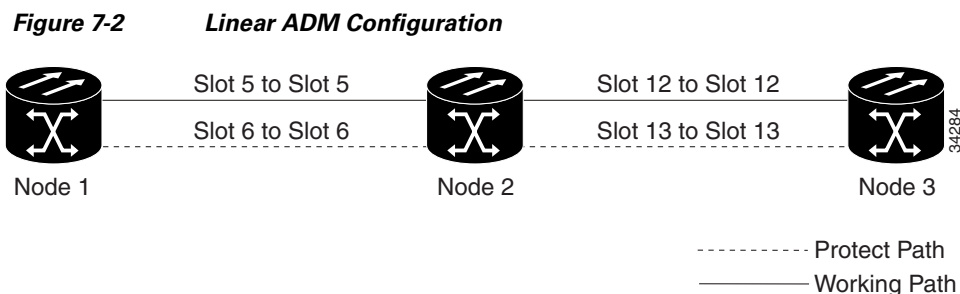
**Figure 7-1** Point-to-Point 1+1 Protection Configuration



## Linear ADM Nodes

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 7-2 shows three ONS 15454 nodes in a linear ADM configuration. Working traffic flows from Slot 5/Node 1 to Slot 5/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.



## Path Protection Nodes

Path protection configurations 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 with the working traffic path, the receiving node switches to the path coming from the opposite direction.

Path protection is the default ring configuration for the ONS 15454. CTC automates the path protection configuration on a circuit-by-circuit basis during the circuit provisioning process. 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 path protection as the default.

A path protection circuit requires two DCC-provisioned optical spans per node. Path protection circuits can be created across these spans until their bandwidth is consumed.



### Note

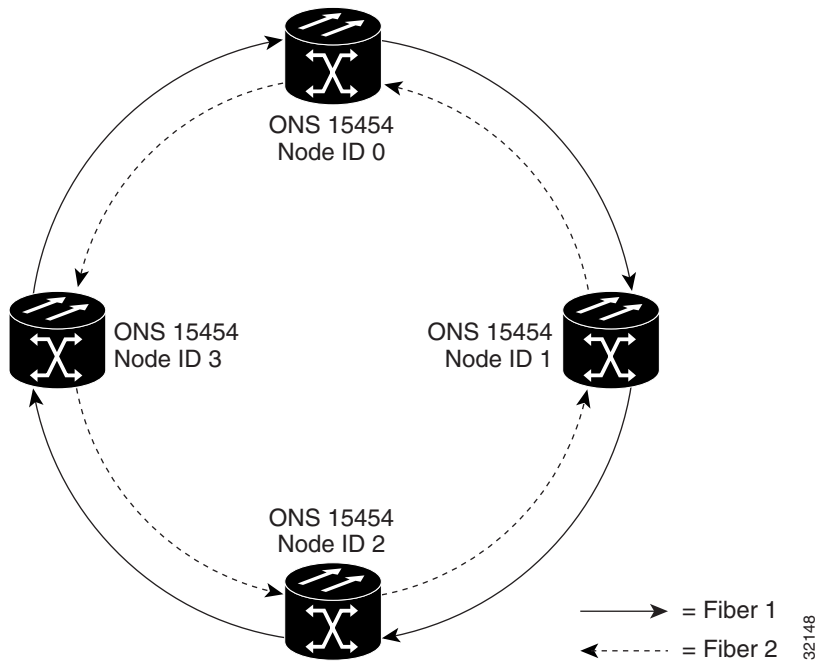
If a path protection circuit is created manually by TL1, data communications channels (DCCs) are not needed. Therefore, path protection circuits are limited by the cross-connection bandwidth, or the span bandwidth, but not by the number of DCCs.

The span bandwidth consumed by a path protection circuit is two times the circuit bandwidth, because the circuit is duplicated. The cross-connection bandwidth consumed by a path protection circuit is three times the circuit bandwidth at the source and destination nodes only. The cross-connection bandwidth consumed by an intermediate node has a factor of one. The same STSs assigned to a circuit are used throughout the ring.

The path protection circuit limit is the sum of the optical bandwidth containing 10 section data communications channels (SDCCs) divided by two if you are using redundant TCC+ cards or 84 SDCCs divided by two if you are using redundant TCC2/TCC2P cards. The spans can be of any bandwidth from OC-3 to OC-192. The circuits can be of any size from VT1.5 to STS-192c.

Figure 7-3 shows a basic OC-48 path protection 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.

Figure 7-3 Basic OC-48 Path Protection Configuration



## Path Protection Fiber Connections

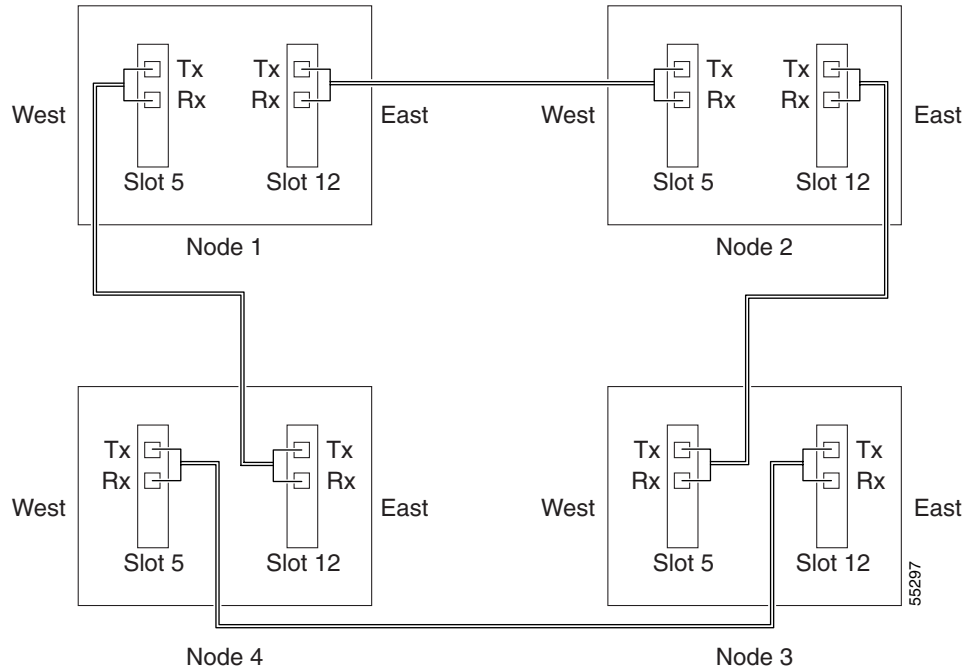
Plan your fiber connections and use the same plan for all path protection nodes. For example, make the east port the farthest slot to the right and the west port the farthest slot to the left. Plug fiber connected to an east port at one node into the west port on an adjacent node. Figure 7-4 shows fiber connections for a path protection with trunk cards in Slot 5 (west) and Slot 12 (east) at each of the nodes in the ring. Refer to the *Cisco ONS 15454 Procedure Guide* for fiber connection procedures.



### 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 display an SF LED when Tx and Rx connections are mismatched.

**Figure 7-4** Connecting Fiber to a Four-Node Path Protection

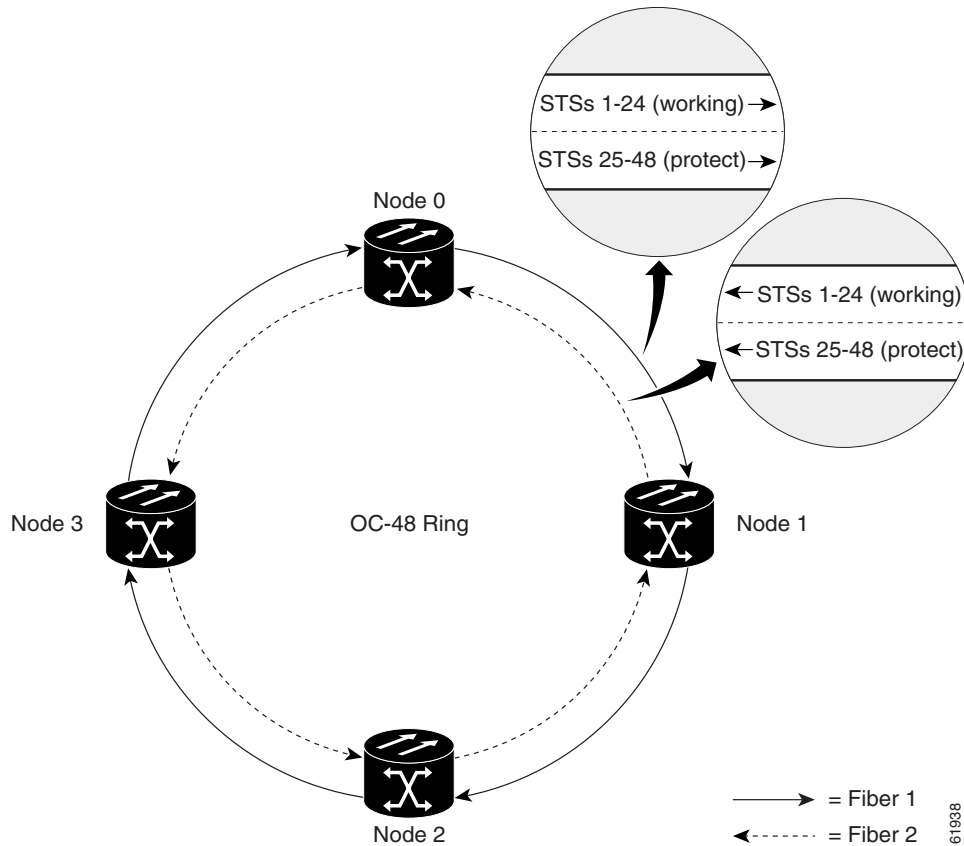


For more information about path protection configurations, refer to Chapter 2 in this document.

## Two-Fiber BLSR Nodes

In two-fiber BLSR nodes, each fiber is divided into working and protect bandwidths. For example, in an OC-48 BLSR (Figure 7-5), STSs 1 to 24 carry the working traffic, and STSs 25 to 48 are reserved for protection. Working traffic (STSs 1 to 24) travels in one direction on one fiber and in the opposite direction on the second fiber. STS bandwidth can be reused as traffic is added or dropped at various nodes. An ONS 15454 network can support up to 16 nodes in a BLSR.

**Figure 7-5 Four-Node, Two-Fiber BLSR**



The Cisco Transport Controller (CTC) circuit routing routines calculate the shortest path for circuits based on many factors, including user requirements, traffic patterns, and distance. For example, in [Figure 7-5](#) circuits going from Node 0 to Node 1 typically travel on Fiber 1, unless that fiber is full, in which case circuits are routed on Fiber 2 through Node 3 and Node 2. Traffic from Node 0 to Node 2 (or Node 1 to Node 3) can be routed on either fiber, depending on circuit provisioning requirements and traffic loads.

The SONET K1, K2, and K3 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 a reverse direction on the protect bandwidth until it reaches its destination node. At that point, traffic is switched back to the working bandwidth.

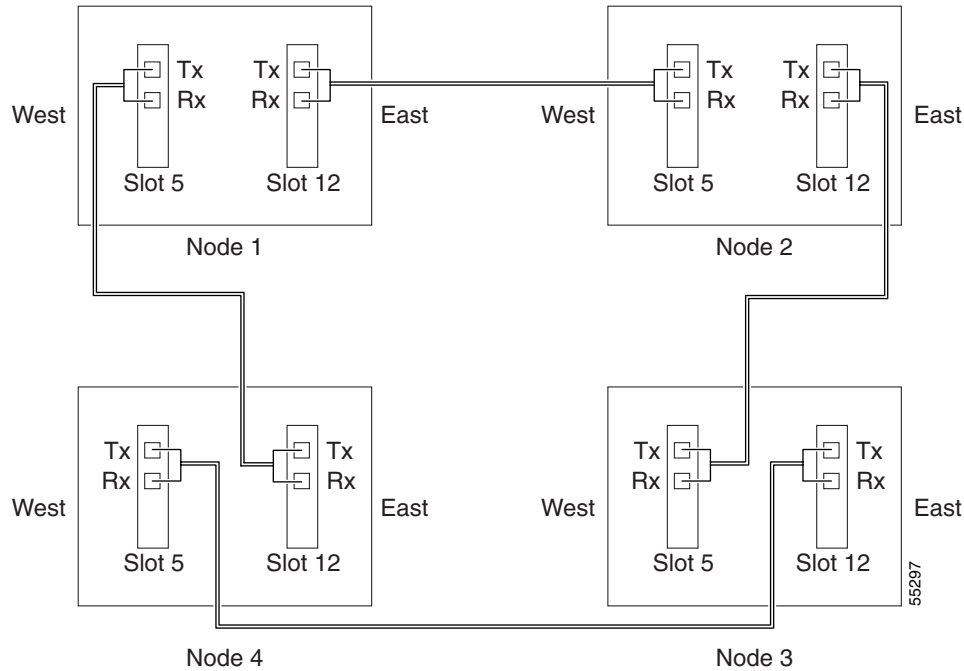
## Fiber Connections for Two-Fiber BLSR Nodes

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 slot to the left. Plug fiber connected to an east port at one node into the west port on an adjacent node. [Figure 7-6](#) shows fiber connections for a two-fiber BLSR with trunk cards in Slot 5 (west) and Slot 12 (east). Refer to the Cisco ONS 15454 Procedure Guide for fiber connection procedures.

**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 display an SF LED when Tx and Rx connections are mismatched.

**Figure 7-6** Connecting Fiber to a Four-Node, Two-Fiber BLSR

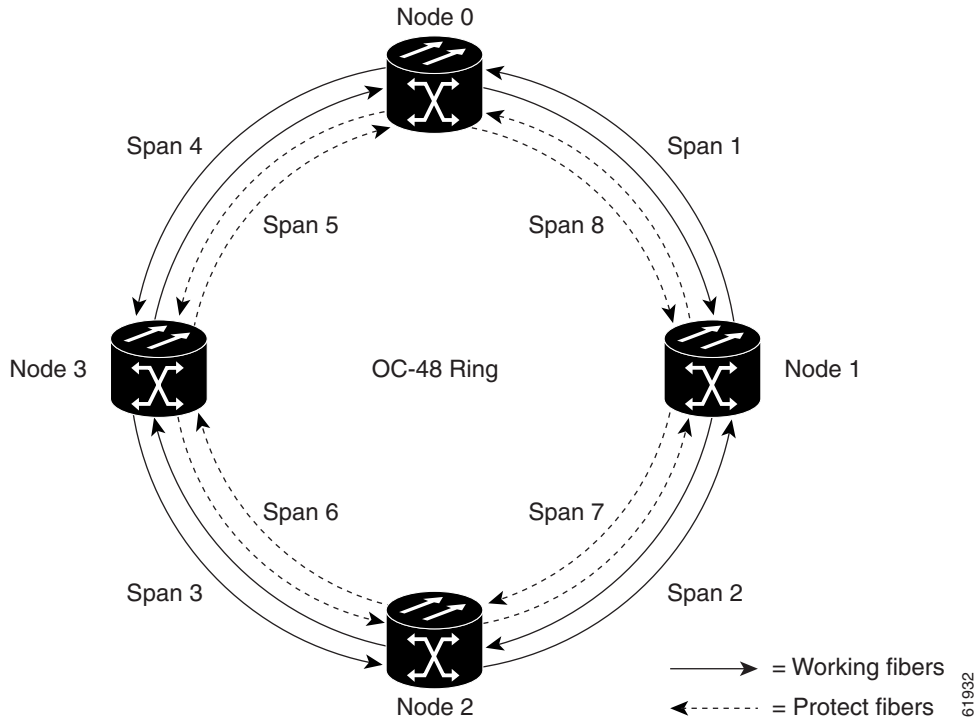


For more information on two-fiber BLSRs, refer to Chapter 2 in this document.

## Four-Fiber BLSR Nodes

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 7-7](#). To implement a four-fiber BLSR, you must install four OC-48, OC-48AS, or OC-192 cards at each BLSR node. Four-fiber BLSRs provide span and ring switching.

Figure 7-7 Four Node, Four-Fiber BLSR

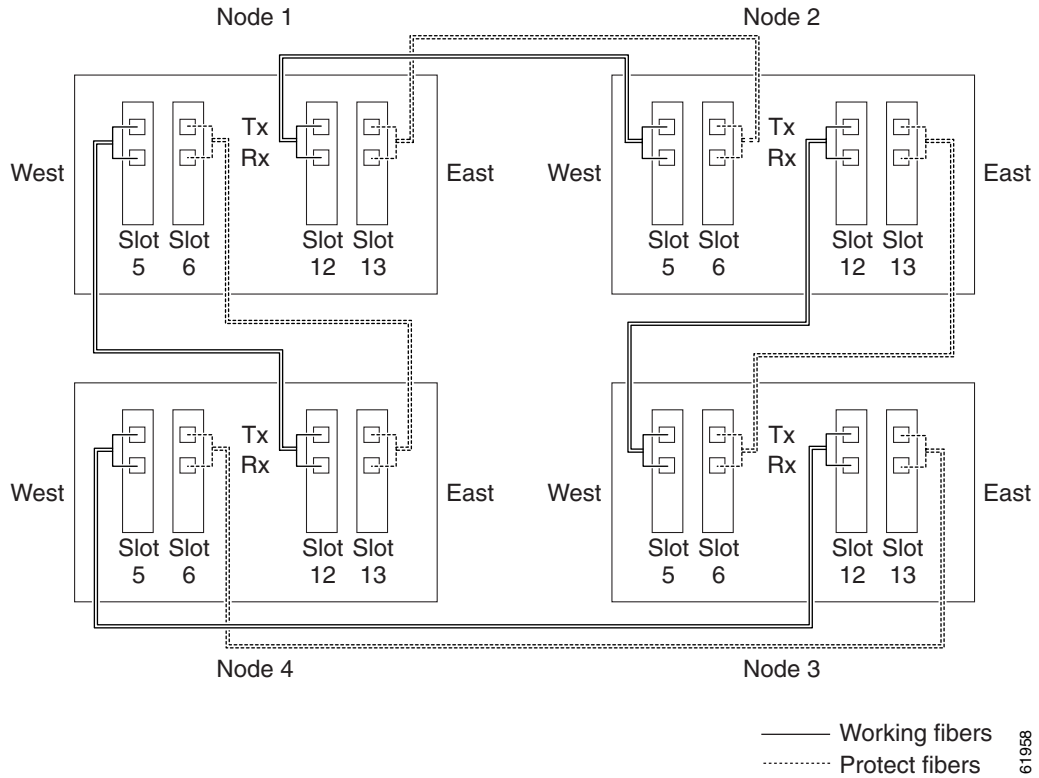


### Fiber Connections to a Four-Fiber BLSR Node

For four-fiber BLSRs, use the same east-west connection pattern for the working and protect fibers as you would for two-fiber BLSRs. Do not mix working and protect card connections. The BLSR does not function if working and protect cards are interconnected. Figure 7-8 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 7-8 Connecting Fiber to a Four-Node, Four-Fiber BLSR**



For more information on four-fiber BLSRs, refer to Chapter 2 in this document.

## Subtended Rings

The ONS 15454 supports up to ten SONET SDCCs with TCC+ cards and 84 SONET SDCCs with TCC2/TCC2P cards. See [Table 7-2](#) and [Table 7-3](#) for the maximum number of rings supported per ONS 15454 node.

**Table 7-2 ONS 15454 Rings with Redundant TCC+ Cards**

Ring Type	Maximum Rings per Node
2-Fiber BLSR	2
4-Fiber BLSR	1
Path protection	5

**Table 7-3 ONS 15454 Rings with Redundant TCC2/TCC2P Cards**

Ring Type	Maximum Rings per Node
2-Fiber BLSR	5
4-Fiber BLSR	1
Path protection	42

Table 7-4 shows the combination of subtending ring configurations each ONS 15454 can support.

**Table 7-4 Supported Subtending Ring Configurations**

< Release 3.4	Release 4.0 - 4.1	> Release 4.6
5 path protection configurations, or	16 path protection configurations, or	34 path protection configurations, or
4 path protection configurations and 1 Two-Fiber BLSR, or	15 path protection configurations and 1 Two-Fiber BLSR, or	29 path protection configurations and 5 Two-Fiber BLSRs, or
3 path protection configurations and 2 Two-Fiber BLSRs, or	14 path protection configurations and 2 Two-Fiber BLSRs, or	28 path protection configurations, 4 Two-Fiber BLSRs, and 1 Four-Fiber BLSR, or
3 path protection configurations and 1 Four-Fiber BLSR	14 path protection configurations and 1 Four-Fiber BLSR	38 path protection configurations and 1 Four-Fiber BLSR

Subtending rings reduce the number of nodes and cards required and reduce external shelf-to-shelf cabling. Figure 7-9 shows multiple rings subtending from Node 1 inside the CO. Node 1 is part of an OC-192 BLSR. It has an OC-192 BLSR going into the primary shelf, three OC-12 subtending path protection configurations, and one 1+1 OC-48 drop to the subtending shelf (see Figure 7-10). The subtending shelf contains multiple OC-3 and DS-3 drops supporting various end users.

**Figure 7-9 Multiple Subtending Rings**

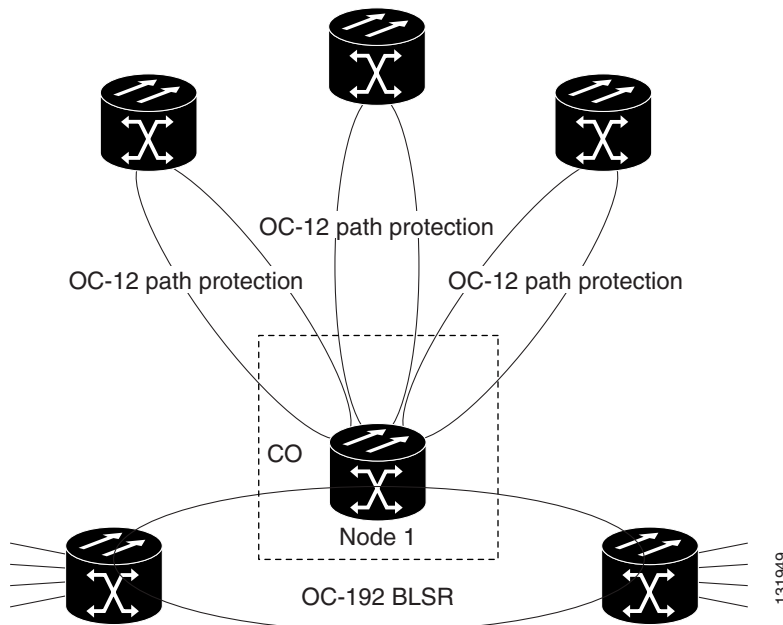
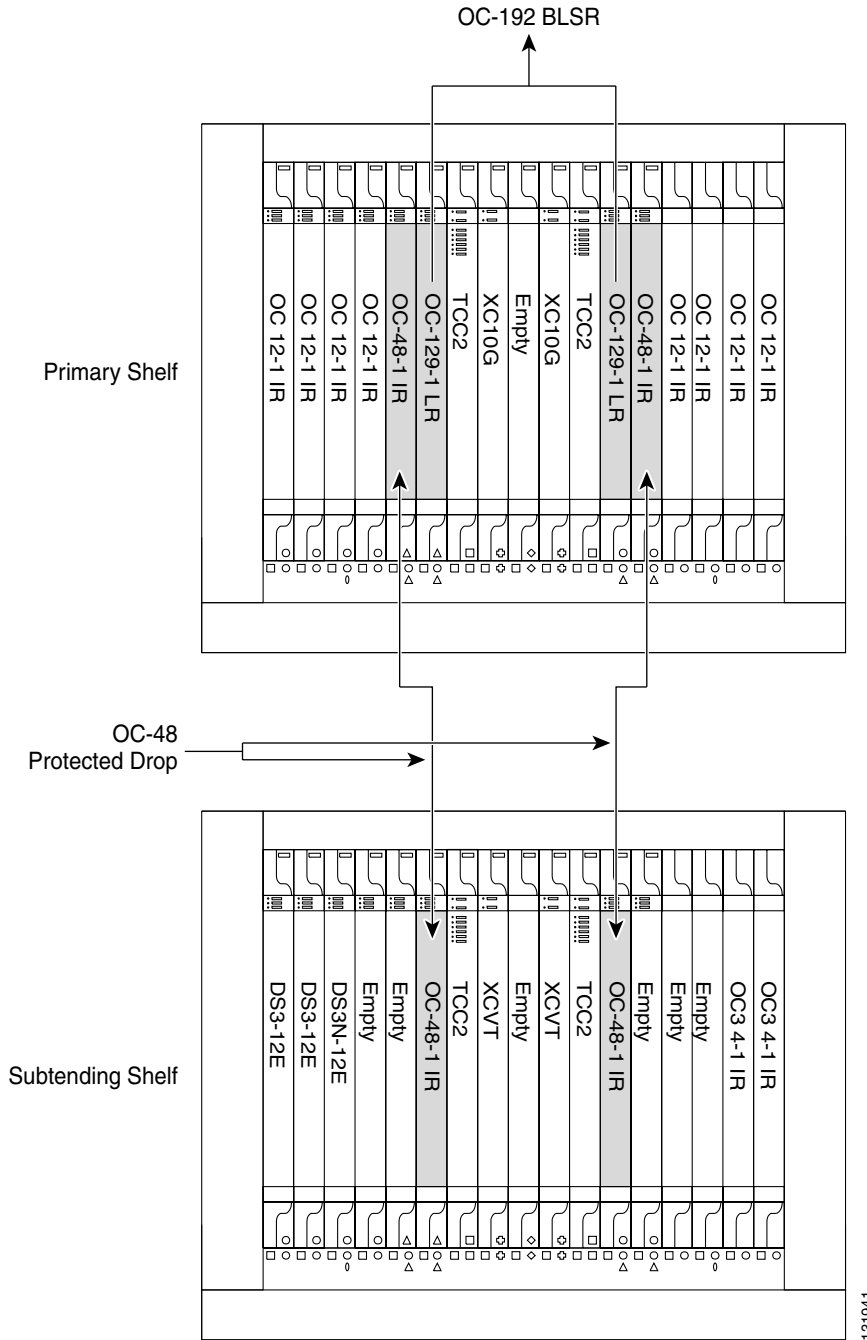


Figure 7-10 Node 1 Subtending Shelves



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## MSTP Configurations

MSTP nodes provide wavelength aggregation for DWDM transport. [Table 7-5](#) and [Table 7-6](#) outline the minimum components necessary, by ring and linear node types, to build a functional MSTP system.

**Note**

The Cisco MetroPlanner R2.5 tool is a network design tool available to Cisco sales engineers for MSTP configurations. MetroPlanner prepares a shelf plan for each network node and calculates the power and attenuation levels for the DWDM cards installed in the node. For information about Cisco MetroPlanner, refer to the *Cisco MetroPlanner DWDM Operations Guide, Release 2.5*.

**Table 7-5 Ring Network Component Requirements by Node Type**

Component	Hub Node	Passive OADM Node	Active OADM Node	Line Amplifier Node
Shelf Assembly	1	1	1	1
Fan Tray Assembly	1	1	1	1
TCC2/TCC2P card	2	2	2	2
Optical Sevice Channel (OSC) card	2	2	2	2
Multiplexer card	2	—	—	—
Demultiplexer card	2	—	—	—
Optical Add/Drop Multiplexer (OADM) card	—	2	2	-
Optical Amplifier card	Distance Dependent	—	2	2
System software license	1	1	1	1
Fiber Patch Panel shelf	2	—	—	—
Fiber Storage shelf	1	1	1	1

**Table 7-6 Linear Network Component Requirements by Node Type**

Component	Hub Node	Passive OADM Node	Active OADM Node	Line Amplifier Node
Shelf Assembly	1	1	1	1
Fan Tray Assembly	1	1	1	1
TCC2/TCC2P Card	2	2	2	2
Optical Sevice Channel (OSC) Card	1	2	2	2
Multiplexer Card	1	—	—	—
Demultiplexer Card	1	—	—	—
Optical Add/Drop Multiplexer (OADM) Card	—	2	2	—
Optical Amplifier Card	Distance Dependent	—	2	2
System Software License	1	1	1	1
Fiber Patch Panel Shelf	1	—	—	—
Fiber Storage Shelf	1	1	1	1

Each of the ONS 15454 MSTP node can be activated with only the above equipment. Depending upon your particular application, the system will require additional components, including optical services cards and additional optical filters. For additional information regarding MSTP node types, refer to Chapter 4 in this document or the Cisco ONS 15454 DWDM Installation and Operations Guide.

## Hybrid Configuration

The Hybrid configuration is a combination of the MSPP and MSTP functionality contained within a single network element. Each of these system configurations will be unique and will require a minimum of the following equipment outlined in [Table 7-7](#).

**Table 7-7** Minimum Hybrid Node Requirements

Component	Hybrid Node
Shelf Assembly	1
Fan Tray Assembly	1
TCC2/TCC2P Card	2
Cross-connect Card	2
System Software License	1

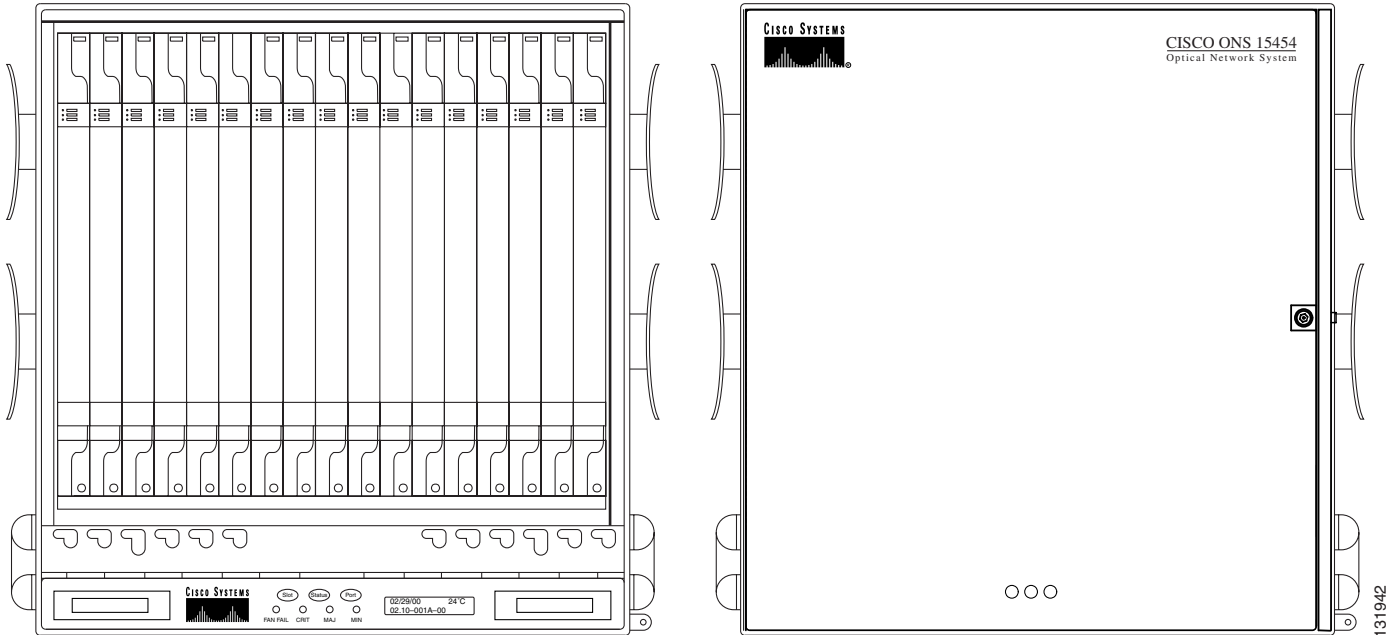
Hybrid nodes may also include optical filters, amplifiers, optical service channel cards, multiservice interfaces, Transponders, Muxponders, or a combination of these components.

## Shelf Assembly Configuration Rules

Each shelf assembly requires you to follow a minimal set of configuration rules for proper operation and performance. The main rules focus on selecting an assembly shelf and fan tray assembly, understanding ONS 15454 card slot assignments, and choosing the common control and cross-connect cards compatible with your software release.

The ONS 15454 shelf assembly, shown in [Figure 7-11](#), is a very compact footprint with an integrated upper air ramp and fan tray slot enabling up to 4 shelves to be installed within a typical 7-foot high ANSI equipment rack, including room for a 1.75-inch high fuse and alarm panel. The shelf assembly supports rear mounted connections for redundant -48 VDC power inputs, LAN interfaces, timing inputs and outputs, and housekeeping alarms. The ONS 15454 shelf assembly provides flexibility through pluggable front access interface card slots for common control and service interface cards and flexible electrical signal termination capabilities through the rear mounted, pluggable electrical interface adapter (EIA) panels. The shelf assembly comes equipped with mounting hardware for installation in 19-inch or 23-inch ANSI compliant racks.

Figure 7-11 ONS 15454 Shelf Assembly



The physical and environmental specifications for both the ONS 15454-SA-ANSI and ONS 15454-SA-HD shelf is listed in [Table 7-8](#).

Table 7-8 ONS 15454 Assembly Shelf Specifications

Physical Dimension	15454-SA-ANSI Shelf	15454-SA-HD Shelf
Height	18.5 inches (40.7 cm)	18.5 inches (40.7 cm)
Width:		
• Minimum	19 inches (41.8 cm)	19 inches (41.8 cm)
• Maximum	23 inches (50.6 cm)	23 inches (50.6 cm)
Depth BNC and SMB EIAs:		
• Without cabling and rear cover	12 inches (26.4 cm)	12 inches (26.4 cm)
• With cabling and rear cover	14 inches (35.6 cm)	14 inches (35.6 cm)
Depth UBIC-H EIAs:		
• Without cabling and rear cover	—	12 inches (26.4 cm)
• With cabling and rear cover	—	15.0 inches (33 cm)
Depth UBIC-V EIAs:		
• Without cabling and rear cover	—	12 inches (26.4 cm)
• With cabling and rear cover	—	16.75 inches (36.85 cm)
Weight:		
• Empty (without cards)	55 lbs (24.947 kg)	55 lbs (24.947 kg)
• Full (with cards)	98 lbs (44.451 kg)	98 lbs (44.451 kg)
Footprint	13 ft <sup>2</sup>	13 ft <sup>2</sup>

**Table 7-8 ONS 15454 Assembly Shelf Specifications (continued)**

Physical Dimension	15454-SA-ANSI Shelf	15454-SA-HD Shelf
Minimum Aisle Clearance Requirement	24-inches	24-inches
Input Power	-48VDC	-48VDC
Maximum Power Consumption	1060W	1060W
Maximum Amperage	24A	24A
Minimum Fuse Recommendation (includes safety margin)	30A	35A
Compliance	NEBS Level 3	NEBS Level 3

For more information on the ONS 15454 assembly shelf, refer to “[Shelf Assemblies](#)” section on page 6-8 in this document.

## Shelf Assemblies

The latest version shelf assembly, model 15454-SA-HD, is the default shelf shipping for new installations since Software Release 4.6. This shelf assembly is backwards compatible to Release 4.0 installations. For installations prior to Release 4.6, select the shelf assembly from [Table 7-9](#) that is compatible with the version of software you plan to use. The 15454-SA-HD, 15454-SA-ANSI, and 15454-SA-NEBS3E shelves meet NEBS Level 3 specifications for Type 2 and Type 4 equipment, which is intended for installation in restricted access areas.

**Table 7-9 Shelf Assembly Software Release Compatibility**

Shelf	Part Number	<R2.2.2	R3.0.1	R3.1	R3.2	R3.3	R3.4	R4.0	R4.1	R4.5	R4.6	R5.0
15454-SA-HD	800-24443	—	—	—	—	—	—	Yes	Yes	Yes	Yes	Yes
15454-SA-ANSI	800-19857	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—
15454-SA-NEBS3E	800-07149	Yes	Yes	—	—	—	—	—	—	—	—	—

System Release 3.1 introduced the 15454-SA-ANSI shelf assembly. This shelf has enhanced fiber management capabilities and is designed to support the 10Gb/s hardware, which includes the XC-10G cross-connect, OC48 any slot, and OC192 cards. This shelf is compatible with Software Release 4.6, but cannot support the high-density electrical cards.

Although the high density shelf became available with Release 4.6, it is not software dependant. The new 15454-SA-HD shelf incorporates additional DS-1, DS-3, and EC-1 interfaces that enable the ONS 15454 to support up to 224 DS-1s, 192 DS-3s and EC-1s, and 1:N protection. Except for these changes and new symbols identifying the high density card slots assignments, this new shelf is identical to the 15454-SA-ANSI shelf assembly. In order to support the additional electrical traffic, the 15454-SA-HD shelf must be equipped with new high density DS-1 and DS-3 plug-in cards and either the MiniBNC, UBIC-H, or UBIC-V electrical interface assemblies (EIAs). The 15454-SA-HD shelf is the standard shelf shipped for new installations starting with Release 4.6.

## Fan-Tray Assemblies



### Caution

Do not operate an ONS 15454 without the mandatory fan-tray air filter.

The fan-tray assembly is located at the bottom of the ONS 15454 fan-tray assembly. 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 LCD also tells you whether the software load is SONET or SDH and the software version number.

Release 4.0 and higher allows you to modify parameters and control the following displayed information:

- Suppression of LCD IP display
- Display of the NE defaults name
- Alarm output one-button toggle (alarm counts and alarm summary in the LCD are displayed alternately)

You can also modify display parameters to prohibit configuration changes via the LCD display touch pad.

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.

There are presently two series of fan tray assemblies available for the ONS 15454: the FTA3-T high airflow assembly and the FTA2 standard airflow assembly. The FTA3-T should be used for all new installations and offers higher airflow capabilities required to support systems equipped with XC-10G cross-connect cards and is rated for industrial temperature installations (-40 to +65 Celsius). The FTA3-T employs a positive stop insertion pin to prevent the installation of the fan tray assembly into shelf assembly versions prior to the current ANSI offering. Use [Table 7-10](#) to select the fan-tray assembly that is compatible with the version of shelf assembly you plan to use.

**Table 7-10 Fan Tray Assembly Compatibility**

Fan-Tray Product Name	Model Number	Compatible Shelf Assemblies	
		Product Name	Model Number
15454-FTA3-T (required for XC-10G equipped systems)	800-21448	15454-SA-HD	800-24443
		15454-SA-ANSI	800-19857
15454-FTA2	800-07145	15454-SA-ANSI	800-19857
	800-07385	15454-SA-NEBS3E	800-07149
	800-19591	15454-SA-NEBS3E	800-07149
	800-19590	15454-SA-NEBS3E	800-07149

Power requirements for the FTA3-T and FTA2 fan-tray assemblies are listed in [Table 7-11](#).



**Table 7-11 Fan Tray Assembly Power Requirements**

Fan Tray Assembly	Watts	Amps	BTU/Hr.
15454-FTA3-T	86.4	1.8	295
15454-FTA2	53	1.21	198

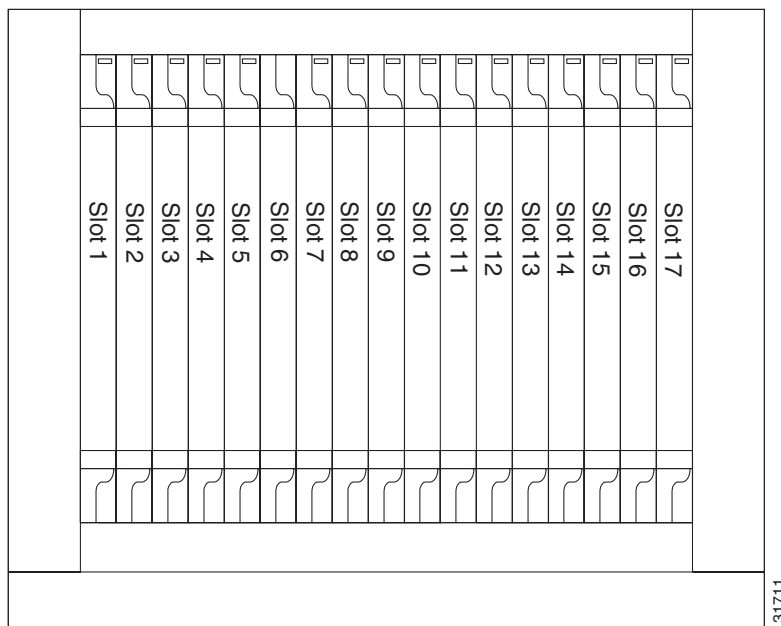
If one or more fans fail on the fan-tray assembly, replace the entire assembly. You cannot replace individual fans. The red Fan Fail LED on the front of the fan tray illuminates when one or more fans fail. For fan tray replacement instructions, refer to the Cisco ONS 15454 Troubleshooting Guide. The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

## Air Filter

The ONS 15454 contains a reusable air filter; Model 15454-FTF2, that is installed either beneath the fan-tray assembly or in the optional external filter brackets. Earlier versions of the ONS 15454 used a disposable air filter that is installed beneath the fan-tray assembly only. However, the reusable air filter is backward compatible.

## Card Slot Assignments

The shelf assembly has 17 card slots as shown in [Figure 7-12](#).

**Figure 7-12 Shelf Assembly Card Slots**

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The card slots are numbered sequentially from 1 to 17 with slot #1 starting at the far left. Each slot is also labeled with an ICON symbol that can be matched with a symbol on the card's faceplate. These symbols provide easy identification of card to slot compatibility. Five card slots, 7 - 11, are dedicated to system operations, also known as common cards, and twelve card slots, 1 - 6 and 12 - 17, are for multi-service interface cards. A further breakout is outlined below:

Slots 1 through 6 - Referred to the A-Side of the shelf assembly and are compatible with a wide variety of interface cards. Bandwidth supported per shelf slot is dependent upon the type of cross-connect card installed. In [Figure 7-12](#), slots 1 through 4, are low-speed card slots and support up to STS-48 (2.49Gb/s) bandwidth. Slots 5 and 6, are considered high-speed slots and support up to STS-192 (10Gb/s) bandwidth. Multi-service interface cards can be operated in protected and unprotected pairs or groups.

Slots 7 and 11 - Support the system processors referred to as the Timing, Communications and Control (TCC) cards. The shelf assembly should be equipped with two TCC cards to enable full system redundancy. Cisco does not support operation of the ONS 15454 with only one TCC card.

Slots 8 and 10 - Support either the system Cross-connect cards or the Optical Service Channel (OSC) cards. For TDM switching, equip the shelf assembly with two cross-connect cards of matching variety, to allow for 1+1 redundant operation. OSC cards are deployed in MSTP configurations for each DWDM span terminating on the shelf.

Slot 9 - Supports the optional Alarm Interface Controller (AIC) card. This card provides environmental alarm inputs and output controls, orderwire, and user data channel (UDC) capabilities. It is not required for system operation.

Slots 12 through 17 - Referred to the B-Side of the shelf assembly and are compatible with a wide variety of interface cards. Bandwidth supported per shelf slot is dependent upon the type of cross-connect card installed. In [Figure 7-12](#), slots 1 through 4, are low-speed card slots and supports up to STS-48 (2.49Gb/s) bandwidth. Slots 12 and 13, are high-speed slots and support up to STS-192 (10Gb/s) bandwidth. Multi-service interface cards can be operated in protected and unprotected pairs or groups.

Shelf Slot Filler Cards - For all unpopulated card slots, numbered 1 to 17, a blank filter slot card must be installed to maintain proper airflow and compliance Telcordia GR-1089-CORE EMI and ESD requirements.

[Table 7-12](#) lists the card slot compatibility for the ONS 15454 shelf assembly.

**Table 7-12 Shelf Assembly Card Slot Compatibility**

Slot Assignment	ONS 15454 Cards
1 - 3 and 15 - 17 only	DS3/EC1-48
1 - 4 and 14 - 17 only	OC3 IR/STM1 SH 1310-8 and OC12 IR/STM4 SH 1310-4
1 - 5 and 12 - 16 only	32MUX-O (2 slot card), 32DMX-O (2 slot card)

**Table 7-12 Shelf Assembly Card Slot Compatibility**

Slot Assignment	ONS 15454 Cards
1 - 6 and 12 - 17 only	DS1-14, DS3-12, DS3-12E, DS3XM-6, DS3XM-12, and EC1-12 OC3 IR SH 1310, OC3 IR 4/STM1 SH 1310, OC3 IR/STM1 SH 1310-8, OC12 IR 1310, OC12 IR/STM4 SH 1310, OC12 LR 1310, OC12 LR/STM4 LH 1310, OC12 LR/STM4 LH 1550, OC12 IR/STM4 SH 1310-4, OC48 IR/STM16 SH AS 1310, and OC48 LR/STM16 LH AS 1550 CE-100T-8, E100T-12, E1000-2, E100T-G, E1000-2-G, G1000-4, G1K4, ML100T-12 (with XC-10G), and ML1000-2 (with XC-10G) FC_MR-4 (with XC-10G) OSC-CSM, OPT-PRE, OPT-BST, 32DMX, 4MD-xx.x, AD-1C-xx.x, AD-2C-xx.x, AD-4C-xx.x, AD-1B xx.x, AD4B-xx.x, and 32WSS (2 slot card)
3 and 15 only	DS1N-14, DS3N-12, DS3N-12E and DS3/EC1-48 cards when provisioned for 1:N protection
5 - 6 and 12 - 13 only	OC48 IR 1310, OC48 LR 1550, OC48 ELR/STM16 EH 100 GHz, OC48 ELR 200 GHz, OC192 SR/STM64 IO 1310, OC192 IR/STM64 SH 1550, OC192 LR/STM64 LH 1550, and OC192 LR/STM64 LH ITU 15xx.xx 100 GHz ML100T-12 (with XC or XC-VT), and ML1000-2 (with XC or XC-VT) FC_MR-4 (with XC-VT)
7 and 11 only	TCC+, TCC2, and TCC2P
8 and 10 only	XC, XC-VT, and XC-10G OSCM
9 only	AIC and AIC-I

**Note**

Each card is marked with a symbol that corresponds to a slot (or slots) on the ONS 15454 shelf assembly. The cards must be installed into slots displaying the same symbols to operate. If a card is installed in the wrong slot, it will not boot up.

## Common-Control Cards

Table 7-13 lists the compatibility of each of the ONS 15454 common-control cards to software releases. In the table below, "Yes" means the card is compatible with the listed software release. Table cells with dashes mean the card is not compatible with the listed software release.

**Table 7-13 Common-Control Card Software Compatibility**

Card	<R2.2.2	R3.0.1	R3.1.x	R3.2.x	R3.3.x	R3.4.x	R4.0.x	R4.1.x	R4.6.x	R5.0.x
TCC+	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	—	—
TCC2	—	—	—	—	—	—	Yes	Yes	Yes	Yes
TCC2P	—	—	—	—	—	—	Yes	Yes	Yes	Yes

**Table 7-13 Common-Control Card Software Compatibility (continued)**

Card	<R2.2.2	R3.0.1	R3.1.x	R3.2.x	R3.3.x	R3.4.x	R4.0.x	R4.1.x	R4.6.x	R5.0.x
XC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
XCVT	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
XC10G	—	—	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
AIC-I	—	—	—	—	—	Yes	Yes	Yes	Yes	Yes
AEP	—	—	—	—	—	Yes	Yes	Yes	Yes	Yes

See [http://cisco.com/en/US/products/hw/optical/ps2006/prod\\_eol\\_notices\\_list.html](http://cisco.com/en/US/products/hw/optical/ps2006/prod_eol_notices_list.html) for updates on End-Of-Life and End-Of-Sale notices.

Table 7-14 lists the compatible cross-connect cards for each ONS 15454 common-control card. In the table below, "Yes" means the card is compatible with the listed cross-connect card. Table cells with dashes mean the card is not compatible with the listed cross-connect card.

**Table 7-14 Common-Control Card Cross-Connect Compatibility**

Card	XC	XCVT	XC10G
TCC+	Yes	Yes	Yes
TCC2	Yes	Yes	Yes
TCC2P	Yes	Yes	Yes
XC	Yes	—	—
XCVT	—	Yes	—
XC10G	—	—	Yes
AIC	Yes	Yes	Yes
AIC-I	Yes	Yes	Yes
AEP	Yes	Yes	Yes

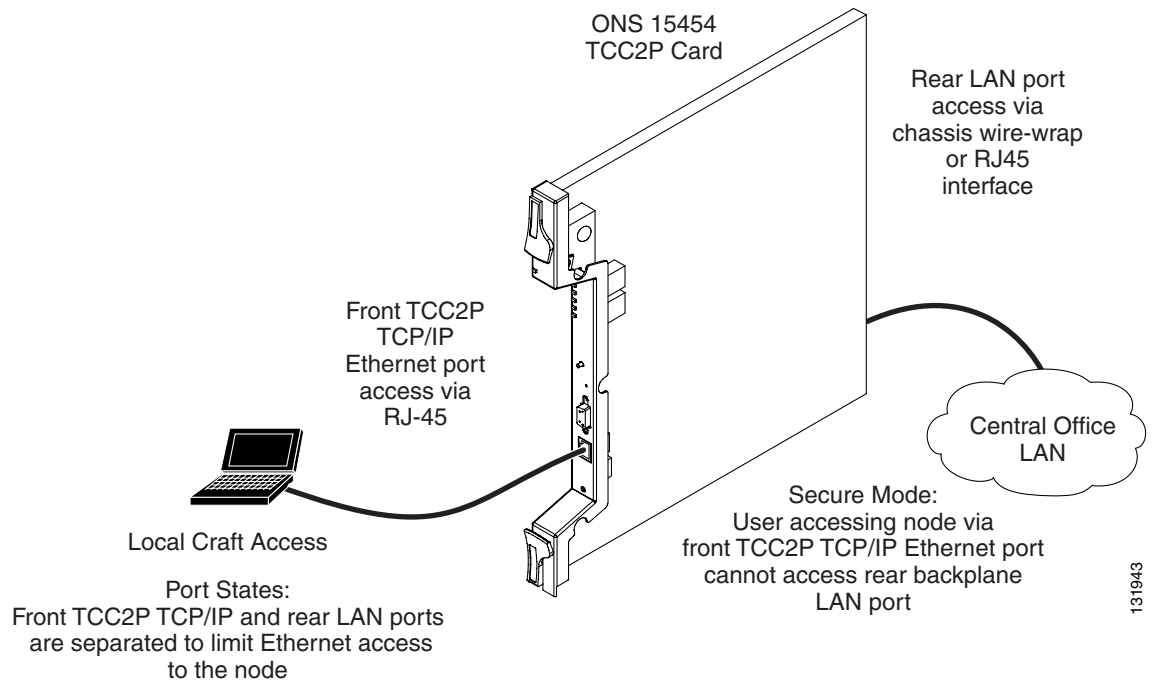
## Timing Control Cards (TCCs)

For systems running Software R4.0 or higher, use the TCC2 or TCC2P card. For all other software releases, use the TCC+ card.

If you want to run the ONS 15454 node in Secure Mode, which allows you to provision two IP addresses for the ONS 15454, use the only TCC2P cards and Software Release 5.0 or higher. In Secure Mode, one IP address (192.1.0.2) is the default IP address provisioned for the ONS 15454 backplane LAN port. The other IP address (10.10.0.1) is the default IP address provisioned for the TCC2P TCP/IP Ethernet port. When Secure Mode is on, the ONS 15454 node automatically configures itself to perform as Gateway Network Element (GNE) and disables the communications link between the TCC2P and LAN Ethernet ports. If Secure Mode is off, the TCC2P and LAN Ethernet ports are bridged together and share a single IP address (192.1.0.2).

Figure 7-13 shows a TCC2P card operating in Secure Mode.

Figure 7-13 TCC2P Secure Mode Operation

**Note**

Before you can connect an ONS 15454 node to other ONS 15454 nodes or to a LAN, you must change the default IP addresses that are shipped with each ONS 15454. The IP addresses provisioned for the TCC2P Ethernet port must follow general IP addressing guidelines. In Secure Mode, the TCC2P TCP/IP address must reside on a different subnet from the backplane LAN port and ONS 15454 default router IP address. For more information about Secure Mode and IP networking, refer to Chapter 8.

To enable OC-192 and OC-48 any-slot card operation, use the XC-10G card, the TCC+, TCC2, or TCC2P card, Software R3.1 and higher, and the 15454-SA-ANSI or new 15454-SA-HD shelf assembly. Do not pair an XC or XC-VT with an XC-10G card.

To enable OC-192 and OC-48 any-slot card operation on systems running Software R4.0 and higher, use the TCC2 or TCC2P card with the XC-10G card, and the 15454-SA-ANSI or new 15454-SA-HD shelf assembly. Do not pair an XC or XC-VT with an XC-10G card.

Cisco does not support operation of the ONS 15454 with only one TCC+, TCC2, or TCC2P card. For full functionality and to safeguard your system, always operate in a redundant configuration using two TCC+, TCC2, or TCC2P cards. You can have a network of ONS 15454 nodes with mixed TCC+, TCC2, and TCC2P cards, but you cannot mix different types of TCC cards in the same node.

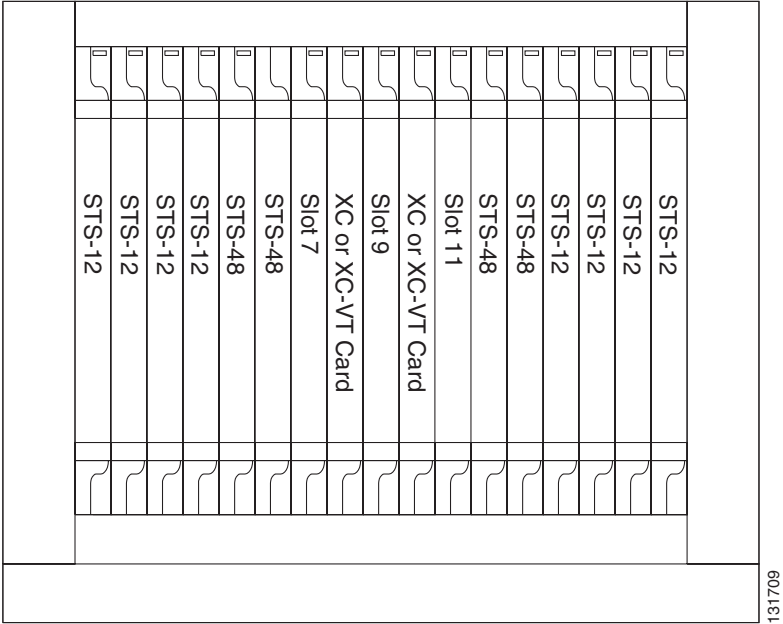
**Note**

The TCC+, TCC2, and TCC2P cards can be installed in slots 7 and 11 only.

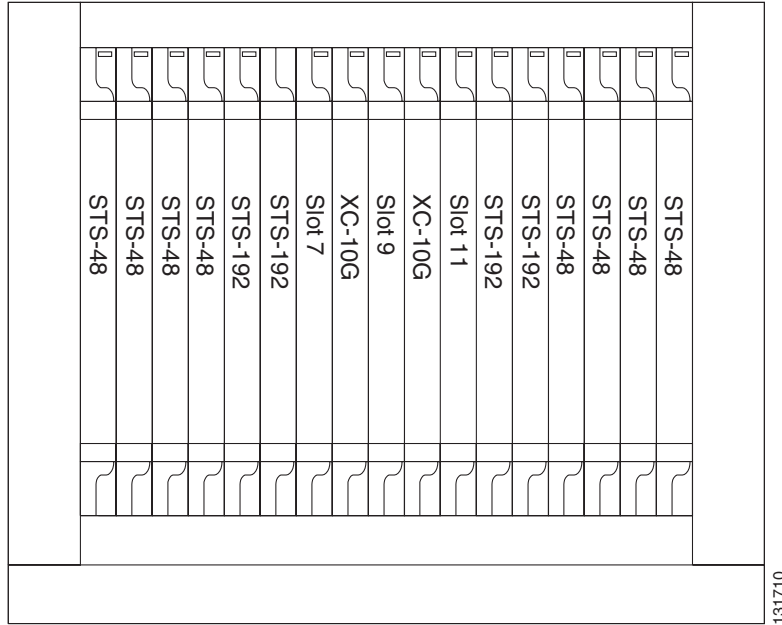
# Cross-connect Cards (XCs)

The selection of the proper cross-connect card is critical, as the cross-connect card is the "bandwidth enabling" device for the shelf assembly. As depicted in Figure 7-14, an ONS 15454 equipped with the XC or XCVT cross-connect card in Slots 8 and 10 can support up to 2.49 Gb/s (STS-48) bandwidth in card Slots 5, 6, 12, and 13, and up to 622 Mb/s (STS-12) bandwidth in card Slots 1 to 4 and 14 to 17.

Figure 7-14 Per Slot Bandwidth Available with the XC and XCVT Cross-Connect Cards



Equipped with the XC10G cross-connect card, Slots 5, 6, 12, and 13 can support up to 10 Gb/s (STS-192) bandwidth and up to 2.49 Gb/s (STS-48) bandwidth in Slots 1 to 4 and 14 to 17, as shown in Figure 7-15.

**Figure 7-15 Per Slot Bandwidth Available with the XC10G Cross-Connect Card**

## Card and Hardware Compatibility

When configuring an ONS 15454 node, use [Table 7-15](#) to determine the compatibility between common-control cards, interface cards, slot assignments, shelf assemblies, and software.

**Table 7-15 ONS 15454 Card Compatibility**

Card	Slot Assignment	TCC Card	Cross-connect Card	Shelf Assembly	Fan-Tray Assembly	Software Release
TCC+	7 and 11	—	All	All	All	R2.1 - R4.1
TCC2	7 and 11	—	All	All	All	>= R4.0
TCC2P	7 and 11	—	All	All	All	>= R4.0
XC	8 and 10	All	—	All	All	>= R2.0
XCVT	8 and 10	All	—	All	All	>= R2.2
XC10G	8 and 10	All	—	SA-HD, SA-ANSI	FTA3-T	>= R3.1
AIC	9	All	All	All	All	>= R2.2
AIC-I	9	TCC+, TCC2, TCC2P	All	All	All	>= R3.4
AEP	Backplane	TCC+, TCC2, TCC2P	All	All	All	>= R3.4
DS1-14	1-6 and 12-17	All	All	All	All	>= R2.2

Table 7-15 ONS 15454 Card Compatibility (continued)

Card	Slot Assignment	TCC Card	Cross-connect Card	Shelf Assembly	Fan-Tray Assembly	Software Release
DS1N-14	1:1 protection: 1-6 and 12-17  1:N protection: 3, 5	All	All	All	All	>= R2.2
DS3-12	1-6 and 12-17	All	All	All	All	>= R2.2
DS3N-12	1:N protection: 3, 5	All	All	All	All	>= R2.2
DS3-12E	1-6 and 12-17	All	All	All	All	>= R3.0
DS3N-12E	1:1 protection: 1-6 and 12-17  1:N protection: 3, 5	All	All	All	All	>= R3.0
DS3/EC1-48	1-3 and 15-17	TCC2, TCC2P	XC-10G	SA-HD	FTA3-T	>= R5.0
DS3XM-6	1-6 and 12-17	All	All	All	All	>= R2.2
DS3XM-12	1-6 and 12-17	TCC2, TCC2P	All	SA-HD, SA-ANSI	FTA3-T	>= R5.0
EC1-12	1-6 and 12-17	All	All	All	All	>= R2.2
OC3-4IR1310	1-6 and 12-17	All	All	All	All	>= R2.2
OC38I-1310	1-4 and 14-17	All	All	SA-HD, SA-ANSI	FTA3-T	>= R4.0
OC12IR1310	1-6 and 12-17	All	All	All	All	>= R2.0
OC12LR1310	1-6 and 12-17	All	All	All	All	>= R2.0
OC12LR1550	1-6 and 12-17	All	All	All	All	>= R2.0
OC12I4-1310	1-4 and 14-17	All	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R3.3
OC48IR1310	5, 6, 12, 13	All	All	All	All	>= R2.2
OC48LR1550	5, 6, 12, 13	All	All	All	All	>= R2.1
OC48IR1310A (any slot)	1-6 and 12-17	TCC+, TCC2, TCC2P	XC-10G	SA-ANSI, SA-HD	FTA3-T	>= R3.1
	5, 6, 12, 13	TCC+, TCC2, TCC2P	XC, XC-VT	All	All	>= R3.2
OC48ELR-100GHz	5, 6, 12, 13	All	All	All	All	>= R3.3
OC48ELR-200G Hz	5, 6, 12, 13	All	All	All	All	>= R2.2



Table 7-15 ONS 15454 Card Compatibility (continued)

Card	Slot Assignment	TCC Card	Cross-connect Card	Shelf Assembly	Fan-Tray Assembly	Software Release
OC192SR1310	5, 6, 12, 13	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
OC192IR1550	5, 6, 12, 13	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
OC192LR1550	5, 6, 12, 13	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R3.1
OC192LR2	5, 6, 12, 13	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
OC192LR-100GH z	5, 6, 12, 13	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
MXP_2.5G_10G	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
MXP_2.5G_10E	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.7
MXP_MR_2.5G MXPP_MR_2.5G	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.7
TXP_MR_10G	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
TXP_MR_10E	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.7
TXP_MR_2.5G TXPP_MR_2.5G	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.0
CE-100T-8	1-6 and 12-17	TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R5.0.2
E100T-12	1-6 and 12-17	All	XC, XC-VT	All	All	>= R2.0
E100T-G	1-6 and 12-17	All	XC, XC-VT, XC 10G	All	All	>= R2.0
E1000-2	1-6 and 12-17	All	All	All	All	>= R2.2
E1000-2-G	1-6 and 12-17	All	All	All	All	>= R2.2
G1000-4	1-6 and 12-17	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R3.2

Table 7-15 ONS 15454 Card Compatibility (continued)

Card	Slot Assignment	TCC Card	Cross-connect Card	Shelf Assembly	Fan-Tray Assembly	Software Release
G1K-4	1-6 and 12-17	TCC+, TCC2, TCC2P	XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R3.2
	5, 6, 12, 13	TCC2, TCC2P	XC, XC-VT	All	All	>=R4.0
ML100T-12	5, 6, 12, 13	TCC2, TCC2P	XC-VT <sup>1</sup>	SA-HD, SA-ANSI	FTA3-T	>= R4.0
	1-6 and 12-17		XC-10G			
ML1000-2	5, 6, 12, 13	TCC2, TCC2P	XC-VT <sup>1</sup>	SA-HD, SA-ANSI	FTA3-T	>= R4.0
	1-6 and 12-17		XC-10G			
FC_MR-4	5, 6, 12, 13	TCC2, TCC2P	XC-VT, XC-10G	SA-HD, SA-ANSI	FTA3-T	>= R4.6
	1-6 and 12-17					
OSCM	8 and 10	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
OSC-CSM	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
OPT-PRE	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
OPT-BST	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
32MUX-O	1&2, 3&4, 5&6, 12&13, 14&15, 16&17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
32DMX-O	1&2, 3&4, 5&6, 12&13, 14&15, 16&17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
32DMX	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.7
4MD-xx.x	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
AD-1C-xx.x	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
AD-2C-xx.x	1-6 and 12-17	TCC2, TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
AD-4C-xx.x	1-6 and 12-17	TCC2 TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
AD-1B-xx.x	1-6 and 12-17	TCC2 TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5

**Table 7-15** ONS 15454 Card Compatibility (continued)

Card	Slot Assignment	TCC Card	Cross-connect Card	Shelf Assembly	Fan-Tray Assembly	Software Release
AD-4B-xx.x	1-6 and 12-17	TCC2 TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.5
32WSS	1-6 and 12-17	TCC2 TCC2P	—	SA-HD, SA-ANSI	FTA3-T	>= R4.7

1. Compatible in Slots 5, 6, 12, and 13 with the XC-VT card.

## Filler Card

The filler card (15454-BLANK or 15454-FILLER) is designed to occupy empty plug-in card slots in the assembly shelf (Slots 1 - 6, 9, and 12 - 17). The filler card cannot operate in the XC slots (Slots 8 and 10) or TCC2/TCC2P slots (7 and 11). In a future software release 15454-FILLER will be detectable through the management interfaces of the ONS 15454.

You must install a filler card in each empty assembly shelf card slot to maintaining proper air flow and EMI requirements.

## Electrical Interface Adapters (EIAs)

Optional Electrical Interface Adapter (EIA) backplane covers are typically preinstalled when ordered with the ONS 15454. EIAs must be ordered when using DS1-14, DS3-12, DS3-12E, DS3/EC1-48, DS3XM-6, DS3XM-12, and EC1-12 cards. For a description of EIAs, refer to Chapter 6.

EIAs are attached to the shelf assembly backplane to provide electrical interface cable connections. EIAs are available with SMB and BNC connectors for DS3-12, DS3-12E, DS3XM-6, DS3XM-12, or EC1-12 cards. EIAs are available with AMP Champ connectors for DS1-14 cards. You must use SMB EIAs for DS-1 twisted-pair cable installation. UBIC-H and UBIC-V EIAs have SCSI connectors, which are used for use with the DS3/EC1-48 card and any of the low-density DS-1, DS-3, DS3XM, or EC-1 cards.



### Note

The MiniBNC EIAs only support cables using the Trompetor connectors for termination.

EIAs can be mixed or matched on an ONS 15454 assembly shelf, allowing flexibility for terminating different electrical interfaces on a single shelf. Any EIA can be installed on any version of ONS 15454 shelf assembly.

As you face the rear of the ONS 15454 shelf assembly, the right side is the A side and the left side is the B side. Side A interoperates with card slots 1 to 6 and side B interoperates with card slots 12 to 17. The top of the EIA connector columns are labeled with the corresponding slot number, and EIA connector pairs are marked transmit (Tx) and receive (Rx) to correspond to transmit and receive cables. You can install EIAs on one or both sides of the assembly shelf 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).

Choose an EIA from [Table 7-16](#) or [Table 7-17](#) that is compatible with your assembly shelf and interface cards.

**Note**

UBIC-H and UBIC-V EIAs can only be installed on shelf assembly 15454-SA-HD. The 15454-SA-HD shelf assembly is differentiated from other shelf assemblies by the blue hexagon symbol, which indicates the available high-density slots, found under Slots 1 through 3 and 15 through 17.

**Note**

You do not need to power down the shelf before removing or installing an EIA that is not terminating any electrical (DS-1, DS-3, and EC-1) traffic. An in-service upgrade of one EIA (A side or B side) is possible if all electrical traffic is being terminated on the other side.

**Table 7-16** EIAs Compatible with the 15454-SA-ANSI Shelf Only

EIA Type	Interface Cards Supported	A Side Capacity	A Side Connectors Map To	A Side product Number	B Side Capacity	B Side Connectors Map To	B Side Product Number
Low-Density BNC	DS3-12, DS3-12E, DS3XM-6, EC1-12	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	DS3-12, DS3-12E, DS3XM-6, EC1-12	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	DS1-14, DS3-12, DS3-12E, EC1-12, 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	DS1-14	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

Table 7-17 EIAs Compatible with the 15454-SA-HD Shelf

EIA Type	Interface Cards Supported	A Side Capacity	A Side Connectors Map To	A Side Product Number	B Side Capacity	B Side Connectors Map To	B Side Product Number
UBIC-H	DS1-14, DS3-12, DS3-12E, DS3/EC1-48, DS3XM-6, DS3XM-12, EC1-12	8 pairs of SCSI connectors	Slot 1, Slot 2, Slot 3, Slot 4, Slot 5, Slot 6	15454-EIA-U BICH-A	8 pairs of SCSI connectors	Slot 12, Slot 13, Slot 14, Slot 15, Slot 16, Slot 17	15454-EIA-U BICH-B
UBIC-V	DS1-14, DS3-12, DS3-12E, DS3/EC1-48, DS3XM-6, DS3XM-12, EC1-12	8 pairs of SCSI connectors	Slot 1, Slot 2, Slot 3, Slot 4, Slot 5, Slot 6	15454-EIA-U BICV-A	8 pairs of SCSI connectors	Slot 12, Slot 13, Slot 14, Slot 15, Slot 16, Slot 17	15454-EIA-U BICV-B
Low-Density BNC	DS3-12, DS3-12E, DS3XM-6, DS3XM-12, EC1-12	24 pairs of BNC connectors	Slot 2, Slot 4	15454-EIA-1 BNC-A24	24 pairs of BNC connectors	Slot 14, Slot 16	15454-EIA-1 BNC-B24
High-Density BNC	DS3-12, DS3-12E, DS3XM-6, DS3XM-12, EC1-12	48 pairs of BNC connectors	Slot 1, Slot 2, Slot 4, Slot 5	15454-EIA-1 BNC-A48	48 pairs of BNC connectors	Slot 13, Slot 14, Slot 16, Slot 17	15454-EIA-1 BNC-B48
MiniBNC	DS3-12, DS3-12E, DS3/EC1-48, DS3XM-6, DS3XM-12, EC1-12	96 pairs of BNC connectors	Slot 1, Slot 2, Slot 4, Slot 5	15454-EIA-H DBNC-A96	96 pairs of BNC connectors	Slot 13, Slot 14, Slot 16, Slot 17	15454-EIA-H DBNC-B96
SMB	DS1-14, DS3-12, DS3-12E, EC1-12, DS3XM-6, DS3XM-12	84 pairs of SMB connectors	Slot 1, Slot 2, Slot 3, Slot 4, Slot 5, Slot 6	15454-EIA-1S MB-A84	84 pairs of SMB connectors	Slot 12, Slot 13, Slot 14, Slot 15, Slot 16, Slot 17	15454-EIA-1S MB-B84
AMP Champ	DS1-14	6 AMP Champ connectors	Slot 1, Slot 2, Slot 3, Slot 4, Slot 5, Slot 6	15454-EIA-1 AMP-A84	6 AMP Champ connectors	Slot 12, Slot 13, Slot 14, Slot 15, Slot 16, Slot 17	15454-EIA-1 AMP-B84

Table 7-18 shows the number of connectors per side for each EIA type according to low-density and high-density interfaces. In the table, high-density (HD) cards include the DS3/EC1-48 card. Low-density (LD) cards include the following:

- DS1-14, DS1N-14
- DS3-12, DS3N-12
- DS3-12E, DS3N-12E
- DS3XM-6
- DS3XM-12
- EC1-12

**Table 7-18 EIA Connector Capacity**

Interfaces per Side	Standard BNC	High Density BNC	Mini BNC	SMB	AMP Champ	UBIC-H and UBIC-V
Total Physical Connectors	48	96	192	168	6	16
Maximum LD DS-1 Interfaces (Tx and Rx)	—	—	—	84 <sup>1</sup>	84	84
Maximum LD DS-3 Interfaces (Tx and Rx)	24	48	72	72	—	72
Maximum HD DS-1 Interfaces (Tx and Rx)	—	—	—	—	—	112
Maximum HD DS-3 Interfaces (Tx and Rx)	—	—	96	—	—	96

1. Use SMB to wire-wrap Baun for DS-1 terminations (15454-WW-14).

## Shelf 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 industrial temperature (I-temp). All I-temp rated components are -40°C to +65°C. To prevent airflow restriction, allow at least 1 inch (25.4 mm) of clearance around the ventilation openings.**

The ONS 15454 shelf assembly comes preset for installation in a 23-inch (584.2 mm) rack, but you can reverse the mounting bracket to fit the smaller 19-inch (482.6 mm) rack. The shelf assembly projects five inches (127 mm) from the front of the rack. It mounts in both ANSI-standard and Telcordia-standard racks. The shelf assembly is a total of 17 inches (431.8 mm) 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.

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 weight of the shelf assembly.

## Typical Bay Installation

You can install up to four ONS 15454 shelves in a seven-foot (2133.6 mm) equipment rack. The ONS 15454 must have one inch (25.4 mm) 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.

These typical equipment rack arrangements meet NEBS central office requirements for bay heat dissipation. If you do not use these arrangements, normal heat flow could be interrupted and adversely affect shelf operation. Fan-tray assemblies must be used to guarantee proper air circulation.

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.

**Caution**

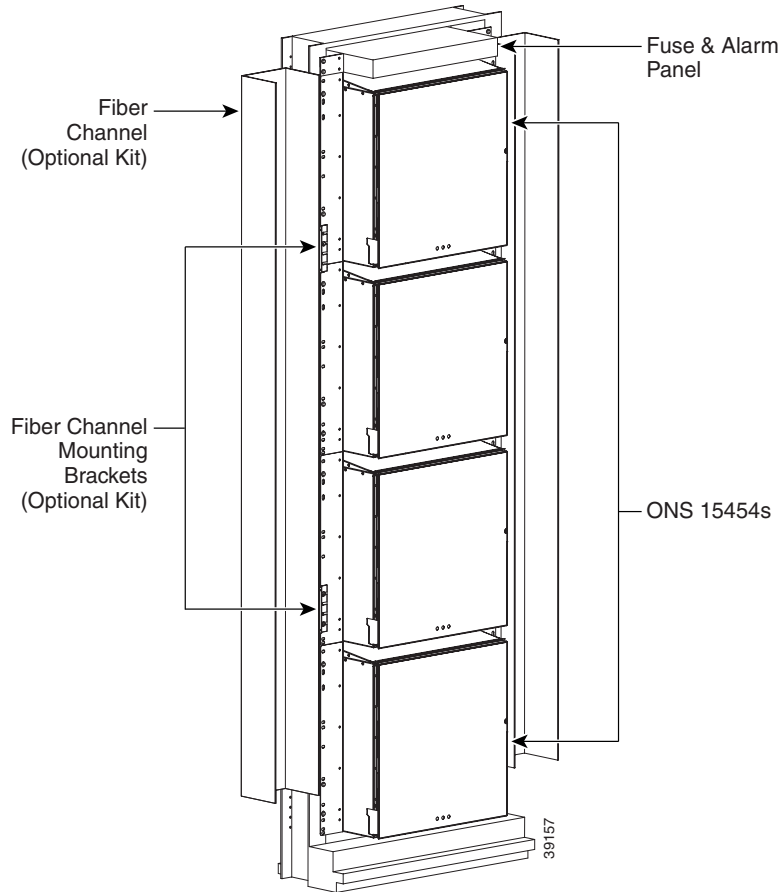
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Do not operate an ONS 15454 without the mandatory fan-tray air filter.

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[Figure 7-16](#) shows a typical bay arrangement using four 15454-SA-HD shelf assemblies. Note that most standard (Telcordia GR-63-CORE, 19-inch [482.6 mm] or 23-inch [584.2 mm]) seven-foot (2,133 mm) racks can hold four ONS 15454s and a fuse and alarm panel.

**Figure 7-16** Typical 4-Shelf Equipment Rack Arrangement

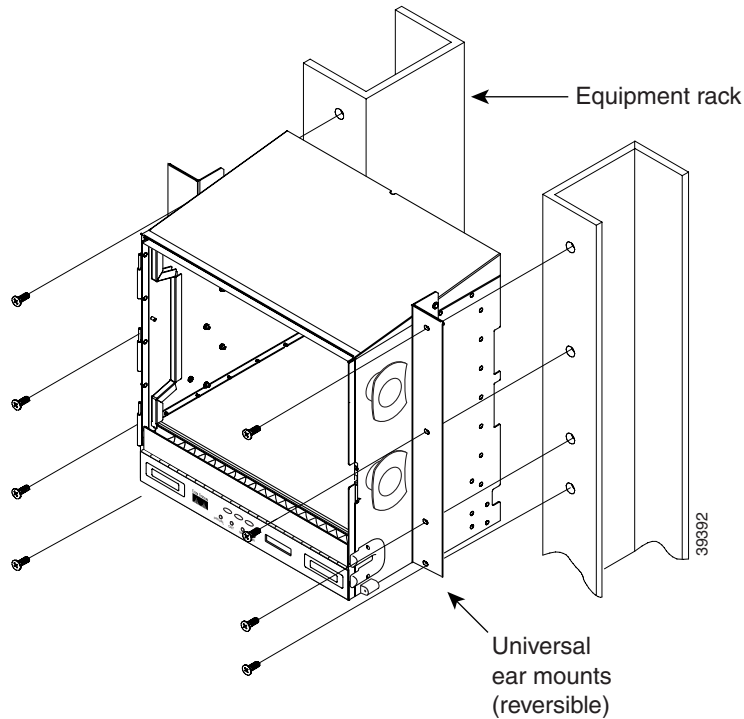


## Mounting a Single Shelf

Mounting the ONS 15454 in a rack requires a minimum of 18.5 inches (469.9 mm) of vertical rack space and one additional inch (25.4 mm) for air flow. To ensure that the mounting is secure, use two to four #12-24 mounting screws for each side of the shelf assembly. [Figure 7-17](#) shows the rack mounting position for the ONS 15454.



**Figure 7-17** Mounting an ONS 15454 in a Rack



## Mounting Multiple Shelves

If incremental shelves are to be installed, Cisco recommends that they be installed from the bottom of the equipment rack to the top to simplify cabling. However, shelves may be added in any position so long as proper bay cabling is selected.

Incremental ONS 15454 shelves can be installed by local technicians. Most standard seven-foot racks can hold four ONS 15454 shelves and a fuse and alarm panel. However, unequal flange racks are limited to three ONS 15454 shelves and a fuse and alarm panel or four ONS 15454 shelves and a fuse and alarm panel from an adjacent rack.

If you plan to use 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 do not use 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.

## OSP Cabinet Installations

The ONS 15454 is industrial temperature rated and can be installed in outside plant (OSP) cabinets when configured with the following components:

- 15454-SA-HD Shelf
- 15454-SA-ANSI Shelf
- 15454-FTA2 Fan Tray
- 15454-FTA3-T Fan Tray

- 15454-TCC+T
- 15454-TCC2
- 15454-TCC2P-K9
- 15454-XC-T
- 15454-XC-VT-T
- 15454-AIC-T
- 15454-AIC-I
- 15454-AEP
- 15454-DS1-14-T
- 15454-DS1N-14-T
- 15454-DS3-12-T
- 15454-DS3-12E-T
- 15454-DS3N-12E-T
- 15454-DS3EC1-48
- 15454-DS3XM-6-T
- 15454-DS3XM-12
- 15454-EC1-12-T
- 15454-OC34I13-T
- 15454-OC12I13-T
- 15454-OC12L13-T
- 15454-OC12L15-T

**Note**

For 15454-DS3EC1-48, I-Temp operation is not supported because XC-10G cross-connect card is not I-Temp rated.

## Power and Grounding

For proper operation, the ONS 15454 must be powered from a power source that can provide sufficient wattage at a specific voltage. These two factors, in addition to how they relate to amperage, must be taken into consideration when choosing a power source for the ONS 15454. [Table 7-19](#) lists the power requirements for the ONS 15454.

**Table 7-19 ONS 15454 Power Supply Requirements**

Item	15454-SA-HD	15454-SA-ANSI	15454-SA-NEBS3E
Acceptable Input DC Voltage Range	-40.5 to -57VDC	-40.5 to -57VDC	-40.5 to -57VDC
Recommended Input DC Voltage (two power feeds: A and B)	-48VDC	-48VDC	-48VDC
Maximum Wattage	1060W	1060W	952W

**Table 7-19 ONS 15454 Power Supply Requirements (continued)**

Item	15454-SA-HD	15454-SA-ANSI	15454-SA-NEBS3E
Maximum Amperage	24A	24A	20A
Recommended circuit breakers (breaker A and breaker B)	35A	30A	25A

Cisco recommends a 100-A fuse panel (30-A fuse per shelf minimum) if you install the 15454-SA-ANSI or 15454-SA-HD shelf. If you install the 15454-SA-NEBS3 shelf, Cisco recommends you use a standard 80-A fuse panel (20-A fuse per shelf minimum).

## Power Supplies

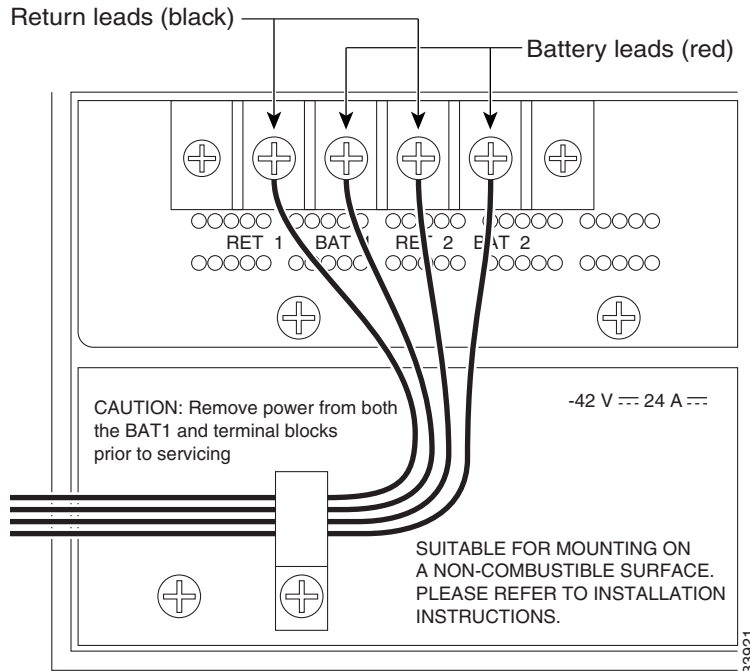
The power supply required for proper operation of a Cisco ONS 15454 is dependent on your specific needs and ONS 15454 shelf configuration. To learn more about Cisco power supplies, see <http://cisco.com/en/US/products/ps6063/index.html>.

Cisco does not endorse any specific vendor and recommends considering solutions from as many vendors as appropriate. Vendors listed below are a sampling of companies providing power solutions suitable for the Cisco ONS 15454. Information regarding these vendor's products can be found on their respective Web sites.

- APC [www.apc.com](http://www.apc.com)
- Hendry [www.hendry.com](http://www.hendry.com)
- Eltek [www.eltek.no](http://www.eltek.no)
- Sorensen [www.sorenson.com](http://www.sorenson.com)

## Power Feeds

The ONS 15454 has redundant -48VDC power feeds on the shelf assembly backplane. Power terminals (shown in [Figure 7-18](#)) are #8-32 screws, labeled RET1, BAT1, RET2, and BAT2, and are located on the lower section of the assembly shelf backplane. The power terminals will accept a conductor lug with a width up to 0.378 inches.

**Figure 7-18 Power Feed Connections**

To install redundant power feeds, use four #10 AWG (copper conductor, 194°F [90°C]) power cables, one ground cable (#10 AWG, copper conductor, 194°F [90°C]) from the 15454 shelf to the equipment rack, and one ground cable (#6 AWG) from the equipment rack to central office. 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. Cisco recommends the following wiring conventions illustrated in [Figure 7-18](#):

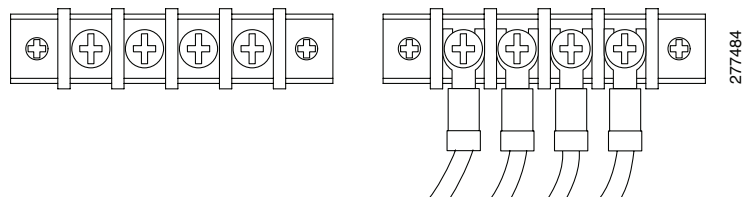
- Red wire for battery connections (-48 VDC)
- Black wire for battery return connections (0 VDC)
- The battery return connection is treated as DC-I, as defined in GR-1089-CORE, issue 3.

When terminating battery and battery return connections as shown in [Figure 7-18](#), follow a torque specification of 10 in-lb.

**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 (2.053 to 1.628 mm<sup>2</sup>) power cable and #14 AWG (1.628 mm<sup>2</sup>) ground cable are required.

The black plastic dielectric dividers shown in [Figure 7-19](#) isolate the A and B power feeds. This design better protects against voltage spikes and accidental shorting.

**Figure 7-19 Dielectric Power Block**

The redundant -48VDC is distributed through the backplane to each of the 17 card slots. Every ONS 15454 card contains ORing diodes to isolate the battery feeds, inrush-limiting and filtering circuitry, and local switching regulation. Wire-wrap pins on the backplane provide frame grounds to minimize any transient voltage or current disruptions to the system when a card is inserted in the shelf.

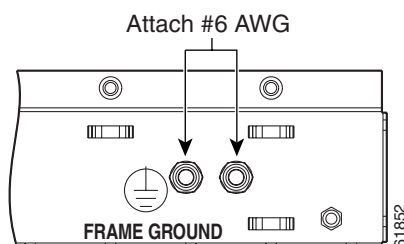
## Power Monitoring

The Alarm Interface Controller-International (AIC-I) card provides a power monitoring circuit that monitors the supply voltage of -48 VDC for presence, under voltage, or over voltage.

The TCC2/TCC2P also monitors both A and B supply voltage inputs of the assembly shelf. It Overrides the AIC-I card and will force the AIC-I LEDs to match Power Monitor LEDs on the TCC2/TCC2P. The TCC2/TCC2P is capable of detecting a blown fuse based on shared knowledge between the active and standby TCC2/TCC2Ps. An alarm will be generated if one of the supply voltage inputs has a voltage out of the specified range of -40.5 to -57VDC.

## Ground Connections

The frame ground posts are two #10-32 studs measuring 5/8 inch center-to-center to accommodate a dual-hole lug. The nuts provided for a field connection includes integral lock washers. The lug must be rated to accept the #10 AWG cable. [Figure 7-20](#) shows the location of the ground posts.

**Figure 7-20 Ground Posts on the ONS 15454 Backplane**

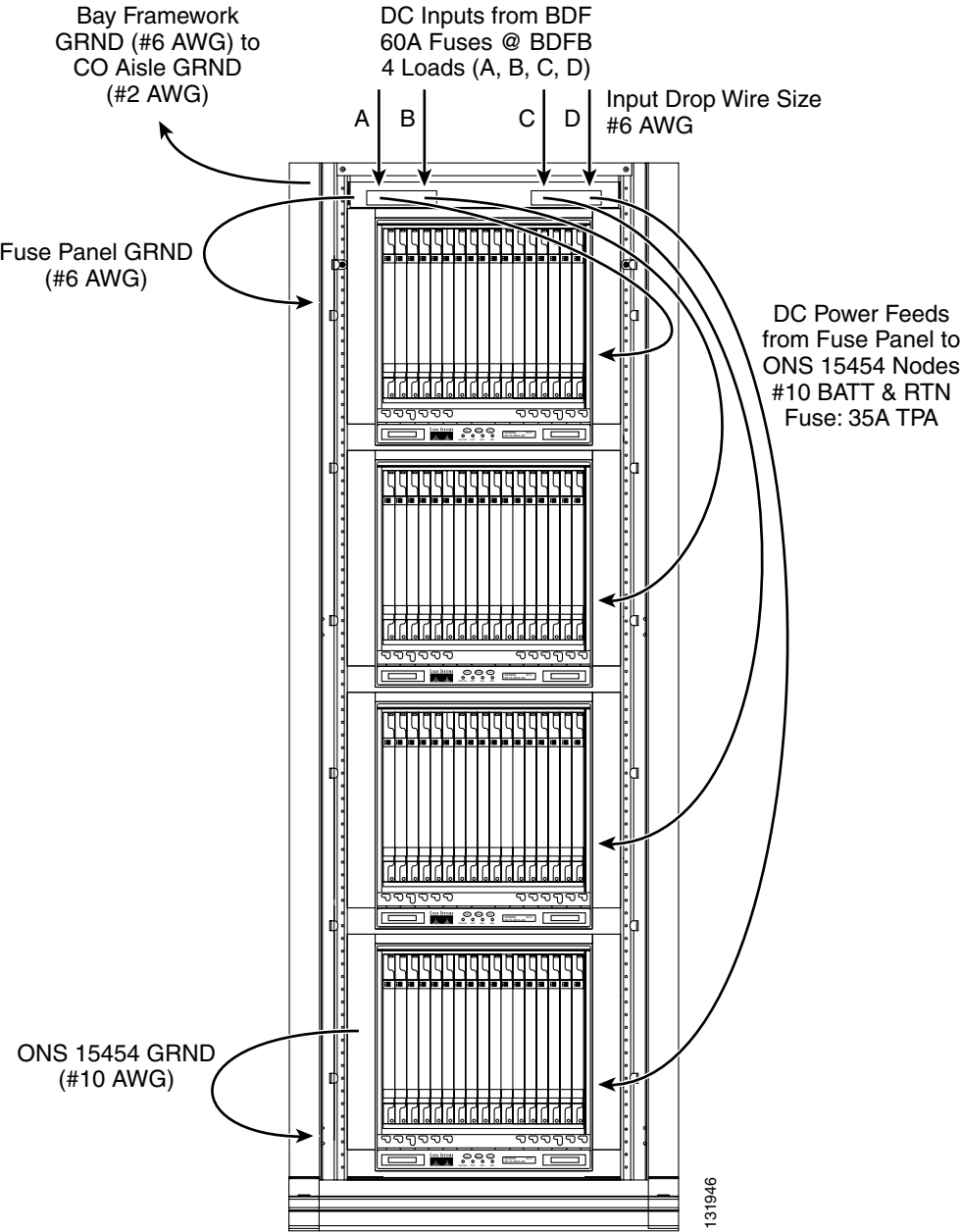
Ground only one cable to ground the shelf assembly. Terminate the other end of the ground cable to ground according to local site practice. Connect a ground terminal for the frame ground (FGND) terminal according to local site practice.

**Note**

When terminating a frame ground, use the kee nuts provided with the ONS 15454 and tighten it to a torque specification of 31 in-lb. The kee nut provides a frame ground connection that minimizes the possibility of loosening caused by rotation during installation and maintenance activity. The type of prevention the kee nut provides for the frame ground connection is inherently provided by the terminal block for battery and battery return connections.

Figure 7-21 shows the typical power and grounding wiring for a four-shelf Central Office bay.

**Figure 7-21** Typical Central Office Bay Power and Grounding



# Alarm and Control Connections

For environmental alarms and power monitoring, use the Alarm Interface Controller (AIC) card with ONS 15454 systems running software prior to R3.4, or use the Alarm Interface Controller-International (AIC-I) card for systems running Software Release 3.4 and higher. The ONS 15454 shelf assembly supports the termination of multiple environmental alarms. [Table 7-20](#) details the alarm termination capacities of the AIC and AIC-I cards based upon the equipment configuration. LEDs on the front panel of the AIC and AIC-I cards indicate the status of the alarm lines, one LED representing all the inputs and one LED representing all the outputs. The physical connections are made using the backplane wire-wrap pins listed in the Alarm Pins section of this document.

**Table 7-20 Alarm Termination Capacity**

Configuration	Termination Capacity
AIC card only	Up to 4 input and 4 output environmental alarms via rear wire-wrap pins
AIC-I card only	12 input plus 4 provisionable as input or output environmental alarms via rear wire-wrap pins
AIC-I plus optional AEP	32 input and 16 output environmental alarms via two 50-pin AMP CHAMP connectors

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 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, because 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 as follows:

- **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.

## Alarm Pins

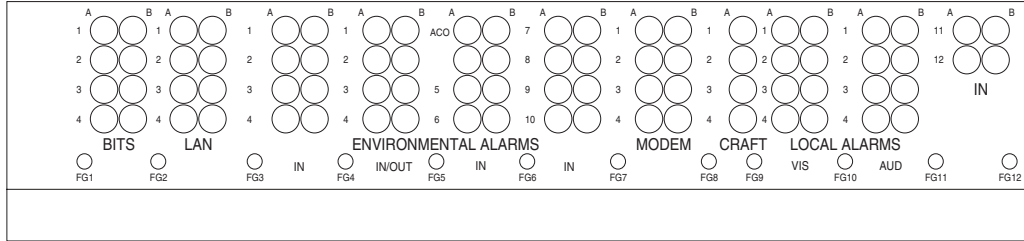
The alarm pin field supports up to 17 alarm contacts, including four audible alarms, four visual alarms, one alarm cutoff (ACO), and four user-definable alarm input and output contacts.

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 and you must have the AIC or AIC-I 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.

The 15454-AIC-I card requires an 15454-SA-ANSI or 15454-SA-HD shelf assembly running Software Release 3.4.0 or higher. The backplane of the 15454-SA-ANSI and 15454-SA-HD shelves contain a wire-wrap field with pin assignment according to the layout in [Figure 7-22](#).



Figure 7-22 ONS 15454 Backplane Pinouts (System Release 3.4 and higher)



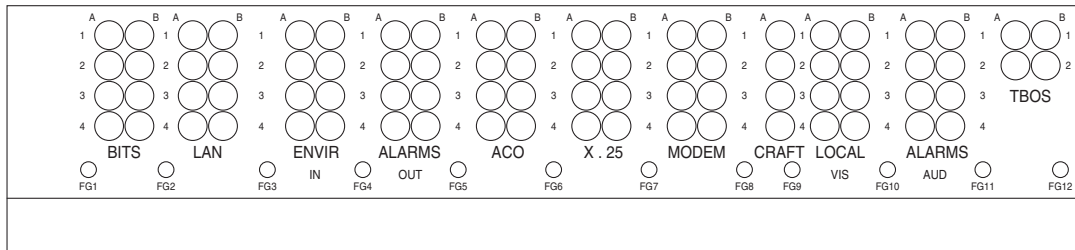
Field	Pin	Function	Field	Pin	Function
BITS	A1	BITS Output 2 negative (-)	ENVIR ALARMS IN/OUT	A1/A13	Normally open output pair number 1
	B1	BITS Output 2 positive (+)		B1/B13	
	A2	BITS Input 2 negative (-)		A2/A14	Normally open output pair number 2
	B2	BITS Input 2 positive (+)		B2/B14	
	A3	BITS Output 1 negative (-)	N/O	A3/A15	Normally open output pair number 3
	B3	BITS Output 1 positive (+)		B3/B15	
	A4	BITS Input 1 negative (-)		A4/A16	Normally open output pair number 4
	B4	BITS Input 1 positive (+)		B4/B16	
LAN	Connecting to a hub, or switch		ACO	A1	Normally open ACO pair
	A1	RJ-45 pin 6 RX-		B1	
	B1	RJ-45 pin 3 RX+	CRAFT	A1	Receive (PC pin #2)
	A2	RJ-45 pin 2 TX-		A2	Transmit (PC pin #3)
	B2	RJ-45 pin 1 TX+		A3	Ground (PC pin #5)
	Connecting to a PC/Workstation or router			A4	DTR (PC pin #4)
	A1	RJ-45 pin 2 RX-	LOCAL ALARMS AUD (Audible)	A1	Alarm output pair number 1: Remote audible alarm.
	B1	RJ-45 pin 1 RX+		B1	
A2	RJ-45 pin 6 TX-	A2		Alarm output pair number 2: Critical audible alarm.	
B2	RJ-45 pin 3 TX+	B2			
ENVIR ALARMS IN	A1	Alarm input pair number 1: Reports closure on connected wires.	N/O	A3	Alarm output pair number 3: Major audible alarm.
	B1			B3	
	A2	Alarm input pair number 2: Reports closure on connected wires.		A4	Alarm output pair number 4: Minor audible alarm.
	B2			B4	
	A3	Alarm input pair number 3: Reports closure on connected wires.	LOCAL ALARMS VIS (Visual)	A1	Alarm output pair number 1: Remote visual alarm.
	B3			B1	
	A4	Alarm input pair number 4: Reports closure on connected wires.		A2	Alarm output pair number 2: Critical visual alarm.
	B4			B2	
	A5	Alarm input pair number 5: Reports closure on connected wires.	N/O	A3	Alarm output pair number 3: Major visual alarm.
	B5			B3	
	A6	Alarm input pair number 6: Reports closure on connected wires.		A4	Alarm output pair number 4: Minor visual alarm.
	B6			B4	
A7	Alarm input pair number 7: Reports closure on connected wires.				
B7					
A8	Alarm input pair number 8: Reports closure on connected wires.				
B8					
A9	Alarm input pair number 9: Reports closure on connected wires.				
B9					
A10	Alarm input pair number 10: Reports closure on connected wires.				
B10					
A11	Alarm input pair number 11: Reports closure on connected wires.				
B11					
A12	Alarm input pair number 12: Reports closure on connected wires.				
B12					

If you are using an AIC-I card, contacts provisioned as OUT are 1-4. Contacts provisioned as IN are 13-16.

83020

Figure 7-23 shows alarm pin assignments using the 15454-AIC in a 15454-SA-NEBS3E shelf for Release 3.3 and earlier.

Figure 7-23 ONS 15454 Backplane Pinouts (prior to System Release 3.4)



Field	Pin	Function	Field	Pin	Function	
BITS	A1	BITS Output 2 negative (-)	ENVIR ALARMS OUT	A1	Normally open output pair number 1	
	B1			B1		
	A2	BITS Input 2 negative (-)		A2	Normally open output pair number 2	
	B2			B2		
	A3	BITS Output 1 negative (-)		A3	Normally open output pair number 3	
	B3			B3		
	A4	BITS Input 1 negative (-)		A4	Normally open output pair number 4	
	B4			B4		
LAN	Connecting to a hub, or switch		ACO	A1	Normally open ACO pair	
	A1	RJ-45 pin 6 RX-		B1		
	B1	RJ-45 pin 3 RX+		CRAFT	A1	Receive (PC pin #2)
	A2	RJ-45 pin 2 TX-			A2	Transmit (PC pin #3)
	B2	RJ-45 pin 1 TX+	A3		Ground (PC pin #5)	
	Connecting to a PC/Workstation or router		A4		DTR (PC pin #4)	
	A1	RJ-45 pin 2 RX-	LOCAL ALARMS AUD (Audible)	A1	Alarm output pair number 1: Remote audible alarm.	
	B1	RJ-45 pin 1 RX+		B1		
A2	RJ-45 pin 6 TX-	A2		Alarm output pair number 2: Critical audible alarm.		
B2	RJ-45 pin 3 TX+	B2				
ENVIR ALARMS IN	A1	Alarm input pair number 1: Reports closure on connected wires.	N/O	A3	Alarm output pair number 3: Major audible alarm.	
	B1			B3		
	A2	Alarm input pair number 2: Reports closure on connected wires.		A4	Alarm output pair number 4: Minor audible alarm.	
	B2			B4		
	A3	Alarm input pair number 3: Reports closure on connected wires.	LOCAL ALARMS VIS (Visual)	A1	Alarm output pair number 1: Remote visual alarm.	
	B3			B1		
	A4	Alarm input pair number 4: Reports closure on connected wires.		A2	Alarm output pair number 2: Critical visual alarm.	
	B4			B2		
		N/O	A3	Alarm output pair number 3: Major visual alarm.		
			B3			
			A4	Alarm output pair number 4: Minor visual alarm.		
			B4			

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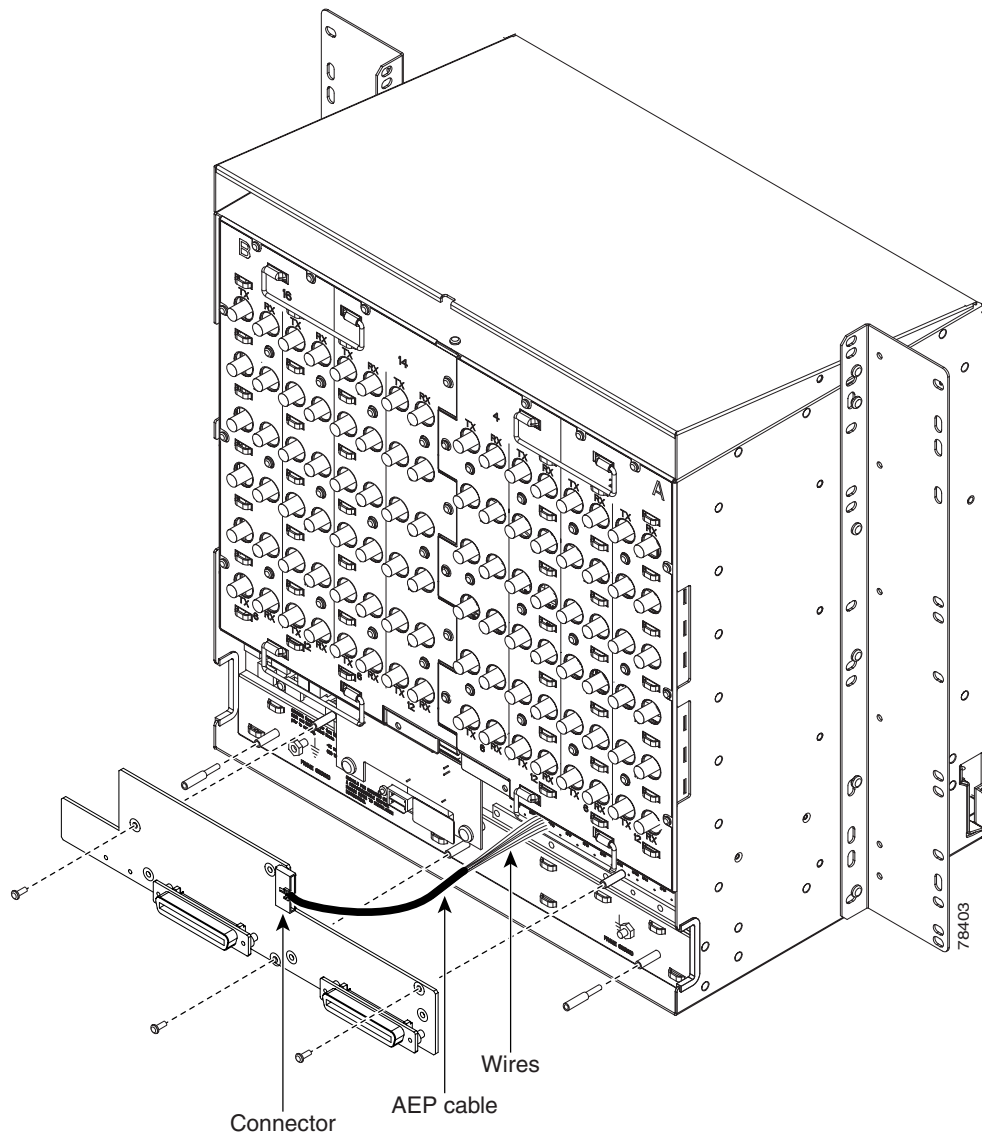
Visual and audible alarms are typically wired to trigger an alarm light or bell at a central alarm collection point when the corresponding contacts are closed. You can use the Alarm Cutoff pins to activate a remote ACO for audible alarms. You can also activate the ACO function by pressing the ACO button on the TCC+/TCC2/TCC2P 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.

## Alarm Expansion Panel

The optional ONS 15454 alarm expansion panel (AEP) can be used with the Alarm Interface Controller card (AIC-I) card to provide upto 48 dry alarm contacts for the ONS 15454, 32 of which are inputs and 16 are outputs. The AEP is a printed circuit board assembly that is installed on the backplane. Typically,

the AEP is preinstalled when ordered with the ONS 15454; however, the AEP can be ordered separately. The AIC-I card must be installed before you can provision the alarm contacts enabled by the AEP. [Figure 7-24](#) shows how an AEP is attached to the backplane of an assembly shelf.

**Figure 7-24 Attaching an AEP to the Backplane**



**Note**

If you install an AEP, the AIC-I alarm contacts cannot be used. Only the AEP alarm contacts can be used.

Each AEP alarm input port has provisionable label and severity. The alarm inputs have optocoupler isolation. They have one common 32VDC output and a maximum of 2 mA per input. Each opto metal oxide semiconductor (MOS) alarm output can operate by definable alarm condition, a maximum open circuit voltage of 60 VDC, and a maximum current of 100 mA.

[Figure 7-25](#) shows where the AEP cable wires connect to the wire-wrap pins on the backplane of the assembly shelf. [Table 7-21](#) shows the wire-wrap pin assignments and corresponding signals on the AIC-I and AEP.

**Figure 7-25** AEP Wire-Wrap Connections to Backplane Pins**Table 7-21** Backplane Wire-Wrap Pin Assignments for the AEP

AEP Cable Wire	Wire-Wrap Pin	Signal on AIC-I	Signal on AEP
Black	A1	GND	AEP_GND
White	A2	AE_+5V	AEP_+5V
Slate	A3	VBAT-	VBAT-
Violet	A4	VB+	VB+
Blue	A5	AE_CLK_P	AE_CLK_P
Green	A6	AE_CLK_N	AE_CLK_N
Yellow	A7	AE_DIN_P	AE_DOUT_P
Orange	A8	AE_DIN_N	AE_DOUT_P
Red	A9	AE_DOUT_P	AE_DIN_P
Brown	A10	AE_DOUT_N	AE_DIN_N

Connecting to external alarm sources via the Amp Champ cable must be done according to [Table 7-22](#).

**Table 7-22** Alarm Input Pin Association

AMP Champ Pin Number	Signal Name	AMP Champ Pin Number	Signal Name
1	ALARM_IN_1-	27	GND
2	GND	28	ALARM_IN_2-
3	ALARM_IN_3-	29	ALARM_IN_4-
4	ALARM_IN_5-	30	GND
5	GND	31	ALARM_IN_6-
6	ALARM_IN_7-	32	ALARM_IN_8-
7	ALARM_IN_9-	33	GND
8	GND	34	ALARM_IN_10-
9	ALARM_IN_11-	35	ALARM_IN_12-

**Table 7-22 Alarm Input Pin Association**

AMP Champ Pin Number	Signal Name	AMP Champ Pin Number	Signal Name
10	ALARM_IN_13-	36	GND
11	GND	37	ALARM_IN_14-
12	ALARM_IN_15-	38	ALARM_IN_16-
13	ALARM_IN_17-	39	GND
14	GND	40	ALARM_IN_18-
15	ALARM_IN_19-	41	ALARM_IN_20-
16	ALARM_IN_21-	42	GND
17	GND	43	ALARM_IN_22-
18	ALARM_IN_23-	44	ALARM_IN_24-
19	ALARM_IN_25-	45	GND
20	GND	46	ALARM_IN_26-
21	ALARM_IN_27-	47	ALARM_IN_28-
22	ALARM_IN_29-	48	GND
23	GND	49	ALARM_IN_30-
24	ALARM_IN_31-	50	N.C.
25	ALARM_IN_+	51	GND1
26	ALARM_IN_0-	52	GND2

Use the pin numbers in [Table 7-23](#) to connect to the external elements being switched by external alarms.

**Table 7-23 Pin Association for Alarm Output Pins**

AMP Champ Pin Number	Signal Name	AMP Champ Pin Number	Signal Name
1	N.C.	27	COM_0
2	COM_1	28	N.C.
3	NO_1	29	NO_2
4	N.C.	30	COM_2
5	COM_3	31	N.C.
6	NO_3	32	NO_4
7	N.C.	33	COM_4
8	COM_5	34	N.C.
9	NO_5	35	NO_6
10	N.C.	36	COM_6
11	COM_7	37	N.C.
12	NO_7	38	NO_8
13	N.C.	39	COM_8

**Table 7-23 Pin Association for Alarm Output Pins (continued)**

AMP Champ Pin Number	Signal Name	AMP Champ Pin Number	Signal Name
14	COM_9	40	N.C.
15	NO_9	41	NO_10
16	N.C.	42	COM_10
17	COM_11	43	N.C.
18	NO_11	44	NO_12
19	N.C.	45	COM_12
20	COM_13	46	N.C.
21	NO_13	47	NO_14
22	N.C.	48	COM_14
23	COM_15	49	N.C.
24	NO_15	50	N.C.
25	N.C.	51	GND1
26	NO_0	52	GND2

## Timing Connections

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.

Cisco recommends using 100 ohm shielded BITS clock cable pair #22 or #24 AWG (0.51 mm<sup>2</sup> or 0.64 mm<sup>2</sup>), twisted-pair T1-type when connecting an ONS 15454 to a BITS input cable. Wrap the clock wires on the appropriate wire-wrap pins according to local site practice. Ground the shield of the BITS input cable at the BITS end. For BITS output, wrap the ground shield of the BITS cable to the frame ground pin (FG1) located beneath the column of BITS Pins. [Table 7-24](#) lists the pin assignments for the BITS timing pin fields.

**Table 7-24 BITS External Timing Pin Assignments**

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

## Operations Systems (OSS) LAN Connections

Use the LAN pins on the ONS 15454 backplane to connect the ONS 15454 to an OSS LAN or to a LAN modem for remote access to the node. You can also use the TCP/IP Ethernet port on the TCC+, TCC2, or TCC2P faceplate to connect a PC to the network. [Table 7-25](#) shows the LAN pin assignments.

**Table 7-25** ONS 15454 LAN Pin Assignments

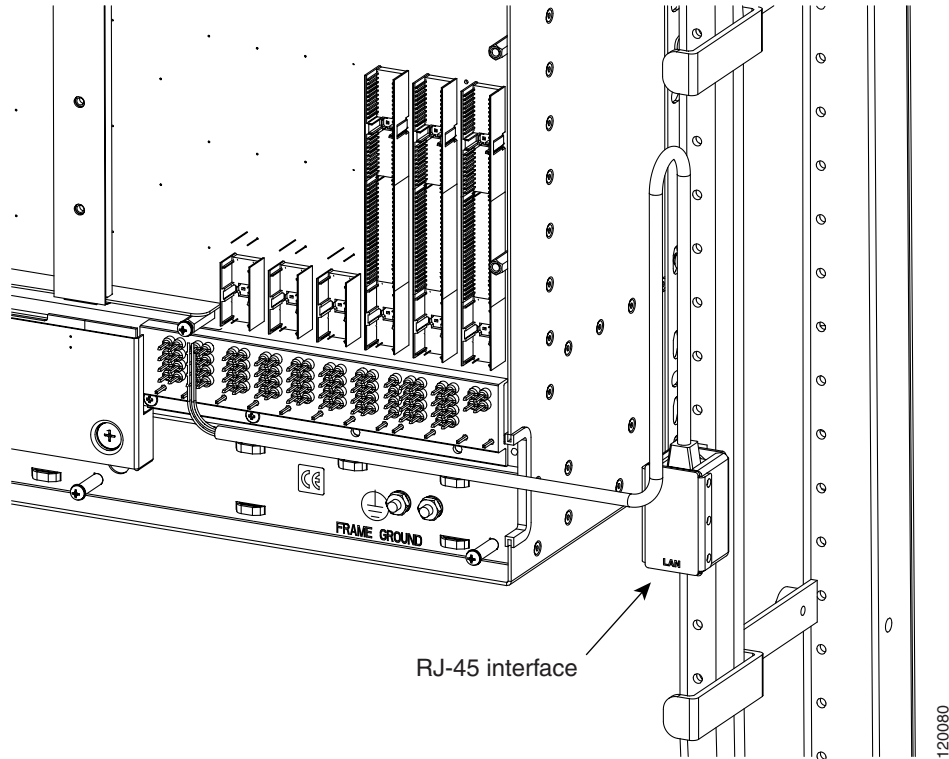
Pin Field	Backplane Pins	RJ-45 Pins
LAN 1	B2	1
Connecting to data circuit-terminating equipment (DCE <sup>1</sup> ) such as a hub or switch	A2	2
	B1	3
	A1	6
LAN 1	B1	1
Connecting to data terminal equipment (DTE) such as a PC, workstation or router	A1	2
	B2	3
	A2	6

1. The Cisco ONS 15454 is a DCE.

An optional RJ45 jack-to-wire-wrap cable is also available that allows the backplane LAN pins to be terminated using an RJ-45 interface attached to the equipment rack (see [Figure 7-26](#)). The RJ45 jack-to-wire-wrap cable and bracket is part of the accessory kit, 53-2329-01, which ships with the following product IDs:

- 15454-SA-HD=
- 15454-HD-SHIPKIT=
- 15454-SA-HD-DDR=

Figure 7-26 Optional RJ45 Jack-to-Wire-Wrap Cable and Connector Installation

**Note**

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

**Note**

If TCC2P cards are installed with Software Release 5.0 or higher, secure mode is available. Secure mode allows you to provision two IP addresses for the ONS 15454. One IP address is provisioned for the ONS 15454 backplane LAN port. The other IP address is provisioned for the TCC2P TCP/IP Ethernet port. When secure mode is off, the default IP address 192.1.0.2 applies to the backplane LAN port and the TCC2P TCP/IP Ethernet port. When secure mode is on, the default IP Address 192.1.0.2 is assigned to the backplane LAN port and a default IP address of 10.10.0.1 is assigned to the TCC2P LAN port.

For more information about IP address requirements, refer to Chapter 8 in this document.

## TL1 Craft Interface

You can use the craft pins on the assembly shelf backplane or the EIA/TIA-232 port on the TCC2/TCC2P card 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 EIA/TIA-232 port. [Table 7-26](#) shows the pin assignments for the CRAFT pin field.

**Note**

You cannot use the craft backplane pins and the EIA/TIA-232 port on the TCC2/TCC2P card simultaneously.



**Table 7-26 TL1 Craft Interface Pin Assignments**

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

## Cabling

Cables are not included with the ONS 15454 and must be ordered separately. Coaxial cables for the BNC EIAs, optical interface cables, and CAT-5 Ethernet cables that have been approved for use with the ONS 15454 can be ordered from the following third party vendors:

- Amphenol RF
- Amphenol Fiber Optic Products
- Fibersource International/Suncall
- Senko Advanced Components
- Seiko Instruments
- Seikoh Geiken
- Molex
- ADC Telecommunications
- AFOP(Alliance Fiber Optic Products)
- UConn
- Diamond
- Westek Electronics

Cisco provides cable assemblies for the following EIAs:

- 15454-EIA-AMP-84
- 15454-EIA-SMB-84
- 15454-EIA-UBIC-H
- 15454-EIA-UBIC-V

Cable assemblies that can be ordered through Cisco are listed in [Table 7-27](#), [Table 7-28](#), and [Table 7-29](#):

**Table 7-27 Cisco ONS 15454 Low-Density Cable Assemblies**

EIA Type	Cable Assembly Part Number	Description	Cable Length (ft)
15454-EIA-BNC-*96 <sup>1</sup>	15454-CA-HDBNC-30	Mini BNC to standard BNC (unterminated), 75 Ohm.	30
	15454-CA-HDBNC-75		75

**Table 7-27 Cisco ONS 15454 Low-Density Cable Assemblies (continued)**

EIA Type	Cable Assembly Part Number	Description	Cable Length (ft)
15454-EIA-AMP-*84	15454-AMP-WW-30	AMP Champ unterminated wire-wrap cable	30
	15454-AMP-WW-50		50
	15454-AMP-WW-100		100
	15454-AMP-WW-250		250
15454-EIA-SMB-*84	15454-SMB-BNC-10	SMB to BNC cable assembly	10
	15454-SMB-BNC-30		30
	15454-SMB-BNC-50		50

1. \* denotes side of shelf (A or B)

**Table 7-28 UBIC-H Cable Assemblies**

EIA Type	Cable Assembly Part Number	Description	Cable Length (ft)
15454-EIA-UBIC-H /	15454-CADS1-H-25	UBIC-H-DS1, one end is terminated with 50-pin SCSI connector and the other end is open-ended twisted pair.	25
	15454-CADS1-H-50		50
15454-EIA-UBICH-*	15454-CADS1-H-75		75
	15454-CADS1-H-100		100
	15454-CADS1-H-150		150
	15454-CADS1-H-200		200
	15454-CADS1-H-250		250
	15454-CADS1-H-350		350
	15454-CADS1-H-450		450
	15454-CADS1-H-550		550
	15454-CADS1-H-655		655
	15454-CADS3-H-25		25
	15454-CADS3-H-50		50
	15454-CADS3-H-75		75
	15454-CADS3-H-100		100
	15454-CADS3-H-125		125
	15454-CADS3-H-150		150
	15454-CADS3-H-175		175
	15454-CADS3-H-200		200
	15454-CADS3-H-225		225
15454-CADS3-H-250	250		
15454-CADS3-H-300	300		
15454-CADS3-H-350	350		
15454-CADS3-H-450	450		

**Table 7-29 UBIC-V Cable Assemblies**

EIA Type	Cable Assembly Part Number	Description	Cable Length (ft)
15454-EIA-UBIC-V /	15454-CADS1-50	UBIC-V-DS1, one end is terminated with 50-pin SCSI connector and the other end is open-ended twisted pair.	50
	15454-CADS1-75		75
15454-EIA-UBICV- *	15454-CADS1-100		100
	15454-CADS1-150		150
	15454-CADS1-200		200
	15454-CADS1-250		250
	15454-CADS1-350		350
	15454-CADS1-450		450
	15454-CADS1-550		550
	15454-CADS1-655		655
15454-CADS3-25	UBIC-V-DS3, one end is terminated with 50-pin SCSI connector and the other end can be terminated with 75 ohms BNC connector	25	
15454-CADS3-50		50	
15454-CADS3-75		75	
15454-CADS3-100		100	
15454-CADS3-125		125	
15454-CADS3-150		150	
15454-CADS3-175		175	
15454-CADS3-200		200	
15454-CADS3-225		225	
15454-CADS3-250		250	
15454-CADS3-300		300	
15454-CADS3-350		350	
15454-CADS3-450		450	

Table 7-30 lists the maximum length of cable you can have between the EIA and patch panel or cross-connect frame.

**Table 7-30 Maximum Cable Distances**

EIA Interface	Impedance	Cable	Cable Length on Each Side of DSX
SMB: AMP #415504-3	75 Ohm	RG179	79 ft (24.1 m)
BNC: Trompeter #UCBJ224 (King or ITT connectors are also compatible)	75 Ohm	RG59	450 ft (137.2 m)
AMP Champ: AMP #552246-1 with #552562-2 bail locks	100 Ohm	Twisted Pair	655 ft (199.6 m)
UBIC-H-DS1	100 Ohm	Twisted Pair	655 ft (199.6 m)

**Table 7-30** Maximum Cable Distances (continued)

EIA Interface	Impedance	Cable	Cable Length on Each Side of DSX
UBIC-H-DS3	75 Ohm	RG734 to RG735A	450 ft (137.2 m)
UBIC-V-DS1	100 Ohm	Twisted Pair	655 ft (199.6 m)
UBIC-V-DS3	75 Ohm	RG734 to RG735A	450 ft (137.2 m)

When using the RG-179 coaxial cable on an EIA, the maximum distance available is less than the maximum distance available with standard RG-59 (734A) cable. The shorter maximum distance available with the RG179 is due to a higher attenuation rate for the thinner cable. The following attenuation rates are calculated using a DS-3 signal:

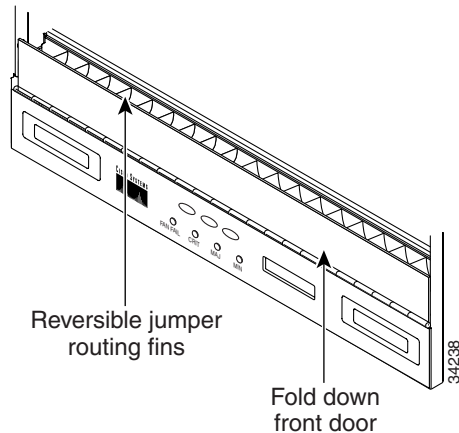
- For RG-179, the attenuation rate is 59 dB/kft at 22 MHz.
- For RG-59 (734A) the attenuation rate is 11.6 dB/kft at 22 MHz.

## Cable Routing and Management Overview

The ONS 15454 cable routing and management facilities include the following:

- A cable-routing channel that runs the width of the shelf assembly (Figure 7-27).
- A fold-down door that provides access to the cable-management tray (Figure 7-27).
- Reversible jumper routing fins that enable you to route cables out either side by positioning the fins as desired. (Figure 7-27)
- Plastic fiber boots, which protects fiber jumpers from excessive bending (Figure 7-28).
- Plastic horseshoe-shaped directional cable guides at each side opening of the cable-routing channel that ensure the proper bend radius is maintained in the fibers (Figure 7-29). You can remove the fiber guide, if necessary, to create a larger opening for routing large cables, such as CAT-5 Ethernet cables (Figure 7-31). To remove the fiber guide, take out the three screws that anchor it to the side of the shelf assembly.
- Plastic post non-directional fiber guides at each side opening of the cable-routing channel that provide universal routing of cables and ensure proper bend radius is maintained for fiber optic cables (Figure 7-30). These guides can be removed in the same manner as the horseshoe-shaped guides.
- Cable tie-wrap facilities on EIAs that secure cables to the cover panel.
- Jumper slack storage reels (2) on each side panel that reduce the amount of slack in cables that are connected to other devices. To remove the jumper slack storage reels, take out the screw in the center of each reel.
- Optional fiber management tray (recommended for MSTP nodes).
- Optional tie-down bar (recommended for use with the UBIC-H and UBIC-V EIAs).

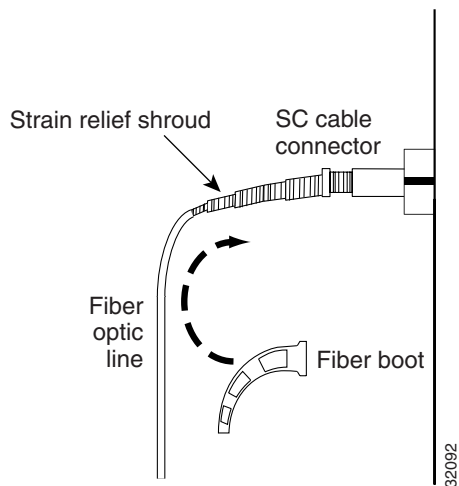
**Figure 7-27 Cable Management Tray and Fold Down Front Door**



## Managing Fiber Optic Cables

Fiber boots (15454-Fiber-Boot=) are included with ONS 15454 OC-N cards that do not have angled optical port to protect the fiber from excessive bending. The fiber boot is placed over the jumper's strain relief shroud connected to the SC connector as shown in [Figure 7-28](#).

**Figure 7-28 Fiber Boot Attachment**



**Note**

The fiber boot does not support the OC-48 IR/STM-16 SH AS 1310, OC-48 LR/STM-16 LH AS 1550, and OC-192 LR/STM64 LH 1550 cards. The boots are not necessary for these cards because of the angled SC connectors on the cards.

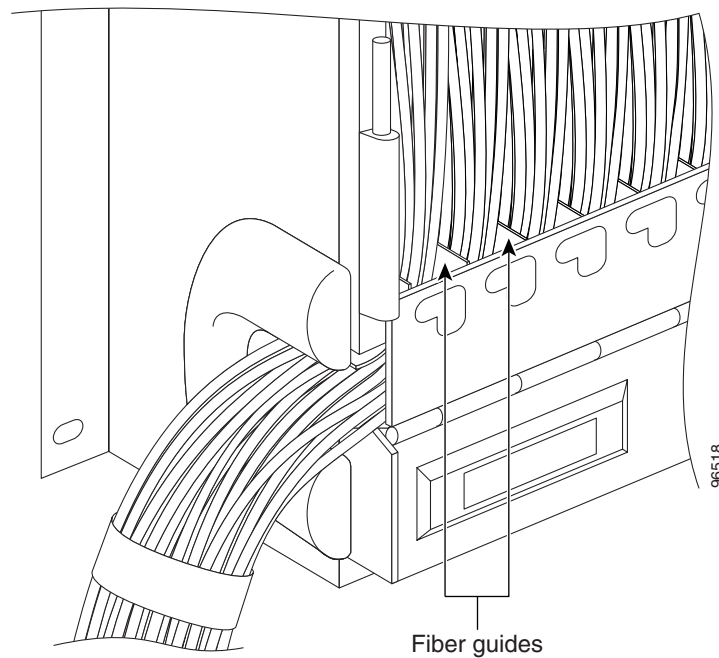
If you are installing an OC3IR/STM1SH 1310-8 card, you must use a fiber clip instead of a fiber boot on the Port 8 Rx fiber connector.

Fiber clips are factory-attached to the faceplate of OC-N cards.

GBICs do not have fiber clips; therefore, if you are routing fiber from an E1000-2-G, E1000-2, G1000-2-G, G10002, or FC\_MR-4 card, route the fiber cables into the cable-management tray.

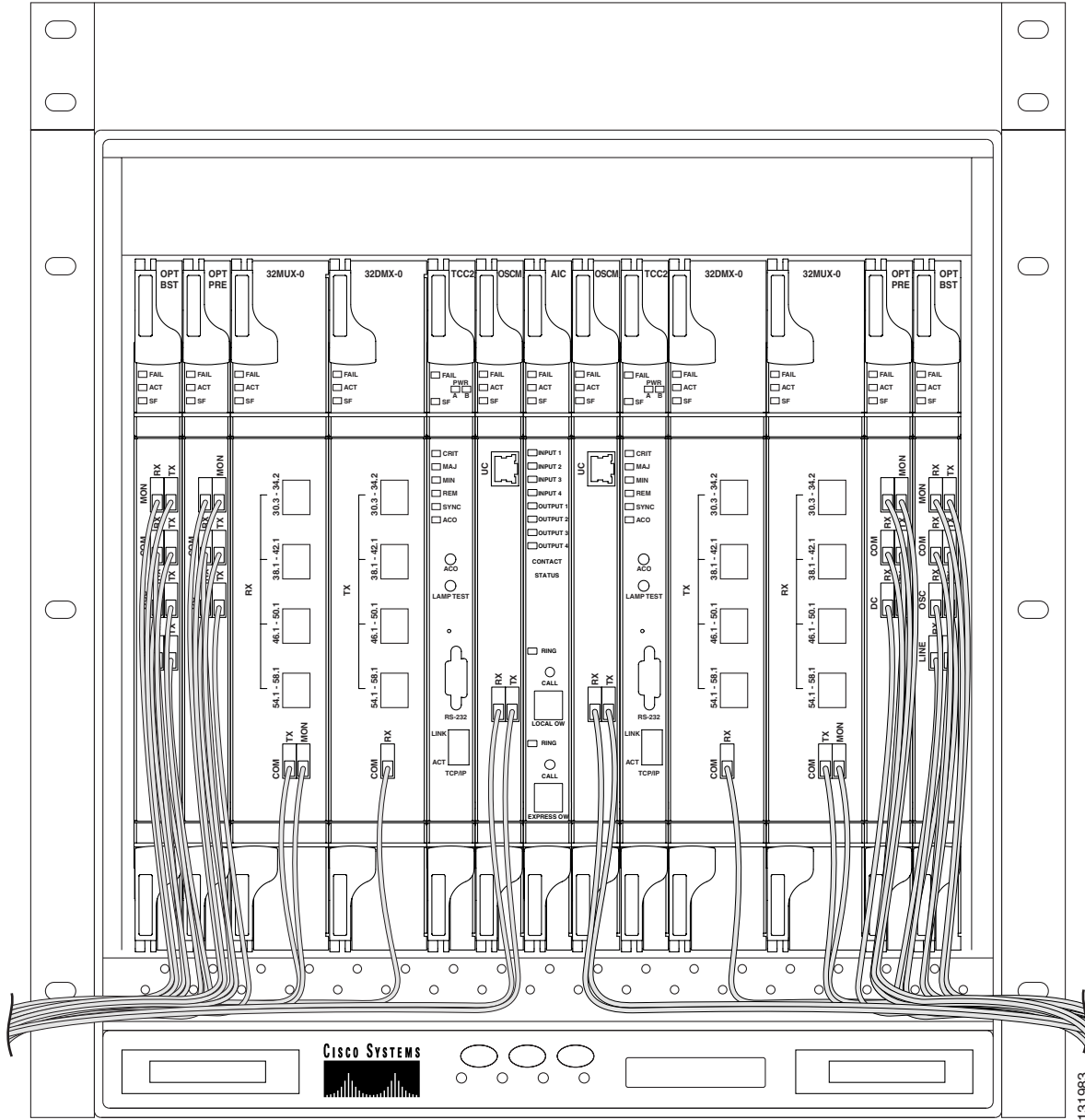
Route the fiber cables out either side of the cable-management tray through the cutouts on each side of the shelf assembly. The jumper routing fins and posts are designed to route fiber jumpers out of both sides of the shelf. Slots 1 to 6 exit to the left, and Slots 12 to 17 exit to the right. [Figure 7-29](#) shows fibers routed from cards in the left slots, down through the fins, then exiting out the fiber channel to the left.

**Figure 7-29** Fiber Optic Cable Guides



[Figure 7-30](#) shows fiber jumpers routed out of both sides of the shelf from any card slot using the universal jumper routing posts.

Figure 7-30 Universal Jumper Routing with Posts



The maximum capacity of the fiber routing channel depends on the jacket diameter of the fiber jumpers. [Table 7-31](#) gives the maximum capacity of the fiber channel for each side of the shelf, for the different fiber sizes.

Table 7-31 Fiber Optic Cable Capacity

Fiber Diameter	Maximum Number of Fibers Exiting Each Side		
	No Ethernet Cables	One Ethernet Cables	Two Ethernet Cables
1.6 mm (0.6 inch)	224	127	110

**Table 7-31** *Fiber Optic Cable Capacity (continued)*

Fiber Diameter	Maximum Number of Fibers Exiting Each Side		
	No Ethernet Cables	One Ethernet Cables	Two Ethernet Cables
2 mm (0.7 inch)	144	80	70
3 mm (0.11 inch)	64	36	32

Plan your fiber size according to the number of cards/ports installed in each side of the shelf. For example, if your port combination requires 36 fibers, 3 mm (0.11 inch) fiber is adequate. If your port combination requires 68 fibers, you must use 2 mm(0.7 inch) or smaller fibers.

## Managing Ethernet Cables

The CE-100T-8, E100T-12, E100T-12G, and ML100-12 Ethernet cards have RJ-45 connectors on the faceplate for client interfaces and do not require an EIA. Use the universal jumper posts or remove the cable routing guides, if necessary, to create a larger opening for Cat 5 Ethernet cables.


**Note**

When installing Ethernet cards with RJ 45 interfaces, it is recommended that only 2 cards per side be installed in each assembly shelf (4 cards per shelf). This will allow for proper cable management of Cat 5 cables.


**Note**

Removing the u-shaped cable routing guides ([Figure 7-31](#)) allows the front door of the ONS 15454 to be closed after fully cabling all 12 ports on each of the four 10/100 Ethernet cards with CAT-5 cables.



**Figure 7-31** Cat 5 Cable Management with Cable Routing Guides Removed

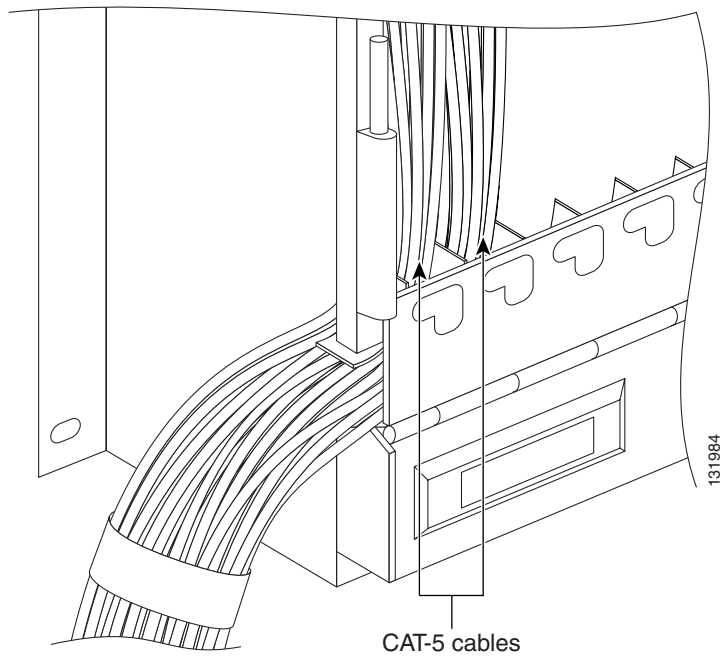
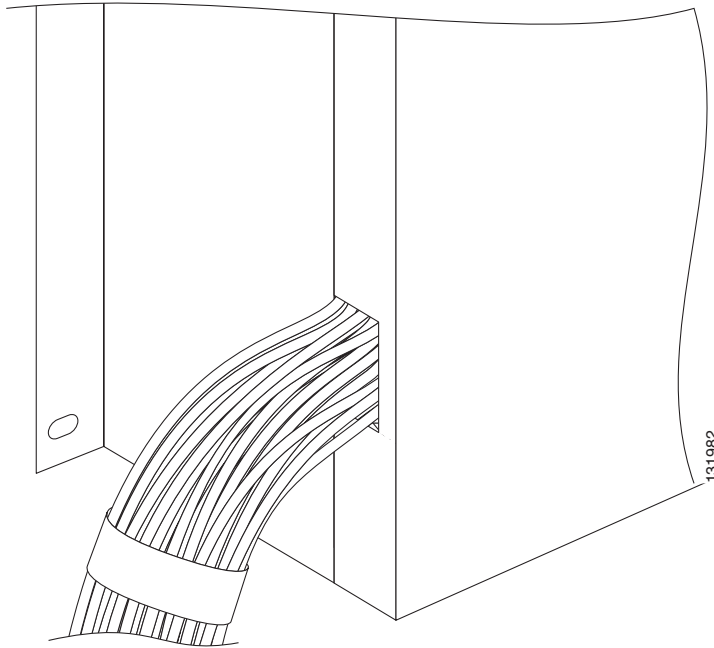


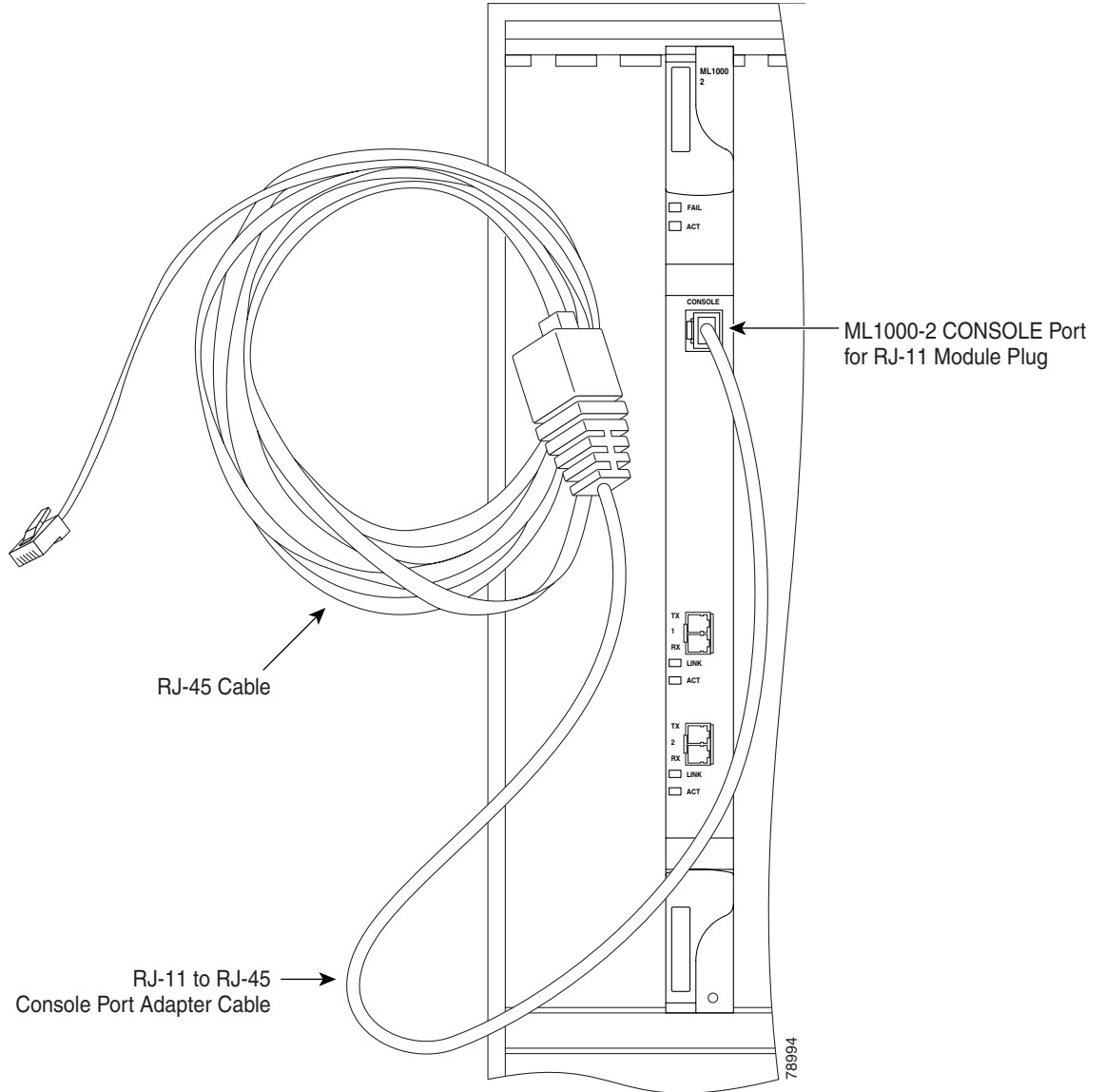
Figure 7-32 shows the door to the ONS 15454 closed after fully cabling all twelve RJ-45 ports on four 10/100 Ethernet cards.

**Figure 7-32** Door Closed with Four 12-Port 10/100 Ethernet Cards Fully Cabled



Use an RJ-11 to RJ-45 console cable adapter, and a DB-9 adapter to connect a PC to the console port on ML100-12 and ML-1000-2 cards. [Figure 7-33](#) shows an RJ-11 cable connected to the console port on the ML1000-2 faceplate via an RJ-11 to RJ-45 cable adapter. The console port on the ML100-12 is at the bottom of the card faceplate.

**Figure 7-33 Connecting to the ML-Series Console Port**



## Managing Coaxial Cables

When using coaxial cables, the cables must terminate on an EIA installed on the shelf assembly backplane. All cables connected to ONS 15454 low-density (LD) DS3-12, DS3-12E, DS3XM-6, DS3XM-12, or EC1-12 cards and high-density (HD) DS3/EC1-48 cards must terminate with coaxial cables using the desired connector type to connect to the specified EIA.

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

The 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. Range does not affect loopback testing.

The BNC and High-Density BNC EIAs support BNC connectors. The MiniBNC EIA supports mini BNC connections.

The connector pairs on the BNC EIAs are marked "Tx" and "Rx" to indicate transmit and receive cables for each port. The MiniBNC EIA also supports the following J-Labeling that corresponds BNC connectors to the ports on low- and high-density electrical interface cards.

[Table 7-32](#) and [Table 7-33](#) show the J-labeling and corresponding card ports for a shelf assembly configured with low-density electrical cards.

**Table 7-32 J-Labeling Port Assignments for a Shelf Assembly Configured with Low-Density (LD) Electrical Cards (A Side)**

Slot	Port Type		<b>J4</b>	<b>J3</b>	<b>J2</b>	<b>J1</b>	<b>J5</b>	<b>J6</b>	<b>J7</b>	<b>J8</b>
			T1	T13	T25	T37	T1	T13	T25	T37
T2	T14	T26	T38	T2	T14	T26	T38			
T3	T15	T27	T39	T3	T15	T27	T39			
T4	T16	T28	T40	T4	T16	T28	T40			
T5	T17	T29	T41	T5	T17	T29	T41			
T6	T18	T30	T42	T6	T18	T30	T42			
T7	T19	T31	T43	T7	T19	T31	T43			
T8	T20	T32	T44	T8	T20	T32	T44			
T9	T21	T33	T45	T9	T21	T33	T45			
T10	T22	T34	T46	T10	T22	T34	T46			
T11	T23	T35	T47	T11	T23	T35	T47			
T12	T24	T36	T48	T12	T24	T36	T48			
<b>TX</b>			<b>J12</b>	<b>J11</b>	<b>J10</b>	<b>J9</b>	<b>J13</b>	<b>J14</b>	<b>J15</b>	<b>J16</b>
R1	R13	R25	R37	R1	R13	R25	R37			
R2	R14	R26	R38	R2	R14	R26	R38			
R3	R15	R27	R39	R3	R15	R27	R39			
R4	R16	R28	R40	R4	R16	R28	R40			
R5	R17	R29	R41	R5	R17	R29	R41			
R6	R18	R30	R42	R6	R18	R30	R42			
R7	R19	R31	R43	R7	R19	R31	R43			
R8	R20	R32	R44	R8	R20	R32	R44			
R9	R21	R33	R45	R9	R21	R33	R45			
R10	R22	R34	R46	R10	R22	R34	R46			
R11	R23	R35	R47	R11	R23	R35	R47			
R12	R24	R36	R48	R12	R24	R36	R48			
<b>RX</b>			<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>
1	LD DS-3/EC1		1-12	—	—	—	—	—	—	—
2	LD DS-3/EC1		—	—	—	—	1-12	—	—	—
3	LD DS-3/EC1		—	—	—	—	—	—	1-12	—
4	LD DS-3/EC1		—	—	—	—	—	1-12	—	—
5	LD DS-3/EC1		—	1-12	—	—	—	—	—	—
6	LD DS-3/EC1		—	—	1-12	—	—	—	—	—

**Table 7-33 J-Labeling Port Assignments for a Shelf Assembly Configure with Low-Density (LD) Electrical Cards (B Side)**

Slot	Port Type		J20	J19	J18	J17	J21	J22	J23	J24
			<b>TX</b>							
			T1	T13	T25	T37	T1	T13	T25	T37
			T2	T14	T26	T38	T2	T14	T26	T38
			T3	T15	T27	T39	T3	T15	T27	T39
			T4	T16	T28	T40	T4	T16	T28	T40
			T5	T17	T29	T41	T5	T17	T29	T41
			T6	T18	T30	T42	T6	T18	T30	T42
			T7	T19	T31	T43	T7	T19	T31	T43
			T8	T20	T32	T44	T8	T20	T32	T44
			T9	T21	T33	T45	T9	T21	T33	T45
			T10	T22	T34	T46	T10	T22	T34	T46
			T11	T23	T35	T47	T11	T23	T35	T47
			T12	T24	T36	T48	T12	T24	T36	T48
<b>RX</b>										
			J28	J27	J26	J25	J29	J30	J31	J32
			R1	R13	R25	R37	R1	R13	R25	R37
			R2	R14	R26	R38	R2	R14	R26	R38
			R3	R15	R27	R39	R3	R15	R27	R39
			R4	R16	R28	R40	R4	R16	R28	R40
			R5	R17	R29	R41	R5	R17	R29	R41
			R6	R18	R30	R42	R6	R18	R30	R42
			R7	R19	R31	R43	R7	R19	R31	R43
			R8	R20	R32	R44	R8	R20	R32	R44
			R9	R21	R33	R45	R9	R21	R33	R45
			R10	R22	R34	R46	R10	R22	R34	R46
			R11	R23	R35	R47	R11	R23	R35	R47
			R12	R24	R36	R48	R12	R24	R36	R48
			Ports	Ports	Ports	Ports	Ports	Ports	Ports	Ports
17	LD DS-3/EC1		1–12	—	—	—	—	—	—	—
16	LD DS-3/EC1		—	—	—	—	1–12	—	—	—
15	LD DS-3/EC1		—	—	—	—	—	—	1–12	—
14	LD DS-3/EC1		—	—	—	—	—	1–12	—	—
13	LD DS-3/EC1		—	1–12	—	—	—	—	—	—
12	LD DS-3/EC1		—	—	1–12	—	—	—	—	—

Table 7-34 and Table 7-35 show the J-labeling and corresponding card ports for a shelf assembly configured with high-density 48-port DS-3/EC-1 electrical cards.

**Table 7-34 J-Labeling Port Assignments for a Shelf Assembly Configure with High-Density (HD) Electrical Cards (A Side)**

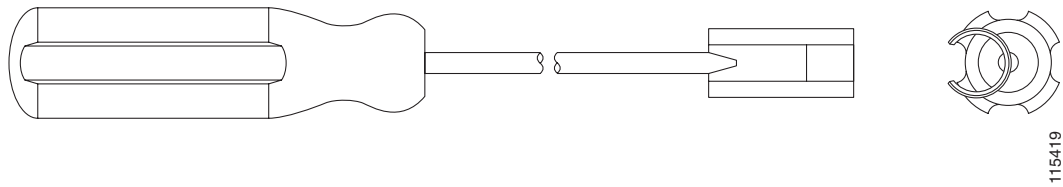
Slot	Port Type		<b>J4</b>	<b>J3</b>	<b>J2</b>	<b>J1</b>	<b>J5</b>	<b>J6</b>	<b>J7</b>	<b>J8</b>
			T1	T13	T25	T37	T1	T13	T25	T37
T2	T14	T26	T38	T2	T14	T26	T38			
T3	T15	T27	T39	T3	T15	T27	T39			
T4	T16	T28	T40	T4	T16	T28	T40			
T5	T17	T29	T41	T5	T17	T29	T41			
T6	T18	T30	T42	T6	T18	T30	T42			
T7	T19	T31	T43	T7	T19	T31	T43			
T8	T20	T32	T44	T8	T20	T32	T44			
T9	T21	T33	T45	T9	T21	T33	T45			
T10	T22	T34	T46	T10	T22	T34	T46			
T11	T23	T35	T47	T11	T23	T35	T47			
T12	T24	T36	T48	T12	T24	T36	T48			
<b>TX</b>			<b>J12</b>	<b>J11</b>	<b>J10</b>	<b>J9</b>	<b>J13</b>	<b>J14</b>	<b>J15</b>	<b>J16</b>
R1	R13	R25	R37	R1	R13	R25	R37			
R2	R14	R26	R38	R2	R14	R26	R38			
R3	R15	R27	R39	R3	R15	R27	R39			
R4	R16	R28	R40	R4	R16	R28	R40			
R5	R17	R29	R41	R5	R17	R29	R41			
R6	R18	R30	R42	R6	R18	R30	R42			
R7	R19	R31	R43	R7	R19	R31	R43			
R8	R20	R32	R44	R8	R20	R32	R44			
R9	R21	R33	R45	R9	R21	R33	R45			
R10	R22	R34	R46	R10	R22	R34	R46			
R11	R23	R35	R47	R11	R23	R35	R47			
R12	R24	R36	R48	R12	R24	R36	R48			
<b>RX</b>			<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>
1	HD DS-3/EC1		1–12	13–24	25–36	37–48	—	—	—	—
2	HD DS-3/EC1		—	—	—	—	1–12	13–24	25–36	37–48

**Table 7-35 J-Labeling Port Assignments for a Shelf Assembly Configure with High-Density (HD) Electrical Cards (B Side)**

Slot	Port Type		<b>J20</b>	<b>J19</b>	<b>J18</b>	<b>J17</b>	<b>J21</b>	<b>J22</b>	<b>J23</b>	<b>J24</b>
						T1	T13	T25	T37	T1
			T2	T14	T26	T38	T2	T14	T26	T38
			T3	T15	T27	T39	T3	T15	T27	T39
			T4	T16	T28	T40	T4	T16	T28	T40
			T5	T17	T29	T41	T5	T17	T29	T41
			T6	T18	T30	T42	T6	T18	T30	T42
			T7	T19	T31	T43	T7	T19	T31	T43
			T8	T20	T32	T44	T8	T20	T32	T44
			T9	T21	T33	T45	T9	T21	T33	T45
			T10	T22	T34	T46	T10	T22	T34	T46
			T11	T23	T35	T47	T11	T23	T35	T47
			T12	T24	T36	T48	T12	T24	T36	T48
		<b>TX</b>								
			<b>J28</b>	<b>J27</b>	<b>J26</b>	<b>J25</b>	<b>J29</b>	<b>J30</b>	<b>J31</b>	<b>J32</b>
			R1	R13	R25	R37	R1	R13	R25	R37
			R2	R14	R26	R38	R2	R14	R26	R38
			R3	R15	R27	R39	R3	R15	R27	R39
			R4	R16	R28	R40	R4	R16	R28	R40
			R5	R17	R29	R41	R5	R17	R29	R41
			R6	R18	R30	R42	R6	R18	R30	R42
			R7	R19	R31	R43	R7	R19	R31	R43
			R8	R20	R32	R44	R8	R20	R32	R44
			R9	R21	R33	R45	R9	R21	R33	R45
			R10	R22	R34	R46	R10	R22	R34	R46
			R11	R23	R35	R47	R11	R23	R35	R47
			R12	R24	R36	R48	R12	R24	R36	R48
		<b>RX</b>								
			<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>	<b>Ports</b>
17	HD DS-3/EC1		1–12	13–24	25–36	37–48	—	—	—	—
16	HD DS-3/EC1		—	—	—	—	1–12	13–24	25–36	37–48

Due to the large number of MiniBNC connectors on the MiniBNC EIA, you might require a special tool for inserting and removing MiniBNC EIAs (Figure 7-34). This tool also helps with ONS 15454 patch panel connections.



**Figure 7-34 MiniBNC Insertion and Removal Tool**

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

Amphenol USA ([www.amphenol.com](http://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](http://www.trompeter.com))  
 31186 La Baya Drive  
 Westlake Village, CA 91362-4047  
 Phone: 800 982-2629 Fax: 818 706-1040

## Managing Twisted-Pair Cables

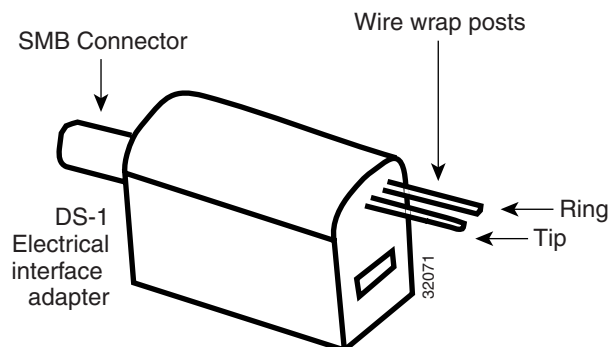
Twisted-pair wire-wrap cables require SMB EIAs and DS-1 electrical interface adapters (baluns). Connect twisted-pair cables to SMB EIAs on the shelf assembly backplane using cable connectors and DS-1 baluns. Installing twisted-pair, wire-wrap cables to terminate DS-1 signals requires separate pairs of grounded twisted-pair wires for receive (in) and transmit (out). Prepare four cables, two for receive and two for transmit, for each DS-1 facility to be installed.



### Note

When using twisted-pair wire-wrap cables, you must install a balun on every transmit and receive connector for each DS-1 termination.

As shown in [Figure 7-35](#), each DS-1 balun has a female SMB connector on one end and a pair of 0.045 inch (1.14 mm) square wire-wrap posts for tip and ring connections on the other end. The wire-wrap posts are 0.200 inches (5.08 mm) apart.

**Figure 7-35 DS-1 Balun**

## Managing AMP Champ Cables

Amp Champ cables are used to terminate DS-1 signals on an ONS 15454. When using Amp Champ cables, you must equip the ONS 15454 with an AMP Champ EIA on each side of the shelf assembly 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.

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 (584.2 mm) rack, two additional inches (50.8 mm) of cable management area is available on each side of the shelf assembly.

To install AMP Champ connector cables to terminate DS-1 signals, 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 fourteen DS-1 ports, only 56 pins (28 pairs) of the 64-pin connector are used. Prepare one 56-wire cable for each working DS1-14 card installed.

Table 7-36 shows the pin assignments for the AMP Champ connectors on the ONS 15454.

**Table 7-36 AMP Champ Connector Pin Assignments**

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

**Table 7-36 AMP Champ Connector Pin Assignments (continued)**

Signal/Wire	Pin	Pin	Signal/Wire	Signal/Wire	Pin	Pin	Signal/Wire
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 7-37 shows the pin assignments for the AMP Champ connectors on the ONS 15454 AMP Champ EIA for a shielded DS-1 cable.

**Table 7-37 AMP Champ Connector Pin Assignments (Shielded DS-1 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

**Table 7-37 AMP Champ Connector Pin Assignments (Shielded DS-1 Cable) (continued)**

64-Pin Blue Bundle				64-Pin Orange Bundle			
Signal/Wire	Pin	Pin	Signal/Wire	Signal/Wire	Pin	Pin	Signal/Wire
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

## Managing UBIC Cables

The UBIC-H and UBIC-V DS-1 and DS3/EC-1 cable assemblies are designed to support both low-density (LD) and high-density (HD) DS-1, DS-3, or EC-1 signals. One end of these cables is terminated with a 50-pin SCSI connector and the other end is unterminated. Each SCSI connector on the DS-1 cable assembly supports 14 separate Tx and Rx DS-1 twisted-pair, 24 AWG cables. Each SCSI connector on the DS-3/EC-1 cable assembly supports 12 separate Tx and Rx DS-3 RG734 to RG735A coaxial cables. If available, tie wrap or lace the cables to the optional ONS 15454 tie-down bar according to GR-1275-CORE or local site practice.



### Note

Cisco recommends that you plan for future slot utilization and fully cable all SCSI connectors you will use later.

Figure 7-36 shows the pin locations on the DS-1 and DS-3/EC-1 SCSI connectors.

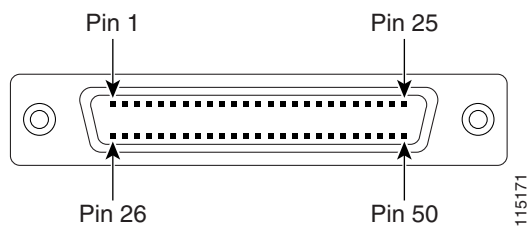
**Figure 7-36 SCSI Cable Connector Pins**

Table 7-38 shows the SCSI connector pin assignments for the DS-1 and DS-3/EC-1 cables.

**Table 7-38 SCSI Pin Assignments**

Pin	Cable Port	Pin	Cable Port
1	1	26	7
2	FGnd	27	FGnd
3	FGnd	28	FGnd
4	FGnd	29	FGnd
5	2	30	7
6	FGnd	31	FGnd

**Table 7-38** *SCSI Pin Assignments*

Pin	Cable Port	Pin	Cable Port
7	FGnd	32	FGnd
8	FGnd	33	FGnd
9	3	34	9
10	FGnd	35	FGnd
11	FGnd	36	FGnd
12	FGnd	37	FGnd
13	4	38	10
14	FGnd	39	FGnd
15	FGnd	40	FGnd
16	FGnd	41	FGnd
17	5	42	11
18	FGnd	43	FGnd
19	FGnd	44	FGnd
20	FGnd	45	FGnd
21	6	46	12
22	FGnd	47	FGnd
23	FGnd	48	FGnd
24	FGnd	49	FGnd
25	13	50	14

Table 7-39 shows the UBIC-H and UBIC-V EIA DS-1 cable wiring.

**Table 7-39** *UBIC-H and UBIC-V EIA DS-1 Wiring*

Signal	Wire Coloring	Signal	Wire Coloring
Tip Port 1	White/Blue	Ring Port 1	Blue/Whit
Tip Port 2	White/Orange	Ring Port 2	Orange/Whit
Tip Port 3	White/Green	Ring Port 3	Green/White
Tip Port 4	White/Brown	Ring Port 4	Brown/White
Tip Port 5	White/Slate	Ring Port 5	Slate/White
Tip Port 6	Red/Blue	Ring Port 6	Blue/Red
Tip Port 7	Red/Orange	Ring Port 7	Orange/Red
Tip Port 8	Red/Green	Ring Port 8	Green/Red
Tip Port 9	Red/Brown	Ring Port 9	Brown/Red
Tip Port 10	Red/Slate	Ring Port 10	Slate/Red
Tip Port 11	Black/Blue	Ring Port 11	Blue/Black
Tip Port 12	Black/Orange	Ring Port 12	Orange/Black

**Table 7-39** UBIC-H and UBIC-V EIA DS-1 Wiring

Signal	Wire Coloring	Signal	Wire Coloring
Tip Port 13	Black/Green	Ring Port 13	Green/Black
Tip Port 14	Black/Brown	Ring Port 14	Brown/Black

## DS-1 Cables

The DS-1 cables are connectorized at the ONS 15454 shelf end and must be wire-wrapped at the DSX end. Each Tx/Rx pair of SCSI connectors will support 140 DS-1s. A total of ten low-density (LD) DS-1 cards in slots 1, 2, 4, 5, 6, 12, 13, 14, 16, and 17 fully cabled can support 140 DS-1 drops. Four high-density (HD) cards in slots 1, 2, 16, and 17 fully cabled will have 224 DS-1 drop capacity when the HD DS-1 card becomes available.



### Note

The connectorized cable end is grounded to the ONS 15454 frame ground through the backplane. Cisco recommends that the shield at the both ends of the cable be grounded. Ground at the DSX end per office requirements.

## DS-3/EC-1 Cables

The DS-3/EC-1 cable assemblies are used for the DS3-12, DS3-12E, DS3/EC1-48, DS3XM-6, DS3XM-12, and EC1-12 cards. The DS-3/EC-1 cables are connectorized at the UBIC Vend and unterminated at the far end. Twelve individual BNC connectors are supplied with each cable assembly in a separate package.

Each Tx/Rx pair of SCSI connectors will support 12 DS-3s or EC-1s. A total of ten LD DS-3 or EC-1 cards in slots 1, 2, 4, 5, 6, 12, 13, 14, 16, and 17 fully cabled can support 120 DS-3 or EC-1 drops. Four HD DS-3/EC-1 cards in slots 1, 2, 16, and 17 fully cabled will have 192 DS-3/EC-1 drop capacity.

Each Tx/Rx pair of SCSI connectors will also support 6 channelized DS-3s drops for the DSXM-6 and 12 channelized drops for the DS3XM-12 cards. Fully cabled the UBIC-H and UBIC-V can support 36 DS3XM-6 drops or 72 DS3XM-12 drops.

The UBIC-H and UBIC-V EIAs support the following J-Labeling that corresponds SCSI connectors to the ports on low- and high-density electrical interface cards.

[Table 7-40](#) and [Table 7-41](#) show the J-labeling and corresponding card ports for a shelf assembly configured for low-density electrical cards.

**Table 7-40 J-Labeling Port Assignments for a Shelf Assembly Configured with Low-Density Electrical Cards (A Side)**

Slot	Port Type	Tx	J4	J3	J2	J1	J5	J6	J7	J8
		Rx	J12	J11	J10	J9	J13	J14	J15	J16
			Ports	Ports	Ports	Ports	Ports	Ports	Ports	Ports
1	DS-1		1-14	—	—	—	—	—	—	—
	DS-3/EC1		1-12	—	—	—	—	—	—	—
2	DS-1		—	—	—	—	1-14	—	—	—
	DS-3/EC1		—	—	—	—	1-12	—	—	—
3	DS-1		—	—	—	—	—	—	1-14	—
	DS-3/EC1		—	—	—	—	—	—	1-12	—
4	DS-1		—	—	—	—	—	1-14	—	—
	DS-3/EC1		—	—	—	—	—	1-12	—	—
5	DS-1		—	1-14	—	—	—	—	—	—
	DS-3/EC1		—	1-12	—	—	—	—	—	—
6	DS-1		—	—	1-14	—	—	—	—	—
	DS-3/EC1		—	—	1-12	—	—	—	—	—

**Table 7-41 J-Labeling Port Assignments for a Shelf Assembly Configured with Low-Density Electrical Cards (B Side)**

Slot	Port Type	Tx	J4	J3	J2	J1	J5	J6	J7	J8
		Rx	J12	J11	J10	J9	J13	J14	J15	J16
			Ports	Ports	Ports	Ports	Ports	Ports	Ports	Ports
17	DS-1		1-14	—	—	—	—	—	—	—
	DS-3/EC1		1-12	—	—	—	—	—	—	—
16	DS-1		—	—	—	—	1-14	—	—	—
	DS-3/EC1		—	—	—	—	1-12	—	—	—
15	DS-1		—	—	—	—	—	—	1-14	—
	DS-3/EC1		—	—	—	—	—	—	1-12	—
14	DS-1		—	—	—	—	—	1-14	—	—
	DS-3/EC1		—	—	—	—	—	1-12	—	—
13	DS-1		—	1-14	—	—	—	—	—	—
	DS-3/EC1		—	1-12	—	—	—	—	—	—
12	DS-1		—	—	1-14	—	—	—	—	—
	DS-3/EC1		—	—	1-12	—	—	—	—	—

Table 7-42 and Table 7-43 show the J-labeling and corresponding card ports for a shelf assembly configured with high-density 48-port DS-3/EC-1 or 56-port DS-1 electrical cards.

**Table 7-42 J-Labeling Port Assignments for a Shelf Configured with High-Density Electrical Cards (A Side)**

Slot	Port Type	TX	J4	J3	J2	J1	J5	J6	J7	J8
		RX	J12	J11	J10	J9	J13	J14	J15	J16
			Ports	Ports	Ports	Ports	Ports	Ports	Ports	Ports
1	DS-1		1–14	15–28	29–42	43–56	—	—	—	—
	DS-3/EC1		1–12	13–24	25–36	37–48	—	—	—	—
2	DS-1		—	—	—	—	1–14	15–28	29–42	43–56
	DS-3/EC1		—	—	—	—	1–12	13–24	25–36	37–48

**Table 7-43 J-Labeling Port Assignments for a Shelf Configured with High-Density Electrical Cards (B Side)**

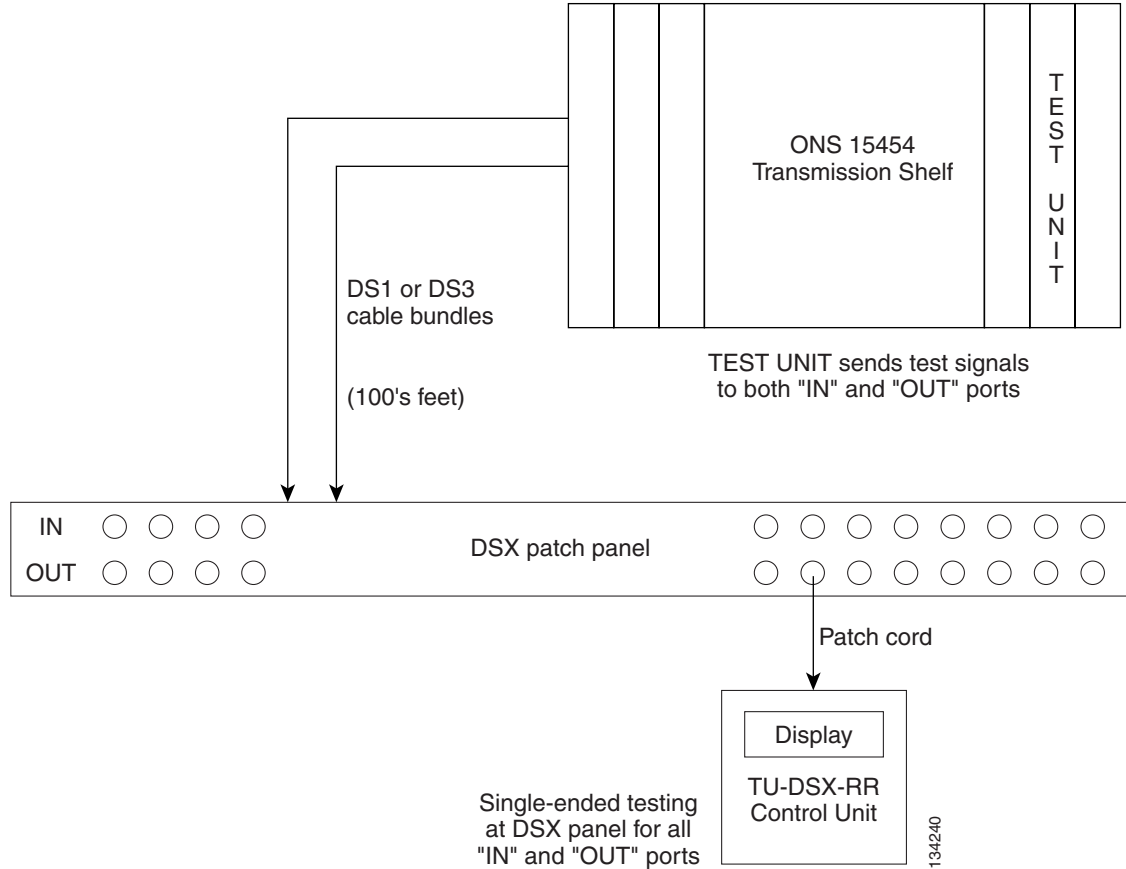
Slot	Port Type	TX	J20	J19	J18	J17	J21	J22	J23	J24
		RX	J28	J27	J26	J25	J29	J30	J31	J32
			Ports	Ports	Ports	Ports	Ports	Ports	Ports	Ports
17	DS-1		1–14	15–28	29–42	43–56	—	—	—	—
	DS-3/EC1		1–12	13–24	25–36	37–48	—	—	—	—
16	DS-1		—	—	—	—	1–14	15–28	29–42	43–56
	DS-3/EC1		—	—	—	—	1–12	13–24	25–36	37–48

## DSX Wiring Verification Kits

The ONS 15454 DSX Wiring Verification Kit consists of an In-service test card (IS-DSX), hand-held control unit (TU-DSX-RR), a circuit card that plugs into the ONS 15454 shelf assembly (TU-DSX TEST UNIT), plus several patch cords and an AC/DC adaptor. The TU-DSX TEST UNIT works in Slots 3 and 15 of the Shelf assembly and gets power from either the shelf's office battery or from an optional low power AC/DC adaptor. The kit verifies installed cabling between the cross-connect DS-1 or DS-3 patch panel and a newly installed ONS 15454 shelf (see Figure 7-39). Tested conditions are for shorts, opens, wrong connections, and tip/ring reversals. Once testing is started, the DSX wiring can be verified at the DSX. There is no need for coordinated operations at both the DSX and the ONS 15454 shelf. For more information about the DSX wiring verification kit, refer to the Cisco Testing DSX Wiring with the Cisco ONS 15454 DSX Wiring Verification Kit document (74-3494-01-A0 Issue 3).



Figure 7-37 ONS 15454 DSX Wiring Verification Kit Block Diagram

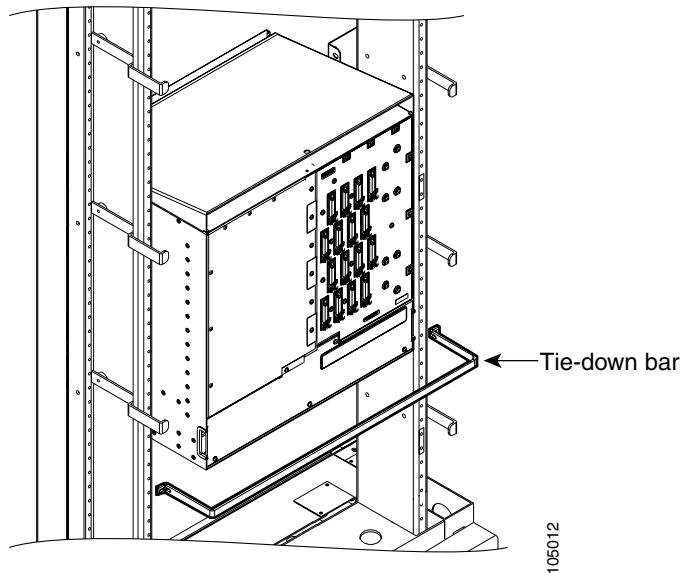


## Electrical Cable Management Using the Optional Tie-Down Bar

Optional ONS 15454 tie-down bars, 19 inches and 23 inches, can be used to provide a diverse path for redundant power feeds and EIA cables. You can install a 5-inch (127 mm) tie-down bar on the equipment rack at the rear of the assembly shelf. You can use tie-wraps or other site-specific material to bundle the cabling and attach it to the bar so that you can more easily route the cable away from the rack.

[Figure 7-38](#) shows the tie-down bar, the ONS 15454 shelf assembly, and the equipment rack.

**Figure 7-38** EIA Cable Management Using the Optional Tie-Down Bar



## Standoffs and Rear Plastic Cover

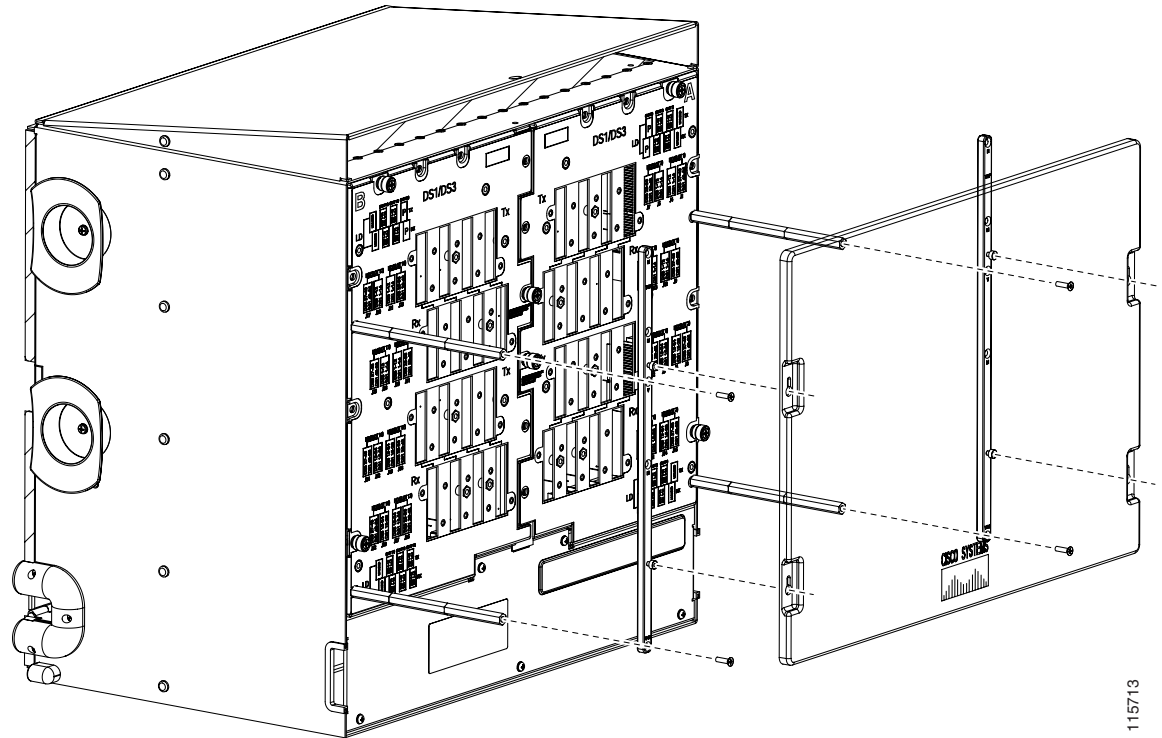
The ONS 15454 has an optional clear plastic rear cover that provides additional protection for the cables and connectors on the EIAs.

Optional spacers are included in the rear cover ship kit to provide the necessary space between the cables and rear covers for the UBIC-H and UBIC-V. You will need the following equipment to install the standoffs (necessary for installing the rear cover with over UBIC-V EIA cables) and the rear cover:

- #2 Phillips screwdriver
- Medium flathead screwdriver
- 1/4-inch nut driver
- 2 mounting screws, 6-32 x 0.375-inch Phillips head (P/N 48-0598-01)
- Four 1-inch standoffs (50-1193-01)
- Four 2-inch standoffs (50-1453-01)
- Two brackets

You attach the rear cover by hanging it from the mounting screws on the back of the mounting brackets and pulling it down until it fits firmly into place (see [Figure 7-39](#)).

**Figure 7-39** Installing the Rear Cover with Standoffs



## Synchronization

The Cisco ONS 15454 is designed to operate in a network that complies with synchronization and timing recommendations stated in GR-253-CORE, GR-436-CORE, and GR-1244-CORE.

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

1. The BITS (building integrated timing supply) pins on the ONS 15454 backplane.
2. An OC-N card installed in the ONS 15454. The card is connected to a node that receives timing through a BITS source.
3. The internal ST3 clock on the TCC2/TCC2P 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 the ONS 15454 timing to external. If the timing comes from an OC-N card, set the timing to line. Node timing for a typical ONS 15454 network would be as follows:

- One node will be set to external timing. The external node will derive its timing from a BITS source wired to the BITS backplane pins. The BITS source will derive its timing from a Primary Reference Source (PRS) such as a Stratum 1 clock or GPS signal.
- The other ONS 15454 nodes will be set to line. The line nodes will derive timing from the externally timed ONS 15454 node through the OC-N trunk (span) cards. Dense wavelength division multiplexing (DWDM) cards normally derive timing from the line using the Optical Service Channel Module (OSCM) or Optical Service Channel and Combiner/Splitter Module (OSC-CSM) card that are inside an OC-3 channel.

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 TCC2/TCC2P card. This clock is a Stratum 3 (ST3). If an ONS 15454 becomes isolated, timing will be maintained at the ST3 level.

Release 5.0 supports a new 64KHz+8KHz composite clock reference, per ITU-T G.703 Table II.1. The 64KHz+8KHz clock features AMI with 8 KHz bipolar violation, and only works with dual TCC2P cards running software Release 5.0 and higher.

You can select the 64KHz+8KHz clock from the Facility Type selection box in the BITS Facilities subtab of the node view, Provisioning > Timing tabs. When using the 64KHz+8KHz clock as a source, only DS1 and 6MHz framing are allowed for BITS out, and the user selected Admin SMM message type is enforced, with the Sync Messaging check box disabled and grayed out. With the 64KHz+8KHz clock selected as the source, the user selectable Admin SSM defaults to STU. The following configurations are supported for the 64+8kHz clock:

- BITS INBITS OUT
- DS1None
- DS1DS1
- 64 KHzNone
- 64 KHzDS1
- 64 KHz
- 6132 KHz (6MHz)


**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.

## Timing Guidelines

Timing guidelines for the ONS 15454 evolve around the following conditions:

- Where BITS timing is available, configure the ONS 15454 node to be externally timed from the BITS clock.
- Where no BITS timing is available, configure the ONS 15454 node to be lined timed from an OC-N signal.
- Where both external and line time references are to be used, configure the ONS 15454 for mixed-timing.

## Timing and Synchronization Features

Timing and synchronization in the ONS 15454 is controlled by the TCC2/TCC2P card which is stratum 3 compliant. A redundant architecture protects against failure or removal of one TCC2/TCC2P card. For timing reliability, the TCC2/TCC2P card selects either a recovered clock, a BITS clock, or an internal stratum as the system timing reference. You can provision any of the clock inputs as primary or secondary timing sources. If you provision two timing references, the secondary reference provides protection. A slow-reference tracking loop allows the TCC2/TCC2P to track the selected timing reference and synchronize to the recovered clock and provide holdover in the event the reference is lost.

In a fail-over scenario, selection of the next timing reference is governed by the availability of the next best (clock quality) timing reference as defined by the Stratum hierarchy (discussed in the next section). The timing modes available on the ONS 15454 include the following:

- External (BITS) timing
- Line (Optical) timing
- Mixed (both External and Internal) sources
- Holdover (automatically provided when all references fail)
- Free-running (a special case of holdover)



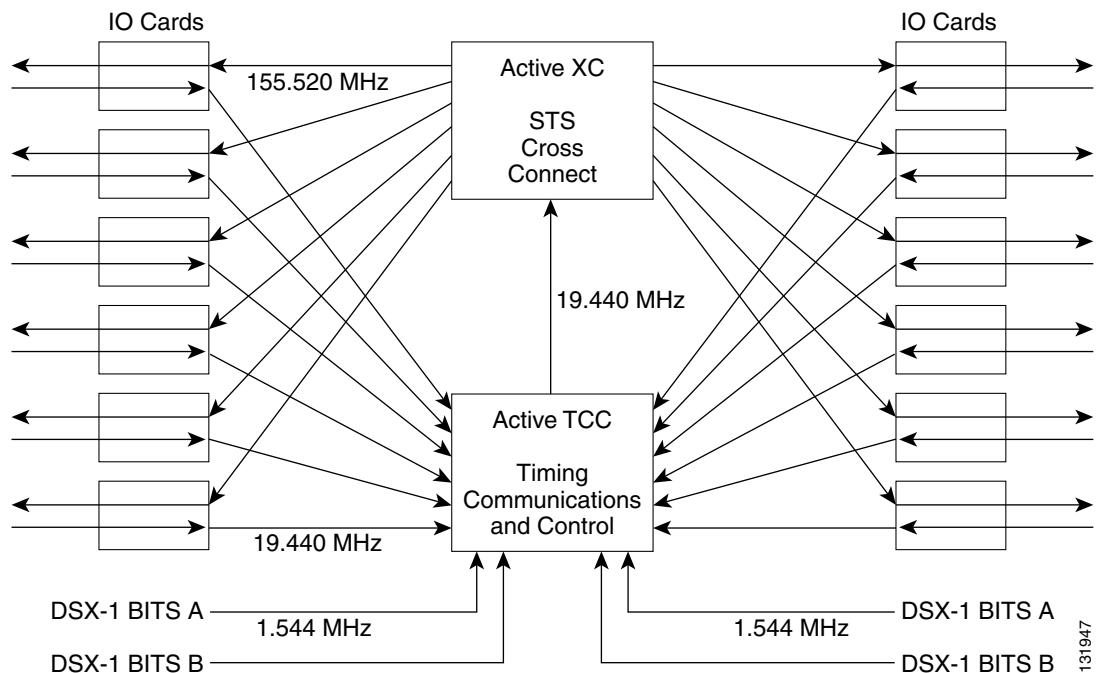
**Warning**

**Timing loops can be created when you select both external and line timing references. Use Mixed mode of timing with caution.**

Through-timing and per-port loop timing are additional timing modes available, but are not supported for the optical synchronous interfaces. DS1 and DS3 asynchronous interfaces are through-timed and do not reference the system timing. For these asynchronous ports, transmit timing is derived from the received timing for that asynchronous signal.

The transmit timing on all optical synchronous interfaces is derived from the system timing reference provided by the TCC2/TCC2P cards. [Figure 7-40](#) illustrates how timing signals flow through the ONS 15454. The TCC2/TCC2P card selects a timing reference from one of several sources as discussed above and distributes this reference to the synchronous interface cards.

**Figure 7-40 ONS 15454 Timing Flow**



The TCC2/TCC2P synchronization functions include:

- Reference monitoring, qualification and selection
- Filtering and locking to the active reference

- Distribution of 19.44MHz system clock
- Termination of two BITS inputs
- Generation of two BITS outputs
- Processing and generating SSM (Synchronization Status Messages)

## External BITS Timing

The external timing input signal on the Cisco ONS 15454 must come from a synchronization source whose timing characteristics are better than the stratum 3 internal clock. The TCC2/TCC2P will track the external reference with the internal clock.

The BITS signal is a DS-1 level, 1.544 MHz signal, formatted either as D4 Superframe (SF, 12 frames per superframe) or the Extended Superframe (ESF, 24 frames per superframe) ESF. For the ONS 15454, the default setting for the BITS framing reference is ESF, but you may change this to SF (D4) if necessary. The default setting for BITS line coding reference is B8ZS, however this can be changed to AMI if required. The default setting for BITS State is OOS (out of service). For nodes using external timing or the external BITS Out, you must change this setting to IS (in-service). The redundant architecture of the ONS 15454 provides two inputs for connection to external BITS clocks: BITS1 and BITS2. If these inputs have been selected as the primary and secondary synchronization sources, the active and standby TCC2/TCC2P cards will monitor both inputs. If the primary input fails, the secondary input will be selected. Failure switching is discussed in more detail later. It is recommended, but not necessary, to have redundant BITS inputs. However, if only a single BITS source is available, the secondary source can be set to Internal or Line synchronization.



### Note

DS-1s delivered over traffic links are not suitable BITS sources. The primary reason is that SONET compensation for off-frequency DS-1s results in jitter since controlled slips are not performed.

Table 7-44 provides a summary of the BITS input physical connections and signal formats for the ONS 15454.

**Table 7-44 Summary of BITS Inputs and Signal Formats**

Number of BITS Inputs	BITS Input Physical Connection	BITS Input Signal Format
2	4 wire-wrap pins provide connections for redundant BITS clock inputs.	1.544 Mb/s DS-1 with either SF (D4) or ESF (required for SSM support) framing format.  Release 5.0 and higher with redundant TCC2P cards supports a 64Khz+8KHz composite clock with AMI framing.

## Line Timing

The ONS 15454 can accept reference timing from any optical port. For increased reliability, optical cards with multiple ports (e.g. 4-port OC-3) can only have one of its ports provisioned as a timing reference. The optical cards divide down the recovered clock to 19.44 MHz and transmit it to the working and protect TCC2/TCC2P cards, where it is qualified for use as a timing reference.

Synchronization Status Messaging (SSM) can be optionally enabled or disabled on an optical port. A controller on the optical card monitors the received SSM and reports any changes to the TCC2/TCC2P synchronization process. If an optical port (receiver) is selected as the active timing reference, the SSM value DUS (Don't Use for Synchronization) is transmitted (on the transmit port) to help prevent timing loops. If SSM is disabled, the controller does not monitor the received SSM value and transmits the SSM value STU (Synchronized, Traceability Unknown). More information on SSM is available later in this chapter.

## Mixed Mode Timing

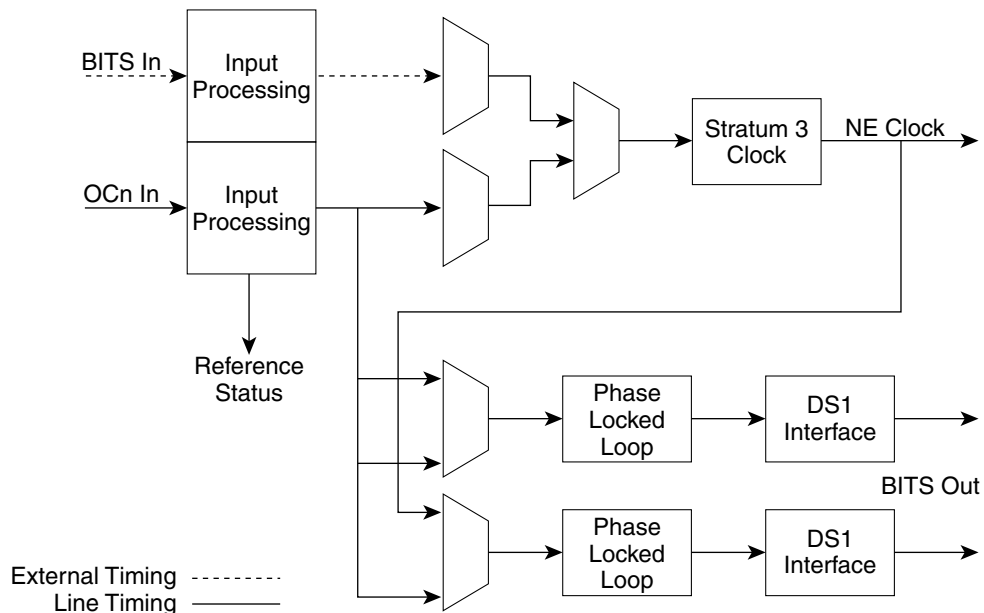


### Caution

Mixed Mode Timing allows you to select both external and line timing sources. However, Cisco does not recommend its use because it can create timing loops. Caution must be used when using Mixed Mode timing as it can result in inadvertent timing loops. The most common reason for using Mixed Mode Timing is so that an OC-N timing source can be provisioned as a backup for the BITS timing source.

The Mixed Mode Timing feature enhances the provisioning options for the NE Reference only. The rules associated with the BITS Out timing source have not changed. To review these rules, [Figure 7-41](#) has been provided to show the ONS 15454 timing circuit.

**Figure 7-41 ONS 15454 Timing Circuit**



The operation of the timing circuit shown above is as follows:

- The incoming references from the BITS input and the OC-N recovered clocks are monitored for errors.
- Depending on the timing mode, the multiplexers select the appropriate input reference for the Stratum 3 clock.
- The timing reference is filtered through the Stratum 3 clock and the resulting output is the NE clock.
- The source of the BITS outputs are selected from either the OC-N recovered clock or the NE clock.

**Note**

If the NE clock is derived from the BITS In (i.e., when the node is provisioned for External Timing or Mixed Mode Timing), then the NE clock cannot be used as the source for a BITS Output.

## Free-running Mode

The ONS 15454 is considered to be in Free-run state when it is operating on its own internal clock. The ONS 15454 has an internal clock in the TCC2/TCC2P that is used to track a higher quality reference, or in the event of node isolation, provide holdover timing or a free-running clock source. The internal clock is a certified stratum 3 clock with enhanced capabilities that match the stratum 3E specifications for:

- Free-run accuracy
- Holdover frequency drift
- Wander tolerance
- Wander generation
- Pull-In and Hold-In
- Reference locking/Settling time
- Phase transient (tolerance and generation)

Table 7-45 provides the timing characteristics of stratum 3 and stratum 3E clocks, and compliance details for the ONS 15454.

**Table 7-45 Stratum 3 and 3E Compliance**

Timing Characteristics	Stratum 3	Stratum 3E	ONS 15454 Compliance
Free Run Accuracy	4.6 ppm	4.6 ppm	Comply with stratum 3E
Holdover Stability			
Holdover - Initial Offset	50 ppb	1ppb	5 ppb
Holdover - Frequency Drift	$4.63 \times 10^{-7}$	$1.16 \times 10^{-8}$	Comply with stratum 3E
Holdover - Temperature Stability	280 ppb	10 ppb	Comply with stratum 3
Wander Tolerance	per GR-253	per GR-253	Comply with stratum 3E
Wander Transfer	0.1Hz	0.01Hz	Comply with stratum 3
Wander Generation	per GR-253	per GR-253	Comply with stratum 3E
Pull-In and Hold-In Reference	$4.6 \times 10^{-6}$	$4.6 \times 10^{-6}$	Comply with stratum 3E
Locking/Settling Time	700 ms	100 ms	Comply with stratum 3E
Phase Transients			
Tolerance	1us	1us	Comply with stratum 3E
Generation	per GR-253	per GR-253	Comply with stratum 3E
Build-Out	None	>3.5us	Comply with stratum 3E <sup>1</sup>

1. Line Build Out (LBO) is not supported in system releases prior to Release 3.3.



## Holdover Mode

Holdover is the operating condition of a clock that has lost its external references, but continues to use reference information that was acquired during normal operation. Holdover is a failover state after a system clock has been continuously "locked & synchronized" to a more accurate reference for more than 140 seconds. It "holds" the original operating parameters for a defined period. The holdover frequency will start to drift over time, particularly when the "holdover period" has expired. Holdover conditions can be caused by:

- Failure of the External BITS timing reference
- Failure of the optical Line timing reference

Holdover frequency is a measure of a clock's performance while in holdover mode. The holdover frequency offset for stratum 3 is  $50 \times 10^{-9}$  initially (the first minute), and an additional  $40 \times 10^{-9}$  for the next 24 hours. The ONS 15454 goes into Holdover when the last available reference is lost and the node was synchronized to that reference for more than 140 seconds. During this period, the internal clock is held at the last known value of the Phase Lock Loop (PLL) parameters when the node was still synchronized to the reference clock. If the holdover frequency value is corrupted, the ONS 15454 will switch to Free-run mode.

## BITS Out

BITS Out provides a clock source for other network elements that do not have a BITS or Line clock source. In the ONS 15454, the BITS Out clock is extracted from an optical Line source, regardless of the selected timing mode (External, Line, or Mixed). If a BITS clock is available at the facility, the other network elements should be timed directly from the BITS source. In Line timed mode, in addition to the optical Line sources, the BITS Out Reference list includes 'NE Reference'. 'NE Reference' enables the node's active Line reference to be automatically selected as the BITS Out signal. This option is not available in External or Mixed timing modes.

Table 7-46 provides a summary of the physical connections and signal formats for BITS Out.

**Table 7-46** BITS Out Connections and Signal Formats

Number of BITS Outputs	BITS Output Physical Connection	BITS Output Signal Characteristics
2	4 BITS pins provide connections for redundant BITS clock outputs on the ONS 15454 backplane.	1.554 Mb/s DS-1 signal. DS-1 format per BITS Facility setting. Release 5.0 and higher with redundant TCC2P cards supports a 6MHz format per 64KHz+8KHz BITS Facility setting.

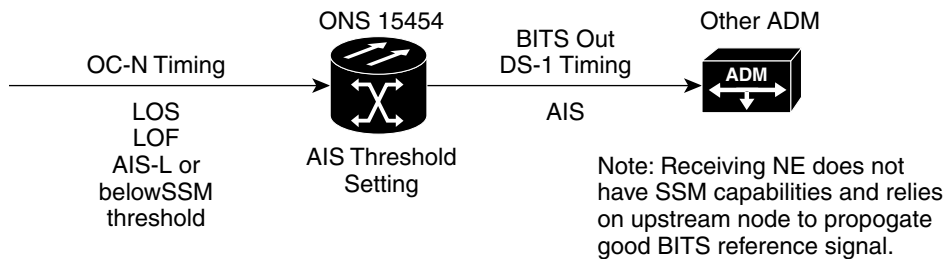
BITS Out framing of ESF or SF (D4) and coding of AMI or B8ZS formats are configured in the BITS Facilities section in the Cisco Transport Controller (CTC). The configured framing and coding formats apply to both, the BITS Out and BITS input signals.

For both ESF and SF (D4), BITS Out is a framed, "all ones" signal (not to be confused with AIS, which is an unframed "all ones" signal). SSM is available only with ESF framing. The SSM value of the selected optical reference for BITS Out is passed through to the BITS Out signal.

SSM is not available with SF (D4) formatted DS-1. However, to insure reliability, when the BITS Out signal is used with equipment in SF (D4) mode or with no SSM capability, an AIS Threshold Settings can be provisioned in CTC. In this configuration, AIS will be sent as the BITS Out signal when the

quality level of all selected optical references fall below the set threshold. The connected equipment can then switch to an alternate timing reference. Figure 7-42 provides a list of conditions under which AIS will be sent on the BITS Out facility.

**Figure 7-42** BITS Out AIS Conditions



## Synchronization Status Messaging

The ONS 15454 node supports two sets of SSMs: Generation 1 and Generation 2. Generation 1 is the most widely used SSM message set. Generation 2 is a newer version that defines additional quality levels. Table 7-47 describes the Generation 1 message set and Table 7-48 describes the Generation 2 message set.

**Table 7-47** SSM Generation 1 Message Set

Message	Quality Level	Description	S1 Bits 5-6-7-8
PRS	1	Primary reference source traceable - Stratum 1	0001
STU	2	Synchronized - traceability unknown	0000
ST2	3	Stratum 2 Traceable	0111
ST3	4	Stratum 3 Traceable	1010
SMC	5	SONET Minimum Clock traceable	1100
ST4	6	Stratum 4 Traceable	NA
DUS	7	Do not use for timing synchronization	1111
RES	User Defined	Reserved - quality level set by user	1110



Caution

**Table 7-48** SSM Generation 2 Message Set

Message	Quality Level	Description	S1 Bits
PRS	1	Primary reference source - Stratum 1	0001
STU	2	Synchronized - traceability unknown	0000
ST2	3	Stratum 2 Traceable	0111

**Table 7-48 SSM Generation 2 Message Set (continued)**

Message	Quality Level	Description	S1 Bits
TNC	4	Transit node clock	0100
ST3E	5	Stratum 3E Traceable	1101
ST3	6	Stratum 3 Traceable	1010
SMC	7	SONET minimum clock	1100
ST4	8	Stratum 4 Traceable	NA
DUS	9	Do not use for timing synchronization	1111
RES	User Defined	Reserved - quality level set by user	1110

**Caution**

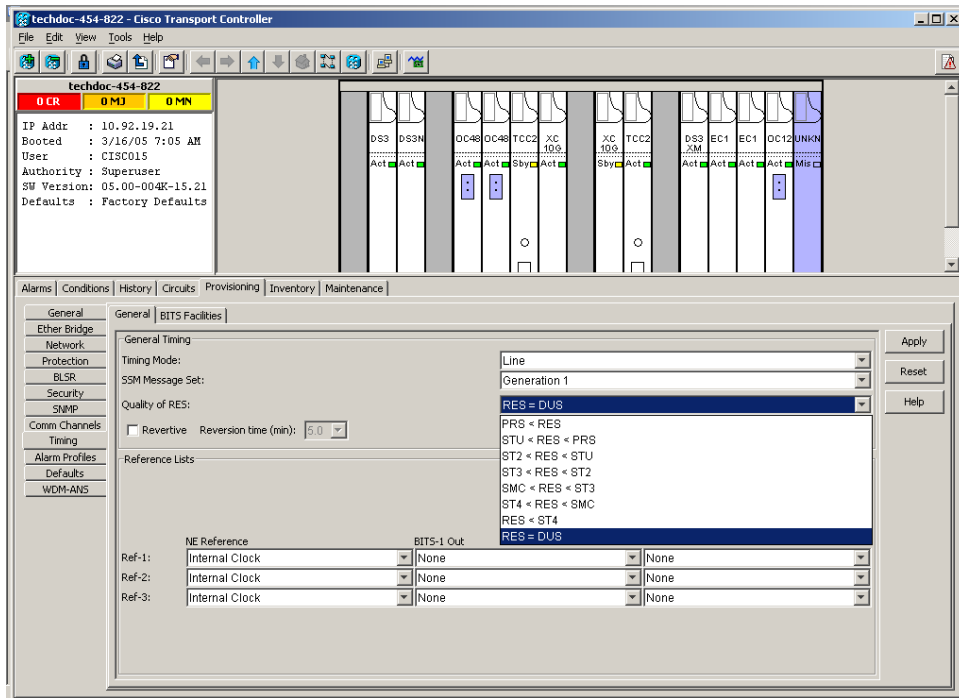
The use of SSM in a timing network does not automatically prevent timing loops. Proper synchronization planning is required.

With Release 5.0 you can configure an SSM value for a timing source (either BITS-IN or Optical Line) by selecting from the "ADMIN. SSM" selection box in the BITS Facilities subtab of the node view, Provisioning > Timing tabs. This feature is useful when the selected external timing source has no SSM information. When you select the Admin SSM value, all switching decisions are subsequently made based on your selection. The same SSM value is transmitted out of the interface configured for BITS Out, and in transmit Optical S1. The DS1 BITS type with framing type SF(D4) only supports Admin SSM. The 64KHz+8KHz clock also only supports Admin SSM. ESF Framing must have Sync Messaging turned off (uncheck the check box) in order to enable Admin SSM selection. SONET nodes use the SSM Generation II message set, as defined in Table 4 of ANSI T1.101-1999.

## Setting Quality of RES

RES is a user-defined SSM value that enables the quality level of a clock source to be set between any of the defined standard levels. For example, if there are two Stratum 1 sources in the network, with one being of slightly lower quality than the other (GPS source versus a Cesium source), its SSM value can be set to RES, instead of PRS. The Cesium source will be PRS. In every node in the network, Quality of RES can be set to "STU<RES<PRS". This setting defines PRS as the highest quality clock and RES as the next highest quality clock (RES is greater than STU, but less than PRS). The CTC screen in [Figure 7-43](#) shows the available settings for RES. If the RES SSM is used in an ONS 15454 network, its assigned quality level must be provisioned in every node in the network. The default setting is RES=DUS.

Figure 7-43 Quality of RES Settings



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## Using the ONS 15454 Without SSM

Older BITS clock sources may not provide SSM to the ONS 15454 BITS input signals. In this case, Sync Messaging must be disabled in CTC for the BITS 1 and BITS 2 inputs. The SSM value of STU (Synchronized, Traceability Unknown) will be assigned to the BITS inputs and used in the S1 byte on the optical ports. Note that a different SSM value (such as PRS) cannot be provisioned for the S1 byte to manually define the quality of the node's clock. A BITS input is considered to be failed when AIS is present at the input.

## Network Synchronization Design

In most ONS 15454 networks, at least one or more nodes must be set to External timing. All other nodes can be set to Line timing. The timing architecture should insure that timing loops do not occur when there is a network failure. Externally timed nodes receive timing from a BITS source wired to the BITS backplane pins. The BITS source, in turn, gets its timing from a PRS, such as a stratum 1 clock or GPS signal. In networks with multiple BITS sources, the "STU<RES<PRS" SSM value can be used as described earlier. The Line timed nodes receive timing from optical pots.



### Caution

Some DS-1 sources have slip buffers that enable controlled slips of the DS-1 signal to be performed. The ONS 15454 does not support controlled slips on its synchronization inputs.

## Number of Line Timed Spans (Daisy-chained)

Currently, test results validate that 13 line-timed nodes can be daisy-chained without any effect on timing wander and jitter. The timing architecture can be arranged such that a single Externally timed source can provide Line timing for 13 nodes in the east direction and 13 nodes in the west direction for a total of 26 nodes.

## 2R and 3R DWDM Spans

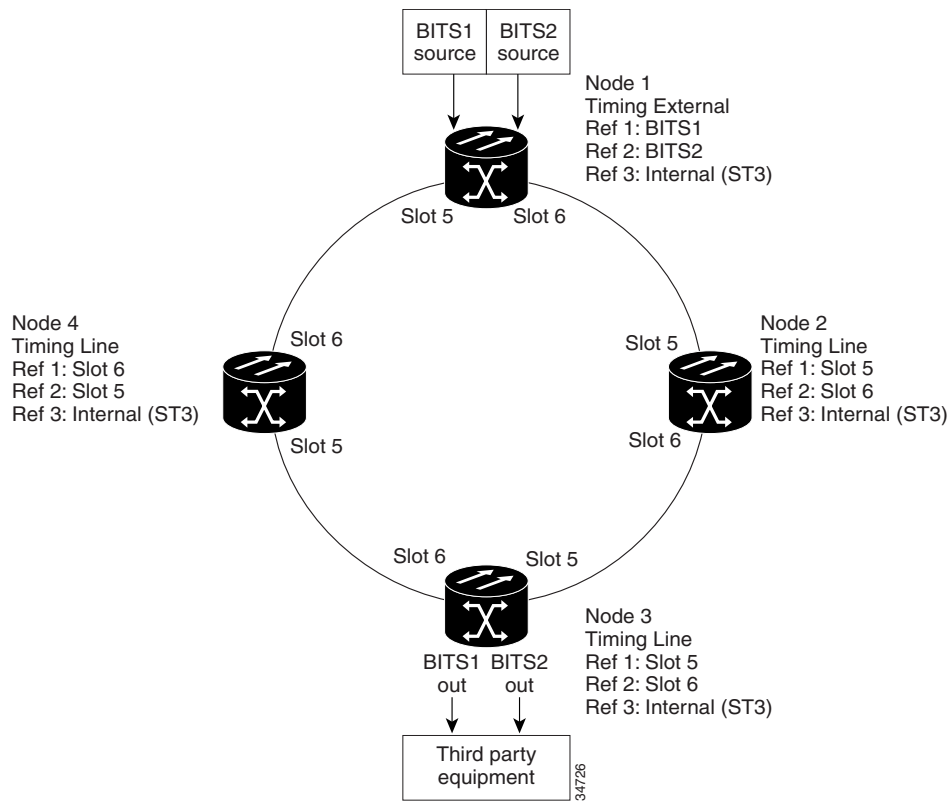
In spans with 2R (Re-shape and Re-amplify, but not Re-time) DWDM systems the synchronization characteristics are simply passed-through (i.e., jitter is passed through) and there is no effect on network synchronization. However, with 3R (Re-shape and Re-amplify, Re-time) DWDM systems, the re-timing must be done from a stratum 1 source.

## Network Timing Example

Figure 7-44 shows a typical 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 backplane of Node 1. 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 OC-N trunk cards in each node. Timing at Nodes 2, 3, and 4 is set to line, and the timing references are set to the port of the trunk OC-N cards based on distance from the BITS source. NE Reference 1 is set to the port of the OC-N trunk card closest to the BITS source. At Node 2, the NE Reference 1 is the port of the OC-N card in Slot 5, because it is connected to Node 1. At Node 4, the NE Reference 1 is set to the port of the OC-N card in Slot 6, because it is connected to Node 1. At Node 3, the NE Reference 1 could be the port of either OC-N trunk card because they are equal distance from Node 1.

Figure 7-44 ONS 15454 Network Timing Example



## Synchronization Failure Switching

Depending on the network condition, the ONS 15454 will operate in one of the following synchronization modes.

- **Normal Mode:** The system clock is synchronized to a reference source. The output frequency of the clock is the same as the input reference frequency over the long term. The Sync LED on the TCC card indicates Normal Mode.
- **Fast Start Mode:** Used for fast pull-in of a reference clock, Fast Start is active when the internal reference frequency is offset from the external reference clock. If the frequency is offset by more than 2ppm (parts per million) in every 30 seconds (called the "wander threshold"), the secondary reference source will be selected. The ONS 15454 will revert back to the primary reference source when it is within the specified threshold (i.e. +/- 15ppm). During the switching process, the internal clock will be in Fast Start mode. Fast Start is sometimes referred to as the "Acquire State".
- **Holdover Mode:** The ONS 15454 goes into Holdover when the last available reference is lost and the node was synchronized to that reference for more than 140 seconds. During this period, the internal clock is held at the last known value of the Phase Lock Loop (PLL) parameters when the node was still synchronized to the reference clock. If the holdover frequency value is corrupted, the ONS 15454 will switch to Free-run mode.

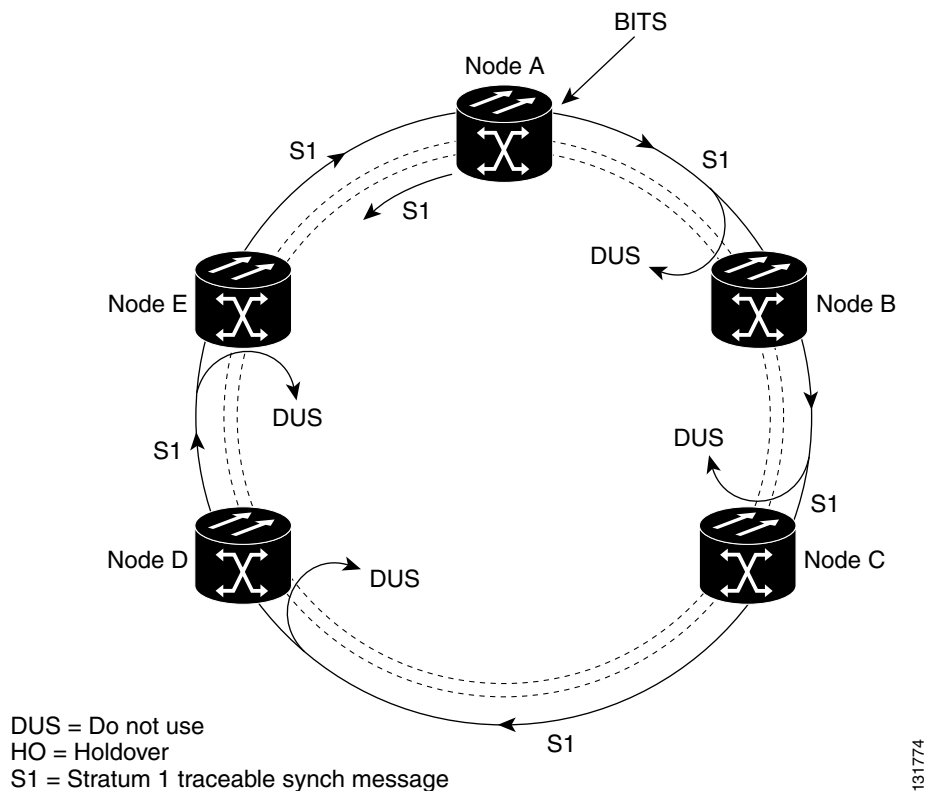
- **Free-run Mode:** The ONS 15454 is considered to be in Free-run state when it is operating on its own internal clock. Free-run accuracy for the ONS 15454 and most SONET nodes is stratum 3. The minimum accuracy for any SONET node must be better than the SONET Minimum Clock (SMC), which is +/- 20ppm.

A timing reference is considered failed if its SSM message is traceable to a source that is worse than the quality of the ONS 15454 internal clock. For example, a node with an internal Stratum 3 clock would consider a reference to be failed if it has a SSM message traceable to SMC or ST4 clock. Also, the node will not select a reference for timing if it has the DUS (Don't Use for Synchronization) SSM message.

## Synchronization Switching Example

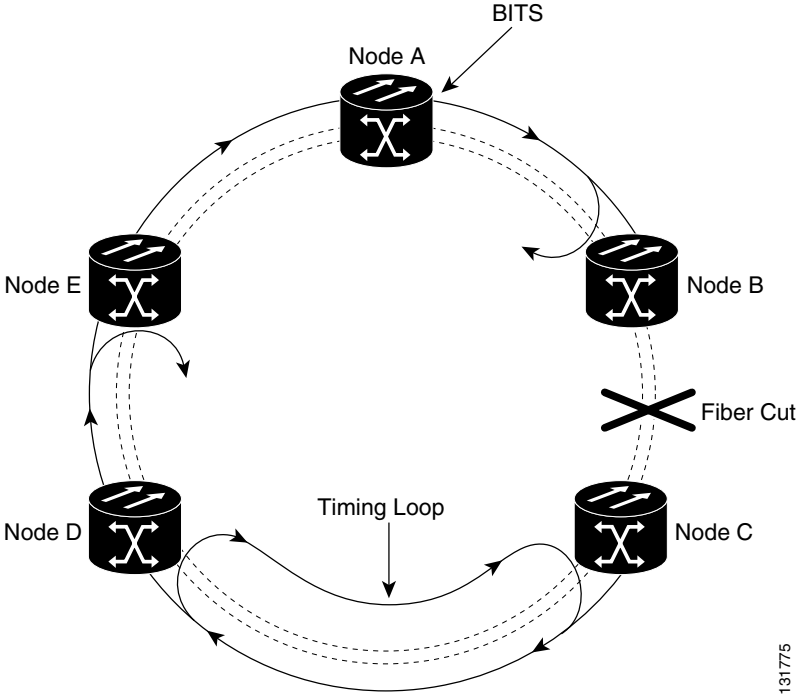
The Cisco ONS 15454 generates the synchronization message in the outgoing SONET signals. The synchronization messaging allows the ONS 15454 nodes in a ring to maintain their correct configuration. In [Figure 7-45](#), the BITS clock is connected to Node A and timing is maintained around the ring from Node A to Node E. The SSM is a Stratum 1 traceable signal that passes from Node A, (external timed) to all the other nodes (line timed).

**Figure 7-45 Normal Operation**



Fiber is cut between Node B and Node C, causing a failure. A ring failure in a system without SSM that uses simple reference switching results in a timing loop shown in [Figure 7-46](#).

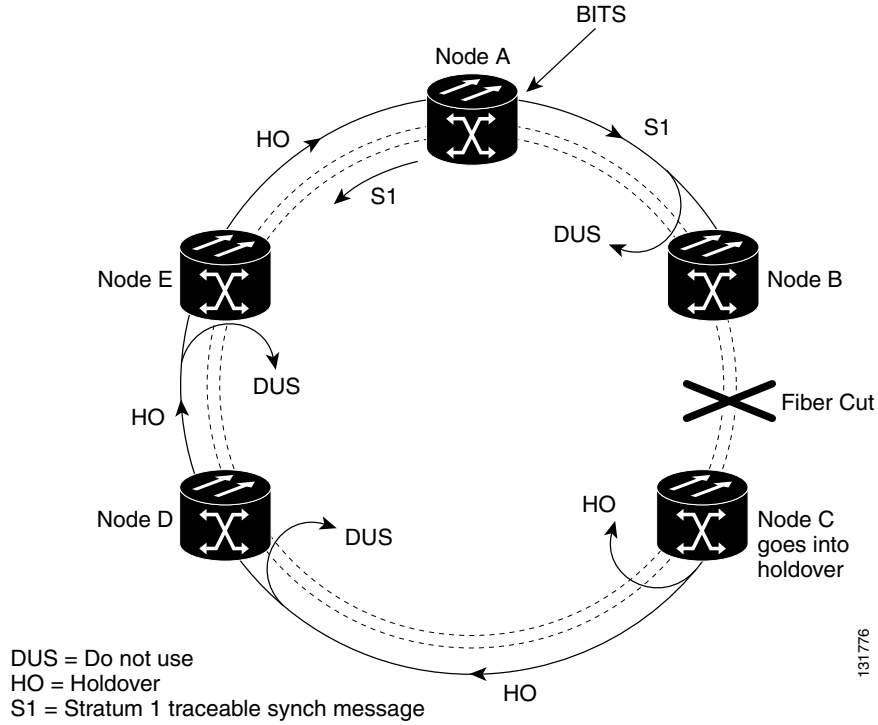
Figure 7-46 Ring Failure and Timing Loop



In a system using SSM, the fiber cut in Figure 7-47 interrupts the timing signal around the ring. Since Node C was the receiving clock from Node B (line timed), and has lost signal, Node C goes into short-term holdover and uses its internal clock.

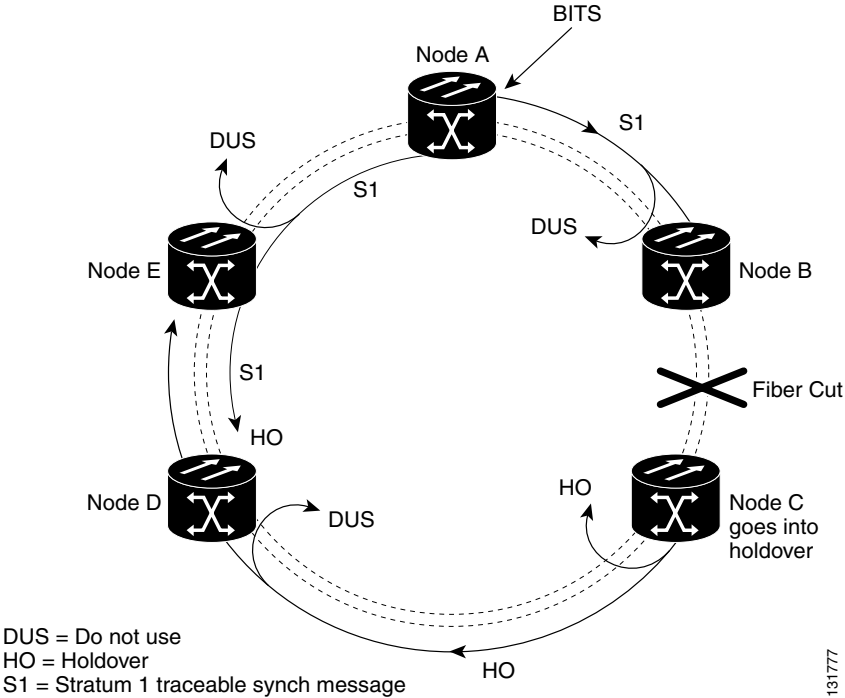


Figure 7-47 Ring Failure with SSM



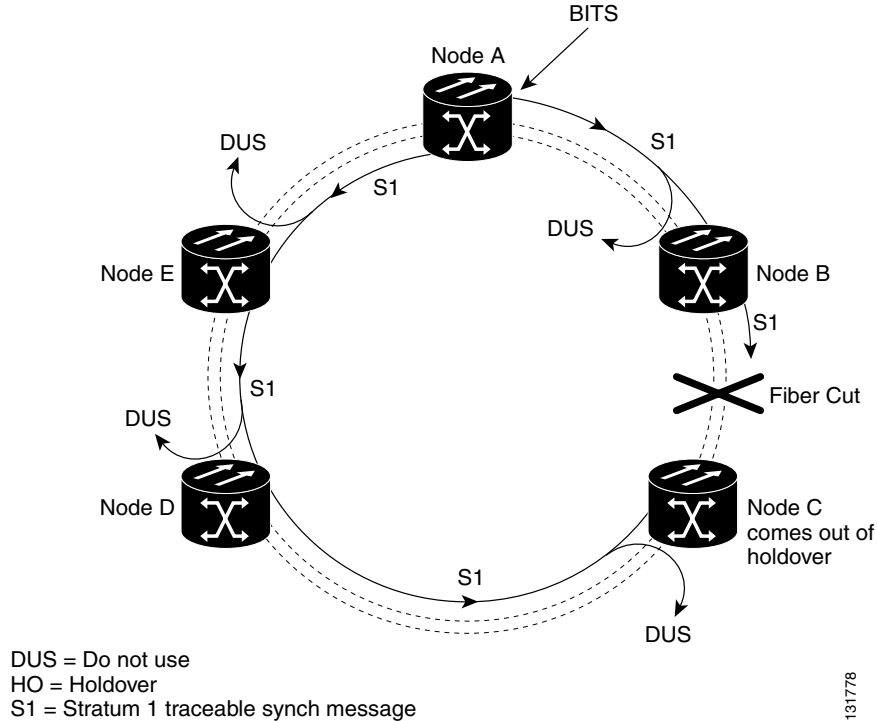
In Figure 7-48, synchronization message 1 is now being sent to Node E directly from Node A (counterclockwise) instead of clockwise around the ring. At this point, Node E switches to lime timing from Node A.

Figure 7-48 Synchronization Switch



Synchronization message S1 continues to Nodes E, D, and C in the counterclockwise direction as shown in Figure 7-49. All nodes switch their line timing to the line receiving S1, which allows Node C to exit holdover. At this point, the ring is reconfigured and all nodes are again synchronized to BITS.

Figure 7-49 Synchronization Reconfigures Around the Ring



## Synchronization Switching Time

On a failure or when the SSM value indicates that a higher quality reference is available, switching is instantaneous. The Wait To Restore period is ignored if reversion to the higher priority reference is active. However, if two references have the same SSM value, the Wait To Restore period must elapse before the ONS 15454 will revert back to the higher priority reference.

## Card Protection Configurations

The ONS 15454 provides 1+1 protection for OC-N cards and a variety of electrical card protection methods. This section describes the card protection configurations supported by the ONS 15454.

### OC-N Card Protection

The ONS 15454 provides two optical card protection methods, 1+1 protection and optimized 1+1 protection. Specific optical card protection schemes depend on the optical cards in use.

OC-N protection switching occurs automatically in response to detected faults, as well as manual requests initiated by local or remote users. The Cisco ONS 15454 supports 50 milliseconds (ms) 1+1 unidirectional or bidirectional protection switching upon detecting a signal failure or condition such as LOS, LOF, AIS-L or high BER on one or more of the optical card's ports. Revertive and nonrevertive switching options are available down to the circuit level.

## 1+1 Protection

Any OC-N card can use 1+1 protection. With 1+1 port-to-port protection, 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 and number of ports. For example, a single-port OC-12 must be paired with another single-port OC-12, and a four-port OC-12 must be paired with another four-port OC-12. You cannot create a 1+1 protection group if one card is single-port and the other is multiport, even if the OC-N rates are the same. The protection takes place on the port level, and 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. In other words, all the ports on the protect card are used in the protection scheme.

1+1 span protection can be either revertive or nonrevertive. With nonrevertive 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. 1+1 protection is unidirectional and nonrevertive by default; revertive switching is easily provisioned using CTC.

## Optimized 1+1 Protection

Optimized 1+1 protection is used in networks that mainly use the linear 1+1 bidirectional protection scheme. Optimized 1+1 is a line-level protection scheme using two lines, working and protect. One of the two lines assumes the role of the primary channel, where traffic is selected, and the other line assumes the role of secondary channel, which protects the primary channel. Traffic switches from the primary channel to the secondary channel based on either line conditions or an external switching command performed by the user. After the line condition clears, the traffic remains on the secondary channel. The secondary channel is automatically renamed as the primary channel and the former primary channel is automatically renamed as the secondary channel.

Unlike 1+1 span protection, 1+1 optimized span protection does not use the revertive or nonrevertive feature. Also, 1+1 optimized span protection does not use the Manual switch command. The 1+1 optimized span protection scheme is supported only on the Cisco ONS 15454 SONET using either OC3-4 cards or OC3-8 cards with ports that are provisioned for SDH payloads.

Optimized 1+1 is fully compliant with Nippon Telegraph and Telephone Corporation (NTT) specifications. With optimized 1+1 port-to-port protection, 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 installed side by side in the node. A working card must be paired with a protect card of the same type and number of ports. For example, a four-port OC-3 must be paired with another four-port OC-3, and an eight-port OC-3 must be paired with another eight-port OC-3. You cannot create an optimized 1+1 protection group if the number of ports do not match, even if the OC-N rates are the same.

The protection takes place on the port level, and 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.

## Electrical Card Protection

This section covers the general concept of electrical card protection. Specific electrical card protection schemes depend on the type of electrical card as well as the electrical interface assembly (EIA) type used on the ONS 15454 backplane. [Table 7-49](#) details the specific electrical card protection schemes.

In the table, high-density (HD) card type include the DS3/EC1-48 card. Low-density (LD) card types include the following:

- DS1-14, DS1N-14
- DS3-12, DS3N-12
- DS3-12E, DS3N-12E
- DS3XM-6
- DS3XM-12
- EC1-12



### Caution

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

**Table 7-49** Electrical Card Protection By EIA Type

Protection Type	Card Type	EIA Side	Standard BNC Card Slots	High-Density BNC Card Slots	MiniBNC Card Slots	SMB Card Slots	AMP Champ Card Slots	UBIC-H and UBIC-V Card Slots
Unprotected	LD-Working	A	2, 4	1, 2, 4, 5	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6
		B	14, 16	13, 14, 16, 17	12, 13, 14, 15, 16, 17	12, 13, 14, 15, 16, 17	12, 13, 14, 15, 16, 17	12, 13, 14, 15, 16, 17
	HD-Working	A	—	—	1, 2	—	—	1, 2
		B	—	—	16, 17	—	—	16, 17
1:1	LD-Working	A	2, 4	2, 4	2, 4, 6	2, 4, 6	2, 4, 6	2, 4, 6
		B	14, 16	14, 16	12, 14, 16	12, 14, 16	12, 14, 16	12, 14, 16
	LD-Protect	A	1, 3	1, 3	1, 3, 5	1, 3, 5	1, 3, 5	1, 3, 5
		B	15, 17	15, 17	13, 15, 17	13, 15, 17	13, 15, 17	13, 15, 17

Table 7-49 Electrical Card Protection By EIA Type (continued)

Protection Type	Card Type	EIA Side	Standard BNC Card Slots	High-Density BNC Card Slots	MiniBNC Card Slots	SMB Card Slots	AMP Champ Card Slots	UBIC-H and UBIC-V Card Slots
1:N	LD-Working	A	—	1, 2, 4, 5	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6	1, 2, 3, 4, 5, 6
		B	—	13, 14, 16, 17	12, 13, 14, 15, 16, 17	12, 13, 14, 15, 16, 17	12, 13, 14, 15, 16, 17	12, 13, 14, 15, 16, 17
	LD-Portect	A	—	—	3	3	3	3
		B	—	—	15	15	15	15
	HD-Working	A	—	—	1, 2	—	—	1, 2
		B	—	—	16, 17	—	—	16, 17
	HD Protect	A	—	—	3	—	—	3
		B	—	—	15	—	—	15

## 1:1 Protection

In 1:1 protection, a working card in an even-numbered slot is paired with a protect card in an odd-numbered slot of the same type. If the working card fails, the traffic from the working card switches to the protect card. You can provision 1:1 to be revertive or nonrevertive. If revertive, traffic automatically reverts to the working card after the failure on the working card is resolved.

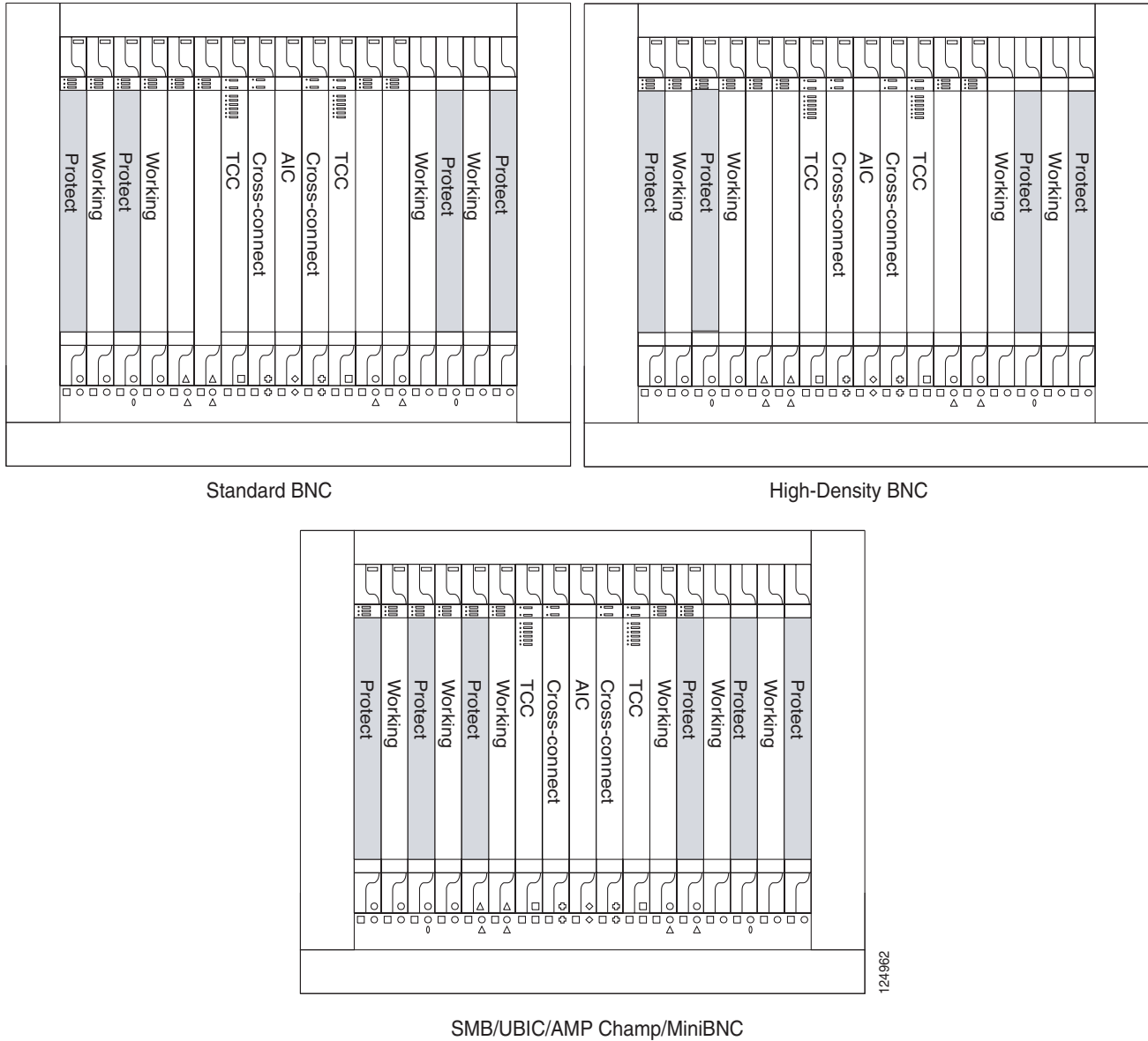
Table 7-50 provides supported 1:1 protection configurations by electrical card type.

Table 7-50 1:1 Protection Configurations Supported by Electrical Cards

Working Card	Protect Card	Working Slots	Protection Slots
DS1-14 or DS1N-14	DS1-14 or DS1N-14	2, 4, 6, 12, 14, 16	1, 3, 5, 13, 15, 17
DS3-12 or DS3N-12	DS3-12 or DS3N-12	2, 4, 6, 12, 14, 16	1, 3, 5, 13, 15, 17
DS3-12E or DS3N-12E	DS3-12E or DS3N-12E	2, 4, 6, 12, 14, 16	1, 3, 5, 13, 15, 17
DS3XM-6	DS3XM-6	2, 4, 6, 12, 14, 16	1, 3, 5, 13, 15, 17
DS3XM-12	DS3XM-12	2, 4, 6, 12, 14, 16	1, 3, 5, 13, 15, 17

Figure 7-50 shows 1:1 low-density card protection configurations support by type of EIA.

Figure 7-50 1:1 Protection Configurations for Low-Density Electrical Cards Supported by EIA Types



## 1:N Protection

1:N protection allows a single card to protect up to five working cards of the same DS-N level. 1:N cards have added circuitry to act as the protect 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.

Table 7-51 provides the supported 1:N configurations by electrical card, as well as the card types that can be used for working and protection cards.

**Table 7-51 1:N Protection Configurations Supported by Electrical Card**

Working Card	Protect Card	Number of Cards Supported In A Protection Group	Working Slots	Protect Slots
DS1-14	DS1N-14	< 5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
DS3-12	DS3N-12	< 5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
DS3-12E	DS3N-12E	< 5	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
DS3/EC1-48	DS3/EC1-48	< 2	1 <sup>1</sup> , 2 <sup>2</sup>	3
			16 <sup>3</sup> , 17 <sup>4</sup>	15
DS3XM-12	DS3XM-12	< 5 (Ported Mode)	1, 2, 4, 5, 6	3
			12, 13, 14, 16, 17	15
		< 7 (Portless Mode <sup>5</sup> )	1, 2, 4, 14, 15 16, 17	3
			1, 2, 3, 4, 14, 16, 17	15

1. A high-density electrical card inserted in Slot 1 restricts the use of Slots 5 and 6 to only optical, data, or storage cards.
2. A high-density electrical card inserted in Slot 2 restricts the use of Slots 4 and 6 to only optical, data, or storage cards.
3. A high-density electrical card inserted in Slot 16 restricts the use of Slot 14 to only optical, data, or storage cards.
4. A high-density electrical card inserted in Slot 17 restricts the use of Slots 12 and 13 to only optical, data, or storage cards.
5. Portless DS-3 Transmux operation does not terminate the DS-3 signal on the EIA panel.

## 1:N Protection Guidelines

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

- Working and protect card groups must reside in the same card bank (side A or side B) of the assembly shelf.
- 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.

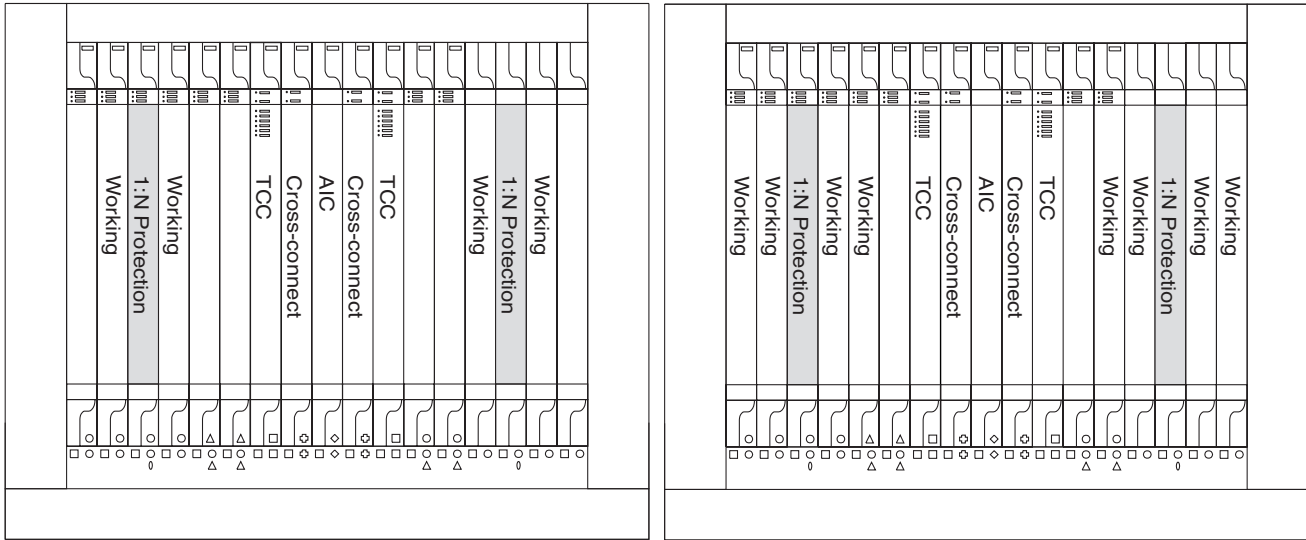
The ONS 15454 automatically detects and identifies a 1:N protection card when the card is installed in Slot 3 or Slot 15. However, the slot containing the 1:N card in a protection group must be manually provisioned as a protect slot because by default all cards are working cards.

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

Figure 7-51 shows 1:N protection configurations supported for low-density electrical cards by type of EIA.

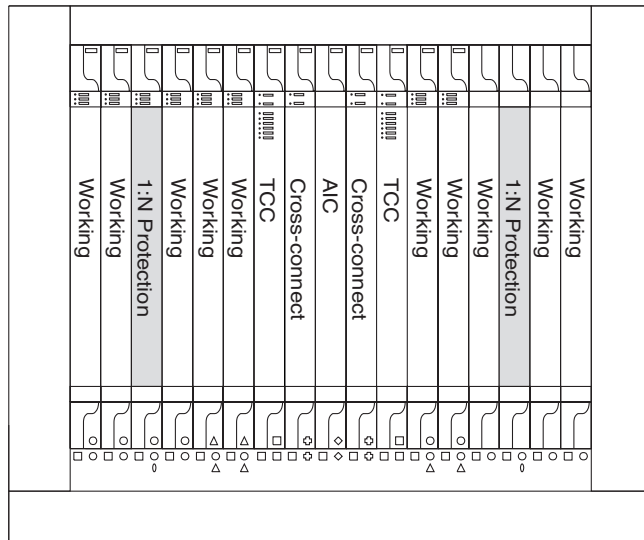


Figure 7-51 1:N Protection Configuration Supported for Low-Density Electrical Cards by EIA Types



Standard BNC

High-Density BNC



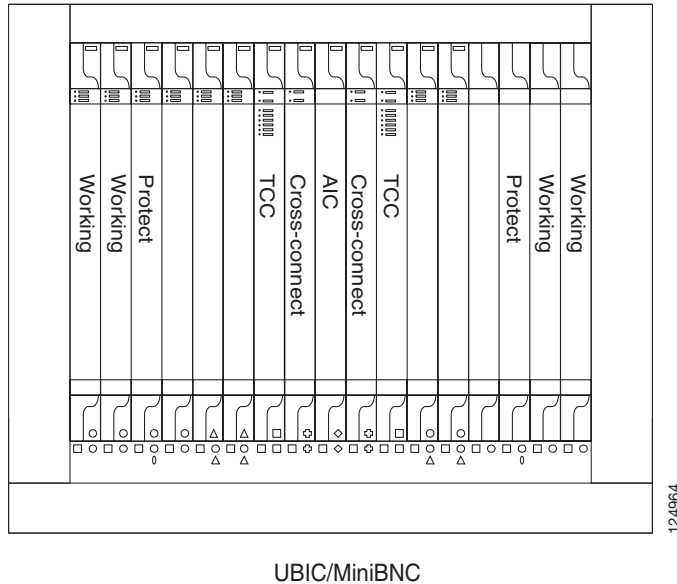
SMB/UBIC/AMP Champ/MiniBNC

**Note**

EC1-12 cards do not support 1:N protection.

Figure 7-52 shows 1:N high-density card protection configurations support by type of EIA.

**Figure 7-52 1:N Protection Configurations for High-Density Electrical Cards Supported by EIA Types**



## Revertive Switching

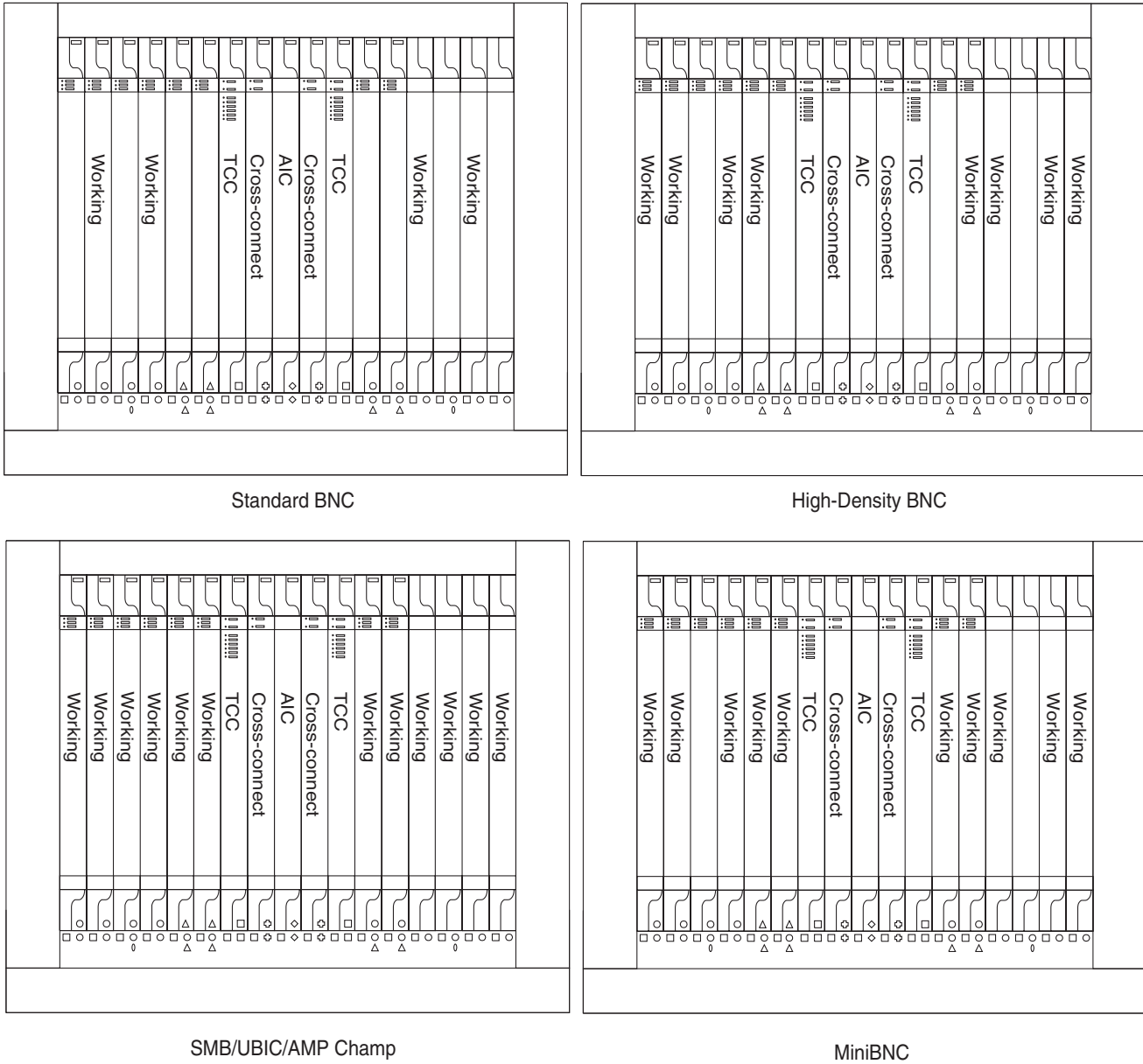
1:N protection supports revertive switching. Revertive switching sends the electrical interfaces (traffic) back to the original working card after the card comes back online. Detecting an active working card triggers the reversion process. There is a variable time period for the lag between detection and reversion, called the revertive delay, which you can set using the ONS 15454 software, 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.

## 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 7-53 shows unprotected low-density electrical card configurations supported by type of EIA.

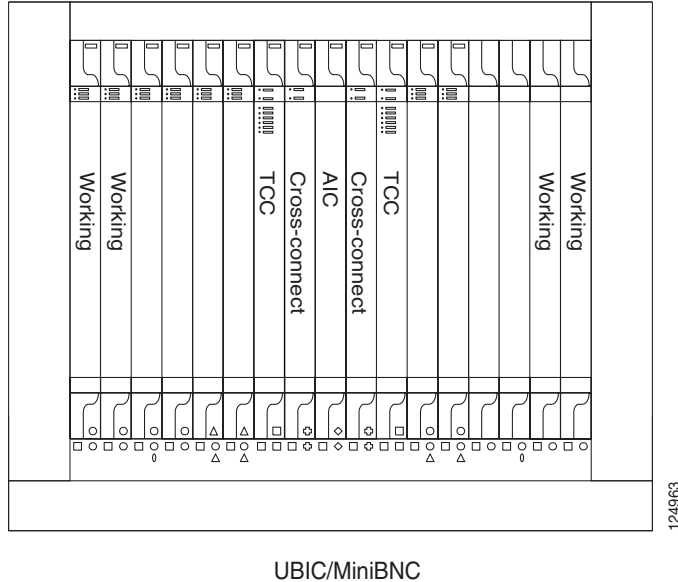
Figure 7-53 Unprotected Low-Density Electrical Card Configurations Supported by EIA Types



124966

Figure 7-54 shows unprotected high-density electrical card configurations supported by type of EIA.

**Figure 7-54** Unprotected High-Density Electrical Card Configurations Supported by EIA Types



## External Switching Commands

The external switching commands on the ONS 15454 are Manual, Force, and Lockout. If you choose a Manual switch, the command will switch traffic only if the path has an error rate less than the signal degrade (SD) bit error rate threshold. A Force switch will switch traffic even if the path has SD or signal fail (SF) conditions; however, a Force switch will not override an SF on a 1+1 protection channel.

## Transponder and Muxponder Card Protection

Two types of protection options are available for the ONS 15454 transponder and muxponder cards:

- Y-cable protection
- Splitter protection

### Y-Cable Protection

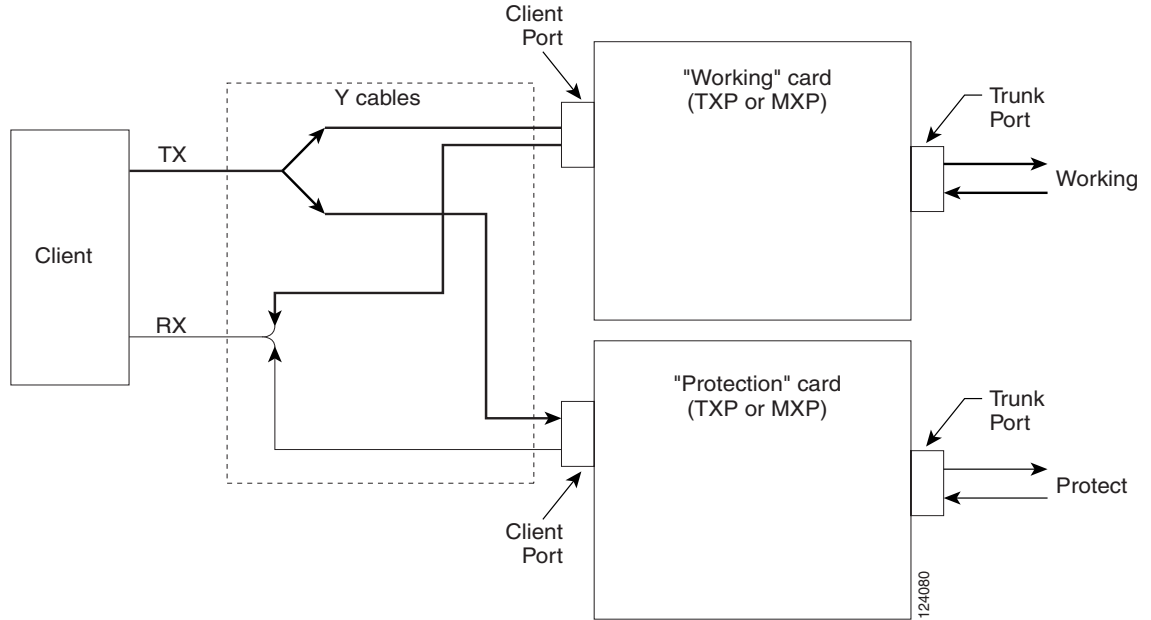
Y-cable protection is available for the ONS 15454 transponder and muxponder cards (TXP\_MR\_10G, TXP\_MR\_2.5G, MXP\_MR\_2.5G, and MXP\_2.5G\_10G). To create Y-cable protection, you create a Y-cable protection group for two TXP or MXP cards in CTC, then connect the client ports of the two cards physically with a Y-cable. The single client signal is sent into the receive (Rx) Y-cable and is split between the two TXP or MXP cards. The two transmit (Tx) signals from the client side of the TXP or MXP cards are combined in the TX Y-cable into a single client signal. Only the active card signal passes through as the single TX client signal. The other card must have its laser turned off to avoid signal degradation where the Y-cable joins. [Figure 7-55](#) shows the Y-cable signal flow.



#### Note

Loss of Signal-Payload (LOS-P) alarms, also called Incoming Payload Signal Absent alarms, can occur on a split signal if the ports are not in a Y-cable protection group.

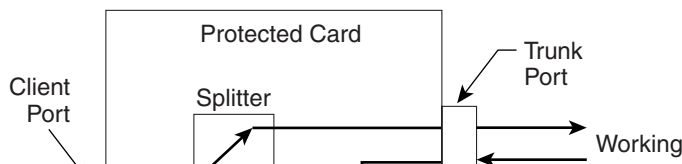
Figure 7-55 Y-Cable Protection



## Splitter Protection

Splitter protection, shown in [Figure 7-56](#), is provided with the TXPP\_MR\_2.5G and MXPP\_MR\_2.5G cards. To implement splitter protection, a client injects a single signal into the client Rx port. An optical splitter internal to the card then splits the signal into two separate signals and routes them to the two trunk Tx ports. The two signals are transmitted over diverse optical paths. The far-end MXPP or TXPP card uses an optical switch to choose one of the two trunk Rx port signals and injects it into the Tx client port. When using splitter protection with two MXPP or TXPP cards, there are two different optical signals that flow over diverse paths in each direction. In case of failure, the far-end switch must choose the appropriate signal using its built-in optical switch. The triggers for a protection switch are LOS, LOF, SF, or SD.

Figure 7-56 Splitter Protection



## Ethernet Protection

Cisco ONS 15454 Ethernet cards use the IEEE 802.1D Spanning Tree Protocol (STP) and IEEE 802.1W Rapid Spanning Tree Protocol (RSTP) for Layer 2 protection, and uses SONET for Layer 1 protection.

### Spanning Tree

STP is a Layer 2 link management protocol that provides path redundancy while preventing loops in the network. For a Layer 2 Ethernet network to function properly, only one active path can exist between any two stations. Spanning-tree operation is transparent to end stations, which cannot detect whether they are connected to a single LAN segment or a switched LAN of multiple segments.

When you create fault-tolerant internetworks, you must have a loop-free path between all nodes in a network. The spanning-tree algorithm calculates the best loop-free path throughout a switched Layer 2 network. Switches send and receive spanning-tree frames, called bridge protocol data units (BPDUs), at regular intervals. The switches do not forward these frames, but use the frames to construct a loop-free path.

Multiple active paths among end stations cause loops in the network. If a loop exists in the network, end stations might receive duplicate messages. Switches might also learn end-station MAC addresses on multiple Layer 2 interfaces. These conditions result in an unstable network.

Spanning tree defines a tree with a root switch and a loop-free path from the root to all switches in the Layer 2 network. Spanning tree forces redundant data paths into a standby (blocked) state. If a network segment in the spanning tree fails and a redundant path exists, the spanning-tree algorithm recalculates the spanning-tree topology and activates the standby path.

When two interfaces on a switch are part of a loop, the spanning-tree port priority and path cost settings determine which interface is put in the forwarding state and which is put in the blocking state. The port priority value represents the location of an interface in the network topology and how well it is located to pass traffic. The path cost value represents media speed.

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. Each circuit runs its own STP to maintain VLAN connectivity in a multi-ring environment.

You can also disable or enable STP on a circuit-by-circuit basis on single-card EtherSwitch 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 EtherSwitch Ethernet cards on the same node to form an intra-node circuit.

### Spanning Tree Parameters

Table 7-52 shows the 802.1D STP parameters for the Ethernet cards.

**Table 7-52 802.1D Spanning Tree Parameters**

Parameter	Description	Default	Range
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.	Read Only	Read Only
Priority	Defines bridge priority	32768	0 - 65535

**Table 7-52 802.1D Spanning Tree Parameters (continued)**

Parameter	Description	Default	Range
TopoAge	Amount of time in seconds since the last topology change	Read Only	Read Only
TopoChanges	Number of times the spanning tree topology has been changed since the node booted up	Read Only	Read Only
DesignatedRoot	Identifies the spanning tree's designated root for a particular spanning tree instance	Read Only	Read Only
RootCost	Identifies the total path cost to the designated root	Read Only	Read Only
RootPort	Port used to reach the root	Read Only	Read Only
MaxAge	Maximum time that received-protocol information is retained before it is discarded	20	6 - 40 seconds
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.	2	1 - 10 seconds
HoldTime	Minimum time period, in seconds, that elapses during the transmission of configuration information on a given port	NA	NA
ForwardDelay	Time spent by a port in the listening state and the learning state	15	4 - 30 seconds

The ML-Series cards also support the IEEE 802.1T spanning tree extensions shown in [Table 7-53](#).

**Table 7-53 IEEE 802.1T Spanning Tree Extensions**

Switch Priority Value				Extended System ID (Set Equal to the Bridge ID)											
Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16	Bit 16
32768	16384	8192	4096	2048	1024	512	256	128	64	43	16	8	4	2	1

## Rapid Spanning Tree

RSTP provides rapid convergence of the spanning tree. It improves the fault tolerance of the network because a failure in one instance (forwarding path) does not affect other instances (forwarding paths). The most common initial deployment of RSTP is in the backbone and distribution layers of a Layer 2 switched network; this deployment provides the highly available network required in a service-provider environment.

RSTP improves the operation of the spanning tree while maintaining backward compatibility with equipment that is based on the (original) IEEE 802.1D spanning tree.

RSTP takes advantage of point-to-point wiring and provides rapid convergence of the spanning tree. Reconfiguration of the spanning tree can occur in less than 2 second (in contrast to 50 seconds with the default settings in the IEEE 802.1D spanning tree), which is critical for networks carrying delay-sensitive traffic such as voice and video.

The ML-Series cards support per-VLAN rapid spanning tree and a maximum of 255 rapid spanning tree (RSTP) instances per port.

## SONET Protection for Ethernet Circuits

Table 7-54 lists the Ethernet topologies where SONET protection can be used for Ethernet circuits.

**Table 7-54 SONET Protection for Ethernet Circuits**

Topology	Path Protection	BLSR	Linear 1+1
Point-to-Point - Stitched	No protection	SONET	SONET
Point-to-Point - Unstitched	SONET	SONET	SONET
Shared Packet Ring - Stitched	SONET	SONET	SONET
Shared Packet Ring - Unstitched	STP	SONET	SONET

## In-Service Low-Density to High-Density Upgrades

The ONS 15454 supports in-service upgrades for OC-N spans, OC-N cards, and electrical cards. Design rules for in-Service upgrades for OC-N spans and OC-N cards is covered in Chapter 2 of this document. This section of the document will focus on upgrading low-density electrical cards to high-density electrical cards.

Total DS-1 capacity can be increased from 112 to 224 DS-1 ports per shelf. Total DS-3 and EC-1 capacity can be increased from 48 to 192 ports.



**Note**

The high-capacity DS-1 card will be available in a future release.



**Note**

Support for the high-density EC-1 interface on the DS3/EC1-48 card is planned for a future release.

## Upgrade Low-Density Electrical Cards to High-Density Electrical Cards

Only the 15454-SA-HD shelf assembly configured with MiniBNC, UBIC-H, or UBIC-V EIAs supports an in-service upgrade of low density DS-1 and DS-3 cards in a 1:N or 1:1 configuration to high-density electrical cards, which allows you to increase DS-1 and DS-3 capacity without affecting service.

Upgrades will not be in-service if the ONS 15454 is configured with any other shelf assembly or other type of EIA.



**Note**

During the upgrade some minor alarms and conditions appear and then clear on their own; however, there should be no Service-Affecting (SA, Major, or Critical) alarms if you are upgrading protected cards. Upgrading an unprotected card can be service affecting.

If future DS-1, DS-3, or EC-1 service demands may require upgrading low-density electrical cards to high-density electrical cards perform the following desing rules:

- Use Software Release 5.0 or higher.
- Configure the ONS 15454 with the high-density (HD) shelf assembly (15454-SA-HD).
- Configure the HD shelf with high-density EIAs (MiniBNC, UBIC-H, or UBIC-V).
- Do not mix different types of low-density electrical cards on the same side of the HD shelf.



- Configure working low-density electrical cards in slots 1 and 2 for the A side of the HD shelf, and 16 and 17 for the B side.
- Configure 1:N protection groups for  $N \leq 2$ .
- Configure the protection cards in slot 3 for the A side of the HD shelf and slot 15 for the B side of the HD shelf.
- Configure slots 4, 5, 6, 12, 13, and 14 with either OC-N, Ethernet, or SAN cards.

In-service low-density to high-density upgrades are supported for slots 1, 2, and 3 on the A side of the HD shelf, and slots 15, 16, and 17 for the B side. Traffic on low-density DS-3 cards installed in slots 4, 5, 6 and 12, 13, 14 cannot be moved to ports on the high-density DS3/EC1-48 cards in slots 1 and 2 or 16 and 17 without losing service greater than 50 milliseconds.

Once high-density cards have been activated in slots 1, 2, 3, and 15, 16, and 17, slots 4, 5, 6, and 12, 13, and 14 cannot support electrical cards. Slots 4, 5, 6, and 12, 13, and 14 can support OC-N, Ethernet, or SAN cards.

## 1:N Protection Groups

In-service low-density to high-density electrical card upgrades require that the working low-density cards be in slots 1, 2, 16, and 17. Slots 3 and 15 are used for 1:N protection groups.

For the A side of the HD shelf (slots 1, 2, 3, 4, 5, and 6), slot 3 will always be the protection card slot for high-density applications. For the B side of the HD shelf (slots 12, 13, 14, 15, 16, and 17), slot 15 will always be the protection card slot for high-density applications.

When performing an upgrade, the protection slot is upgraded first. Since a DS3/EC1-48 card can protect a DS3-12 card, the DS3N-12 protection card in slot 3 (15) is upgraded to a DS3/EC-1-48 card first. Traffic from the DS3-12 card in slot 1 (16) is then switched to the DS3/EC1-48 protect card. The DS3-12 card in slot 1 (16) is then upgraded to a DS3/EC1-48 card and traffic is switched back to slot 1 (16). The process is repeated for slot 2 (17). For detailed low-density to high-density electrical card upgrade procedures, refer to the Cisco ONS 15454 Procedure Guide.

## 1:1 Protection Groups

In-service low-density to high-density electrical card upgrades require that the working low-density cards be in slots 2 and 16. Slots 3 and 15 will be used for 1:1 protection groups just as described in the 1:N protection groups above.

When performing an upgrade, the protection slot is upgraded first. Since a DS3/EC1-48 card can protect a DS3-12 card, a DS3/EC1-48 is installed in slot 3 (15) first. The old 1:1 protection group is deleted and a new 1:1 protection group is created. Traffic from the DS3-12 card in slot 2 (16) is then switched to the DS3/EC1-48 protect card. The DS3-12 card in slot 1 (17) is upgraded to a DS3/EC1-48 card and traffic is switched back to slot 1 (17). The DS3-12 card in slot 2 (16) is removed.

## GBICs and SFPs

The ONS 15454 Ethernet cards use industry standard Small Form-factor Pluggable connectors (SFPs) and Gigabit Interface Converter (GBIC) modular receptacles. The ML-Series Gigabit Ethernet (GE) cards use standard Cisco SFPs. The Gigabit E-Series card and the G-Series card use standard Cisco GBICs. With Software Release 4.1 and later, G-Series cards can also be equipped with dense wavelength division multiplexing (DWDM) and coarse wavelength division multiplexing (CWDM) GBICs to function as Gigabit Ethernet transponders.

For all Ethernet cards, the type of GBIC or SFP plugged into the card is displayed in CTC and TL1. Cisco offers GBICs and SFPs as separate orderable products.

Table 7-55 lists Cisco ONS 15454 Ethernet cards with their compatible GBICs and SFPs.

**Table 7-55 GBIC and SFP Card Compatibility**

Card	Compatible GBIC or SFP	Cisco Top Assembly Number (TAN)
E1000-2	ONS-GC-GE-SX	30-0759-01
E1000-2-G	ONS-GC-GE-LX	800-06780-01 <sup>1</sup>
	15454-GBIC-SX	10-1743-01
	15454E-GBIC-SX	30-0703-01
	15454-GBIC-LX/LH	
	15454E-GBIC-LX/LH	
FC-MR-4	ONS-GC-GE-SX	30-0759-01
	ONS-GC-GE-LX	800-06780-01
	15454-GBIC-SX	10-1743-01
	15454E-GBIC-SX	30-0703-01
	15454-GBIC-LX/LH	10-2015-01
	15454E-GBIC-LX/LH	10-2016-01
	ONS-GX-2FC-MMI	
ONS-GX-2FC-SML		
G1000-4	ONS-GC-GE-SX	30-0759-01
G1K-4	ONS-GC-GE-LX	800-06780-01
	ONS-GC-GE-ZX	10-1743-01
	15454-GBIC-SX	30-0703-01
	15454E-GBIC-SX	30-0848-01
	15454-GBIC-LX/LH	10-1744-01
	15454E-GBIC-LX/LH	10-1845-01 through 10-1876-01
	15454-GBIC-ZX	10-1845-01 through 10-1876-01
	15454E-GBIC-ZX	10-1453-01 through 10-1460-01
	15454-GBIC-xx.x <sup>2</sup>	10-1453-01 through 10-1460-01
	15454E-GBIC-xx.x <sup>2</sup>	
	15454-GBIC-xxx <sup>3</sup>	
15454E-GBIC-xxx <sup>3</sup>		
ML1000-2	15454-SFP-LC-SX	30-1301-01
	15454E-SFP-LC-SX	30-1301-01
	15454-SFP-LC-LX/LH	30-1299-01
	15454E-SFP-LC-LX/LH	30-1299-01

1. This TAN is only compatible with ONS 15454-E1000-2 or 15454-E1000-2-G cards.

2. xx.x defines the 32 possible wavelengths.
3. xxxx defines the 8 possible wavelengths.

Table 7-56 lists the transponder and muxponder cards and their compatible SFPs.

**Table 7-56 SFP Card Compatibility**

Card	Compatible SFP	Cisco Top Assembly Number (TAN)
MXP_2.5G_10G	15454-SFP-OC48-IR=	10-1975-01
MXP_2.5G_10E	ONS-SE-2G-S1=	10-2017-01
MXP_MR_2.5G	15454-SFP-GE+-LX=	10-1832-03
MXPP_MR_2.5G	15454E-SFP-GE+-LX=	10-1832-03
	15454-SFP-GEFC-SX=	10-1833-01
	15454E-SFP-GEFC-S=	10-1833-02
TXP_MR_2.5G	15454-SFP3-1-IR=	10-1828-01
TXPP_MR_2.5G	15454E-SFP-L.1.1=	10-1828-01
	15454-SFP12-4-IR=	10-1976-01
	15454E-SFP-L.4.1=	10-1976-01
	15454-SFP-OC48-IR=	10-1975-01
	15454E-SFP-L.16.1=	10-1975-01
	ONS-SE-2G-S1=	10-2017-01
	15454-SFP-200=	10-1750-01
	15454E-SFP-200=	10-1750-01
	15454-SFP-GEFC-SX=	10-1833-01
	15454E-SFP-GEFC-S=	10-1833-02
	15454-SFP-GE+-LX=	10-1832-01
	15454E-SFP-GE+-LX=	10-1832-02

