



# CHAPTER 7

## Circuits and Tunnels

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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 explains Cisco ONS 15600 synchronous transport signal (STS) circuits and data communications channel (DCC) and IP-encapsulated tunnels. To provision circuits and tunnels, refer to the *Cisco ONS 15600 Procedure Guide*.

Chapter topics include:

- [7.1 Overview, page 7-2](#)
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- [7.3 Cross-Connect Card Bandwidth, page 7-11](#)
- [7.4 DCC Tunnels, page 7-12](#)
- [7.5 Multiple Destinations for Unidirectional Circuits, page 7-13](#)
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**Note**

In this chapter, “cross-connect” and “circuit” have the following meanings: cross-connect refers to the connections that occur within a single ONS 15600 to allow a circuit to enter and exit an ONS 15600. Circuit refers to the series of connections from a traffic source (where traffic enters the ONS 15600 network) to the destination (where traffic exits an ONS 15600 network).

## 7.1 Overview

You can create circuits across and within ONS 15454 nodes and assign different attributes to circuits. For example, you can:

- Create one-way, two-way (bidirectional), or broadcast circuits.
- Assign user-defined names to circuits.
- Assign different circuit sizes.
- Automatically or manually route circuits.
- Automatically create multiple circuits with autoranging.
- Provide full protection to the circuit path.
- Provide only protected sources and destinations for circuits.
- Define a secondary circuit source or destination that allows you to interoperate an ONS 15600 path protection with third-party equipment path protection configurations.
- Set path protection circuits as revertive or nonrevertive.

You can provision circuits at either of the following points:

- Before cards are installed. The ONS 15600 allows you to provision slot and circuits before installing the traffic cards.
- After you preprovision the small-form factor pluggables (SFPs) (also called provisionable port modules [PPMs]).
- Cards and SFPs are installed and ports are in service. Circuits do not actually carry traffic until the cards and SFPs are installed and the ports are In-Service and Normal (IS-NR); Out-of-Service and Autonomous, Automatic In-Service (OO-AU,AINS); or Out-of-Service and Management, Maintenance (OOS-MA,MT). Circuits will carry traffic as soon as the signal is received.

## 7.2 Circuit Properties

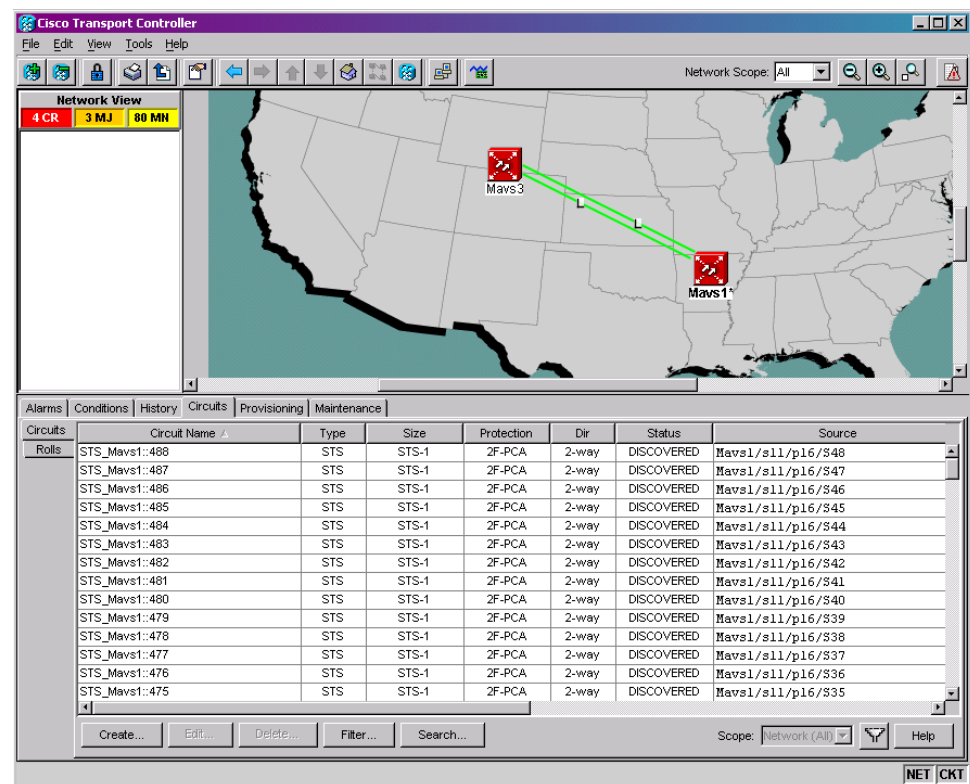
The ONS 15600 Circuits window ([Figure 7-1 on page 7-3](#)), which is available from network, node, and card view, is where you can view information about circuits, including:

- Name—The name of the circuit (user-assigned or automatically generated).
- Type—For the ONS 15600, the circuit type is STS (STS circuit).
- Size—The STS circuit size can be 1, 3c, 12c, 24c, 48c, or 192c. The STS circuit size for ASAP PPM ports also includes 6c and 9c. For time slot availability on concatenated STSs, see the [“7.2.1 Concatenated STS Time Slot Assignments” section on page 7-4](#).
- Protection—The protection type; see the [“7.2.4 Circuit Protection Types” section on page 7-8](#).

- Direction—The circuit direction, either two-way or one-way.
- Status—The circuit status; for details, see the “7.2.2 Circuit Status” section on page 7-6.
- Source—The circuit source in the format: *node/slot/port/STS*. If an ASAP PPM port is the circuit source, the port format is *PIM-PPM-port*, where pluggable interface module (PIM) and PPM values are 1 through 4 (for example, p1-1-1). PPMs have only one port.
- Destination—The circuit destination in the format: *node/slot/port/STS*. If an ASAP PPM port is the circuit destination, the port format is *PIM-PPM-port*, where PIM and PPM values are 1 through 4 (for example, p1-1-1). PPMs have only one port.
- # of VLANs—(Future use) The number of VLANs used by an Ethernet circuit.
- # of Spans—The number of internode links that constitute the circuit. Right-clicking the column shows a shortcut menu from which you can choose Span Details to show or hide circuit span detail. For each node in the span, the span detail shows the *node/slot (card type)/port/STS/VT*.
- State—The circuit state; for details, see the “7.2.3 Circuit States” section on page 7-7.

The Filter button allows you to filter the circuits in network, node, or card view based on circuit name, size, type, direction, and other attributes. In addition, you can export the Circuit window data in HTML, comma-separated values (CSV), or tab-separated values (TSV) format using the Export command from the File menu.

**Figure 7-1** ONS 15600 Circuit Window in Network View



The ONS 15600 supports up to 6144 STS-1 circuits. The Circuit Filter feature allows you to reduce the number of circuits that appear in the Circuits window. You can specify certain filter criteria, such as name, direction, and state; only the circuits that match the criteria will appear in the Circuits window.

## 7.2.1 Concatenated STS Time Slot Assignments

Table 7-1 shows the available time slot assignments for concatenated STSs when using Cisco Transport Controller (CTC) to provision circuits.

**Table 7-1** STS Mapping Using CTC

Starting STS	STS-3c	STS-6c	STS-9c	STS-12c	STS-18c	STS-24c	STS-36c	STS-48c	STS-192c
1	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
7	Yes	Yes	No	No	Yes	Yes	Yes	No	No
10	Yes	No	Yes	No	Yes	Yes	Yes	No	No
13	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
16	Yes	Yes	Yes	No	Yes	Yes	No	No	No
19	Yes	Yes	Yes	No	Yes	Yes	No	No	No
22	Yes	No	No	No	Yes	Yes	No	No	No
25	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
28	Yes	Yes	Yes	No	Yes	No	No	No	No
31	Yes	Yes	No	No	Yes	No	No	No	No
34	Yes	No	No	No	No	No	No	No	No
37	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
40	Yes	Yes	Yes	No	No	No	No	No	No
43	Yes	Yes	No	No	No	No	No	No	No
46	Yes	No	Yes	No	No	No	No	No	No
49	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
52	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
55	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
58	Yes	No	No	No	Yes	Yes	Yes	No	No
61	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
64	Yes	Yes	Yes	No	Yes	Yes	No	No	No
67	Yes	Yes	No	No	Yes	Yes	No	No	No
70	Yes	No	No	No	Yes	Yes	No	No	No
73	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
76	Yes	Yes	Yes	No	Yes	No	No	No	No
79	Yes	Yes	No	No	Yes	No	No	No	No
82	Yes	No	Yes	No	No	No	No	No	No
85	Yes	Yes	Yes	Yes	No	No	No	No	No
88	Yes	Yes	Yes	No	No	No	No	No	No
91	Yes	Yes	Yes	No	Yes	No	No	No	No

Table 7-1 STS Mapping Using CTC (continued)

Starting STS	STS-3c	STS-6c	STS-9c	STS-12c	STS-18c	STS-24c	STS-36c	STS-48c	STS-192c
94	Yes	No	No	No	No	No	No	No	No
97	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
100	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
103	Yes	Yes	No	No	Yes	Yes	Yes	No	No
106	Yes	No	No	No	Yes	Yes	Yes	No	No
109	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
112	Yes	Yes	Yes	No	Yes	Yes	No	No	No
115	Yes	Yes	No	No	Yes	Yes	No	No	No
118	Yes	No	Yes	No	Yes	Yes	No	No	No
121	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
124	Yes	Yes	Yes	No	Yes	No	No	No	No
127	Yes	Yes	Yes	No	Yes	No	No	No	No
130	Yes	No	No	No	No	No	No	No	No
133	Yes	Yes	Yes	Yes	No	No	No	No	No
136	Yes	Yes	Yes	No	No	No	No	No	No
139	Yes	Yes	No	No	No	No	No	No	No
142	Yes	No	No	No	No	No	No	No	No
145	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No
148	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No
151	Yes	Yes	No	No	Yes	Yes	Yes	No	No
154	Yes	No	Yes	No	Yes	Yes	Yes	No	No
157	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
160	Yes	Yes	Yes	No	Yes	Yes	No	No	No
163	Yes	Yes	Yes	No	Yes	Yes	No	No	No
166	Yes	No	No	No	Yes	Yes	No	No	No
169	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
172	Yes	Yes	Yes	No	Yes	No	No	No	No
175	Yes	Yes	No	No	Yes	No	No	No	No
178	Yes	No	No	No	No	No	No	No	No
181	Yes	Yes	Yes	Yes	Yes	No	No	No	No
184	Yes	Yes	Yes	No	Yes	No	No	No	No
187	Yes	Yes	No	No	Yes	No	No	No	No
190	Yes	No	No	No	Yes	No	No	No	No

## 7.2.2 Circuit Status

The circuit statuses that appear in the Circuit window Status column are generated by CTC based on an assessment of conditions along the circuit path. [Table 7-2](#) shows the statuses that can appear in the Status column.

**Table 7-2 ONS 15600 Circuit Status**

Status	Definition/Activity
CREATING	CTC is creating a circuit.
DISCOVERED	CTC created a circuit. All components are in place and a complete path exists from circuit source to destination.
DELETING	CTC is deleting a circuit.
PARTIAL	<p>A CTC-created circuit is missing a connection or circuit span (network link), a complete path from source to destination(s) does not exist, or a MAC address change occurred on one of the circuit nodes and the circuit is in need of repair (in the ONS 15454, the MAC address resides on the AIP; in the ONS 15600, the MAC address resides on the backplane EEPROM).</p> <p>In CTC, circuits are represented using cross-connects and network spans. If a network span is missing from a circuit, the circuit status is PARTIAL. However, a PARTIAL status does not necessarily mean a circuit traffic failure has occurred, because traffic might flow on a protect path.</p> <p>Network spans are in one of two states: up or down. On CTC circuit and network maps, up spans appear as green lines, and down spans appear as gray lines. If a failure occurs on a network span during a CTC session, the span remains on the network map but its color changes to gray to indicate that the span is down. If you restart your CTC session while the failure is active, the new CTC session cannot discover the span and its span line does not appear on the network map.</p> <p>Subsequently, circuits routed on a network span that goes down appear as DISCOVERED during the current CTC session, but appear as PARTIAL to users who log in after the span failure.</p>
DISCOVERED_TL1	A TL1-created circuit or a TL1-like, CTC-created circuit is complete. A complete path from source to destination(s) exists.
PARTIAL_TL1	A TL1-created circuit or a TL1-like, CTC-created circuit is missing a cross-connect or circuit span (network link), and a complete path from source to destination(s) does not exist.
CONVERSION_PENDING	An existing circuit in a topology upgrade is set to this state. The circuit returns to the DISCOVERED state when the topology upgrade is complete. For more information about topology upgrades, see <a href="#">Chapter 8, “SONET Topologies and Upgrades.”</a>

Table 7-2 ONS 15600 Circuit Status (continued)

Status	Definition/Activity
PENDING_MERGE	Any new circuits created to represent an alternate path in a topology upgrade are set to this status to indicate that it is a temporary circuit. These circuits can be deleted if a topology upgrade fails. For more information about topology upgrades, see <a href="#">Chapter 8, “SONET Topologies and Upgrades.”</a>
DROP_PENDING	A circuit is set to this status when a new circuit drop is being added.

**Note**

If an ONS 15600 node is running Software R5.0.2, it is in a BLSR with an ONS 15454 node running Software R7.0 or later, and the login node is running Software R7.0 or later, the Protection column in the CTC Circuits window will show “Unknown” and the Status column will show “CONVERSION\_PENDING.” This status occurs until the ONS 15600 node is running Release 7.0 or later software.

## 7.2.3 Circuit States

The circuit service state is an aggregate of the cross-connect states within the circuit.

- If all cross-connects in a circuit are in the IS-NR service state, the circuit service state is In-Service (IS).
- If all cross-connects in a circuit are in an OOS service state, such as OOS-MA,MT; Out-of-Service and Autonomous, Automatic In-Service (OOS-AU,AINS); or Out-of-Service and Management, Disabled (OOS-MA,DSBLD) service state, the circuit service state is Out-of-Service (OOS).
- PARTIAL is appended to the OOS circuit service state when circuit cross-connects state are mixed and not all in IS-NR. The OOS-PARTIAL state can occur during automatic or manual transitions between states. OOS-PARTIAL can appear during a manual transition caused by an abnormal event such as a CTC crash or communication error, or if one of the cross-connects could not be changed. Refer to the *Cisco ONS 15600 Troubleshooting Guide* for troubleshooting procedures.

You can assign a service state to circuit cross-connects at two points:

- During circuit creation, you can set the state on the Create Circuit wizard.
- After circuit creation, you can change a circuit state in the Edit Circuit window or from the Tools > Circuits > Set Circuit State menu.

**Note**

After you have created an initial circuit in a CTC session, the subsequent circuit states default to the circuit state of the initial circuit, regardless of which nodes in the network the circuits traverse or the node.ckt.state default setting.

During circuit creation, you can apply a service state to the drop ports in a circuit. You cannot transition a drop port from the IS-NR service state to the OOS-MA,DSBLD service state; you must first put the port in the OOS-MA,MT state before changing it to the OOS-MA,DSBLD state. For more information about port service state transitions, see [Appendix B, “Administrative and Service States.”](#)

Circuits do not use the soak timer, but ports do. The soak period is the amount of time that the port remains in the OOS-AU,AINS service state after a signal is continuously received. When the cross-connects in a circuit are in the OOS-AU,AINS service state, the ONS 15600 monitors the cross-connects for an error-free signal. It changes the state of the circuit from OOS to IS or to OOS-PARTIAL as each cross-connect assigned to the circuit path is completed. This allows you to provision a circuit using TL1, verify its path continuity, and prepare the port to go into service when it receives an error-free signal for the time specified in the port soak timer. For example, when assigning the IS,AINS administrative state to cross-connects in STS circuits, the circuit source and destination ports transition to the OOS-AU,AINS service state. When an alarm-free signal is received, the source and destination ports remain OOS-AU,AINS for the duration of the soak timer. After the port soak timer expires, STS source and destination ports change to IS-NR and the circuit service state to IS.

To find the remaining port soak time, choose the Maintenance > AINS Soak tabs in card view and click the Retrieve button. If the port is in the OOS-AU,AINS state and has a good signal, the Time Until IS column shows the soak count down status. If the port is OOS-AU,AINS and has a bad signal, the Time Until IS column indicates that the signal is bad. You must click the Retrieve button to obtain the latest time value.

For more information about cross-connect states, see [Appendix B, “Administrative and Service States.”](#)

## 7.2.4 Circuit Protection Types

The Protection column in the Circuit window shows the card (line) and SONET topology (path) protection used for the entire circuit path. [Table 7-3](#) lists the protection type indicators that you will see in this column.

**Table 7-3** *Circuit Protection Types*

Protection Type	Description
1+1	The circuit is protected by a 1+1 protection group.
2F BLSR	The circuit is protected by a 2-fiber BLSR.
2F-PCA	The circuit is routed on a protection channel access (PCA) path on a two-fiber BLSR. PCA circuits are unprotected.
DRI	The circuit is protected by dual-ring interconnection.
N/A	A circuit with connections on the same node is not protected.
Protected	The circuit is protected by diverse SONET topologies, for example a BLSR and a path protection, or a path protection and 1+1.
Unknown	A circuit has a source and destination on different nodes and communication is down between the nodes. This protection type appears if not all circuit components are known.
Unprot (black)	A circuit with a source and destination on different nodes is not protected.
Unprot (red)	A circuit created as a fully protected circuit is no longer protected due to a system change, such as removal of a BLSR or 1+1 protection group.
Path Protection	The circuit is protected by a path protection.



## 7.2.5 Circuit Information in the Edit Circuit Window

You can edit a selected circuit using the Edit button on the Circuits window. The tabs that appear depend on the circuit chosen:

- General—Displays general circuit information and allows you to edit the circuit name.
- Drops—Allows you to add a drop to a unidirectional circuit. For more information, see the [“7.5 Multiple Destinations for Unidirectional Circuits”](#) section on page 7-13.
- Path Protection Selectors—Allows you to change path protection selectors. For more information, see the [“7.6 Path Protection Circuits”](#) section on page 7-13.
- Path Protection Switch Counts—Allows you to change path protection switch protection paths. For more information, see the [“7.6 Path Protection Circuits”](#) section on page 7-13.
- State—Allows you to edit cross-connect service states.
- Merge—Allows you to merge aligned circuits. For more information, see the [“7.14 Merged Circuits”](#) section on page 7-25.

Using the Export command from the File menu, you can export data from the Path Protection Selectors, Path Protection Switch Counts, State, and Merge tabs in HTML, comma-separated values (CSV), or tab-separated values (TSV) format.

The Show Detailed Map checkbox in the Edit Circuit window updates the graphical view of the circuit to show more detailed routing information, such as:

- Circuit direction (unidirectional or bidirectional)
- The nodes and STSs that the circuit traverses, including slots and port numbers
- The circuit source and destination points
- Open Shortest Path First (OSPF) area IDs
- Link protection (Path Protection, unprotected, BLSR, 1+1) and bandwidth (OC-N)

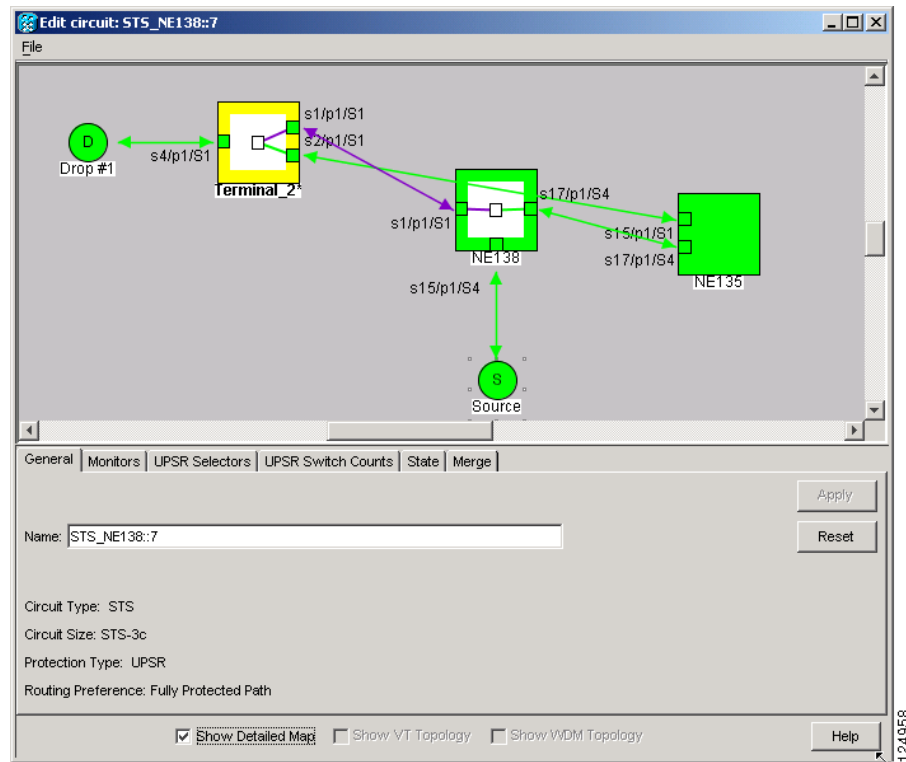
For BLSRs, the detailed map shows the number of BLSR fibers and the BLSR ring ID. For path protection configurations, the map shows the active and standby paths from circuit source to destination, and it also shows the working and protect paths. Selectors appear as pentagons on the detailed circuit map.

Alarms and states can also be viewed on the circuit map, including:

- Alarm states of nodes on the circuit route
- Number of alarms on each node organized by severity
- Port service states on the circuit route
- Alarm state/color of most severe alarm on port
- Loopbacks
- Path trace states
- Path selector states

Figure 7-2 shows a bidirectional STS circuit routed on a path protection.

**Figure 7-2 Path Protection Circuit on the Edit Circuit Window**



By default, the working path is indicated by a green, bidirectional arrow, and the protect path is indicated by a purple, bidirectional arrow. Source and destination ports are shown as circles with an S and D, respectively. Port states are indicated by colors, shown in Table 7-4.

**Table 7-4 Port State Color Indicators**

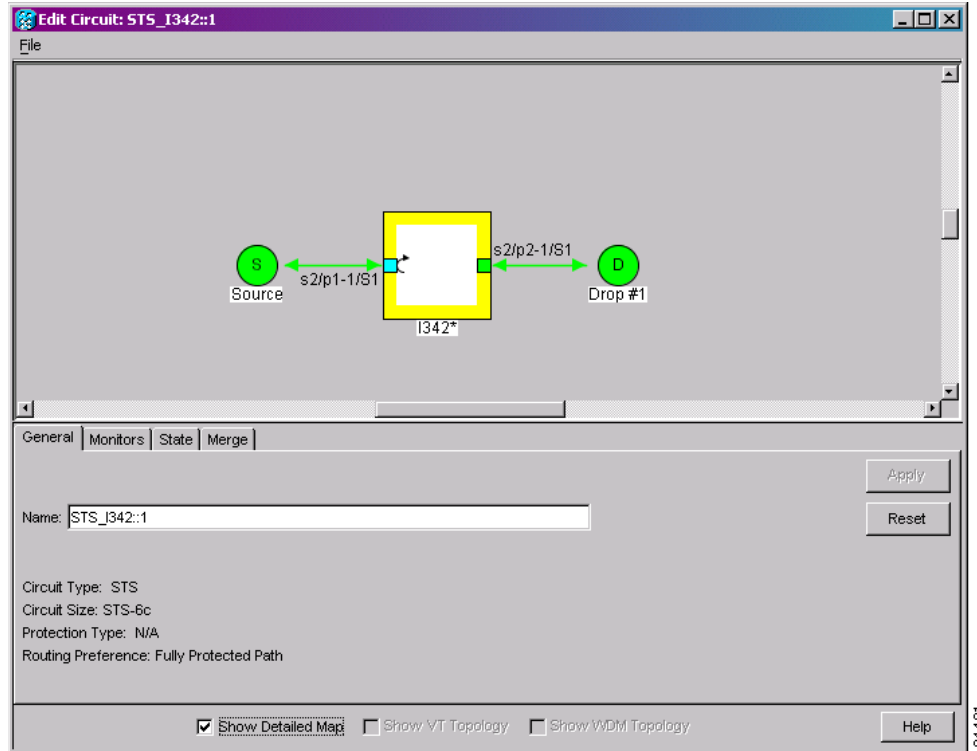
Port Color	Service State
Green	IS-NR
Gray	OOS-MA,DSBLD
Purple	OOS-AU,AINS
Cyan (Blue)	OOS-MA,MT

A notation within or by the squares or selector pentagons in detailed view indicates switches and loopbacks, including:

- F = Force switch
- M = Manual switch
- L = Lockout switch
- Arrow = Facility (outward) or terminal (inward) loopback

Figure 7-3 shows an example of the Edit Circuit window with a terminal loopback.

**Figure 7-3 Detailed Circuit Map Showing a Terminal Loopback**



Move the mouse cursor over nodes, ports, and spans to see tooltips with information including the number of alarms on a node (organized by severity), a port's service state, and the protection topology.

Right-click a node, port, or span on the detailed circuit map to initiate certain circuit actions:

- Right-click a unidirectional circuit destination node to add a drop to the circuit.
- Right-click a port containing a path-trace-capable card to initiate the path trace.
- Right-click a path protection span to change the state of the path selectors in the path protection circuit.

## 7.3 Cross-Connect Card Bandwidth

The single shelf cross-connect card (SSXC) cross-connect cards perform port-to-port, time-division multiplexing (TDM). The STS matrix has the capacity for 6144 STS terminations. Because each STS circuit requires a minimum of two terminations, one for ingress and one for egress, the SSXC has a capacity for 3072 STS circuits. However, this capacity is reduced at path protection and 1+1 nodes because three STS terminations are required at circuit source and destination nodes and four terminations are required at 1+1 circuit pass-through nodes. Path Protection pass-through nodes only require two STS terminations.

## 7.4 DCC Tunnels

SONET provides four data communications channels (DCCs) for network element operations, administration, maintenance, and provisioning: one on the SONET Section layer (DCC1) and three on the SONET Line layer (DCC2, DCC3, DCC4). The ONS 15600 uses the Section DCC (SDCC) for ONS 15600 management and provisioning. An SDCC and Line DCC (LDCC) each provide 192 Kbps of bandwidth per channel. The aggregate bandwidth of the three LDCCs is 576 Kbps. You can tunnel third-party SONET equipment across ONS 15600 networks using one of two tunneling methods, a traditional DCC tunnel or an IP-encapsulated tunnel.

### 7.4.1 Traditional DCC Tunnels

In traditional DCC tunnels, you can use the three Line DCCs (LDCCs) and the SDCC (when not used for ONS 15600 DCC terminations). A DCC tunnel endpoint is defined by slot, port, and DCC, where DCC can be either the SDCC or one of the LDCCs. You can link LDCCs to LDCCs and link SDCCs to SDCCs. You can also link an SDCC to an LDCC and an LDCC to an SDCC. To create a DCC tunnel, connect the tunnel endpoints from one ONS 15600 optical port to another. [Table 7-5](#) lists the DCC tunnels that you can create.

**Table 7-5** DCC Tunnels

DCC	SONET Layer	SONET Bytes
DCC1	Section	D1 to D3
DCC2	Line	D4 to D6
DCC3	Line	D7 to D9
DCC4	Line	D10 to D12

When you create DCC tunnels, keep the following guidelines in mind:

- Each ONS 15600 can have up to 64 DCC tunnel connections.
- An SDCC that is terminated cannot be used as a DCC tunnel endpoint.
- An SDCC that is used as an DCC tunnel endpoint cannot be terminated.
- All DCC tunnel connections are bidirectional.

### 7.4.2 IP-Encapsulated Tunnels

An IP-encapsulated tunnel puts an SDCC in an IP packet at a source node and dynamically routes the packet to a destination node. To compare traditional DCC tunnels with IP-encapsulated tunnels, a traditional DCC tunnel is configured as one dedicated path across a network and does not provide a failure recovery mechanism if the path is down. An IP-encapsulated tunnel is a virtual path, which adds protection when traffic travels between different networks.

IP-encapsulated tunneling has the potential of flooding the DCC network with traffic resulting in a degradation of performance for CTC. The data originating from an IP tunnel can be throttled to a user-specified rate, which is a percentage of the total SDCC bandwidth.

Each ONS 15600 supports up to 128 IP-encapsulated tunnels. You can convert a traditional DCC tunnel to an IP-encapsulated tunnel or an IP-encapsulated tunnel to a traditional DCC tunnel. Only tunnels in the DISCOVERED status can be converted.

**Caution**

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Converting from one tunnel type to the other is service-affecting.

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## 7.5 Multiple Destinations for Unidirectional Circuits

Unidirectional circuits can have multiple destinations (drops) for use in broadcast circuit schemes. In broadcast scenarios, one source transmits traffic to multiple destinations, but traffic is not returned to the source. The ONS 15600 supports one of the following:

- Up to 2048 1:2 nonblocking broadcast connections
- Up to 682 1:*n* nonblocking broadcast connections (where *n* is less than or equal to 8)

When you create a unidirectional circuit, the card that does not have its backplane receive (Rx) input terminated with a valid input signal generates a Loss of Signal (LOS) alarm. To mask the alarm, create an alarm profile suppressing the LOS alarm and apply the profile to the port that does not have its Rx input terminated. To create an alarm profile, refer to the “Manage Alarms” chapter in the *Cisco ONS 15600 Procedure Guide*.

## 7.6 Path Protection Circuits

Use the Edit Circuit window to change Path Protection selectors and switch protection paths (Figure 7-4). In the Path Protection Selectors subtab in the Edit Circuits window, you can:

- View the path protection circuit’s working and protection paths.
- Edit the reversion time.
- Set the hold-off timer.
- Edit the Signal Fail (SF) and Signal Degrade (SD) thresholds.
- Change Path Payload Defect Indication (PDI-P) settings.

**Note**

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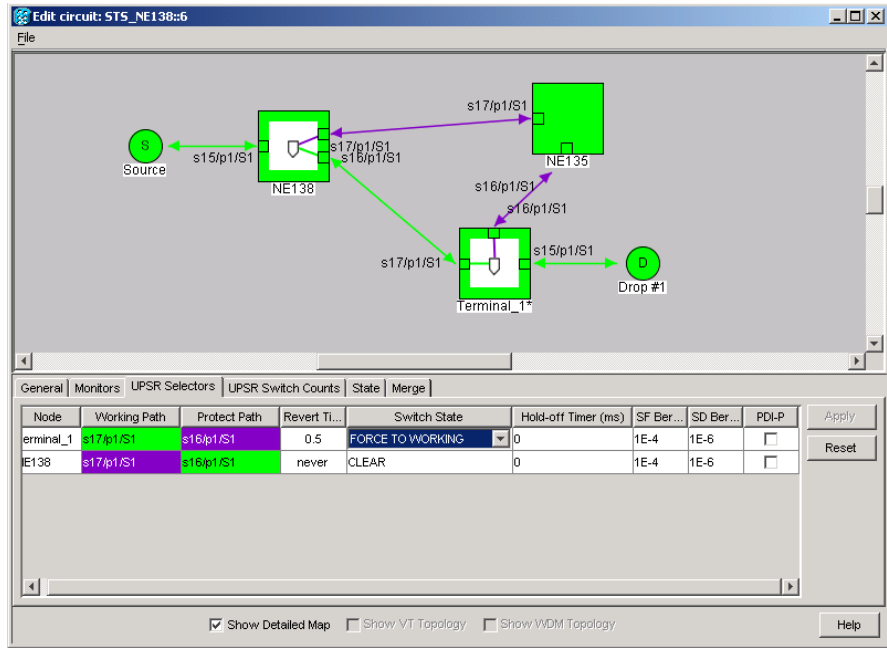
In the Path Protection Selectors tab, the SF Ber Level and SD Ber Level columns display “N/A” for those nodes that do not support VT signal bit error rate (BER) monitoring.

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From the Path Protection Switch Counts subtab, you can:

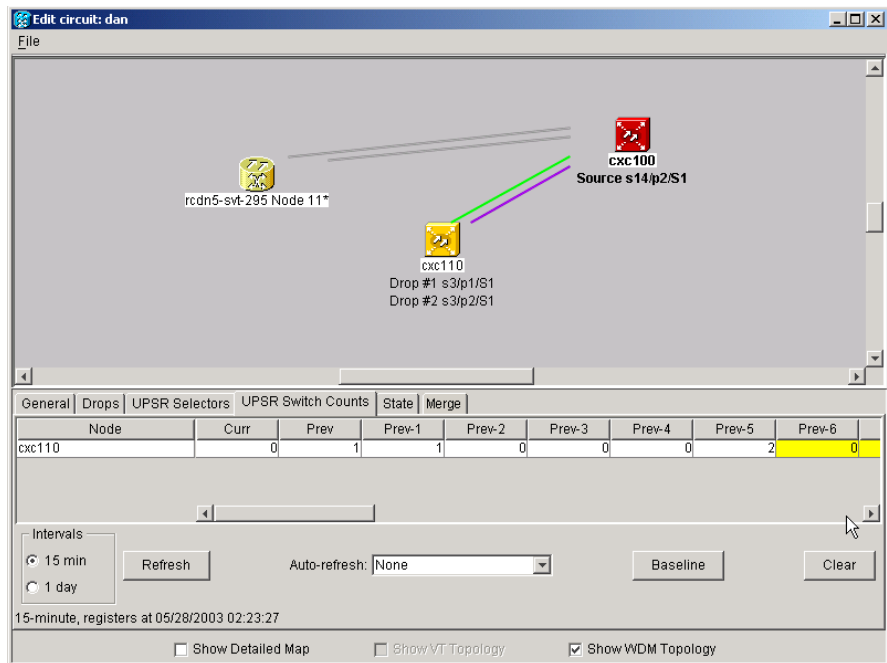
- Perform maintenance switches on the circuit selector.
- View switch counts for the selectors.

Figure 7-4 Editing Path Protection Selectors



On the Path Protection Switch Counts tab, you can view switch counts for the selectors (Figure 7-5).

Figure 7-5 Viewing Path Protection Switch Counts



## 7.7 Protection Channel Access Circuits

You can provision circuits to carry traffic on BLSR protection channels when conditions are fault-free and set up BLSR diagnostic test circuits. Traffic routed on BLSR PCA circuits, called extra traffic, has lower priority than the traffic on the working channels and has no means for protection. During ring or span switches, PCA circuits are preempted and squelched. For example, in a two-fiber OC-48 BLSR, STSs 25 to 48 can carry extra traffic when no ring switches are active, but PCA circuits on these STSs are preempted when a ring switch occurs. When the conditions that caused the ring switch are resolved and the ring switch is removed, PCA circuits are restored. If the BLSR is provisioned as revertive, this occurs automatically after the fault conditions are cleared and the reversion timer has expired.

Traffic provisioning on BLSR protection channels is performed during circuit provisioning. The Protection Channel Access check box appears whenever Fully Protected Path is unchecked on the circuit creation wizard. Refer to the *Cisco ONS 15600 Procedure Guide* for more information. If BLSRs are provisioned as nonrevertive, PCA circuits are not restored automatically after a ring or span switch. You must switch the BLSR manually.

## 7.8 BLSR STS and VT Squelch Tables

If a ONS 15600 is on a network with ONS 15454 nodes, it is possible to display STS and VT squelch tables on the ONS 15454 nodes depending on the type of circuits created. For example, if a fiber cut occurs, the BLSR squelch tables show STSs or VTs that will be squelched for every isolated node. Squelching replaces traffic by inserting the appropriate alarm indication signal path (AIS-P) and prevents traffic misconnections. For an STS with a VT-access check mark, the AIS-P will be removed after 100 ms. To view the squelch tables, refer to the “Manage Circuits” chapter in the *Cisco ONS 15454 Procedure Guide* for detailed instructions. For more information about BLSR squelching, refer to Telcordia GR-1230.

### 7.8.1 BLSR STS Squelch Table

BLSR STS squelch tables show STSs that will be squelched for every isolated node.

The BLSR Squelch Table window displays the following information:

- **STS Number**—Shows the BLSR STS numbers. For two-fiber BLSRs, the number of STSs is half the BLSR OC-N, for example, an OC-48 BLSR squelch table will show 24 STSs. For four-fiber BLSRs, the number of STSs in the table is the same as the BLSR OC-N.
- **West Source**—If traffic is received by the node on its west span, the BLSR node ID of the source appears. (To view the BLSR node IDs for all nodes in the ring, click the Ring Map button.)
- **West VT (from the West Source)** — A check mark indicates that the STS carries incoming VT traffic. The traffic source is coming from the west side.
- **West VT (from the West Destination)** — A check mark indicates that the STS carries outgoing VT traffic. The traffic is dropped on the west side.
- **West Dest**—If traffic is sent on the node’s west span, the BLSR node ID of the destination appears.
- **East Source**—If traffic is received by the node on its east span, the BLSR node ID of the source appears.
- **East VT** — (from the East Source) - A check mark indicates that the STS carries incoming VT traffic. The traffic source is coming from the east side.

- East VT — (from the East Destination) - A check mark indicate that the STS carries outgoing VT traffic. The traffic is dropped on the east side.
- East Dest—If traffic is sent on the node’s east span, the BLSR node ID of the destination appears.

**Note**

BLSR squelching is performed on STSs that carry STS circuits only. Squelch table entries will not appear for STSs carrying VT circuits or Ethernet circuits to or from E-Series Ethernet cards provisioned in a multiscard Ethergroup.

## 7.8.2 BLSR VT Squelch Table

BLSR VT squelch tables only appear on the node that is dropping VTs from a BLSR; the tables are used to perform VT-level squelching when a node is isolated. VT squelching is supported on the ONS 15454 platform. The ONS 15600 platform does not support VT squelching; however, when an ONS 15454 and an ONS 15600 are in the same network, the ONS 15600 node allows the ONS 15454 node to carry VT circuits in a VT tunnel. The ONS 15600 performs 100-ms STS-level squelching for each VT-access STS at the switching node in case of a node failure.

When using a VT circuit on a VT tunnel (VTT), the VTT allows multiple VT circuits to be passed through on a single STS without consuming VT matrix resources on the cross-connect card. Both endpoints of the VTT are the source and destination nodes for the VTT. The node carrying VT circuits through a VTT is called a VT-access node. In case of a source and destination node failure of the VTT, the switching node performs 100-ms STS-level squelching for the VTT STS. The node dropping VT traffic performs VT-level squelching. VT traffic on the VTT that is not coming from the failed node is protected.

When using a VT circuit on a VT aggregation point (VAP), the VAP allows multiple VT circuits to be aggregated into a single STS without consuming VT matrix resources on the cross-connect card. The source for each VAP STS timeslot is the STS-grooming end where VT1.5 circuits are aggregated into a single STS. The destination for each VAP STS is the VT-grooming end where VT1.5 circuits originated. The source node for each VT circuit on a VAP is the STS-grooming end where the VT1.5 circuits are aggregated into a single STS. The STS grooming node is not a VT-access node. The non VT-access node performs STS-level squelching for each STS timeslot at the switching node in case the VT-grooming node fails. The node dropping VT traffic performs VT-level squelching for each VT timeslot in case the STS-grooming end node fails. No VT traffic on the VAP is protected during a failure of the STS-grooming node or the VT-grooming node.

To view the VT squelch table, double-click the VT with a check mark in the BLSR STS squelch table window. The check mark appears on every VT-access STS; however, the VT-squelch table appears only by double-clicking the check mark on the node dropping the VT. The intermediate node of the VT does not maintain the VT-squelch table.

The VT squelch table provides the following information:

- VT Number—Shows the BLSR VT numbers. The VT number includes VT group number and VT number in group (VT group 2 and channel 1 are displayed as 2-1.)
- West Source—If traffic is received by the node on its west span, the BLSR node ID of the source appears. (To view the BLSR node IDs for all nodes in the ring, click the Ring Map button.)
- East Source—If traffic is received by the node on its east span, the BLSR node ID of the source appears.



## 7.9 Path Trace

SONET J1 path trace is a repeated, fixed-length string that includes 64 consecutive J1 bytes. You can use the string to monitor interruptions or changes to circuit traffic. If the string received at a circuit drop port does not match the string the port expects to receive, the Trace Identifier Mismatch Path (TIM-P) alarm is raised. The ONS 15600 can also monitor a 16-byte ITU pattern.

Table 7-6 lists the ONS 15600 cards that support path trace.

**Table 7-6 ONS 15600 Cards Supporting J1 Path Trace**

Card	Receive	Transmit
OC48/STM16 SR/SH 16 Port 1310	Yes	No
OC48/STM16 LR/LH 16 Port 1550	Yes	No
OC192/STM64 SR/SH 4 Port 1310	Yes	No
OC192/STM64 LR/LH 4 Port 1550	Yes	No
OC192LR/STM64 4 Port ITU C-Band	Yes	No
ASAP OC-N ports	Yes	No
ASAP Ethernet ports	Yes	Yes

SONET J0 section trace is not supported on ONS 15600 cards.

The ONS 15600 supports both automatic and manual J1 path trace monitoring to detect and report the contents of the 64-byte STS path trace message (nonterminated) for the designated STS path.

- Automatic—The receiving port assumes that the first J1 string it receives is the baseline J1 string.
- Manual—The receiving port uses a string that you manually enter as the baseline J1 string.



**Note**

When J1 path trace is enabled on a two-fiber BLSR circuit, CTC will not retrieve the path trace information from the card view Maintenance > Path Trace subtab.

## 7.10 Automatic Circuit Routing

If you select automatic routing during circuit creation, CTC routes the circuit by dividing the entire circuit route into segments based on protection domains. For unprotected segments of circuits provisioned as fully protected, CTC finds an alternate route to protect the segment, creating a virtual path protection. Each segment of a circuit path is a separate protection domain. Each protection domain is protected in a specific protection scheme including card protection (1+1) or SONET topology (path protection or BLSR).

The following list provides principles and characteristics of automatic circuit routing:

- Circuit routing tries to use the shortest path within the user-specified or network-specified constraints.
- If you do not choose fully path protected during circuit creation, circuits can still contain protected segments. Because circuit routing always selects the shortest path, one or more links and/or segments can have some protection. CTC does not look at link protection while computing a path for unprotected circuits.

- Circuit routing does not use links that are down. If you want all links to be considered for routing, do not create circuits when a link is down.
- Circuit routing computes the shortest path when you add a new drop to an existing circuit. It tries to find the shortest path from the new drop to any nodes on the existing circuit.

## 7.10.1 Bandwidth Allocation and Routing

Within a given network, CTC routes circuits on the shortest possible path between source and destination based on the circuit attributes, such as protection and type. CTC considers using a link for the circuit only if the link meets the following requirements:

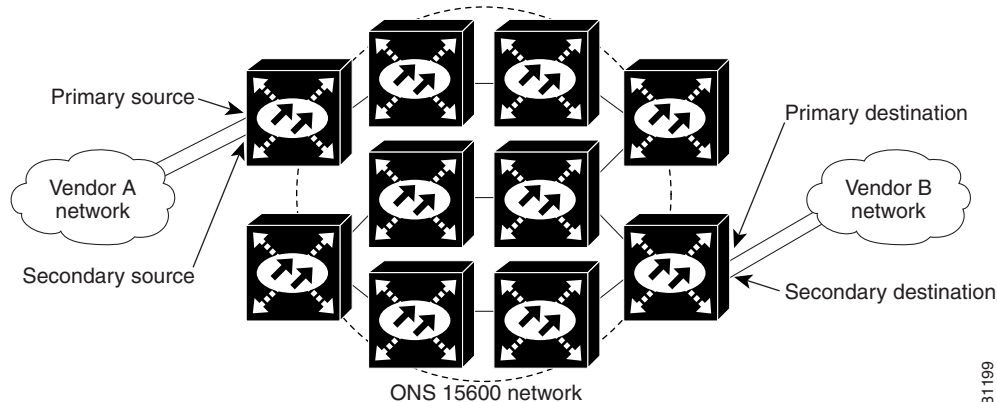
- The link has sufficient bandwidth to support the circuit.
- The link does not change the protection characteristics of the path.
- The link has the required time slots to enforce the same time slot restrictions for BLSR.

If CTC cannot find a link that meets these requirements, an error appears.

## 7.10.2 Secondary Sources and Destination

CTC supports secondary sources and destinations (drops). Secondary sources and destinations typically interconnect two third-party networks, as shown in [Figure 7-6](#). Traffic is protected while it traverses a network of ONS 15600s.

**Figure 7-6** Secondary Sources and Drops



For bidirectional circuits, CTC creates a path protection connection at the source node that allows traffic to be selected from one of the two sources on the ONS 15600 network. If you check the Fully Path Protected option during circuit creation, traffic is protected within the ONS 15600 network. At the destination, another path protection connection is created to bridge traffic from the ONS 15600 network to the two destinations. A similar but opposite path exists for the reverse traffic flowing from the destinations to the sources.

For unidirectional circuits, a path protection drop-and-continue connection is created at the source node.

**Note**

Automatic routing and its associated subfields are not available if both the Automatic Circuit Routing NE default and the Network Circuit Automatic Routing Overridable NE default are set to FALSE. For a full description of these defaults see [Appendix C, “Network Element Defaults.”](#)

## 7.11 Manual Circuit Routing

Routing circuits manually allows you to:

- Choose a specific path, not just the shortest path chosen by automatic routing.
- Choose a specific STS on each link along the route.

CTC imposes the following rules on manual routes:

- All circuits in a shared packet ring should have links with a direction that flows from source to destination.
- If you enabled Fully Protected Path, choose a diverse protect (alternate) path for every unprotected segment.
- For a node that has a path protection selector based on the links chosen, the input links to the path protection selectors cannot be 1+1 protected. The same rule applies at the path protection bridge.

If you enabled Fully Protected Path, CTC verifies that the route selection is protected at all segments. A route can have multiple protection domains with each domain protected by a different scheme.

[Table 7-7](#) summarizes the available bidirectional connections. Any other combination is invalid and generates an error.

**Table 7-7 Bidirectional STS Circuits**

No. of Inbound Links	No. of Outbound Links	No. of Sources	No. of Drops	Connection Type
—	2	1	—	Path Protection
2	—	—	1	Path Protection
2	1	—	—	Path Protection
1	2	—	—	Path Protection
1	—	—	2	Path Protection
—	1	2	—	Path Protection
2	2	—	—	Double Path Protection
2	—	—	2	Double Path Protection
—	2	2	—	Double Path Protection
1	1	—	—	Two-way

[Table 7-8](#) summarizes the available unidirectional connections. Any other combination is invalid and generates an error.

**Table 7-8 Unidirectional STS Circuits**

No. of Inbound Links	No. of Outbound Links	No. of Sources	No. of Drops	Connection Type
1	1	—	—	One-way
1	2	—	—	Path Protection head end
—	2	1	—	Path Protection head end
2	—	—	1+	Path Protection drop and continue

## 7.12 Constraint-Based Circuit Routing

When you create circuits, you can choose Fully Protected Path to protect the circuit from source to destination. The protection mechanism used depends on the path that CTC calculates for the circuit. If the network is comprised entirely of BLSR or 1+1 links, or the path between source and destination can be entirely protected using 1+1 or BLSR links, no path-protected mesh network (PPMN), or virtual Path Protection, protection is used.

If PPMN protection is needed to protect the path, set the level of node diversity for the PPMN portions of the complete path on the Circuit Routing Preferences area of the Circuit Creation dialog box:

- **Nodal Diversity Required**—Ensures that the primary and alternate paths of each PPMN domain in the complete path have a diverse set of nodes.
- **Nodal Diversity Desired**—CTC looks for a node-diverse path; if a node-diverse path is not available, CTC finds a link-diverse path for each PPMN domain in the complete path.
- **Link Diversity Only**—Creates only a link diverse path for each PPMN domain.

When you choose automatic circuit routing during circuit creation, you have the option to require or exclude nodes and links in the calculated route. You can use this option to achieve the following results:

- **Simplify manual routing**, especially if the network is large and selecting every span is tedious. You can select a general route from source to destination and allow CTC to fill in the route details.
- **Balance network traffic**; by default CTC chooses the shortest path, which can load traffic on certain links while other links are either free or use less bandwidth. By selecting a required node and/or a link, you force CTC to use (or not use) an element, resulting in more efficient use of network resources.

CTC considers required nodes and links to be an ordered set of elements. CTC treats the source nodes of every required link as required nodes. When CTC calculates the path, it makes sure the computed path traverses the required set of nodes and links and does not traverse excluded nodes and links.

The required nodes and links constraint is used only during the primary path computation and only for PPMN domains/segments. The alternate path is computed normally; CTC uses excluded nodes/links when finding all primary and alternate paths on PPMNs.

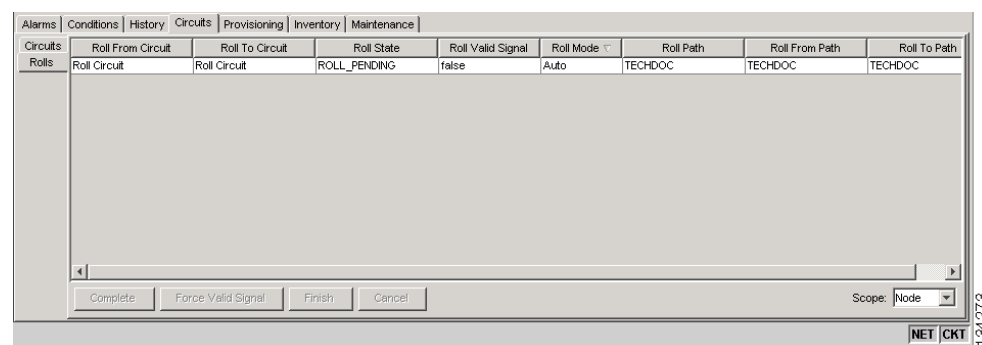
## 7.13 Bridge and Roll

The CTC Bridge and Roll wizard reroutes live traffic without interrupting service. The bridge process takes traffic from a designated “roll from” facility and establishes a cross-connect to the designated “roll to” facility. When the bridged signal at the receiving end point is verified, the roll process creates a new cross-connect to receive the new signal. When the roll completes, the original cross-connects are released. You can use the bridge and roll feature for maintenance functions such as card or facility replacement, or for load balancing. You can perform a bridge and roll on the following ONS platforms: ONS 15600, ONS 15454, ONS 15454 SDH, ONS 15310-CL, and ONS 15310-MA.

### 7.13.1 Rolls Window

The Rolls window lists information about a rolled circuit before the roll process is complete. You can access the Rolls window by clicking the Circuits > Rolls tabs in either network or node view. [Figure 7-7](#) shows the Rolls window.

**Figure 7-7**      **Rolls Window**



The Rolls window information includes:

- Roll From Circuit—The circuit with connections that will no longer be used when the roll process is complete.
- Roll To Circuit—The circuit that will carry the traffic when the roll process is complete. The Roll To Circuit is the same as the Roll From Circuit if a single circuit is involved in a roll.
- Roll State—The roll status; see the “7.13.2 Roll Status” section on page 7-22 for information.
- Roll Valid Signal—If the Roll Valid Signal status is true, a valid signal was found on the new port. If the Roll Valid Signal status is false, a valid signal was not found. It is not possible to get a true Roll Valid Signal status for a one-way destination roll.
- Roll Mode—The mode indicates whether the roll is automatic or manual.

CTC implements a roll mode at the circuit level. TL1 implements a roll mode at the cross-connect level. If a single roll is performed, CTC and TL1 behave the same. If a dual roll is performed, the roll mode specified in CTC might be different than the roll mode retrieved in TL1. For example, if you select Automatic, CTC coordinates the two rolls to minimize possible traffic hits by using the Manual mode behind the scenes. When both rolls have a good signal, CTC signals the nodes to complete the roll.

- Automatic—When a valid signal is received on the new path, CTC completes the roll on the node automatically. One-way source rolls are always automatic.

- Manual—You must complete a manual roll after a valid signal is received. One-way destination rolls are always manual.
- Roll Path—The fixed point of the roll object.
- Roll From Path— The old path that is being rerouted.
- Roll To Path—The new path where the Roll From Path is rerouted.
- Complete—Completes a manual roll after a valid signal is received. You can complete a manual roll if it is in a ROLL\_PENDING status and you have not yet completed the roll or have not cancelled its sibling roll.
- Force Valid Signal—Forces a roll onto the Roll To Circuit destination without a valid signal. If you choose Force Valid Signal, traffic on the circuit that is involved in the roll will be dropped once the roll is completed.
- Finish—Completes the circuit processing of both manual and automatic rolls and changes the circuit status from ROLL\_PENDING to DISCOVERED. After a roll, the Finish button also removes any cross-connects that are no longer used from the Roll From Circuit field.
- Cancel—Cancels the roll process. When the roll mode is Manual, cancel roll is only allowed before you click the Complete button. When the roll mode is Auto, cancel roll is only allowed before a good signal is detected by the node or before you click the Force Valid Signal button.

## 7.13.2 Roll Status

Table 7-9 lists the roll statuses. You can only reroute circuits that have a DISCOVERED status. (See Table 7-2 on page 7-6 for a list of circuit statuses.) You cannot reroute circuits that are in the ROLL\_PENDING status.

**Table 7-9** Roll Statuses

State	Description
ROLL_PENDING	The roll is awaiting completion or cancellation.
ROLL_COMPLETED	The roll is complete. Click the Finish button.
ROLL_CANCELLED	The roll has been canceled.
TL1_ROLL	A TL1 roll was initiated.  <b>Note</b> If a roll is created using TL1, a CTC user cannot complete or cancel the roll. Also, if a roll is created using CTC, a TL1 user cannot complete or cancel the roll. You must use the same interface to complete or change a roll.
INCOMPLETE	This state appears when the underlying circuit becomes incomplete. To correct this state, you must fix the underlying circuit problem before the roll state will change.  For example, a circuit traveling on Nodes A, B, and C can become INCOMPLETE if Node B is rebooted. The cross connect information is lost on Node B during a reboot. The Roll State on Nodes A and C will change to INCOMPLETE.

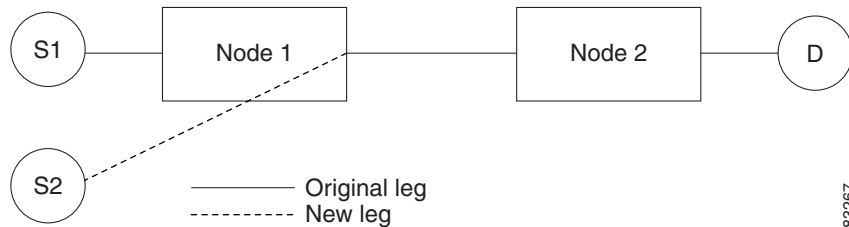
## 7.13.3 Single and Dual Rolls

Circuits have an additional layer of roll types: single and dual. A single roll on a circuit is a roll on one of its cross-connects. Use a single roll to:

- Change either the source or destination of a selected circuit (Figure 7-8 and Figure 7-9, respectively).
- Roll a segment of the circuit onto another chosen circuit (Figure 7-10 on page 7-23). This roll also results in a new destination or a new source.

In Figure 7-8, you can select any available STS on Node 1 for a new source.

**Figure 7-8 Single Source Roll**



In Figure 7-9, you can select any available STS on Node 2 for a new destination.

**Figure 7-9 Single Destination Roll**

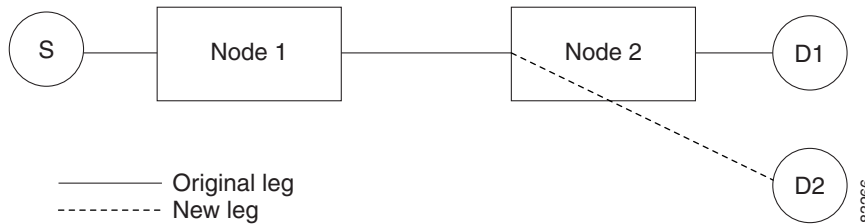


Figure 7-10 shows one circuit rolling onto another circuit at the destination. The new circuit has cross-connects on Node 1, Node 3, and Node 4. CTC deletes the cross-connect on Node 2 after the roll.

**Figure 7-10 Single Roll from One Circuit to Another Circuit (Destination Changes)**

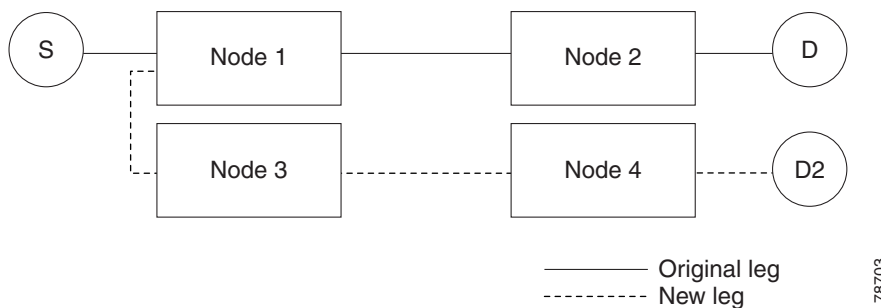
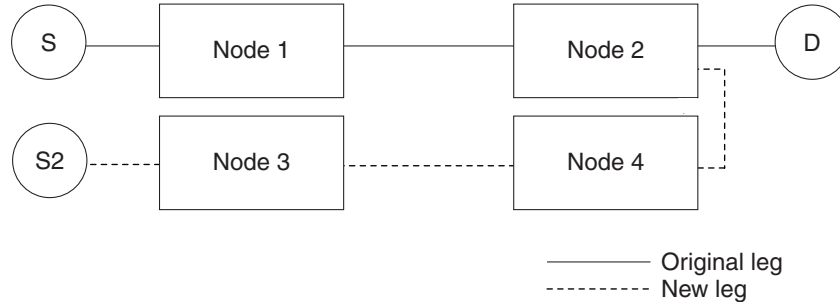


Figure 7-11 shows one circuit rolling onto another circuit at the source.

**Figure 7-11** Single Roll from One Circuit to Another Circuit (Source Changes)**Note**

Create a Roll To Circuit before rolling a circuit with the source on Node 3 and the destination on Node 4.

A dual roll involves two cross-connects. It allows you to reroute intermediate segments of a circuit, but keep the original source and destination. If the new segments require new cross-connects, use the Bridge and Roll wizard or create a new circuit and then perform a roll.

**Caution**

Only single rolls can be performed using TL1. Dual rolls require the network-level view that only CTC or CTM provide.

Dual rolls have several constraints:

- You must complete or cancel both cross-connects rolled in a dual roll. You cannot complete one roll and cancel the other roll.
- When a Roll To circuit is involved in the dual roll, the first roll must roll onto the source of the Roll To circuit and the second roll must roll onto the destination of the Roll To circuit.

Figure 7-12 illustrates a dual roll on the same circuit.

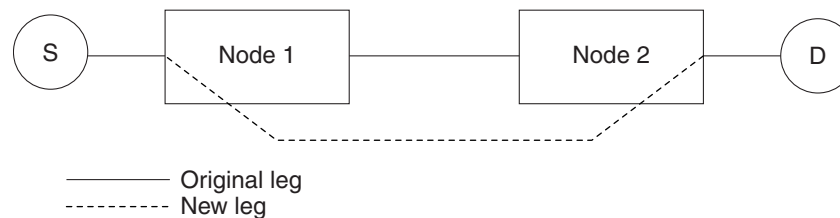
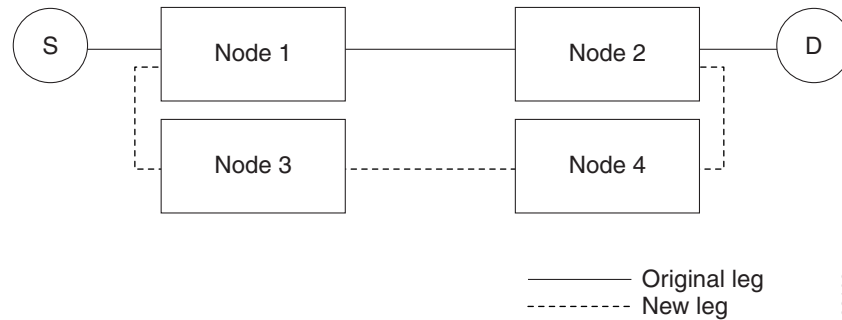
**Figure 7-12** Dual Roll to Reroute a Link

Figure 7-13 illustrates a dual roll involving two circuits.



Figure 7-13 Dual Roll to Reroute to a Different Node

**Note**

If a new segment is created on Nodes 3 and 4 using the Bridge and Roll wizard, the created circuit has the same name as the original circuit with the suffix `_ROLL**`. The circuit source is on Node 3 and the circuit destination is on Node 4.

## 7.13.4 Two Circuit Bridge and Roll

When using the bridge and roll feature to reroute traffic using two circuits, the following constraints apply:

- DCC must be enabled on the circuits involved in a roll before roll creation.
- A maximum of two rolls can exist between any two circuits.
- If two rolls are involved between two circuits, both rolls must be on the original circuit. The second circuit should not carry live traffic. The two rolls loop from the second circuit back to the original circuit. The roll mode of the two rolls must be identical (either automatic or manual).
- If a single roll exists on a circuit, you must roll the connection onto the source or the destination of the second circuit and not an intermediate node in the circuit.

## 7.13.5 Protected Circuits

CTC allows you to roll the working or protect path regardless of which path is active. You can upgrade an unprotected circuit to a fully protected circuit or downgrade a fully protected circuit to an unprotected circuit with the exception of a Path Protection circuit. When using bridge and roll on Path Protection circuits, you can roll the source or destination or both path selectors in a dual roll. However, you cannot roll a single path selector.

## 7.14 Merged Circuits

A circuit merge combines a single selected circuit with one or more circuits. You can merge CTC-created circuits and TL1-created circuits. To merge circuits, you choose a circuit in the CTC Circuits window and the circuits that you want to merge with the chosen (master) circuit on the Merge tab in the Edit Circuit window. The Merge tab shows only the circuits that are available for merging with the master circuit:

- Circuit cross-connects must create a single, contiguous path.

- Circuits types must be a compatible.
- Circuit directions must be compatible. You can merge a one-way and a two-way circuit, but not two one-way circuits in opposing directions.
- Circuit sizes must be identical.
- Circuit end points must send or receive the same framing format.
- The merged circuits must become a DISCOVERED circuit.

**Note**


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CTC automatically merges aligned TL1-like circuits.

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If all connections from the master circuit and all connections from the merged circuits align to form one complete circuit, the merge is successful. If all connections from the master circuit and some, but not all, connections from the other circuits align to form a single complete circuit, CTC notifies you and gives you the chance to cancel the merge process. If you choose to continue, the aligned connections merge successfully into the master circuit, and unaligned connections remain in the original circuits. All connections in the completed master circuit use the original master circuit name.

All connections from the master circuit and at least one connection from the other selected circuits must be used in the resulting circuit for the merge to succeed. If a merge fails, the master circuit and all other circuits remain unchanged. When the circuit merge completes successfully, the resulting circuit retains the name of the master circuit.

## 7.15 Reconfigured Circuits

You can reconfigure multiple circuits, which is typically necessary when a large number of circuits are in the PARTIAL status. When you reconfigure multiple circuits, the selected circuits can be any combination of DISCOVERED, PARTIAL, DISCOVERED\_TL1, and PARTIAL\_TL1 circuits. You can reconfigure tunnels, CTC-created circuits, and TL1-created circuits. The Reconfigure command maintains the names of the original cross-connects.

Use the CTC Tools > Circuits > Reconfigure Circuits command to reconfigure selected circuits. During reconfiguration, CTC reassembles all connections of the selected circuits into circuits based on path size, direction, and alignment. Some circuits might merge and others might split into multiple circuits. If the resulting circuit is a valid circuit, it appears as a DISCOVERED circuit. Otherwise, the circuit appears as a PARTIAL or PARTIAL\_TL1 circuit.

**Note**


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PARTIAL tunnel circuits do not split into multiple circuits during reconfiguration.

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## 7.16 Server Trails

A server trail is a non-DCC (logical or virtual) link across a third-party network that connects two CTC network domains. A server trail allows A-Z circuit provisioning when no DCC is available. You can create server trails between two distant optical or EC-1 ports. The end ports on a server trail can be different types (for example, an OC-3 port can be linked to an OC-12 port). Server trails are not allowed on DCC-enabled ports.

The server trail link is bidirectional and can be VT1.5, VT2, STS1, STS-3c, STS-6c, STS-12c, STS-48c, or STS-192c; you cannot change an existing server trail to another size. It must be deleted and recreated. A circuit provisioned over a server trail must match the type and size of the server trail it uses. For example, an STS-3c server trail can carry only STS-3c circuits and not three STS-1 circuits.

**Note**

There is no OSPF or any other management information exchange between NEs over a server trail.

## 7.16.1 Server Trail Protection Types

The server trail protection type determines the protection type for any circuits that traverse it. A server trail link can be one of the following protection types:

- **Preemptible**—PCA circuits will use server trails with the Preemptible attribute.
- **Unprotected**—In Unprotected Server Trail, CTC assumes that the circuits going out from that specific port will not be protected by provider network and will look for a secondary path from source to destination if you are creating a protected circuit.
- **Fully Protected**—In Fully Protected Server Trail, CTC assumes that the circuits going out from that specific port will be protected by provider network and will not look for a secondary path from source to destination.

**Note**

Only path protection is available on server trails. BLSR protection is not available on server trail.

## 7.16.2 VCAT Circuit Routing over Server Trails

An STS-3c server trail can be used to route STS-3c circuits and an STS-1 server trail can be used to route STS-1 circuits. Similarly, a VT1.5 server trail can be used to route VT1.5 circuits and an STS-12c server trail can only be used for STS-12c circuits.

For example, to route a STS-3c-2v circuit over a server trail, you must enable split fiber routing and create two STS-3c server trails and route each member manually or automatically over each server trail. To route a STS-12c-2v circuit over a server trail, you must enable split fiber routing and create two STS-12c server trails and route each member manually or automatically over each server trail.

**Note**

Server trails can only be created between any two optical ports or EC-1 ports.

VCAT circuits can be created over server trails in the following ways:

- Manual routing
- Automatic routing
  - Diverse routing: This method enables VCAT circuit routing over diverse server trail links.

**Note**

When creating circuits or VCATs, you can choose a server trail link during manual circuit routing. CTC may also route circuits over server trail links during automatic routing. VCAT common-fiber automatic routing is not supported.

For a detailed procedure on how to route a VCAT circuit over a server trail, refer “Chapter 6, Create Circuits and VT Tunnels, Section NTP-A264, Create an Automatically Routed VCAT Circuit and Section NTP-A265, Create a Manually Routed VCAT Circuit” in the *Cisco ONS 15454 Procedure Guide*.

### 7.16.2.1 Shared Resource Link Group

The Shared Resource Link Group (SRLG) attribute can be assigned to a server trail link using a commonly shared resource such as port, fiber or span. For example, if two server trail links are routed over the same fiber, an SRLG attribute can be assigned to these links. SRLG is used by Cisco Transport Manager (CTM) to specify link diversity. If you create multiple server trails from one port, you can assign the same SRLG value to all the links to indicate that they originate from the same port.

## 7.17 Traffic Routing over a Third-Party Network

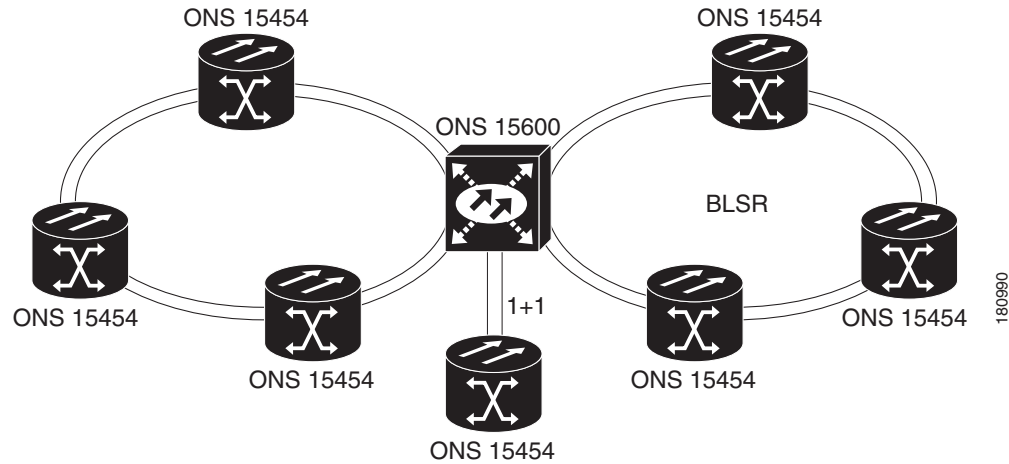
If ONS 15600s are connected to a third-party network, you can create an open-ended Path Protection circuit to route a circuit through it. To do this, you create three STS circuits. One circuit is created on the source ONS 15600 network. This circuit has one source and two destinations, one at each ONS 15600 that is connected to the third-party network. The second circuit is created on the third-party network so that the circuit travels across the network on two paths to the ONS 15600s. That circuit routes the two circuit signals across the network to ONS 15600s that are connected to the network on other side. At the destination node network, the third circuit is created with two sources, one at each node connected to the third-party network. A selector at the destination node chooses between the two signals that arrive at the node, similar to a regular Path Protection circuit.

## 7.18 VT Traffic Routing over an ONS 15600 Hub Node

When an ONS 15600 node is configured as a hub between compatible protection domains, it is possible to use CTC to automatically create circuits, including VT circuits from an ONS 15454 node, across the domains. VT circuits cannot terminate on an ONS 15600 node. All combinations of protection domains are compatible for STS circuits, including combinations of Path Protection and line-protected domains.

When you must route VT traffic over an ONS 15600 hub node connecting Path Protection, line-protected, and unprotected domains, you must manually create the circuits for this traffic. For specific information on ONS 15454 VT circuit creation and tunneling, refer to the *Cisco ONS 15454 Procedure Guide*

**Figure 7-14** shows an ONS 15600 as a protection domain hub between a ONS 15454 Path Protection network, an ONS 15454 BLSR network, and a 1+1 protected ONS 15454 node.

**Figure 7-14 ONS 15600 as Hub Node between Protection Domains**

## 7.18.1 Automatic VT Circuit Creation

To route VT traffic across an ONS 15600 for compatible protection domains, you must create a VT tunnels on an ONS 15454 node or create an end-to-end circuit. If you create an end-to-end circuit, CTC automatically creates a tunnel to route the VT traffic. You can create circuits or tunnels with an ONS 15600 as a hub node for the following domain combinations:

- Path Protection to Path Protection
- 1+1 to 1+1
- BLSR to BLSR
- 1+1 to BLSR
- Unprotected to BLSR

Once the tunnel or end-to-end circuit exists, additional VT circuits can be routed until all of the bandwidth is used. The tunnel source and destination are the VT circuit source and destination, and when created results in the creation of STS pass-through circuits on each node in the path. For any of the listed topology combinations except Path Protection to Path Protection, one tunnel is required; a Path Protection-to-Path Protection topology requires two tunnels.

## 7.18.2 Manual VT Circuit Creation

When you must route VT traffic from an ONS 15454 Path Protection across an ONS 15600 hub to a line-protected domain, CTC cannot automatically create the end-to-end VT1.5 circuit. The configuration requires three TL1-like circuits. You must create all three circuits separately:

1. VT1.5 open-ended circuit on the ONS 15454 Path Protection
2. STS open-ended circuit on the ONS 15600 hub node
3. VT1.5 two-way circuit on the ONS 15454 line-protected node

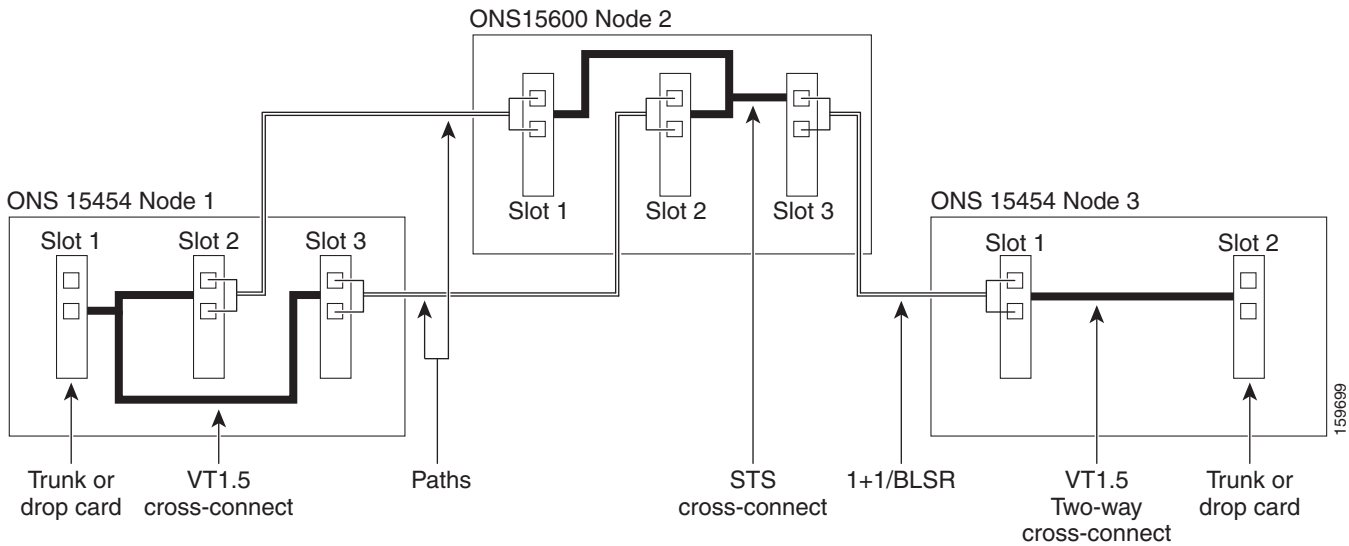
The three TL1-like circuits must physically align for CTC to automatically merge the circuits.

[Figure 7-15](#) is an example of an ONS 15600 node bridging an ONS 15454 Path Protection and an ONS 15454 line-protected domain.

In [Figure 7-15](#), the following circuits are present:

- An open-ended VT1.5 circuit exists on Node 1. Slot 1 is the source, and Slots 2 and 3 are the destinations.
- An open-ended STS circuit exists on Node 2 (the hub ONS 15600 node). Slot 1 and Slot 2 are the sources, and Slot 3 is the destination.
- A two-way VT1.5 circuit exists on Node 3 between Slot 1 and Slot 2.

**Figure 7-15** VT Traffic Routing over an ONS 15600 Hub Node



For information on creating an open-ended circuit on the ONS 15600 to bridge protection domains, refer to the “Turn Up Network” chapter in the *Cisco ONS 15600 Procedure Guide*.