



# Troubleshooting Network Topologies

This chapter provides information on troubleshooting point-to-point, ring, and meshed ring network topologies. This chapter includes the following sections:

- [Checking Connectivity, page 5-1](#)
- [Troubleshooting Unprotected Point-to-Point Topology, page 5-5](#)
- [Troubleshooting Point-to-Point Topology with Splitter Protection, page 5-7](#)
- [Troubleshooting Point-to-Point Topology with Line Card Protection, page 5-9](#)
- [Troubleshooting Hubbed Ring Topology with Splitter Protection, page 5-11](#)
- [Troubleshooting Hubbed Ring Topology with Line Card Protection, page 5-14](#)
- [Troubleshooting Meshed Ring Topology with Splitter Protection, page 5-17](#)
- [Troubleshooting Meshed Ring Topology with Line Card Protection, page 5-20](#)

Each of these topologies can be configured with or without protection. For detailed information on network topologies, refer to the *Cisco ONS 15540 ESP Planning Guide* and for information on how to configure these topologies, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

## Checking Connectivity

There are two procedures for troubleshooting connections in network topologies. The first involves checking the connectivity of the interfaces. If that fails, then the second involves running the more disruptive loopback tests.

Loopback tests are an important part of troubleshooting. They are used to isolate the fault on an end-to-end circuit (especially when the circuit is down). The **loopback** diagnostic command causes traffic going out of a transparent or a wave interface to come back to the system and confirms the connection.



### Caution

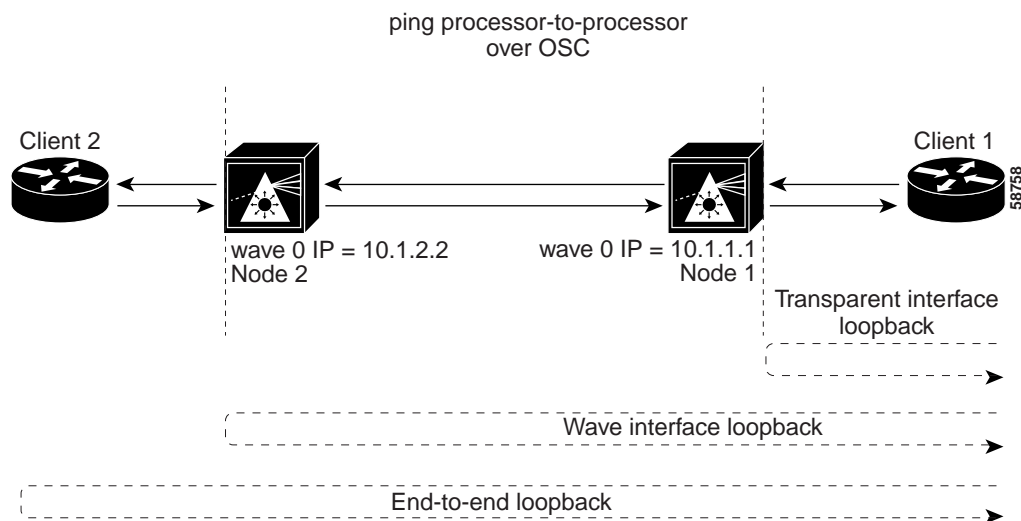
When you configure loopback on an interface, communication over the link is interrupted but performance statistics are still updated.

[Figure 5-1](#) shows a simple, point-to-point topology without protection between two Cisco ONS 15540 systems, node 1 and node 2. Some steps may seem redundant but following this process in this order should help troubleshoot the connection with the least disruption to the other connections on the network.

**Note**

The following troubleshooting process assumes that the OSC wave interfaces are configured between the Cisco ONS 15540 systems. Without the OSC configured, troubleshooting the Cisco ONS 15540 connections requires you to log into each system and confirm each individual transparent and wave interface individually.

**Figure 5-1** General Connection Troubleshooting Steps



To troubleshoot the configuration and status of the optical connections, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent slot/subcard/0</b>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave slot/subcard</b>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping {ip-address   hostname}</b>	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these general steps to troubleshoot an optical fiber network connection between two end user clients:

- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment.

```
Node1# show interfaces transparent 2/2/0
```

```
→ Transparent2/2/0 is up, line protocol is up
   Encap: Sonet      Rate: ocl2
   Signal monitoring: on
   Configured threshold Group: None
   Threshold monitored for: BIP1 error
```

```

Set threshold SF:10e-5 SD:10e-7
Bipl Count: 0
Number of times SF threshold exceeded: 0
Number of times SD threshold exceeded: 0
Number of errored seconds: 0
Number of severely errored seconds: 0
Number of severely errored framing seconds: 0
Number of times SEF alarm raised: 0
Hardware is transparent
Encapsulation UNKNOWN, loopback not set
Last input never, output never, output hang never
Last clearing of "show interface" counters 04:17:45
Node1#

```

The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.

- Step 2** From node 1, use the **show interfaces wave** command to display the status of the trunk side laser on the transponder.

```

Node1# show interfaces wave 2/2
→ Wave2/2 is up, line protocol is up
  Channel: 3      Frequency: 192.3 Thz      Wavelength: 1558.98 nm
  Active Wavepatch : Wavepatch2/2/0
  Splitter Protected: No
  Receiver power level: -15.34 dBm
  Forward laser control: Off
  Laser safety control: Off
  Osc physical port: No
  Wavelength used for inband management: No
  Configured threshold Group: None
  Code violation and running disparity error count(cvrd): 0
  Number of times SF threshold exceeded: 0
  Number of times SD threshold exceeded: 0
  Loopback not set
  Last clearing of "show interface" counters 14:35:39
  Hardware is data_only_port
Node1#

```

The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the next neighboring node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.

- Step 3** From node 1, use the **ping** command and the IP address of the node 2 wave 0 interface. The following **ping** command tests the connection between the processor on node 1, through the wave 0 interface, to the processor on node 2.

```

Node1# ping 10.1.2.2

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.2.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 68/72/76 ms
Node1#

```

The **ping** command between the nodes proves the trunk connection between node 1 and node 2 has not failed. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.

For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

If these three steps have not found the failed connection between nodes, continue with the following more disruptive connection loopback troubleshooting steps.


**Caution**

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.

- Step 4** From node 1, configure a loopback on the transparent interface that connects to the client equipment.

```
Node1(config)# interface transparent10/0/0
Node1(config-if)# loopback
Node1(config-if)# end
Node1#
```

Confirm the loopback configuration using the **show interfaces transparent** command.

```
Node1# show interfaces transparent10/0/0
→ Transparent10/0/0 is up, line protocol is up
   Encapsulation: GigabitEthernet
   Signal monitoring: on
   Time of last "monitor" state change 14:36:48
   Time of last "encapsulation" change 14:36:48
   Forward laser control: Off
   Configured threshold Group: None
   Code violation and running disparity error count(cvrd): 0
   Number of times SF threshold exceeded: 0
   Number of times SD threshold exceeded: 0
   Loopback set
   Last clearing of "show interface" counters 14:36:48
   Hardware is transparent
Node1#
```

Loopback should appear as set in the **show interfaces transparent** display.

From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.


**Note**

Before continuing with the next loopback test, disable loopback on the transparent interface using the **no loopback** command.

- Step 5** From node 2, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection.

```
Node2(config)# interface wave10/0
Node2(config-if)# loopback
Node2(config-if)# end
Node2#
```

Confirm the loopback configuration using the **show interfaces wave** command.

```
Node2# show interfaces wave 10/0
Wave10/0 is up, line protocol is up
   Channel: 25   Frequency: 195.1 Thz   Wavelength: 1536.61 nm
   Active Wavepatch : Wavepatch10/0/0
   Splitter Protected: No
   Receiver power level: -6.0 dBm
   Forward laser control: Off
   Laser safety control: Off
   Osc physical port: No
   Wavelength used for inband management: No
```

```

→ Configured threshold Group: None
   Loopback set
   Last clearing of "show interface" counters never
   Hardware is data_only_port
Node2#

```

Loopback should appear as set in the **show interfaces wave** display.

From the client connection through node 1 to node 2, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 2 is working.

From the client equipment connected to node 2, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 2 at both ends.

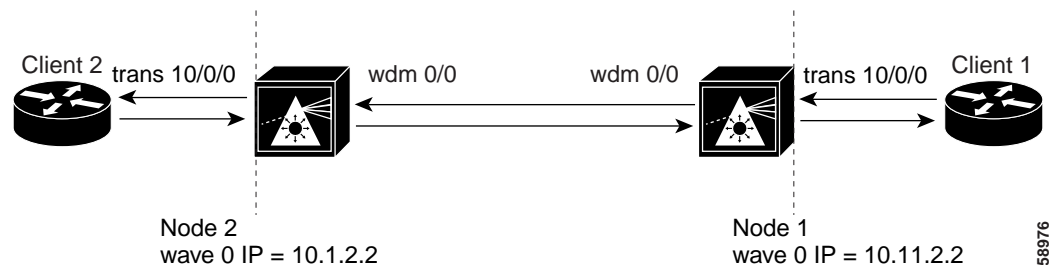
## Troubleshooting Unprotected Point-to-Point Topology

Figure 5-2 shows an unprotected topology with two nodes. Both nodes use channels 1-32 and use the following:

- Transparent interfaces 2/0/0 through 11/3/0 on west line card motherboards
- Mux/demux module wdm 0/0 out to the west

To troubleshoot a point-to-point configuration with only user level protection, you must visually check for irregular connections and component LEDs, check for system alarms or error messages, use the trial-and-error method, or replace components until you solve the problem.

**Figure 5-2** Point-to-Point Configuration Without Protection



For an example configuration of an unprotected point-to-point topology, see the *Cisco ONS 15540 ESP Planning Guide*.

To troubleshoot the configuration and status of point-to-point unprotected topology, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.

Command	Purpose
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Use the following steps to troubleshoot a point-to-point unprotected topology between two end user clients:

- 
- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment.
- The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the connection status of the trunk side laser on the transponder.
- The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the neighboring node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.
- Step 3** From node 1, use the **ping** command and the IP address of the node 2 wave 0 OSC interface. The following **ping** command tests the connection between the processor on node 1, through the OSC wave 0 interface, to the processor on node 2.
- Using the **ping** command between the nodes over the OSC interface proves the connection between the two nodes has not failed. It does not prove that the individual channel connections have not been misconfigured or one of the patch connections or components has not failed.
- For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.
- If these three steps have not found the failed connection between the nodes, continue with the following more disruptive connection loopback troubleshooting steps.



#### Caution

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.

- Step 4** From node 1, configure the transparent interface connected to the client equipment as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).
- Confirm the loopback configuration using the **show interfaces transparent** command. Loopback should appear as set in the **show interfaces transparent** display.
- From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.



#### Note

Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.

- Step 5** From node 2, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces wave** command. Loopback should appear as set in the **show interfaces wave** display.

From the client connection through node 1 to node 2, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 2 is working.

- Step 6** From the client equipment connected to node 1, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 2 at both ends.

## Troubleshooting Point-to-Point Topology with Splitter Protection

Figure 5-3 shows a splitter protected topology with two nodes. Both nodes use channels 1-32 and use the following:

- Transparent interfaces 2/0/0 through 11/3/0 on splitter protected line card motherboards
- Mux/demux module wdm 0/0 patched to wdm 0/0 out to the west
- Mux/demux module wdm 1/0 patched to wdm 1/0 out to the east

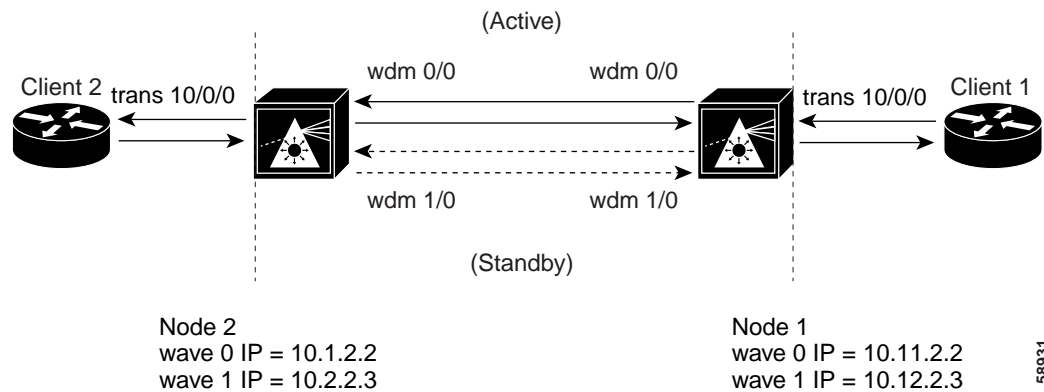


### Note

For splitter protected connections, alarms are only generated for the active side of the connection. Failures on the standby connection do not generate alarms.

For an example configuration of a splitter protected point-to-point topology, refer to the *Cisco ONS 15540 ESP Planning Guide*.

**Figure 5-3** Point-to-Point Connection with Splitter Protection



To troubleshoot the configuration and status of the point-to-point connection with splitter protection, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these general steps to troubleshoot an optical fiber network connection between two end user clients on a splitter protected point-to-point topology:


- 
- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment.
- The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the status of the trunk side laser on the transponder.
- The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the next optical fiber node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.
- Step 3** From node 1, use the **ping** command and the IP address of the node 2 wave 0 OSC interface. The following **ping** command tests the connection between the processor on node 1, through the OSC wave 0 interface (west), to the processor on node 2.
- If the connection fails, it could indicate a fiber failure in the west direction from node 1.
- Step 4** From node 1, use the **ping** command and the IP address of the node 2, wave 1 OSC interface. The following **ping** command tests the connection between the processor on node 1, through the OSC wave 1 interface (east), to the processor on node 2.
- The **ping** commands between the nodes proves the optical fiber connection between node 1 and node 2 in the west direction has failed and the standby connection in the east direction is working. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.
- For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.
- If these four steps have not found the failed connection between nodes, continue with the following more disruptive connection loopback troubleshooting steps.



#### Caution

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.



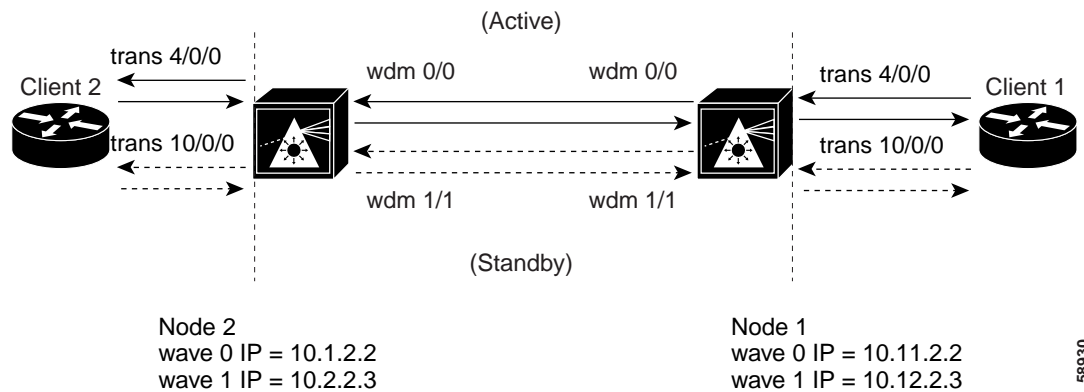
- Step 5** From node 1, configure the transparent interface between the Cisco ONS 15540 and the client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).
- Confirm the loopback configuration using the **show interfaces transparent** command. The field Loopback set should appear in the **show interfaces transparent** display.
- From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.
- 
-  **Note** Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.
- 
- Step 6** From node 2, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).
- Confirm the loopback configuration using the **show interfaces wave** command.
- The field Loopback set should appear in the **show interfaces wave** display.
- From the client connection through node 1 to node 2, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 2 is working.
- Step 7** From the client equipment connected to node 1, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 2 at both ends.
- 

## Troubleshooting Point-to-Point Topology with Line Card Protection

[Figure 5-4](#) shows a line card protected topology with two nodes. Both nodes use channels 1-16 and use the following:

- Transparent interfaces 2/0/0 through 5/3/0 (active) on a west line card motherboard
- Transparent interfaces 8/0/0 through 11/3/0 (standby) on an east line card motherboard
- Mux/demux module wdm 0/0 out to the west
- Mux/demux module wdm 1/2 out to the east

Figure 5-4 Point-to-Point Network with Line Card Protection



For an example configuration of a line card protected point-to-point topology, refer to the *Cisco ONS 15540 ESP Planning Guide*.

To troubleshoot the configuration and status of the point-to-point connection with line card protection, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC Wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these general steps to troubleshoot point-to-point connections with line card protection between two end user clients:

- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment.

The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the connection status between the laser on the transponder all the way to the next Cisco ONS 15540 node.

The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the neighboring node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.
- Step 3** From node 1, use the **ping** command and the IP address of the node 2 wave 0 OSC channel interface. If the connection fails, as in the previous example, this could indicate a fiber failure in the west direction from node 1.

**Step 4** From node 1, use the **ping** command and the IP address of the node 2, wave 1 OSC channel interface. The **ping** commands between the nodes proves the optical fiber connection between node 1 and node 2 in the west direction has failed and the standby connection in the east direction is working. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.

For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

If these four steps have not found the failed connection between the nodes, continue with the following more disruptive connection loopback troubleshooting steps.



#### Caution

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.

**Step 5** From node 1, configure the transparent interface between the Cisco ONS 15540 and the client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces transparent** command.

The field Loopback set should appear in the **show interfaces transparent** display.

From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.



#### Note

Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.

**Step 6** From node 2, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces wave** command. The field Loopback set should appear in the **show interfaces wave** display.

From the client connection through node 1 to node 2, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 2 is working.

**Step 7** From the client equipment connected to node 1, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 2 at both ends.

## Troubleshooting Hubbed Ring Topology with Splitter Protection

[Figure 5-5](#) shows a network configured as a hubbed ring with splitter protection.

When a failure occurs between two nodes in a ring network, for example the failure between nodes 4 and 5 shown in [Figure 5-5](#), alarms may appear on connections all around the network. For example, a “loss of signal” alarm may appear on the functioning connection between nodes 1 and 5 and a “loss of light” alarm may appear on the failed connection between nodes 4 and 5.



**Note**

For splitter protected connections, alarms are only generated for the active side of the connection. Failures on the standby connection do not generate alarms.

For an example configuration of a splitter protected hubbed ring topology, refer to the *Cisco ONS 15540 ESP Planning Guide*.

**Figure 5-5 Hubbed Ring Network with Splitter Protection**

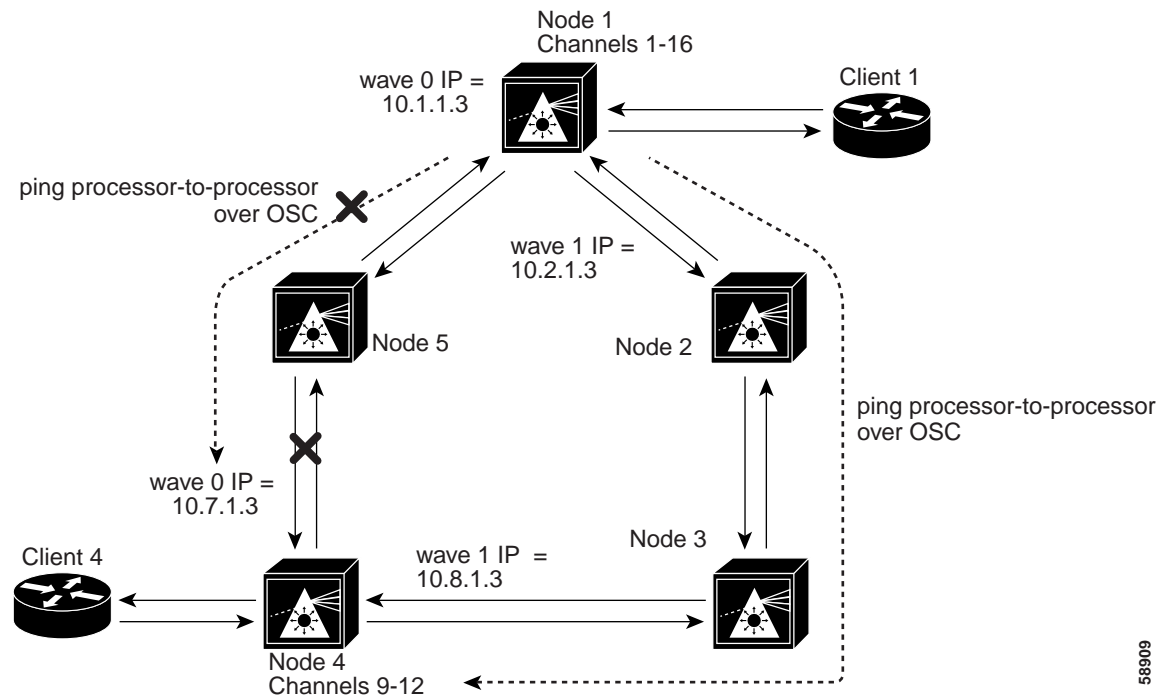


Figure 5-5 shows a splitter protected hubbed ring topology with five nodes. Node 1 and node 4 are configured as follows:

- Node 1—Channels 9-12 use the following:
  - Transparent interfaces 8/0/0 through 8/3/0 on a splitter protected line card motherboard
  - Mux/demux module wdm 0/0 out to the west
  - Mux/demux module wdm 1/0 out to the east
- Node 4—Channels 9-12 use the following:
  - Transparent interfaces 8/0/0 through 8/3/0 on a splitter protected line card motherboard
  - Mux/demux module wdm 0/2 out to the west
  - Mux/demux module wdm 1/2 out to the east

To troubleshoot the configuration and status of the optical connections in the hubbed ring with splitter protection, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these steps to troubleshoot a splitter protected hubbed ring connection between two end user clients, shown in [Figure 5-8](#):

- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment connection.
- The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the status of the trunk side laser on the transponder.
- The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the next optical fiber node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.
- Step 3** From node 1, use the **ping** command and the IP address of the node 4 wave 0 OSC interface (west).
- If the connection fails, as in the previous example, this could indicate a fiber failure in the west direction from node 1.
- Step 4** From node 1, use the **ping** command and the IP address of the node 4, wave 1 OSC interface (east). The **ping** commands between the nodes proves the optical fiber connection between node 1 and node 4 in the west direction has failed and the standby connection in the east direction is working. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.
- To determine which connections has failed, the connection between node 1 and node 5 or the connection between node 5 and node 4, use the same process to ping the processors over the OSC interface. This confirms the failure is a component of those two nodes or a cable in between node 5 and node 4.
- For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.
- If these four steps have not found the failed connection between nodes continue with the following more disruptive connection loopback troubleshooting steps.



#### Caution

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.

- Step 5** From node 1, configure the transparent interface between the Cisco ONS 15540 and the client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces transparent** command.

The field Loopback set should appear in the **show interfaces transparent** display.

From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.



**Note**

Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.

**Step 6**

From node 4, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces wave** command. The field Loopback set should appear in the **show interfaces wave** display.

From the client connection through node 1 to node 4, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 4 is working.

**Step 7**

From the client equipment connected to node 4, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 2 at both ends.

## Troubleshooting Hubbed Ring Topology with Line Card Protection

[Figure 5-6](#) shows a network configured as a hubbed ring with line card protection.

When a failure occurs between two nodes in a ring network, for example the failure between nodes 4 and 5 shown in [Figure 5-6](#), alarms may appear on connections all around the network. For example, a “loss of signal” alarm may appear on the functioning connection between nodes 1 and 5 and a “loss of light” alarm may appear on the failed connection between nodes 4 and 5.

For an example configuration of a line card protected hubbed ring topology, refer to the *Cisco ONS 15540 ESP Planning Guide*.

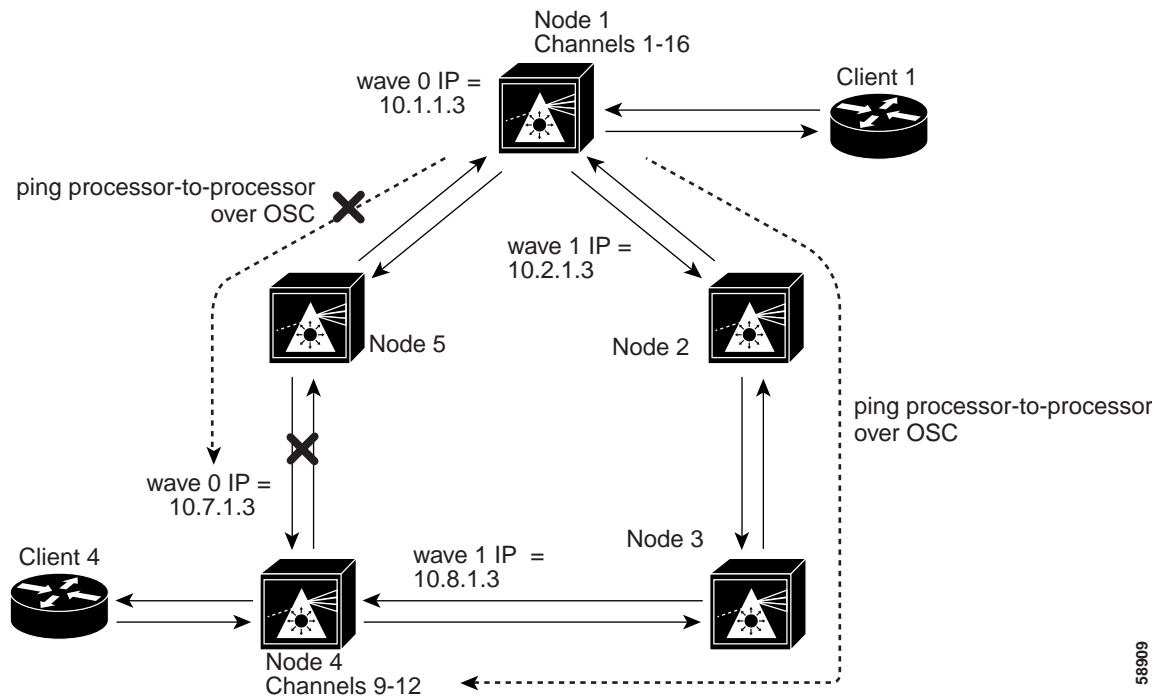
**Figure 5-6** Hubbed Ring Network with Line Card Protection

Figure 5-6 shows a line card protected hubbed ring topology with five nodes. Node 1 and node 4 are configured as follows:

- Node 1—Channels 9-12 use the following:
  - Transparent interfaces 4/0/0 through 4/3/0 (active) on a west line card motherboard
  - Transparent interfaces 10/0/0 through 10/3/0 (standby) on an east line card motherboard
  - Mux/demux module wdm 0/0 out to the west
  - Mux/demux module wdm 1/1 out to the east
- Node 4—Channels 9-12 use the following:
  - Transparent interfaces 8/0/0 through 8/3/0 (active) on a west line card motherboard
  - Transparent interfaces 10/0/0 through 10/3/0 (standby) on an east line card motherboard
  - Mux/demux module wdm 0/2 out to the west
  - mux/demux module wdm 1/3 out to the east

For a detailed description of this configuration, refer to the *Cisco ONS 15540 ESP Planning Guide*.

The following steps describe the troubleshooting process needed to find the failed connection between node 4 and node 5 in Figure 5-6. This failure causes the active connection between nodes 1 and 4, through node 5, to automatically switch to the standby connection through nodes 2 and 3.

To troubleshoot the configuration and status of the optical connections in the hubbed ring with line card protection, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these general steps to troubleshoot an optical fiber network connection between two end user clients in a hubbed ring network with line card protection.

- 
- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interfaces on the Cisco ONS 15540 and the client equipment connection.
- The **show interfaces transparent** command confirms whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the status of the trunk side laser on the transponder.
- The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the next optical fiber node is up.
- Step 3** From node 1, use the **ping** command and the IP address of the node 4 wave 0 OSC interface. This tests the connection between the processor on node 1, through the OSC wave 0 interface (west), to the processor on node 4.
- If the connection fails, this indicates a fiber failure in the west direction from node 1.
- Step 4** From node 1, use the **ping** command and the IP address of the node 4, wave 1 OSC interface. This tests the connection between the processor on node 1, through the OSC wave 1 interface (east), to the processor on node 4.
- The **ping** commands between the nodes proves the optical fiber connection between node 1 and node 4 in the west direction has failed and the standby connection in the east direction is working. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.
- To determine which connections have failed, the connection between node 1 and node 5 or the connection between node 5 and node 4, use the same process to ping the processors over the OSC interface. In this example, using the **ping** command to test the connection between node 1 and node 5 will work but the test from node 5 to node 4 will fail. This confirms the failure is a component of those two nodes or a cable in between node 5 and node 4.
- If these four steps have not found the failed connection between nodes, continue with the following more disruptive connection loopback troubleshooting steps.



#### Caution

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.



- Step 5** From node 1, configure the transparent interface between the Cisco ONS 15540 and the client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).
- Confirm the loopback configuration using the **show interfaces transparent** command.
- The field Loopback set should appear in the **show interfaces transparent** display.
- From the client connected to node 1, confirm the connection to the client is looped back. This proves the connection from the client to the transparent interface on node 1 is working.

**Note**

Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.

- Step 6** From node 4, configure the wave interface between the Cisco ONS 15540 and the far-end client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).
- Confirm the loopback configuration using the **show interfaces wave** command.
- The field Loopback set should appear in the **show interfaces wave** display.
- From the client connection through node 1 to node 4, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 4 is working.
- If the wave loopback test of node 4 fails on *all* channels 9-12 that could indicate one of the following failures:
- The DWDM mux/demux installed in node 4, slot 0/2, failed.
  - The fiber optic connection to the west between nodes 4 and 5 failed.
  - The line card motherboard failed.

If the wave loopback test of node 4 fails on only *one* channel, for example channel 12, that could indicate the client connection to the transponder module for channel 12 has failed or the transponder has failed.

**Note**

Failure of the transponder module should have been found using the **show transparent** interface command.

From the client equipment connected to node 4, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 4 at both ends.

## Troubleshooting Meshed Ring Topology with Splitter Protection

This section describes troubleshooting meshed ring network with splitter protection. A meshed ring is a physical ring that has the logical characteristics of a mesh. While traffic travels on a physical ring, the logical connections between individual nodes are meshed.

[Figure 5-7](#) shows a network configured as a meshed ring with splitter protection.

When a failure occurs between two nodes in a ring network, for example the failure between nodes 3 and 4 shown in [Figure 5-7](#), alarms may appear on connections all around the network. For example, a “loss of signal” alarm may appear on the functioning connection between nodes 1 and 4 and a “loss of light” alarm may appear on the failed connection between nodes 3 and 4.



**Note**

For splitter protected connections, alarms are only generated for the active side of the connection. Failures on the standby connection do not generate alarms.

For an example configuration of a splitter protected meshed ring topology, refer to the *Cisco ONS 15540 ESP Planning Guide*.

**Figure 5-7** *Meshed Ring Network with Splitter Protection*

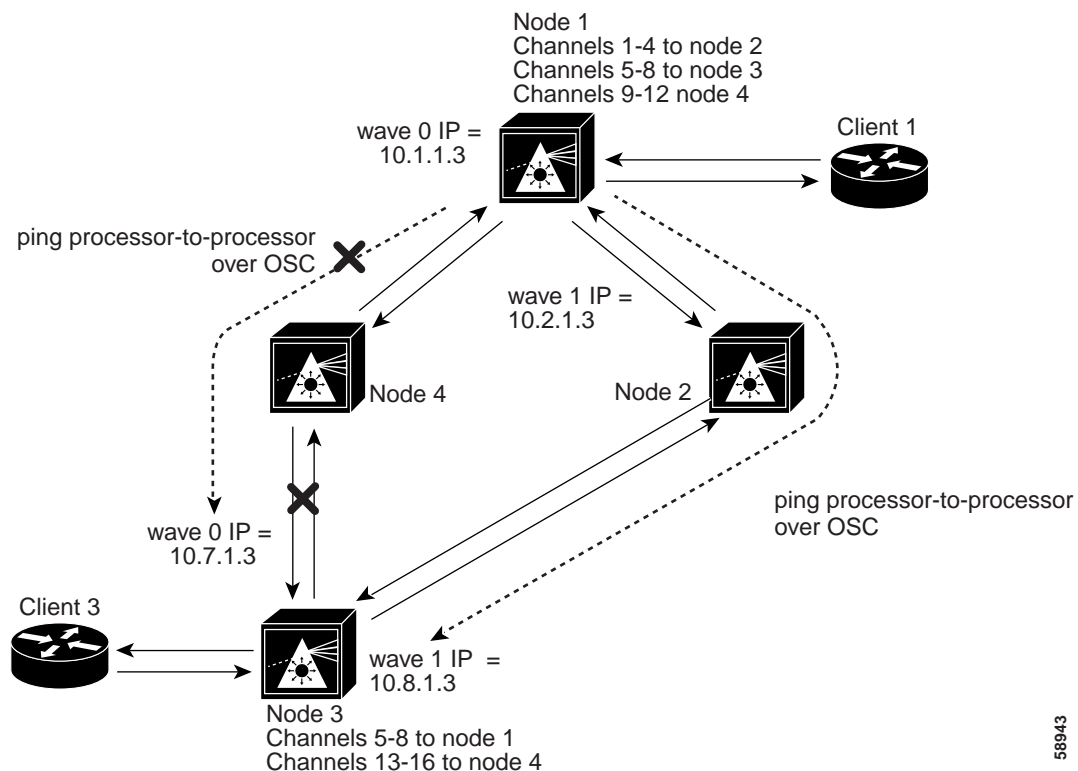


Figure 5-7 shows a splitter protected meshed ring topology with four nodes. Node 1 and node 3 are configured as follows:

- Node 1—Channels 5-8 use the following:
  - Transparent interfaces 5/0/0 through 5/3/0 on a splitter protected line card motherboard
  - Mux/demux module wdm 0/1 patched to wdm 0/0 out to the west
  - Mux/demux module wdm 1/1 patched to wdm 1/2 out to the east
- Node 3—Channels 5-8 use the following:
  - Transparent interfaces 5/0/0 through 5/3/0 on a splitter line card motherboard
  - Mux/demux module wdm 0/1 out to the west
  - mux/demux module wdm 1/1 out to the east

For an example of configuring a splitter protected meshed ring topology, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.

To troubleshoot the configuration and status of the optical connections in the meshed ring with splitter protection, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these steps to troubleshoot a meshed ring topology with splitter protection between two end user clients:

- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment connection.
- The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the connection status between the laser on the transponder all the way to the next Cisco ONS 15540 node.
- The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the next optical fiber node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.
- Step 3** From node 1, use the **ping** command and the IP address of the node 3 wave 0 OSC interface. This tests the connection between the processor on node 1, through the OSC wave 0 interface (west), to the processor on node 3.
- If the connection fails, as in the previous example, this could indicate a fiber failure in the west direction from node 1.
- Step 4** From node 1, use the **ping** command and the IP address of the node 3, wave 1 OSC interface. This tests the connection between the processor on node 1, through the OSC wave 1 interface (east), to the processor on node 3.
- The **ping** commands between the nodes proves the optical fiber connection between node 1 and node 3 in the west direction has failed and the standby connection in the east direction is working. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.
- To determine which connection has failed, the connection between node 1 and node 4 or the connection between node 4 and node 3, use the same process to ping the processors over the OSC interface. In this example, using the **ping** command to test the connection between node 1 and node 4 will work but the test from node 4 to node 3 will fail. This confirms the failure is a component of those two nodes or a cable in between node 4 and node 3.
- For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.
- If these four steps have not found the failed connection between nodes, continue with the following more disruptive connection loopback troubleshooting steps.

**Caution**

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.

**Step 5**

From node 1, configure the transparent interface between the Cisco ONS 15540 and the client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces transparent** command. The field Loopback set should appear in the **show interfaces transparent** display.

From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.

**Note**

Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.

**Step 6**

From node 3, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces wave** command.

The field Loopback set should appear in the **show interfaces wave** display.

From the client connection through node 1 to node 3, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 3 is working.

**Step 7**

From the client equipment connected to node 3, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 3 at both ends.

## Troubleshooting Meshed Ring Topology with Line Card Protection

This section describes troubleshooting a connection over a meshed ring network with line card protection.

[Figure 5-8](#) shows a network configured as a meshed ring with line card protection.

When a failure occurs between two nodes in a ring network, for example the failure between nodes 3 and 4 shown in [Figure 5-8](#), alarms may appear on connections all around the network. For example, a “loss of signal” alarm may appear on the functioning connection between nodes 1 and 4 and a “loss of light” alarm may appear on the failed connection between nodes 3 and 4.

For an example configuration of a line card protected meshed ring topology, refer to the *Cisco ONS 15540 ESP Planning Guide*.

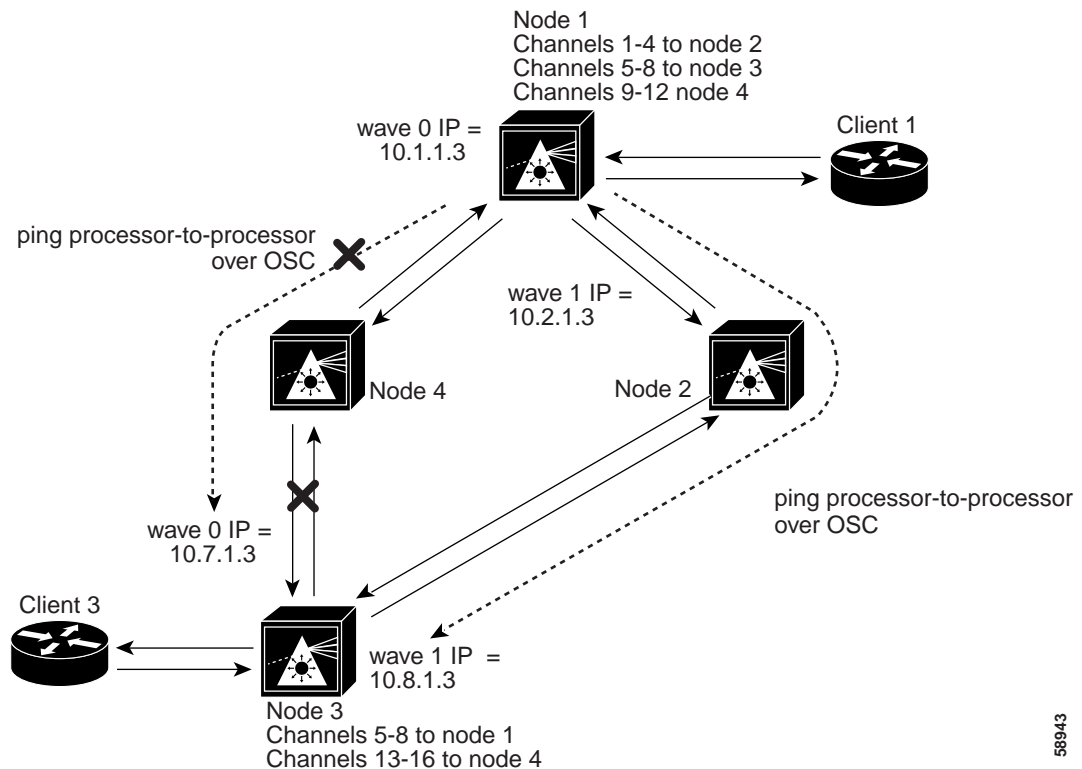
**Figure 5-8** Meshed Ring Network with Line Card Protection

Figure 5-8 shows a line card protected meshed ring topology with four nodes. Node 1 and node 3 are configured as follows:

- Node 1—Channels 5-8 use the following:
  - Transparent interfaces 3/0/0 through 3/3/0 (active) on a west line card motherboard
  - Transparent interfaces 5/0/0 through 5/3/0 (standby) on an east line card motherboard
  - Mux/demux module wdm 0/1 patched to wdm 0/0 out to the west
  - Mux/demux module wdm 1/0 patched to wdm 1/3 out to the east
- Node 3—Channels 5-8 use the following:
  - Transparent interfaces 3/0/0 through 3/3/0 (active) on a west line card motherboard
  - Transparent interfaces 5/0/0 through 5/3/0 (standby) on an east line card motherboard
  - Mux/demux module wdm 0/1 patched to wdm 0/3 out to the west
  - Mux/demux module wdm 1/0 patched to wdm 1/2 out to the east

For a detailed description of this configuration, refer to the *Cisco ONS 15540 ESP Planning Guide*.

To troubleshoot the configuration and status of the optical connections in the meshed ring with line card protection, use the following EXEC commands:

Command	Purpose
<b>show interfaces transparent</b> <i>slot/subcard/0</i>	Shows the status of the physical interfaces between the Cisco ONS 15540 and the clients.
<b>show interfaces wave</b> <i>slot/subcard</i>	Displays the status and configuration of the wave interface between Cisco ONS 15540 systems.
<b>ping</b> { <i>ip-address</i>   <i>hostname</i> }	Confirms the connection between OSC wave interfaces and the system fiber connections.
<b>[no] loopback</b>	Enables and disables loopback on the interface.

Follow these steps to troubleshoot a line card protected meshed ring optical fiber network connection between two end user clients:

- 
- Step 1** From node 1, use the **show interfaces transparent** command to display the connection between the transparent interface on the Cisco ONS 15540 and the client equipment connection.
- The **show interfaces transparent** command indicates whether the connection between the Cisco ONS 15540 and the client equipment is up. See the [“Troubleshooting Client Side Transparent Interfaces” section on page 3-1](#) for information about the fields in this display.
- Step 2** From node 1, use the **show interfaces wave** command to display the connection status between the laser on the transponder all the way to the next Cisco ONS 15540 node.
- The **show interfaces wave** command indicates whether the connection between the Cisco ONS 15540 and the next optical fiber node is up. See the [Chapter 4, “Troubleshooting Trunk Side Interfaces,”](#) for information about the fields in this display.
- Step 3** From node 1, use the **ping** command and the IP address of the node 3 wave 0 OSC interface. This tests the connection between the processor on node 1, through the OSC wave 0 interface (west), to the processor on node 3.
- If the connection fails, as in the previous example, this could indicate a fiber failure in the west direction from node 1.
- Step 4** From node 1, use the **ping** command and the IP address of the node 3, wave 1 OSC interface. This tests the connection between the processor on node 1, through the OSC wave 1 interface (east), to the processor on node 3.
- The **ping** commands between the nodes proves the optical fiber connection between node 1 and node 4 in the west direction has failed and the standby connection in the east direction is working. It does not indicate if the individual channel connections have been misconfigured or one of the patch connections or components has failed.
- To determine which connection has failed, the connection between node 1 and node 4 or the connection between node 4 and node 3, use the same process to ping the processors over the OSC interface. In this example, using the **ping** command to test the connection between node 1 and node 4 will work but the test from node 4 to node 3 will fail. This confirms the failure is a component of those two nodes or a cable between node 4 and node 3.
- For IP address configuration instructions for the OSC channel interface, refer to the *Cisco ONS 15540 ESP Configuration Guide and Command Reference*.
- If these four steps have not found the failed connection between nodes, continue with the following more disruptive connection loopback troubleshooting steps.

**Caution**

The following troubleshooting steps for the individual channels and components of the Cisco ONS 15540 are disruptive to the client connections and can only be completed with login access to the client end-station equipment connected to the Cisco ONS 15540.

**Step 5**

From node 1, configure the transparent interface between the Cisco ONS 15540 and the client as a loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

The field Loopback set should appear in the **show interfaces transparent** display.

From the client equipment connected to node 1, confirm the connection to the client appears as looped back. This proves the connection from the client to the transparent interface on node 1 is working.

**Note**

Before continuing with the next loopback test, disable loopback on the transparent interface connected to the near end client.

**Step 6**

From node 3, configure the wave interface between the Cisco ONS 15540 and the far-end client loopback connection using the instructions in the [“Checking Connectivity” section on page 5-1](#).

Confirm the loopback configuration using the **show interfaces wave** command.

The field Loopback set should appear in the **show interfaces wave** display.

From the client connection through node 1 to node 3, confirm the connection to the client is looped back. This proves the connection from the client to the wave interface on node 3 is working.

**Step 7**

From the client equipment connected to node 3, configure a loopback connection through the entire network end-to-end. This confirms the connection between the clients connected to node 1 and node 3 at both ends.

