# Cisco NCS 1010 Optical Applications Configuration Guide, IOS XR Release 25.x.x

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CHAPTER 1

# NCS 1010 Overview



## NCS 1010 Optical Line System

Cisco NCS 1010 is a next-generation OLS optimized for ZR and ZR+ WDM router interfaces.

The salient features of NCS 1010 are:

- Provides point-to-point connectivity between routers with WDM interfaces.
- Multiplexes the signals received from multiple routers over a single fiber.
- With one MPO port, it can be scaled to 8 Degree.
- Caters to C-band WDM transmission to maximize capacity, and can be enhanced to C+L combined band in the future.

Cisco NCS 1010 is a 3RU chassis that has an in-built External Interface Timing Unit (EITU) and the following field-replaceable modules.

- Controller
- Two power supply units
- Two fan trays
- Fan filter
- Line card

For more information about the line cards and passive modules supported on NCS 1010, see Cisco NCS 1010 Optical Line System.

CHAPTER 2

# Topology Discovery and Communication



## Topology discovery and communication using OSPF in NCS 1010 nodes

NCS 1010 nodes and their optical applications rely on OSPF (Open Shortest Path First) protocol to automatically discover and share network topology information. An enhanced version of OSPF is implemented to support the unique requirements of optical networks deployed on NCS 1010. This reference summarizes the key attributes and mechanisms of OSPF-based topology discovery and communication in this context.

#### Topology discovery

Optical applications on the NCS 1010 must identify both OLT-OLT link topology and adjacent nodes at the span-level. Link-level applications require a comprehensive view of the OLT-OLT link topology.

#### OSPF usage

NCS 1010 devices use OSPF to detect changes in topology, flood link-state updates to neighboring routers, and rapidly converge on an accurate network map. Each OSPF-enabled device updates its internal topology view in response to changes.

#### Enhanced OSPF

The version of OSPF used on NCS 1010 supports a new link-state advertisement attribute. This attribute advertises node type and optical spectral band, ensuring that applications can recognize node roles and the bands on which they operate.

These OSPF enhancements enable NCS 1010 nodes and their applications to maintain an up-to-date, detailed understanding of both optical connectivity and spectral allocation in the deployed network.

### Configure OSPF on an NCS 1010 node

Use this task to include NCS 1010 in OSPF-enabled networks.

**Important** You must configure the router ID during OSPF configuration on NCS 1010 nodes.

See Implementing OSPF for description of the concepts and tasks necessary to implement OSPF on Cisco IOS XR.

### Procedure

**Step 1** Use these commands to configure OSPF on an NCS 1010 OLT node.

**Example:**

```
configure
router ospf process-name
router-id router-id
distribute link-state
nsf
network point-to-point
redistribute connected
area area-id
interface Loopback1
interface GigabitEthernet0/0/0/0
```

**Step 2** Use these commands to configure OSPF on an NCS 1010 ILA node.

**Example:**

```
configure
router ospf process-name
router-id router-id
distribute link-state
nsf
network point-to-point
redistribute connected
area area-id
interface Loopback1
interface GigabitEthernet0/0/0/0
interface GigabitEthernet0/0/0/2
```

NCS 1010 nodes will participate in OSPF routing, which enables inter-node topology discovery and communication.

# Configure OSPF cost

Use this task to identify the best route when there are two equal-cost routes to the same destination.

*Table 1: Feature History*

| Feature Name | Release Information | Description |
|---|---|---|
| Configure OSPF cost | Cisco IOS XR Release 7.11.1 | To identify the best route, OSPF path computation uses the link cost. The system calculates the cost based on the available interface bandwidth. From this release onwards, you can set a user-defined cost value using the **cost***variable* in the **router ospf** command. As a result, this feature enables you to set a specific route when there are two equal-cost routes to the same destination. |

Cost is the metric used by OSPF. You can use the **cost** command to explicitly specify the network interface for OSPF path calculation.

**Note** The cost of the link is inversely proportional to the bandwidth of the link.

### Procedure

Use these commands to configure OSPF cost.

**Example:**

```
configure
router ospf process-name
router-id router-id
area area-id
interface Loopback1
interface GigabitEthernet0/0/0/0
cost cost
```

See cost (OSPF) for different command modes and usage guidelines to implement **cost** OSPF on Cisco IOS XR software.

The interface cost used by OSPF for path calculation is explicitly specified.

CHAPTER 3

# Span Loss



## Span loss

A span loss is an optical network measurement that

- determines the signal power loss between two nodes in an optical transmission network,
- compares the power measurements at transmitter (Tx) and receiver (Rx) ports at the near and far ends of a fiber span, and
- automatically raises the *Span Loss Value Out Of Range* alarm when the calculated loss does not fall within configured thresholds.

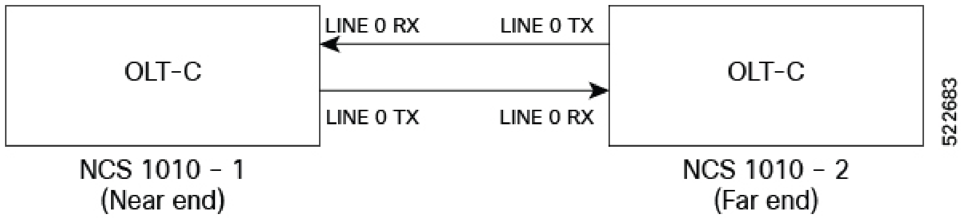
On a Raman span with Raman tuning enabled, span loss verification reports these values:

- **Span loss with pumps off:** This measurement is the difference in power values between the DFB-Tx/Rx of the remote node and the DFB-Rx/Tx of the local node. This measurement also includes a timestamp. When a Raman span is up, the span loss application latches on to the difference in power between DFB-Tx and DFB-Rx before Raman tuning turns the Raman pumps on.
- **Apparent span loss:** This measurement is based on the power values of C band, L band and Optical Service Channel (OSC). For a Raman span, the span loss application uses this span loss value to raise the *Span Loss Value Out Of Range* alarm.
- **Estimated span loss:** This value is based on Raman gain that is achieved by Raman tuning application. Estimated span loss value is based on Raman gain that is achieved when safety loop was closed and tuning was performed. Raman tuning application reports the Raman gain measurement. When you disable Raman tuning, the span loss application does not compute the Estimated span loss.

  Estimated span loss = Apparent span loss + Raman gain
- **OSC span loss**: This measurement is the difference in OSC power values between the Tx/Rx of the remote node and the Rx/Tx of the local node.
- **Signal span loss**: This measurement is the difference in the received C band signal power values between the Tx/Rx of the remote node and the Rx/Tx of the local node.

Span loss calculations are performed automatically between nodes to continuously monitor the condition of the optical span. The span loss application reports the span loss value for a span every 90 seconds. If span loss changes, for example when a change in fiber loss occurs, the span loss application typically takes 90 seconds to update the span loss.

*Figure 1: Sample two node topology of NCS 1010 nodes*




For example, in the previous figure, the **Tx Span Loss** on NCS 1010-1 is the difference in signal power between LINE 0 TX on NCS 1010-1 and LINE 0 RX on NCS 1010-2.

# View span loss values

Use this task to display span loss measurements between two nodes. This task helps verify optical signal integrity and diagnose network issues.

**Note** Rx span loss values are not available on a network where one NCS 1010 node is upgraded to R25.3.1 while other nodes are on an earlier software version.

From Release 24.1.1, span loss measurements include OSC span loss and Signal span loss.

### Procedure

Use the **show olc span-loss** command to view the Tx span loss and Rx span loss.

**Example:**

This sample shows the Tx span loss and Rx span loss on a Raman span with Raman tuning enabled.

This sample is applicable for NCS 1010 node until Release 7.11.1.

```
RP/0/RP0/CPU0:ios#show olc span-loss
 Mon Jun 20 04:21:34.543 IST
controller name                           : Ots0/0/0/0
Neighbour RID                             : 10.1.1.2
Apparent Rx Span Loss                     : 7.7 dB
Rx Span Loss (with pumps off)             : 23.2 dB
Rx Span Loss (with pumps off) measured at : 2022-04-11 07:42:26
Estimated Rx Span Loss                    : 23.5 dB
Apparent Tx Span Loss                     : 17.5 dB
Tx Span Loss (with pumps off)             : 33.3 dB
Tx Span Loss (with pumps off) measured at : 2022-04-11 07:42:56
Estimated Tx Span Loss                    : 33.5 dB
```

This is a sample output that includes OSC span loss and Signal span loss measurements.

```
RP/0/RP0/CPU0:ios#show olc span-loss
Sat Nov  2 00:38:53.498 IST
```

```
Controller                                : Ots0/0/0/0
Neighbour RID                             : 25.1.1.4
Apparent Rx Span Loss                     : 6.88 dB
Apparent Rx OSC Span Loss                 : 12.65 dB
Apparent Rx Signal Span Loss              : 6.82 dB
Rx Span Loss (with pumps off)             : 18.80 dB
Rx Span Loss (with pumps off) measured at : 2024-10-29 20:19:28
Estimated Rx Span Loss                    : 20.08 dB
Apparent Tx Span Loss                     : 8.84 dB
Apparent Tx OSC Span Loss                 : 15.20 dB
Apparent Tx Signal Span Loss              : 8.78 dB
Tx Span Loss (with pumps off)             : 23.50 dB
Tx Span Loss (with pumps off) measured at : 2024-10-29 20:19:36
Estimated Tx Span Loss                    : 24.74 dB
```

This sample shows the output of the **show olc span-loss** command on a Raman span with Raman tuning disabled. In this sample output, Raman tuning is disabled on both Ots0/0/0/0 and Ots0/0/0/2 on the near end node. The far end nodes have Raman tuning enabled.

This sample is applicable for NCS 1010 node until Release 7.11.1.

```
RP/0/RP0/CPU0:ios#show olc span-loss
Mon Jun 20 06:51:58.601 UTC

Controller name                           : Ots0/0/0/0
Neighbour RID                             : 10.1.1.5
Apparent Rx Span Loss                     : 16.3 dB
Rx Span Loss (with pumps off)             : 16.4 dB
Rx Span Loss (with pumps off) measured at : 2022-06-20 05:53:52
Estimated Rx Span Loss                    : NA
Apparent Tx Span Loss                     : 5.8 dB
Tx Span Loss (with pumps off)             : 21.6 dB
Tx Span Loss (with pumps off) measured at : 2022-06-20 05:54:08
Estimated Tx Span Loss                    : 18.6 dB


Controller name                           : Ots0/0/0/2
Neighbour RID                             : 10.1.1.3
Apparent Rx Span Loss                     : 27.1 dB
Rx Span Loss (with pumps off)             : 30.3 dB
Rx Span Loss (with pumps off) measured at : 2022-06-20 06:51:22
Estimated Rx Span Loss                    : NA
Apparent Tx Span Loss                     : 6.4 dB
Tx Span Loss (with pumps off)             : 19.2 dB
Tx Span Loss (with pumps off) measured at : 2022-06-20 05:54:08
Estimated Tx Span Loss                    : 19.6 dB
```

This is a sample output that includes OSC span loss and Signal span loss measurements.

```
RP/0/RP0/CPU0:ios#show olc span-loss
Mon Sep  9 17:14:26.149 IST

Controller                                : Ots0/0/0/0
Neighbour RID                             : 24.1.1.2
Apparent Rx Span Loss                     : 23.9 dB
Apparent Rx OSC Span Loss                 : 26.8 dB
Apparent Rx Signal Span Loss              : 23.9 dB
Rx Span Loss (with pumps off)             : 23.8 dB
Rx Span Loss (with pumps off) measured at : 2024-09-06 19:01:50
Estimated Rx Span Loss                    : NA
Apparent Tx Span Loss                     : 24.7 dB
Apparent Tx OSC Span Loss                 : 27.9 dB
Apparent Tx Signal Span Loss              : 24.7 dB
Tx Span Loss (with pumps off)             : 24.4 dB
```

```
Tx Span Loss (with pumps off) measured at : 2024-09-06 15:57:12
Estimated Tx Span Loss                    : NA
```

This sample shows the output of the **show olc span-loss** command on a non-Raman span.

This sample is applicable for NCS 1010 node until Release 7.11.1.

```
RP/0/RP0/CPU0:ios#show olc span-loss
Mon Apr 11 09:37:31.950 UTC

Controller name                           : Ots0/0/0/0
Neighbour RID                             : 10.91.1.90
Rx Span Loss                              : 10.2 dB
Rx Span Loss (with pumps off)             : NA
Rx Span Loss (with pumps off) measured at : NA
Estimated Rx Span Loss                    : NA
Tx Span Loss                              : 9.7 dB
Tx Span Loss (with pumps off)             : NA
Tx Span Loss (with pumps off) measured at : NA
Estimated Tx Span Loss                    : NA
```

This is a sample output that includes OSC span loss and Signal span loss measurements.

```
RP/0/RP0/CPU0:ios#show olc span-loss
Tue Nov  5 11:09:06.736 IST

Controller                                : Ots0/0/0/0
Neighbour RID                             : 24.1.1.3
Rx Span Loss                              : 4.56 dB
Rx OSC Span Loss                          : 4.50 dB
Rx Signal Span Loss                       : 4.57 dB
Rx Span Loss (with pumps off)             : NA
Estimated Rx Span Loss                    : NA
Tx Span Loss                              : 6.13 dB
Tx OSC Span Loss                          : 6.54 dB
Tx Signal Span Loss                       : 6.12 dB
Tx Span Loss (with pumps off)             : NA
Estimated Tx Span Loss                    : NA

Controller                                : Ots0/0/0/2
Neighbour RID                             : 24.1.1.5
Rx Span Loss                              : 5.84 dB
Rx OSC Span Loss                          : 6.02 dB
Rx Signal Span Loss                       : 5.84 dB
Rx Span Loss (with pumps off)             : NA
Estimated Rx Span Loss                    : NA
Tx Span Loss                              : 5.65 dB
Tx OSC Span Loss                          : 6.08 dB
Tx Signal Span Loss                       : 5.64 dB
Tx Span Loss (with pumps off)             : NA
Estimated Tx Span Loss                    : NA
```

# Configure span loss thresholds

Use this task to configure the minimum and maximum span loss threshold values for optical spans between nodes.

**Procedure**

**Step 1** Enter the optical applications configuration mode and select the controller on which the span loss thresholds must be configured.

**Example:**

```
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
```

**Step 2** Configure the minimum and maximum span loss threshold values for the span.

**Example:**

```
RP/0/RP0/CPU0:ios(config)#span-loss min 100
RP/0/RP0/CPU0:ios(config)#span-loss max 200
```

This example sets the minimum threshold to 10 dB and maximum threshold to 20 dB.

The system raises a *SPAN-LOSS-OUT-OF-RANGE* alarm if span loss is greater than the maximum threshold or less than the minimum threshold.

**Step 3** Commit the changes and exit all the configuration modes.

**Example:**

```
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

CHAPTER 4

# Raman Tuning

*Table 2: Feature History*

| Feature Name | Release Information | Description |
|---|---|---|
| Raman Tuning Manual Mode | Cisco IOS XR Release 7.11.1 | You can now configure Raman Tuning in manual mode to not initiate tuning automatically. You can initiate tuning manually. This feature gives you the flexibility to initiate tuning and not have Raman Tuning run every time there is a span-up event in the network. |



## Raman tuning

Raman tuning is a process that adjusts the power and wavelength of Raman pump lasers to optimize optical signal amplification over a fiber span.

- Controls Raman pump power and wavelength.
- Targets a specific fiber span to achieve the required Raman gain.
- Optimizes end-to-end signal performance.

### Purpose of Raman tuning

The primary purpose of Raman tuning is to achieve the desired Raman gain across a fiber span while maintaining optimal signal quality.

Raman tuning follows these operational principles:

- Raman tuning is performed independently in both directions of a fiber span.
- Peer nodes communicate to coordinate tuning and achieve the target gain across the span.

When Raman tuning is configured in automatic mode, the NCS 1010 system initiates the tuning process without manual intervention to maintain optimal signal amplification.

#### Conditions that trigger automatic Raman tuning

The NCS 1010 automatically initiates Raman tuning under these conditions:

- After the initial link bring-up.
- After a fiber cut is detected and cleared.
- After a device power cycle.
- After a line card cold reload.
- During a Distributed Feedback (DFB) shut or unshut event.
- After an OTS controller is shut or unshut on the near-end or far-end node.
- After a span length configuration change.
- After high back reflection conditions return to acceptable levels.
- During a span loss check at system startup.

## Raman tuning parameters

This section describes the parameters used by the Raman tuning algorithm to optimize Raman amplifier performance.

The Raman tuning algorithm uses the following parameters to achieve the target signal amplification across an optical fiber span.

- Target Raman gain defines the required level of signal amplification.
- Raman pump power controls the strength of the Raman amplification.
- DFB VOA attenuation fine-tunes the amplified signal to meet gain requirements.

*Table 3: Raman tuning parameters*

| Parameter | Description | Usage |
|---|---|---|
| Target Raman Gain (dB) | It is the desired level of amplification the Raman amplifier aims to achieve. This gain is the increase in optical signal power resulting from Raman scattering when the signal passes through the medium with co-propagating or counter-propagating pump lasers. | The desired Raman gain is typically used for compensating for signal losses in the optical fiber, ensuring signal integrity and strength over long distances. |

| Parameter | Description | Usage |
|---|---|---|
| Raman Pump Powers (mW) | It is the power levels of the Raman pump lasers used in the Raman amplification process.<br><br>Higher pump power results in a higher gain but also increases the risk of fiber damage. | The power from Raman pumps is used to inject laser at specific wavelengths into the fiber, which then interacts with the signal through the Raman scattering effect to amplify it. |
| DFB VOA Attenuation (dB) | It is the attenuation settings of the Variable Optical Attenuator (VOA) used with Distributed Feedback (DFB) lasers.<br><br>DFB lasers provide high-precision, stable-wavelength light emission, commonly used in telecommunications. | DFB VOA attenuation is used to fine-tune the signal power levels to ensure the amplified signal meets the target gain requirements.<br><br>Adjusting the attenuation helps balance the pump power and signal power. |

# Raman tuning modes

This section describes the Raman tuning modes available on the NCS 1010 and how each mode affects tuning behavior.

Use Raman tuning modes to control when Raman tuning runs and which parameters are set automatically.

- Automatic mode starts Raman tuning based on system events and sets key parameters automatically.
- Manual and disable modes provide more operator control over when tuning starts and how parameters are set.

***Table 4: Raman tuning modes***

| Raman tuning modes | Description |
|---|---|
| Enable (Automatic mode) | In this mode, the system automatically initiates Raman tuning when a link goes down and comes back up. Raman tuning calculates and sets the values of the following parameters automatically:<br>• Raman target gain<br>• Raman power<br>• DFB VOA attenuation<br><br>However, this mode also allows you to manually set the target gain, which triggers Raman tuning to adjust pump powers and DFB VOA attenuation values to achieve the target gain.<br><br>For more details about the conditions that trigger Raman tuning automatically, see Raman tuning initiation conditions, on page 16. |

| Raman tuning modes | Description |
|---|---|
| Disable | In this mode, you must manually set the values Raman tuning parameters. After configuring these values, you must manually initiate Raman tuning.<br><br>It may be necessary to manually configure these parameters to troubleshoot network issues or fine-tune the system for improved performance. |
| Manual | In this mode, Raman tuning must be manually initiated when a link goes down and comes back up.<br><br>Once initiated, the system automatically calculates the desired gain and adjusts both pump powers and DFB VOA attenuation to achieve the specified target gain. |

# Raman tuning initiation conditions

This section describes the conditions under which the NCS 1010 automatically initiates Raman tuning.

When Raman tuning is configured in automatic mode, the system initiates tuning after the following events:

- An initial link bring-up.
- A fiber cut and subsequent recovery.
- A device power cycle.
- A line card cold reload.
- A Distributed Feedback (DFB) shut or unshut event.
- An OTS controller shut or unshut event on either the near-end or far-end node.
- A change in the span length configuration.
- Clearance of high back reflection conditions.
- A span loss check during system startup.

# Raman tuning status

This section describes the possible Raman tuning status values and what each status indicates during the tuning process.

The Raman tuning status reflects whether the system is actively tuning, has completed tuning, or cannot perform tuning.

- Working states indicate active measurement, calculation, or optimization.
- Non-working states indicate completion, blockage, or disabled tuning.

*Table 5: Raman tuning status*

| Raman tuning status | Description |
|---|---|
| WORKING—MEASUREMENT | Raman tuning is measuring the span loss on the link. |
| WORKING—CALCULATION | Raman tuning is calculating the gain target and required pump powers. |
| WORKING—OPTIMIZATION | Raman tuning is optimizing the pump powers. |
| TUNED | Raman tuning is complete. |
| BLOCKED | The system cannot perform Raman tuning because the link is down or there is a high Raman back reflection. |
| DISABLED | Raman tuning is disabled. |

# Configure Raman tuning

Use these tasks to configure Raman tuning based on your operational requirements.

- Configure Raman tuning mode, on page 17: Configure Raman tuning to run automatically or require manual initiation.
- Configure Raman tuning parameters manually, on page 18: Disable Raman tuning and manually configure Raman tuning parameters.

## Configure Raman tuning mode

Configure the Raman tuning mode to control how and when Raman tuning runs on the optical span. Use automatic mode to:

- allow the system to trigger Raman tuning automatically.
- start Raman tuning only when you explicitly initiate it.

Raman tuning optimizes signal amplification on an optical span. You can configure the tuning process to run automatically based on system events or manually based on operational requirements.

**Before you begin**

- Ensure that you have access to the device CLI with configuration privileges.
- The optical controller must be available and operational.

Follow these steps to configure Raman tuning mode.

**Procedure**

---

**Step 1** Enter optical line control configuration mode and select the OTS controller.

**Example:**

```
RP/0/RP0/CPU0:ios(config)# optical-line-control
RP/0/RP0/CPU0:ios(config-olc)# controller ots 0/0/0/0
```

**Step 2** Enable Raman tuning in automatic or manual mode.

Use the following command to configure the tuning mode:

**raman-tuning {enable | manual}**

**Step 3** Commit the configuration and exit configuration mode.

**Example:**

```
RP/0/RP0/CPU0:ios(config-olc-ots)# commit
RP/0/RP0/CPU0:ios(config-olc-ots)# exit
RP/0/RP0/CPU0:ios(config-olc)# exit
```

**Step 4** Start Raman tuning if the controller is configured in manual mode.

**Example:**

```
RP/0/RP0/CPU0:ios# olc start-raman-tuning controller ots 0/0/0/0
```

---

Raman tuning is configured in the selected mode.

When automatic mode is enabled, the system triggers Raman tuning automatically. After successful tuning, events such as soft reloads, Route Processor reloads, OSRI configuration changes, or forced Automatic Power Reduction (APR) changes do not retrigger Raman tuning.

### What to do next

Verify Raman tuning status to confirm successful configuration and monitor system logs or controller status for tuning completion.

# Configure Raman tuning parameters manually

Manually configure Raman tuning parameters to troubleshoot network issues or fine-tune system performance.

- Disable automatic Raman tuning.
- Set Raman gain, pump power, and DFB VOA attenuation values.

When Raman tuning is disabled, the system does not automatically calculate or adjust tuning parameters. You must manually configure the required values before initiating Raman tuning.

Use this task when you need full control over Raman tuning behavior. Common use cases include troubleshooting and performance optimization.

**Before you begin**

The OTS controller must be available and operational.

Follow these steps to manually configure Raman tuning parameters.

### Procedure

**Step 1** Enter optical line control configuration mode and select the OTS controller.

**Example:**

```
RP/0/RP0/CPU0:ios(config)# optical-line-control
RP/0/RP0/CPU0:ios(config-olc)# controller ots 0/0/0/0
```

**Step 2** Disable Raman tuning.

Disabling Raman tuning allows you to manually configure tuning parameters.

**Example:**

```
RP/0/RP0/CPU0:ios(config-olc-ots)# raman-tuning disable
```

**Step 3** Configure the Raman tuning parameters.

Set the target gain, pump power, and DFB VOA attenuation values.

**Example:**

```
RP/0/RP0/CPU0:ios(config-olc-ots)# raman-tuning raman-gain-target 180
RP/0/RP0/CPU0:ios(config-olc-ots)# raman-tx-power 1 value 21100
RP/0/RP0/CPU0:ios(config-olc)# controller DFB 0/0/0/0
RP/0/RP0/CPU0:ios(config-Dfb)# tx-voa-attenuation 100
```

**Step 4** Commit the configuration and exit configuration mode.

**Example:**

```
RP/0/RP0/CPU0:ios(config-olc-ots)# commit
RP/0/RP0/CPU0:ios(config-olc-ots)# exit
RP/0/RP0/CPU0:ios(config-olc)# exit
```

**Step 5** Start Raman tuning manually.

This step is required when Raman tuning is disabled or configured in manual mode.

**Example:**

```
RP/0/RP0/CPU0:ios# olc start-raman-tuning controller ots 0/0/0/0
```

Raman tuning runs using the manually configured parameters.

### What to do next

- Verify the Raman tuning status to confirm successful tuning.
- Check the controller status for a **TUNED** state.

# Verify Raman tuning configuration and status

Use the following tasks to verify Raman tuning configuration, review tuning history, and inspect Raman pump values.

- Verify Raman tuning configuration, on page 20: Verify the current Raman tuning status and parameter values.
- View detailed Raman tuning status, on page 21: View detailed Raman tuning status, including failure reasons and historical timestamps.
- View Raman pump values, on page 22: View individual Raman pump values and related safety and configuration parameters.

## Verify Raman tuning configuration

Use this task to verify Raman tuning configuration to confirm the current tuning state and the configured gain-related values.

- Check whether Raman tuning is measuring, calculating, optimizing, tuned, blocked, or disabled.
- View the Raman tuning parameter values reported by the controller.

Raman tuning status indicates the current state of the Raman tuning process. The output also displays key parameter values, such as target gain and achieved gain, and shows conditions that can prevent tuning.

Follow these steps to verify Raman tuning configuration.

### Procedure

Verify Raman tuning status and parameter values.

The entries highlighted in bold show the Raman tuning status and Raman tuning parameter values.

**Example:**

```
/*Verify Raman tuning status if All Controllers*/
RP/0/RP0/CPU0:ios#show olc raman-tuning
Tue Mar 21 06:11:36.944 UTC
Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
```

```
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
```

```
/*Verify Raman tuning status on a specific controller*/
RP/0/RP0/CPU0:ios#show olc raman-tuning controller ots 0/0/0/0
Tue Mar 21 06:13:26.535 UTC
Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
```

For more information about Raman tuning status, see Raman tuning status, on page 16. For information about Raman tuning parameters, see Raman tuning parameters, on page 14.

The system displays the Raman tuning status and the Raman tuning parameter values for all controllers or for the specified controller.

### What to do next

If tuning is blocked or disabled, correct the condition and re-run the verification command.

# View detailed Raman tuning status

View detailed Raman tuning status information to understand the outcome of previous tuning attempts.

- Identify the reason and timestamp of the last Raman tuning failure.
- Review the last successful Raman tuning gain and timestamp.

In addition to the current Raman tuning state, the system maintains historical information about previous tuning attempts. This information helps troubleshoot tuning failures and verify successful tuning history.

Follow these steps to view detailed Raman tuning status.

### Procedure

View the detailed Raman tuning status.

The entries highlighted in bold show the previous Raman tuning failure reason and timestamps.

**Example:**

```
/*View detailed Raman tuning status for all controllers*/
RP/0/RP0/CPU0:ios#show olc raman-tuning details
Tue Mar 21 06:27:13.302 UTC

Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
Last Run Fail Reason : [ Peer node is unreachable ]
Last Run Fail Timestamp : 2023-03-19 12:20:37
```

```
Last Successful Tuning Gain : 15.7 dB
Last Successful Tuning Timestamp : 2023-03-20 07:54:00


/*View detailed Raman tuning status for a specific controller*/
RP/0/RP0/CPU0:ios#show olc raman-tuning details controller ots 0/0/0/0
Tue Mar 21 06:27:58.213 UTC

Controller : Ots0/0/0/0
Raman-Tuning Status : TUNED
Tuning Complete Timestamp : 2023-03-20 07:54:00
Estimated Max Possible Gain : 19.8 dB
Raman Gain Target : 16.0 dB
Gain Achieved on Tuning Complete : 15.7 dB
Last Run Fail Reason : [ Peer node is unreachable ]
Last Run Fail Timestamp : 2023-03-19 12:20:Last Successful Tuning Gain : 15.7 dB
Last Successful Tuning Timestamp : 2023-03-20 07:54:00
```

The system displays detailed Raman tuning status, including failure reasons, timestamps, and successful tuning history.

# View Raman pump values

View individual Raman pump values and related parameter details to verify current pump power, configured pump values, and safety controls.

- Confirm composite Raman power and individual pump measured powers.
- Verify Raman safety control mode, OSRI status, and APR state.
- Compare configured pump values with measured values reported by the controller.

Raman pump values and parameter statistics help you assess amplifier health and safety conditions. The controller reports alarm statistics, measured pump powers, composite power, and the configured pump values. Use this task when troubleshooting Raman-related alarms, validating pump configuration, or confirming safety lock and OSRI status.

Follow these steps to view individual Raman pump values and related parameter details.

### Procedure

Show Raman pump values and parameter details for the OTS controller.

The entries highlighted in bold show the Raman safety/OSRI status, composite power, and the measured pump powers. The configured pump values are shown in the Configured Parameters section.

**Example:**

```
/*View Raman pump values and other parameter details*/
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 raman-info
Fri Apr  1 06:40:33.849 UTC

Alarm Status:
-------------
Detected Alarms: None
```

```
Alarm Statistics:
-----------------
RAMAN-AUTO-POW-RED = 0
RAMAN-1-LOW-POW = 0
RAMAN-2-LOW-POW = 0
RAMAN-3-LOW-POW = 0
RAMAN-4-LOW-POW = 0
RAMAN-5-LOW-POW = 0
RAMAN-1-HIGH-POW = 1
RAMAN-2-HIGH-POW = 0
RAMAN-3-HIGH-POW = 0
RAMAN-4-HIGH-POW = 0
RAMAN-5-HIGH-POW = 0

Parameter Statistics:
---------------------
Raman Safety Control mode = auto
    Raman Osri = OFF
    Raman Force Apr = OFF
    Composite Raman Power = 886.60 mW

RAMAN Pump Info:
    ---------------------
    Instance        Wavelength(nm)  Power(mW)
    1               1424.00                257.60
    2               1438.00                255.10
    3               1457.00                71.60
    4               1470.00                127.50
    5               1495.00                170.10


Configured Parameters:
-------------
Raman Safety Control mode = auto
Raman Osri = OFF
Raman Force Apr = OFF

RAMAN Pump Info:
---------------------
Instance        Power(mW)
1               45.00
2               40.00
3               40.00
4               40.00
5               35.00
```

The command displays alarm statistics, parameter statistics (including safety and OSRI state), measured individual pump powers, and configured pump values.

# Raman tuning with OTDR lock and OSRI

Raman tuning with OTDR lock and OSRI is a coordinated operating mechanism that prevents interference between Raman tuning and OTDR scanning while maintaining optical safety during tuning.

- Prevents OTDR scans and Raman tuning from running concurrently on the same fiber.

- Coordinates OTDR lock acquisition between peer nodes.
- Uses OSRI to protect personnel from high-power laser exposure.

*Table 6: Feature History*

| Feature Name | Release Information | Description |
|---|---|---|
| Raman Tuning with OTDR Lock | Cisco IOS XR Release 7.10.1 | If the OTDR scan and Raman tuning are performed on the same fiber simultaneously, the OTDR reports unexpected results.<br>In this release, a check is being implemented to prevent both operations from running simultaneously. The Raman tuning application imposes an OTDR lock at both ends of the fiber before the process starts and releases the same after the tuning is completed. |

### Concurrent operation of OTDR and Raman tuning

OTDR lock prevents OTDR scanning and Raman tuning from running concurrently on a single fiber. This avoids interference from Raman pump lasers that could introduce noise and reduce OTDR measurement accuracy.

Before Raman tuning begins, the system acquires OTDR lock at both ends of the fiber span. The lock is released after tuning completes. If Raman tuning is active, the system rejects any request to start an OTDR scan.

When an OTDR scan is already in progress:

- Raman tuning lock requests are rejected, and the system retries every minute.
- Raman tuning starts only after OTDR lock is acquired at both ends of the fiber.
- The system acquires OTDR lock at both ends of the fiber span, performs Raman tuning, and releases the lock after tuning completes.
- If an OTDR scan request occurs while Raman tuning is active, the system rejects the request to prevent interference.

For more information, see Optical Time Domain Reflectometer.

### Raman tuning with OSRI

Raman tuning uses the Optical Safety Remote Interlock (OSRI) feature to safely disable the amplifier on the peer node during tuning. This reduces the risk of accidental exposure to high-power laser light.

**Note** While Raman tuning is in progress and traffic is blocked, only the OSC remains active.

At the transmit end of the span, the system combines a dedicated Raman probe laser—typically a Distributed Feedback (DFB) laser operating at a defined frequency such as 191.1 THz—with the outgoing optical channels. This probe laser provides a continuity check to support optical safety.

At the receive end, the system injects multiple wavelengths in the 1424 nm to 1495 nm range opposite to signal propagation. These wavelengths provide Raman amplification for both C-band and L-band channels.

CHAPTER 5

# Gain Estimator



## Gain estimator

Gain estimator

- analyzes the span loss,
- sets the gain mode of the EDFA amplifier, and
- provides the initial target gain for the amplifier.

### Modes of gain estimator

EDFA amplifiers are present in both OLT and ILA line cards of NCS 1010. These EDFA amplifiers are variable-gain optical amplifiers that can operate in two gain modes: normal and extended. Extended mode provides higher gain than normal mode. Running the gain estimator can impact traffic.

### Parameters used by gain estimator

The gain estimator uses these parameters to estimate the gain necessary on a span:

- Ingress span loss
- Span length
- Transmitter (Tx) connector loss
- Spectrum density
- Fiber type
- Raman gain (only on Raman spans)

The gain estimator uses the estimated gain to set the gain range.

### Automatic start of gain estimator

NCS 1010 and NCS 1020 automatically starts gain estimator

- during automatic link bring-up,

- after line card cold reload, and
- after device power cycle.

# Enable or disable gain estimator

Use this task to control whether the gain estimator feature on the optical line controller is activated or deactivated.

### Procedure

Use the **gain-estimator enable** command to enable the gain estimator.

**Example:**

```
RP/0/RP0/CPU0:ios#configure terminal
Mon Jun 13 05:35:20.510 UTC
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#gain-estimator enable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
```

Use the **gain-estimator disable** command to disable the gain estimator.

# Start gain estimator

Use this task to analyze the span loss and set the gain mode of the EDFA amplifier. This task provides the initial target gain for the amplifier.

### Procedure

Use the **olc start-gain-estimation controller ots** *Rack/Slot/Instance/Port* command to start the gain estimator.

**Example:**

```
RP/0/RP0/CPU0:ios# olc start-gain-estimation controller ots 0/0/0/0
Thu May 12 09:32:05.414 UTC

Gain Estimation: is running
```

The gain estimation operation runs, then the system calculates the estimated gain and gain mode for the EDFA amplifier on the specified controller.

# View gain estimator status

Use this task to view the gain estimation details of the optical line controller.

### Procedure

**Step 1** Use the **show olc gain-estimator** command to view the gain estimation details.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc gain-estimator
Thu May 12 09:30:39.987 UTC
Controller                          : Ots0/0/0/0
Egress  Gain Estimator Status       : IDLE
Egress  Estimated Gain              : 25.9 dB
Egress  Estimated Gain Mode         : Extended
Egress  Gain Estimation Timestamp   : 2022-05-07 09:16:53

Controller                          : Ots0/0/0/2
Egress  Gain Estimator Status       : IDLE
Egress  Estimated Gain              : 11.7 dB
Egress  Estimated Gain Mode         : Normal
Egress  Gain Estimation Timestamp   : 2022-05-07 10:13:53
```

**Step 2** Use the **show olc gain-estimator controller ots** *Rack/Slot/Instance/Port* command to view the gain estimation details for a specific controller.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc gain-estimator controller Ots 0/0/0/0
Fri Jun 10 05:47:21.119 UTC
Controller                          : Ots0/0/0/0
Ingress Gain Estimator Status       : IDLE
Ingress Estimated Gain              : 21.7 dB
Ingress Estimated Gain Mode         : Normal
Ingress Gain Estimation Timestamp   : 2022-06-10 05:46:48
```

The output displays the gain estimator status, estimated gain, gain mode, and the timestamp of the gain estimation for each controller or for a specific controller.

CHAPTER 6

# Link Tuner



# Link tuner

Link tuner computes the target Power Spectral Densities (PSD) for APC by calculating the optimal PSDs for a span. PSD represents the power for each 12.5 GHz segment of the spectrum. Link tuner is enabled if automatic link bring up is enabled. It is specific to the span and computes the target PSDs for channels entering the span.

### Parameters used by link tuner

Link tuner uses these parameters to compute the target PSD:

- Fiber type
- Span loss measurement
- Spectral density
- Connector losses
- Span length, and
- Raman gain (only on Raman spans).

### Link tuner status

This table describes the different link tuner status values.

***Table 7: Link tuner status***

| Status | Description |
|---|---|
| Operational | The link tuner is active and operational. |
| Blocked | The link tuner is active but unable to com |
| Disabled | The link tuner is disabled. |

### Operational considerations

The link tuner application finds the target PSD for the best performance for channels entering a span. You have to manually configure **drop-psd**. The **drop-psd** is the target PSD for OLT drop ports.

Link tuner monitors the span loss and total noise in the link. When the link tuner detects changes in span loss, span length, or connector loss, it recomputes the target PSDs. However, it applies the new target PSDs only if it detects a change of 0.1 dB or more in the total noise value.

Link tuner computes the target PSDs and total noise whenever a link goes down and comes back up. Any action that impacts traffic triggers the link tuner.

**Restriction** From Cisco IOS XR Release 7.9.1, NCS 1010 supports C+L band networks. In Cisco IOS XR Release 7.9.1, link tuner support is not available for C+L band networks. In Cisco IOS XR Release 7.9.1, link tuner is available only for C band only networks. If you are deploying a C+L band configuration for your network, you can obtain the PSD profiles (single band and dual band) from Cisco Optical Network Planner.

# Enable or disable link tuner

Use this task to control whether the link tuner application on the optical line controller is activated or deactivated.

### Procedure

Use the **link-tuner enable** command to enable the link tuner.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#link-tuner enable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Use the **link tuner disable** command to disable the link tuner.

# Configure link tuner parameters

Use this task to set the necessary parameters for accurate link tuning in the link tuner application.

Use the **fiber-type** command to configure the fiber type. SMF is the default fiber type.

You can configure these fiber types using the **fiber-type** command:

- E-LEAF
- FREE-LIGHT
- METRO-CORE

- SMF
- SMF-28E
- TERA-LIGHT
- TW-RS
- TW-Reach
- TW-minus

Use the **link-tuner spectrum-density** command to configure the spectrum density. You can configure a spectrum density as a percentage value from 1 to 100. The default value is 81.

Use the **connector-loss** command to configure the connector loss for both the Tx and Rx ports. The supported range for each port is 0 to 20 dB.

The default connector loss is

- 0.25 dB for ports without Raman module.
- 0.3 dB for ports with Raman module.

Use the **span-length** command to configure the span length. You can specify a value from 0.1 km to 200 km in increments of 0.1 km. If you do not configure the span length, the link tuner calculates the span length based on span loss.

### Procedure

Use these commands to configure the link tuner parameters.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#fiber-type SMF
RP/0/RP0/CPU0:ios(config-olc-ots)#link-tuner spectrum-density 80
RP/0/RP0/CPU0:ios(config-olc-ots)#connector-loss rx 1
RP/0/RP0/CPU0:ios(config-olc-ots)#connector-loss tx 1
RP/0/RP0/CPU0:ios(config-olc-ots)#span-length 100
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

When you configure the fiber type, spectrum density, connector losses, and span length, the link tuner calculates the target PSDs for the span. This calculation helps optimize channel performance by selecting the best PSD values based on your settings.

# View link tuner parameters

Use this task to view key link tuner operational parameters and power spectral density (PSD) details for optical links.

### Procedure

**Step 1** Use the **show olc link-tuner** command to view the link tuner status and PSD computation information.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc link-tuner
Controller          : Ots0/0/0/0
Link Tuner Status   : OPERATIONAL
Last PSD computation: 2022-05-06 10:59:51
----------------------------------------------------------------------
Setpoint            : Computed PSD
                     (dBm/12.5 GHz)
---------------------------s------------------------------------------
01                    -5.7
02                    -5.6
03                    -5.6
04                    -5.5
05                    -5.5
06                    -5.4
07                    -5.4
08                    -5.3
09                    -5.3
10                    -5.2
11                    -5.2
12                    -5.1
13                    -5.1
14                    -5.0
15                    -5.0
16                    -4.9
17                    -4.9
18                    -4.8
19                    -4.8
20                    -4.7
21                    -4.7
22                    -4.6
23                    -4.6
24                    -4.5
25                    -4.4
26                    -4.4
27                    -4.3
28                    -4.3
29                    -4.2
30                    -4.2
31                    -4.1
32                    -4.1
33                    -4.0
```

**Step 2** Use the **show olc link-tuner detail** command to view the link tuner status, PSD computation information, and computed total noise.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc link-tuner detail
Controller          : Ots0/0/0/0
Link Tuner Status   : OPERATIONAL
Last PSD computation: 2022-05-06 10:59:51
Computed Total Noise: -35.4 dB
----------------------------------------------------------------------
Setpoint            : Computed PSD
                     (dBm/12.5 GHz)
----------------------------------------------------------------------
```

```
01                    -5.7
02                    -5.6
03                    -5.6
04                    -5.5
05                    -5.5
06                    -5.4
07                    -5.4
08                    -5.3
09                    -5.3
10                    -5.2
11                    -5.2
12                    -5.1
13                    -5.1
14                    -5.0
15                    -5.0
16                    -4.9
17                    -4.9
18                    -4.8
19                    -4.8
20                    -4.7
21                    -4.7
22                    -4.6
23                    -4.6
24                    -4.5
25                    -4.4
26                    -4.4
27                    -4.3
28                    -4.3
29                    -4.2
30                    -4.2
31                    -4.1
32                    -4.1
33                    -4.0
```

**Step 3** Use the **show olc apc-local target-psd-profile** command to view the target PSDs configured for all the setpoints. The output also shows the source of the PSD configuration. The target PSD source can be link tuner or configuration.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc apc-local target-psd-profile
Mon Jun 20 06:40:32.779 UTC
Controller          : Ots0/0/0/0
Target PSD source   : Link Tuner
-------------------------------------------------------------------------------
Setpoint                Frequency                       Target PSD
                          (THz)                       (dBm/12.5 GHz)
-------------------------------------------------------------------------------
01                    191.337494                          -6.3
02                    191.488495                          -6.3
03                    191.639496                          -6.2
04                    191.790497                          -6.2
05                    191.941498                          -6.2
06                    192.092499                          -6.1
07                    192.243500                          -6.1
08                    192.394501                          -6.1
09                    192.545502                          -6.0
10                    192.696503                          -6.0
11                    192.847504                          -5.9
12                    192.998505                          -5.9
13                    193.149506                          -5.8
14                    193.300507                          -5.8
15                    193.451508                          -5.8
16                    193.602493                          -5.7
17                    193.753494                          -5.7
18                    193.904495                          -5.7
```

```
19                     194.055496                           -5.6
20                     194.206497                           -5.6
21                     194.357498                           -5.5
22                     194.508499                           -5.5
23                     194.659500                           -5.5
24                     194.810501                           -5.4
25                     194.961502                           -5.4
26                     195.112503                           -5.3
27                     195.263504                           -5.3
28                     195.414505                           -5.3
29                     195.565506                           -5.2
30                     195.716507                           -5.2
31                     195.867493                           -5.1
32                     196.018494                           -5.1
33                     196.169495                           -5.1
```

CHAPTER 7

# Automatic Power Control

*Table 8: Feature History*

| Feature Name | Release Information | Feature Description |
|---|---|---|
| APC enhancements | Cisco IOS XR Release 7.9.1 | APC (Automatic Power Control) on NCS 1010 now supports C+L band networks in addition to C band only networks. Also, APC is enhanced to perform power correction even when it doesn’t have end-to-end network visibility. This ensures that the operational section of the network always has power at the target PSD profile, and when the network comes up, the traffic restoration is faster. |
| Span-mode APC | Cisco IOS XR Release 7.11.1 | Span-mode APC is a decentralized approach to APC.Span-mode APC Span-mode APC allows for faster network convergence as power correction is performed independently for each span. |



# Automatic Power Control

On a fiber, the power level may vary between channels. Over long distances and with multiple amplifications, these power level differences can reduce the quality of some channels. APC corrects the power level differences and ensures that power for different channels is according to the target power profile for the spectrum. APC compensates for the degradation of the network over time. APC activates if automatic link bringup is enabled.

Automatic Power Control (APC) is a network-level feature that is distributed among different nodes. An APC domain is a set of nodes that is controlled by the same instance of APC at the network level. An APC domain identifies a portion of the network that can be independently regulated. The source OLT node acts as the APC Manager or Domain Manager for all the nodes in the path. The subsequent nodes in the path act as APC agent nodes.

The manager node enables APC on agent nodes, monitors discrepancy, and initiates regulation if correction is required. To avoid large power fluctuations, APC adjusts power levels incrementally. APC performs power correction in steps of plus or minus 0.8 dB. This incremental correction continues until the optimal power level is reached.

Starting with R7.11.1, you can use APC as a span-level application by using span-mode APC.

APC is direction-specific. You can enable APC for each direction at the transmitting OLT node. The source node enables and controls different parameters in all ILA nodes on the path and the far-end OLT ingress EDFA.

### Parameters configured by APC

This table lists the parameters that APC configures and controls in different nodes.

| Node | Parameters |
|---|---|
| Transmitting OLT | EDFA Gain<br>EDFA Tilt<br>VOA Attenuation<br>WSS Attenuation |
| ILA | EDFA Gain<br>EDFA Tilt<br>VOA Attenuation<br>DGE Attenuation |
| Receiving OLT | EDFA Gain<br>EDFA Tilt<br>WSS Attenuation |

When you enable APC, APC controls these parameters. APC overrides any manual configuration. When you disable APC, user configuration is applied.

### Functions of APC

APC divides the C band spectrum into 32 equal parts. APC uses 33 frequencies across the C band to perform this division. We call these 33 frequencies, **setpoints**. Each setpoint is 150 GHz apart from the adjacent setpoints. You can configure a power profile across the spectrum using these setpoints. You can configure the target PSD for each OLT and ILA node on a link.

APC applies amplification and attenuation as required at channel level and composite signal level to ensure that the channels are at the target power level. You can configure the target power spectral densities for 33 points across the band. If you enable link tuner, link tuner sets the target PSDs for APC on all nodes in the path.

APC performs these functions:

- Monitors the current PSD against the target PSD for each channel (ASE and user channel) and changes the amplifier parameters including VOA, WSS, and DGE to achieve the target PSD.
- Detects optical network changes on the path and alters the amplifier parameters on the nearest nodes to compensate for the changes. APC performs these alterations in multiple steps.
- Collects measurements from other link nodes at the transmitting OLT to precisely locate optical network changes.

From Cisco IOS XR Release 7.9.1, NCS 1010 supports C+L band networks. Before Cisco IOS XR Release 7.9.1, APC did not start regulating the power levels in a link until the full topology was discovered by OSPF. From Cisco IOS XR Release 7.9.1, APC regulation begins as soon as it discovers any part of the topology. At a transmitting OLT, APC starts power correction at the OLT and subsequent ILA nodes even if the complete OLT-OLT link has not been discovered. When APC detects a partial topology, the NCS 1010 raises the PARTIAL-TOPOLOGY alarm. APC moves to BLOCKED state after regulation is complete.

**Note**

- If the input slice power of a channel is below psd-min and APC is unable to bring the channel above psd-min even after setting the WSS attenuation to 0dB, APC declares the channel as failed.
- After APC regulation, all channel powers must be above psd-min (-24 dBm default) and at least one channel should be within 0.5 dB of psd-min.

# PSD regulation states of APC channels

The APC channel PSD regulation feature operates in these ways:

- **Monitoring:** The APC system periodically checks the Power Spectral Density (PSD) discrepancy for each channel.
- **Trigger:** If the measured discrepancy exceeds the configured PSD correction tolerance, the regulation process is initiated.
- **Regulation action:** The Line Controller (LC) applies changes to reduce the discrepancy below the defined tolerance, ensuring a flat spectrum before the Erbium-Doped Fiber Amplifier (EDFA) at the LINE port.
- **Status states:** During regulation, the APC status transitions through various states before reaching the final state, IDLE.
- **Command usage:** The **show olc channel-apc controller Ots0/0/0/0 regulation-info** command displays the LC state.
- **State interpretation:** When regulation is in progress, some displayed values may represent final values, while others may not yet be updated.

# APC status and internal states

APC status refers to the current state of APC throughout the entire path.

### Description of APC status

This table lists and describes the APC status.

***Table 9: Description of APC status***

| APC status | Description |
|---|---|

| | |
|---|---|
| BLOCKED | APC moves to the BLOCKED state if:<br>• there is an event in the network which resulted in topology failure,<br>• an amplifier safety event like APR or OSRI has been triggered in the network, and<br>• APC is locally disabled on the agent node. |
| PAUSED | APC is paused using the **apc-pause** command. |
| IDLE | APC regulation has been completed successfully. All channels in the network have achieved the target PSD provided by the link tuner or configured by the user. |
| WORKING | When APC detects a discrepancy between the current and target PSD, it regulates to converge the power to the target PSD. |
| DISABLED | APC is disabled. |
| PARTIAL-TOPOLOGY NODE-BLOCKED | APC has limited visibility. APC manager does not have visibility to the full OLT-OLT topology. APC manager tries to correct the power levels on the agent nodes that are reachable and after the regulation is complete, APC moves to BLOCKED state. |

### Description of APC internal states

Internal state is the state of APC on each individual node.

This table lists and describes the internal states of APC.

***Table 10: Description of APC internal states***

| APC internal state | Description |
|---|---|
| DISCREPANCY | The APC manager flags an agent node which needs correction when there is a discrepancy between target PSD and current PSD. This state is temporary and lasts until APC starts power correction and goes into CORRECTING state. |
| CORRECTING | APC correction is in progress on the node. |

| | |
|---|---|
| OOR | APC-OUT-OF-RANGE condition is raised on an agent node when APC fails to regulate and achieve the target PSD power level because the requested gain or attenuation setpoint cannot be set due to one of these conditions:<br>• Amplifier gain is exhausted in the current gain range.<br>• WSS range (0 to 25dB) is exhausted for a single or multiple channels.<br>• DGE range (0 to 3dB) is exhausted for a single or multiple channels.<br>• Span loss has increased, and amplifier gain is insufficient to achieve the target PSD. |
| IDLE | APC regulation has been completed successfully. All channels in the network have achieved the target PSD, either provided by the link tuner or configured by the user. |
| BLOCKED | APC is unable to perform for these reasons:<br>• OSRI has shut down the amplifier: AMPLI-SHUT.<br>• APC is disabled locally on the node: USER-DISABLED.<br>• Gain Estimation is in progress: GAIN-ESTIMATION-IN-PROGRESS.<br>• Amplifier auto power reduction is enabled: AMPLI-APR-ENABLED.<br>• Amplifier is shut because of loss of input power: AMPLI-SHUT.<br>• An event in the network resulted in topology failure.<br>• APC is BLOCKED as Band Failure Recovery sets Safe mode because of a band failure event in C+L network: BAND-FAILURE. |

# View APC status and information

Use this task to verify whether APC is working, blocked, idle, or paused. You can also view detailed parameters such as target PSDs, amplifier gain, attenuation settings, and discrepancies between current and target power levels for each node in the APC domain.

**Procedure**

**Step 1** Use the **show olc apc** command to view the APC status.

This sample shows the output of the **show olc apc** command when APC is in Centralized mode

**Example:**

```
RP/0/RP0/CPU0:OLT1#show olc apc

Controller       : Ots0/0/0/0
APC Status       : WORKING

Node RID         : 10.1.1.1
Internal State   : IDLE

Node RID         : 10.99.1.2
Internal State   : IDLE

Node RID         : 10.99.2.2
Internal State   : IDLE

Node RID         : 10.99.4.1
Internal State   : IDLE

Node RID         : 10.1.1.5
Internal State   : DISCREPANCY
```

This sample shows the output of the **show olc apc** command when APC is in span-mode.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc apc

Controller       : Ots0/0/0/0
APC Status       : MANUAL
```

For information about APC statuses and APC internal states, see APC status and internal states, on page 39.

This sample shows the output of the **show olc apc** command when OSRI has shut down an amplifier in the link.

**Example:**

```
RP/0/RP0/CPU0:ios#sh olc apc
Thu Jul  7 13:21:05.807 UTC

Controller       : Ots0/0/0/0
APC Status       : BLOCKED

Node RID         : 10.1.1.1
Internal State   : IDLE

Node RID         : 10.1.1.2
Internal State   : BLOCKED
Blocked Reason   : [ AMPLI-SHUT ]

Node RID         : 10.1.1.3
Internal State   : DISCREPANCY

Node RID         : 10.1.1.4
Internal State   : DISCREPANCY
```

```
Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

This sample shows the output of the **show olc apc** command when APC is disabled locally on a node.

**Example:**

```
RP/0/RP0/CPU0:ios#sh olc apc
Thu Jul  7 13:22:44.145 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
Internal State  : BLOCKED
Blocked Reason  : [ USER-DISABLED ]

Node RID        : 10.1.1.3
Internal State  : DISCREPANCY

Node RID        : 10.1.1.4
Internal State  : DISCREPANCY

Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

This sample shows the output of the **show olc apc** command when Gain Estimation is in progress on a node.

**Example:**

```
RP/0/RP0/CPU0:ios#sh olc apc
Tue Jun 7 11:43:10.801 UTC

Controller : Ots0/0/0/0
APC Status : BLOCKED

Node RID : 10.1.1.1
Internal State : DISCREPANCY

Node RID : 10.1.1.2
Internal State : DISCREPANCY

Node RID : 10.1.1.3
Internal State : BLOCKED
Blocked Reason : [ GAIN-ESTIMATION-IN-PROGRESS ]
```

This sample shows the output of the **show olc apc** command when amplifier auto power reduction is enabled on a node.

**Example:**

```
RP/0/RP0/CPU0:ios#sh olc apc
Thu Jul  7 13:21:49.530 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
Internal State  : BLOCKED
Blocked Reason  : [ AMPLI-APR-ENABLED ]
```

```
Node RID        : 10.1.1.3
Internal State  : DISCREPANCY

Node RID        : 10.1.1.4
Internal State  : DISCREPANCY

Node RID        : 10.1.1.5
Internal State  : DISCREPANCY
```

This sample shows the output of the **show olc apc** command when band failure has occurred and the APC manager has visibility only to a partial topology.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc apc
Wed Jan 18 12:21:28.195 UTC

Controller      : Ots0/0/0/0
APC Status      : BLOCKED
Blocked Reason  : [ PARTIAL-TOPOLOGY  NODE-BLOCKED ]

Node RID        : 10.1.1.1
Internal State  : IDLE

Node RID        : 10.1.1.2
Internal State  : BLOCKED
Blocked Reason  : [ BAND-FAILURE ]
```

**Step 2** Use the **show olc apc-local** command to view the local status of APC on each node.

This command shows if APC is enabled or disabled on the node.

This sample shows the output of the**show olc apc-local** command.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc apc-local
Mon Apr 11 06:59:14.679 UTC

Controller : Ots0/0/0/0

TX Status : ENABLED
RX Status : ENABLED
```

**Step 3** Use the **show olc apc-local target-psd-profile** command to view the target PSDs configured for all the setpoints.

This sample shows the output of the **show olc apc-local target-psd-profile** command on a C band node. The output also displays the PSD configuration source and indicates whether the target PSD source is the link tuner or a configuration.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc apc-local target-psd-profile
Tue Apr 26 10:19:24.910 UTC
Controller          : Ots0/0/0/0
Target PSD source   : Configuration
-------------------------------------------------------------------------------
Setpoint                Frequency                        Target PSD
                          (THz)                        (dBm/12.5 GHz)
-------------------------------------------------------------------------------
01                    191.337494                           15.0
02                    191.488678                           15.0
03                    191.639847                           -4.1
04                    191.791016                           -4.1
05                    191.942184                           -4.1
```

```
06                     192.093353                          -4.1
07                     192.244537                          -4.1
08                     192.395706                          -4.1
09                     192.546875                          -4.1
10                     192.698044                          -4.1
11                     192.849213                          -4.1
12                     193.000397                          -4.1
13                     193.151566                          -4.1
14                     193.302734                          -4.1
15                     193.453903                          -4.1
16                     193.605072                          -4.1
17                     193.756256                          -4.1
18                     193.907425                          -4.1
19                     194.058594                          -4.1
20                     194.209763                          -4.1
21                     194.360931                          -4.1
22                     194.512115                          -4.1
23                     194.663284                          -4.1
24                     194.814453                          -4.1
25                     194.965622                          -4.1
26                     195.116791                          -4.1
27                     195.267975                          -4.1
28                     195.419144                          -4.1
29                     195.570312                          -4.1
30                     195.721481                          -4.1
31                     195.872650                          -4.1
32                     196.023834                          -4.1
33                     196.175003                          -4.1
```

This sample shows the output of the **show olc apc-local target-psd-profile** command on an L band node.

**Example:**

```
RP/0/RP0/CPU0:ios#sh olc apc-local target-psd-profile
Wed Jan 18 12:12:02.236 UTC
Controller          : Ots0/0/0/0
Target PSD source   : Configuration
--------------------------------------------------------------------------------
Setpoint                 Frequency                          Target PSD
                           (THz)                          (dBm/12.5 GHz)
--------------------------------------------------------------------------------
01                     186.050000                          -6.4
02                     186.201000                          -6.3
03                     186.352000                          -6.2
04                     186.503000                          -6.2
05                     186.654000                          -6.1
06                     186.805000                          -6.1
07                     186.956000                          -6.0
08                     187.107000                          -6.0
09                     187.258000                          -5.9
10                     187.409000                          -5.9
11                     187.560000                          -5.9
12                     187.711000                          -5.8
13                     187.862000                          -5.7
14                     188.013000                          -5.7
15                     188.164000                          -5.6
16                     188.315000                          -5.5
17                     188.466000                          -5.5
18                     188.617000                          -5.4
19                     188.768000                          -5.4
20                     188.919000                          -5.3
21                     189.070000                          -5.2
22                     189.221000                          -5.2
23                     189.372000                          -5.1
24                     189.523000                          -5.1
```

```
25                      189.674000                                    -5.0
26                      189.825000                                    -5.0
27                      189.976000                                    -4.9
28                      190.127000                                    -4.9
29                      190.278000                                    -4.8
30                      190.429000                                    -4.7
31                      190.580000                                    -4.7
32                      190.731000                                    -4.6
33                      190.882000                                    -4.6
```

**Step 4** Use the **show olc apc-local regulation-info** command to view the detailed information about APC on each node.

This command provides this information:

- Controller
- APC Domain Manager
- Internal status
- Minimum PSD
- Last correction timestamp
- Gain range
- Amplifier and attenuation parameters: configured and current values and available ranges
- Detailed information on the channels

This command also provides detailed information on the channels:

- Center frequency of each channel
- Channel width
- Channel ID
- Channel source (ASE or user channel)
- Slice number of the center frequency of the channel in the WSS
- PSD of the channel at the input of the amplifier
- Target and current PSD for the channel
- Discrepancy between current and target PSD
- The configured attenuation on the WSS (OLT) or DGE (ILA) for the channel

**Step 5** Use the **tx|rx** keyword with the **show olc apc-local regulation-info controller ots** *R/S/I/P* command to view the APC information for only the Tx or Rx direction.

This sample shows the output of the**show olc apc-local regulation-info** command.

**Example:**

```
RP/0/RP0/CPU0:ios#show olc apc-local regulation-info controller ots 0/0/0/0 tx
Wed Jul  6 05:01:45.177 UTC
Controller            : Ots0/0/0/0
Domain Manager        : 10.1.1.1
Internal Status       : OOR
```

```
Direction            : TX
PSD Minimum          : -24.0 (dBm/12.5 GHz)
Gain Range           : Normal
Last Correction      : 2022-07-06 05:01:28

  Device Parameters                Min   Max  Configuration Operational
============================================================================
  Egress Ampli Gain (dB)         :15.4  29.4 19.5          19.5
  Egress Ampli Tilt (dB)         :-5.0  3.1  -2.2          -2.2
  TX Ampli Power (dBm)           : -    22.4  -            21.4
  TX VOA Attenuation (dB)        :0.0   20.0 0.0           0.0
  Egress WSS/DGE Attenuation (dB)  :0.0   25.0  -            -


Channel Center Channel Channel Channel Spectrum   Ampli-Input     Target      Current    Discrepancy
 Channel Slice
  Frequency     Width    ID    Source  Slice Num       PSD           PSD           PSD
     Attn Config
    (THz)       (GHz)                                (dBm/12.5 GHz)(dBm/12.5 GHz)(dBm/12.5 GHz)     (dB)
        (dB)
====================================================================================================


 191.375000    75.00    1      OCh       13          -23.2         -4.6          -4.9          0.2
       7.1
 191.449997    75.00    -      ASE       37          -23.0         -4.6          -4.7          0.1
       9.2
 191.524994    75.00    -      ASE       61          -23.1         -4.6          -4.7          0.1
       9.3
 191.600006    75.00    4      OCh       85          -23.1         -4.5          -4.7          0.1
       8.0
 191.675003    75.00    -      ASE       109         -23.0         -4.5          -4.5          0.0
       9.1
 191.750000    75.00    6      OCh       133         -23.0         -4.4          -4.6          0.1
       8.0
 191.824997    75.00    -      ASE       157         -23.1         -4.4          -4.6          0.1
       9.3
 191.899994    75.00    8      OCh       181         -23.0         -4.4          -4.4          0.0
       8.0
 191.975006    75.00    -      ASE       205         -23.0         -4.3          -4.5          0.1
       9.1
 192.050003    75.00    10     OCh       229         -23.0         -4.3          -4.5          0.1
       8.2
 192.125000    75.00    -      ASE       253         -22.9         -4.3          -4.3          0.0
       9.0
 192.199997    75.00    12     OCh       277         -22.8         -4.2          -4.3          0.0
       8.3
 192.274994    75.00    -      ASE       301         -22.9         -4.2          -4.4          0.1
       9.0
 192.350006    75.00    14     OCh       325         -22.6         -4.2          -4.2          0.0
       8.3
 192.425003    75.00    -      ASE       349         -22.8         -4.2          -4.3          0.1
       8.7
 192.500000    75.00    16     OCh       373         -22.4         -4.1          -3.9          -0.2
       8.1
 192.574997    75.00    -      ASE       397         -22.7         -4.1          -4.2          0.1
       8.6
 192.649994    75.00    18     OCh       421         -22.6         -4.1          -4.2          0.1
       8.1
 192.725006    75.00    -      ASE       445         -22.7         -4.0          -4.2          0.1
       8.6
 192.800003    75.00    20     OCh       469         -22.7         -4.0          -4.1          0.1
       7.9
 192.875000    75.00    -      ASE       493         -22.6         -4.0          -4.0          0.0
       8.4
```

```
192.949997    75.00    22    OCh    517     -22.6    -3.9    -4.1    0.1
     7.6
193.024994    75.00    -     ASE    541     -22.5    -3.9    -4.0    0.1
     8.2
193.100006    75.00    24    OCh    565     -22.7    -3.8    -4.0    0.1
     7.5
193.175003    75.00    -     ASE    589     -22.7    -3.8    -4.0    0.1
     8.2
193.250000    75.00    26    OCh    613     -22.5    -3.8    -3.9    0.1
     7.2
193.324997    75.00    -     ASE    637     -22.6    -3.8    -4.0    0.2
     8.1
193.399994    75.00    28    OCh    661     -22.7    -3.7    -3.9    0.1
     7.2
193.475006    75.00    -     ASE    685     -22.5    -3.7    -3.8    0.1
     8.0
193.550003    75.00    30    OCh    709     -22.7    -3.7    -3.8    0.1
     7.0
193.625000    75.00    -     ASE    733     -22.7    -3.6    -3.8    0.1
     8.1
193.699997    75.00    32    OCh    757     -22.7    -3.6    -3.7    0.1
     6.7
193.774994    75.00    -     ASE    781     -22.7    -3.5    -3.7    0.1
     8.2
193.850006    75.00    34    OCh    805     -22.7    -3.5    -3.7    0.1
     6.6
193.925003    75.00    -     ASE    829     -22.7    -3.5    -3.6    0.1
     8.1
194.000000    75.00    36    OCh    853     -22.8    -3.5    -3.7    0.2
     6.6
194.074997    75.00    -     ASE    877     -22.8    -3.4    -3.6    0.1
     8.3
194.149994    75.00    38    OCh    901     -22.7    -3.4    -3.5    0.1
     10.9
194.225006    75.00    -     ASE    925     -22.8    -3.3    -3.5    0.1
     8.2
194.300003    75.00    40    OCh    949     -22.9    -3.3    -3.5    0.1
     7.1
194.375000    75.00    -     ASE    973     -22.8    -3.3    -3.4    0.1
     8.4
194.449997    75.00    42    OCh    997     -22.9    -3.2    -3.5    0.2
     7.3
194.524994    75.00    -     ASE    1021    -22.9    -3.2    -3.4    0.1
     8.4
194.600006    75.00    44    OCh    1045    -22.8    -3.2    -3.3    0.1
     7.2
194.675003    75.00    -     ASE    1069    -22.8    -3.2    -3.3    0.1
     8.4
194.750000    75.00    46    OCh    1093    -22.9    -3.1    -3.4    0.2
     7.3
194.824997    75.00    -     ASE    1117    -22.8    -3.1    -3.2    0.1
     8.2
194.899994    75.00    48    OCh    1141    -22.8    -3.0    -3.3    0.2
     6.9
194.975006    75.00    -     ASE    1165    -22.9    -3.0    -3.2    0.1
     8.3
195.050003    75.00    50    OCh    1189    -22.8    -3.0    -3.1    0.1
     6.6
195.125000    75.00    -     ASE    1213    -22.9    -3.0    -3.1    0.1
     8.3
195.199997    75.00    52    OCh    1237    -22.9    -2.9    -3.1    0.1
     6.3
195.274994    75.00    -     ASE    1261    -23.0    -2.9    -3.0    0.1
     8.1
```

```
195.350006    75.00    54    OCh    1285    -23.1    -2.8    -3.0    0.1
      6.4
195.425003    75.00    -     ASE    1309    -23.2    -2.8    -3.0    0.1
      8.3
195.500000    75.00    56    OCh    1333    -23.1    -2.8    -2.9    0.1
      6.2
195.574997    75.00    -     ASE    1357    -23.4    -2.8    -3.0    0.2
      8.2
195.649994    75.00    58    OCh    1381    -23.4    -2.7    -2.9    0.1
      6.4
195.725006    75.00    -     ASE    1405    -23.4    -2.7    -2.8    0.1
      8.5
195.800003    75.00    60    OCh    1429    -23.6    -2.7    -2.8    0.1
      6.6
195.875000    75.00    -     ASE    1453    -23.7    -2.6    -2.9    0.2
      8.7
195.949997    75.00    62    OCh    1477    -23.7    -2.6    -2.8    0.2
      6.9
196.024994    75.00    -     ASE    1501    -23.6    -2.5    -2.7    0.1
      9.0
196.100006    75.00    64    OCh    1525    -23.7    -2.5    -2.7    0.1
      7.1


ASE - Noise Loaded Channel
OCh - Optical Channel
```

**Note**

- In the previous sample output, the channel source is ASE for channels that are empty and for channels that failed due to power level dropping below psd-min. ASE or a noise loader fills noise across the spectrum at intervals of 75 GHz wherever optical cross connects are not present. For dropped channels, the channel ID is present, and the channel source is ASE.
- When APC is in span-mode, the apc regulation info output does not show the channel source on ILA nodes

You can assess and monitor the power regulation and discrepancies across the network nodes for effective optical network management.

# Configure the target PSDs

If you enable link tuner, it sets the target PSDs for APC on all nodes in the path.

You can configure the target power spectral densities at 33 points across the band. Each PSD value divides the spectrum into 150-GHz steps. APC uses the PSD value when a channel frequency matches a configured point. If not, APC calculates the target PSD for a channel based on the two nearest steps.

### Procedure

**Step 1** Use the **psd** *<1-33> value* command to set the target PSDs for single-band for each node on a C-band network.

This sample configuration sets the PSD value to 15 dBm or 12.5 GHz for setpoints 1 and 2.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#psd 1 150
RP/0/RP0/CPU0:ios(config-olc-ots)#psd 2 150
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Step 2** (Only for NCS 1010) Use the **dual-band-psd** *<1-33> value* command to set the target PSDs for dual-band for each node on a C+L band network.

This sample configuration sets the dual-band PSD values to -50 and -49 on setpoints 1 and 2 respectively, on the 0/0/0/0 controller.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#dual-band-psd 1 -50
RP/0/RP0/CPU0:ios(config-olc-ots)#dual-band-psd 2 -49
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

---

The target PSD profiles are now configured for the selected band on all nodes in the path.

# Disable centralized APC

Use this procedure to manually disable centralized APC, allowing user configuration to take effect instead of APC's automatic power regulation.

### Procedure

---

Use the **apc disable** command to disable APC for a link on the transmitting OLT node.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Important**

- When you disable APC, the device sets all the setpoints to values in the configuration. If there is no configuration, the device sets all setpoints to their default values. Disabling APC affects traffic.
- (Only for NCS 1010) For BFR to work, APC must be enabled on both C and L-band devices. We recommend to pause BFR before running the **apc-pause** or **apc disable** commands.

---

User configuration is applied instead of APC. All setpoints are set to either configured values or default values.

# Manage centralized APC

Use this procedure to manage APC by enabling and disabling APC domains.

### Procedure

**Step 1** Use the **apc enable** command on the transmitting OLT node to enable APC for a link.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc enable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Step 2** Use the **apc pause** command on the transmitting OLT node to modify the network without APC compensating for the changes.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc pause
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Note**

- If you run the **apc-pause** command when APC is in idle state, APC remains in the idle state until changes in the network require power correction. The status changes to paused after changes are detected, but the system does not perform power correction.
- Running the **apc-pause** command does not pause channel startup.

**Step 3** Use the **apc-local [ RX | TX ] disable** command on an ILA node to disable APC locally.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-local RX disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Consider a scenario where the headend OLT encounters a headless event. If power correction is required at agent nodes, the APC manager is unavailable to initiate regulation. When APC is enabled, adjustments cannot be performed, and user configuration of **target-psd** does not take effect. Disabling APC locally on an agent node allows manual adjustment of parameters. Use the **apc-local disable** command to disable APC on an agent node.

# Configure target drop PSD and minimum PSD

Use this task to manually configure the target PSD for drop ports. You can also set the minimum PSD threshold. These actions ensure that channel power levels meet the required target and maintain optimal channel quality across the network.

The link tuner does not set the target PSD for drop ports. The default target PSD for drop ports is –8.0 dBm/12.5 GHz. The device applies drop PSD configuration for channels with cross connect settings. Use the **drop-psd** command to set the desired drop PSD.

If the PSD of a channel with minimal attenuation at the amplifier input on an OLT is less than the minimum PSD, APC marks the channel as failed. APC then replaces the channel using the ASE source.The default minimum PSD is –24 dBm/2.5 GHz. Use the **psd-min** command to set the desired minimum PSD.

### Procedure

**Step 1** Use the **drop-psd** command to set the desired drop PSD.

This sample configuration sets the target PSD at drop ports to –25 dBm/12.5 GHz.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#drop-psd -250
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Tue Apr 26 09:50:12.055 UTC
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Step 2** Use the **psd-min** command to set the desired minimum PSD.

This sample configuration sets the minimum PSD to –25 dBm/12.5 GHz.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#psd-min -250
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Tue Apr 26 09:50:12.055 UTC
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

Channel power levels meet the required target power profile.

# View patchcord loss and path loss

In a C+L band configuration, optical applications require data about loss between the LINE-TX port of the L-band device to the LINE-TX port of the C-band device to launch correct power into the transmission fiber.

This data, also known as path loss, is calculated from these components:

- patchcord loss between the LINE-TX port of the L-band device and the L-Band-RX port of the C-band device.
- insertion loss between the L-Band-RX port of the C-band device and the LINE-TX port of the C-band device.
- insertion loss due to the Raman modules inside the C-band device.

### Procedure

**Step 1** Use the **show olc partner-band-loss** command to view the patchcord loss and path loss values.

This sample is an output of the **show olc partner-band-loss** when executed on a C-band device.

**Example:**

```
RP/0/RP0/CPU0#show olc partner-band-loss
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.2
Partner Controller                          : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX            : 2.3 dB
L-LINE-TX Patchcord Loss                    : 1.0 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```

This sample is an output of the **show olc partner-band-loss** when executed on a L-band device.

```
RP/0/RP0/CPU0#show olc partner-band-loss
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.3
Partner Controller                          : ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX         : 2.3 dB
L-LINE-TX Patchcord Loss                    : 1.0 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```

**Step 2** Use the **show olc partner-band-loss controller ots** *R/S/I/P* command to view the patchcord loss and path loss values for individual controllers.

This sample is an output of the **show olc partner-band-loss controller ots** *R/S/I/P* when executed on a C-band device.

**Example:**

```
RP/0/RP0/CPU0#show olc partner-band-loss controller Ots 0/0/0/0
Wed Feb 1 12:51:59.605 UTC

Controller                                  : Ots0/0/0/0
Partner IP address                          : 10.1.1.2
Partner Controller                          : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX         : 1.9 dB
L-LINE-TX Patchcord Loss                    : 1.2 dB
Loss Measurement Timestamp                  : 2023-02-01 12:51:54
```

This sample is an output of the **show olc partner-band-loss controller ots** *R/S/I/P* when executed on a L-band device.

```
RP/0/RP0/CPU0#show olc partner-band-loss controller Ots 0/0/0/0
```

```
Wed Feb 1 12:51:59.605 UTC

Controller                                 : Ots0/0/0/0
Partner IP address                         : 10.1.1.3
Partner Controller                         : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX           : 1.9 dB
L-LINE-TX Patchcord Loss                   : 1.2 dB
Loss Measurement Timestamp                 : 2023-02-01 12:51:54
```

You can accurately monitor and manage optical power levels in the network.

# Configure APC alarm hold-off timer and discrepancy threshold

Use this task to configure APC alarm sensitivity and timing. You can avoid false or premature alarms during APC.

### Procedure

**Step 1** Use the **apc-alarm-hold-off-timer** *time* command to configure the timer.

You can configure the time interval that must pass after APC detects a discrepancy before the APC-TARGET-PSD-NOT-MET alarm is raised. The default value is 30 seconds.

This sample configuration sets the APC alarm hold-off timer to 45 seconds.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-alarm-hold-off-timer 45
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Tue Apr 26 09:50:12.055 UTC
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Step 2** Use the **apc-alarm-discrepancy-threshold** *discrepancy*command to configure the discrepancy threshold.

You can configure the allowed discrepancy threshold before APC-TARGET-PSD-NOT-MET alarm is raised. The default value is 1 dB.

This sample configuration sets the APC alarm discrepancy threshold to 1.5 dB.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-alarm-discrepancy-threshold 15
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Tue Apr 26 09:50:12.055 UTC
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

The APC alarm parameters are configured, reducing false or premature alarms during APC operation.

# Operation of span-mode APC

Starting with R7.11.1, you can configure APC in span-mode. span-mode APC is a decentralized automatic power control method used in optical networks, where each node independently adjusts its power levels based on changes in span loss.

If there is a discrepancy in the network without any change in span-loss, instead of triggering APC regulation, the system raises the corresponding alarm. For centralized APC, the power correction threshold is 0.7 dB. The threshold for span-mode APC is 0.5 dB.

Unlike centralized power control mode, where the manager node controls power adjustments across the network, each node in span-mode adjusts its own power based on the conditions of its direct connections or spans. There are no APC manager nodes in span-mode. Regulation in span-mode APC takes place when a node detects a change in Rx span loss. Span-mode APC does not perform regulation when there is a change in Rx power as a result of other changes. There are two exceptions to this:

- Span-mode APC compensates for power changes in the channels that an OLT receives on the ADD ports.
- Span-mode APC performs power correction when you change the DROP PSD configuration

When a node is unable to compensate for changes that require power correction, it raises the OOR (Out-of-Range) alarm and informs the receiving node of the discrepancy. The receiving node then performs power correction to address the issue.

If there is a power change in the network due to another cause, APC does not perform power correction. However, APC raises the APC-TARGET-PSD-NOT-MET alarm after a configured interval. You can investigate the cause of the change in the network and fix the issues.

APC behavior before R7.11.1 is Centralized APC.

### Restrictions for span-mode APC

- Do not delete channels when APC is in span mode.
- Do not disable or enable APC, link tuner, or gain estimator after the ALC process is complete and span-mode APC is active.
- Do not initiate gain estimator application using exec CLI after ALC process is complete and span-mode APC is active.
- You must configure channel maps on all ILA nodes. Use **hw-module location 0/0/NXR0 grid-mode flex[inline-ampli | terminal-ampli] channel-id***id***centre-freq***frequency***width***width* command to configure the channel map for all 32 channels.
- You must pause span-mode APC before deleting or creating cross-connects.

# Configure APC in span mode

Use this procedure to configure APC in span mode on OLT node and ILA node.

**Procedure**

---

**Step 1** Use these commands to configure APC in span mode on an OLT node.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-span-mode RX
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-span-mode TX
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Step 2** Use these commands to configure APC in span mode on an ILA node.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-span-mode TX
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

---

APC operates in centralized mode during automatic link calibration. After ALC completes, it saves a system baseline. If span mode configurations are present, ALC switches APC mode to span mode.

# Pause APC in span mode

Use this procedure to pause APC in span mode.

**Procedure**

---

Use these commands to pause APC in span mode.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#apc-span-mode-pause tx
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

---

# Switch between APC modes

### Procedure

**Step 1** Switch from centralized APC to span mode APC.

a) Configure APC in manual mode on the OLT nodes.
b) Configure apc-span-mode on all nodes.
c) Initiate ALC and wait for the ALC process to complete.

   After saving the ALC baseline, APC switches to span mode.

**Step 2** Switch from span mode APC to centralized APC using one of these methods:

- **commit replace**

  **a.** Reset all the nodes to their default configuration by using the **commit replace** command.

  **b.** Reload all the nodes.

  **c.** Configure the nodes with the required settings for link bringup.

  **d.** Configure automatic link bringup or enable APC.

  APC starts regulation in centralized mode.

- **no** configuration of optical applications

  **a.** Remove the optical applications configurations by using the **no** form of APC, link tuner, and gain estimator.

  **b.** Configure the nodes with required configuration for link bring up.

  **c.** Configure automatic link bringup or enable APC.

  APC starts regulation in centralized mode.

CHAPTER 8

# Band Failure Recovery

*Table 11: Feature History*

| Feature Name | Release Information | Description |
|---|---|---|
| Band Failure Recovery (BFR) Pause | Cisco IOS XR Release 7.10.1 | Use the new **bfr-pause** configuration command from this release to pause the BFR function. Unlike in the previous releases, the BFR pause state is now preserved during a system reload. BFR pause stays paused indefinitely until you resume it.<br><br>Command added: bfr-pause |
| **olc bfr-pause** (Command deprecated) | Cisco IOS XR Release 7.10.1 | The command olc bfr-pause is deprecated starting R7.10.1. To pause and resume BFR, use the bfr-pause command.<br><br>To upgrade from R7.9.1 to R7.10.1 or later with BFR pause enabled, before upgrading software, pause BFR on the OLT-C band using the **olc bfr pause** command before beginning the software upgrade. Once the upgrade is finished, pause and resume BFR using the **bfr-pause** configuration command on the OLT-C and OLT-L bands. |

| Feature Name | Release Information | Description |
|---|---|---|
| Band Failure Recovery (BFR) | Cisco IOS XR Release 7.9.1 | During the C+L band network bring up, as both the bands travel through the same fiber, optical power is transferred from higher frequency to lower frequency due to SRS (Stimulated Raman Scattering). This degrades the C-band channel power and causes the existing C-band power profile to change.<br><br>BFR compensates for this dynamic power change by adjusting the power profile that minimizes the impact when upgrading from C-band to the C+L band network. BFR also adjusts power during a band failure to minimize the impact on the surviving band. |



# Band Failure Recovery

A band failure recovery is a mechanism that

- applies dual-band PSD profiles to both C-band and L-band devices to compensate for power transfer caused by Stimulated Raman Scattering (SRS),
- coordinates with agent nodes along the transmission path, and
- manages PSD profile switching and recovery of each node in case of band failure.

### Band Failure Recovery in C-band and L-band optical networks

NCS 1010 can be configured to operate in both C-band and L-band wavelengths to increase the capacity of optical fibers. This is achieved by connecting the C-band OLT or ILA line cards to the corresponding L-band OLT or ILA line cards. When C-band and L-band signals travel through the same fiber, SRS causes a transfer of optical power from higher to lower frequencies. This process alters the C-band power profile . BFR compensates for this by applying dual-band PSD profiles to both C-band and L-band devices.

The source OLT node functions as the BFR manager for all nodes in the transmit direction. Other nodes in the path act as BFR agent nodes and report to the manager. The manager node collects information from agent nodes, coordinates failure, and recovery actions.

1. When a band fails in a C and L band network, the surviving band experiences a change in optical power due to the absence of SRS.
2. The BFR manager sends commands to the agent nodes to switch the PSD profile on the surviving band to a single-band PSD profile.

3. After resolving the failure, the BFR manager initiates recovery on each failed band node to ensure there is no traffic impact on the surviving band.

# Enable BFR on the controller

BFR is not enabled by default. It is enabled automatically if partner band IP address and dual-band PSD configurations are present on both the C-band and L-band cards.

**Before you begin**

Disable link tuner and gain estimator before BFR is automatically enabled.

### Procedure

**Step 1** Enter the **partner-band-port** command to configure the partner band IP address.

**Example:**

```
partner-band-port ipv4 address ip-address controller Ots0/0/0/x
```

**Step 2** Enter the **dual-band-port** command to configure the dual-band PSD profile.

**Example:**

```
dual-band-psd index value
```

For more information about these configurations, see partner-band-port and Configure APC .

BFR is enabled on the system and is operational.

# View BFR status on all nodes

### Procedure

Use the **show olc band-status** command to view the status of BFR on all the nodes.

This example shows the status of BFR on all the nodes of a controller. BFR shows a *Running* status. BFR applies dual band PSD to both bands.

**Example:**

```
RP/0/RP0/CPU0#show olc band-status
Tue Dec 13 10:45:30.594 UTC
Controller                : Ots0/0/0/0
Self-Band                 : C-Band
```

```
BFR status              : Running
Node RID                : 10.1.1.1
Self IP Address     : 192.0.2.1
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.2
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
Node RID                : 10.1.1.2

Self IP Address         : 192.0.2.21
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.22
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
Node RID                : 10.1.1.3
Self IP Address     : 192.0.2.31
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.32
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
Node RID                : 10.1.1.4
Self IP Address     : 192.0.2.41
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.42
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
Node RID                : 10.1.1.5
Self IP Address     : 192.0.2.51
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.52
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
```

For more information about this command, see the show olc band-status command in the *Command Reference for Cisco NCS 1010* guide.

**Note**

If the OLC process is restarted on OLT-CR while Raman tuning is in progress, the *Partner link status* might show as DOWN in the output of the **show olc band-status** command. The *Partner link status* will change to UP after Raman tuning is completed.

# Pause and resume BFR on the controller

While recovering from a span failure, if one of the bands is in a failed state, BFR is not initiated, and the other band is not recovered. In these cases, you can pause BFR, initialize it, and then resume BFR to start the process and recover the other band.

### Procedure

**Step 1** Enter the **bfr-pause** command to pause BFR on the controller.

**Example:**

```
RP/0/RP0/CPU0:#configure
RP/0/RP0/CPU0:(config)#optical-line-control
RP/0/RP0/CPU0:(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:(config-olc-ots)#bfr-pause
RP/0/RP0/CPU0:(config-olc-ots)#commit
```

**Step 2** Enter the **no bfr-pause** command to resume BFR on the controller.

**Example:**

```
RP/0/RP0/CPU0:#configure
RP/0/RP0/CPU0:(config)#optical-line-control
RP/0/RP0/CPU0:(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:(config-olc-ots)#no bfr-pause
RP/0/RP0/CPU0:(config-olc-ots)#commit
```

For more information about these commands, see bfr-pause in the *Command Reference for Cisco NCS 1010*.

**Note**
To upgrade from R7.9.1 to R7.10.1 or later with BFR pause enabled, before upgrading software, pause BFR on the OLT-C band using the olc bfr pause command before beginning the software upgrade. Once the upgrade is finished, pause and resume BFR using the bfr-pause configuration command on the OLT-C and OLT-L bands.

BFR is paused and resumed, which can help recover bands after a span failure.

# Events leading to band failure

Band failure can occur due to several events, such as connectivity issues, device failures, and power loss.

### Events leading to band failure

Band failure can happen due to any of these events:

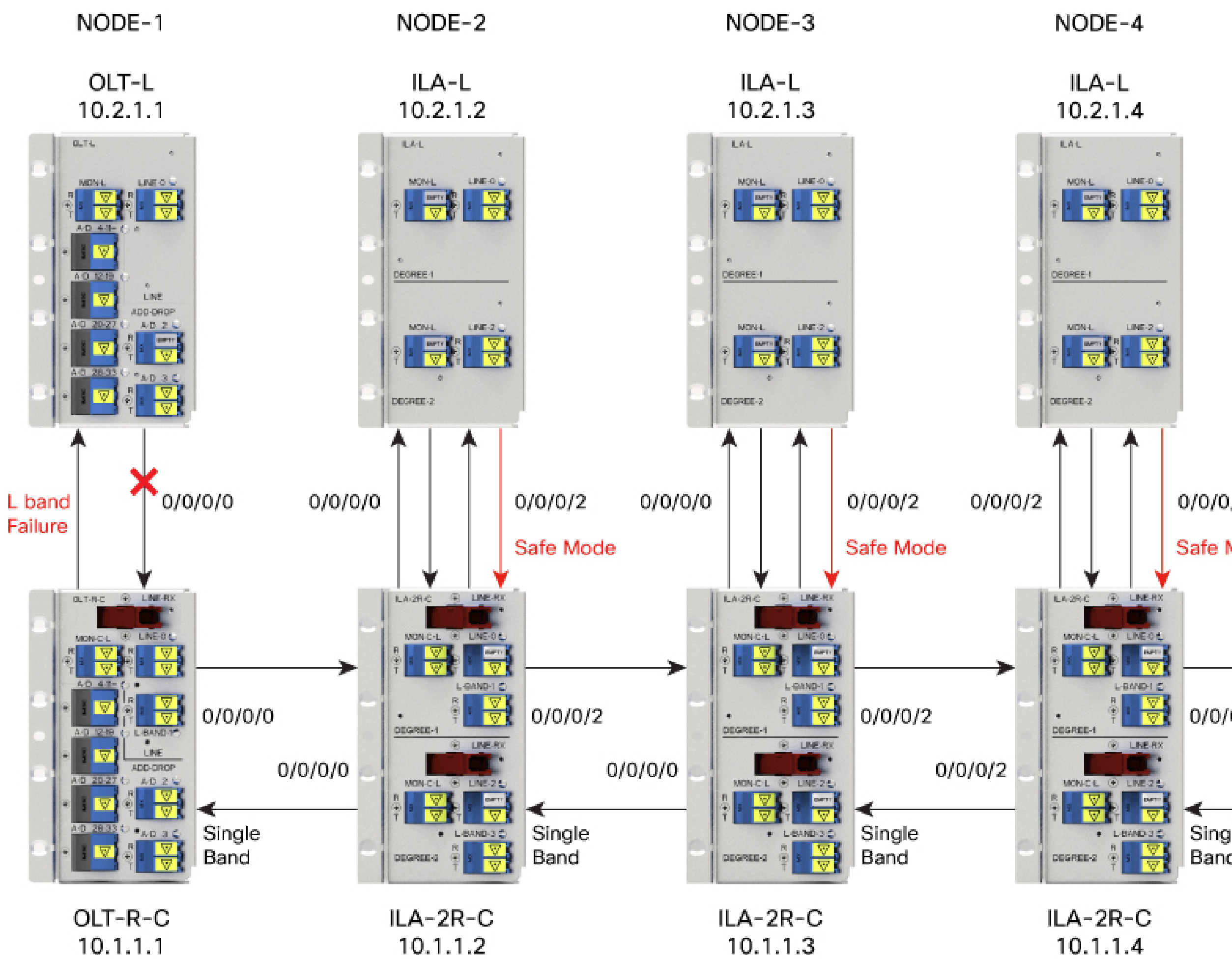
- Optical connectivity fails between devices operating in the C-band and L-band.
- The amplifier or controller on the L-band or C-band device has failed.
- The amplifier on the L-band or C-band is shut down due to Optical Safety Remote Interlock (OSRI).
- The node is shut down due to power failure.
- Line cards operating in the L-band or C-band are in a cold-reload state.
- A card operating in the L-band or C-band fails.
- Multiple fiber cuts and high availability events.
- High back reflection.

**Note** Span fiber failure is not considered as band failure as both bands are impacted due to the failure.

### Example of L-band failure

This scenario illustrates the BFR procedure in the event of an L-band failure. As soon as the band failure is detected, BFR sets safe mode on the failed band devices and switches the PSD profile of the surviving band devices to single-band PSD. The status of the devices operating in the C band is ACTIVE and the PSD profile for the devices is displayed as *Single Band*.

*Figure 2: Example of L-band failure*




This example shows the status of BFR when the L-band is in the FAILED state. In this case, all the C-band nodes are switched to single-band PSD profiles and L-band devices are set to the safe mode.

```
RP/0/RP0/CPU0#show olc band-status
Controller                 : Ots0/0/0/0
Self-Band                  : C-Band
BFR status                 : Running
Node RID                   : 10.2.1.1

Self IP Address            : 192.0.2.1
Self Controller            : Ots0/0/0/0
Partner IP address         : 192.0.2.2
Partner Controller         : Ots0/0/0/0
Partner link status        : UP
C-Band status              : ACTIVE
C-Band PSD                 : Single Band
L-Band status              : FAILED
L-Band PSD                 : NA
Node RID                   : 10.2.1.2

Self IP Address            : 192.0.2.21
Self Controller            : Ots0/0/0/0
```

```
Partner IP address      : 192.0.2.22
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Single Band
L-Band status           : FAILED
L-Band PSD              : NA
Node RID                : 10.2.1.3

Self IP Address         : 192.0.2.31
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.32
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Single Band
L-Band status           : FAILED
L-Band PSD              : NA
Node RID                : 10.2.1.4
Self IP Address     : 192.0.2.41
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.42
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Single Band
L-Band status           : FAILED
L-Band PSD              : NA
Node RID                : 10.2.1.5
Self IP Address     : 192.0.2.51
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.52
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
L-Band status           : FAILED
L-Band PSD              : NA
```

# Band failure recovery in various scenarios

After the optical fiber fault is cleared, BFR starts the recovery procedure on each failed band node individually. BFR also ensures that traffic is not impacted.

### Band failure recovery

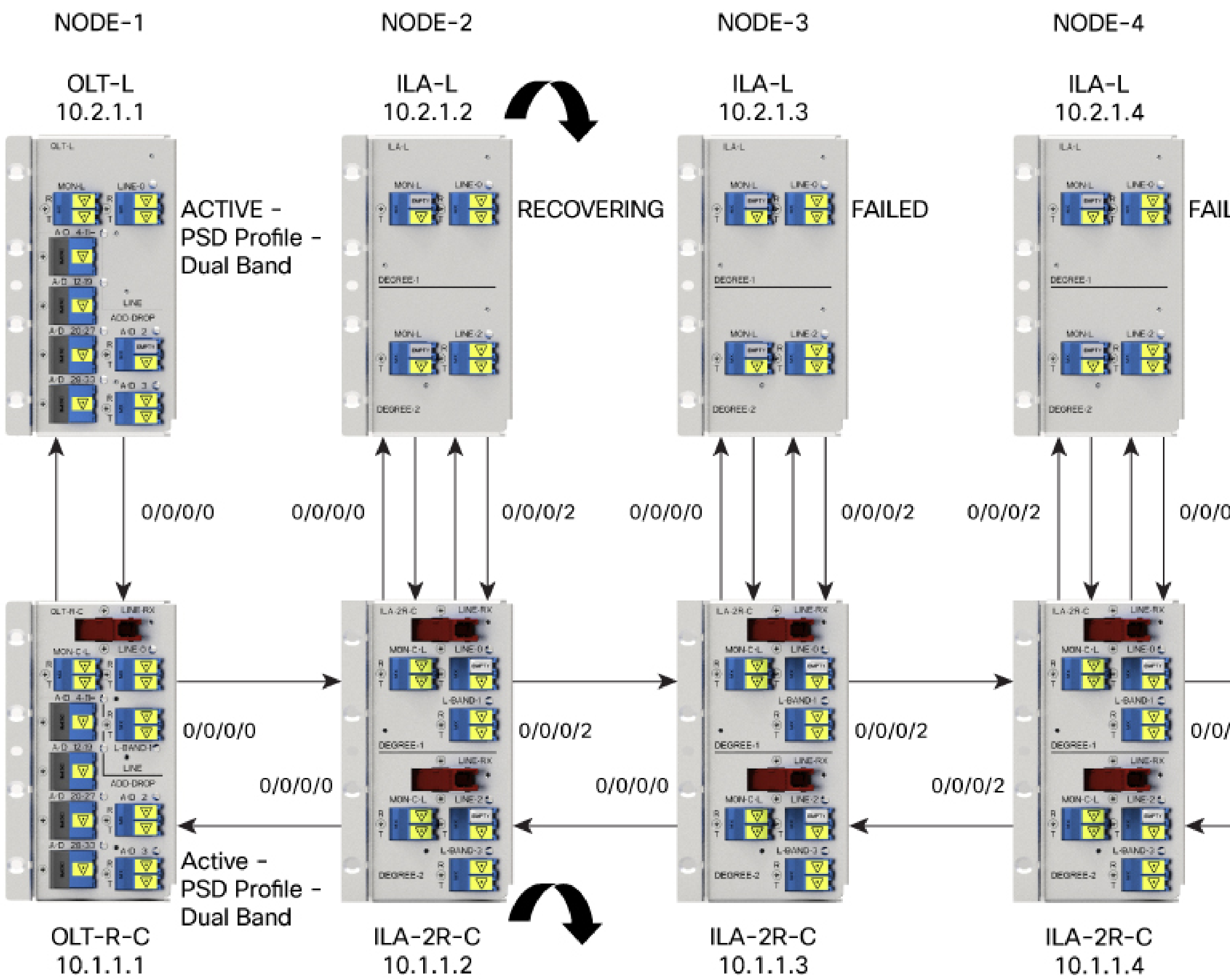
After the optical fiber fault is cleared, BFR starts the recovery procedure on the failed band nodes one at a time. BFR also ensures that traffic is not impacted. The PSD profiles on the recovered and surviving bands are switched to dual-band PSD profiles.

**Note**

- Recovery procedure is initiated only if all the nodes (both C-band and L-band) are active and reachable.
- BFR runs the recovery procedure on the failed band while APC shifts the PSD profiles. APC must be enabled on both C and L-band devices for BFR to work. We recommend pausing BFR before running the **apc-pause** or **apc disable** commands.

This figure shows how BFR recovers from an L-band failure. After the fiber fault is cleared, BFR starts recovery on all C and L-band nodes one node at a time. The recovery procedure on Node 1 is completed and the status is shown as ACTIVE. The recovery procedure on Node 2 is in progress, so the node status is shown as RECOVERING. BFR starts recovery on each remaining node, one at a time, after recovering Node 2.

***Figure 3: Example of BFR recovering nodes***




This example shows the C and L-band status as RECOVERING on the *192.0.2.1* node:

```
RP/0/RP0/CPU0:#show olc band-status
Controller                : Ots0/0/0/0
Self-Band                 : C-Band
BFR status                : Running
Node RID                  : 10.1.1.1
Self IP Address       : 192.0.2.1
Self Controller           : Ots0/0/0/0
Partner IP address        : 192.0.2.2
Partner Controller        : Ots0/0/0/0
Partner link status       : UP
C-Band status             : ACTIVE
C-Band PSD                : Dual Band
L-Band status             : ACTIVE
L-Band PSD                : Dual Band
Node RID                  : 10.1.1.2
```

```
Self IP Address     : 192.0.2.21
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.22
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
```

```
C-Band status           : RECOVERING
```

```
C-Band PSD              : NA
```

```
L-Band status           : RECOVERING
```

```
L-Band PSD              : NA
Node RID                : 10.1.1.3

Self IP Address         : 192.0.2.31
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.32
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Single Band
L-Band status           : FAILED
L-Band PSD              : NA
Node RID                : 10.1.1.4

Self IP Address         : 192.0.2.41
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.42
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Single Band
L-Band status           : FAILED
L-Band PSD              : NA
Node RID                : 10.1.1.5

Self IP Address         : 192.0.2.51
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.52
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
L-Band status           : FAILED
```

### Single band failure recovery on non-Raman network

After the optical fiber fault is cleared, BFR performs these operations for single band failure on a non-Raman network.

- Starts recovery on the failed band one node at a time.
- After the recovery is completed and both bands are active, BFR switches the PSD profiles on both bands to dual-band PSD.

### Span failure recovery

On a C and L band network, when both bands fail, BFR does not change the PSD profile to single-band PSD. After the failure is cleared, both bands recover quickly.

When a span failure is cleared on a Raman network and Raman tuning is disabled, BFR starts recovery of nodes. If Raman tuning is enabled, BFR suspends recovery and resumes it only after Raman tuning is completed.

### Single band failure recovery on a Raman network

On a C+L band network without Raman amplifiers, when a band fails, Loss of Signal (LOS) is reported because the total power drops below the safe value. This shuts down the amplifiers on other nodes. If a band fails on the near end node of a Raman network, the far end amplifiers receive some band power because of ASE. In this case, LOS is not reported and the amplifiers on far end nodes remain active. BFR ensures that recovery on the far end nodes is started even if the amplifiers on the nodes are active because of ASE and sets safe mode on the failed band.

Once the optical fiber fault is cleared on a Raman network, if Raman tuning is started, BFR suspends recovery and resumes it only after Raman tuning is completed. If Raman tuning is not started, BFR starts the recovery of nodes one by one.

### Band failure recovery due to device in headless mode

In the event of a band failure on a network with an OLT device in headless mode, BFR performs these operations.

- BFR does not switch the PSD profile to single-band PSD.
- BFR does not run the recovery procedure.

In the event of a band failure on a network with an ILA device in headless mode, BFR performs these operations.

- BFR switches the PSD profile to single-band PSD on all the nodes that are reachable by C-band OLT.
- BFR does not run the recovery procedure on all the OLT and ILA nodes.
- If one or more nodes on the network are in headless mode, BFR is not initiated, which might affect traffic recovery. Perform these tasks to restore traffic:
  1. Pause BFR
  2. Initialize BFR
  3. Resume BFR

For more information about these commands, see the Command Reference for Cisco NCS 1010 Guide.

### Band failure recovery due to partner link status

On a C+L band network, if there is a connectivity failure between the C-band and L-band ILA nodes, BFR does not start the recovery procedure. If the recovery procedure is running and the *Partner link status* is DOWN, BFR suspends recovery and resumes it after the *Partner link status* changes to UP.

This example shows the output of the **show olc band-status** command with *Partner link status* status set to UP.

```
                RP/0/RP0/CPU0:#show olc band-status
Controller              : Ots0/0/0/0
Self-Band               : C-Band
BFR status              : Running
Node RID                : 10.1.1.1
```

```
Self IP Address         : 192.0.2.1
Self Controller         : Ots0/0/0/0
Partner IP address      : 192.0.2.2
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
```

CHAPTER 9

# Upgrade C-Band to C+L Band Without Affecting Traffic Flow



## Upgrade a C-band network to C+L band without impacting traffic

*Table 12: Feature History*

| Feature Name | Release Information | Description |
| --- | --- | --- |
| Nontraffic Affecting C+L Band Upgrade | Cisco IOS XR Release 7.10.1 | Upgrading an existing C-band network to a C+L band network is now possible without impacting the traffic flow. Cisco Optical Network Planner (CONP) computes the values for relevant parameters in C+L network configuration. The upgrade benefits even those networks that were not planned for a future L-band upgrade. C+L band upgrade enables you to accommodate more bands to your network to boost network bandwidth. |

**Note** Use the Cisco Optical Network Planner (CONP) to compute these values for C-band and L-band devices in C+L network configuration:

1. Single band and dual band target PSD values
2. Gain range for amplifiers

Follow these steps to bring up the L-band node while upgrading a C-band only network to a C+L network.

### Procedure

**Step 1** Configure the required gain and gain-range settings for each L-band node to ensure accurate amplification.

**Note**

Gain-Estimator (GE) must be in `DISABLED` state.

**Example:**

This sample configuration disables gain estimator.

```
RP/0/RP0/CPU0:ios#configure terminal
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#gain-estimator disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
```

**Step 2** Configure single band PSD on all L-band nodes.

**Note**
Link Tuner (LT) must be in `DISABLED` state.

**Example:**

This sample configuration disables link tuner.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#link-tuner disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
RP/0/RP0/CPU0:ios(config-olc-ots)#end
```

**Step 3** Configure the dual band PSD set points obtained from CONP and the partner-band configuration on all L-band nodes.

For more information on L-band dual band PSD configuration, see Modify L-Band Amplifier Properties.

**Step 4** Manually configure the gain and gain-range values computed by the gain-estimator application on all C-band nodes, and then disable the gain-estimator.

**Note**
Disabling Gain estimator causes traffic impact if there is a mismatch between the gain-range configured by the user and the gain-range configured by the gain-estimator.

**Step 5** Manually configure the single band PSD set points obtained from the link tuner on all C-band nodes, and then disable the link tuner.

**Note**
Link tuner is in *Enabled* state in the C-band network. Configure the same PSD values that are obtained from the link tuner and then disable the link tuner. Any mismatch between the PSD value configured by the user and and the PSD value configured by the link tuner leads to traffic impact.

**Step 6** Configure the dual band PSD set points obtained from CONP and the partner-band configuration on all C-band nodes.

For more information on C-Band dual band PSD configuration, see Modify C-Band Amplifier Properties.

**Note**
Ensure that dual band configurations are present (dual band PSD and partner-band) on all the C- and L-band nodes during L-band device addition. If either configuration is missing, BFR does not work properly, and the bands start in an uncontrolled manner. This may impact traffic.

**Step 7** Bring up the connectivity between C-band and L-band devices.

a) Bring up the interlink connectivity between C-band and L-band devices by enabling the management interfaces for partner-band communication between C-band and L-band nodes.
b) Bring up the fiber connectivity between C-band and L-band devices and enable Gigabit Ethernet interfaces.

**Note**

Fiber connectivity is the connection between the L-band port on the C-band nodes and the Line port on the L-band nodes.

c) Verify that the connectivity is fine and there are no alarms present on OSC and OTS controller.
d) After completing the connectivity to the last terminal node, verify that the topology is *UP*, and APC has cleared the *PARTIAL TOPOLOGY* alarm on all OLT C-band and L-band nodes.

**Example:**

This sample is an output of **show olc apc** command.

```
RP/0/RP0/CPU0:OLT1#show olc apc

Controller      : Ots0/0/0/0
APC Status : WORKING
```

**Step 8** On the L-band BFR manager, band status remains *NA* until end-to-end connectivity is up. After the end-to-end terminal (OLT-OLT) is discovered, the band status is updated on all the agent nodes. BFR initiates the BRING UP (RECOVERY) procedure and recovers node one at a time.

**Example:**

This example shows the output of the **show olc band-status** command where the L-Band recovery is not initiated and *BFR status* is *NA*.

```
RP/0/RP0/CPU0:#show olc band-status

Thu Dec 15 13:54:25.703 UTC

Controller              : Ots0/0/0/0
Self-Band               : None
BFR status      : NA
```

This example shows the output of the **show olc band-status** command where the L-Band recovery is in progress and *BFR status* is *Running*.

```
RP/0/RP0/CPU0:#show olc band-status

Thu Dec 15 13:54:25.703 UTC

Controller              : Ots0/0/0/0
Self-Band               : None
BFR status      : Running
Node RID                : 10.1.1.1
Self IP address         : 10.9.1.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.1.1
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status   : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band
Node RID                : 10.2.1.2
Self IP address         : 10.9.2.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.2.1
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status   : RECOVERING
C-Band PSD              : NA
L-Band status           : RECOVERING
L-Band PSD              : NA
Node RID                : 10.2.1.3
```

```
Self IP address         : 10.9.3.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.3.1
Partner Controller      : Ots0/0/0/2
Partner link status     : UP
C-Band status   : RECOVERING
C-Band PSD              : NA
L-Band status           : RECOVERING
L-Band PSD              : NA
Node RID                : 10.2.1.4
Self IP address         : 10.9.4.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.4.1
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status   : RECOVERING
C-Band PSD              : NA
L-Band status           : RECOVERING
L-Band PSD              : NA

Node RID                : 10.2.1.5
Self IP address         : 10.9.5.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.5.1
Partner Controller      : Ots0/0/0/0
Partner link status     : UP
C-Band status           : RECOVERING
L-Band status           : RECOVERING
```

**Step 9** Wait for recovery to complete on all nodes. After recovery, verify the PSD status of the C-band and partner L-band nodes to confirm the PSD profile is *DUAL BAND PSD*.

**Step 10** Verify that BFR converged on all nodes and the state on the agent nodes are *ACTIVE* with *DUAL BAND PSD*. Check the traffic status on C-band nodes and verify that traffic was not impacted during the L-band addition.

**Example:**

This example shows the output of the **show olc band-status** command where the L-Band bring up is complete, PSD profile is *DUAL BAND PSD*, and band status of all the agent nodes is *Active*.

```
RP/0/RP0/CPU0:#show olc band-status

Thu Dec 15 13:54:25.703 UTC

Controller              : Ots0/0/0/0
Self-Band               : None
BFR status      : Running

Node RID                : 10.2.1.1
Self IP address         : 10.9.1.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.1.1
Partner Controller      : Ots0/0/0/0
Partner link status     : UP

C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band

Node RID                : 10.2.1.2
Self IP address         : 10.9.2.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.2.1
```

```
Partner Controller      : Ots0/0/0/2
Partner link status     : UP

C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band

Node RID                : 10.2.1.3
Self IP address         : 10.9.3.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.1.1
Partner Controller      : Ots0/0/0/2
Partner link status     : UP

C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band

Node RID                : 10.2.1.4
Self IP address         : 10.9.4.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.4.1
Partner Controller      : Ots0/0/0/0
Partner link status     : UP

C-Band status           : ACTIVE
C-Band PSD              : Dual Band
L-Band status           : ACTIVE
L-Band PSD              : Dual Band

Node RID                : 10.2.1.5
Self IP address         : 10.9.5.2
Self Controller         : Ots0/0/0/0
Partner IP address      : 10.9.5.1
Partner Controller      : Ots0/0/0/0
Partner link status     : UP

C-Band status   : ACTIVE
L-Band status   : ACTIVE
```

The network now supports simultaneous operation of C-band and L-band wavelengths, resulting in improved bandwidth. This maintains continuous service and ensures that uninterrupted traffic during the upgrade.

CHAPTER 10

# Automatic Link Bringup



## Automatic link bringup

You can bring up an NCS 1010 DWDM link without using any external tools. The device measures optical parameters for all spans at power-up. Each device then computes setpoints for every span to ensure optimal link performance and to allow end-to-end traffic.

### Applications enabling automatic link bringup

These optical applications enable automatic link bringup:

- Span loss measurement
- Gain estimator
- Link tuner
- Automatic power control
- Raman tuning

### Configurations used by automatic link bringup

Automatic link bringup uses these user configurations if they are available:

- Measured span loss
- Fiber type
- Spectral density
- Span length.

### Assumptions of automatic link bringup

Automatic link bringup works under these assumptions:

- The fiber connections are proper. There are no fiber cuts or faulty connectors blocking link bring up.

- OSC link comes up without need for Raman gain. If the span length is high and the device is not able to turn up the OSC without Raman Gain, you must disable Raman tuning and manually configure Raman amplification.

### DHCP and ZTP considerations

You need automatic link bring up after physically installing your device and connecting the fibers as necessary. The automatic link bringup process starts when you turn on a device. A newly powered device has no configuration. First, the device joins the network and obtains an IP address.

The NCS 1010 and NCS 1020 devices use DHCP to get an IP address. After receiving an IP address, the device retrieves a ZTP configuration file from either the DHCP server or a separate ZTP server. Configure the DHCP server with the desired IP address and configuration file for each device you want to configure. The device uses the configuration file and configures itself.

In optical networks with long spans, it is not always practical for all nodes to have direct connectivity to a DHCP server. In such cases, the OLT node that has server connectivity acts as a DHCP relay and provides the next node with DHCP connectivity. The ILA node that connects to the OLT then acts as a DHCP relay for the next ILA node in the link. Each node acts as a DHCP relay for the next adjacent node in the link. See Remote Node Management in NCS 1010 for more information. As this process completes, all nodes get network connectivity and receive the ZTP configuration files. ZTP allows you to provision the network device with day 0 configurations.

The ZTP configuration file must contain these configurations:

- Host configuration
- DHCP relay configuration only if there are nodes further down the link
- Interface configuration
- OSPF configuration
- SSH configuration

See Boot Using Zero Touch Provisioning for more information on configuring and using ZTP.

This example shows a sample ZTP configuration file with the minimum required configuration.

```
!! IOS XR Configuration
!
hostname ios
username cisco
group root-lr
group cisco-support
secret 10
$6$7motIAh93vG/I...$iM64ZfsZ5ciicdcsdsewHdEIvLTq0YEc1G1NMpauwJUiEnkV8LwMJUDZnnTkVj9RPgf4wffWJYelPN7jqiN3q/

dhcp ipv4
profile r1 relay
  helper-address vrf default 10.33.0.51 giaddr 10.7.3.2
!
profile r2 relay
  helper-address vrf default 10.33.0.51 giaddr 10.7.2.2
!
interface GigabitEthernet0/0/0/0 relay profile r2
interface GigabitEthernet0/0/0/2 relay profile r1
!
call-home
service active
```

```
contact smart-licensing
profile CiscoTAC-1
  active
  destination transport-method email disable
  destination transport-method http
!
!
interface Loopback0
ipv4 address 10.3.3.13 255.255.255.255
!
interface GigabitEthernet0/0/0/0
ipv4 address 10.7.2.2 255.255.255.0
!
interface GigabitEthernet0/0/0/2
ipv4 address 10.7.3.2 255.255.255.0
!
router ospf 1
router-id 10.3.3.13
distribute link-state
nsf
network point-to-point
redistribute connected
area 0
  interface Loopback0
  !
  interface GigabitEthernet0/0/0/0
  !
  interface GigabitEthernet0/0/0/2
  !
!
!
ssh server v2
ssh server vrf default
ssh server netconf vrf default
!
end
```

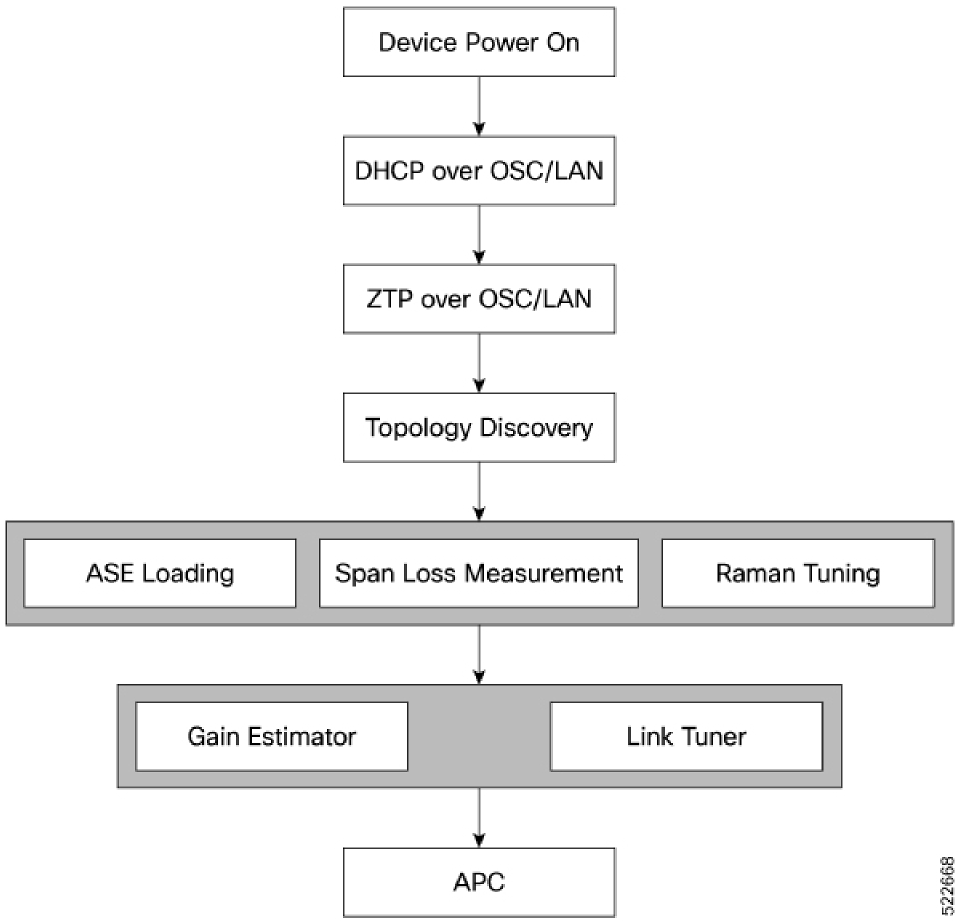
# How optical applications work during automatic link bringup

### Summary

The automatic link bringup process uses integrated optical applications to measure span loss, estimate amplifier gain, tune the link, and control power. This enables automated DWDM optical link activation without manual intervention.

### Workflow

*Figure 4: Sequence of optical applications during automatic link bringup*




These stages describe how optical applications work during automatic link bringup.

1. After you complete ZTP configuration, the NCS 1010 and NCS 1020 devices use OSPF to perform topology discovery.

   Each node identifies its adjacent node and learns the network topology.

2. After discovering neighbor nodes, the device initiates span loss measurement.

3. The device initiates Raman tuning if the span is a Raman span.

4. The OLT begins ASE loading to load all the channels with noise.

5. After ASE loading, span loss measurement, and Raman tuning finish, the device begins startup gain estimation and link tuner operations.

   The startup gain estimation sets the target gain and gain mode for the EDFA amplifier. The link tuner provides the target PSDs for the channels.

**Note** The startup gain estimation analyzes the span loss. It sets the gain mode of the EDFA amplifier and provides the initial target gain for the amplifier. EDFA amplifiers are present in both OLT and ILA variants of NCS 1010. These EDFA amplifiers are variable-gain optical amplifiers capable of working at two different gain ranges or modes. The modes are normal mode and extended mode. Extended mode provides higher gain than the normal mode. Changing the gain mode of an amplifier is impacting traffic. Therefore, Automatic Power Correction (APC) is unable to change the gain mode of an amplifier.

6. After startup gain estimation and link tuner operations finish, the device initiates APC.

   APC uses the target PSDs set by the link tuner and regulates power output for all channels.

**Result**

The automatic link bringup process is complete. The optical link is active, and all the noise channels loaded with ASE have their target PSDs set by the link tuner.

**What's next**

Create and configure optical cross-connects so that traffic runs on the link.

# Enable or disable automatic link bringup

Use this task to automatically bring up the DWDM optical link without manual intervention.

### Procedure

Use these commands to enable automatic link bringup.

**Example:**

```
configure
optical-line-control
automatic-link-bringup
commit
end
```

Use the **no automatic-link-bringup** command to disable automatic link bringup.

CHAPTER 11

# Optical Time Domain Reflectometer

*Table 13: Feature History*

| Feature Name | Release Information | Feature Description |
|---|---|---|
| OTDR enhancements | Cisco IOS XR Release 25.4.1 | These enhancements have been made to OTDR functionality:<br>• OTDR results now include total measured loss and total measured length alongside existing measurements.<br>• Unique names can be assigned to SOR files for easier identification.<br>• SOR files from automatic and manual OTDR scans are organized into separate folders to differentiate between file types.<br>CLI:<br>The keyword **label** *string* is added to the command **otdr-start controller ots** *R/S/I/P direction*. |



## Fiber link monitoring and diagnostics using OTDR

An Optical Time Domain Reflectometer (OTDR) is a fiber optic measurement device that

- captures real-time data on loss and back reflection across fiber links,
- performs bidirectional analysis by connecting to both transmitter (TX) and receiver (RX) ports, and
- enables assessment and ongoing monitoring of fiber quality and performance.

The NCS 1010 OLT and ILA nodes feature in-built bidirectional OTDR functionality, allowing them to measure loss and back reflection in real time for fiber pairs linked to the TX and RX ports. For the OLT device, the OTDR port can switch between LINE-TX and LINE-RX ports. For the ILA device, the OTDR port can switch among LINE-1-TX, LINE-1-RX, LINE-2-TX, and LINE-2-RX ports.

### SOR file

You can view OTDR measurement results in a Standard OTDR Record (SOR) file. The SOR file includes fiber trace details such as distance, reflectance, loss, and fiber attenuation measurements.

You can export the SOR file from NCS 1010 using the command: **scp username@device-ip:filename_with_source_location destination-location**.

**Example:**

```
scp test@192.168.0.1:/harddisk:/otdr/ios_OTDR_Ots0_0_0_0_RX_20230301-101927.sor /users/test/
```

From Release 25.4.1, SOR files from manual and automatic scans are stored in separate folders within the OTDR directory. Automatically generated SOR files are saved in `/harddisk:/otdr/auto/`, while manually triggered SOR files are stored in the existing `/harddisk:/otdr/` folder.

### Benefits

The OTDR offers several key benefits, including:

- Assess the quality of the fiber during system installation, before any live traffic run.
- Monitor the fiber link during operation, including live traffic. You can also monitor the fiber link during troubleshooting after cable cuts or repairs.
- Measure attenuation over the entire fiber link and across individual fiber sections.
- Determine the distance and magnitude of insertion loss and reflection loss.
- Detect fiber events, including concentrated loss events, reflection events, end-of-fiber events, and discontinuities or defects such as pinches or cuts. The OTDR pluggable can also detect loss events from splicing, patch panel connections, and couplers.

# OTDR modes

OTDR modes are operational configurations that

- determine how scan parameters (like pulse width and scan duration) are selected and applied,
- optimize measurements for different user needs or fiber types, and
- support both automated and manual control for various operational scenarios.

An OTDR can operate in several modes to suit different network testing requirements. Selecting the appropriate mode helps ensure efficient, accurate fiber characterization by adapting OTDR performance to the specific task or fiber segment.

These modes are designed to address different testing needs and operational preferences:

1. Auto: The device automatically selects the optimal values for OTDR pulse width, scan duration, capture start time, and capture end time parameters. This is the default mode and does not require explicit configuration. However, you can manually configure the other scan parameters if needed.

2. Expert: You must manually configure all OTDR scan parameters with the valid values that are required for the OTDR measurement. Automatic adjustments are not performed in this mode.

# Configure the OTDR scan parameters

Use this procedure to configure the parameters for the OTDR scan. If you do not configure the parameters, the NCS 1010 device uses the default values.

### Procedure

**Step 1** Enter the OTS controller configuration mode for the port where you want to configure the OTDR parameters.

**Example:**

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
```

**Step 2** Enter the OTDR mode.

| If you want to configure the | then run this command |
|---|---|
| Expert mode | `RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert` |
| Auto mode | Auto mode is the default and you do not need to configure it |

**Step 3** Set the required parameters for the OTDR scan. For a complete list of OTDR parameters, refer to OTDR scan parameters, on page 85.

**Example:**

```
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx auto reflectance-threshold -50
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx auto splice-loss-threshold 200
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx expert pulse-width 6000
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

**Step 4** Commit the changes and exit the configuration mode.

**Example:**

```
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
```

### What to do next

Start the OTDR scan manually, on page 87.

# OTDR scan parameters

This table provides an overview of key OTDR parameters, including their definitions, measurement units, range of values, and the default values.

*Table 14: OTDR scan parameters in Auto mode*

| Parameter | Description | Unit | Range | Default |
|---|---|---|---|---|
| **otdr { rx \| tx} auto reflectance-threshold** <*value*> | Threshold beyond which a reflective anomaly is reported as an event in the Rx or Tx direction. | dB | –50 to –10 | –40 |
| **otdr { rx \| tx} auto splice-loss-threshold** <*value*> | Threshold beyond which a loss anomaly is reported as an event in Rx or Tx direction. | dB | 0.2 to 5 | 0.35 |
| **otdr { rx \| tx} auto excess-reflection-threshold** <*value*> | Threshold beyond which a reflective event is reported as an excessive reflection event in the Rx or Tx direction. | dB | –50 to –10 | –20 |
| **otdr { rx \| tx} auto back-scattering** <*value*> | The back scattering value in the Rx or Tx direction. | dB | –90 to –70 | –81.87 |
| **otdr { rx \| tx} auto refractive-index** <*value*> | The refractive-index value in the Rx or Tx direction. | - | 1.000 to 2.000 | 1.4682 |
| **otdr { rx \| tx} auto excess-orl-threshold**<*value*> | Threshold below which OTDR-ABS-ORL-EXCEEDED alarm is reported in the Rx or Tx direction. | dB | 10–60 | 60 |
| **otdr { rx \| tx} auto excess-attenuation-threshold**<*value*> | Threshold beyond which a Non-Reflective event is reported as an excessive attenuation event in the Rx or Tx direction. | dB | 0.5 to 5 | 5 |
| **otdr { rx \| tx} auto end-of-fiber-loss-threshold** <*value*> | Threshold based on which the OTDR identifies the fiber's end, distinguishing it from other components like splices or connectors. | dB | 5–99 | 5.5 |

*Table 15: OTDR scan parameters in Expert mode*

| Parameter | Description | Unit | Range | Default |
|---|---|---|---|---|
| **otdr {rx \| tx} expert pulse-width** <*value*> | Pulse width to be used during the expert scan in the Rx or Tx direction. | ns | 5–20000 | 20 |
| **otdr {rx \| tx} expert capture-end**<*value*> | OTDR capture endpoint during the expert scan in the Rx or Tx direction. | cm | 0–15000000 | 15000000 |
| **otdr {rx \| tx} expert capture-start** <*value*> | OTDR capture start point during the expert scan in the Rx or Tx direction | cm | 0–10000000 | 0 |
| **otdr {rx \| tx} expert scan duration**<*value*> | OTDR scan duration during the expert scan in the Rx or Tx direction. | Seconds | 0–180 | 60 |

# Start the OTDR scan manually

Manually initiate the OTDR scan to diagnose fiber defects, check fiber quality, or verify proper installation.

**Note** The Raman tuning application locks the OTDR scan at both fiber ends before the tuning starts, and releases the lock after the tuning completes. Therefore, when you try to start the OTDR scan when Raman tuning is running, your request gets rejected.

From Release 25.4.1, you can use the `label` keyword to append a custom substring as a prefix to the SOR file name. This substring helps you identify and retrieve specific SOR files stored in the directory.

### Procedure

**Step 1** Use the **otdr-start controller ots** *R/S/I/P direction* to start the OTDR scan manually.

**Example:**

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx
Wed Feb  9 05:49:39.178 UTC
OTS OTDR Scan Started at RX
RP/0/RP0/CPU0:ios#
```

This example illustrates a rejected OTDR start request. Once an OTDR scan request has been rejected, it will not automatically run after the lock is released. You will need to create a new request to start the OTDR scan again. These examples show that OTDR scan is locked by Raman tuning:

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx
Tue Feb 28 10:25:43.379 UTC
OTDR Scan cannot be started as it is locked by Another Entity/Application.
RP/0/RP0/CPU0:ios#
```

**Step 2** Use the `label` *string* keyword, to append a custom substring as a prefix to the SOR file name.

**Example:**

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx label Site1.ABC_xyz-1
Mon Nov 3 09:56:23.278 UTC
OTS OTDR Scan Started at RX
RP/0/RP0/CPU0:ios#
```

This example appends the string *Site1.ABC_xyz-1* to the SOR file name. For example: `/harddisk:/otdr/Site1.ABC_xyz-1_ios _OTDR_Ots0_0_0_0_RX_20250306-110133.sor`.

The OTDR label must adhere to these limitations: Only the special characters dot, hyphen, and underscore are permitted. The maximum file name length is 255 characters. The maximum label length is 55 characters.

---

The OTDR scan initiates and begins analyzing the fiber. If the scan cannot start, an error message states the reason.

### What to do next

Review scan results to identify defects and assess fiber quality.

## View the OTDR measurements

Use this procedure to view the OTDR scan measurement results.

*Table 16: Feature History*

| Feature Name | Release Information | Description |
|---|---|---|
| Optical Return Loss Reporting | Cisco IOS XR Release 7.11.1 | The Optical Return Loss (ORL) is now calculated during the OTDR scan and displayed as part of the OTDR results. You can also set the ORL threshold value.<br><br>The ORL represents the total reflected optical power from a complete fiber link while accounting for fiber attenuation. When the ORL falls below a user-configured threshold value, the OTDR-ABS-ORL-EXCEEDED-TX or OTDR-ABS-ORL-EXCEEDED-RX alarm is raised. You can troubleshoot fiber transmission issues using the ORL value and OTDR results.<br><br>To set the ORL threshold value, these keywords are added to the controller ots command:<br><br>• otdr rx auto excess-orl-threshold *value*<br><br>• otdr tx auto excess-orl-threshold *value* |

From Release 25.4.1, the OTDR scan measurement results show Total Measured Loss and Total Measured Length.

From Release 7.11.1, Optical Return Loss (ORL) is measured during the OTDR scan and displayed as part of the OTDR results. ORL represents the total reflected optical power from a complete fiber link, while considering the attenuation.

This measurement includes the natural backscattered power of the fiber and the reflected power coming from optical connectors, fiber splicing, or other discontinuities along the link. ORL is expressed with a positive number.

**Note** Higher ORL values are desirable for the fiber because they indicate lower back reflection. For example, an ORL of 40 dB is better than 20 dB.

### Procedure

Use the command **show controllers ots** *R/S/I/P* **otdr-info** *direction* to view the OTDR scan measurements.

**Example:**

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 otdr-info rx
Wed Feb  9 05:55:19.791 UTC
       Scan Direction: RX
       Scan Status: Data Ready
       SOR file: /harddisk:/otdr/IOS_NCS1010_OTDR_Ots0_0_0_0_RX_20220209-055045.sor
       Total Events detected: 11
       Scan Timestamp: Wed Feb  9 05:50:45 2022 UTC
       Event Type Legend:  NR:Non-Reflective  R:Reflective  FE:Fiber-End  ER:Excess-Reflection
      Event#  | Detected Event(s) | Location(km) | Accuracy(m) | Magnitude(dB)| Attenuation/km(dB)
      1       | R                 | 50.4709      | 52.47       | -39.87       |  0.18
      2       | NR                | 50.4709      | 52.47       | 1.17         |  0.18
      3       | R                 | 100.9261     | 102.92      | -37.73       |  0.21
      4       | NR                | 100.9261     | 102.92      | 1.01         |  0.21
      5       | R                 | 105.9500     | 107.94      | -38.52       |  0.24
      6       | NR                | 105.9500     | 107.94      | 0.85         |  0.24
      7       | R                 | 112.7458     | 114.74      | -40.56       |  0.00
      8       | NR                | 112.7458     | 114.74      | 1.48         |  0.00
      9       | NR                | 117.9873     | 119.98      | 0.66         |  -0.02
      10      | R FE              | 120.1206     | 122.12      | -35.55       |  0.00
      11      | NR FE             | 120.1206     | 122.12      | 21.65        |  0.00
```

**Example:**

These are the sample OTDR measurement results displaying Total Measured Loss, Total Measured Length and SOR file with appended OTDR label.

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/2 otdr-info tx
Thu Dec  4 09:28:25.136 IST
        Scan Direction: TX
        Scan Status: Data Ready
        Total Measured Loss: 11.04 dB
        Total Measured Length: 50746.3000 m
        Optical Return Loss: 25.0 dB
        SOR file: /harddisk:/otdr/auto/ios_OTDR_Ots0_0_0_2_TX_20251203-122210.sor
        Total Events detected: 4
        Scan Timestamp: Wed Dec  3 12:22:10 2025 UTC
        Event Type Legend:  NR:Non-Reflective  R:Reflective  FE:Fiber-End  ER:Excess-Reflection
EA:Excess-Attenuation

        Event#      |  Detected Event(s)       |  Location(m)     |  Accuracy(m)     |  Magnitude(dB)
   |  Attenuation/km(dB)
         1          |  NR                       |  0.6800           |  2.00              |  0.66
     |  0.00
         2          |  R                        |  10.4800          |  2.01              |  -33.66
     |  0.00
         3          |  R FE ER                  |  50746.3000       |  52.74             |  -15.28
     |  0.20
         4          |  NR FE                    |  50746.3000       |  52.74             |  11.04
     |  0.20
```

**Note**

The output shows Total measured loss and Total measured length only if a Fiber-End (FE) event is detected.

After you upgrade the FPD of the line card, you may not be able to view the previous OTDR scan results using the **show controllers ots** *Rack/Slot/Instance/Port* otdr-info *direction*. To access results from earlier OTDR scans, locate the .SOR files on the hard disk.

You can dynamically raise or clear Excessive Reflection (ER) and Excess Attenuation (EA) events and alarms by modifying their respective threshold values. In contrast, to raise or clear Fiber End (FE) and Reflectance (R) events, change the relevant thresholds and rerun the OTDR scan.

See OTDR scan measurement results, on page 91 for various examples.

### OTDR scan measurement results

This sample displays the ORL value as part of OTDR status:

```
RP/0/RP0/CPU0:ios#show controllers Ots 0/0/0/2 otdr-info rx
Mon Oct 2 11:55:48.552 UTC
Scan Direction: RX
Scan Status: Data Ready
Optical Return Loss: 39.0 dB
SOR file: /harddisk:/otdr/ios_OTDR_Ots0_0_0_2_RX_20231001-110754.sor
Total Events detected: 8
Scan Timestamp: Sun Oct  1 11:07:54 2023 UTC
Event Type Legend:NR:Non-Reflective R:Reflective FE:Fiber-End ER:Excess-Reflection
EA:Excess-Attenuation
Event# | Detected Event(s)  | Location(m) | Accuracy(m)  | Magnitude(dB)| Attenuation/km(dB)
1      | NR EA              | 4.4100      | 2.00         | 0.69         | 0.00
2      | NR                 | 664.3200    | 2.66         | 0.21         | 0.00
3      | R ER               | 18222.3900  | 20.22        | -33.78       | 0.19
4      | NR                 | 18222.3900  | 20.22        | 0.35         | 0.19
5      | R ER               | 68674.4800  | 70.67        | -32.25       | 0.20
6      | NR                 | 68674.4800  | 70.67        |  0.36        | 0.20
7      | R FE ER            | 118765.2600 | 120.76       | -28.55       | 0.23
8      | NR FE              | 118765.2600 | 120.76       | 25.86        | 0.23
```

# Stop the OTDR scan manually

Use this procedure to stop the OTDR scan manually.

### Procedure

Enter the command **otdr-stop controller ots** *R/S/I/P direction* to stop the OTDR scan.

**Example:**

```
RP/0/RP0/CPU0:ios#otdr-stop controller ots 0/0/0/0 rx
Wed Feb  9 06:03:37.406 UTC
OTS OTDR Scan Stopped at RX
RP/0/RP0/CPU0:ios#
```

# Automatic OTDR scans

An automatic OTDR scan is a fiber diagnostics feature that

- automatically triggers OTDR tests in response to specific events such as span fault, span restoration, device power cycling, and line card cold reload that affect the optical span,
- enables RX directionscanning for comprehensive fault detection and prevents scan collisions, and
- provides rapid fault localization by monitoring and raising relevant alarms during scan execution.

*Table 17: Feature History*

| Feature Name | Release Information | Feature Description |
|---|---|---|
| Automatic OTDR Scan | Cisco IOS XR Release 7.11.1 | An OTDR scan is automatically triggered on Rx direction, whenever events such as span fault, span restore, device power cycle, and line card cold reload occur. The automatic scan lets you quickly identify fiber failure type and fault location.<br>Commands added to enable and view OTDR results:<br>`otdr auto-scan [enable \| disable]`<br>`show olc otdr-status [details]` |

### Autoscan direction and duration

In Release 7.11.1, autoscan is performed only in the Rx direction, regardless of whether the span fault is unidirectional or bidirectional.

In both span up and span down events, the bidirectional OTDR scan process terminates after both Rx and Tx scans have been completed successfully. You can stop the scan sequence by disabling the autoscan feature.

The OTDR autoscan takes less than three minutes to complete. During the autoscan, the OTDR-SCAN-IN-PROGRESS-RX alarm is raised and gets cleared once the scan is finished.

# Autoscan behavior

Autoscan manages OTDR scanning by coordinating access to scanning resources and responding to interactions with manual and application-triggered scans:

Autoscan manages OTDR scanning operations in these ways:

- Autoscan locks the OTDR resource to prevent manual scan triggers using the **otdr-start** command. However, if a manual scan is already in progress, autoscan waits for its completion before proceeding.
- Autoscan terminates any ongoing scan that was triggered by other applications, such as Raman turn-up.

- During autoscan, if a change in Span Status is detected, it terminates the ongoing scan and automatically initiates a new autoscan.

# Criteria for span fault and restoration events

This table lists the detection criteria for span fault and restoration events.

*Table 18: Definition of span up and span down events*

| Events | Non-Raman span | Raman span | Raman span with dual safety configured |
|---|---|---|---|
| **Span Down** | Raise of RX-LOS-P alarm at OSC controller | Raise of RX-LOS-P alarm at DFB controller | Raise of RX-LOS-P alarm at both OSC and DFB controllers |
| **Span Up** | Clearing of RX-LOS-P alarm at OSC controller | Clearing of RX-LOS-P alarm at DFB controller | Clearing of RX-LOS-P alarm at both OSC and DFB controllers |

# Fault and restoration scenarios in bidirectional OTDR

This reference describes how bidirectional OTDR performs automatic scans in fiber networks during both fault (cut) and restoration conditions between nodes, detailing differences for OLT and ILA node types.

### Unidirectional and bidirectional failures between two OLT nodes

This image illustrates the timeslot-based OTDR automatic scans in the event of bidirectional and unidirectional fiber cuts between Node A and Node B.

*Figure 5: Bidirectional autoscan during span fault scenarios*

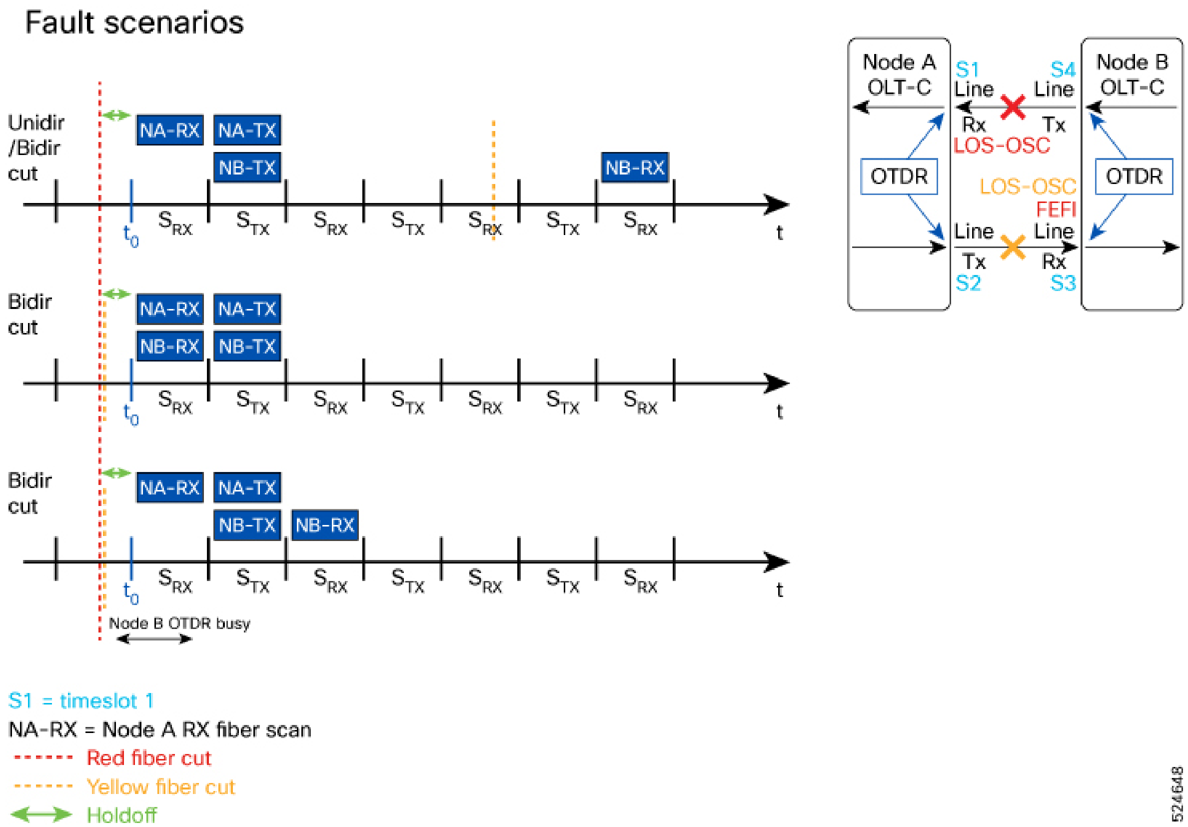



*Table 19: Bidirectional autoscan during span fault scenarios*

| Span fault | How bidirectional scan is performed |
|---|---|
| Scenario 1:A unidirectional fiber cut occurs first, followed by a bidirectional fiber cut after some time. | The fiber cut happens in one fiber. This is marked as a red cross in the image:<br>• In the first timeslot, Node A performs an Rx scan (NA-RX) for the cut fiber.<br>• In the subsequent timeslot, Node A and Node B perform scan in the Tx direction (NA-TX, NB-TX).<br><br>The fiber cut happens in another fiber some time after the unidirectional cut. This is marked as a yellow cross in the image.<br>• Only Node B performs the Rx scan. Node A does not perform any scan as there are no changes detected in Node A. |

| Span fault | How bidirectional scan is performed |
|---|---|
| Scenario 2: Bidirectional cuts happen simultaneously | Both Node A and Node B perform the scans in the RX direction in the first timeslot (t0), and in the Tx direction for the subsequent timeslot. |
| Scenario 3: Node B is busy for some time when bidirectional cuts occur. | Node A performs an Rx scan in one timeslot and continues with the Tx scan in the next timeslot. While Node B waits for the current scan to complete, it starts the Tx scan in the second timeslot and continues the Rx scan in the following timeslot. |

### Unidirectional and bidirectional failure restoration between two OLT nodes

When a fiber fault is restored (span up), the NE and FE nodes coordinate Rx and Tx scans to prevent simultaneous scanning and scan collisions. In this process:

- Rx and Tx scans are performed sequentially, one immediately after the other.
- After restoration, both Tx and Rx scans are performed on the restored fiber, regardless of whether the original cut was unidirectional or bidirectional.

### Unidirectional and bidirectional failure and restoration between two ILA nodes

Bidirectional autoscan behavior between two ILA nodes is the same as that of OLT nodes. The only difference is that the OTDR module is shared between the two line ports in an ILA node. If a simultaneous fault occurs on both sides, the two ports must serialize the scan operations. Each port performs its scan one after the other to avoid overlap and ensure accurate fault detection and restoration.

# Configure automatic OTDR scan

Use this task to enable OTDR scan to run automatically during certain events.

### Procedure

**Step 1** Enter OTS controller configuration mode for the port on which you want to enable automatic OTDR scan.

**Example:**

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control controller Ots 0/0/0/0
```

**Step 2** Enable automatic OTDR scan.

**Example:**

```
RP/0/RP0/CPU0:ios(config-olc-ots)#otdr auto-scan enable
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
```

If you want to disable the automatic OTDR scan, use the **otdr auto-scan disable** command.

Automatic OTDR scans are enabled for the selected port. The system will now run OTDR scans automatically during applicable events, allowing you to proactively monitor fiber links and detect faults without manual intervention.

# Verify autoscan status

Use this procedure to verify the status of the autoscan.

### Procedure

View the automatic OTDR scan results using the command **show olc otdr-status [details]**.

#### Example:

This sample display the status of autoscan triggered due to a span fault. See Automatic OTDR scan results, on page 96 for more examples.

```
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:16:16.461 UTC
Controller                                    : Ots0/0/0/0
Auto-scan Start Time                          : NA
OTDR Auto-scan Status                         : RUNNING
Status Detail                                 : Starting on Span Down
Optical Span Status                           : Down
Trigger Event                                 : Span Fault
Last Trigger Event                            : Span Restore

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:16:33.304 UTC
Controller                                    : Ots0/0/0/0
Auto-scan Start Time                          : 2023-09-18 13:16:27
OTDR Auto-scan Status                         : RUNNING
Status Detail                                 : Waiting Scan Completion on Span Down
Optical Span Status                           : Down
Trigger Event                                 : Span Fault
Last Trigger Event                            : Span Restore

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:18:54.154 UTC
Controller                                    : Ots0/0/0/0
Auto-scan Start Time                          : 2023-09-18 13:16:27
OTDR Auto-scan Status                         : COMPLETED
Status Detail                                 : Completed on Span Down
Optical Span Status                           : Down
Trigger Event                                 : Span Fault
Last Trigger Event                            : Span Fault
```

### What to do next

If events indicate potential fiber issues, review the SOR file or perform additional analysis as needed.

# Automatic OTDR scan results

This table presents automatic OTDR scan results observed across different network scenarios.

*Table 20: Automatic scan results*

| Network scenarios | Sample OTDR scan results |
|---|---|
| Non-Raman span | RP/0/RP0/CPU0:ios#show olc otdr-status<br>Mon Sep 18 13:10:57.733 UTC<br>Controller : Ots0/0/0/0<br>Auto-scan Start Time : NA<br>**OTDR Auto-scan Status : DISABLED**<br>Status Detail : NA<br>Optical Span Status : UP<br>Trigger Event : NA<br><br>RP/0/RP0/CPU0:ios#show olc otdr-status details<br>Mon Sep 18 13:11:00.565 UTC<br>Controller : Ots0/0/0/0<br>Auto-scan Start Time : NA<br>**OTDR Auto-scan Status : DISABLED**<br>Status Detail : NA<br>Optical Span Status : UP<br>Trigger Event : NA<br>Last Trigger Event : NA |
| Raman span | RP/0/RP0/CPU0:ios#show olc otdr-status<br>Mon Sep 18 13:41:05.088 UTC<br>Controller : Ots0/0/0/0<br>Auto-scan Start Time : NA<br>**OTDR Auto-scan Status : DISABLED**<br>**Raman Turn Up Fiber Check : NA**<br>Status Detail : NA<br>Optical Span Status : UP<br>Trigger Event : NA<br><br>RP/0/RP0/CPU0:ios#show olc otdr-status details<br>Mon Sep 18 13:41:08.825 UTC<br>Controller : Ots0/0/0/0<br>Auto-scan Start Time : 2023-09-20<br>13:58:17<br>**OTDR Auto-scan Status : DISABLED**<br>Status Detail : NA<br>**Raman Turn Up Fiber Check : NA**<br>Optical Span Status : UP<br>Trigger Event : NA<br>Last Raman Turn Up Scan Time : NA<br>Last Raman Turn Up Fiber Check : NA<br>Last Trigger Event : NA |

<table>
<tr><th>Network scenarios</th><th>Sample OTDR scan results</th></tr>
<tr><td>Span restore</td><td><pre>
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:12:40.430 UTC
Controller                                   : Ots0/0/0/0
Auto-scan Start Time                         : NA
OTDR Auto-scan Status                        : RUNNING
Status Detail                                : Starting on
Span Up
Optical Span Status                          : Up
Trigger Event                                : Span Restore
Last Trigger Event                           : NA

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:15:06.153 UTC
Controller                                   : Ots0/0/0/0
Auto-scan Start Time                         : 2023-09-18
13:12:42
OTDR Auto-scan Status                        : RUNNING
Status Detail                                : Waiting Scan
Completion on Span Up
Optical Span Status                          : Up
Trigger Event                                : Span Restore
Last Trigger Event                           : NA

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:15:06.153 UTC
Controller                                   : Ots0/0/0/0
Auto-scan Start Time                         : 2023-09-18
13:12:42
OTDR Auto-scan Status                        : COMPLETED
Status Detail                                : Completed on
Span Up
Optical Span Status                          : Up
Trigger Event                                : Span Restore
Last Trigger Event                           : Span Restore
</pre></td></tr>
<tr><td>Autoscan is unable to lock the OTDR resource</td><td><pre>
RP/0/RP0/CPU0:ios# show olc otdr-status details
Wed Sep 20 14:09:37.011 UTC
Controller                                    : Ots0/0/0/0
Auto-scan Start Time                          : 2023-09-20
13:58:17
OTDR Auto-scan Status                         : COMPLETED
Status Detail                                 : Failed due to
 Timeout
Raman Turn Up Fiber Check                     : NA
Optical Span Status                           : UP
Trigger Event                                 : Span Restore
Last Raman Turn Up Scan Time                  : NA
Last Raman Turn Up Fiber Check                : NA
Last Trigger Event                            : NA
</pre></td></tr>
</table>

| Network scenarios | Sample OTDR scan results |
|---|---|
| Autoscan on one port is waiting for the OTDR resource, because the autoscan is running on another port. | <pre>RP/0/RP0/CPU0:ios#show olc otdr-status details<br>Mon Sep 18 15:57:43.671 UTC<br>Controller                                : Ots0/0/0/0<br>Auto-scan Start Time                      : 2023-09-18<br>15:57:43<br>OTDR Auto-scan Status                     : COMPLETED<br>**Status Detail                             : Waiting for<br>OTDR Resource**<br>Raman Turn Up Fiber Check                 : NA<br>Optical Span Status                       : UP<br>Trigger Event                             : Span Restore<br>Last Raman Turn Up Scan Time              : NA<br>Last Raman Turn Up Fiber Check            : NA<br>Last Trigger Event                        : NA</pre> |
| Autoscan is enabled and Raman turnup is disabled on a Raman span<br><br>In this case<br><br>• On the span down event, the autoscan is triggered.<br><br>• On the span up event, autoscan is not triggered and OTDR Autoscan Status will be IDLE, because Raman pumps are turned on before the start of autoscan.<br><br>• On the span up event, autoscan is triggered and *OTDR Autoscan Status* is displayed as RUNNING. | <pre>RP/0/RP0/CPU0:ios#show olc otdr-status details<br>Sat Sep 23 12:42:11.304 UTC<br>Controller                                : Ots0/0/0/0<br>Auto-scan Start Time                      : NA<br>**OTDR Auto-scan Status                     : IDLE**<br>Status Detail                             : NA<br>Raman Turn Up Fiber Check                 : NA<br>Optical Span Status                       : UP<br>Trigger Event                             : Span Fault<br>Last Raman Turn Up Scan Time              : NA<br>Last Raman Turn Up Fiber Check            : NA<br>Last Trigger Event                        : Span Restore</pre> |
| Ongoing autoscan is stopped by the user | <pre>RP/0/RP0/CPU0:ios#show olc otdr-status details<br>Mon Sep 18 15:08:27.370 UTC<br>Controller                                : Ots0/0/0/0<br>Auto-scan Start Time                      : 2023-09-18<br>15:08:09<br>OTDR Auto-scan Status                     : COMPLETED<br>**Status Detail                             : Stopped by<br>User**<br>Raman Turn Up Fiber Check                 : NA<br>Optical Span Status                       : DOWN<br>Trigger Event                             : Span Fault<br>Last Raman Turn Up Scan Time              : 2023-09-18<br>14:55:40<br>Last Raman Turn Up Fiber Check            : Success<br>Last Trigger Event                        : Span Restore</pre> |

See OTDR scan status, on page 100 for a list of the different OTDR scan statuses and their definitions.

# OTDR scan status

This section describes and explains the various OTDR statuses that appear when using the **show olc controller ots R/S/I/P otdr-status** and **show controller ots R/S/I/P otdr-info** commands.

*Table 21: OTDR scan status*

| Scan status | Description |
|---|---|
| Measuring | OTDR scan is currently in progress. |
| Data Processing | OTDR scan has completed, and the data is ready for review |
| Data Ready | OTDR scan is stopped by the user, when it is in progress. |
| Stopped | OTDR is processing data just before populating the event table. |
| Error | The OTDR status may occasionally enter an Error state for various unpredictable reasons. One possible cause is a timeout event, which occurs if the scan is not completed within five minutes. In such cases, no SOR files or event table is generated. It is important to note that this is a rare occurrence. You can still initiate the OTDR scan to obtain the scan results. |

This table explains the various OTDR scan statuses that are applicable for manual and autoscan.

*Table 22: OTDR scan status applicable for manual and autoscan*

| Type of OTDR scan | Scan Status | |
|---|---|---|
| | show olc controller ots R/S/I/P otdr-status | show controller ots R/S/I/P otdr-info |
| Manual | NA | • Measuring<br>• Data Processing<br>• Data Ready<br>• Stopped<br>• Error |
| Autoscan | • Measuring<br>• Data Processing<br>• Data Ready<br>• Stopped<br>• Error | • Measuring<br>• Data Processing<br>• Data Ready<br>• Stopped<br>• Error |