

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

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C-band to C+L band upgrades

A C-band to C+L band upgrade is a network capacity enhancement that

- integrates additional L-band optical channels alongside existing C-band channels,
- enables service providers to increase overall fiber bandwidth, and
- maintains the original C-band infrastructure, minimizing service interruptions during the upgrade.

Table 1: Feature History

Feature Name	Release Information	Description
Nontraffic- Affecting C+L Band Upgrade	Cisco IOS XR Release 26.1.1	You can now upgrade an existing C-band network to a C+L band network using **C+L** or **C+L Futuristic** Band Type, without affecting traffic flow. Cisco Optical Network Planner (CONP) computes the values for relevant parameters in a C+L network configuration. The C+L band upgrade allows you to add more bands to your network and increase its bandwidth.

Key components of C+L band upgrade

These components work together during a C+L band upgrade:

- **Cisco Optical Network Planner (CONP):** Computes target PSD values and amplifier gain ranges for C-band and L-band devices; requires manual partner-band configuration through CLI.
- **Partner-band port:** Facilitates communication between C-band and L-band nodes by utilizing an available management port. To establish this connection, the management port IP addresses must be cross-configured on both nodes.

- **Band Failure Recovery (BFR):** Initiates the recovery procedure on the L-band node once end-to-end terminal connectivity is established.
- **Link Tuner (LT) and Gain Estimator (GE):** Ensures precise power level computation and transitions the PSD profile from Single Band to Dual Band.

Upgrade a C-band network to C+L band

Upgrade your optical network from C-band to C+L band to enable additional wavelengths and bandwidth, ensuring uninterrupted traffic flow during the transition.

Perform this task using the Cisco Optical Network Planner (CONP) to compute and configure parameters for both C-band and L-band devices in the C+L band network.

Before you begin

Note

- Use the Cisco Optical Network Planner (CONP) to compute values for C-band and L-band devices in C+L network configuration. You must design the network in CONP using either band type **C+L** or **C+L Futuristic** to generate parameters related to the C+L network.
- For initial network planning in the Cisco Optical Network Planner, it is highly recommended to select the **C+L Futuristic**configuration if you expect to expand to the L-band in the future. Deploying with **C-Band** mode initially will require Raman tuning to be re-triggered to switch to **C+L** mode during future expansions. This recalibration process is a traffic-impacting operation. By configuring for **C+L Futuristic** mode from the beginning, you can minimize the risk of service disruption during future capacity upgrades.

Follow these steps to upgrade your C-band network to C+L band without disrupting traffic:

Procedure

Step 1 Upload CONP XML configuration files to both C-band and L-band devices by specifying the XML file location.

Example:

This is a sample to specify the XML file location and initiate the configuration upload.

```
netconf-yang-console file harddisk:/CONP-CL-ILA.xml
```

Step 2 Establish connectivity between C-band and L-band devices.

a) Establish 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.

Example:

In this sample, `Mgmt0` is used for node management (DCN) and `Mgmt1` is used for partner band connectivity.

```
RP/0/RP0/CPU0:ios#show ipv4 interface brief
Fri Jun 19 12:38:04.338 IST

Interface                      IP-Address      Status          Protocol Vrf-Name
Loopback0                      10.1.1.1        Up              Up       default
GigabitEthernet0/0/0/0         10.1.1.1        Up              Up       default
MgmtEth0/RP0/CPU0/0            4.34.0.21       Up              Up       default
```

```
PTP0/RP0/CPU0/0                unassigned      Shutdown        Down     default
MgmtEth0/RP0/CPU0/1            27.1.1.1        Up              Up       default
PTP0/RP0/CPU0/1                unassigned      Shutdown        Down     default
MgmtEth0/RP0/CPU0/2            unassigned     Up              Up        default
MgmtEth0/RP0/RCOM0/0           unassigned      Shutdown        Down     default
```

b) Establish fiber connectivity between C-band and L-band devices. Enable Gigabit Ethernet interfaces for L-band devices.

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) Configure partner-band settings on both C-band and L-band nodes by entering the required CLI command.

Note
CONP does not automatically generate the partner-band configuration. You must manually set up the configuration on the device using CLI commands.

Example:

In this sample, `27.1.1.4` is the `Mgmt1IP` of the L band node. The same configuration must be applied to the L-band node by providing the C-band's `Mgmt1` connectivity. This configuration is required for both the C band and L band. On the L band, the C band `Mgmt1IP` will be configured, and vice versa.

This is a sample for partner band configuration.

```
RP/0/RP0/CPU0:ios(config)#optical-line-control
RP/0/RP0/CPU0:ios(config-olc)# controller Ots0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#partner-band-port ip address 27.1.1.4 controller Ots0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
Fri Jun 19 11:28:53.411 IST
```

This is a sample to verify if partner band link is up.

```
RP/0/RP0/CPU0:ios#sh olc partner-band-loss
Mon Jun 22 15:03:23.802 IST
Controller                        : Ots0/0/0/0
Partner IP address                : 27.1.1.4
Partner Controller                : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX  : 1.8 dB
L-LINE-TX Patchcord Loss          : 0.5 dB
C-LINE-RX Path Loss at L-LINE-RX  : 1.8 dB
L-LINE-RX Patchcord Loss          : 0.0 dB
Loss Measurement Timestamp        : 2026-06-20 13:31:44
```

d) After connecting 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
```

e) Ensure connectivity is established and that no alarms are present on the OSC and OTS controllers.

Step 3 Ensure that the Link Tuner (LT) and Gain Estimator (GE) are enabled on both C-band and L-band devices.

Example:

This is a sample to verify the gain estimator.

```
RP/0/RP0/CPU0:ios#show olc gain-estimator
Fri Jun 19 12:50:52.268 IST
Controller                          : Ots0/0/0/0
Config Mode                         : ENABLED
Ingress Gain Estimator Status       : IDLE
Ingress Estimated Gain              : 12.9 dB
Ingress Estimated Gain Mode         : Normal
Ingress Gain Estimation Timestamp   : 2026-06-19 10:30:14
```

Example:

This is a sample to verify the link tuner for single-band and dual-band.

```
RP/0/RP0/CPU0:ios#show olc link-status
Fri Jun 19 12:46:17.668 IST

Controller             : Ots0/0/0/0
Status                 : RUNNING
Last Update            : -

Node RID 10.1.1.1
-------------------------------------------------------------------------------
                              C-Band                   L-Band
Controller                 Ots0/0/0/0               Ots0/0/0/0
Link Tuner Status         OPERATIONAL              OPERATIONAL
Tx Ampli Power (dBm)             22.4                     24.5
-------------------------------------------------------------------------------
PSD (dBm/12.5 GHz)        Single Band    Dual Band  Single Band    Dual Band
Average                          -4.7         -4.7         -4.6         -5.6

Node RID 11.1.1.2
-------------------------------------------------------------------------------
                              C-Band                   L-Band
Controller                 Ots0/0/0/2               Ots0/0/0/2
Link Tuner Status         OPERATIONAL              OPERATIONAL
Gain Estimator Status            IDLE                     IDLE
Tx Ampli Gain Mode              Normal                   Normal
Tx Ampli Power (dBm)             22.4                     24.5
-------------------------------------------------------------------------------
PSD (dBm/12.5 GHz)        Single Band    Dual Band  Single Band    Dual Band
Average                          -4.1         -4.1         -4.1         -4.1

Node RID 11.1.1.3
-------------------------------------------------------------------------------
                              C-Band                   L-Band
Controller                 Ots0/0/0/0               Ots0/0/0/0
Gain Estimator Status     OPERATIONAL              OPERATIONAL
Rx Ampli Gain Mode              Normal                   Normal


RP/0/RP0/CPU0:ios#show olc link-tuner
Fri Jun 19 12:47:08.014 IST
Controller          : Ots0/0/0/0
Config Mode         : ENABLED
Spectral Density    : 50 %
Link Tuner Status   : OPERATIONAL
Last PSD computation: 2026-06-19 12:47:07
-------------------------------------------------------------------
Single Band
-------------------------------------------------------------------
```

```
Setpoint            : Computed PSD
                       (dBm/12.5 GHz)
-------------------------------------------------------------------------
01                      -5.6
02                      -5.5
03                      -5.5
04                      -5.4
05                      -5.4
06                      -5.3
07                      -5.2
08                      -5.2
09                      -5.1
10                      -5.1
11                      -5.0
12                      -4.9
13                      -4.9
14                      -4.8
15                      -4.8
16                      -4.7
17                      -4.7
18                      -4.6
19                      -4.5
20                      -4.5
21                      -4.4
22                      -4.4
23                      -4.3
24                      -4.3
22                      -4.4
23                      -4.3
24                      -4.3
25                      -4.2
26                      -4.1
27                      -4.1
28                      -4.0
29                      -4.0
30                      -3.9
31                      -3.9
32                      -3.8
33                      -3.7

-------------------------------------------------------------------------
Dual Band
-------------------------------------------------------------------------
Setpoint            : Computed PSD
                       (dBm/12.5 GHz)
-------------------------------------------------------------------------
01                      -4.7
02                      -4.6
03                      -4.6
04                      -4.5
05                      -4.4
06                      -4.3
07                      -4.2
08                      -4.2
09                      -4.1
10                      -4.0
11                      -3.9
12                      -3.8
13                      -3.8
14                      -3.7
15                      -3.6
16                      -3.5
17                      -3.4
18                      -3.3
```

```
19                    -3.3
20                    -3.2
21                    -3.1
22                    -3.0
23                    -2.9
24                    -2.9
25                    -2.8
26                    -2.7
27                    -2.6
28                    -2.5
29                    -2.5
30                    -2.4
31                    -2.3
32                    -2.2
33                    -2.1
```

Step 4 On the L-band BFR manager, band status remains *NA* until end-to-end connectivity is established. When the system discovers the end-to-end terminal (OLT-OLT), all agent nodes update their band status. BFR then initiates the BRING UP (RECOVERY) procedure and recovers nodes 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:ios#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:ios#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 5 Wait until recovery is complete on all nodes. Then, verify the PSD status of the C-band and partner L-band nodes to confirm that the PSD profile is *DUAL BAND PSD*.

Step 6 Verify that BFR has 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 confirm 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:ios#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
```

Step 7 Perform these tasks to verify the upgrade.

- **Verify APC state:** Ensure that APC is in the **IDLE** state on both C-band and L-band nodes using the `show olc apc`command.

```
RP/0/RP0/CPU0:ios#show olc apc
Wed Jun 24 12:01:03.321 IST
Controller      : Ots0/0/0/0
APC Status      : IDLE
Correcting Node : 11.1.1.2
Node RID        : 10.1.1.1
Internal State  : IDLE
Node RID        : 11.1.1.2
Internal State  : IDLE
Node RID        : 11.1.1.3
Internal State  : IDLE
```

- **Check for alarms:** Check if a "Patch loss exceeded" alarm is present.

```
RP/0/RP0/CPU0:ios#sh alarms brief system active
0/0/NXR0        Minor        Software         11/14/2023 15:19:00 UTC    Ots0/0/0/0 - Measured
```

```
Patchcord Loss above the Threshold


RP/0/RP0/CPU0:ios#show olc partner-band-loss
Tue Nov 14 15:54:14.442 UTC
Controller                        : Ots0/0/0/0
Partner IP address                : 10.58.1.1
Partner Controller                : Ots0/0/0/0
L-LINE-TX Path Loss at C-LINE-TX  : 2.7 dB
L-LINE-TX Patchcord Loss          : 1.3 dB
C-LINE-RX Path Loss at L-LINE-RX  : 1.8 dB
L-LINE-RX Patchcord Loss          : 0.2 dB
Loss Measurement Timestamp        : 2023-11-14 15:54:13
```

If this alarm is detected, perform one of these corrective actions:

- Clean the L-band line port and the C-band's L-band port.
- Replace the patch cable.
- Change the patch loss threshold to a higher value. The default is 0.5 dB.

  In this sample the patch loss threshold is set to 2 dB.

```
RP/0/RP0/CPU0:ios(config)#optical-line-control controller Ots 0/0/0/0 patchcord-loss-threshold
 20
RP/0/RP0/CPU0:ios(config)#commit
Wed Jun 24 12:05:21.215 IST
```

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