Configuring Controllers

This chapter describes the Optics Controller and Coherent DSP Controller for the 6-port Coherent Line Card (NC55-6X200-DWDM-S). This chapter also describes the procedures used to configure the controllers.

Note When you plan to replace a configured optical module with a different type of optical module, you must clear the configurations of the old module before installing the new optical module.

Note When two MACsec enabled Cisco NCS 5500 routers with Coherent Line Cards are connected, there is no compatibility between Coherent Line Cards of IOS XR Release version 6.5.x (or lower) and 6.6.1 (or higher).

Optics Controllers

Controllers are represented in the *rack*/*slot*/*instance*/*port* format (*r*/*s*/*i*/*p*); for example, 0/3/0/1. Each port has an optics controller that is created on startup.

Note You must shut down the optics controller before you perform any of the following tasks:

- Configure the controller
- Restore a saved configuration
- Upgrade the DSP processor or CFP2 optics module Field Programmable Device (FPD)

Note When there are dualrate optics on NCS-57C3-MOD-S/-SE-S + NC57-MPA-12L-S, and while configuring lower speed, you may see a few initial link flaps, after that the link stabilizes and no further flaps will be seen.

CFP2 DCO Optics Support

There are two hardware versions of the CFP DCO optics (A0 and B0). You can identify the version A0 and B0 using a show coherent driver internal location 0/0/CPU0 command and looking at "VID".

A0 = V01

B0 = V02

The CFP2 DCO version A0 optics support the following traffic types:

Traffic Type Index	Speed	Modulation	Forward Error Correction	Differential
1	100G	qpsk	15sdfec	disable
2	100G	qpsk	15sdfecde	enable
3	200G	16qam	15sdfec	disable
4	200G	8qam	15sdfec	disable

The CFP2 DCO version B0 optics support the following traffic-types:

Traffic Type Index	Speed	Modulation	Forward Error Correction	Differential
1	100G	qpsk	15sdfec	disable
2	100G	qpsk	15sdfecde	enable
3	100G	qpsk	otu7staircase	enable
4	200G	16qam	15sdfec	disable
5	200G	8qam	15sdfec	disable

The 100G/Staircase FEC traffic-type is supported with CFP2 DCO version B0 optics.

Bidirectional CFP2 DCO Optics Support

Table 1: Feature History Table

Feature Name	Release	Description
Support for DP04CFP2-D15 Bidirectional CFP2-DCO Optical Module	Release 7.8.1	In this release, support for DP04CFP2-D15 bidirectional CFP2-DCO optical module is added for NC55-MOD-A-S and NCS-55A2-MOD-S routers with the following MPAs: • NC55-MPA-2TH-S • NC55-MPA-1TH2H-S The bidirectional CFP2-DCO optical module allows for data transmission and reception in both directions over a single fiber of a network, offering a cost and operationally effective method for expanding the network capacity in fiber-restricted networks.

The bidirectional CFP2-DCO optical module provides an effective way to increase the network capacity in situations where only single fiber is available. The bidirectional CFP2-DCO optical module enables data transmission and reception in both directions over single fiber of a network. Using dense wavelength division multiplexing (DWDM), the bidirectional CFP2-DCO optics can operate at 100G and 200G speeds through NC55-MPA-2TH-S and NC55-MPA-1TH2H-S MPAs operating in NC55-MOD-A-S and NCS-55A2-MOD-S routers.

The bidirectional CFP2 DCO optics support the following traffic configurations:

Speed	Modulation	Forward Error Correction	Differential
100G	qpsk	ofec	disable
200G	qpsk	ofec	disable

The bidirectional CFP2 DCO optics support the following Tx-Rx channel mapping:

Table 2: Tx-Rx Channel Map

Tx channel	Rx channel
1	3
5	7
9	11
13	15

Tx channel	Rx channel
17	19
21	23
25	27
29	31
33	35
37	39
41	43
45	47
49	51
53	55
57	59
61	63
65	67
69	71
73	75
77	79
81	83
85	87
89	91
93	95

Configuring Bidirectional CFP2 DCO Optical Module

This example shows steps to configure a 200G bidirectional CFP2 DCO optical module with Tx channel 1 and Rx channel 3:

```
RP/0/RP0/CPU0:router(config)#controller optics 0/0/1/0
RP/0/RP0/CPU0:router(config-optics)#port-mode 200G qpsk ofec diff disable
RP/0/RP0/CPU0:router(config-optics)#commit
RP/0/RP0/CPU0:router(config-optics)#dwdm-carrier 50Ghz-grid itu-ch 1
RP/0/RP0/CPU0:router(config-optics)#commit
RP/0/RP0/CPU0:router(config-optics)#exit
RP/0/RP0/CPU0:router(config)#controller optics 0/0/1/1
RP/0/RP0/CPU0:router(config-optics)#port-mode 200G qpsk ofec diff disable
RP/0/RP0/CPU0:router(config-optics)#commit
RP/0/RP0/CPU0:router(config-optics)#dwdm-carrier 50Ghz-grid itu-ch 3
```

```
RP/0/RP0/CPU0:router(config-optics)#commit
RP/0/RP0/CPU0:router(config-optics)#exit
```

Verification

This example displays the verification of bidirectional CFP2 DCO optical module communication between 0/0/1/0 and 0/0/1/1:

```
RP/0/RP0/CPU0:router#show coherent driver summary location 0/0/CPU0
Thu Sep 29 03:23:58.778 UTC
=============================================================================================================
PORT       ADMIN-STATE    PLUGGABLE   TRAFFIC TYPE                FREQUENCY(100Mhz)
LASER STATE
=============================================================================================================
0/0/1/0    UP             CFP2        200G_QPSK_0-FEC_NODIFF      1961000
OFF
0/0/1/1    UP             CFP2        200G_QPSK_0-FEC_NODIFF      1960000
OFF
```

Maintenance Mode

Coherent DSP controllers can be placed in maintenance mode. Use the **controller coherentDSP secondary-admin-state maintenance** command to place controllers in maintenance mode.

Use the **show controllers optics** *r*/*s*/*i*/*p* command to view optics parameter values, laser state, controller state, admin state, and trunk alarms on the card, and threshold values for the different optics parameters.

Use the **show controllers coherentDSP** *r*/*s*/*i*/*p* command to view the DSP controller state and alarm status and statistics.

Note In maintenance mode, all alarms are suppressed and the **show alarms** command does not display alarm details. However, traffic is not affected in maintenance mode.

Note The FEC is disabled for 25G and 50G optics in NC57-MPA-12L-S MPA when connected on 55A2-MOD-SE-S/-SE-H-S router, and in Line card NC57-MOD-S while verifying the FEC status using **show controllers** { **TwentyfiveGigE** | **FiftyGigE**}

Performance Monitoring

Performance monitoring (PM) parameters are used by service providers to gather, store, set thresholds for, and report performance data for early detection of problems. The user can retrieve both current and historical PM counters for the various controllers in 30-second, 15-minute, and 24-hour intervals.

PM for optical parameters include input signal power and transmit power, optical signal-to-noise ratio, chromatic dispersion, polarization dependent loss, second order polarization mode dispersion, differential group delay, and transmitter laser bias current.

PM for DSP parameters include:

- FEC: error corrected bits, uncorrectable blocks, pre-FEC BER (block errors ratio)

- OTN: errored seconds, severely effected seconds, unavailable seconds, failed counts

These parameters simplify troubleshooting operations and enhance data that can be collected directly from the equipment.

Fibre Channel over PLE Transmission Using TTS Auto-Negotiation

Table 3: Feature History Table

Feature Name	Release Information	Feature Description
Fibre Channel over PLE Transmission Using TTS Auto-Negotiation	Release 7.10.1	Introduced in this release on: NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5700 line cards [Mode: Compatibility; Native]) You can now enhance transmission speed and connectivity between ports with Fibre Channel (FC) over Private Line Emulation (PLE) using Transmitter Training Signal (TTS) with auto-negotiation function. FC over PLE technology facilitates fast and efficient connections and data storage replication between multiple data centers in a Storage Area Network (SAN) spanning different geographical locations. TTS is a feature introduced for the 32G FC ports. The feature introduces these changes: • **CLI:** The **tts** keyword is added to the **controller** command for FC. • **YANG Data Model:** New XPaths for `Cisco-IOS-XR-mpls-te-cfg.yang` (see GitHub, YANG Data Models Navigator)

SAN replication, or Storage Area Network replication, is a technology used in data storage and disaster recovery strategies to create redundant copies of data between storage systems located in different geographical locations. The primary goal of SAN replication is to ensure data availability, business continuity, and data protection in case of hardware failures, data corruption, or site-level disasters. SAN replication typically involves two or more storage arrays connected through a high-speed network, such as Fibre Channel.

SAN extension technologies enable the connection of remote storage systems, facilitating the replication of data between them. Together, SAN extension and replication form an integrated solution that provides both data replication and data accessibility between geographically dispersed data centers.

Private Line Emulation (PLE) using Transmitter Training Signal (TTS) with auto-negotiation function emulates the switching capabilities of FC ports without requiring dedicated equipment, enabling seamless interconnection between optical networks and Ethernet networks. FC over PLE involves extending FC connections using dedicated leased lines or private circuits. It's used for scenarios where the FC traffic needs to travel over a controlled and secure network, such as for SAN disaster recovery purposes.

The following illustration shows the example of an FC over PLE transmission between two SAN sites connected to two PE routers* using 32G FC ports through an MPLS core network.

Figure 1: FC over PLE Transmission between two SANs Through MPLS Core Network

* NCS 5700 fixed port routers; NCS 5500 modular routers (NCS 5700 line cards [Mode: Compatibility; Native]

When transporting Private Line Emulation (PLE) FC client traffic over an MPLS core network, TTS facilitates communication between sender and receiver FC ports. It allows both ends of the FC link to adjust their equalization settings based on the actual characteristics of the link, considering factors like distance, cable quality, and signal attenuation. As a result, the FC receiver uses this information to optimize the signal reception and compensate for any signal impairments that might occur during data transmission.

Restrictions and Usage Guidelines for FC over PLE transmission using TTS Auto-Negotiation

The following restrictions and guidelines are applicable for FC over PLE transmission using TTS:

- You must enable the FC ThirtyTwoGigFibreChanCtrlr controller interface (32G FC) on the NCS 5500 or NCS 5700 devices that are connected to the SAN devices.
- You must configure this feature only on the PLE MPA1 even ports, that is, 0, 2, 4, 6, and so on.

Configure FC over PLE transmission using TTS Auto-Negotiation

Perform the following tasks to configure the FC over PLE transmission using TTS auto-negotiation:

1. Enable the FC controller interface.

```
Router(config)# controller Optics0/0/1/6
Router(config-Optics)# port-mode FC framing cem-packetize rate FC32
Router(config-Optics)# commit
Router(config-Optics)# exit
```

2. Configure TTS

```
outer(config)# controller ThirtyTwoGigFibreChanCtrlr 0/1/1/0
Router(config-ThirtyTwoGigFibreChanCtrlr)# tts
Router(config-ThirtyTwoGigFibreChanCtrlr)# commit
```

Running Configuration

```
Router# show running-config controller ThirtyTwoGigFibreChanCtrlr 0/1/1/0
controller ThirtyTwoGigFibreChanCtrlr 0/1/1/0
tts
!
```

Verification

The following example shows the operational speed value of the 32G FC port used for PLE transmission:

```
Router# show controllers ThirtyTwoGigFibreChanCtrlr 0/1/1/0
Operational data for Fibre Channel controller ThirtyTwoGigFibreChanCtrlr 0/1/1/0
State:
 Admin State : Up
 Operational state : Down
 LED state : Red On
 Secondary admin state : Normal
 Laser Squelch : Disabled
Performance Monitoring is enabled
Operational values:
 Speed : 32 Gbps
 Loopback : None
 BER monitoring:
 Signal Degrade : 1e-0
 Signal Fail : 1e-0
 Hold-off Time : 0 ms
 Forward Error Correction : Not Configured
```

How to Configure Controllers

This section contains the following procedures:

Configuring Optics Controller

You can configure parameters such as performance monitoring, high power threshold, and wavelength for Optics controller.

To configure the Optics controller, use the following commands:

Before you begin

You must shut down the optics controller before you perform any of the following tasks:

- Configure the controller
- Restore a saved configuration
- Upgrade the DSP processor or CFP2 optics module Field Programmable Device (FPD)

SUMMARY STEPS

1. **configure**
2. **controller optics** *r*/*s*/*i*/*p*
3. **shutdown**
4. **commit**
5. **rx-high-threshold** *rx-high*
6. **tx-high-threshold** *tx-high*
7. **no shutdown**
8. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RP0/CPU0:router# configure terminal`	Enters global configuration mode.
Step 2	**controller optics** *r*/*s*/*i*/*p* **Example:** `RP/0/RP0/CPU0:router(config)# controller optics 0/3/0/1`	Enters optics controller configuration mode.
Step 3	**shutdown** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# shutdown`	Shuts down the optics controller.
Step 4	**commit** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.
Step 5	**rx-high-threshold** *rx-high* **Example:** `RP/0/RP0/CPU0:router(config-Optics)# rx-high-threshold 200`	Configures the high receive power threshold. The range is -400 to 300 (in the units of 0.1 dBm).
Step 6	**tx-high-threshold** *tx-high* **Example:** `RP/0/RP0/CPU0:router(config-Optics)# tx-high-threshold 300`	Configures the high transmit power threshold. The range is -400 to 300 dBm (in the units of 0.1 dBm).
Step 7	**no shutdown** **Example:**	Removes the shutdown configuration on the optics controller.

	Command or Action	Purpose
	`RP/0/RP0/CPU0:router(config-Optics)# no shutdown`	
Step 8	**commit** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.

Note When you bring up the local optics controller, you might briefly see transient loss of signal (LOS) alarms on the console. This behavior might be observed during the initial tuning of the channel.

```
PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :LOS-P :DECLARE :CoherentDSP0/3/0/1:
PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :LOS-P :CLEAR :CoherentDSP0/3/0/1:
```

During the laser-on process, you might briefly see transient loss of line (LOL) alarms on the console. This alarm is cleared when the laser-on process is complete.

```
PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :CTP2 RX LOL :DECLARE ::
PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :CTP2 RX LOL :CLEAR ::
```

The laser-on process can take up to 120 seconds to complete.

Configuring Port Mode Speed

Each port on the 6-port Coherent Line Card can support 100 Gbps (DWDM QPSK), 150Gbps (DWDM 8 QAM), or 200Gbps (DWDM 16 QAM) WDM signals.

Note You might rarely see up to five syslog messages mentioning that the recovery mechanism got triggered to recover the port. These messages are about a port in down state due to auto-negotiation mismatch with the peer port and other port-down scenarios. You can ignore such syslog messages as they will not affect the functionality of the ports.

Note The line card has three Digital Signal Processors (DSPs), one for each pair of ports:

- Ports 0 and 1 – DSP0
- Ports 2 and 3 – DSP1
- Ports 4 and 5 – DSP2

When you configure the port-mode speed for 150Gbps (8 QAM), the port pairs belonging to a DSP are coupled. Ensure that you configure the port-mode speed on each port of the port pair that belongs to the same DSP.

To configure the port mode speed, use the following commands:

Before you begin

Ensure that you shut down the controller before you configure the controller or restore a saved configuration.

SUMMARY STEPS

1. **configure**
2. **controller optics** *r*/*s*/*i*/*p*
3. **shutdown**
4. **commit**
5. **port-mode speed** { **100G** | **150G** | **200G** } **mod** { **16qam** | **8qam** |**qpsk** } **fec** { **15sdfec** | **15sdfecde** | **25sdfec** | **otu7staircase** } **diff** { **enable** | **disable** }
6. **no shutdown**
7. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**controller optics** *r*/*s*/*i*/*p* **Example:** `RP/0/RP0/CPU0:router(config)# controller optics 0/3/0/0`	Enters optics controller configuration mode
Step 3	**shutdown** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# shutdown`	Shuts down the optics controller.
Step 4	**commit** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.
Step 5	**port-mode speed** { **100G**	**150G**	**200G** } **mod** { **16qam**	**8qam** |**qpsk** } **fec** { **15sdfec**	**15sdfecde**	**25sdfec**	**otu7staircase** } **diff** { **enable**	**disable** } **Example:** `RP/0/RP0/CPU0:router(config-Optics)# port-mode speed 100G mod qpsk fec 15sdfec diff`	Configures the port mode speed.

	Command or Action	Purpose
Step 6	**no shutdown** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# no shutdown`	Removes the shutdown configuration on the optics controller.
Step 7	**commit** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# commit`	Saves the configuration changes to the running configuration file.

Note When you bring up the local optics controller, you might briefly see transient loss of signal (LOS) alarms on the console. This behavior might be observed during the initial tuning of the channel.

```
PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :LOS-P :DECLARE :CoherentDSP0/3/0/1:
PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :LOS-P :CLEAR :CoherentDSP0/3/0/1:
```

During the laser-on process, you might briefly see transient loss of line (LOL) alarms on the console. This alarm clears when the laser-on process is complete.

```
PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :CTP2 RX LOL :DECLARE ::
PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :CTP2 RX LOL :CLEAR ::
```

Note On NCS-55A2-MOD-S and NC55-MOD-A-S with CFP2-DCO optics:

- During the laser-on process, you might briefly see Optical Transport Network (OTN) alarms on the console. This alarm clears when the laser-on process is complete.

  ```
  PKT_INFRA-FM-6-FAULT_INFO : OTUK-BDI :DECLARE :CoherentDSP0/0/2/2:
  PKT_INFRA-FM-6-FAULT_INFO : OTUK-BDI :CLEAR :CoherentDSP0/0/2/2:
  ```

- During the laser-on process, you might briefly see transient transmit power and receive power alarms on the console. These alarms are cleared when the laser-on process is complete.

  ```
  PKT_INFRA-FM-4-FAULT_MINOR : ALARM_MINOR :LO-RXPOWER :DECLARE :Optics0/0/2/0:
  PKT_INFRA-FM-4-FAULT_MINOR : ALARM_MINOR :LO-TXPOWER :DECLARE :Optics0/0/2/0:
  PKT_INFRA-FM-4-FAULT_MINOR : ALARM_MINOR :HI-RXPOWER :DECLARE :Optics0/0/2/0:

  PKT_INFRA-FM-4-FAULT_MINOR : ALARM_MINOR :LO-RXPOWER :CLEAR :Optics0/0/2/0:
  PKT_INFRA-FM-4-FAULT_MINOR : ALARM_MINOR :HI-RXPOWER :CLEAR :Optics0/0/2/0:
  PKT_INFRA-FM-4-FAULT_MINOR : ALARM_MINOR :LO-TXPOWER :CLEAR :Optics0/0/2/0:
  ```

- When you bring up the local optics controller, you might see repeated remote faults on the console.

  ```
  PLATFORM-DPA-2-RX_FAULT : Interface HundredGigE0/0/2/2/0, Detected Remote Fault
  PLATFORM-DPA-2-RX_FAULT : Interface HundredGigE0/0/2/2/1, Detected Remote Fault
  PLATFORM-DPA-2-RX_FAULT : Interface HundredGigE0/0/2/2/0, Detected Local Fault
  PLATFORM-DPA-2-RX_FAULT : Interface HundredGigE0/0/2/2/1, Detected Local Fault
  PLATFORM-DPA-2-RX_FAULT : Interface HundredGigE0/0/2/2/0, Detected Remote Fault
  PLATFORM-DPA-2-RX_FAULT : Interface HundredGigE0/0/2/2/1, Detected Remote Fault
  ```

If you need to change the port-mode speed, ensure that you remove the existing port mode speed configuration by entering the **no port-mode** command. You can then change the port mode speed.

The following example shows how to change the port mode speed to 100Gbps.

```
RP/0/RP0/CPU0:router# configure
RP/0/RP0/CPU0:router(config)# controller optics 0/3/0/0
RP/0/RP0/CPU0:router(config-Optics)# shutdown
RP/0/RP0/CPU0:router(config-Optics)# commit
RP/0/RP0/CPU0:router(config-Optics)# no port-mode
RP/0/RP0/CPU0:router(config-Optics)# commit
RP/0/RP0/CPU0:router(config-Optics)# port-mode speed 100G mod qpsk fec 15sdfec diff enable
RP/0/RP0/CPU0:router(config-Optics)# commit
RP/0/RP0/CPU0:router(config-Optics)# no shutdown
RP/0/RP0/CPU0:router(config-Optics)# commit
RP/0/RP0/CPU0:router(config-Optics)# exit
RP/0/RP0/CPU0:router(config)#
```

What to do next

Configuring Port Speed on 25G ports

The 25G ports are divided into four quads (0-3). Each quad houses the following ports:

- Quad 0 - Ports 24-27
- Quad 1 - Ports 28-31
- Quad 2 - Ports 32-35
- Quad 3 - Ports 36-39

Generic Limitations and Guidelines

- 25G is the default mode set on the quad.
- 1G and 10G cannot co-exist on the same quad as 25G.
- 10G mode supports both 1G and 10G.

To modify the default 25G quad ports into 10G ports, perform the below configuration:

Before Release 7.5.1:

```
RP/0/RP0/CPU0:router(config)# hw-module quad X location 0/0/CPU0

RP/0/RP0/CPU0:router(config-quad-0x0)# mode 10g
```

From Release 7.5.1:

```
RP/0/RP0/CPU0:router(config)# hw-module quad X location 0/0/CPU0 instance Y mode 10g

RP/0/RP0/CPU0:router(config-quad-0x0)# mode 10g
```

Here, X is the number of quads (0,1,2,3...n) supported. Each quad has a default speed of 25G.

Note To revert to the default 25G mode, use the `no` form of the `hw-module quad` command.

Y denotes MPA card instance. It can range from 0-5. For Cisco NCS 540 Series Routers, it is always 0. Whereas, for Cisco NCS 5500 Series Routers, the instance can be between 0-5, adding 1 for every MPA instance. The default value is 0.

Note A quad number always starts from 0 to the maximum supported number. The number of quads supported varies from platform to platform and the CLI validates it. For example, the NCS 540 Series Router supports two quads (0 and 1). If you enter X=3, the CLI returns an error.

After you configure the port-mode speed, you can configure the following interfaces:

- 100G – Each optics controller configuration creates a single 100GE port:
  - **interface HundredGigE** *r*/*s*/*i*/*p*/**0** (where*p* = CTP2 port 0-5)

    0/3/0/0/0

    0/3/0/1/0

    0/3/0/2/0

    0/3/0/3/0

    0/3/0/4/0

    0/3/0/5/0

- • 200G – Each optics controller configuration creates two 100GE ports:
  - **interface HundredGigE** *r*/*s*/*i*/*p*/**0,** *r*/*s*/*i*/*p*/**1** (where*p* = CTP2 port 0-5

    0/3/0/0/0, 0/3/0/0/1

    0/3/0/1/0, 0/3/0/1/1

    0/3/0/2/0, 0/3/0/2/1

    0/3/0/3/0, 0/3/0/3/1

    0/3/0/4/0, 0/3/0/4/1

    0/3/0/5/0, 0/3/0/5/1

- 150G (coupled) – Coupled optics controller configuration creates three 100GE port:
  - **interface HundredGigE** *r*/*s*/*i*/*p*/**0,** *r*/*s*/*i*/*p*/**1,** *r*/*s*/*i*/*p*+1/**0** (where*p* = CTP2 port: 0, 2, 4 [port *p* and *p* +1 are coupled])

    0/3/0/0/0, 0/3/0/0/1, 0/3/0/1/0

    0/3/0/2/0, 0/3/0/2/1, 0/3/0/3/0

    0/3/0/4/0, 0/3/0/4/1, 0/3/0/5/0

For more information, see the Configuring Ethernet Interfaces chapter.

Configure Lower Port Speeds for Dual-Mode Optical Modules

Table 4: Feature History Table

Feature Name	Release	Description
Configure lower port speeds for dual-mode optical modules	Release 7.9.1	You can now configure the lower port speed using simple CLI keyword: **speed** or **quad** and switch between the higher and lower speeds without changing the optical module. Earlier, by default, only the higher port speed was available. The feature introduces new XPaths for YANG Data Model: **Cisco-IOS-XR-optics-speed-cfg.yang** (see GitHub, YANG Data Models Navigator.)

A dual-mode optic operates in two port speeds, a higher or a lower speed. For more information on how to configure the Port Mode Speed, refer Configuring Port Mode Speed, on page 10.

From Cisco IOS XR Software Release 7.9.1 onwards, you can configure the following dual-mode optical modules to operate on their lower port speeds:

- SFP-10/25G-CSR-S
- SFP-10/25G-LR-S
- SFP-10/25G-LR-I
- SFP-10/25G-BXD-I
- SFP-10/25G-BXU-I
- QSFP-40/100-SRBD

Configuration

To configure a lower port speed use the following command:

hw-module quad*number* **location** *node-id* **[instance** *mpa-instance* **] mode** *mode-type*

A **quad** number always starts from 0 to the maximum supported number (0,1,2,3...n). Each quad houses a group of 2 or 4 ports. The number of quads supported varies from platform to platform and the CLI validates it.

Based on the platform support, configure the optical module to operate at lower port speed by using the CLI keywords: **speed** or **quad**.

For more information on the platforms supported, refer Optics Compatibility Matrix.

Examples

In the following example, **quad** keyword is used in the command to change the speed from 25G to 10G:

```
Router (config)#hw-module quad 2 location 0/0/CPU0 instance 2 mode 10g
Router (config)#commit
```

Verification

Use the `show controller` command to verify the configuration:

```
Router #show controller tengige 0/2/2/0 internal
Mon Mar  6 11:43:02.036 UTC

Internal data for interface: TenGigE0/2/2/0
Subport Number      : 255
Port Number         : 0 *
Bay Number          : 2 *
Board Type          : 0x000069bc *
Port Type           : 10GE *
Bandwidth(Kbps)     : 10000000 *
Transport mode      : LAN *
BIA MAC addr        : 008a:96f5:2d60
Oper. MAC addr      : 008a:96f5:2d60
Egress MAC addr     : 008a:96f5:2d60
Port Available      : true *
Status polling is   : disabled *
Status events are   : disabled
I/F Handle          : 0x04000210 *
Cfg Link Enabled    : enabled
H/W Tx Enable       : yes
MTU                 : 1514 *
H/W Speed           : 10 Gbps *
H/W Duplex          : Full *
H/W Loopback Type   : None *
FEC                 : Not Configured *
H/W FlowCtrl Type   : Disabled *
H/W AutoNeg Enable  : Off *
H/W Link Defects    : Link Local Fault *
Link Up             : no *
Link Led Status     : Yellow On *
Pluggable Present   : Yes *
Pluggable Type      :
Pluggable PID       :  *
Pluggable Compl.    : Third Party Optics
```

In the following example, **speed** keyword is used in the command to change the speed from 100G to 40G:

```
Router (config)#controller optics 0/0/1/1
Router (config)#speed 40g
Router (config)#commit
```

Verification

Use the `show controller` command to verify the configuration:

```
Router #show controller fortyGigE 0/1/0/34 internal
Mon Mar  6 11:39:22.635 UTC

Internal data for interface: FortyGigE0/1/0/34
Subport Number      : 255
Port Number         : 34 *
Bay Number          : 0 *
Board Type          : 0x0000698f *
Port Type           : 40GE *
Bandwidth(Kbps)     : 40000000 *
```

```
Transport mode      : LAN *
BIA MAC addr        : 008a:96f5:2d18
Oper. MAC addr      : 008a:96f5:2d18
Egress MAC addr     : 008a:96f5:2d18
Port Available      : true *
Status polling is   : disabled *
Status events are   : disabled
I/F Handle          : 0x02001a08 *
Cfg Link Enabled    : enabled
H/W Tx Enable       : yes
MTU                 : 1514 *
H/W Speed           : 40 Gbps *
H/W Duplex          : Full *
H/W Loopback Type   : None *
FEC                 : Not Configured *
H/W FlowCtrl Type   : Disabled *
H/W AutoNeg Enable  : Off *
H/W Link Defects    : No Fault *
Link Up             : yes *
Link Led Status     : Green ON *
Pluggable Present   : Yes *
Pluggable Type      : QSFP28 100G SR BD
Pluggable PID       : QSFP-40/100-SRBD *
Pluggable Compl.    : Compliant
```

Note You can configure the port in 10G or revert to 25G using **no** form of the command:

Use the following command to revert the speed to 25G.

```
Router (config)#no hw-module quad 2 location 0/0/CPU0 instance 2 mode 10g
Router (config)#commit
```

Use the following command to revert the speed to 100G.

```
Router (config)#no controller optics 0/0/1/1 speed 40g
Router (config)#commit
```

Configuring Wavelength

To configure wavelength, use the following commands:

Before you begin

- Before configuring the wavelength, use the **show controllers optics***r*/*s*/*i*/*p* **dwdm-carrrier-map** command to display the wavelength and channel mapping for optics controllers.
- You must shut down the controller before you configure the controller or restore a saved configuration.

SUMMARY STEPS

1. **configure**
2. **controller optics** *r*/*s*/*i*/*p*
3. **shutdown**
4. **commit**
5. **dwdm-carrier** {**100MHz-grid frequency** *frequency* } | {**50GHz-grid** [**frequency** *frequency* | *channel-number*] }

6. **no shutdown**
7. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**controller optics** *r*/*s*/*i*/*p* **Example:** `RP/0/RP0/CPU0:router(config)# controller optics 0/3/0/1`	Enters optics controller configuration mode.
Step 3	**shutdown** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# shutdown`	Shuts down the optics controller.
Step 4	**commit** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.
Step 5	**dwdm-carrier** {**100MHz-grid frequency** *frequency* } | {**50GHz-grid** [**frequency** *frequency* | *channel-number*] } **Example:** `RP/0/RP0/CPU0:router(config-Optics)# dwdm-carrier 100MHz-grid frequency 1960875`	Configures the frequency on the trunk port.
Step 6	**no shutdown** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# no shutdown`	Removes the shutdown configuration on the optics controller.
Step 7	**commit** **Example:** `RP/0/RP0/CPU0:router(config-Optics)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.

To configure a DWDM carrier with the required frequency:

```
RP/0/RP0/CPU0:router#config
RP/0/RP0/CPU0:router(config)#controller Optics0/3/0/0
RP/0/RP0/CPU0:router(config-Optics)#dwdm-carrier
RP/0/RP0/CPU0:router(config-Optics)#dwdm-carrier 100MHz-grid
```

```
RP/0/RP0/CPU0:router(config-Optics)#dwdm-carrier 100MHz-grid frequency
RP/0/RP0/CPU0:router(config-Optics)#dwdm-carrier 100MHz-grid frequency 1960625
```

The output of `show run controller optics 0/3/0/0` command is:

```
RP/0/RP0/CPU0:router#show run controller optics 0/3/0/0
Wed Nov  6 13:47:33.178 UTC
controller Optics0/3/0/0
transmit-power -7
port-mode speed 100G mod qpsk fec 25sdfec diff disable
dwdm-carrier 100MHz-grid frequency 1960625
```

Note When you bring up the local optics controller, you might briefly see transient loss of signal (LOS) alarms on the console. This behavior might be observed during the initial tuning of the channel.

```
PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :LOS-P :DECLARE :CoherentDSP0/3/0/1:
PKT_INFRA-FM-2-FAULT_CRITICAL : ALARM_CRITICAL :LOS-P :CLEAR :CoherentDSP0/3/0/1:
```

During the laser-on process, you might briefly see transient loss of line (LOL) alarms on the console. This alarm is cleared when the laser-on process is complete.

```
PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :CTP2 RX LOL :DECLARE ::
PKT_INFRA-FM-3-FAULT_MAJOR : ALARM_MAJOR :CTP2 RX LOL :CLEAR ::
```

Configuring Coherent DSP Controller

You can configure the administrative state for the Coherent DSP controller. To configure the Coherent DSP controller, use the following commands.

Note The coherent DSP controller doesn't support Q factor, Q margin, and post FEC BER reporting. Therefore, no threshold crossing alert (TCA) is raised for these parameters.

SUMMARY STEPS

1. **configure**
2. **controller coherentDSP** *r*/*s*/*i*/*p*
3. **secondary-admin-state** *admin-state*
4. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RP0/CPU0:router# configure`	Enters global configuration mode.

	Command or Action	Purpose
Step 2	**controller coherentDSP** *r/s/i/p* **Example:** `RP/0/RP0/CPU0:router(config)# controller coherentDSP 0/3/0/1`	Enters Coherent DSP optics controller configuration mode.
Step 3	**secondary-admin-state** *admin-state* **Example:** `RP/0/RP0/CPU0:router(config-CoDSP)# secondary-admin-state maintenance`	Configures the administrative state of the controller indicating that the controller is under maintenance.
Step 4	**commit** **Example:** `RP/0/RP0/CPU0:router(config-CoDSP)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.

Configuring Performance Monitoring

You can configure the performance monitoring parameters for the optics and Coherent DSP controllers. To configure PM parameters, use the following commands.

SUMMARY STEPS

1. **configure**
2. **controller** { **optics** | **coherentDSP** } *r/s/i/p*
3. **pm** { **30-sec** | **15-min** | **24-hour** } { **optics** | **fec** | **otn** } [**report** | **threshold** *value*]
4. **commit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**configure** **Example:** `RP/0/RP0/CPU0:router# configure`	Enters global configuration mode.
Step 2	**controller** { **optics**	**coherentDSP** } *r/s/i/p* **Example:** `RP/0/RP0/CPU0:router(config)# controller coherentDSP 0/3/0/1`	Enters optics or Coherent DSP controller configuration mode.
Step 3	**pm** { **30-sec**	**15-min**	**24-hour** } { **optics**	**fec**	**otn** } [**report**	**threshold** *value*] **Example:**	Configures the performance monitoring parameters.

	Command or Action	Purpose
	`RP/0/RP0/CPU0:router(config-CoDSP)# pm 15-min otn threshold es-ne`	
Step 4	**commit** **Example:** `RP/0/RP0/CPU0:router(config-CoDSP)# commit`	Saves the configuration changes to the running configuration file and remains within the configuration session.

Verify Controller Details

Execute the **show controllers** *controller-type* command to display and verify the controller details of the Optical Transport Network (OTN).

Note Due to a hardware limitation, this command cannot display the Forward Error Correction (FEC) Correctable and FEC Uncorrectable alarms on the NCS 5500 12 port 10G Modular Port Adaptor (MPA) with PID NC55-MPA-12T-S.

```
Router# show controllers otu20/0/2/1
Thu Jul 14 10:41:57.642 UTC

Port                                        : OTU2 0/0/2/1
Controller State                            : Down
LED state                                   : Red Flashing
Inherited Secondary State                   : Normal
Configured Secondary State                  : Normal
Derived State                               : In Service
Loopback mode                               : None
BER Thresholds                              : SF = 1.0E-6  SD = 1.0E-7
Performance Monitoring                      : Enable

Alarm Information:
LOS = 0 LOF = 1 LOM = 0
OOF = 1 OOM = 1 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0     FLEXO_GIDM = 0
FLEXO-MM = 0    FLEXO-LOM = 0   FLEXO-RDI = 0
FLEXO-LOF = 0
Detected Alarms                             : LOF OOF OOM

OTU TTI Received

FEC mode                                    : STANDARD

AINS Soak                                   : None
AINS Timer                                  : 0h, 0m
AINS remaining time                         : 0 seconds
```

Execute the **show controllers coherentDSP** command to display status and configuration information for interfaces configured as coherent DSP controllers.

```
Router#show controllers coherentDSP 0/0/0/13
Thu May 27 06:56:37.505 UTC

Port                                          : CoherentDSP 0/0/0/13
Controller State                              : Up
Inherited Secondary State                     : Normal
Configured Secondary State                    : Normal
Derived State                                 : In Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 400.0Gb/s

Alarm Information:
LOS = 32        LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0     FLEXO_GIDM = 0
FLEXO-MM = 0    FLEXO-LOM = 0   FLEXO-RDI = 0
FLEXO-LOF = 43
Detected Alarms                               : None

Bit Error Rate Information
PREFEC  BER                                   : 8.5E-04
POSTFEC BER                                   : 0.0E+00
Q-Factor                                      : 9.90 dB

Q-Margin                                      : 2.70dB

OTU TTI Received
```

Execute the **show controllers optics** command to display status and configuration information about the interfaces configured as optics controller.

```
Router#show controllers optics 0/0/0/7
 Controller State: Up
 Transport Admin State: In Service
 Laser State: On
 LED State: Green
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZR
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm
         Alarm Status:
         -------------
         Detected Alarms: None
         LOS/LOL/Fault Status:
         Alarm Statistics:
         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 0
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 55
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0
         Actual TX Power = -8.16 dBm
         RX Power = -7.85 dBm
         RX Signal Power = -7.55 dBm
         Frequency Offset = 5 MHz
         Performance Monitoring: Enable
```

```
        THRESHOLD VALUES
        ----------------
        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          1.9      -28.2           0.0        -25.0
        Tx Power Threshold(dBm)          0.0      -15.0          -2.0        -16.0
        LBC Threshold(mA)               0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)       80.00      -5.00         75.00        15.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -6.00 dBm
        Configured CD High Threshold = 80000 ps/nm
        Configured CD lower Threshold = -80000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  59.8437500000 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 2 ps/nm
        Configured CD-MIN -2400 ps/nm  CD-MAX 2400 ps/nm
        Second Order Polarization Mode Dispersion = 87.00 ps^2
        Optical Signal to Noise Ratio = 36.30 dB
        Polarization Dependent Loss = 0.40 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 2.00 ps
        Temperature = 51.00 Celsius
        Voltage = 3.36 V
Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZR
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E20-19E
        Rev Number              : 10
        Serial Number           : ACA2449003P
        PID                     : QDD-400G-ZR-S
        VID                     : ES03
        Firmware Version        : 61.12
        Date Code(yy/mm/dd)     : 20/12/03
```

Replace Optical Module

In this example, we are replacing QSFP-100G-SR4-S QSFP optics configured for 4x25 breakout with QSFP-40G-SR4 optics and configure it for 4x10 breakout.

1. Delete the optical module configuration using the **no breakout** command.

   ```
   Router# configure
   Router(config)# controller optics 0/2/0/35
   Router(config-Optics)# no breakout 4x25
   Router(config-Optics)# commit
   ```

2. Replace the QSFP-100G-SR4-S QSFP optical module with QSFP-40G-SR4 optical module.

3. Configure 4x10 breakout for QSFP-40G-SR4 optical module.

   ```
   Router# configure
   Router(config)# controller optics 0/2/0/35
   Router(config-Optics)# breakout 4x10
   Router(config-Optics)# commit
   ```