

Configuring 400G Digital Coherent Optics

Table 1: Feature History Table

Feature Name	Release Information	Description
Support for DP04QSDD-LLH-A1 optical module	Release 26.2.1	Introduced in this release on: NCS 5500 modular routers;NCS 5700 line cards [Mode: Compatibility; Native] (select variants only*) This release extends support for the Cisco 400G Coherent QSFP-DD Ultra Long Haul reach L-band, on this line card: * Line cards: • NC57-24DD
Extended Support for DP04QSDD-ULH optical module	Release 26.2.1	Introduced in this release on:NCS 5700 fixed port routers;NCS 5700 line cards [Mode: Compatibility; Native] (select variants only*) This release extends support for the Cisco 400G QSFP-DD Ultra Long-Haul (ULH) coherent optical module, on the Cisco NCS 5500 series modular chassis using these line cards: * Line cards: • NC57-MOD-S via NC57-MPA-2D4H-S • NC-57-48Q2D-S/SE

Feature Name	Release Information	Description
Support for 1x100G breakout mode on NC57-36H6D-S line card using DP04QSDD-HE0 and QDD-400G-ZRP-S	Release 25.4.1	Introduced in this release on: NCS 5700 line cards [Mode: Compatibility; Native] (select variants only*) You can now configure 1x100G breakout mode on this line card using the DP04QSDD-HE0 and QDD-400G-ZRP-S optics. * Line card: • NC57-36H6D-S
Support for DP04QSDD-ULH optical module	Release 25.2.1	Introduced in this release on: NCS 5500 modular routers;NCS 5700 line cards [Mode: Compatibility; Native] (select variants only*) This release introduces support for the Cisco 400G QSFP-DD Ultra Long-Haul (ULH) coherent optical module, on the Cisco NCS 5500 series modular chassis using the following line cards- * Line cards: • NC57-24DD • NC57-18DD-SE
Support for DP04QSDD-ER1 optical module	Release 7.10.1	Introduced in this release on: NCS 5500 modular routers; NCS 5500 line cards(select variants only*) This release introduces support for the Cisco DP04QSDD-ER1 Ethernet variant optical module. The Cisco DP04QSDD-ER1 optical module is an enhanced version of the currently available QDD-400G-ZR Optical Module. It leverages the same operational modes while providing an extended range of up to 40km using 16QAM transmission. * The DP04QSDD-ER1 optical module is supported on Cisco NCS 5500 Series Modular Chassis through the NC57-18DD-SE line card.

Feature Name	Release Information	Description
Extended Support for DP04QSDD-HE0 optical module	Release 7.10.1	Introduced in this release on: NCS 5500 modular routers (select variants only*); NCS 5700 fixed port routers (select variants only*); NCS 5700 line cards [Mode: Compatibility; Native] (select variants only*) This release introduces support for the Cisco 400G QSFP-DD High-Power (Bright) Optical Module, Ethernet Variant on the following routers and line cards- * Routers: • NCS-57B1-6D24H-S • NCS-57B1-5D24-SE • NCS-57C1-48Q6-S • NCS-57D2-18DD-S • NCS-55A2 via NC57-MPA-2D4H-S • NC55-MOD via NC57-MPA-2D4H-S * Line cards: • NC57-24DD • NC57-18DD-SE • NC57-36H6D-S • NC57-48Q2D-S • NCS-57B1-6D24H-S • NC57-MOD-S via NC57-MPA-2D4H-S
Support for DP04QSDD-HE0 optical module	Release 7.9.1	This release introduces support for the Cisco 400G QSFP-DD High-Power (Bright) Optical Module, Ethernet Variant. The Cisco 400G QSFP-DD High-Power (Bright) Optical module is an enhanced version of the currently available QSFP-DD ZR+ Optical Module, leveraging the same operational modes but providing as a major enhancement the increase of the Tx Optical Power up to +1dBm.

Feature Name	Release Information	Description
oFEC Traffic Configuration for QDD-400G-ZRP-S	Release 7.9.1	QDD-400G-ZRP-S optical module can now support the following oFEC traffic configurations: • 400G-TXP-1x1 DAC-16 QAM • 3x100G-MXP-1x1 DAC-8 QAM • 2x100G-MXP-1x1.25 DAC-8 QAM • 2x100G-MXP-1x1.25 DAC-16 QAM This increases the interoperability of the QDD-400G-ZRP-S optical module across network components supporting these formats.

The following 400G Digital Coherent QSFP-DD optical modules are supported:

- QDD-400G-ZR-S
- QDD-400G-ZRP-S
- DP04QSDD-HE0
- DP04QSDD-ER1
- DP04QSDD-ULH
- DP04QSDD-LLH-A1

Note

- The information in this chapter applies to all supported 400G Digital Coherent QSFP-DD optical modules unless otherwise specified.
- To determine the transceivers that Cisco hardware device supports, refer to the Transceiver Module Group (TMG) Compatibility Matrix tool.

This chapter describes the 400G Digital Coherent QSFP-DD optical modules and their supported configurations.

Table 2: Hardware and Software Support

Hardware PID	Optics PID	Minimum IOS XR Software Release
NC57-24DD	DP04QSDD-LLH-A1	Release 26.2.1
NC-57-48Q2D-S/SE	DP04QSDD-ULH	Release 26.2.1
NC57-18DD-SE	DP04QSDD-ULH	Release 25.2.1
NC57-24DD	DP04QSDD-ULH	Release 25.2.1

NC57-18DD-SE	DP04QSDD-ER1	Release 7.10.1
NC55-MOD-A-SE-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.9.1
NC55-MOD-A-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.9.1
NC57-MPA-2D4H-S	QDD-400G-ZR-S QDD-400G-ZRP-S DP04QSDD-HE0	Release 7.9.1
NCS-57C3-MODS-SYS	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1
NCS-57C3-MOD-SYS	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1
NCS-57D2-18DD-SYS	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1
NCS-57D2-18DD-SYS	DP04QSDD-HE0	Release 7.10.1
NC57-MOD-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.8.1
NC57-MOD-S	DP04QSDD-HE0	Release 7.10.1
NC57-MOD-S	DP04QSDD-ULH	Release 26.2.1
NCS-57C1-48Q6D-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.5.2
NC57-48Q2D-S	DP04QSDD-HE0	Release 7.10.1
NCS-57B1-5D24-SE	DP04QSDD-HE0	Release 7.10.1
NCS-57C1-48Q6-S	DP04QSDD-HE0	Release 7.10.1
NC57-18DD-SE	DP04QSDD-HE0	Release 7.10.1
NCS-57B1-6D24H-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2
NCS-57B1-6D24H-S	DP04QSDD-HE0	Release 7.10.1
NC57-24DD	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2

NC57-24DD	DP04QSDD-HE0	Release 7.10.1
NC57-18DD-SE	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2
NC57-36H6D-S	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2
NC57-36H6D-S	DP04QSDD-HE0	Release 7.10.1
NCS-57B1-5D24H-SE	QDD-400G-ZR-S QDD-400G-ZRP-S	Release 7.3.2

The 400G Digital Coherent QSFP-DD optical modules enable wavelength-division multiplexing (WDM) functionality in the router. These optical modules are DWDM C-band (196.1 THz to 191.3 THz) tunable optical modules. They can be used in both transponder and muxponder modes.

Cisco IOS XR software creates optics and coherent DSP controllers to configure and monitor the performance of the 400G Digital Coherent QSFP-DD optical modules. Optics controllers are used to configure and monitor optical parameters, such as frequency, chromatic dispersion, transmitted output power, modulation, and so on. Coherent DSP controllers are used to monitor network performance parameters like pre- and post-forward error correction (FEC) bit-error rate (pre-FEC BER, post-FEC BER), error corrected bits (EC-BITS), and so on. Forward error correction (FEC) is configured using optical controllers and monitored using coherent DSP controllers.

The 400G Digital Coherent QSFP-DD optical modules support traffic configuration and firmware download. The Cisco IOS XR software collects performance monitoring data and alarms using versatile DOM (VDM).

Due to more power consumption by the 400G Digital Coherent QSFP-DD optical modules, the Cisco IOS XR software operates the fans at an higher speed to cool these optical modules.

The 400G Digital Coherent QSFP-DD optical module configuration is divided into the following categories:

- Traffic configuration – Comprises configuring DAC rate, muxponder mode, modulation, and FEC parameters. Applicable for optics controllers:
  - Configuring DAC Rate, on page 29
  - Configuring Muxponder Mode, on page 20
  - Configuring Modulation, on page 27
  - Configuring FEC, on page 30
- Optical configuration – Comprises configuring frequency, chromatic dispersion, and optical transmit power. Applicable for optics controllers:
  - Configuring Frequency, on page 14
  - Configuring Chromatic Dispersion, on page 16
  - Configuring Optical Transmit Power, on page 18
- Performance monitoring (PM) – Enables or disables performance monitoring in optical modules. You can also configure PM parameters that comprise signal power, chromatic dispersion, optical signal-to-noise

ratio (OSNR), and differential group delay (DGD). Applicable for optics controllers and coherent DSP controllers:

- Configuring Performance Monitoring, on page 34
- Configuring PM Parameters, on page 34

- Loopback configuration – Configures loopback. Applicable for coherent DSP controller:
  - Configuring Loopback, on page 32

- Alarms threshold configuration – Configures thresholds for monitoring alarms that include optical signal-to-noise ratio (OSNR), differential group delay (DGD), chromatic dispersion (cd high and low), and so on. Applicable for optics controllers:
  - Configuring Alarms Threshold, on page 37

The following table contains the possible traffic configuration values for the 400G Digital Coherent QSFP-DD optical modules, in the transponder and muxponder mode:

Table 3: 400G Digital Coherent QSFP-DD Traffic Configuration Values

Optical Module	Client Speed	Trunk Speed	Frequency	FEC	Modulation	DAC-Rate	Chromatic Dispersion (CD)	Transmitted (Tx) Power
QDD-400G-ZR-S	1x400, 4x100	400G	C-Band, 196.1 To 191.3 THz	cFEC	16QAM	1x1	-2400 to +2400	Each optical module has its own transmitting (TX) power range. You can change the transmitting (TX) power value based on the module capability.

Optical Module	Client Speed	Trunk Speed	Frequency	FEC	Modulation	DAC-Rate	Chromatic Dispersion (CD)	Transmitted (Tx) Power
QDD-400G-ZR-S	1x400, 4x100, 3x100, 2x100, 1x100	400G, 300G, 200G, 100G	C-Band, 196.1 To 191.3 THz	oFEC, cFEC	16QAM, 8QAM, QPSK	1x1.25, 1x1	-160000 to +160000	Each optical module has its own transmitting (TX) power optimal values. You can change the transmitting (TX) power value based on the module capability.
DP04QSDD-HE0	1x400, 4x100, 3x100, 2x100, 1x100	400G, 300G, 200G, 100G	C-Band, 196.1 To 191.3 THz	oFEC, cFEC	16QAM, 8QAM, QPSK	1x1.25, 1x1.5	-160000 to +160000	Each optical module has its own transmitting (TX) power optimal values. You can change the transmitting (TX) power value based on the module capability.
DP04QSDD-HR1	1x400	1x400	C-Band, 193.70 THz	oFEC, cFEC	16QAM	1x1, 1x2	-2400 to +2400	Each optical module has its own transmitting (TX) power range. You can change the transmitting (TX) power value based on the module capability.

Optical Module	Client Speed	Trunk Speed	Frequency	FEC	Modulation	DAC-Rate	Chromatic Dispersion (CD)	Transmitted (Tx) Power
DP04QSDD-HE0	1x400, 4x100	400G, 100G	C-Band, 191.25THz To 196.125THz	oFEC	QPSK, PCS (Probabilistic Constellation Shaping)	1x1	-13000 to 13000	Each optical module has its own transmitting (TX) power range. You can change the transmitting (TX) power value based on the module capability.
DP04QSDD-HA1	1x400, 4x100	400G, 100G	L-Band, 186.1THz To 191.0THz	oFEC	QPSK, PCS (Probabilistic Constellation Shaping)	1x1	-13000 to 13000	Each optical module has its own transmitting (TX) power range. You can change the transmitting (TX) power value based on the module capability.

Restrictions and Limitations

- DP04QSDD-HE0 optical modules are supported on the NCS-57C3-MOD-SYS and NCS-57C3-MODS-SYS routers using NC57-MPA-2D4H-S MPA.
- 400G Digital Coherent QSFP-DD optical modules are supported on all 400G ports of the MPA (NC57-MPA-2D4H-S) available on the NC55-MOD-A-S and NC55-MOD-A-SE-S line cards.
- 400G Digital Coherent QSFP-DD optical modules are supported on all 400G ports of the MPA (NC57-MPA-2D4H-S) available on the NCS-55A2-MOD-S and NCS-55A2-MOD-SE-S routers.
- 400G Digital Coherent QSFP-DD optical modules are supported on all 400G ports of NC57-MOD-S line cards.
- 400G Digital Coherent QSFP-DD optical modules are supported on all 400G ports of fixed-port routers.
- 400G Digital Coherent QSFP-DD optical modules are supported only on 400G even-numbered ports (at the top row) of the line cards. In addition, the following points describe the limitations of specific line cards:

- NC57-24DD: All twelve 400G even-numbered ports support 400G Digital Coherent QSFP-DD optical modules.
- NC57-18DD-SE: Up to a maximum of six 400G Digital Coherent QSFP-DD optical modules are supported in the 400G even-numbered ports.
- NC57-36H6D-S: Up to a maximum of six 400G Digital Coherent QSFP-DD optical modules are supported in the 400G even-numbered ports.

- The following platform combination doesn't support native 400G speed but can operate in 4x100G mode:
  - NCS-57C3-MOD-S/-SE-S with NC57-MPA-2D4H-S in MPA slot1
  - NC55-MOD-A-SE-S with NC57-MPA-2D4H-S
  - NCS-55A2-MOD-S/-HD-S/-HX-S with NC57-MPA-2D4H-S

  The DP04QSDD-ULH optical module is supported on the following ports:
  - NC57-24DD: All twelve even-numbered 400G ports.
  - NC57-18DD-SE: Up to a maximum of six DP04QSDD-ULH optical modules are supported in the 400G even-numbered ports.

FPD Upgrades Enabled for QDD-400G-ZR-S and QDD-400G-ZRP-S Optical Modules

Table 4: Feature History Table

Feature Name	Release Information	Feature Description
FPD Upgrades Enabled for QDD-400G-ZR-S and QDD-400G-ZRP-S Optical Modules	Release 7.3.2	This feature allows you to perform Field Programmable Device (FPD) upgrades on the QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules to ensure they have the latest fixes and features. For more information about the optic module portfolio, see the Cisco 400G Digital Coherent Optics QSFP-DD Optical Modules Data Sheet.

Although an FPD upgrade is not mandatory in this release, we recommend upgrading the FPD to the latest version in the subsequent releases to ensure that all the latest fixes and features are enabled on the optical modules.

The QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules have two internal FPD image banks: image banks A and B. These image banks contain running and programmed FPD versions, which are fetched during boot-up. The active image is fetched from bank A, while the standby image is fetched from bank B. To upgrade the optical modules, you must perform the FPD upgrade twice, once for the active image bank and once for the standby image bank. After each upgrade, you must disable and re-enable the QDD-400G-ZR-S and QDD-400G-ZRP-S optical modules using the **controller optics** command to activate the latest firmware.

See the ***Upgrading Field-Programmable Device*** chapter in the *System Management Configuration Guide for Cisco NCS 5500 Series Routers* for details on the procedure to upgrade the FPD.

QDD-400G-ZR-S Transponder and Muxponder Configuration Values

The following table contains the possible Transponder and Muxponder configuration values for the QDD-400G-ZR-S optical module:

Table 5: QDD-400G-ZR-S Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 client, 400G speed	1 trunk, 400G	16 QAM	cFEC	1x1
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G	16 QAM	cFEC	1x1

DP04QSDD-ER1 Transponder and Muxponder Configuration Values

The following table contains the possible Transponder and Muxponder configuration values for the DP04QSDD-ER1 optical module:

Table 6: DP04QSDD-ER1 Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 client, 400G speed	1 trunk, 400G	16 QAM	cFEC	1x1
400G-TXP	1 client, 400G speed	1 trunk, 400G	16 QAM	oFEC	1x2

QDD-400G-ZRP-S Transponder and Muxponder Configuration Values

The following table contains the possible Transponder and Muxponder configuration values for the QDD-400G-ZRP-S optical module:

Table 7: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
4x100G-MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1
3x100G-MXP	3 clients, 100G speed	1 trunk, 300G speed	8 QAM	oFEC	1x1.25
3x100G-MXP	3 clients, 100G speed	1 trunk, 300G speed	8 QAM	oFEC	1x1
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	QPSK	oFEC	1x1.5
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	8 QAM	oFEC	1x1.25
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	16 QAM	oFEC	1x1.25
1x100G-TXP	1 client, 100G speed	1 trunk, 100G speed	QPSK	oFEC	1x1.5

DP04QSDD-HE0 Transponder and Muxponder Configuration Values

The following table contains the possible Transponder and Muxponder configuration values for the DP04QSDD-HE0 optical module:

Table 8: DP04QSDD-HE0 Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1.5
400G-TXP	1 Client, 400G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.5
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.25
4x100G- MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	cFEC	1x1.5
4x100G-MXP	4 clients, 100G speed	1 trunk, 400G speed	16 QAM	oFEC	1x1.5
3x100G-MXP	3 clients, 100G speed	1 trunk, 300G speed	8 QAM	oFEC	1x1.25

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
3x100G-MXP	3 clients, 100G speed	1 trunk, 300G speed	8 QAM	oFEC	1x1.5
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	QPSK	oFEC	1x1.5
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	8 QAM	oFEC	1x1.25
2x100G-MXP	2 clients, 100G speed	1 trunk, 200G speed	16 QAM	oFEC	1x1.25
1x100G-TXP	1 client, 100G speed	1 trunk, 100G speed	QPSK	oFEC	1x1.5

DP04QSDD-ULH Transponder and Muxponder Configuration Values

Table 9: DP04QSDD-ULH Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 client, 400G speed	1 trunk, 400G	QPSK, PCS (changes based on appsel values configured)	oFEC (changes based on appsel values configured)	1x1
4x100G-MXP	4 clients, 100G speed	1 trunk, 400G	QPSK, PCS (changes based on appsel values configured)	oFEC (changes based on appsel values configured)	1x1

DP04QSDD-LLH-A1 Transponder and Muxponder Configuration Values

Table 10: DP04QSDD-LLH-A1 Transponder and Muxponder Configuration Values

TXP/MXP	Client	Trunk	Modulation	FEC	DAC Rate
400G-TXP	1 client, 400G speed	1 trunk, 400G	QPSK, PCS (changes based on appsel values configured)	oFEC (changes based on appsel values configured)	1x1
4x100G-MXP	4 clients, 100G speed	1 trunk, 400G	QPSK, PCS (changes based on appsel values configured)	oFEC (changes based on appsel values configured)	1x1

- Configuring Frequency, on page 14
- Configuring Chromatic Dispersion, on page 16
- Configuring Optical Transmit Power, on page 18

- Configuring Muxponder Mode, on page 20
- Configuring Modulation, on page 27
- Configuring DAC Rate, on page 29
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- Disable Auto-Squelching, on page 33
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- Alarms Troubleshooting, on page 54

Configuring Frequency

You can configure frequency on optics controllers. You can select any C band frequency between the range 196.1 to 191.3 THz, in both ITU and NON-ITU channels.



Note The 100MHz-grid keyword accepts only frequency values as user input. The 50GHz-grid keyword accepts frequency, ITU-channel, or wavelength values as user input. The Cisco IOS XR software then caculates the frequency for a given wavelength or ITU-channel.

Frequency Configuration Example

The following example shows how to configure frequency on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#dwdm-carrier 100MHz-grid frequency 1921500
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration:

```
Router#show run controller optics 0/2/0/16
Fri May 28 01:42:32.488 UTC
controller Optics0/2/0/16
 dwdm-carrier 100MHz-grid frequency 1921500
 cd-low-threshold -5000
 cd-high-threshold -5000
!
```

Verification

This example shows how to verify the frequency configuration:

```
Router#show controller optics 0/2/0/16
Fri May 28 01:47:23.953 UTC
 Controller State: Up
 Transport Admin State: In Service
```

```
Laser State: Off
LED State: Off
FEC State: FEC ENABLED
Optics Status
        Optics Type:  QSFPDD 400G ZRP
        DWDM carrier Info: C BAND, MSA ITU Channel=80, Frequency=192.15THz,
        Wavelength=1560.200nm
        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 = 0
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 mA
        Actual TX Power = -40.00 dBm
        RX Power = -40.00 dBm
        RX Signal Power = -40.00 dBm
        Frequency Offset = 0 MHz
        Laser Temperature = 0.00 Celsius
        Laser Age = 0 %
        DAC Rate = 1x1.25
        Performance Monitoring: Enable
        THRESHOLD VALUES
        ----------------
        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
        Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
        LBC Threshold(mA)               0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -10.00 dBm
        Configured CD High Threshold = -5000 ps/nm
        Configured CD lower Threshold = -5000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -26000 ps/nm  CD-MAX 26000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 21.00 Celsius
        Voltage = 3.42 V
Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZRP
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E30-19E
        Rev Number              : 10
        Serial Number           : ACA244900GN
        PID                     : QDD-400G-ZRP-S
```

```
        VID                  : ES03
        Firmware Version     : 161.06
        Date Code(yy/mm/dd)  : 20/12/08
!
```

Configuring Chromatic Dispersion

You can configure chromatic dispersion on optics controllers. When you configure the maximum and minimum values for chromatic dispersion for any data rate, ensure that the minimum difference between the configured values is equal to or greater than 1000 ps/nm.

The following table lists the default CD search range:

Table 11: Default CD Search Range

Muxponder Rate	FEC Value	Default CD Search Range (Min-Max)
400	OFEC	-26000 to +26000
400	CFEC	-2400 to +2400
300	OFEC	-50000 to +50000
200	OFEC	-50000 to +50000
100	OFEC	-80000 to +80000

Note For **cd-max** and **cd-min** range details, see the controller optics command.

Chromatic Dispersion Configuration Example

This example shows how to configure chromatic dispersion on the optics controller:

```
Router#configure
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#cd-max 4000
Router(config-Optics)#cd-min -4000
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration for the optics controller:

```
Router#show run controller optics 0/0/0/13
Thu May 13 12:24:42.353 UTC
controller Optics0/0/0/13
 cd-min -4000
 cd-max 4000
 !
```

Verification

This example shows how to verify the configured chromatic dispersion values for the optics controller:

```
Router#show controller optics 0/0/0/13
 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 = 35
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 %
         Actual TX Power = -7.87 dBm
         RX Power = -8.27 dBm
         RX Signal Power = -8.43 dBm
         Frequency Offset = 130 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 0 ps/nm
         Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
         Second Order Polarization Mode Dispersion = 5.00 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 = 4.00 ps
         Temperature = 54.00 Celsius
         Voltage = 3.37 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          : ACA2447003L
         PID                    : QDD-400G-ZR-S
```

```
VID                    : ES03
Firmware Version       : 61.12
Date Code(yy/mm/dd)    : 20/12/02
```

Configuring Optical Transmit Power

You can set the transmit power of the optical signal.

Each 400G Digital Coherent QSFP-DD optical module has its own optical transmit (TX) power range. User can change the optical transmit (TX) power value based on the module capability. For "Transmitter specifications", see the following data sheets:

- *Cisco 400G Digital Coherent Optics QSFP-DD Optical Modules Data Sheet*
- *Cisco 400G QSFP-DD High-Power (Bright) Optical Module Data Sheet*
- *Cisco 400G QSFP-DD Ultra Long Haul Coherent Optics Module Data Sheet*

Table 12: Optical Transmit Power Values

Optical Module	Trunk Speed	Optical Transmit Power (Tx) Shaping	Interval	Supported Range of Optical Transmit Power (Tx) Values (in units of 0.1dBm)[1]		
				Minimum Value	Maximum Value - Typical	Maximum Value - Worst Case
QDD-400G-ZR-S	400G	No	1	-150	-100	-100
QDD-400G-ZRP-S	400G	Yes	1	-150	-110	-130
	300G			-150	-104	-119
	200G			-150	-90	-105
	100G			-150	-59	-75
DP04QSDD-HE0	400G	Yes	1	-100	20	10
	300G					
	200G					
	100G					
DP04QSDD-ER1	400G	No	1	-90	-40	-70
DP04QSDD-ULH	400G	Yes	1	depends on the appsel configuration	depends on the appsel configuration	depends on the appsel configuration
	100G					
DP04QSDD-LLH-A1	400G 100G	Yes	1	depends on the appsel configuration	depends on the appsel configuration	depends on the appsel configuration

1. The default optical transmit power (Tx) value is -10 dBm, however with TX shaping enabled the maximum power in 1x400G, 4x100G, 3x100G, 2x100G, and 1x100G modes may be less than -10 dBm.

Transmitting Power Configuration Example

The following example shows how to configure the optical transmit (TX) power on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#transmit-power -125
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration for the optics controller:

```
Router#show run controller optics 0/2/0/16
Thu May 13 12:52:35.020 UTC
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -125
!
```

Verification

This example shows how to verify the configured optical transmit power for the optics controller:

```
Router#show controller optics 0/2/0/16
Fri May 28 02:52:06.182 UTC
 Controller State: Up
 Transport Admin State: In Service
 Laser State: Off
 LED State: Off
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZRP
         DWDM carrier Info: C BAND, MSA ITU Channel=80, Frequency=192.15THz,
         Wavelength=1560.200nm
         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 = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 mA
         Actual TX Power = -40.00 dBm
         RX Power = -40.00 dBm
         RX Signal Power = -40.00 dBm
         Frequency Offset = 0 MHz
         Laser Temperature = 0.00 Celsius
         Laser Age = 0 %
         DAC Rate = 1x1.25
         Performance Monitoring: Enable
         THRESHOLD VALUES
         ----------------
```

```
        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
        Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
        LBC Threshold(mA)               0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -12.50 dBm
        Configured CD High Threshold = -5000 ps/nm
        Configured CD lower Threshold = -5000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 20.00 Celsius
        Voltage = 3.41 V
Transceiver Vendor Details
        Form Factor            : QSFP-DD
        Optics type            : QSFPDD 400G ZRP
        Name                   : CISCO-ACACIA
        OUI Number             : 7c.b2.5c
        Part Number            : DP04QSDD-E30-19E
        Rev Number             : 10
        Serial Number          : ACA244900GN
        PID                    : QDD-400G-ZRP-S
        VID                    : ES03
        Firmware Version       : 161.06
        Date Code(yy/mm/dd)    : 20/12/08
```

Configuring Muxponder Mode

By default, the Cisco IOS XR software configures the 400G Digital Coherent QSFP-DD optical modules in the 400G transponder mode.

However, you can configure muxponder mode on optics controllers. Based on the muxponder mode, you can choose the modulation.

Table 13: Supported Ports and Command for Configuring Muxponder Mode

Platforms with 400G Direct Ports	Direct Ports (n) with 400G	ZR/ZRP	Bright ZRP	Mode	Command
NC57-24DD	n = 0,2,4,6,8,10,12,14,16,18,20,22	7.3.2/7.5.1	7.10.1	400G	*Default*
NC57-18DD-SE	n = 18,20,22	7.3.2/7.5.1	7.10.1	4x100G	**controller optics** *0/x/0/n* **breakout** *4x100*
NC57-MOD-S	n = 8,9	7.8.1	7.10.1	3x100G	**controller optics** *0/x/0/n* **breakout** *3x100*

NC57-48Q2D-(S/SE-S)	n = 48,49	7.10.1	7.10.1	2x100G	**controller optics** *0/x/0/n* **breakout** *2x100*
NCS-57B1-6D24H-S	n = 24,25,26,27,28,29	7.3.2/7.5.1	7.10.1	1x100G	**controller optics** *0/x/0/n* **breakout** *1x100*
NCS-57B1-5D24H-SE	n = 24,25,26,27,28	7.3.2/7.5.1	7.10.1		
NCS-57C1-48Q6D-S	n = 0,2,4	7.5.2/7.7.1	7.10.1		
Platforms with Flex Port Pairs	**Port Pairs (n,n+1) sharing 400G**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NC57-18DD-SE (max 6 ZR or 3 ZRP)	n = 0,2,4,6,8,10,12,14,16,24,26,28	7.3.2/7.5.1	7.10.1	400G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *400*
NC57-36H6D-S	n = 24,26,28,30,32,34	7.3.2/7.5.1	7.10.1	4x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *4x100*
				3x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *3x100*
				2x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *2x100-pam4*
				1x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *1x100*
Platforms with Flex Port Quads	**Port Quads (n - n+3) sharing 400G, Direct Ports m with 400G**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NCS-57D2-18DD-S	n = 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60, m = 64,65	7.8.1	7.10.1	400G	**controller optics** *0//0/0/{n | m}* **speed** *400*

	4x100G	**controller optics** *0//0/0/{n | m}* **speed** *4x100*
	3x100G	**controller optics** *0//0/0/{n | m}* **speed** *3x100*
	2x100G	**controller optics** *0//0/0/{n | n+3 | m}* **speed** *2x100*
	1x100G	**controller optics** *0//0/0/{n | n+3 | m}* **speed** *1x100*

Table 14: Supported Ports and Command for Configuring Muxponder Mode

Platforms with 400G Direct Ports	**Direct Ports (n) with 400G**	**ZR/ZR+**	**Bright ZRP**	**DR4/SR4/LR4**	**Mode**	**Command**
NC57-24DD	n = 0,2,4,6,8,10,12,14,16,18,20,22	7.3.2/7.5.1	7.10.1	25.2.1	400G	*Default*
NC57-18DD-SE	n = 18,20,22	7.3.2/7.5.1	7.10.1	25.2.1	4x100G	**controller optics** *0/x/0/n* **breakout** *4x100*
NC57-MOD-S	n = 8,9	7.8.1	7.10.1	-	3x100G	**controller optics** *0/x/0/n* **breakout** *3x100*
NC57-48Q2D-(S/SE-S)	n = 48,49	7.10.1	7.10.1	-	2x100G	**controller optics** *0/x/0/n* **breakout** *2x100*
NCS-57B1-6D24H-S	n = 24,25,26,27,28,29	7.3.2/7.5.1	7.10.1	-	1x100G	**controller optics** *0/x/0/n* **breakout** *1x100*
NCS-57B1-5D24H-SE	n = 24,25,26,27,28	7.3.2/7.5.1	7.10.1	-		
NCS-57C1-48Q6D-S	n = 0,2,4	7.5.2/7.7.1	7.10.1	-		
Platforms with Flex Port Pairs	**Port Pairs (n,n+1) sharing 400G**	**ZR/ZR+**	**Bright ZRP**	**DR4/SR4/LR4**	**Mode**	**Command**
NC57-18DD-SE (max 6 ZR or 3 ZRP)	n = 0,2,4,6,8,10,12,14,16,24,26,28 **Note** n=16 is the only flex port that the DP04QSDD-ULH optical module supports	7.3.2/7.5.1	7.10.1	25.2.1	400G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *400*

NC57-36H6D-S	n = 24,26,28,30,32,34	7.3.2 7.5.1	7.10.1	-	4x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *4x100*
					3x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *3x100*
					2x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *2x100-pam4*
					1x100G	**hw-module port-range** *n n+1* **location** *0/x/CPU0* **mode** *1x100*
Platforms with Flex Port Quads	**Port Quads (n - n+3) sharing 400G, Direct Ports m with 400G**	**ZR/ZR+**	**Bright ZRP**	-	**Mode**	**Command**
NCS-57D2-18DD-S	n = 0,4,8,12,16,20,24,28,32,36,40,44,48,52,56,60, m = 64,65	7.8.1	7.10.1	-	400G	**controller optics** *0//0/0/{n | m}* **speed** *400*
				-	4x100G	**controller optics** *0//0/0/{n | m}* **speed** *4x100*
				-	3x100G	**controller optics** *0//0/0/{n | m}* **speed** *3x100*
				-	2x100G	**controller optics** *0//0/0/{n | n+3 | m}* **speed** *2x100*
				-	1x100G	**controller optics** *0//0/0/{n | n+3 | m}* **speed** *1x100*

Table 15: Other Platform Combinations: Supported Ports and Commands for Configuring Muxponder Mode

Platforms with NC57-MPA-2D4H-S in 800G mode, (0,1) and (2,3) sharing 400G	**MPA Slots**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NCS-57C3-MOD-(S/SE-S)	m = 2,3	7.8.1	7.9.1	400G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *400*
NC57-MOD-S	m = 1,2	7.8.1	7.10.1	4x100G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *4x100*
				3x100G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *3x100*
				2x100G	**controller optics** *0/x/m/{0 | 1 | 2 | 3}* **breakout** *2x100*
				1x100G	**controller optics** *0/x/m/{0 | 1 | 2 | 3}* **breakout** *1x100*
Platforms with NC57-MPA-2D4H-S in 400G mode, (0,1,2,3) sharing 400G	**MPA Slots**	**ZR/ZRP**	**Bright ZRP**	**Mode**	**Command**
NCS-57C3-MOD-(S/SE-S)	m = 1	7.8.1	7.9.1	4x100G	**hw-module port-range** *0 3* **instance** *m* **location** *0/x/CPU0* **mode** *4x100*
NCS-55A2-MOD-(S/SE-S/SE-H-S/HD-S/HX-S)	m = 1,2	7.5.1	7.10.1	3x100G	**hw-module port-range** *0 2* **instance** *m* **location** *0/x/CPU0* **mode** *3x100*
NC55-MOD-A-(S/SE-S)	m = 1,2	7.9.1	7.10.1	2x100G	**hw-module port-range** *{0 1 | 2 3}* **instance** *m* **location** *0/x/CPU0* **mode** *2x100-pam4*
				1x100G	**controller optics** *0/x/m/{0 | 1 | 2 | 3}* **breakout** *1x100*

Note The following line cards do not support CVR-QSFP-SFP10G and any 1Gbps optics:

- NCS-57B1-6D24-SYS
- NCS-57B1-5DSE-SYS
- NC57-24DD
- NC57-18DD-SE
- NC57-36H-SE
- NC57-36H6D
- NC57-MOD-S

Muxponder mode options available for QDD-400G-ZR-S are:

- 4x100

Muxponder mode options available for QDD-400G-ZRP-S and DP04QSDD-HE0 are:

- 4x100
- 3x100
- 2x100 (or 2x100-PAM4)
- 1x100

Muxponder mode options available for DP04QSDD-ULH are:

- 4x100

See the following tables for the modulation values, based on the muxponder mode:

- Table 5: QDD-400G-ZR-S Transponder and Muxponder Configuration Values, on page 11
- Table 7: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values, on page 11
- Table 8: DP04QSDD-HE0 Transponder and Muxponder Configuration Values, on page 12
- DP04QSDD-ER1 Transponder and Muxponder Configuration Values, on page 11
- Table 9: DP04QSDD-ULH Transponder and Muxponder Configuration Values, on page 13

Using the **no breakout** *muxponder mode* command, you can switch from the muxponder mode to the transponder mode, on optics controllers.

Muxponder Mode Configuration Example

The following example shows how to configure muxponder mode on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#breakout 4x100
Router(config-Optics)#commit
```

```
Router(config-Optics)#exit
Router(config)#exit
```



Note In the above example, the Cisco IOS XR software creates four Ethernet clients with 100GE speed, which can be verified using the **show interfaces brief | include** *R/S/I/P* command.

Running Configuration

This example shows the running configuration for the optics controller:

```
Router#show run controller optics 0/0/0/13
Thu May 13 12:24:42.353 UTC
controller Optics0/0/0/13
 cd-min -4000
 cd-max 4000
 breakout 4x100
 !
```

Verification

This example shows how to verify the muxponder mode configuration:

```
Router#show interfaces brief | include 0/0/0/13
 Hu0/0/0/13/0           up          up               ARPA  1514  100000000
 Hu0/0/0/13/1           up          up               ARPA  1514  100000000
 Hu0/0/0/13/2           up          up               ARPA  1514  100000000
 Hu0/0/0/13/3           up          up               ARPA  1514  100000000
```

Transponder Mode Configuration Example

The following example shows how to switch to the transponder mode, on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#no breakout 4x100
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```



Note The Cisco IOS XR software creates a single 400GE interface, which can be verified using the **show interfaces brief | include** *R/S/I/P* command.

Running Configuration

This example shows the running configuration for the optics controller. The breakout configuration is absent in the running configuration.

```
Router#show run controller optics 0/0/0/13
Thu May 13 13:51:20.330 UTC
controller Optics0/0/0/13
 cd-min -4000
 cd-max 4000
 transmit-power -100
 !
```

Verification

This example shows how to verify the transponder mode configuration:

```
Router#show interfaces brief | include 0/0/0/13
FH0/0/0/13          up          up               ARPA  1514  400000000
```

Configuring Modulation

You can configure modulation on optics controllers. Based on the muxponder mode, you can choose the modulation.

Note The system accepts any modulation value that is entered. However, if the modulation value is outside the supported range, it is not configured on the optical module. Instead, the optical module is auto-configured with a valid modulation value. To view this value, use the **show controller optics** *R/S/I/P* command.

See the following tables for the supported modulation values:

- Table 5: QDD-400G-ZR-S Transponder and Muxponder Configuration Values, on page 11
- Table 7: QDD-400G-ZRP-S Transponder and Muxponder Configuration Values, on page 11
- Table 8: DP04QSDD-HE0 Transponder and Muxponder Configuration Values, on page 12

Modulation Configuration Example

The following example shows how to configure modulation on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/1
Router(config-Optics)#modulation 16Qam
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration:

```
Router#show run controller optics 0/0/0/1
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -100
 modulation 16Qam
!
```

Note Use the **show controller optics** *R/S/I/P* command to verify the modulation value of the optical module.

Verification

This example shows how to verify the configured modulation value for the optics controller:

```
Router#show controller optics 0/0/0/1
 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 = 35
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = -7.87 dBm
        RX Power = -8.27 dBm
        RX Signal Power = -8.43 dBm
        Frequency Offset = 130 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 0 ps/nm
        Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
        Second Order Polarization Mode Dispersion = 5.00 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 = 4.00 ps
        Temperature = 54.00 Celsius
        Voltage = 3.37 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          : ACA2447003L
        PID                    : QDD-400G-ZR-S
        VID                    : ES03
        Firmware Version       : 61.12
        Date Code(yy/mm/dd)    : 20/12/02
```

Configuring DAC Rate

You can set the DAC (digital to analog conversion) sampling rate on optics controllers. You can modify the DAC sampling rate only on the QDD-400G-ZRP-S and DP04QSDD-HE0 optical modules.

Note QDD-400G-ZR-S supports 1x1 dac-rate in cFEC mode. QDD-400G-ZRP-S optical modules support 1x1 dac-rate in cFEC mode and 1x1.25 dac-rate in oFEC mode. DP04QSDD-HE0 optical modules support 1x1.5 dac-rate in cFEC mode and 1x1.25 dac-rate in oFEC mode

DAC Rate Configuration Example

The following example shows how to set the DAC rate on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/1
Router(config-Optics)#dac-rate 1x1
```

Verification

This example shows the running configuration:

```
Router#show run controller optics 0/0/0/1
Thu May 13 12:52:35.020 UTC
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -100
 modulation 16Qam
 DAC-Rate 1x1
!
!
```

Verification

This example shows how to verify the configured DAC rate for the optics controller:

```
Router#show controller optics 0/0/0/1
 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 = 35
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
```

```
        Laser Bias Current = 0.0 %
        Actual TX Power = -7.87 dBm
        RX Power = -8.27 dBm
        RX Signal Power = -8.43 dBm
        Frequency Offset = 130 MHz
        DAC Rate = 1x1
        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 0 ps/nm
        Configured CD-MIN -4000 ps/nm  CD-MAX 4000 ps/nm
        Second Order Polarization Mode Dispersion = 5.00 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 = 4.00 ps
        Temperature = 54.00 Celsius
        Voltage = 3.37 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          : ACA2447003L
        PID                    : QDD-400G-ZR-S
        VID                    : ES03
        Firmware Version       : 61.12
        Date Code(yy/mm/dd)    : 20/12/02
```

Configuring FEC

You can configure forward error correction (FEC) only on optics controllers. You can modify FEC only on the QDD-400G-ZRP-S and DP04QSDD-HE0 optical modules. FEC is a feature that is used for controlling errors during data transmission. This feature works by adding data redundancy to the transmitted message using an algorithm. This redundancy allows the receiver to detect and correct a limited number of errors occurring anywhere in the message, instead of having to ask the transmitter to resend the message.



Note QDD-400G-ZR-S supports cFEC (concatenated forward error correction). QDD-400G-ZRP-S and DP04QSDD-HE0 support cFEC and oFEC (open forward error correction).

FEC Configuration Example

The following sample shows how to configure FEC on the optics controller:

```
Router#configure
Router(config)#controller optics 0/0/0/13
Router(config-Optics)#fec CFEC
Router(config-Optics)#commit
Router(config-Optics)#exit
Router(config)#exit
```

Running Configuration

This example shows the running configuration:

```
Router#show controllers optics 0/0/0/13
controller Optics0/0/0/1
 cd-min -4000
 cd-max 4000
 transmit-power -100
 fec CFEC
 modulation 16Qam
 DAC-Rate 1x1.25
!
```

Verification

This example shows how to verify the FEC configuration for the optics controller:

```
Router#show controller coherentdsp 0/0/0/13
Thu May 27 17:28:51.960 UTC
Port                                          : CoherentDSP 0/0/0/13
Controller State                              : Down
Inherited Secondary State                     : Normal
Configured Secondary State                    : Maintenance
Derived State                                 : Maintenance
Loopback mode                                 : Internal
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 400.0Gb/s

Alarm Information:
LOS = 6 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 = 5
Detected Alarms                               : LOS
Bit Error Rate Information
PREFEC  BER                                   : 5.0E-01
POSTFEC BER                                   : 0.0E+00
Q-Factor                                      : 0.00 dB
Q-Margin                                      : -7.20dB
OTU TTI Received

FEC mode                                      : C_FEC
```

Configuring Loopback

You can configure internal or line loopback on coherent DSP controllers. Loopback can be performed only in the maintenance mode.

Loopback Configuration Example

This example shows how to enable internal loopback configuration on coherent DSP controllers:

```
Router#config
Router(config)#controller coherentDSP 0/0/0/4
Router(config-CoDSP)#secondary-admin-state maintenance
Router(config-CoDSP)#loopback internal
Router(config-CoDSP)#commit
```

Running Configuration

This example shows the running configuration on coherent DSP controllers:

```
Router#show run controller coherentdsp 0/0/0/4
Thu May 13 19:51:08.175 UTC
controller CoherentDSP0/0/0/4
 secondary-admin-state maintenance
 loopback internal
!
```

Verification

This example shows how to verify the loopback configuration on coherent DSP controllers:

```
Router#show controller coherentdsp 0/0/0/4
Thu May 27 17:28:51.960 UTC
Port                                          : CoherentDSP 0/0/0/4
Controller State                              : Down
Inherited Secondary State                     : Normal
Configured Secondary State                  : Maintenance
Derived State                                 : Maintenance
Loopback mode                               : Internal
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 400.0Gb/s
Alarm Information:
LOS = 6 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 = 5
Detected Alarms                               : LOS
Bit Error Rate Information
PREFEC  BER                                   : 5.0E-01
POSTFEC BER                                   : 0.0E+00
Q-Factor                                      : 0.00 dB
Q-Margin                                      : -7.20dB
OTU TTI Received
FEC mode                                      : C_FEC
```

Disable Auto-Squelching

Table 16: Feature History Table

Feature Name	Release Information	Description
Disable Auto-Squelching	Release 7.11.1	Introduced in this release on: NCS 5500 modular routers; NCS 5700 fixed port routers This release introduces support to disable Auto squelching. This helps to detect weak signals that are hidden within the laser source noise. By disabling Auto squelch, you can reduce the processing overhead in systems that have stable laser sources and minimal noise, helping you optimize the performance of your system. When the Auto squelch function is enabled, the optical module will generate a local fault signal on the host side if it detects a fault on the media side. By default, Auto squelch is enabled. The feature introduces these changes: **CLI:**The following keyword has been introduced. • **host auto-squelch disable** **YANG DATA models:** • New XPaths for `Cisco-IOS-XR-controller-optics-cfg` (see Github, YANG Data Models Navigator)

This release introduces the support to disable auto-squelch functionality on the module on the host side. When enabled, the squelch function is activated on the module when no suitable media-side input signal from the remote end is available to be forwarded to the host-side output (example: Rx LOS is asserted). Auto squelching is commonly used to suppress unwanted noise from laser sources in communication systems. When disabled and no valid signal is detected on the module from the remote end, the module will generate a local fault towards the NPU. However, disabling auto-squelching provides you with expanded signal detection. This enables you to detect extremely weak signals that are embedded within the laser source noise. Also, by eliminating the need to continuously monitor and suppress unwanted noise, system resources can be allocated more efficiently, leading to improved performance.

In this feature, we introduced the **host auto-squelch disable** command to disable the auto-squelch functionality when there is an invalid input signal from the remote end. This feature provides you with the flexibility to customize the system's behavior according to your requirements.

Disabling Laser Squelching Configuration Example

This example shows how to disable laser squelching for a host on controller optics:

```
router#config
router(config)#controller 0/0/0/0
router(config-Optics)#host auto-squelch disable
router(config-Optics)#commit
```

Verification

This example shows how to verify the laser squelching disabled configuration:

```
router#show controllers optics 0/0/0/0
    Host Squelch Status: disable
```

Configuring 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.

Performance monitoring can be configured on optics controllers and coherent DSP controllers.

To stop performance monitoring on optics or coherent DSP controllers, use the **perf-mon disable** keyword.

Configuring PM Parameters

The performance monitorning (PM) threshold and the threshold crossing alert (TCA) reporting status can be configured for optics controllers and coherent DSP controllers:

Table 17: PM Thresholds and TCA Report Status for Optics Controllers

PM Parameters	Description
CD	Sets the CD (chromatic dispersion) threshold or TCA reporting status.
DGD	Sets the DGD (differential group delay) threshold or TCA reporting status.
LBC	Sets the LBC (laser bias current) threshold or TCA reporting status in mA.
FREQ-OFF	Sets the FREQ-OFF (low signal frequency offset) threshold or TCA reporting status in Mhz.
OPR	Sets the OPR (optical power RX) threshold or TCA reporting status in uW or dbm.

PM Parameters	Description
OPT	Sets the OPT (optical power TX) threshold or TCA reporting status in uW or dbm.
OSNR	Sets the OSNR (optical signal-to-noise ratio) threshold or TCA reporting status.
PCR	Sets the PCR (polarization change rate) threshold or TCA reporting status.
PDL	Sets the PDL (polarization dependent loss) threshold or TCA reporting status.
RX-SIG	Sets the RX-SIG (receiving signal power) threshold or TCA reporting status in uW or dbm.
SNR	Sets the SNR (signal-to-noise ratio) threshold or TCA reporting status.
SOPMD	Sets the SOPMD (second order polarization mode dispersion) threshold or TCA reporting status.

Table 18: PM Thresholds TCA Report Status for Coherent DSP Controllers

PM Parameters	Description
Q	Sets the Q threshold or TCA reporting status.
Q-margin	Sets the Q margin threshold or TCA reporting status.
EC-BITS	Sets the EC-BITS (error corrected bits) threshold or TCA reporting status.
PostFEC BER	Sets the post-FEC BER threshold or TCA reporting status.
PreFEC BER	Sets the pre-FEC BER threshold or TCA reporting status.
UC-WORDS	Sets the UC-WORDS (uncorrected words) threshold or TCA reporting status.

Performance Monitoring Configuration Example

This example shows how to enable performance monitoring and set PM thresholds on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#perf-mon enable
Router(config-Optics)#pm 30-sec optics threshold cd max 100
Router(config-Optics)#pm 30-sec optics threshold cd min -100
Router(config-Optics)#commit
```

Running Configuration

This example shows the running configuration on optics controllers:

```
Router#show run controller optics 0/2/0/16
Thu May 13 20:18:55.957 UTC
controller Optics0/2/0/16
pm 30-sec optics threshold cd max 100
pm 30-sec optics threshold cd min -100
 perf-mon enable
!
```

Verification

This example shows how to verify the PM parameters on optics controllers. Verify the configuration changes in the Configured Threshold fields:

```
Router#show controller optics 0/2/0/16 pm current 30-sec optics 1
  Thu May 27 17:58:49.889 UTC
Optics in the current interval [17:58:30 - 17:58:49 Thu May 27 2021]
Optics current bucket type : Valid
            MIN       AVG       MAX      Operational      Configured      TCA   Operational
      Configured     TCA
                                          Threshold(min)   Threshold(min) (min) Threshold(max)
   Threshold(max) (max)
LBC[mA ]      : 0.0       0.0       0.0      0.0               NA              NO   100.0
          NA              NO
OPT[dBm]      : -9.98     -9.98     -9.98    -15.09            NA              NO   0.00
          NA              NO
OPR[dBm]      : -40.00    -40.00    -40.00   -30.00            NA              NO   8.00
          NA              NO
CD[ps/nm]     : 0         0         0        -80000          -100          NO   100
    100          NO
DGD[ps ]      : 0.00      0.00      0.00     0.00              NA              NO   80.00
          NA              NO
SOPMD[ps^2]   : 0.00      0.00      0.00     0.00              NA              NO   2000.00
          NA              NO
OSNR[dB]      : 0.00      0.00      0.00     0.00              NA              NO   40.00
          NA              NO
PDL[dB]       : 0.00      0.00      0.00     0.00              NA              NO   7.00
          NA              NO
PCR[rad/s]    : 0.00      0.00      0.00     0.00             NA              NO   2500000.00
       NA              NO
RX_SIG[dBm]   : -40.00    -40.00    -40.00   -30.00            NA              NO   1.00
          NA              NO
FREQ_OFF[Mhz]: 0          0         0        -3600             NA              NO   3600
          NA              NO
SNR[dB]       : 0.00      0.00      0.00     7.00              NA              NO   100.00
          NA              NO

Last clearing of "show controllers OPTICS" counters never
!
```

Performance Monitoring Configuration Example

This example shows how to enable performance monitoring and set PM thresholds and TCA reporting status on the coherent DSP controller:

```
Router#config
Router(config)#controller CoherentDSP0/2/0/16
Router(config-CoDSP)#perf-mon enable
Router(config-CoDSP)#pm 30-sec fec report Q max-tca enable
Router(config-CoDSP)#pm 30-sec fec report Q-margin max-tca enable
Router(config-CoDSP)#pm 30-sec fec report Q min-tca enable
Router(config-CoDSP)#pm 30-sec fec report Q-margin min-tca enable
Router(config-CoDSP)#pm 30-sec fec threshold Q max 1200
Router(config-CoDSP)#pm 30-sec fec threshold Q-margin max 500
Router(config-CoDSP)#pm 30-sec fec threshold Q min 900
```

```
Router(config-CoDSP)#pm 30-sec fec threshold Q-margin min 280
Router(config-CoDSP)#commit
```

Running Configuration

This example shows the running configuration on coherent DSP controllers:

```
Router#show run controller coherentdsp 0/2/0/16
Thu May 13 19:56:09.136 UTC
controller CoherentDSP0/2/0/16
 pm 30-sec fec report Q max-tca enable
 pm 30-sec fec report Q-margin max-tca enable
 pm 30-sec fec report Q min-tca enable
 pm 30-sec fec report Q-margin min-tca enable
 pm 30-sec fec threshold Q max 1200
 pm 30-sec fec threshold Q-margin max 500
 pm 30-sec fec threshold Q min 900
 pm 30-sec fec threshold Q-margin min 280
 perf-mon enable
 !
```

Verification

This example shows how to verify the PM parameters on coherent DSP controllers. Verify the configuration changes in the highlighted fields:

```
Router#show controllers coherentdsp 0/2/0/16 pm current 30-sec fec
Thu May 27 23:04:54.167 UTC
g709 FEC in the current interval [23:04:30 - 23:04:54 Thu May 27 2021]
FEC current bucket type : Valid
    EC-BITS   : 0                       Threshold : 111484000000           TCA(enable)  :
YES
    UC-WORDS  : 0                       Threshold : 5                      TCA(enable)  :
YES
                                      MIN       AVG        MAX      Threshold      TCA
 Threshold     TCA
                                                                        (min)     (enable)
   (max)     (enable)
PreFEC BER                    :     0E-15     0E-15     0E-15      0E-15        NO
0E-15        NO
PostFEC BER                   :     0E-15     0E-15     0E-15      0E-15        NO
0E-15        NO
Q[dB]                         :      0.00      0.00      0.00      9.00  YES 120.00  YES
Q_Margin[dB]                  :      0.00      0.00      0.00      2.80  YES  5.00   YES
 !
```

Configuring Alarms Threshold

The alarms threshold can be configured for monitoring alarms on optics controllers:

Table 19: Alarms Threshold Parameters for Optics Controllers

Alarm Threshold Parameters	Description
CD	Sets the CD (chromatic dispersion) alarm threshold (cd-low-threshold and cd-high-threshold).
DGD	Sets the DGD (differential group delay) alarm threshold.

Alarm Threshold Parameters	Description
LBC	Sets the LBC (laser bias current) threshold in mA.
OSNR	Sets the OSNR (optical signal-to-noise ratio) alarm threshold.

Alarm Threshold Configuration Example

This example shows how to configure alarm threshold on the optics controller:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#cd-low-threshold -2000
Router(config-Optics)#cd-high-threshold 2000
Router(config-Optics)#commit
```

Running Configuration

This example shows the running configuration on the optics controller:

```
Router#show run controller optics 0/2/0/16
Thu May 13 20:18:55.957 UTC
controller Optics0/2/0/16
 cd-low-threshold 2000
 cd-high-threshold 2000
!
```

Verification

This example shows how to verify the alarm threshold on optics controllers:

```
Router#show controller optics 0/2/0/16
Fri May 28 01:04:33.604 UTC
 Controller State: Up
 Transport Admin State: In Service
 Laser State: Off
 LED State: Off
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZRP
         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 = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 0
         TX-POWER-PROV-MISMATCH = 0
         Laser Bias Current = 0.0 mA
         Actual TX Power = -40.00 dBm
         RX Power = -40.00 dBm
         RX Signal Power = -40.00 dBm
         Frequency Offset = 0 MHz
         Laser Temperature = 0.00 Celsius
         Laser Age = 0 %
         DAC Rate = 1x1.25
```

```
        Performance Monitoring: Enable
        THRESHOLD VALUES
        ----------------
        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
        Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
        LBC Threshold(mA)               0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -10.00 dBm
        Configured CD High Threshold = -5000 ps/nm
        Configured CD lower Threshold = -5000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -26000 ps/nm  CD-MAX 26000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 21.00 Celsius
        Voltage = 3.42 V
Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZRP
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E30-19E
        Rev Number              : 10
        Serial Number           : ACA244900GN
        PID                     : QDD-400G-ZRP-S
        VID                     : ES03
        Firmware Version        : 161.06
        Date Code(yy/mm/dd)     : 20/12/08
!
```

Configuring FEC Alarm Threshold

Table 20: Feature History Table

Feature Name	Release Information	Description
Configurable FDD and FED Alarm Threshold Values	Release 24.3.1	

Feature Name	Release Information	Description
		Introduced in this release on: NCS 5700 Fixed Port Routers. We now ensure that you have accurate data to initiate proactive maintenance for non-critical FEC errors or take prompt action to prevent potential optical link data loss in your network. This is made possible because we've enabled the configuration of FEC (Forward Error Correction) Detected Degrade (FDD) alarm threshold values for non-critical FEC errors and FEC Excessive Degrade (FED) alarm threshold values for critical FEC errors. You can configure or clear these values for QDD-400G-ZR, QDD-400G-ZRP, and DP04QSDD-HE0 optical modules. Prior to this release, the router would automatically generate FEC alarms based on default threshold values. The feature introduces these changes: **CLI:** Modified the **controller optics** command by adding the following keywords: • **host fec-threshold excess-degrade raise** • **media fec-threshold excess-degrade raise** • **host fec-threshold excess-degrade clear** • **media fec-threshold excess-degrade clear** • **host fec-threshold detected-degrade raise** • **media fec-threshold detected-degrade raise** • **host fec-threshold detected-degrade clear**

Feature Name	Release Information	Description
		• **media fec-threshold detected-degrade clear** The **fec-thresholds** keyword is added to the **show controllers optics** command. **YANG Data Model:** • New XPaths for Cisco-IOS-XR-controller-optics-oper.yang • Cisco-IOS-XR-um-cont-optics-fec-threshold-cfg.yang
Configurable FDD and FED Alarm Threshold Values	Release 25.2.1	You can configure or clear the FDD and FED alarm threshold values for the DP04QSDD-ULH optical modules.

Forward Error Correction (FEC) is used to control errors during data transmission. FEC works by adding data redundancy to the transmitted message. This redundancy allows the receiver to detect and correct a limited number of errors occurring anywhere in the message, instead of the transmitter resending the entire message. For additional information on FEC, see Understanding FEC and Its Implementation.

There are two types of FEC alarms:

- FEC Detected Degrade (FDD) alarm: The FDD alarm is raised when the link degradation is within the permissible limit and does not cause traffic disruption. This alarm indicates the system is working harder than usual to maintain data transmission. Link degradation could be due to issues in the cable, network congestion, or other hardware failure.
- FEC Excessive Degrade (FED) alarm: The FED alarm is raised when the link degradation exceeds beyond the permissible limit and causes traffic disruption. This alarm indicates the system is working harder than usual to maintain data transmission. Without corrective measures, network performance deteriorates further and eventually results in traffic loss. Link degradation could be due to issues in the cable, network congestion, or other hardware failure.

The FEC alarms threshold values can now be configured to control alarms (raise and clear FEC alarms) on both media and host side of the optical tranceiver. The optical transceiver is divided into two sides, the host side, which is positioned towards the router, and the media side, which is positioned towards the wire or cable media.

When the average bit error rate (BER) exceeds the **raise threshold value**, the FEC alarm is raised (or asserted). Similarly, when the BER drops below the **clear threshold value**, then the alarm is cleared (or de-asserted).

Guidelines and Restrictions for Setting the FEC Alarm Thresholds

- The **raise threshold value** must always be greater than the **clear threshold value** for both FDD and FED alarms.
- The **raise** or **clear threshold value** of FED alarm must always be greater than the **raise or clear threshold value** of the FDD alarm.

- While the router configuration permits a range of 1 to 18446744073709551615, the router only supports a range of 1 to 2046000000000000000. The threshold value provided by users is converted from a 64 bit number to a 16 bit number. As a result, there is minor variation between the user provided value (configured value) and the programmed value. The user input (threshold value) is appended with exponents relative to E-18.

Table 21:

Configured Value	Programmed Value (Displayed using the Show CLI command)	Pattern	
1, 2, 3, ….,10	0, 1, 2,….,9	1<ConfiguredValue< 10, show command value = ConfiguredValue - 1	1->>>0.9999, displayed as 0 and so on
11,12,13,….,99	1.0, 1.1, 1.2,…9.8	10<ConfiguredValue<99, show command value = ConfiguredValue - 0.1	
111,222,333…999	1.10, 2.21, 3.32	100<ConfiguredValue<999, show command value = ConfiguredValue - 0.01	
1111,1112,1113 upto 2047	1.110, 1.111, 1.112…	1000<ConfiguredValue< 2047 show command value = ConfiguredValue - 0.001	
2050, 12345, 23456,65432,…	2.0500, 1.2300, 2.3400,6.5400…	2047<ConfiguredValue<maximum-range show command value = first 3 digits appended by 0s	

Configuration Examples to Set FEC Alarm Threshold

Examples to configure FEC alarm threshold:

Configuring FDD Alarm Thresholds

FDD Configuration Example

This example shows how to set FDD clear and raise alarm thresholds on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/10
Router(config-Optics)#host fec-threshold detected-degrade clear 12000
Router(config-Optics)#host fec-threshold detected-degrade raise 22000
Router(config-Optics)#commit
Router(config-Optics)#end
```

Running Configuration

This example shows the running configuration on the optics controller:

```
Router#show running-config controller optics 0/0/0/10
Sat Feb  3 06:01:56.354 UTC
controller Optics0/0/0/10
host fec-threshold detected-degrade raise 22000
host fec-threshold detected-degrade clear 12000
!
!
```

Verification

This example shows how to verify the alarm threshold values on optics controllers:

```
Router#show controller optics 0/0/0/10 fec-thresholds
FEC Threshold Information

                                Raise                    Clear
 Media FEC excess degrade   :   1.2600E-02               1.2100E-02
 Media FEC detected degrade :   1.1700E-02               1.1300E-02
 Host FEC excess degrade    :   2.4000E-02               2.4000E-03
 Host FEC detected degrade  :   2.2000E-14               1.1989E-14
```

Configuring FED Alarm Thresholds

FED Configuration Example

This example shows how to set FED raise and clear alarm thresholds on the optics controller:

```
Router#config
Router(config)#controller optics 0/0/0/12
Router(config-Optics)#host fec-threshold excess-degrade clear 14000
Router(config-Optics)#host fec-threshold excess-degrade raise 24000
Router(config-Optics)#commit
Router(config-Optics)#end
```

Running Configuration

This example shows the running configuration on the optics controller:

```
Router#show running-config controller optics 0/0/0/12
Sat Feb  3 06:02:00.153 UTC
controller Optics0/0/0/12
host fec-threshold excess-degrade raise 24000
host fec-threshold excess-degrade clear 14000
!
```

Verification

This example shows how to verify the alarm threshold values on optics controllers:

```
Router#show controller optics 0/0/0/12 fec-thresholds
FEC Threshold Information

                               Raise                    Clear
 Media FEC excess degrade   :   1.2600E-02               1.2100E-02
 Media FEC detected degrade :   1.1700E-02               1.1300E-02
 Host FEC excess degrade    :   2.3900E-14               1.3999E-14
 Host FEC detected degrade  :   9.0000E-03               9.0000E-04
```

Media Link-down PreFEC Degrade Enablement

Table 22: Feature History Table

Feature Name	Release Information	Description
Media Link-down PreFEC Degrade Enablement	Release 24.3.1	Introduced in this release on: NCS 5700 Fixed Port Routers. The Media Link-down PreFEC Degrade functionality can be used to protect the media side of the optical transceiver during transmission errors. By using this feature, you can proactively switch the traffic to standby path when the BER counter crosses the threshold value. This feature helps to avoid further traffic impact when the optical network reaches more noise or error. The feature introduces these changes: **CLI:** Modified the **controller optics** command by adding the **media link-down prefec-degrade** keyword. **YANG Data Model:** • New XPaths for `Cisco-IOS-XR-controller-optics-oper.yang` • New XPaths for `Cisco-IOS-XR-um-cont-optics-fec-threshold-cfg.yang` (see GitHub, YANG Data Models Navigator)

The Media Link-down PreFEC Degrade functionality can be used to protect the media side of the optical transceiver during transmission errors, such as errors due to noise, or data transmission errors. This feature is disabled by default. You can enable this feature by using the **media link-down prefec-degrade** command.

Prerequisites for using Media Link-down PreFEC Degrade Functionality

To use the Media Link-down PreFEC Degrade functionality, you must configure the FEC Alarm Threshold. For information on configuring FEC alarms threshold, see Configuring FEC Alarm Threshold.

About Media Link-down PreFEC Degrade Functionality

Prior to this release, the FEC Alarm Threshold functionality enabled you to configure the FEC alarms threshold values to control alarms (raise and clear FEC alarms) on media and host side of the optical transceiver. Using the FEC Alarm Threshold functionality, you can configure the FDD and FED alarm threshold values and set the **raise threshold value** and **clear threshold value** values to control alarms.

After you configure FEC Alarm Threshold and enable Media Link-down PreFEC Degrade functionality, you get the alarm notification when the average bit error rate (BER) exceeds the threshold value. This triggers

link-down and enables switchover functionality automatically. The traffic is switched to standby path, and remains in the standby path until the alarm is cleared or based on the settings done by the network operator.



Note In Cisco IOS XR Release 24.3.1, the Link-down PreFEC Degrade feature is supported only on the media side of the optical transceiver.

Configure Media Link-down PreFEC Degrade

The purpose of this task is to enable the media link-down preFEC degrade functionality to proactively switch the traffic to standby path.

Procedure

Step 1 Execute the **media link-down prefec-degrade** command to configure link-down preFEC degrade on the media side of the optics controller.

Example:

```
Router#config
Router(config)#controller optics 0/2/0/16
Router(config-Optics)#media link-down prefec-degrade
Router(config-Optics)#commit
```

Step 2 Execute the **show running-config controller optics** *R/S/I/P* command to view the running configuration on the optics controller.

Example:

```
Router#show running-config controller optics 0/2/0/16
Thu May 13 20:18:55.957 UTC
controller Optics0/2/0/16
 media link-down prefec-degrade
!
```

Step 3 Execute the **show controller optics** *R/S/I/P* command to verify link-down preFEC degrade feature on optics controllers.

Example:

```
Router#show controller optics 0/2/0/16
Fri May 28 01:04:33.604 UTC
 Controller State: Up
 Transport Admin State: In Service
 Laser State: On
 Media linkdown prefec degrade : Enabled
 LED State: Green
 FEC State: FEC ENABLED
 Optics Status
         Optics Type:  QSFPDD 400G ZRP
         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 = 0
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 mA
        Actual TX Power = -40.00 dBm
        RX Power = -40.00 dBm
        RX Signal Power = -40.00 dBm
        Frequency Offset = 0 MHz
        Laser Temperature = 0.00 Celsius
        Laser Age = 0 %
        DAC Rate = 1x1.25
        Performance Monitoring: Enable
        THRESHOLD VALUES
        ----------------
        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         13.0      -24.0          10.0        -22.0
        Tx Power Threshold(dBm)          0.0      -16.0          -2.0        -14.0
        LBC Threshold(mA)               0.00       0.00          0.00         0.00
        Temp. Threshold(celsius)       80.00      -5.00         75.00         0.00
        Voltage Threshold(volt)         3.46       3.13          3.43         3.16
        LBC High Threshold = 98 %
        Configured Tx Power = -10.00 dBm
        Configured CD High Threshold = -5000 ps/nm
        Configured CD lower Threshold = -5000 ps/nm
        Configured OSNR lower Threshold = 9.00 dB
        Configured DGD Higher Threshold = 80.00 ps
        Baud Rate =  60.1385459900 GBd
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -26000 ps/nm  CD-MAX 26000 ps/nm
        Second Order Polarization Mode Dispersion = 0.00 ps^2
        Optical Signal to Noise Ratio = 0.00 dB
        Polarization Dependent Loss = 0.00 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 0.00 ps
        Temperature = 21.00 Celsius
        Voltage = 3.42 V
 Transceiver Vendor Details
        Form Factor             : QSFP-DD
        Optics type             : QSFPDD 400G ZRP
        Name                    : CISCO-ACACIA
        OUI Number              : 7c.b2.5c
        Part Number             : DP04QSDD-E30-19E
        Rev Number              : 10
        Serial Number           : ACA244900GN
        PID                     : QDD-400G-ZRP-S
        VID                     : ES03
        Firmware Version        : 161.06
        Date Code(yy/mm/dd)     : 20/12/08
!
```

Application select codes

Application select codes are configuration parameters that:

- allow the host device to select the operating mode of a QDD optical module,
- specify the media code to configure the module's optical side, and
- enable direct control of the module’s application modes for operational flexibility.

Table 23: Feature History Table

Feature Name	Release Information	Feature Description
Application select code provisioning	Release 25.2.1	You can now configure application select codes directly on a QDD module by using a CLI. This simplifies provisioning by allowing the selection of advertised application modes such as 400ZR, OpenZR+ and others. The router activates the selected code to ensure compatibility and reduce configuration complexity. This feature introduces these changes: **CLI**: • The **appsel simple code** keyword is introduced in the Controller optics command.

The Common Management Interface Specification (CMIS) defines standardized rules for how QDD modules operate and how host devices configure them. CMIS ensures routers and switches can communicate with and control optical modules from different manufacturers consistently.

Each QDD module supports multiple operating modes, uniquely identified by an AppSel code (application select code). The AppSel code includes an application descriptor, which explains how the module functions (for example, how signals are processed between the module’s host side and media side). The media side, or optical side, of the module is configured according to the media code within the AppSel code. Host software uses this code to manage the optical interface and to configure supporting components such as the physical layer (PHY), SerDes, and MacPort.

Modules store a list of supported AppSel codes in EEPROM memory. This inventory allows the host system to identify which application modes are available for use. Standard codes such as 400G-OIF-ZR and 400G-OpenZR+ ensure interoperability and alignment with industry standards, whereas custom, third-party AppSel codes provide additional options but may create compatibility challenges if a host device does not recognize them.

By selecting an application mode advertised by the module, users can customize module operation for their needs. AppSel codes enable configuration of operation modes based on criteria such as:

- Data rate (for example, 100GbE, 400GbE),
- Signal type (examples include NRZ, PAM4, or others),
- Signal processing between the host and media sides, and
- Optical configuration based on the embedded media code.

AppSel supports operation modes based on these parameters:

- Data rate, such as 100GbE or 400GbE
- Signal type
- Signal processing between host side and media side
- Optical configuration, based on the media code, which is part of the AppSel code.

Benefits of AppSel code provisioning

These are the benefits of provisioning AppSel code:

- Enable selection of any supported application mode on an optical module for maximum flexibility.
- Allow direct configuration of NPU, PHY, and optical components to align with the chosen data path.
- Eliminate the need for Cisco IOS XR to implement new proprietary modes for every vendor's module, simplifying software requirements.
- Provide straightforward configuration by letting the operator directly select the desired AppSel code, without requiring IOS XR to interpret vendor-specific modes.
- Remove the extra step of mapping custom vendor codes, reducing time-to-support for new modules.

Configuration guidelines and restrictions for AppSel code provisioning

Configuration guidelines for AppSel code provisioning

These configurations apply for AppSel code provisioning:

- You must explicitly configure the AppSel code provisioning feature; it is not enabled by default.
- If you remove a non-default application ID configuration, the system immediately reverts to the default application ID.
- If you overwrite a valid application ID with an invalid one, the system reverts to the default application ID and raises an alarm to indicate the invalid configuration.
- Ensure that the number of configured applications does not exceed the module's supported maximum as listed in the AppSel list.

Restrictions for AppSel code provisioning

These restrictions apply to AppSel code provisioning:

- Do not attempt In Service Software Upgrade (ISSU) or In Service Software Downgrade (ISSD) on Cisco 8000 series routers; these features are not supported.
- Do not use Optical Transport Network (OTN) features; they are not supported for AppSel code provisioning.

How AppSel code provisioning works

AppSel code provisioning allows routers to dynamically configure pluggable optical modules, ensuring that each module operates in the correct mode for data transmission between the host device and the optical network.

The key components involved in the process are:

- Optical side: The portion of a pluggable module that connects to the optical network, converting electrical signals to optical signals and vice versa.
- Host side: The portion of the module that interfaces with the host device (such as a router or switch) and processes electrical signals.
- Optics driver: Software that collects supported application codes from the module, allows selection of a code, and programs the chosen application code into the module.
- Application codes: Unique identifiers representing supported operational modes of the optical module.
- Optics Management Agent (MA): Software that provides default configurations to the optics driver when no user configuration is specified and manages fallback behavior if no application code is selected.

Workflow

These stages describe how AppSel code provisioning process works.

1. When a pluggable optical module is inserted into a router, the AppSel code identifies the module's available operational modes.
2. The AppSel code points to an application descriptor, serving as a reference for the operational mode's configuration.
3. The application descriptor specifies the required transmission configuration, including how signals are processed between host and media lanes.
4. The AppSel code containing the appropriate media code is used to configure the optical (media) side of the module.
5. The router (host) software applies the media code to set up the optical module's interface accordingly.
6. Depending on the module's host side interface, additional parameters such as PHY, NPU SerDes, and MacPort can be configured.
7. Once both host side and media side configurations are complete, the datapath between the host and the optical network is established.

Result

AppSel code provisioning completes the setup of both host and media interfaces on the optical module, ensuring correct, efficient, and reliable operation for data transmission according to the selected operational mode.

Configure an AppSel code on an optical module

Configure the AppSel code to enable the optical module to operate in a specific application mode, such as 400ZR or OpenZR+.

AppSel codes are advertised by the module and must be validated before configuration. This ensures compatibility between the host and the module.

Before you begin

Ensure the router is running Cisco IOS XR Software Release 25.2.1 or later.

Procedure

Step 1 Identify the AppSel code that needs to be configured on a particular port from the list of available appcodes.

Example:

```
Router# show controllers optics 0/0/0/0 appsel advertised
Router# show controllers optics 0/0/0/0 appsel detailed
```

Step 2 Enter configuration mode on the router.

Example:

```
Router# conf
```

Step 3 (Optional) Identify the controller optics interface and configure breakout to match with the AppSel code that you want to configure.

Example:

```
Router(config)# controller optics 0/0/0/0 breakout 4x100
```

Step 4 Configure the AppSel code.

Example:

```
Router(config)# controller optics 0/0/0/0
appsel simple code 4
   !
!
```

Step 5 Verify the configuration.

Example:

```
Router# #show controllers optics 0/0/0/0 appsel advertised

Sun Feb  2 20:00:04.884 UTC
-------------------------------------------------------------------------------------------------------------------

  App-ID  |  Host-ID                        |  Media-ID                       |  Standard       |
Host     |  Power          |
          |                                 |                                 |                 |
Supported|  Consumption(W) |
          |                                 |                                 |                 |
          |                 |
-------------------------------------------------------------------------------------------------------------------

  1       |  17    ETH 400GAUI-8 C2M (Annex |  62    OIF 400ZR, DWDM, amplifi |  OIF            |
Yes      |  n/a            |
  2       |  13    ETH 100GAUI-2 C2M (Annex |  62    OIF 400ZR, DWDM, amplifi |  OIF            |
Yes      |  n/a            |
  3       |  17    ETH 400GAUI-8 C2M (Annex |  70    OpenZR+ ZR400-OFEC-16QAM |  OpenZR+        |
Yes      |  n/a            |
  4       |  13    ETH 100GAUI-2 C2M (Annex |  70    OpenZR+ ZR400-OFEC-16QAM |  OpenZR+        |
Yes      |  n/a            |
  5       |  17    ETH 400GAUI-8 C2M (Annex |  199   0xC0-0xFE  Vendor Specif |  0xC0-0xFE      |
Yes      |  n/a            |
  6       |  15    ETH 200GAUI-4 C2M (Annex |  199   0xC0-0xFE  Vendor Specif |  0xC0-0xFE      |
```

```
Yes       |  n/a            |
  7       |  13    ETH 100GAUI-2 C2M (Annex |  199   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  8       |  17    ETH 400GAUI-8 C2M (Annex |  196   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  9       |  15    ETH 200GAUI-4 C2M (Annex |  196   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  10      |  13    ETH 100GAUI-2 C2M (Annex |  196   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  11      |  17    ETH 400GAUI-8 C2M (Annex |  200   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  12      |  15    ETH 200GAUI-4 C2M (Annex |  200   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  13      |  13    ETH 100GAUI-2 C2M (Annex |  200   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
  14      |  17    ETH 400GAUI-8 C2M (Annex |  83    OTN-ITU-T FOIC4.8-DO (G. |  OTN-ITU-T       |
Yes       |  n/a            |
  15      |  254   0xC0-0xFE  Vendor Specif |  254   0xC0-0xFE  Vendor Specif |  0xC0-0xFE       |
Yes       |  n/a            |
-------------------------------------------------------------------------------------------------------------------------------

Router# show controllers optics 0/0/0/0 appsel detailed

Sun Feb  2 20:00:29.702 UTC
-------------------------------------------------------------------------------------------------------------------------------

  App-ID  |  Host-ID     |  Media-ID    |  Host Lane |  Media Lane|  Host Lane   |  Media Lane  |
Host      |
          |              |              |  Count     |  Count     |  Assign      |  Assign      |
Supported |
          |              |              |            |            |              |              |
          |
-------------------------------------------------------------------------------------------------------------------------------

  1       |  17          |  62          |  8         |  1         |  1           |  1           |
Yes       |
  2       |  13          |  62          |  2         |  1         |  85          |  1           |
Yes       |
  3       |  17          |  70          |  8         |  1         |  1           |  1           |
Yes       |
  4       |  13          |  70          |  2         |  1         |  85          |  1           |
Yes       |
  5       |  17          |  199         |  8         |  1         |  1           |  1           |
Yes       |
  6       |  15          |  199         |  4         |  1         |  17          |  1           |
Yes       |
  7       |  13          |  199         |  2         |  1         |  85          |  1           |
Yes       |
  8       |  17          |  196         |  8         |  1         |  1           |  1           |
Yes       |
  9       |  15          |  196         |  4         |  1         |  17          |  1           |
Yes       |
  10      |  13          |  196         |  2         |  1         |  85          |  1           |
Yes       |
  11      |  17          |  200         |  8         |  1         |  1           |  1           |
Yes       |
  12      |  15          |  200         |  4         |  1         |  17          |  1           |
Yes       |
  13      |  13          |  200         |  2         |  1         |  85          |  1           |
Yes       |
  14      |  17          |  83          |  8         |  1         |  1           |  1           |
Yes       |
  15      |  254         |  254         |  8         |  1         |  255         |  1           |
Yes       |
```

```
---------------------------------------------------------------------------------------------------------------


Router# show controllers optics 0/0/0/0 appsel active

Sun Feb  2 20:00:47.776 UTC
 Instance           : 1
 App-ID             : 3
 Host-ID            : 17    ETH 400GAUI-8 C2M (Annex
 Media-ID           : 70    OpenZR+ ZR400-OFEC-16QAM
 Host Lane Count    : 8
 Media Lane Count   : 1
 Host Lane Assign   : 0x1
 Media Lane Assign  : 0x1
```

The optical module operates in the selected application mode, ensuring compatibility and optimal performance.

What to do next

- Monitor the interface status and confirm the active AppSel code.
- Ensure alarms are cleared, and the interface is operational.

Alarms Troubleshooting

Table 24: Feature History Table

Feature Name	Release	Description
Enhanced Alarm Prioritization, Monitoring, and Management	Release 7.10.1	Introduced in this release on: NCS 5500 fixed port routers NCS 5500 modular routers (NCS 5500 line cards) In this release, we introduce enhanced alarm management that offers improved alarm prioritization, monitoring and management, as listed below: • Suppression of LOL (Loss of Line) alarm when the LOS-P (Loss of Signal-Payload) alarm is generated. This prioritizes the detection and handling of the LOS-P alarm. • Ability to clear alarm static counters using the command **clear counters controller coherentDSP location**. Clearing static counters enables you to monitor alarms generated for a definitive time period. • Suppression of warnings when the respective alarm is triggered. This prevents redundant or repetitive alerts.

This section contains the procedures for troubleshooting alarms.

CD Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The Chromatic Dispersion (CD) alarm is raised when the detected chromatic dispersion value is above or below the configured threshold values.

Clear the CD Alarm

Procedure

Configure threshold value within range if CD value is not within the threshold range.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

DGD Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The Differential Group Delay (DGD) alarm is raised when the value of the differential group delay read by the pluggable port module exceeds the configured threshold value.

Clear the DGD Alarm

Procedure

Configure the threshold value within range if DGD value is not within the threshold range.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

FLEXO_LOF

Default Severity: Critical

Logical Object: OTN

Flexo LOF alarm is raised when loss of alignment is detected on the Flexo frame for more than 3ms.

Clear the FLEXO_LOF Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOF (Loss of Frame) alarm is cleared when good alignment is detected on the Flexo frame for more than 3ms.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

FLEXO_LOM

Default Severity: Critical

Logical Object: OTN

Flexo LOM (Loss of Multi-Frame) is raised when loss of multi-frame alignment is detected on the Flexo multi-frame for more than 10ms

Clear the FLEXO_LOM Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOM alarm is cleared when good multi-frame alignment is detected on the Flexo multi-frame.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-LASERBIAS Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The HI-LASERBIAS alarm is raised when the physical pluggable port laser detects a laser bias value beyond the configured high threshold.

Clear the HI-LASERBIAS Alarm

Procedure

Configure the threshold value within range if high laser bias threshold value is not within the threshold range.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-RXPOWER Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The HI-RXPOWER alarm occurs on the client optics controller when the measured individual lane optical signal power of the received signal exceeds the default threshold. The HI-RXPOWER alarm occurs on the trunk optics controller when the total optical signal power of the received signal exceeds the default threshold.

Clear the HI-RXPOWER Alarm

Procedure

Physically verify by using a standard power meter that the optical input power is overcoming the expected power threshold. Connect an attenuator accordingly.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-RXPOWER Warn

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Software

The HI-RXPOWER warning occurs on the client optics controller when the measured individual lane optical signal power of the received signal exceeds the default threshold. The HI-RXPOWER warning occurs on the trunk optics controller when the total optical signal power of the received signal exceeds the default threshold.

Clear the HI-RXPOWER Warn Alarm

Procedure

Physically verify by using a standard power meter that the optical input power is overcoming the expected power threshold. Connect an attenuator accordingly.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-TEMP Alarm

Default Severity: Critical

Logical Object: Software

The HI-TEMP alarm occurs when the optical module temperature exceeds the default threshold.

Clear the HI-TEMP Alarm

Procedure

Verify the fan is intact and empty slots are blocked for cooling.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-TEMP Warn

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Software

The HI-TEMP warning occurs when the optical module temperature exceeds the default threshold.

Clear the HI-TEMP Warn Alarm

Procedure

Verify the fan is intact and empty slots are blocked for cooling

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-TXPOWER Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The HI-TXPOWER alarm occurs on the client optics controller when the measured individual lane optical signal power of the transmitted signal exceeds the default threshold. The HI-TXPOWER alarm occurs on the trunk optics controller when the total optical signal power of the transmitted signal exceeds the default threshold.

Clear the HI-TXPOWER Alarm

Procedure

Physically verify by using a standard power meter that the optical output power is overcoming the expected power threshold.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

HI-TXPOWER Warn

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Software

The HI-TXPOWER warning occurs on the client optics controller when the measured individual lane optical signal power of the transmitted signal exceeds the default threshold. The HI-TXPOWER warning occurs on the trunk optics controller when the total optical signal power of the transmitted signal exceeds the default threshold.

Clear the HI-TXPOWER Warn Alarm

Procedure

Physically verify by using a standard power meter that the optical output power is overcoming the expected power threshold.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

IMPROPER-REM

Default Severity: Critical

Logical Object: Software

The Improper Removal alarm is raised when a physical pluggable is not present on a service-provisioned port.

Clear the IMPROPER-REM Alarm

Procedure

Insert the appropriate QSFP.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LOF

Default Severity: Critical

Logical Object: OTN

Flexo LOF alarm is raised when loss of alignment is detected on the Flexo frame for more than 3ms.

Clear the LOF Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOF (Loss of Frame) alarm is cleared when good alignment is detected on the Flexo frame for more than 3ms.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LOL

Default Severity: Major

Logical Object: Software

LOL alarm is raised when loss of lock is detected on the receive side of the CDR (Clock and Data Recovery)

Clear the LOL Alarm

Procedure

Verify the fiber and power levels.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LOM

Default Severity: Critical

Logical Object: OTN

Flexo LOM (Loss of Multi-Frame) is raised when loss of multi-frame alignment is detected on the Flexo multi-frame for more than 10ms

Clear the LOM Alarm

Procedure

Identify and correct the underlying cause of mis-alignment. The Flexo LOM alarm is cleared when good multi-frame alignment is detected on the Flexo multi-frame.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LO-RXPOWER Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The LO-RXPOWER alarm is raised on the client or trunk optics controller when the measured individual lane optical signal power of the received signal falls below the default threshold.

Clear the LO-RXPOWER Alarm

Procedure

Verify that the trunk-rx port is cabled correctly and clean the fiber connecting the faulty TXP/MXP card to the drop port of the DWDM card.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LO-RXPOWER Warn

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Software

The LO-RXPOWER warning is raised on the client or trunk optics controller when the measured individual lane optical signal power of the received signal falls below the default threshold.

Clear the LO-RXPOWER Warn Alarm

Procedure

Verify that the trunk-rx port is cabled correctly and clean the fiber connecting the faulty TXP/MXP card to the drop port of the DWDM card.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LOS

Default Severity: Major

Logical Object: Software

This alarm occurs when there is a loss of signal

Clear the LOS Alarm

Procedure

Identify and correct the underlying cause of signal LOS. The alarm is cleared when signal is improved.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LOS-P

Default Severity: Minor

Logical Object: OTN

This alarm occurs when there is a loss of signal.

Clear the LOS-P Alarm

Procedure

Identify and correct the underlying cause of signal LOS. The alarm is cleared when signal is improved.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LO-TXPOWER Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The LO-TXPOWER alarm is raised on the client or trunk optics controller when the measured individual lane optical signal power of the transmitted signal falls below the default threshold.

Clear the LO-TXPOWER Alarm

Procedure

Verify the optics detection and any failures.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

LO-TXPOWER Warn

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Software

The LO-TXPOWER warning is raised on the client or trunk optics controller when the measured individual lane optical signal power of the transmitted signal falls below the default threshold.

Clear the LO-TXPOWER Warn Alarm

Procedure

Verify the optics detection and any failures.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

OOR_CD

Default Severity: Minor

Logical Object: Controller

This alarm occurs when the Chromatic Dispersion is out of range

Clear the OOR_CD Alarm

Procedure

Configure threshold value within range if CD value is not within the threshold range.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

OSNR Alarm

Default Severity: Minor (MN), Non-Service-Affecting (NSA)

Logical Object: Controller

The Optical Signal Noise Ratio (OSNR) alarm occurs when the measured OSNR falls below the threshold.

Clear the OSNR Alarm

Procedure

Step 1 Verify the value of the minimum acceptable OSNR value of NCS 5500 using the show controller optics R/S/I/P command.

Step 2 If the value is not within the OSNR threshold range, configure the minimum acceptable OSNR value using the controller optics R/S/I/P osnr-low-threshold command in the config mode. The range is 0–4000 (in units of 01db).

Step 3 If the value is within the range of the minimum acceptable OSNR, contact TAC.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

UNC-WORD Alarm

Default Severity: Not Reported (NR), Not-Alarmed, Non-Service-Affecting (NSA)

Logical Object: OTN

The Uncorrected FEC Word (UNC-WORD) condition is raised when the FEC is unable to correct the frame.

Clear the UNC-WORD Alarm

Procedure

Step 1 Ensure that the fiber connector for the card is completely plugged in.

Step 2 Ensure that the ports on the far end and near end nodes have the same port rates and FEC settings.

Step 3 If the BER threshold is correct and at the expected level, use an optical test set to measure the power level of the line to ensure it is within guidelines. For specific procedures to use the test set equipment, consult the manufacturer.

Step 4 If the optical power level is good, verify that the optical receive levels are within the acceptable range.

Step 5 If receive levels are good, clean the fibers at both ends.

Step 6 If the condition does not clear, verify that a single-mode fiber is used.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).

WVL-OOL

Default Severity: Major

Logical Object: Controller

The Wavelength Out of Lock alarm is raised when the port detects the optical input frequency to be out of range.

Clear the WVL-OOL Alarm

Procedure

Step 1 Verify the wavelength configuration.

Step 2 Verify whether the pluggable is inserted properly.

If the alarm does not clear, log into the Technical Support Website at http://www.cisco.com/c/en/us/support/index.html for more information or call Cisco TAC (1 800 553-2447).