Configuring Controllers

There are three types of controllers for the line card. The controllers are the optics controller, the ethernet controller, and the coherent DSP controller. This chapter describes the procedures used to configure these controllers.

Note Unless otherwise specified, “line cards” refers to 1.2T and 1.2TL line cards.

AINS

The Automatic-In-Service (AINS) feature allows the controller to automatically move to the automatic-in-service state after the maintenance window is completed. A soak time period is associated with the AINS state. The controller automatically moves to the In-Service state after the soak time period is completed. During the AINS maintenance window, alarms are not propagated to the EMS/NMS monitoring system.

You can configure AINS on the client ports of the card.

AINS States

The following table lists the AINS states.

State	Description
None	AINS is not enabled on the controller or the soak time period is complete.
Pending	AINS is configured on the controller. However, the soak time period has not started because either the primary state of controller is in Shutdown, Admin down, or Not ready state or the secondary state is in Maintenance state. AINS can also move to Pending state if alarms are raised during the soak time period.
Running	AINS is enabled on the controller. The primary state of the controller is Up and the secondary state is AINS.

If there are any service-affecting alarms when AINS is runring on ethernet or optics controllers, the AINS state moves to Pending state. When the alarms are cleared, the AINS state moves to Running state.

The AINS soak time period restarts when there are line card reloads, XR reloads, line card warm reloads, power cycles, or alarm conditioning.

Soak Time Period

You can configure the soak time period to be between 1 minute to 48 hours.

All alarms are suppressed during the AINS state. When the optical and ethernet alarms are raised on the port during the soak time period, the AINS state moves to Pending. These alarms are not displayed in the output of the **show alarms brief card location 0/RP0/CPU0 active** command but in the output of the **show alarms brief card location 0/RP0/CPU0 conditions** command. When all the alarms clear, the soak time period starts, and the AINS state moves to Running. When the soak time period expires, the port moves to IS state.

Configuring AINS

To configure AINS on a muxponder, use the following command:

configure

hw-module location *location* **mxponder client-port-ains-soak hours** *hours* **minutes** *minutes*

commit

The following is a sample in which all client ports are configured with AINS with soak time period specified to be 15 minutes.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#hw-module location 0/3 mxponder client-port-ains-soak hours 0
minutes 15
RP/0/RP0/CPU0:ios(config)#commit
```

To configure AINS on a muxponder slice, use the following command:

configure

hw-module location *location* **mxponder-slice** *slice-number* **client-port-ains-soak hours** *hours* **minutes** *minutes*

commit

The following is a sample in which slice 0 client ports are configured with AINS with soak time period specified to be 40 minutes.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#hw-module location 0/3 mxponder-slice 0 client-port-ains-soak
hours 0 minutes 40
RP/0/RP0/CPU0:ios(config)#commit
```

Disabling AINS

To disable AINS on all muxponder client ports, set the hours and minutes to 0. Use the following commands:

configure

hw-module location *location* **mxponder client-port-ains-soak hours** *hours* **minutes** *minutes*

commit

The following is a sample in which AINS is disabled on all client ports.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#hw-module location 0/3 mxponder client-port-ains-soak hours 0
minutes 0
RP/0/RP0/CPU0:ios(config)#commit
```

To disable AINS on a muxponder slice, set the hours and minutes to 0. Use the following command:

configure

hw-module location *location* **mxponder-slice** *slice-number* **client-port-ains-soak hours** *hours* **minutes** *minutes*

commit

The following is a sample in which AINS is disabled on all client ports of slice 0.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#hw-module location 0/3 mxponder-slice 0 client-port-ains-soak
hours 0 minutes 0
RP/0/RP0/CPU0:ios(config)#commit
```

Displaying the AINS Configuration

The AINS Soak field in the output indicates the current state of AINS. The current state can be None, Pending, or Running. The Total Duration field indicates the total soak time period that is configured. The Remaining Duration field indicates the soak time that remains, after which, the AINS state moves to None.

This example displays the ethernet controller statistics with AINS Soak in running state.

```
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/1/0/2

Thu Feb 21 19:52:55.001 UTC
Operational data for interface HundredGigECtrlr0/1/0/2:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: Running
      Total Duration: 0 hour(s) 15 minute(s)
      Remaining Duration: 0 hour(s) 5 minute(s) 37 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Holdoff Time: 0ms
```

This example displays the ethernet controller statistics with AINS Soak in pending state.

```
RP/0/RP0/CPU0:ios#show controllers HuC 0/0/0/2
Thu Mar 12 13:52:12.129 UTC
Operational data for interface HundredGigECtrlr0/0/0/2:

State:
    Administrative state: enabled
    Operational state: Down (Reason: State undefined)
    LED state: Red On
    Maintenance: Disabled
    AINS Soak: Pending
      Total Duration: 0 hour(s) 30 minute(s)
      Remaining Duration: 0 hour(s) 30 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known
    Alarms:
        Current:
            Local Fault
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 9

Autonegotiation disabled.
```

```
Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

This example displays the optics controller statistics with AINS Soak in running state.

```
RP/0/RP0/CPU0:ios#show controller optics 0/1/0/3

Thu Feb 21 19:45:41.088 UTC

 Controller State: Up

 Transport Admin State: Automatic In Service

 Laser State: On

 LED State: Green

 Optics Status

         Optics Type:  Grey optics

         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

         Performance Monitoring: Enable

         THRESHOLD VALUES
         ----------------

         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
         Rx Power Threshold(dBm)          4.9      -12.0           0.0          0.0
         Tx Power Threshold(dBm)          3.5      -10.1           0.0          0.0
         LBC Threshold(mA)                N/A        N/A          0.00         0.00

         LBC High Threshold = 98 %
         Polarization parameters not supported by optics

        Total TX Power = 6.39 dBm

        Total RX Power = 5.85 dBm
```

```
        Lane  Laser Bias    TX Power    RX Power  Output Frequency
        ----  ----------  ----------  ----------  ----------------
          1      75.0 %    0.59 dBm    0.63 dBm  230.43 THz
          2      68.6 %    0.06 dBm   -0.68 dBm  230.43 THz
          3      69.0 %    0.26 dBm   -0.63 dBm  230.43 THz
          4      69.1 %    0.56 dBm   -0.10 dBm  230.43 THz

Transceiver Vendor Details

        Form Factor             : QSFP28
        Name                    : CISCO-FINISAR
        Part Number             : FTLC1152RGPL-C2
        Rev Number              : CISCO-FINISAR
        Serial Number           : FNS22150LEC
        PID                     : QSFP-100G-CWDM4-S
        VID                     : V02
        CISCO-FINISAR
        Date Code(yy/mm/dd)     : 18/04/11
        Fiber Connector Type: LC
        Sonet Application Code: Not Set
        Ethernet Compliance Code: 100GBASE-CWDM4

Transceiver Temperature : 32 Celsius


AINS Soak               : Running
AINS Timer              : 0h, 15m
AINS remaining time     : 771 seconds
```

When the soak time expires, AINS state changes from Running to None. The Transport Admin State of optics controller changes from Automatic In Service to In Service.

```
RP/0/RP0/CPU0:ios# show controllers optics 0/1/0/3


Thu Feb 21 20:02:34.126 UTC

 Controller State: Up

 Transport Admin State: In Service

 Laser State: On

 LED State: Green

 Optics Status

        Optics Type:  Grey optics

        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

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          4.9      -12.0           0.0          0.0
        Tx Power Threshold(dBm)          3.5      -10.1           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 98 %
        Polarization parameters not supported by optics

       Total TX Power = 6.41 dBm

       Total RX Power = 5.85 dBm

        Lane  Laser Bias    TX Power    RX Power  Output Frequency
        ----  ----------  ----------  ----------  ----------------
          1      74.9 %    0.60 dBm    0.63 dBm  230.43 THz
          2      68.6 %    0.06 dBm   -0.70 dBm  230.43 THz
          3      69.0 %    0.30 dBm   -0.63 dBm  230.43 THz
          4      69.1 %    0.57 dBm   -0.11 dBm  230.43 THz

Transceiver Vendor Details

        Form Factor            : QSFP28
        Name                   : CISCO-FINISAR
        Part Number            : FTLC1152RGPL-C2
        Rev Number             : CISCO-FINISAR
        Serial Number          : FNS22150LEC
        PID                    : QSFP-100G-CWDM4-S
        VID                    : V02
        CISCO-FINISAR
        Date Code(yy/mm/dd)    : 18/04/11
        Fiber Connector Type: LC
        Sonet Application Code: Not Set
        Ethernet Compliance Code: 100GBASE-CWDM4

Transceiver Temperature : 32 Celsius


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

Configuring AINS on OTN-XP Card

You can configure the default AINS settings for all controllers on the OTN-XP card using the shared plane configuration. The configuration is applied to any line card that is installed in the NCS 1004. Use the following commands:

configure

ains-soak hours *hours* **minutes** *minutes*

commit

The following is a sample in which all the controllers on the OTN-XP card are configured with AINS with soak time period specified to be two minutes.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#ains-soak hours 0 minutes 2
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#do show controllers optics 0/1/0/0
Tue Apr 28 11:50:15.431 UTC

Controller State: Down

Transport Admin State: Automatic In Service

Laser State: On

LED State: Red

 Optics Status

         Optics Type:  100G QSFP28 LR4

         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

         Performance Monitoring: Enable

         THRESHOLD VALUES
         ----------------

         Parameter                High Alarm  Low Alarm  High Warning  Low Warning
         -----------------------  ----------  ---------  ------------  -----------
         Rx Power Threshold(dBm)          4.9      -12.0           0.0          0.0
         Tx Power Threshold(dBm)          3.5      -10.1           0.0          0.0
         LBC Threshold(mA)                N/A        N/A          0.00         0.00

         LBC High Threshold = 98 %
         Polarization parameters not supported by optics

        Total TX Power = 7.74 dBm

        Total RX Power = -40.00 dBm

         Lane  Laser Bias    TX Power    RX Power  Output Frequency
         ----  ----------  ----------  ----------  ----------------
           1      67.2 %    1.85 dBm  -40.00 dBm  231.39 THz
           2      67.9 %    1.55 dBm  -40.00 dBm  230.59 THz
           3      67.5 %    1.58 dBm  -40.00 dBm  229.79 THz
           4      66.8 %    1.89 dBm  -40.00 dBm  230.25 THz
```

```
Transceiver Vendor Details

        Form Factor             : QSFP28
        Name                    : CISCO-FINISAR
        Part Number             : 10-3204-01
        Rev Number              : B
        Serial Number           : FNS20510YUB
        PID                     : ONS-QSFP28-LR4
        VID                     : V01
        Date Code(yy/mm/dd)     : 16/12/15
        Fiber Connector Type: LC
        Otn Application Code: 4I1-9D1F
        Sonet Application Code: Not Set
        Ethernet Compliance Code: 100GBASE-LR4

Transceiver Temperature : 27 Celsius



AINS Soak               : Pending
AINS Timer              : 0h, 2m
AINS remaining time     : 120 seconds
```

To override the default AINS settings on a specific controller, use the following commands:

automatic-in-service controller optics *R/S/I/P* **hours** *hours* **minutes** *minutes*

Note This configuration does not persist after an RP reload operation.

The following is a sample in which the optics controller on the OTN-XP card is configured with a soak time period of 45 minutes.

```
RP/0/RP0/CPU0:ios#automatic-in-service controller optics 0/1/0/0 hours 0 minutes 45
Tue Apr 28 11:55:15.666 UTC
RP/0/RP0/CPU0:ios#show controllers optics 0/1/0/0
Tue Apr 28 11:55:30.323 UTC

Controller State: Down

Transport Admin State: Automatic In Service

Laser State: On

LED State: Red

 Optics Status

        Optics Type:  100G QSFP28 LR4

        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

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          4.9      -12.0           0.0          0.0
        Tx Power Threshold(dBm)          3.5      -10.1           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 98 %
        Polarization parameters not supported by optics

       Total TX Power = 7.74 dBm

       Total RX Power = -40.00 dBm

        Lane  Laser Bias    TX Power    RX Power  Output Frequency
        ----  ----------  ----------  ----------  ----------------
          1      67.2 %    1.85 dBm  -40.00 dBm  231.39 THz
          2      67.9 %    1.55 dBm  -40.00 dBm  230.59 THz
          3      67.5 %    1.58 dBm  -40.00 dBm  229.79 THz
          4      66.8 %    1.89 dBm  -40.00 dBm  230.25 THz

Transceiver Vendor Details

        Form Factor            : QSFP28
        Name                   : CISCO-FINISAR
        Part Number            : 10-3204-01
        Rev Number             : B
        Serial Number          : FNS20510YUB
        PID                    : ONS-QSFP28-LR4
        VID                    : V01
        Date Code(yy/mm/dd)    : 16/12/15
        Fiber Connector Type: LC
        Otn Application Code: 4I1-9D1F
        Sonet Application Code: Not Set
        Ethernet Compliance Code: 100GBASE-LR4

Transceiver Temperature : 27 Celsius


AINS Soak               : Pending
AINS Timer              : 0h, 45m
AINS remaining time     : 2700 seconds
```

From Release 7.5.2 onwards, AINS is supported on the 16G FC and 32FC controllers.

The following is a sample to configure AINS in 16G FC controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#automatic-in-service controller SixteenGigFibreChanCtrlr  0/0/0/6/2
```

```
 hours 0 minutes 15
RP/0/RP0/CPU0:ios(config)#commit
```

The following is a sample to verify AINS in 16G FC controller.

```
 show controllers SixteenGigFibreChanCtrlr 0/0/0/6/2 on XR

+++ 15:04:25 ne(default) exec +++
show controllers SixteenGigFibreChanCtrlr 0/0/0/6/2

Wed Apr 13 15:04:25.206 UTC

Operational data for Fibre Channel controller SixteenGigFibreChanCtrlr0/0/0/6/2

State:
        Admin State           : Up
        Operational state     : Up
        LED state             : Green On
        Secondary admin state : Automatic In Service
        AINS Soak             : Running
            Total Duration    : 0 hour(s) 15 minute(s)
            Remaining Duration: 0 hour(s) 14 minute(s) 29 second(s)
        Laser Squelch         : Disabled

Performance Monitoring is enabled

Operational values:
        Speed                    : 16 Gbps
        Loopback                 : None
        BER monitoring:
            Not supported
        Hold-off Time            : 0 ms
        Forward Error Correction : Not Configured
```

The following is a sample to configure AINS in 32G FC controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#automatic-in-service controller ThirtyTwoGigFibreChanCtrlr
0/0/0/0/4 hours 0 minutes 15
RP/0/RP0/CPU0:ios(config)#commit
```

The following is a sample to verify AINS in 32G FC controller.

```
 show controllers ThirtyTwoGigFibreChanCtrlr 0/0/0/0/4 on XR

+++ 15:04:25 ne(default) exec +++
show controllers ThirtyTwoGigFibreChanCtrlr 0/0/0/0/4

Wed Apr 13 15:04:25.393 UTC

Operational data for Fibre Channel controller ThirtyTwoGigFibreChanCtrlr0/0/0/0/4

State:
        Admin State           : Up
        Operational state     : Up
        LED state             : Green On
        Secondary admin state : Automatic In Service
        AINS Soak             : Running
            Total Duration    : 0 hour(s) 15 minute(s)
            Remaining Duration: 0 hour(s) 14 minute(s) 29 second(s)
        Laser Squelch         : Disabled

Performance Monitoring is enabled

Operational values:
```

```
        Speed                    : 32 Gbps
        Loopback                 : None
        BER monitoring:
            Not supported
        Hold-off Time            : 0 ms
        Forward Error Correction : Standard(Reed Solomon)

RP/0/RP0/CPU0:ne#
```

From Release 7.5.2 onwards, AINS is supported on the controllers for OTUCn-REGEN mode.

The following is a sample to configure AINS on the coherentDSP controllers for OTUCn-REGEN mode.

```
RP/0/RP0/CPU0:ios#automatic-in-service controller coherentDSP 0/0/0/12 hours 0 minutes 15
Tue May 24 17:51:06.979 UTC
```

The following sample verifies the AINS configured on the coherentDSP controllers for OTUCn-REGEN mode.

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/12
Tue May 24 17:52:29.558 UTC

Port                                          : CoherentDSP 0/0/0/12
Controller State                              : Up
Inherited Secondary State                     : Automatic-In-Service
Configured Secondary State                    : Automatic-In-Service
Derived State                                 : Automatic-In-Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 400.0Gb/s

Alarm Information:
LOS = 0 LOF = 0 LOM = 0
OOF = 4 OOM = 0 AIS = 3
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 3 TIM = 1
FECMISMATCH = 0 FEC-UNC = 0     FLEXO_GIDM = 2
FLEXO-MM = 0    FLEXO-LOM = 0   FLEXO-RDI = 2
FLEXO-LOF = 0
Detected Alarms                               : None

Bit Error Rate Information
PREFEC  BER                                   : 1.42E-04
POSTFEC BER                                   : 0.00E+00
Q-Factor                                      : 11.10 dB

Q-Margin                                      : 4.60dB

TTI :
        Remote hostname                       : ios
        Remote interface                      : CoherentDSP 0/0/0/12
        Remote IP addr                        : 0.0.0.0

FEC mode                                      : O_FEC

Flexo-Mode                                    : Enable
Flexo Details:
        Tx GID                                : 10
        TX IID                                : 1, 2, 3, 4,
        Rx GID                                : 10
        RX IID                                : 1, 2, 3, 4,

AINS Soak                                     : Running
```

```
AINS Timer                                          : 0h, 15m
AINS remaining time                                 : 855 seconds
```

The following is a sample to configure AINS globally on the OTUCn-REGEN mode.

```
RP/0/RP0/CPU0:ios#configure terminal
Tue May 24 17:51:34.545 UTC
RP/0/RP0/CPU0:ios(config)#ains-soak hours 0 minutes 15
RP/0/RP0/CPU0:ios(config)#commit
Tue May 24 17:51:44.144 UTC
```

The following sample verifies the AINS configured on the coherentDSP controllers:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Tue May 24 17:52:34.445 UTC

Controller State: Up

Transport Admin State: Automatic In Service

Laser State: On

LED State: Green

Optics Status

        Optics Type:  CFP2 DWDM
        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 = 1
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = 0.47 dBm
        RX Power = 0.40 dBm
        RX Signal Power = 0.30 dBm
        Frequency Offset = -1358 MHz

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         3.0      -25.5           0.0          0.0
        Tx Power Threshold(dBm)         3.0      -12.0           0.0          0.0
        LBC Threshold(mA)               N/A        N/A          0.00         0.00

        LBC High Threshold = 90 %
```

```
          Configured Tx Power = 0.50 dBm
          Configured CD High Threshold = 48000 ps/nm
          Configured CD lower Threshold = -48000 ps/nm
          Configured OSNR lower Threshold = 22.00 dB
          Configured DGD Higher Threshold = 67.00 ps
          Baud Rate =  63.1394679230 GBd
          Bits per Symbol = 4.0000000000  bits/symbol
          Modulation Type: 16QAM
          Chromatic Dispersion -1 ps/nm
          Configured CD-MIN -24000 ps/nm  CD-MAX 24000 ps/nm
          Polarization Mode Dispersion = 0.0 ps
          Second Order Polarization Mode Dispersion = 52.00 ps^2
          Optical Signal to Noise Ratio = 35.90 dB
          SNR = 19.40 dB
          Polarization Dependent Loss = 1.70 dB
          Polarization Change Rate = 0.00 rad/s
          Differential Group Delay = 2.00 ps
          DAC RATE:  1x1.50

Transceiver Vendor Details

          Form Factor            : CFP2
          Name                   : CISCO-ACACIA
          Part Number            : 10-3555-01
          Rev Number             : A0
          Serial Number          : ACA25420007
          PID                    : DP04CFP2-M25-K9
          VID                    : VES1
          Date Code(yy/mm/dd)    : 21/09/28
          Fiber Connector Type: LC
          Otn Application Code: Not Set
          Sonet Application Code: Not Set
          Ethernet Compliance Code: Not set

Transceiver Temperature : 41 Celsius


AINS Soak               : Running
AINS Timer              : 0h, 15m
AINS remaining time     : 850 seconds
```

FEC

Table 1: Feature History

Feature Name	Release Information	Description
Forward Error Correction (FEC) support on QXP card for Ethernet controllers	Cisco IOS XR Release 7.8.1	FEC is now supported by the 100GE Ethernet controller on the NCS1K4-QXP-K9 card. FEC is supported for all pluggables except QSFP-100G-LR4-S and ONS-QSFP28-LR4.

Forward error correction (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.

FEC States for Ethernet Controller

The following table lists the FEC states for the Ethernet controller.

State	Description
None	FEC is not enabled on the Ethernet controller.
Standard	Standard (Reed-Solomon) FEC is enabled on the Ethernet controller.

FEC configuration is automatically enabled for only the pluggables that support Auto-FEC. If you manually configure FEC, the manual configuration overrides the Auto-FEC.

The supported pluggables for Auto-FEC are:

- QSFP-100G-SR4-S
- QSFP-100G-CWDM4-S
- QSFP-100G-SM-SR
- QSFP-100G-AOC-1M
- QSFP-100G-AOC-3M
- QSFP-100G-AOC-10M
- QDD-400-AOC15M
- QDD-400G-FR4-S
- QSFP-100G-ER4L
- QDD-400G-DR4-S
- QDD-400G-LR8-S
- QDD-4X100G-LR-S

The LR4 pluggable is a 1310nm long range band pluggable that does not require you to enable FEC.

The software automatically enables FEC mode on the pluggables installed in the Cisco NCS 1004. When you upgrade the software of an NCS 1004 with pluggables in the FEC disabled mode, traffic is affected.

The following sample shows the running FEC configuration on the LR4 pluggable:

```
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/0/0/4
Thu Aug  8 15:41:20.857 IST
Operational data for interface HundredGigECtrlr0/0/0/4:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
```

```
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Holdoff Time: 0ms
```

The following sample shows the running FEC configuration on the non LR4 pluggable:

```
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/0/0/2
Thu Aug  8 15:41:56.457 IST
Operational data for interface HundredGigECtrlr0/0/0/2:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 66

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Configuring FEC on the Ethernet Controller

Note The FEC configuration is not required for the supported pluggables. The configuration is required only in the case of non-Cisco qualified non-LR4 pluggables.

To configure FEC on the Ethernet controller, use the following command:

configure

controller HundredGigECtrlr *R/S/I/P* **fec { none | standard }**

commit

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

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/1/0/10 fec standard
RP/0/RP0/CPU0:ios(config)#commit
```

The following sample shows the running FEC configuration on the Ethernet controller:

```
RP/0/RP0/CPU0:BH-SIT2#show controller HundredGigECtrlr 0/1/0/10
Tue Jul 16 15:30:30.165 IST
Operational data for interface HundredGigECtrlr0/1/0/10:

State:
    Administrative state: enabled
    Operational state: Down (Reason: State undefined)
    LED state: Red On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known
    Alarms:
        Current:
            Loss of Frequency Sync Data
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

FEC States for CoherentDSP Controller

The following table lists the FEC states for the coherentDSP controllers.

Table 2: FEC State for CoherentDSP Controllers

State	Description
EnhancedSD15	FEC Soft-Decision 15.
EnhancedSD27	FEC Soft-Decision 27. Default.

Q-Margin Support

Q-margin is an important optical parameter that characterizes the health of an optical link. The Q-margin value is calculated based on the average bit error rate (BER) in the optical link.

Table 3: Feature History

Feature Name	Release Information	Description
Enhanced Q-Margin Support	Cisco IOS XR Release 7.3.1	Enhanced Q-Margin is supported for Forward error correction (FEC) and performance monitoring on CoherentDSP Controllers for 1.2T and 1.2TL cards. This enhanced Q-margin value is calculated based on the maximum number of errors for each frame. An attribute that is called **instantaneous Q-margin** is displayed in the output of the **show controllers coherentDSP** command. The lower the delta value between the instantaneous Q-margin value with the Q-margin value, the better the FEC performance of the NCS 1004 system. The instantaneous Q-margin values thus help you to optimize the system with continuous error correction in subsea transport networks. Command modified: • **show controllers coherentDSP**

Enhanced Q-Margin Support

From Release 7.3.1 onwards, enhanced Q-Margin is supported for Forward error correction (FEC) and performance monitoring on CoherentDSP controllers for 1.2T and 1.2TL cards. Enhanced Q-margin provides

a better error free signal in the optical link. The enhanced Q-margin value is calculated based on the maximum number of errors per frame. An attribute that is called instantaneous Q-margin is displayed in the output of the **show controllers coherentDSP** command. The lower the delta value between the instantaneous Q-margin value with the Q-margin value, the better the FEC performance of the NCS 1004 system.

To view Q-margin and enhanced Q-margin values for FEC on CoherentDSP controllers, see Verifying FEC on CoherentDSP Controllers, on page 19.

To view Q-margin and enhanced Q-margin values for performance monitoring on CoherentDSP controllers, see Configuring PM Parameters.

Configuring FEC on CoherentDSP Controllers

To configure FEC on the CoherentDSP controller, use the following command:

configure

controller coherentDSP *R/S/I/P*

fec {**EnhancedSD15** | **EnhancedSD27**}

commit

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

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/0
RP/0/RP0/CPU0:ios(config-CoDSP)#fec EnhancedSD15
Tue Feb 25 11:25:52.670 UTC
WARNING! Changing FEC mode can impact traffic
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

Verifying FEC on CoherentDSP Controllers

The following sample shows the FEC configuration on the CoherentDSP controller:

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/0

Tue Feb 25 11:26:08.235 UTC


Port                                          : CoherentDSP 0/0/0/0
Controller State                              : Up
Inherited Secondary State                     : Normal
Configured Secondary State                    : Normal
Derived State                                 : In Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 50.0Gb/s
Alarm Information:
LOS = 1 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
Detected Alarms                               : None
Bit Error Rate Information
PREFEC  BER                                   : 0.00E+00
POSTFEC BER                                   : 0.00E+00
```

```
Q-Factor                                        : 0.00 dB
Q-Margin                                        : -5.00dB
Instantaneous Q_margin                        :  0 dB


TTI :
       Remote IP addr                           : 0.0.0.0
FEC mode                                        : Soft-Decision 15

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

Configuring FEC on OTN-XP Card

FEC is supported on the CoherentDSP controllers for the OTN-XP card and O-FEC is the default FEC option configured on the card.

From Release 7.3.1 onwards, CFP2-DCO trunk is configured with 0-FEC.

Note The options enhanced SD15 and SD17 are not supported on the OTN-XP card.

Note CFEC is not supported on CFP2-DCO.

To configure FEC on the CoherentDSP controller for the OTN-XP card, use the following command:

configure

controller coherentDSP *R/S/I/P*

fec OFEC

commit

The following sample shows how to configure O-FEC option on the CoherentDSP controller for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/0
RP/0/RP0/CPU0:ios(config-CoDSP)#fec OFEC
Tue Feb 25 11:25:52.670 UTC
WARNING! Changing FEC mode can impact traffic
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

Verifying FEC on OTN-XP Card

The following sample shows the FEC configuration on the CoherentDSP controller for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/0

Tue Feb 25 11:26:08.235 UTC
```

```
Port                                            : CoherentDSP 0/0/0/0
Controller State                                : Up
Inherited Secondary State                       : Normal
Configured Secondary State                      : Normal
Derived State                                   : In Service
Loopback mode                                   : None
BER Thresholds                                  : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                          : Enable
Bandwidth                                       : 50.0Gb/s
Alarm Information:
LOS = 1 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
Detected Alarms                                 : None
Bit Error Rate Information
PREFEC  BER                                     : 0.00E+00
POSTFEC BER                                     : 0.00E+00
Q-Factor                                        : 0.00 dB
Q-Margin                                        : -5.00dB
Instantaneous Q_margin                        :  0 dB


TTI :
        Remote IP addr                          : 0.0.0.0
FEC mode                                        : O-FEC

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

Configuring FEC on OTN-XP Card – QDD-400G-ZRP

The QDD-400G-ZRP coherent trunk pluggable supports two types of FEC modes on the OTN-XP card:

- C-FEC
- O-FEC

You can configure the required FEC mode on the OTN-XP card. You can migrate from CFEC to OFEC or OFEC to CFEC mode.

Note On configuring datapath, the default FEC enabled is C-FEC mode.

Note The change in FEC mode affects traffic.

To configure FEC on the CoherentDSP controller for the OTN-XP card, use the following command:

configure

controller coherentDSP *R/S/I/P*

fec *fec-type*

commit

The following sample shows how to configure O-FEC option on the CoherentDSP controller for the OTN-XP card:

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/11
RP/0/RP0/CPU0:ios(config-CoDSP)#fec OFEC
Fri Jul 23 18:19:31.204 UTC
WARNING! Changing FEC mode can impact traffic
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Fri Jul 23 18:19:32.835 UTC
```

The following sample shows how to configure C-FEC option on the CoherentDSP controller for the OTN-XP card:

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/11
RP/0/RP0/CPU0:ios(config-CoDSP)#fec CFEC
Fri Jul 23 18:19:31.204 UTC
WARNING! Changing FEC mode can impact traffic
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Fri Jul 23 18:19:32.835 UTC
```

Verifying FEC on OTN-XP Card – QDD-400G-ZRP

The following sample shows the FEC configuration on the CoherentDSP controller with the trunk controller status as C-FEC for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#show controller coherentDSP 0/0/0/11
Fri Jul 23 17:36:45.342 UTC

Port                                        : CoherentDSP 0/0/0/11
Controller State                            : Up
Inherited Secondary State                   : Normal
Configured Secondary State                  : Normal
Derived State                               : In Service
Loopback mode                               : None
BER Thresholds                              : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                      : Enable
Bandwidth                                   : 400.0Gb/s

Alarm Information:
LOS = 1 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 = 0
Detected Alarms                             : None

Bit Error Rate Information
PREFEC  BER                                 : 9.02E-04
POSTFEC BER                                 : 0.00E+00
Q-Factor                                    : 9.90 dB

Q-Margin                                    : 2.70dB

TTI :
        Remote IP addr                      : 0.0.0.0

FEC mode                                    : C_FEC

Flexo-Mode                                  : Enable
```

```
Flexo Details:
        Tx GID                                  : 0
        Rx GID                                  : 0

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

The following sample shows the FEC configuration on the CoherentDSP controller with the trunk controller status as O-FEC for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#show controller coherentDSP 0/0/0/11
Fri Jul 23 17:46:51.775 UTC

Port                                            : CoherentDSP 0/0/0/11
Controller State                                : Up
Inherited Secondary State                       : Normal
Configured Secondary State                      : Normal
Derived State                                   : In Service
Loopback mode                                   : None
BER Thresholds                                  : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                          : Enable
Bandwidth                                       : 400.0Gb/s

Alarm Information:
LOS = 3 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 = 1
Detected Alarms                                 : None

Bit Error Rate Information
PREFEC  BER                                     : 3.36E-04
POSTFEC BER                                     : 0.00E+00
Q-Factor                                        : 10.60 dB

Q-Margin                                        : 4.10dB

TTI :
        Remote IP addr                          : 0.0.0.0

FEC mode                                        : O_FEC

Flexo-Mode                                      : Enable
Flexo Details:
        Tx GID                                  : 0
        Rx GID                                  : 0

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

The following sample shows the FEC configuration on the optics controller with the trunk controller optics as C-FEC for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#show controller optics 0/0/0/11
Wed Sep 15 00:36:24.383 UTC
```

```
Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Green

Optics Status

        Optics Type:  QSFP-DD DWDM
        DWDM carrier Info: C BAND, MSA ITU Channel=49, Frequency=193.70THz,
        Wavelength=1547.715nm

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


        LOS/LOL/Fault Status:

        Alarm Statistics:

        -------------
        HIGH-RX-PWR = 0            LOW-RX-PWR = 1
        HIGH-TX-PWR = 0            LOW-TX-PWR = 1
        HIGH-LBC = 0               HIGH-DGD = 0
        OOR-CD = 0                 OSNR = 1
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = -8.09 dBm
        RX Power = -7.31 dBm
        RX Signal Power = -7.67 dBm
        Frequency Offset = 81 MHz
Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          3.0      -23.5           0.0          0.0
        Tx Power Threshold(dBm)          0.0      -16.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 90 %
        Configured Tx Power = -7.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 24.00 dB
        Configured DGD Higher Threshold = 40.00 ps
        Baud Rate =  59.8437500000 GBd
        Bits per Symbol = 4.0000000000  bits/symbol
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -2400 ps/nm  CD-MAX 2400 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.40 dB
        SNR = 17.30 dB
        Polarization Dependent Loss = 0.40 dB
        Polarization Change Rate = 0.00 rad/s
```

```
        Differential Group Delay = 3.00 ps

 Transceiver Vendor Details

        Form Factor            : QSFP-DD
        Name                   : CISCO
        Part Number            : 10-3496-01
        Rev Number             : 11
        Serial Number          : 210153241
        PID                    : QDD-400G-ZRP-S
        VID                    : ES04
        Date Code(yy/mm/dd)    : 20/21/01
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set
 Transceiver Temperature : 57 Celsius
 AINS Soak               : None
 AINS Timer              : 0h, 0m
 AINS remaining time     : 0 seconds
```

The following sample shows the FEC configuration on the optics controller with the trunk controller optics as O-FEC for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#show controller optics 0/3/0/9
Wed Sep 15 00:41:22.027 UTC

 Controller State: Up

 Transport Admin State: In Service

 Laser State: On

 LED State: Green

 Optics Status

        Optics Type:  QSFP-DD DWDM
        DWDM carrier Info: C BAND, MSA ITU Channel=49, Frequency=193.70THz,
        Wavelength=1547.715nm

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


        LOS/LOL/Fault Status:

        Alarm Statistics:

        -------------
        HIGH-RX-PWR = 0            LOW-RX-PWR = 3
        HIGH-TX-PWR = 0            LOW-TX-PWR = 5
        HIGH-LBC = 0               HIGH-DGD = 0
        OOR-CD = 0                 OSNR = 4
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 6
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = -11.10 dBm
        RX Power = -11.56 dBm
        RX Signal Power = -11.62 dBm
        Frequency Offset = -66 MHz
Performance Monitoring: Enable
```

```
        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          3.0      -24.5           0.0          0.0
        Tx Power Threshold(dBm)          0.0      -16.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 90 %
        Configured Tx Power = -10.00 dBm
        Configured CD High Threshold = 52000 ps/nm
        Configured CD lower Threshold = -52000 ps/nm
        Configured OSNR lower Threshold = 21.10 dB
        Configured DGD Higher Threshold = 67.00 ps
        Baud Rate =  60.1385467980 GBd
        Bits per Symbol = 4.0000000000  bits/symbol
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -13000 ps/nm  CD-MAX 13000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 24.00 ps^2
        Optical Signal to Noise Ratio = 35.70 dB
        SNR = 19.40 dB
        Polarization Dependent Loss = 0.20 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : QSFP-DD
        Name                   : CISCO-ACACIA
        Part Number            : DP04QSDD-E
        Rev Number             : A
        Serial Number          : ACA2524006W
        PID                    : QDD-400G-ZRP-S
        VID                    : V01
        Date Code(yy/mm/dd)    : 21/06/18
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 62 Celsius
AINS Soak               : None
AINS Timer              : 0h, 0m
AINS remaining time     : 0 seconds
```

Laser Squelching

Table 4: Feature History

Feature Name	Release Information	Feature Description
Laser Squelching	Cisco IOS XR Release 7.8.1	Laser Squelching is now triggered using a new interrupt mechanism to detect faults in the client or trunk connections. Compared to the earlier poll-based triggers, the new interrupt-based mechanism makes the protection switching considerably faster. This feature is supported on the following line cards with 100GE client rate with the ONS-QSFP28-LR4 pluggable: • NCS1K4-1.2T-K9 • NCS1K4-1.2TL-K9 • NCS1K4-OTN-XP • NCS1K4-2-QDD-C-K9

You can enable laser squelching on Ethernet controllers. When laser squelching is enabled, the laser is shut down in the event of trunk faults (LOS, LOF), and a SQUELCHED alarm is raised on the mapped client port.

In previous releases, implementation was based on a poll mechanism and client squelch was supported only in case of trunk fault scenarios. From 7.8.1 release squelching uses an interrupt based method. Hence squelching happens faster when compared to previous releases. Squelch happens for client alarms also like Ingress LF, LOA, and CSF (not for egress client alarms) in addition to trunk fault cases. Fast squelching helps to achieve faster protection switching. See Protection Switching Use Cases, on page 28. This feature is supported on the following line cards with 100GE client rate with the ONS-QSFP28-LR4 pluggable:

- NCS1K4-1.2T-K9
- NCS1K4-1.2TL-K9
- NCS1K4-OTN-XP
- NCS1K4-2-QDD-C-K9

To configure laser squelching on the Ethernet controllers, use the following commands:

configure

controller HundredGigECtrlr *Rack/Slot/Instance/Port*

laser-squelch

commit

The following is a sample where laser squelching is enabled on the Ethernet controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/1/0/10
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#laser-squelch
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the laser squelch status on the controller.

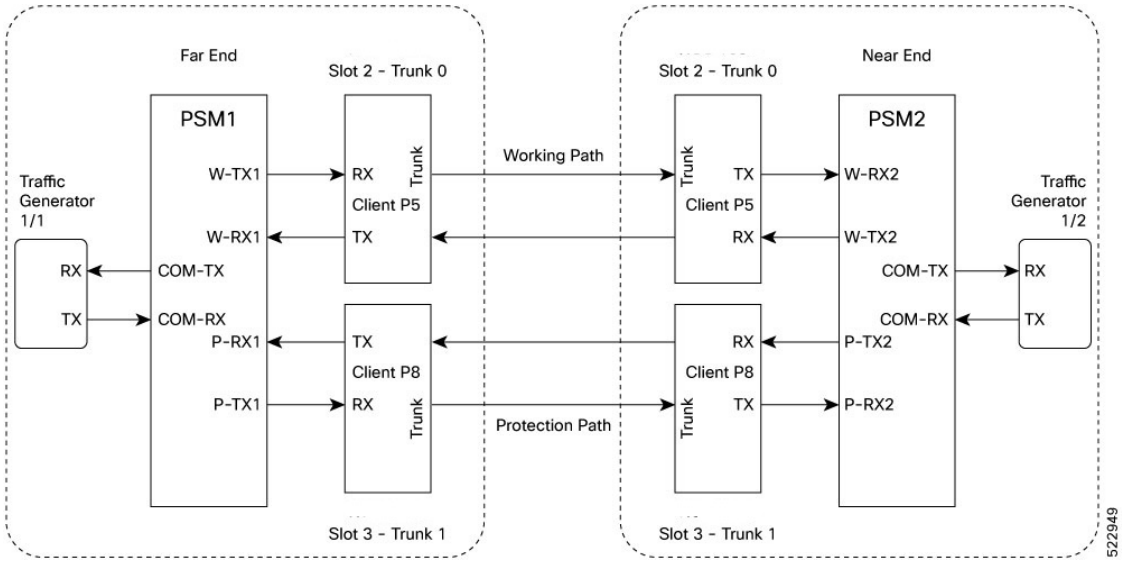
```
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/1/0/10
Fri Feb 22 15:18:47.011 UTC
Operational data for interface HundredGigECtrlr0/1/0/10:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Protection Switching Use Cases

Fast-Squelching provides increased protection switching speed when there's a trunk fault or a client fault.

The following sample topology includes a Far End (FE) station and a Near End (NE) station. Each station includes an NCS 1004 node having two line cards. The nodes are connected to the respective Traffic generators through a Protection Switching Module (PSM).

Figure 1: Reference Topology for Protection Switching



Protection Switching Principle (Trunk fault)

If there is a fiber cut in the trunk working path from the FE station to the NE station, an LOS alarm is raised on the NE working trunk. This results in the squelching of all client ports mapped to the working NE trunk port. As the laser of the client port is squelched, LOS is reported on the W-RX2 port of the PSM2. As the received optical power on the W-RX2 port of PSM is below the threshold, PSM2 switches to receive the optical signal in the P-RX2 port instead of the W-RX2 port. Hence switching happens for traffic from work to protect in FE station to NE station direction. In this way, bidirectional switching is implemented.

In the case of a unidirectional trunk fault, switching happens in one direction as explained above. In the other direction, when LOS is received at the W-RX2 port of PSM2, W-TX2 sends LOS for 25 milliseconds. When LOS is reported on the NE client port, fault gets propagated over the trunk, resulting in the squelching of FE station client ports. Finally, the LOS on the PSM port results in switching in this direction as well.

Protection Switching Principle (Client fault)

When a client failure happens on the FE station, a Client Signal Failure (CSF) alarm is raised on the NE station trunk. The CSF on the trunk results in the squelching of the corresponding client port, and the PSM switching happens. In summary, a fault on the NE station client RX port results in CSF on the FE station trunk, and the switching happens. And, a fault on the NE station client TX port results in LOS on the PSM ports, and the switching happens.

Note

- PSM must be in the standalone mode.
- PSM alarm threshold must be set to +/ –3 dBm from the actual power received in the PSM RX port.
- If line card protection is required, the working and protect path must be configured in two different line cards.
- If only client protection is required, the working and protection path can be configured in the same line card.
- If the LC trunk configuration is x50 rate, then we can't use a single-line card for work and protection due to x50 coupled mode limitations (coupled trunk).
- Manual switch, Force switch, and lock-out protection on PSM, result in bidirectional switching.

The PSM supports both C2B (4x100G-MXP-400G-TXP) and C3B (40x10G-4x100G-MXP) cards. The C2B card allows client data rates of 100G and 400G, while the C3B card supports client data rates of 10G and 100G. The PSM supports upto 400G with the GL-2 pluggable module.

The PAM4 and QDD pluggable modules take more than 50ms to recover traffic when switching between working and protection modes.

The GL-2 DP04CFP2-M25-K9 pluggable module supports both Flexcoh streaming and ODUCn termination modes. Compared to Flexcoh streaming mode, the ODUCn termination mode with chromatic dispersion configuration of +/- 10000 has a shorter switching time.

The following table lists 400G client pluggables that do not support switching from the active path to the protection path within 50 milliseconds:

Operating Mode	Pluggables not Supporting Switching within 50 ms
400GE to 2×400G	QDD-400G-DR4-S
	QDD-400G-FR4-S

Note According to the QDD pluggable standard, if an electrical (TP1) or optical (TP3) signal is interrupted or disturbed at a client pluggable, and the Clock and Data Recovery (CDR) inside the QDD loses the lock, the QDD pluggable requires some time to recover the signal. Hence, when a fault is identified on the trunk port, the client port Rx loses the lock. The recovery takes between 1.5 to 2 seconds depending on the pluggable standard.

Configuring Laser Squelching on OTN-XP Card

From R7.2.1 onwards, laser squelching is supported on 10GE controllers for the OTN-XP card.

From R7.3.1 onwards, laser squelching is supported on 100GE or 400GE controllers for the OTN-XP card.

From Release 7.5.2 onwards, laser squelching is supported on the 16G FC and 32G FC controllers for the OTN-XP card.

Configuring Laser Squelching on 10GE Controllers

To configure laser squelching on the 10GE controllers for the OTN-XP card, use the following commands:

configure

controller tenGigECtrlr *Rack/Slot/Instance/Port/Lanenumber*

laser-squelch

commit

The range of *Lanenumber* is from 1 to 4.

The following is a sample where laser squelching is enabled on the 10GE controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller tenGigECtrlr 0/0/0/4/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#laser-squelch
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the laser squelch status on the 10GE controller.

```
P/0/RP0/CPU0:ios#show controllers tenGigECtrlr 0/0/0/4/1
Wed May 6 06:28:29.603 UTC
Operational data for interface TenGigECtrlr0/0/0/4/1:

State:
Administrative state: enabled
Operational state: Up
LED state: Green On
Maintenance: Disabled
AINS Soak: None
Total Duration: 0 hour(s) 0 minute(s)
Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
Laser Squelch: Enabled

Phy:
Media type: Not known

Autonegotiation disabled.

Operational values:
Speed: 10Gbps
Duplex: Full Duplex
Flowcontrol: None
Loopback: None (or external)
Inter-packet gap: standard (12)
BER monitoring:
Not supported
Holdoff Time: 0ms
```

Configuring Laser Squelching on 100GE Controllers

To configure laser squelching on the 100GE controllers for the OTN-XP card, use the following commands:

configure

controller HundredGigECtrlr *Rack/Slot/Instance/Port*

laser-squelch

commit

The following is a sample where laser squelching is enabled on the 100GE controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/0/0/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#laser-squelch
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the laser squelch status on the 100GE controller.

```
RP/0/RP0/CPU0:ios#show controller hundredGigECtrlr 0/0/0/1
Fri Jul 23 16:07:11.541 UTC
Operational data for interface HundredGigECtrlr0/0/0/1:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
Statistics:
FEC:
Corrected Codeword Count: 134967789
Uncorrected Codeword Count: 0
Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Configuring Laser Squelching on 400GE Controllers

To configure laser squelching on the 400GE controllers for the OTN-XP card, use the following commands:

configure

controller fourHundredGigECtrlr *Rack/Slot/Instance/Port*

laser-squelch

commit

The following is a sample where laser squelching is enabled on the 400GE controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller fourHundredGigECtrlr 0/0/0/8
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#laser-squelch
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the laser squelch status on the 400GE controller.

```
RP/0/RP0/CPU0:ios#show controller fourhundredGigECtrlr 0/0/0/8
Fri Jul 23 16:07:11.541 UTC
Operational data for interface fourHundredGigECtrlr0/0/0/8:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known

Statistics:
FEC:
Corrected Codeword Count: 134967789
Uncorrected Codeword Count: 0
Autonegotiation disabled.

Operational values:
    Speed: 400Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Configuring Laser Squelching on 16G FC and 32G FC Controllers

The following is a sample where laser squelching is enabled on the 16G FC controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller SixteenGigFibreChanCtrlr 0/1/0/0/2 laser-squelch
RP/0/RP0/CPU0:ios(config)#commit
Sat Apr  9 13:03:26.746 UTC
RP/0/RP0/CPU0:ios(config)#end
```

The following is a sample where laser squelching is enabled on the 32G FC controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller ThirtyTwoGigFibreChanCtrlr 0/1/0/6/4 laser-squelch
RP/0/RP0/CPU0:ios(config)#commit
Sat Apr  9 13:05:26.746 UTC
RP/0/RP0/CPU0:ios(config)#end
```

The following sample verifies the laser squelching enabled on the 16G FC controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#show controllers SixteenGigFibreChanCtrlr 0/1/0/0/2

+++ 13:03:44 fe(default) exec +++
show controllers SixteenGigFibreChanCtrlr 0/1/0/0/2

Sat Apr  9 13:03:43.743 UTC
```

```
Operational data for Fibre Channel controller SixteenGigFibreChanCtrlr0/1/0/0/2

State:
 Admin State           : Up
 Operational state     : Up
 LED state             : Green On
 Secondary admin state : Normal
 AINS Soak             : None
     Total Duration    : 0 hour(s) 0 minute(s)
     Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
 Laser Squelch         : Enabled

Performance Monitoring is enabled

Operational values:
 Speed                    : 16 Gbps
 Loopback                 : None
 BER monitoring:
     Not supported
 Hold-off Time            : 0 ms
 Forward Error Correction : Not Configured
RP/0/RP0/CPU0:ios#
```

The following sample verifies the laser squelching enabled on the 32G FC controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#show controllers ThirtyTwoGigFibreChanCtrlr 0/1/0/6/4

+++ 13:03:44 fe(default) exec +++
show controllers ThirtyTwoGigFibreChanCtrlr 0/1/0/6/4

Sat Apr  9 13:03:43.923 UTC

Operational data for Fibre Channel controller ThirtyTwoGigFibreChanCtrlr0/1/0/6/4

State:
 Admin State           : Up
 Operational state     : Up
 LED state             : Green On
 Secondary admin state : Normal
 AINS Soak             : None
     Total Duration    : 0 hour(s) 0 minute(s)
     Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
 Laser Squelch         : Enabled

Performance Monitoring is enabled

Operational values:
 Speed                    : 32 Gbps
 Loopback                 : None
 BER monitoring:
     Not supported
 Hold-off Time            : 0 ms
 Forward Error Correction : Standard(Reed Solomon)
```

Idle Insertion

When a fault occurs on the trunk port, you can hold the propagation of local faults using the idle insertion feature. This feature is enabled on the ethernet controller by configuring the hold-off timer.

When the fault occurs on the trunk, idles are inserted in the traffic stream from the trunk port to the client port for the duration of the configured holdoff-time. If the trunk port remains faulty beyond the configured holdoff-time, a local fault is transmitted towards the client device. If the trunk recovers from the fault before the holdoff-time expires, traffic resumes.

This feature can be used on customer deployments to prevent reset of client ports during a PSM switchover.

You can enable the idle insertion feature by using the following commands:

configure

controller HundredGigECtrlr *Rack/Slot/Instance/Port*

holdoff-time trunk-fault *time-value*

The range of *timevalue* is from 0 ms to 3000 ms.

The following is a sample for enabling the hold off -timer in 100GE controllers:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/1/0/10
RP/0/RP0/CPU0:ios (config-eth-ctrlr)#holdoff-time trunk-fault 3000
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

To view the hold-off time that is configured on 100GE controller, use the following command:

show controllers hundredGigECtrlr *Rack/Slot/Instance/Port*

Example

```
RP/0/RP0/CPU0:ios#show controllers HundredGigECtrlr 0/1/0/10
Fri Feb 22 18:58:06.888 UTC
Operational data for interface HundredGigECtrlr0/1/0/10:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 3000ms
```

Enabling Idle Insertion on OTN-XP Card

From R7.2.1 onwards, you can enable the idle insertion feature on the 10GE controller for OTN-XP card.

From R7.3.1 onwards, you can enable the idle insertion feature on 100GE or 400GE controllers for the OTN-XP card.

To enable idle insertion on the 10GE controller, enter the following commands:

configure

controller tenGigECtrlr *Rack/Slot/Instance/Port/Lanenumber*

holdoff-time trunk-fault *time-value*

commit

The range of *Lanenumber* is from 1 to 4 and the range of holdoff-time trunk-fault *time-value* is from 0 to 3000 ms.

The following is a sample for enabling the idle insertion feature in 10GE controllers:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller tenGigECtrlr 0/0/0/4/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#holdoff-time trunk-fault 2000
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

To view the hold-off time that is configured on 10GE controllers, use the following command:

show controllers tenGigECtrlr *Rack/Slot/Instance/Port/Lanenumber*

Example

```
RP/0/RP0/CPU0:ios#show controllers TenGigECtrlr 0/0/0/4/1
Thu Mar 26 12:46:16.543 UTC
Operational data for interface TenGigECtrlr0/0/0/4/1:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 10Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    Inter-packet gap: standard (12)
    BER monitoring:
        Not supported
    Holdoff Time: 2000ms
```

Configuring Idle Insertion on 100GE Controllers

To configure idle insertion on the 100GE controllers for the OTN-XP card, use the following commands:

configure

controller HundredGigECtrlr *Rack/Slot/Instance/Port*

holdoff-time trunk-fault *time-value*

commit

The range of *timevalue* is from 0 ms to 3000 ms.

The following is a sample where idle insertion is enabled on the 100GE controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/0/0/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#holdoff-time trunk-fault 3000
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the idle insertion status on the 100GE controller.

```
RP/0/RP0/CPU0:ios#show controller hundredGigECtrlr 0/0/0/1
Fri Jul 23 16:07:11.541 UTC
Operational data for interface HundredGigECtrlr0/0/0/1:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
Statistics:
FEC:
Corrected Codeword Count: 134967789
Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
        Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 3000ms
```

Configuring Idle Insertion on 400GE Controllers

To configure idle insertion on the 400GE controllers for the OTN-XP card, use the following commands:

configure

controller fourHundredGigECtrlr *Rack/Slot/Instance/Port*

holdoff-time trunk-fault *time-value*

commit

The following is a sample where idle insertion is enabled on the 400GE controller for the OTN-XP card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller fourHundredGigECtrlr 0/0/0/10
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#holdoff-time trunk-fault 2000
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the idle insertion status on the 400GE controller.

```
RP/0/RP0/CPU0:ios#show controller fourhundredGigECtrlr 0/0/0/10
Fri Jul 23 16:07:11.541 UTC
Operational data for interface fourHundredGigECtrlr0/0/0/10:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
Statistics:
FEC:
Corrected Codeword Count: 134967789
Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 400Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
        Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 2000ms
```

Enable Idle Insertion on QXP Card

From R7.8.1 onwards, you can enable idle insertion on 100GE or 400GE controllers for the QXP card such as the NCS1K4-QXP-K9 card.

Configure Idle Insertion on 100GE Controllers

To configure idle insertion on the 100GE controllers for the NCS1K4-QXP-K9 card, use the following commands:

configure

controller HundredGigECtrlr *Rack/Slot/Instance/Port*

holdoff-time trunk-fault *time-value*

commit

The range of *timevalue* is from 0 ms to 3000 ms.

The following is a sample where idle insertion is enabled on the 100GE controller for the NCS1K4-QXP-K9 card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/1/0/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#holdoff-time trunk-fault 3000
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the idle insertion status on the 100GE controller.

```
RP/0/RP0/CPU0:ios#show controller hundredGigECtrlr 0/1/0/1
Fri Jul 23 16:07:11.541 UTC
Operational data for interface HundredGigECtrlr0/1/0/1:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
Statistics:
FEC:
Corrected Codeword Count: 134967789
Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
        Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 3000ms
```

Configure Idle Insertion on 400GE Controllers

To configure idle insertion on the 400GE controllers for the NCS1K4-QXP-K9 card, use the following commands:

configure

controller fourHundredGigECtrlr *Rack/Slot/Instance/Port*

holdoff-time trunk-fault *time-value*

commit

The following is a sample where idle insertion is enabled on the 400GE controller for the NCS1K4-QXP-K9 card.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller fourHundredGigECtrlr 0/0/0/10
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#holdoff-time trunk-fault 2000
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following is a sample to view the idle insertion status on the 400GE controller.

```
RP/0/RP0/CPU0:ios#show controller fourhundredGigECtrlr 0/0/0/10
Fri Jul 23 16:07:11.541 UTC
Operational data for interface fourHundredGigECtrlr0/0/0/10:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
Statistics:
FEC:
Corrected Codeword Count: 134967789
Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 400Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
        Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 2000ms
```

Idle Insertion for Ethernet Controllers

Table 5: Feature History

Feature Name	Release Information	Feature Description
Idle Insertion for Ethernet Controllers	Cisco IOS XR Release 7.5.2	Idle insertion for Ethernet controllers feature performs end-to-end link verification between 100GE or 400GE Ethernet controllers before bringing up the actual traffic. This feature enables you to perform pre-provisioning checks to isolate link errors in advance without any Ethernet testers. This feature is supported on the 1.2T C band, 1.2T L band, and 800G QSFP-DD Transponder line cards.

Idle insertion for Ethernet controllers feature allows you to perform end-to-end link verification between 100GE or 400GE Ethernet controllers before bringing up the actual traffic. This feature is supported on the 1.2T, 1.2TL, and 2-QDD-C cards.

Note OTU4 client rate is not supported.

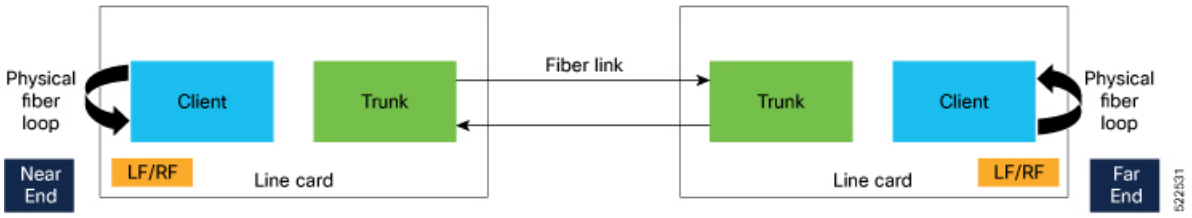
Idle frames can be inserted in both the ingress and egress directions on Ethernet controllers and the LOCAL-FAULT and REMOTE-FAULT alarms are cleared. The performance monitoring counters on the pcs layer are monitored to check for any errors on the link.

Warning Do not configure the Idle insertion for Ethernet controllers feature on the link that carries live traffic.

Recommended Topology for Link Verification

The following diagram describes the recommended topology for link verification:

Figure 2: Topology for Link Verification



The following steps describe the sequence for link verification using this topology:

1. Both the near-end and far-end clients have the LOCAL-FAULT alarm if the trunk is up on both the ends.
2. Enable idle ingress on the near-end client. The idle frame transmits toward the trunk link and reaches the far-end client. The LOCAL-FAULT alarm is then cleared on the far-end client.
3. As the far-end client has fiber loop, the idle frame is inserted again into the same client RX toward the trunk link and reaches the near-end client. The LOCAL-FAULT alarm is then cleared on the near-end client as well.
4. When you enable idle insertion on any client and in any direction, the idle frame transmits in loop similar to this topology and all the LOCAL-FAULT and the REMOTE-FAULT alarms are cleared.
5. The link can be monitored after all the alarms are cleared. The link has a problem if any alarm is reported during the link test.

Configuring Idle Insertion for Ethernet Controllers

Before You Begin:

- Do not configure idle frame insertion with hold-off timer.
- Do not configure PRBS on the trunk.

You can configure this feature by using the following commands:

configure

controller hundredGigECtrlr *Rack/Slot/Instance/Port*

insert-idle ingress

insert-idle egress

commit

end

The following is a sample for enabling the idle ingress and idle egress in 100GE controllers:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller hundredGigECtrlr 0/2/0/2
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#insert-idle ingress
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#insert-idle egress
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#end
```

You can disable this feature by using the following commands:

configure

controller hundredGigECtrlr *Rack/Slot/Instance/Port*

no insert-idle ingress

no insert-idle egress

commit

end

Limitation

After disabling the idle frame insertion feature, the LOCAL-FAULT or REMOTE-FAULT alarm may not appear again because the idle frames are in loop. Hence, you must break the idle frame loop in the link by performing either one of the following:

- Perform fiber OIR on either the near-end or far-end client port.
- Perform shut and unshut operation on any client port.

Verifying Idle Insertion Configuration for Ethernet Controllers

To verify the idle ingress and idle egress that is configured on the Ethernet controllers, use the following command:

RP/0/RP0/CPU0:ios# **show controllers hundredGigECtrlr** *Rack/Slot/Instance/Port*

Example

```
RP/0/RP0/CPU0:ios#show controllers hundredGigECtrlr 0/2/0/2
Wed Mar 30 06:56:58.878 UTC
Operational data for interface HundredGigECtrlr0/2/0/2:
State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

    Insert Idle Ingress: Enabled
    Insert Idle Egress: Enabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0
Autonegotiation disabled.
Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

LLDP Drop

Link Layer Discovery Protocol (LLDP) Snooping is enabled by default on all ethernet controllers.

To verify the LLDP neighbors, use the following commands:

```
RP/0/RP0/CPU0:ios#show lldp neighbors detail
Tue Mar 12 11:49:20.819 IST
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

------------------------------------------------
Local Interface: HundredGigECtrlr0/1/0/7
Chassis id: 008a.96cd.34e1
Port id: Hu0/0/0/4
Port Description - not advertised
System Name: ncs5500_node

System Description:
 6.1.4, NCS-5500

Time remaining: 116 seconds
Hold Time: 120 seconds
System Capabilities: R
Enabled Capabilities: R
Management Addresses - not advertised
Peer MAC Address: 00:8a:96:cd:34:10


------------------------------------------------
Local Interface: HundredGigECtrlr0/1/0/13
Chassis id: 008a.96cd.34e1
Port id: Hu0/0/0/5
Port Description - not advertised
System Name: ncs5500_node

System Description:
 6.1.4, NCS-5500

Time remaining: 90 seconds
Hold Time: 120 seconds
System Capabilities: R
Enabled Capabilities: R
Management Addresses - not advertised
Peer MAC Address: 00:8a:96:cd:34:14


Total entries displayed: 2


RP/0/RP0/CPU0:ios#show lldp neighbors
Tue Mar 12 16:17:56.713 IST
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID       Local Intf              Hold-time  Capability     Port ID
ncs5500_node    HundredGigECtrlr0/1/0/7  120        R               Hu0/0/0/4
ncs5500_node    HundredGigECtrlr0/1/0/13 120        R               Hu0/0/0/5

Total entries displayed: 2
```

When you enable LLDP drop on the client controller ports of the muxponder or muxponder slice, the LLDP frames drop on the ports without forwarding.

Note LLDP on 400GE is not supported on the OTN-XP card.

Configuring LLDP Drop

You can configure the LLDP drop for a muxponder or muxponder slice. By default, the LLDP drop status is set to False. On enabling the LLDP Drop, the status is set to True.

To configure LLDP drop on a muxponder use the following command:

configure

hw-module location *location* **mxponder drop-lldp**

Note Use the **no** form of the command to disable LLDP drop.

commit

Limitation

- When you disable LLDP globally, the LLDP gets disabled on all the interfaces.

Note By default, LLDP is enabled for NCS 1004. But when you enable and disable LLDP in the global configuration mode, LLDP gets disabled on all the interfaces.

Workaround: You must enable LLDP globally or reload the Router.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios#hw-module location 0/1 mxponder drop-lldp
RP/0/RP0/CPU0:ios#commit
```

configure

hw-module location *location* **mxponder-slice** *slice-number* **drop-lldp**

Note Use the **no** form of the command to disable LLDP drop.

To configure LLDP drop on a muxponder slice, use the following command:

commit

The following is a sample in which slice 0 client ports are enabled with LLDP drop.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder-slice 0 drop-lldp
RP/0/RP0/CPU0:ios(config)#commit
```

Verifying the Status of LLDP Drop

To verify the LLDP drop enabled status, use the following command.

```
RP/0/RP0/CPU0:ios#show hw-module location all mxponder
Fri Feb 22 13:22:19.281 UTC

Location:            0/0
```

```
Client Bitrate:       NONE
Trunk  Bitrate:       NONE
Status:               Not Provisioned


Location:             0/1
Slice ID:             0
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port                     Mapper/Trunk Port          CoherentDSP0/1/0/0
                                Traffic Split Percentage

HundredGigECtrlr0/1/0/2         ODU40/1/0/0/0                     100
HundredGigECtrlr0/1/0/3         ODU40/1/0/0/1                     100
HundredGigECtrlr0/1/0/4         ODU40/1/0/0/2                     100
HundredGigECtrlr0/1/0/5         ODU40/1/0/0/3                     100
HundredGigECtrlr0/1/0/6         ODU40/1/0/0/4                     100


Location:             0/1
Slice ID:             1
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port                     Mapper/Trunk Port          CoherentDSP0/1/0/1
                                Traffic Split Percentage

HundredGigECtrlr0/1/0/8         ODU40/1/0/1/0                     100
HundredGigECtrlr0/1/0/9         ODU40/1/0/1/1                     100
HundredGigECtrlr0/1/0/10        ODU40/1/0/1/2                     100
HundredGigECtrlr0/1/0/11        ODU40/1/0/1/3                     100
HundredGigECtrlr0/1/0/12        ODU40/1/0/1/4                     100


Location:             0/2
Slice ID:             0
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port                     Mapper/Trunk Port          CoherentDSP0/2/0/0
                                Traffic Split Percentage

HundredGigECtrlr0/2/0/2         ODU40/2/0/0/0                     100
HundredGigECtrlr0/2/0/3         ODU40/2/0/0/1                     100
HundredGigECtrlr0/2/0/4         ODU40/2/0/0/2                     100
HundredGigECtrlr0/2/0/5         ODU40/2/0/0/3                     100
HundredGigECtrlr0/2/0/6         ODU40/2/0/0/4                     100


Location:             0/2
Slice ID:             1
Client Bitrate:       100GE
Trunk  Bitrate:       500G
Status:               Provisioned
LLDP Drop Enabled:    FALSE
Client Port                     Mapper/Trunk Port          CoherentDSP0/2/0/1
                                Traffic Split Percentage

HundredGigECtrlr0/2/0/8         ODU40/2/0/1/0                     100
HundredGigECtrlr0/2/0/9         ODU40/2/0/1/1                     100
```

```
HundredGigECtrlr0/2/0/10        ODU40/2/0/1/2                     100
HundredGigECtrlr0/2/0/11        ODU40/2/0/1/3                     100
HundredGigECtrlr0/2/0/12        ODU40/2/0/1/4                     100


Location:             0/3
Slice ID:             0
Client Bitrate:       100GE
Trunk  Bitrate:       300G
Status:               Provisioned
LLDP Drop Enabled:    TRUE
Client Port                     Mapper/Trunk Port          CoherentDSP0/3/0/0
                                Traffic Split Percentage

HundredGigECtrlr0/3/0/2         ODU40/3/0/0/0                     100
HundredGigECtrlr0/3/0/3         ODU40/3/0/0/1                     100
HundredGigECtrlr0/3/0/4         ODU40/3/0/0/2                     100
```

Link Layer Discovery Protocol (LLDP) Support on Management Interface

The LLDP support on management interface feature requires a system to form LLDP neighborship over the system management interface, through which it advertises and learns LLDP neighbor information. This information about neighbors used to learn about the neighbors and in turn the topology of the devices for Operations, Administration, and Maintenance (OAM) purposes.

Advantages of LLDP

- Provides support on non-Cisco devices.
- Enables neighbor discovery between non-Cisco devices.

Limitation

- When you disable LLDP globally, the LLDP gets disabled on all the interfaces.

Note By default, LLDP is enabled for NCS 1004. But when you enable and disable LLDP in the global configuration mode, LLDP gets disabled on all the interfaces.

Workaround: You must enable LLDP globally or reload the Router.

Cisco Discovery Protocol (CDP) vs LLDP

The CDP is a device discovery protocol that runs over Layer 2. Layer 2 is also known as the data link layer that runs on all Cisco devices, such as routers, bridges, access servers, and switches. This protocol allows the network management applications to automatically discover and learn about other Cisco devices that connect to the network.

The LLDP is also a device discovery protocol that runs over Layer 2. This protocol allows the network management applications to automatically discover and learn about other non-Cisco devices that connect to the network.

Interoperability between non-Cisco devices using LLDP

LLDP is also a neighbor discovery protocol that is used by network devices to advertise information about themselves to other devices on the network. This protocol runs over the data link layer, which allows two systems running different network layer protocols to learn about each other.

With LLDP, the user can also access the information about a particular physical network connection. If the user uses a non-Cisco monitoring tool (through SNMP), LLDP helps you identify the Object Identifiers (OIDs) that the system supports. The following OIDs are supported:

- 1.0.8802.1.1.2.1.4.1.1.4
- 1.0.8802.1.1.2.1.4.1.1.5
- 1.0.8802.1.1.2.1.4.1.1.6
- 1.0.8802.1.1.2.1.4.1.1.7
- 1.0.8802.1.1.2.1.4.1.1.8
- 1.0.8802.1.1.2.1.4.1.1.9
- 1.0.8802.1.1.2.1.4.1.1.10
- 1.0.8802.1.1.2.1.4.1.1.11
- 1.0.8802.1.1.2.1.4.1.1.12

Neighbor Discovery

System advertises the LLDP TLV (Type Length Value) details over the management network using which other devices in the management network can learn about this device.

Configuring LLDP

- LLDP full stack functionality is supported on all three management interfaces supported in NCS 1004.
- You can selectively enable or disable LLDP on any of the management interfaces on demand.
- You can selectively enable or disable LLDP transmit or receive functionality at the management interface level.
- Information gathered using LLDP can be stored in the device Management Information Database (MIB) and queried with the Simple Network Management protocol (SNMP).
- LLDP operational data are available in both Command Line Interface and netconf-yang interface.

Enabling LLDP Globally

When you enable LLDP globally, all interfaces that support LLDP are automatically enabled for both transmit and receive operations.

Note You can override this default operation at the interface to disable receive or transmit operations.

The following table describes the global LLDP attributes that the user can configure:

Table 6:

Attribute	Default	Range	Description
Holdtime	120	0–65535	Specifies the hold time (in sec). Hold time refers to the time or duration that an LLDP device maintains the neighbor information before discarding.
Reinit	2	2–5	Delay (in sec) for LLDP initialization on any interface
Timer	30	5-65534	Specifies the rate at which LLDP packets are sent (in sec)

The following example shows the commands to configure LLDP globally. The global LLDP configuration enables LLDP on all the three management interfaces.

```
RP/0/RP0/CPU0:regen#configure terminal
RP/0/RP0/CPU0:regen(config)#lldp management enable
RP/0/RP0/CPU0:regen(config)#lldp holdtime 30
RP/0/RP0/CPU0:regen(config)#lldp reinit 2
RP/0/RP0/CPU0:regen(config)#commit
```

Verification

You can verify the LLDP configuration using the **show running-config lldp** command.

The output of **show running-config lldp** command is as follows:

```
RP/0/RP0/CPU0:regen#show running-config lldp
Tue Dec 10 10:36:11.567 UTC
lldp
timer 30
reinit 2
holdtime 120
management enable
!
```

You can verify the LLDP data using the **show lldp interface** and **show lldp neighbors** commands.

The output of **show lldp interface** command is as follows:

```
RP/0/RP0/CPU0:regen#show lldp interface
Thu Nov  7 08:45:22.934 UTC


MgmtEth0/RP0/CPU0/0:
        Tx: enabled
        Rx: enabled
        Tx state: IDLE
        Rx state: WAIT FOR FRAME


MgmtEth0/RP0/CPU0/1:
        Tx: enabled
        Rx: enabled
```

```
        Tx state: IDLE
        Rx state: WAIT FOR FRAME
```

The output of **show lldp neighbors** command is as follows:

```
RP/0/RP0/CPU0:M-131#show lldp neighbors
Mon Dec  2 11:01:20.143 CET
Capability codes:
        (R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
        (W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID       Local Intf              Hold-time  Capability     Port ID
[DISABLED]      MgmtEth0/RP0/CPU0/0     120        B               gi19
MYS-130         MgmtEth0/RP0/CPU0/1     120        R               MgmtEth0/RP0/CPU0/1
```

where [DISABLED] shows that the LLDP is disabled on the interface MgmtEth0/RP0/CPU0/0.

Enabling LLDP per Management Interface

The following example shows the commands to configure LLDP at the management interface level.

```
RP/0/RP0/CPU0:ios(config)#interface mgmtEth 0/RP0/CPU0/X
RP/0/RP0/CPU0:ios(config-if)#lldp enable
RP/0/RP0/CPU0:ios(config-if)#commit
```

Disabling LLDP Transmit and Receive Operations

The following example shows the commands to disable the LLDP transmit operations at the specified management interface.

```
RP/0/RP0/CPU0:ios(config)#interface mgmtEth 0/RP0/CPU0/X
RP/0/RP0/CPU0:ios(config-if)#lldp transmit disable
RP/0/RP0/CPU0:ios(config-if)#commit
```

The following example shows the commands to disable the LLDP receive operations at the specified management interface.

```
RP/0/RP0/CPU0:ios(config)#interface mgmtEth 0/RP0/CPU0/X
RP/0/RP0/CPU0:ios(config-if)#lldp receive disable
RP/0/RP0/CPU0:ios(config-if)#commit
```

Debugging LLDP Issues

The following commands are used for debugging issues in the LLDP functionality.

- **show lldp traffic**
- **debug lldp all**
- **debug lldp errors**
- **debug lldp events**
- **debug lldp packets**
- **debug lldp tlvs**
- **debug lldp trace**
- **debug lldp verbose**

Daisy Chain Support on Management Ports

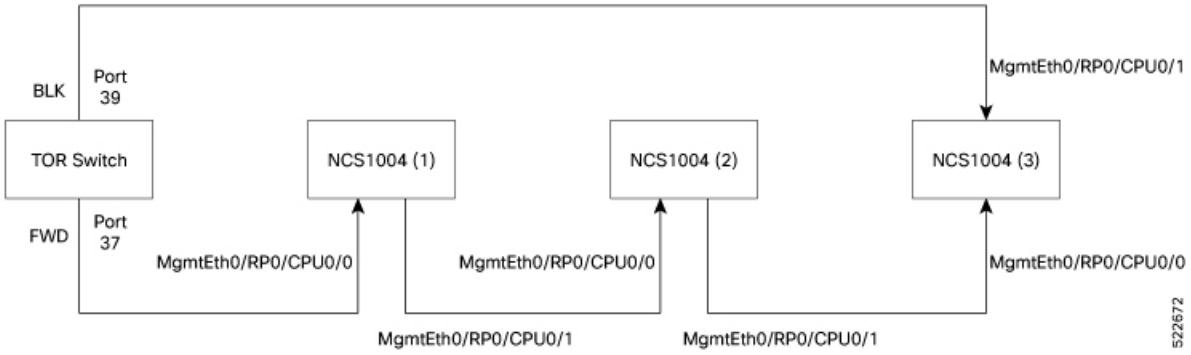
Table 7: Feature History

Feature Name	Release Information	Description
Daisy Chain Support on Management Ports	Cisco IOS XR Release 7.7.1	In a daisy chain arrangement, multiple NCS 1004 devices are connected to form a ring-like topology, and only the first and last nodes are connected to a Top-of-Rack (TOR) switch. The first connection serves as the main path for data transmission and carries the traffic, while the last connection acts as a backup or secondary path. If the primary path fails, the secondary path takes over and allows traffic to continue transmitting in the network. You can daisy chain up to five NCS 1004 nodes in the network.

Daisy Chain feature is supported only on the management ports 0 and 1 on the NCS 1004 chassis.

The following diagram shows the Daisy Chain topology. In this topology, three NCS 1004 nodes are connected to each other over the management ports.

Figure 3: Daisy Chain Topology



Configure Daisy Chain Support on Management Ports

Daisy Chain must be configured only on the management port 1.

Before You Begin:

- Enable Storm Control on TOR Switch, on page 52
- Disable DAD on Management Port, on page 52

- STP must be running on the TOR switch.
- Management port 0 must not be in shut down state and must be configured with either IPv4 or IPv6 address.
- Management port 1 must not be configured with either IPv4 or IPv6 address.
- LLDP is not supported on the management port 1 if Daisy Chain is configured.

To configure Daisy Chain on the management port 1, enter the following commands:

configure

interface mgmtEth 0/RP0/CPU0/1

no ipv4 address

no ipv6 address

bridge-port routed-interface mgmtEth 0/RP0/CPU0/0

Verify Daisy Chain

To verify the daisy chain that is configured on the management port, use the following commands.

```
!
interface MgmtEth0/RP0/CPU0/0
 ipv4 address 10.127.60.220 255.255.255.0
!
interface MgmtEth0/RP0/CPU0/1
 bridge-port routed-interface MgmtEth0/RP0/CPU0/0
!
interface MgmtEth0/RP0/CPU0/2
 shutdown
!
```

Enable Storm Control on TOR Switch

In Daisy Chain configuration, one of the Top of the Rack (TOR) switch ports is in blocked state, provided NCS 1004 forwards STP BPDU in periodic intervals. Three consecutive hello misses move the port state from blocked to forwarding state.

When the NCS 1004 node reboots, the other port state of the TOR switch changes from blocking to forwarding state. Hence, a loop is created momentarily when both the TOR switch ports are in forwarding state. This loop results in duplication of packets on the network. Hence, storm control must be enabled on the TOR switch.

Enter the following commands from the TOR switch to enable storm control.

errdisable recovery interval 60

errdisable recovery cause storm-control

Disable DAD on Management Port

By default, IPv6 Duplicate Address Detection (DAD) is enabled on the management ports. Similar to storm control scenario, when IPv6 is configured for a management port, DAD happens due to looping in the network.

Since DAD was enabled, management port will be down. In order to avoid management port being down due to momentary looping, DAD must be disabled on the management port 0.

Enter the following commands to disable DAD on the management port 0.

configure

interface mgmtEth0/RP0/CPU0/0

ipv6 nd dad attempts 0

DHCP Client

Table 8: Feature History

Feature Name	Release Information	Feature Description
Dynamic Host Configuration Protocol (DHCP) Client	Cisco IOS XR Release 7.3.2	The DHCP client enables the router interfaces to dynamically acquire the IPv4 or DHCPv4 or DHCPv6 server which is used to forward the response to the correct layer 2 address. The DHCP client ensures that configuration information reaches the correct device.

The Dynamic Host Configuration Protocol (DHCP) client functionality enables the router interfaces to dynamically acquire the IPv4 or DHCPv4 or DHCPv6 server, and forwards the responses back to the correct Layer 2 address so that the correct device gets the correct configuration information.

DHCP has the ability to allocate IP addresses only for a configurable period of time, called the lease period. If the client is required to retain this IP address for a longer period beyond the lease period, the lease period must be renewed before the IP address expires. The client renews the lease based on configuration that was sent from the server. The client unicasts a REQUEST message using the IP address of the server. When a server receives the REQUEST message and responds with an ACK message. The lease period of the client is extended by the lease time configured in the ACK message. DHCP client supports DHCPv6.

DHCP Client Options

You can configure DHCPv6 client on management Ethernet interfaces. You can configure different DHCPv6 client options to differentiate between clients as required. The different DHCPv6 client options are also configured to differentiate how a DHCPv6 client communicates with a DHCPv6 server. The different DHCPv6 client options that can be configured are:

- **DUID:** If the DUID DHCPv6 client option is configured on an interface, DHCPv6 client communicates with the DHCPv6 server through the link layer address.
- **Rapid Commit:** If the Rapid Commit DHCPv6 client option is configured on an interface, DHCPv6 client can obtain configuration parameters from the DHCPv6 server through a rapid two-step exchange (solicit and reply) instead of the default four-step exchange (solicit, advertise, request, and reply).
- **DHCP Options:** The various other DHCPv6 options that can be configured on a DHCPv6 client are:

- **Option 15:** Option 15 is also known as the User Class option and it is used by a DHCPv6 client to identify the type or category of users or applications it represents.
- **Option 16:** Option 16 is also known as the Vendor ID option and it is used by a DHCPv6 a client to identify the vendor that manufactured the hardware on which the client is running.
- **Option 23:** Option 23 is also known as the Domain name Server (DNS) option provides a list of one or more IPv6 addresses of DNS recursive name servers to which a client's DNS resolver can send DNS queries.
- **Option 24:** Option 24 is also known as the Domain List option and it specifies the domain search list that the client uses to resolve hostnames with the DNS.

- **DHCP Timers:** This option is used to set different timer value for DHCP client configurations. The various DHCP timer options are:
  - **Release-timeout:** It is used to set retransmission timeout value for the initial release message.
  - **Req-max-rt:** It is used to set the maximum retransmission timeout value for the request message.
  - **Req-max-rt:** It is used to set the maximum retransmission timeout value for the request message.
  - **Sol-max-delay:** It is used to set the maximum delay time of the first solicit message.
  - **Sol-max-rt:** It is used to set the maximum solicit retransmission time.
  - **Sol-time-out:** It is used to set the intial timeout value of the solicit message.

Enabling DHCP Client on Management Ethernet Interface

To enable DHCP client on the management Ethernet interface, use the following command:

configure

interface MgmtEth *R/S/I/P*

ipv6 address dhcp-client-options

duid linked-layer-address

rapid-commit

{**option 16 vendor** | **option 15 ciscoupnnp** | **option 23** | **option 24**}

timers sol-max-delay *value* | **timers sol-time-out** *value* | **timers req-timeout** *value* | **timers req-max-rt** *value* | **timers release-timeout** *value*}

ipv6 address dhcp

commit

The following sample shows to enable DHCP client on the management Ethernet interface:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#interface MgmtEth0/0/CPU0/0
RP/0/RP0/CPU0:ios(config)#ipv6 address dhcp-client-options
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#duid linked-layer-address
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#rapid-commit
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#option 16 vendor
```

```
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#option 15 ciscoupnnp
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#option 23
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#option 24
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#timers sol-max-delay 1
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#timers sol-time-out 1
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#timers sol-max-rt 120
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#timers req-timeout 1
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#timers req-max-rt 30
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#timers release-timeout 1
RP/0/RP0/CPU0:ios(config-dhcpv6-client)#commit
```

Verifying DHCP Client on Management Ethernet Interface

To verify DHCP client options on the management Ethernet interface, use the **show dhcp ipv6 client** and **show dhcp ipv6 client detail** commands:

```
RP/0/0/CPU0:ios#show dhcp ipv6 client
Thu Sep 17 10:45:44.493 IST

Interface name IPv6 Address State Lease Time Rem
---------------------- -------------- ---------------- --------------------
MgmtEth0/0/1/0 500:1::1a/128 BOUND 7116


RP/0/RP0/CPU0:ios#show dhcp ipv6 client detail
Thu Sep 17 10:45:48.880 IST

------------------------------------------------------
Client Interface name : MgmtEth0/0/`/0
Client Interface handle : 0x4040
Client MACAddr : 0219.bc81.e750
Client State : BOUND
Client Link Local Address : fe80::19:bcff:fe81:e750
Client IPv6 Address (Dhcp) : 500:1::1a/128
Lease Remaining (in secs) : 7112
DUID : 000300010219bc81e750

Client Configuration
Timers
SOL_MAX_DELAY : 1 secs (00:00:01)
SOL_TIMEOUT : 1 secs (00:00:01)
SOL_MAX_RT : 120 secs (00:02:00)
REQ_TIMEOUT : 1 secs (00:00:01)
REQ_MAX_RT : 30 secs (00:00:30)
REL_TIMEOUT : 1 secs (00:00:01)

Options
RAPID-COMMIT : True
USER-CLASS : ciscoupnnp
VENDOR-CLASS : vendor
DNS-SERVERS : True
DOMAIN-LIST : True

DUID Type : DUID_LL

Server Information
Server Address : fe80::1a:19ff:fe03:99ca
Preference : 255
DUID : 000300010206826e2e00
Status : SUCCESS
IA-NA
Status : SUCCESS
```

```
IAID : 0x40400001
T1 : 3600 secs (01:00:00)
T2 : 5760 secs (01:36:00)
IA-ADDR
IA NA Address : 500:1::1a
Preferred Time : 7200 secs (02:00:00)
Valid Time : 7200 secs (02:00:00)
Flags : 0x0
-----------------------------------------------------
```

MAC Address Snooping on Client Ports

MAC address snooping allows you to learn the MAC address of the neighbor, that is connected to the client ports. You can enable ARP snooping on all client ports and learn the MAC address of neighbors through CLI.

This feature overcomes the limitation, where LLDP (Link Layer Discovery protocol) cannot be enabled in some networks.

Limitations

- When you enable or disable MAC address snooping on any slice, few packets are dropped during configuration.
- Open config interface for enabling or disabling MAC address snooping is not supported.
- SNMP MIB is not supported for the MAC address attribute.

Note When you enable MAC address snooping on client ports, it overrides LLDP.

Configuring MAC Address Snooping on Client Ports

You can configure MAC address or ARP snoop on slice in Muxponder slice mode using the following commands.

configure

hw-module location *location* **mxponder-slice** *slice-number*

client-rate 100GE

trunk-rate 600G { 100G | 150G | 200G | 250G | 300G | 350G | 400G | 450G | 500G | 550G | 600G }

arp-snoop

commit

Example

The following is a sample in which, MAC address or ARP snoop is configured on the client ports of slice 0 in Muxponder slice mode.

```
RP/0/RP0/CPU0:ios#configure
Mon Mar 16 19:30:33.933 UTC
RP/0/RP0/CPU0:ios(config)#hw-module location 0/3 mxponder-slice 0
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-rate 100GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#trunk-rate 600G
```

```
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#arp-snoop
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
Mon Mar 16 19:30:52.636 UTC
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#end
```

The following is a sample in which, MAC address or ARP snoop is configured in Muxponder mode.

```
RP/0/RP0/CPU0:ios#configure
Mon Mar 16 19:08:17.154 UTC
RP/0/RP0/CPU0:ios(config)#hw-module location 0/1 mxponder arp-snoop
RP/0/RP0/CPU0:ios(config)#commit
```

The following sample shows the output of **show controllers hundredGigEctrlr** command, before configuring MAC address or ARP snoop on client ports.

```
RP/0/RP0/CPU0:ios#show controllers hundredGigECtrlr 0/1/0/2
Mon Mar 16 19:40:37.434 UTC
Operational data for interface HundredGigECtrlr0/1/0/2:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Holdoff Time: 0ms
```

Viewing Neighbor MAC Address

You can view the neighbor's physical address after enabling MAC address or ARP snoop using the following command. MAC address snoop output is enabled after ARP packets are received on the respective 100G client.

show controllers hundredGigEctrlr *R/S/I/P*

The following sample shows the neighbor's MAC address after configuring MAC address or ARP snoop on client ports.

```
RP/0/RP0/CPU0:ios#show controllers hundredGigECtrlr 0/1/0/2
Mon Mar 16 19:41:08.047 UTC
Operational data for interface HundredGigECtrlr0/1/0/2:

State:
```

```
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Disabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled
    Neighbor Address:
    0010.9400.5502

Phy:
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
```

Transmit Shutdown

Transmit shut on trunk optics controller brings down the CFP2 transmit power.

From R7.3.2 onwards, you can configure transmit shut on optics controller in the 4x100GE-MXP-DD muxponder mode.

Configuring Transmit Shutdown on Trunk Optics Controller

To perform transmit shutdown, enter the following commands:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller Optics R/S/I/P
RP/0/RP0/CPU0:ios(config-Optics)#transmit-shutdown
RP/0/RP0/CPU0:ios(config-Optics)#commit
RP/0/RP0/CPU0:ios(config-Optics)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

The following is a sample to perform transmit shutdown on the trunk port:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller Optics 0/1/0/12
RP/0/RP0/CPU0:ios(config-Optics)#transmit-shutdown
RP/0/RP0/CPU0:ios(config-Optics)#commit
RP/0/RP0/CPU0:ios(config-Optics)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

The following is a sample to perform transmit shutdown on the trunk port in the 4x100GE-MXP-DD muxponder mode:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller Optics 0/1/0/9
RP/0/RP0/CPU0:ios(config-Optics)#transmit-shutdown
RP/0/RP0/CPU0:ios(config-Optics)#commit
RP/0/RP0/CPU0:ios(config-Optics)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

Verifying Transmit Shutdown on Trunk Optics Controller

```
RP/0/RP0/CPU0:ios#sh controllers optics 0/1/0/12
Fri Feb 26 21:36:16.009 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: Off

LED State: Yellow

Optics Status

Optics Type: CFP2 DWDM
DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
Wavelength=1552.524nm

Alarm Status:
-------------
Detected Alarms:
LOW-TX-PWR

LOS/LOL/Fault Status:

Alarm Statistics:

-------------
HIGH-RX-PWR = 0 LOW-RX-PWR = 1
HIGH-TX-PWR = 0 LOW-TX-PWR = 1
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 %
Actual TX Power = -40.00 dBm
RX Power = -1.02 dBm
RX Signal Power = -12.20 dBm
Frequency Offset = -8 MHz

Performance Monitoring: Enable

THRESHOLD VALUES
----------------

Parameter High Alarm Low Alarm High Warning Low Warning
------------------------ ---------- --------- ------------ -----------
Rx Power Threshold(dBm) 4.9 -12.0 0.0 0.0
Tx Power Threshold(dBm) 3.5 -10.1 0.0 0.0
LBC Threshold(mA) N/A N/A 0.00 0.00

LBC High Threshold = 98 %
Configured Tx Power = -1.50 dBm
Configured CD High Threshold = 180000 ps/nm
Configured CD lower Threshold = -180000 ps/nm
Configured OSNR lower Threshold = 0.00 dB
Configured DGD Higher Threshold = 180.00 ps
Baud Rate = 63.1394691467 GBd
Bits per Symbol = 4.0000000000 bits/symbol
Modulation Type: 16QAM
Chromatic Dispersion 0 ps/nm
```

```
Configured CD-MIN -26000 ps/nm CD-MAX 26000 ps/nm
Polarization Mode Dispersion = 0.0 ps
Second Order Polarization Mode Dispersion = 16.00 ps^2
Optical Signal to Noise Ratio = 35.90 dB
SNR = 17.00 dB
Polarization Dependent Loss = 0.70 dB
Polarization Change Rate = 0.00 rad/s
Differential Group Delay = 1.00 ps

Transceiver Vendor Details

Form Factor : CFP2
Name : CISCO-ACACIA
Part Number : 10-3500-01
Rev Number : 01
Serial Number : ACA24230026
PID : ONS-CFP2D-400G-C
VID : VES1
Date Code(yy/mm/dd) : 10/09/Í
Fiber Connector Type: LC
Otn Application Code: Not Set
Sonet Application Code: Not Set
Ethernet Compliance Code: Not set

Transceiver Temperature : 55 Celsius



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


RP/0/RP0/CPU0:ios#show controller optics 0/1/0/9
Wed Sep 15 00:41:22.027 UTC

 Controller State: Up

 Transport Admin State: In Service

 Laser State: On

 LED State: Green

 Optics Status

         Optics Type:  QSFP-DD DWDM
         DWDM carrier Info: C BAND, MSA ITU Channel=49, Frequency=193.70THz,
         Wavelength=1547.715nm

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


         LOS/LOL/Fault Status:

         Alarm Statistics:

         -------------
         HIGH-RX-PWR = 0            LOW-RX-PWR = 3
         HIGH-TX-PWR = 0            LOW-TX-PWR = 5
         HIGH-LBC = 0               HIGH-DGD = 0
         OOR-CD = 0                 OSNR = 4
         WVL-OOL = 0                MEA  = 0
```

```
        IMPROPER-REM = 6
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = -11.10 dBm
        RX Power = -11.56 dBm
        RX Signal Power = -11.62 dBm
        Frequency Offset = -66 MHz

  Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
        ------------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          3.0      -24.5           0.0          0.0
        Tx Power Threshold(dBm)          0.0      -16.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 90 %
        Configured Tx Power = -10.00 dBm
        Configured CD High Threshold = 52000 ps/nm
        Configured CD lower Threshold = -52000 ps/nm
        Configured OSNR lower Threshold = 21.10 dB
        Configured DGD Higher Threshold = 67.00 ps
        Baud Rate =  60.1385467980 GBd
        Bits per Symbol = 4.0000000000  bits/symbol
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -13000 ps/nm  CD-MAX 13000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 24.00 ps^2
        Optical Signal to Noise Ratio = 35.70 dB
        SNR = 19.40 dB
        Polarization Dependent Loss = 0.20 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : QSFP-DD
        Name                   : CISCO-ACACIA
        Part Number            : DP04QSDD-E
        Rev Number             : A
        Serial Number          : ACA2524006W
        PID                    : QDD-400G-ZRP-S
        VID                    : V01
        Date Code(yy/mm/dd)    : 21/06/18
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 62 Celsius
AINS Soak               : None
AINS Timer              : 0h, 0m
```

Loopback

Table 9: Feature History

Feature Name	Release Information	Description
Configuration Alarms for Loopback	Cisco IOS XR Release 7.8.1	A configuration alarm is now triggered whenever there is a change in the loopback configuration. This alarm helps in improving loopback status monitoring. You can now view the alarm details such as, the configuration time and date, description, severity, and location using the **show alarms brief system active** command.

You can configure the loopback on the CoherentDSP, FC, OTU, and Ethernet controllers to identify connection problems. The loopback can be configured only in the maintenance mode. Use the **controller** ***controller-type*** and the **secondary-admin-state maintenance** commands to place the controllers in the maintenance mode.

From R7.8.1, loopback configuration alarm details for each controller are triggered whenever there is a change in the loopback configuration. Details such as, location of the controller, severity, configuration date and time, and description are available in the output of the **show alarms brief system active** and **show alarms brief history** commands.

Note Internal and line loopbacks are supported on the FC, OTU, and Ethernet controllers whereas only internal loopbacks are supported on the CoherentDSP controllers.

Configuring Loopback on the 1.2T Card

To configure the loopback, use the following commands:

configure

controller *controllertype Rack/Slot/Instance/Port*

sec-admin-state maintenance

loopback [**line** | **internal**]

commit

Example 1

The following example shows how a line loopback is configured on the Ethernet controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 1/0/1/10 secondary-admin-state
maintenance
```

```
RP/0/RP0/CPU0:ios(config)#commit
Fri Feb 22 19:49:46.504 UTC
RP/0/RP0/CPU0:ios(config)#exit
```

The following example shows how to verify a line loopback configured on the Ethernet controller.

```
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/1/0/10
Fri Feb 22 19:50:08.328 UTC
Operational data for interface HundredGigECtrlr0/1/0/10:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Enabled
    AINS Soak: Pending
      Total Duration: 0 hour(s) 30 minute(s)
      Remaining Duration: 0 hour(s) 30 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 0

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: None (or external)
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/1/0/10 loopback line
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/1/0/10
Fri Feb 22 20:01:00.521 UTC
Operational data for interface HundredGigECtrlr0/1/0/10:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Enabled
    AINS Soak: Pending
      Total Duration: 0 hour(s) 30 minute(s)
      Remaining Duration: 0 hour(s) 30 minute(s) 0 second(s)
    Laser Squelch: Enabled

Phy:
    Media type: Not known
    Statistics:
        FEC:
            Corrected Codeword Count: 0
            Uncorrected Codeword Count: 6

Autonegotiation disabled.
```

```
Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: Line
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Example 2

The following example shows how to verify an internal loopback configured on the coherent DSP controller.

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP  0/0/0/0
Fri Mar 13 22:00:20.951 UTC

Port                                          : CoherentDSP 0/0/0/0
Controller State                              : Up
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                                     : 200.0Gb/s

Alarm Information:
LOS = 0 LOF = 1 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 3 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0
Detected Alarms                               : None

Bit Error Rate Information
PREFEC  BER                                   : 0.00E+00
POSTFEC BER                                   : 0.00E+00
Q-Factor                                      : 16.70 dB

Q-Margin                                      : 0.99dB

TTI :
        Remote hostname                       : ios
        Remote interface                      : CoherentDSP 0/0/0/0
        Remote IP addr                        : 0.0.0.0

FEC mode                                      : Soft-Decision 27

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

Configuring Loopback on OTN-XP Card

From R7.2.1 onwards, OTN-XP card supports loopback on the OTU2, OTU2e, OTU4, 10GE, and CoherentDSP controllers.

From R7.3.2 onwards, OTN-XP card supports loopback on the 100GE and 400GE controllers.

From R7.5.2 onwards, OTN-XP card supports loopback on the 16G FC and 32G FC controllers.

The CoherentDSP controller supports both line and internal.

To configure the loopback on the controllers, use the following commands:

configure

controller *controller type Rack/Slot/Instance/Port/Lane number*

sec-admin-state maintenance

loopback [**line** | **internal**]

commit

The range of *Lane number* is 1–4.

Restriction From R7.10.1, OTN-XP card supports loopback on STM64 and OC192 controllers. You must use **no sec-admin-state** command instead of **sec-admin-state normal**.

Example 1

The following example shows how an internal loopback is configured on the 10GE controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller tenGigECtrlr 0/0/0/5/2
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following example shows how to verify an internal loopback configured on the 10GE controller.

```
RP/0/RP0/CPU0:ios#show controllers tenGigECtrlr 0/0/0/5/2
Thu Apr 23 10:47:48.020 UTC
Operational data for interface TenGigECtrlr0/0/0/5/2:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Enabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 10Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: Internal
    Inter-packet gap: standard (12)
    BER monitoring:
        Not supported
    Holdoff Time: 0ms
```

Example 2

The following example shows how a line loopback is configured on the OTU2e controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller otu2e 0/0/0/11/3
RP/0/RP0/CPU0:ios(config-otu2e)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-otu2e)#loopback line
RP/0/RP0/CPU0:ios(config-otu2e)#commit
Thu Apr 23 10:55:19.319 UTC
RP/0/RP0/CPU0:ios(config-otu2e)#end
```

The following example shows how to verify a line loopback configured on the OTU2e controller.

```
RP/0/RP0/CPU0:ios#show controllers otu2e 0/0/0/11/3
Thu Apr 23 10:55:28.014 UTC

Port                                        : OTU2E 0/0/0/11/3
Controller State                            : Up
Inherited Secondary State                   : Normal
Configured Secondary State                  : Maintenance
Derived State                               : Maintenance
Loopback mode                               : Line
BER Thresholds                              : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                      : Enable
Bandwidth                                   : 10.0Gb/s

Alarm Information:
LOS = 0 LOF = 1 LOM = 0
OOF = 1 OOM = 1 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 0 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0
Detected Alarms                             : None

Bit Error Rate Information
PREFEC  BER                                 : 0.00E+00
POSTFEC BER                                 : 0.00E+00

TTI :
        Remote hostname                     : ios
        Remote interface                    : OTU2E 0/0/0/11/3
        Remote IP addr                      : 0.0.0.0

FEC mode                                    : STANDARD

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

Example 3

The following example shows how an internal loopback is configured on the OTU2 controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller otu2 0/0/0/5/1
RP/0/RP0/CPU0:ios(config-otu2)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-otu2)#loopback internal
RP/0/RP0/CPU0:ios(config-otu2)#commit
Thu Apr 23 11:01:00.562 UTC
RP/0/RP0/CPU0:ios(config-otu2)#end
```

The following example shows how to verify an internal loopback configured on the OTU2 controller.

```
RP/0/RP0/CPU0:ios#show controllers otU2 0/0/0/5/1
Thu Apr 23 11:01:04.126 UTC

Port                                            : OTU2 0/0/0/5/1
Controller State                                : Up
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                                       : 10.0Gb/s

Alarm Information:
LOS = 0 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
Detected Alarms                                 : None

Bit Error Rate Information
PREFEC  BER                                     : 0.00E+00
POSTFEC BER                                     : 0.00E+00

TTI :
        Remote hostname                         : SM-TRC SAPI-SECSM-TRC DA
        Remote IP addr                          : 209.165.200.229

FEC mode                                        : STANDARD

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

Example 4

The following example shows how an internal loopback is configured on the OTU4 controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller otu4 0/0/0/0
RP/0/RP0/CPU0:ios(config-otu4)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-otu4)#loopback internal
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Apr 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how to verify an internal loopback configured on the OTU4 controller.

```
RP/0/RP0/CPU0:ios#show controllers otu4 0/0/0/0
Thu Apr 23 11:05:30.281 UTC

Port                                            : OTU4 0/0/0/0
Controller State                                : Up
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                                          : 100.0Gb/s

Alarm Information:
LOS = 1 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
Detected Alarms                                    : None

Bit Error Rate Information
PREFEC  BER                                        : 0.00E+00
POSTFEC BER                                        : 0.00E+00

TTI :
        Remote hostname                            : ios
        Remote interface                           : OTU4 0/0/0/0
        Remote IP addr                             : 0.0.0.0

FEC mode                                           : STANDARD

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

Example 5

The following example shows how an internal loopback is configured on the 16G FC controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller SixteenGigFibreChanCtrlr 0/2/0/1/1
RP/0/RP0/CPU0:ios(config-SixteenGigFibreChanCtrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-SixteenGigFibreChanCtrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-SixteenGigFibreChanCtrlr)#commit
Thu Apr 11 10:05:21.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how to verify the internal loopback configured on the 16G FC controller:

```
RP/0/RP0/CPU0:ios#show controller SixteenGigFibreChanCtrlr 0/1/0/0/2

Sat Apr  9 22:50:38.930 UTC

Operational data for Fibre Channel controller SixteenGigFibreChanCtrlr0/1/0/0/2

State:
 Admin State           : Up
 Operational state     : Up
 LED state             : Green On
 Secondary admin state : Maintenance
 AINS Soak             : None
     Total Duration    : 0 hour(s) 0 minute(s)
     Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
 Laser Squelch         : Disabled

Performance Monitoring is enabled

Operational values:
 Speed                   : 16 Gbps
 Loopback                : Internal
 BER monitoring:
     Not supported
```

```
 Hold-off Time            : 0 ms
 Forward Error Correction : Not Configured
RP/0/RP0/CPU0:ios#
```

Example 6

The following example shows how an internal loopback is configured on the 32G FC controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller ThirtyTwoGigFibreChanCtrlr 0/1/0/6/4
RP/0/RP0/CPU0:ios(config-ThirtyTwoGigFibreChanCtrlr)#loopback internal

RP/0/RP0/CPU0:ios(config-ThirtyTwoGigFibreChanCtrlr)#commit

Sat Apr  9 22:50:11.666 UTC
RP/0/RP0/CPU0:ios(config-ThirtyTwoGigFibreChanCtrlr)#end
```

The following example shows how to verify the internal loopback configured on the 32G FC controller:

```
RP/0/RP0/CPU0:ios#show controller ThirtyTwoGigFibreChanCtrlr 0/1/0/6/4

Sat Apr  9 22:50:39.082 UTC

Operational data for Fibre Channel controller ThirtyTwoGigFibreChanCtrlr0/1/0/6/4

State:
 Admin State           : Up
 Operational state     : Up
 LED state             : Green On
 Secondary admin state : Maintenance
 AINS Soak             : None
     Total Duration    : 0 hour(s) 0 minute(s)
     Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
 Laser Squelch         : Disabled

Performance Monitoring is enabled

Operational values:
 Speed                 : 32 Gbps
 Loopback              : Internal
 BER monitoring:
     Not supported
 Hold-off Time         : 0 ms
 Forward Error Correction : Standard(Reed Solomon)
RP/0/RP0/CPU0:ios#
```

Example: Loopback Configuration in 4X100G MXP on 100GE Controller

The following example shows how the client internal loopback is configured on the 100GE controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/2/0/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how the client line loopback is configured on the 100GE controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller HundredGigECtrlr 0/2/0/1
```

```
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback line
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how the trunk internal is configured on the coherentDSP controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/2/0/11
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback internal
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how the trunk line is configured on the coherentDSP controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/2/0/11
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback line
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

Example: Loopback Configuration in 400G-TXP on 400GE Controller

The following example shows how the client internal loopback is configured on the 400GE controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller FourHundredGigECtrlr 0/2/0/10
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how the client line loopback is configured on the 100GE controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller FourHundredGigECtrlr 0/2/0/10
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback line
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how the trunk internal is configured on the coherentDSP controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/2/0/10
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback internal
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

The following example shows how the trunk line is configured on the coherentDSP controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/2/0/10
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback line
RP/0/RP0/CPU0:ios(config-otu4)#commit
Thu Sep 23 11:05:22.429 UTC
RP/0/RP0/CPU0:ios(config-otu4)#end
```

Configure Loopback in Inverse Muxponder Configured on the OTN-XP Card

You can configure loopback on the coherentDSP controllers in the inverse muxponder configuration.

Note You must configure loopback on both trunk ports 12 and 13, otherwise traffic goes down.

The following example shows how loopback is configured on both the trunk ports:

```
RP/0/RP0/CPU0:ios#configure
Thu Sep 30 14:16:04.678 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/2/0/12
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback internal
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Thu Sep 30 14:16:19.594 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#controller coherentDSP 0/2/0/13
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback internal
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Thu Sep 30 14:16:32.390 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#
```

The following examples shows how to verify loopback configured on the OTN-XP card in the inverse muxponder configuration:

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/2/0/12
Thu Sep 30 14:17:04.411 UTC

Port                                        : CoherentDSP 0/2/0/12
Controller State                            : Up
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                                   : 200.0Gb/s

Alarm Information:
LOS = 2 LOF = 0 LOM = 0
OOF = 1 OOM = 0 AIS = 1
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 = 1
FLEXO-LOF = 0
Detected Alarms                             : None

Bit Error Rate Information
PREFEC  BER                                 : 2.46E-08
POSTFEC BER                                 : 0.00E+00
Q-Factor                                    : 14.60 dB
```

```
Q-Margin                                        : 8.30dB

TTI :
        Remote hostname                         : ios
        Remote interface                        : CoherentDSP 0/2/0/12
        Remote IP addr                          : 0.0.0.0

FEC mode                                        : O_FEC

Flexo-Mode                                      : Enable
Flexo Details:
        Tx GID                                  : 1
        TX IID                                  : 1, 2,
        Rx GID                                  : 1
        RX IID                                  : 1, 2,

Flexo Peers Information:
        Controller                              : CoherentDSP0_2_0_13
        OTUCn rate                              : OTUC2


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


RP/0/RP0/CPU0:ios#sh controllers coherentDSP 0/2/0/13
Thu Sep 30 14:17:08.140 UTC

Port                                            : CoherentDSP 0/2/0/13
Controller State                                : Up
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                                       : 200.0Gb/s

Alarm Information:
LOS = 1 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 = 1
FLEXO-LOF = 0
Detected Alarms                                 : None

Bit Error Rate Information
PREFEC  BER                                     : 0.00E+00
POSTFEC BER                                     : 0.00E+00
Q-Factor                                        : 15.70 dB

Q-Margin                                        : 9.50dB

TTI :
        Remote IP addr                          : 0.0.0.0

FEC mode                                        : O_FEC

Flexo-Mode                                      : Enable
Flexo Details:
```

```
        Tx GID                                  : 1
        TX IID                                  : 3, 4,
        Rx GID                                  : 1
        RX IID                                  : 3, 4,

Flexo Peers Information:
        Controller                              : CoherentDSP0_2_0_12
        OTUCn rate                              : OTUC2


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

Configuring Loopback on 2-QDD-C Card

From R7.3.1 onwards, 2-QDD-C card supports loopback on the 100 and 400GE controllers.

Note On applying client-side loopbacks, traffic is looped and does not continue in the 2-QDD-C card. QSFP squelching happens on applying internal loopback.

To configure the loopback on the controllers, use the following commands.

configure

controller *controllertype Rack/Slot/Instance/Port/Lanenumber*

sec-admin-state maintenance

loopback [**line** | **internal**]

commit

Example

The following example shows how an internal loopback is configured on a 100GE controller.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller hundredGigECtrlr 0/0/0/5
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following example shows how to verify the internal loopback configured on a 100GE controller.

```
RP/0/RP0/CPU0:ios#show controllers hundredGigECtrlr 0/0/0/5
Thu Apr 23 10:47:48.020 UTC
Operational data for interface hundredGigECtrlr0/0/0/5:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Enabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled

Phy:
```

```
    Media type: Not known

Autonegotiation disabled.

Operational values:
    Speed: 10Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: Internal
    Inter-packet gap: standard (12)
    BER monitoring:
        Not supported
    Holdoff Time: 0ms
```

From R7.5.2 onwards, Loopback is supported for the OTUCn-REGEN mode on the coherent DSP controller.

Example

The following example shows how to configure an internal loopback on a coherent DSP controller.

```
Sun Dec 26 14:34:02.733 UTC
RP/0/RP0/CPU0:ios(config)#controller CoherentDSP 0/3/0/12
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Sun Dec 26 14:34:03.437 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#end
```

The following example shows how to verify internal loopback configured on a coherent DSP controller.

```
RP/0/RP0/CPU0:ios#show controller CoherentDSP 0/3/0/12

Sun Dec 26 14:34:28.391 UTC

Port : CoherentDSP 0/3/0/12
Controller State : Up
Inherited Secondary State : Normal
Configured Secondary State : Maintenance
Derived State : Maintenance
Loopback mode : Line
BER Thresholds : SF = 1.0E-5 SD = 1.0E-7
Performance Monitoring : Enable
Bandwidth : 200.0Gb/s

Alarm Information:
LOS = 1 LOF = 0 LOM = 0
OOF = 1 OOM = 0 AIS = 1
IAE = 0 BIAE = 0 SF_BER = 0
SD_BER = 0 BDI = 5 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0 FLEXO_GIDM = 0
FLEXO-MM = 0 FLEXO-LOM = 0 FLEXO-RDI = 0
FLEXO-LOF = 0
Detected Alarms : None

Bit Error Rate Information
PREFEC BER : 3.12E-07
POSTFEC BER : 0.00E+00
Q-Factor : 14.00 dB

Q-Margin : 6.40dB

TTI :
Remote hostname : ios
Remote interface : CoherentDSP 0/2/0/13
Remote IP addr : 0.0.0.0
```

```
FEC mode : O_FEC

Flexo-Mode : Enable
Flexo Details:
Tx GID : 1
TX IID : 1, 2,
Rx GID : 1
RX IID : 1, 2,

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

Configuring Loopback on the QXP Card

Example 1

The following example shows how to configure internal loopback on a coherent DSP controller.

```
RP/0/RP0/CPU0:ios#configure
Fri Jul 8 10:42:51.329 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/0
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback internal
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Fri Jul 8 10:43:48.644 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#end
```

The following example shows how to verify the internal loopback configured on a coherent DSP controller.

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/0
Fri Jul 8 10:45:53.820 UTC
Port : CoherentDSP 0/0/0/0
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 = 2 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 = 0
Detected Alarms : LOS
Bit Error Rate Information
PREFEC BER : 5.00E-01
POSTFEC BER : 0.00E+00
Q-Factor : 0.00 dB
Q-Margin : 0.00dB
OTU TTI Received
FEC mode : C_FEC
Flexo-Mode : Enable
Flexo Details:
Tx GID : 0
Rx GID : 0
AINS Soak : None
AINS Timer : 0h, 0m
AINS remaining time : 0 seconds
```

Example 2

The following example shows how to configure line loopback on a coherent DSP controller.

```
RP/0/RP0/CPU0:ios#configure
Fri Jul 8 10:48:48.577 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/0
RP/0/RP0/CPU0:ios(config-CoDSP)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-CoDSP)#loopback line
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Fri Jul 8 10:49:26.809 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#end
```

The following example shows how to verify the line loopback configured on a coherent DSP controller.

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/0
Fri Jul 8 10:49:44.073 UTC
Port : CoherentDSP 0/0/0/0
Controller State : Down
Inherited Secondary State : Normal
Configured Secondary State : Maintenance
Derived State : Maintenance
Loopback mode : Line
BER Thresholds : SF = 1.0E-5 SD = 1.0E-7
Performance Monitoring : Enable
Bandwidth : 400.0Gb/s
Alarm Information:
LOS = 2 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 = 0
Detected Alarms : LOS
Bit Error Rate Information
PREFEC BER : 5.00E-01
POSTFEC BER : 0.00E+00
Q-Factor : 0.00 dB
Q-Margin : 0.00dB
OTU TTI Received
FEC mode : C_FEC
Flexo-Mode : Enable
Flexo Details:
Tx GID : 0
Rx GID : 0
AINS Soak : None
AINS Timer : 0h, 0m
AINS remaining time : 0 seconds
```

Example 3

The following example shows how to configure internal loopback on the 400GE controller.

```
RP/0/RP0/CPU0:ios#configure
Fri Jul 8 11:19:26.286 UTC
RP/0/RP0/CPU0:ios(config)#controller FourHundredGigECtrlr 0/0/0/3
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
Fri Jul 8 11:19:47.496 UTC
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#end
```

The following example shows how to verify the internal loopback configured on the 400GE controller.

```
RP/0/RP0/CPU0:ios#show controllers FourHundredGigECtrlr 0/0/0/3
Fri Jul 8 11:19:59.597 UTC
Operational data for interface FourHundredGigECtrlr0/0/0/3:
State:
Administrative state: enabled
Operational state: Down (Reason: State undefined)
LED state: Red On
Maintenance: Enabled
AINS Soak: None
Total Duration: 0 hour(s) 0 minute(s)
Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
Laser Squelch: Disabled
Insert Idle Ingress: Disabled
Insert Idle Egress: Disabled
Phy:
Media type: Not known
Alarms:
Current:
Loss of Signal
Statistics:
FEC:
Corrected Codeword Count: 702710
Uncorrected Codeword Count: 1147
Autonegotiation disabled.
Operational values:
Speed: 400Gbps
Duplex: Full Duplex
Flowcontrol: None
Loopback: Internal
BER monitoring:
Not supported
Forward error correction: Standard (Reed-Solomon)
Holdoff Time: 0ms
```

Example 4

The following example shows how to configure line loopback on the 4X100GE MXP.

```
RP/0/RP0/CPU0:ios(config)#controller hundredGigECtrlr 0/3/0/1/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback line
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following example shows how to verify the line loopback configured on the 4X100GE MXP.

```
RP/0/RP0/CPU0:ios#sh controllers hundredGigECtrlr 0/3/0/1/1
Fri Jul 22 10:34:39.730 UTC
Operational data for interface HundredGigECtrlr0/3/0/1/1:

State:
    Administrative state: enabled
    Operational state: Up
    LED state: Green On
    Maintenance: Enabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled
    Insert Idle Ingress: Disabled
    Insert Idle Egress: Disabled

Phy:
    Media type: Not known
    Statistics:
```

```
        FEC:
            Corrected Codeword Count: 6110368                Valid: True       Start time:
 13:10:41 Thu Jul 21 2022
            Uncorrected Codeword Count: 2771                 Valid: True       Start time:
 13:10:41 Thu Jul 21 2022
        PCS:
            Total BIP errors: 63700992                       Valid: True       Start time:
 13:10:41 Thu Jul 21 2022
            Total frame errors: 0                            Valid: False      Start time:
 13:10:41 Thu Jul 21 2022
            Total Bad SH: 0                                  Valid: False      Start time:
 13:10:41 Thu Jul 21 2022

Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: Line
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Example 5

The following example shows how to configure internal loopback on the 4X100GE MXP.

```
RP/0/RP0/CPU0:ios#conf
RP/0/RP0/CPU0:ios(config)#controller hundredGigECtrlr 0/3/0/7/1
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#loopback internal
RP/0/RP0/CPU0:ios(config-eth-ctrlr)#commit
```

The following example shows how to verify the internal loopback configured on the 4X100GE MXP.

```
RP/0/RP0/CPU0:ios#show controller HundredGigECtrlr 0/3/0/7/1
Fri Jul 22 10:40:34.928 UTC

Operational data for interface HundredGigECtrlr0/3/0/7/1:

State:
    Administrative state: enabled
    Operational state: Down (Reason: State undefined)
    LED state: Red On
    Maintenance: Enabled
    AINS Soak: None
      Total Duration: 0 hour(s) 0 minute(s)
      Remaining Duration: 0 hour(s) 0 minute(s) 0 second(s)
    Laser Squelch: Disabled
    Insert Idle Ingress: Disabled
    Insert Idle Egress: Disabled

Phy:
    Media type: Not known
    Alarms:
        Current:
            Loss of Signal
    Statistics:
        FEC:
            Corrected Codeword Count: 31426046
            Uncorrected Codeword Count: 2187
```

```
Autonegotiation disabled.

Operational values:
    Speed: 100Gbps
    Duplex: Full Duplex
    Flowcontrol: None
    Loopback: Internal
    BER monitoring:
        Not supported
    Forward error correction: Standard (Reed-Solomon)
    Holdoff Time: 0ms
```

Viewing Loopback Configuration Alarm

The following example shows how to view the loopback configuration alarms on the 2-QDD-C, 1.2TC, 1.2TL, OTN-XP, and QXP cards.

```
RP/0/RP0/CPU0:ios#show alarms brief system active
Tue Sep 13 17:43:35.212 UTC

------------------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------------------
Location        Severity     Group            Set Time                    Description


------------------------------------------------------------------------------------------



         0/2             Minor        Controller       09/13/2022 17:34:32 UTC
HundredGigECtrlr0/2/0/2 - Internal Loopback Configured
0/2             Minor        Controller       09/13/2022 17:34:32 UTC
HundredGigECtrlr0/2/0/2 - Internal Loopback Configured
0/2             Minor        Controller       09/13/2022 17:34:32 UTC
HundredGigECtrlr0/2/0/8 - Line Loopback Configured


0/2             Major        Ethernet         09/13/2022 17:34:31 UTC
HundredGigECtrlr0/2/0/4 - Loss of Synchronization The Data Interface


0/2             Minor        Controller       09/13/2022 17:37:42 UTC    OTU40/2/0/8 -
Internal Loopback Configured

0/2            Minor       Controller       09/13/2022 17:39:19 UTC    CoherentDSP0/2/0/0
 - Internal Loopback Configured
```

Restore Factory Settings

Note Perform this operation only on the console port.

You can restore the factory settings on the NCS 1004. The entire system configuration, including usernames, passwords, and IP addresses, is removed. You can perform this operation only through the console port and

not on the management interface. To restore NCS 1004 to factory settings, use the **commit replace** command. After the **commit replace** operation completes, you must perform the IOS XR reload operation.

The **commit best-effort** command merges the target configuration with the running configuration and commits only valid changes (best effort). Some configuration changes might fail due to semantic errors.

Example

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#commit replace
Tue Sep 24 09:36:59.430 UTC

This commit will replace or remove the entire running configuration. This
operation can be service affecting.
Do you wish to proceed? [no]: yes
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#reload
Tue Sep 24 09:38:12.881 UTC

Standby card not present or not Ready for failover. Proceed? [confirm]

Preparing system for backup. This may take a few minutes especially for large configurations.

        Status report: node0_RP0_CPU0: BACKUP INPROGRESS

        Status report: node0_RP0_CPU0: BACKUP HAS COMPLETED SUCCESSFULLY
[Done]

Proceed with reload?  [confirm]
Reloading node  0/RP0/CPU0

RL: Reboot initiated with code 1, cause User initiated graceful reload reboot_timeout 30
shutdown delay 0
RL: Shutdown initiated
Query the node to be reloaded
 NODE_IP of noded to be reloaded 192.0.2.4
sending stop hb
Cause: User initiated graceful reload
VM IP addr sent for reload 192.0.2.4

Received ack from sdrmgr for reload request.Returncode:0
successful disconnection from service
wd_disconnect_cb 548 CMP-WD disconnected successfully
Invmgr successful disconnection from service

RP/0/RP0/CPU0:ios#
Disconnecting from 'default-sdr--1' console. Continue(Y/N)?


Connecting to 'default-sdr--1' console
ÿûÿûÿûÿýbootlogd: ioctl(/dev/pts/2, TIOCCONS): Device or resource busy
/sbin/restorecon:  lstat(/etc/adjtime) failed:  No such file or directory
Configuring network interfaces... done.
Starting system message bus: dbus.
Starting OpenBSD Secure Shell server: sshd
sshd start/running, process 1739
Starting rpcbind daemon...done.
Starting random number generator daemonUnable to open file: /dev/tpm0
.
Starting system log daemon...0
Starting kernel log daemon...0
tftpd-hpa disabled in /etc/default/tftpd-hpa
```

```
Starting internet superserver: xinetd.
net.ipv4.ip_forward = 1
Libvirt not initialized for container instance
Starting crond: OK
SIOCADDRT: File exists

DBG_MSG: platform type is 0
[*] ima_policy have loaded, or IMA policy file does not exist
Start serial incoming on , Clearing ..
RP/0/RP0/CPU0:Sep 24 09:38:44.284 UTC: fpd-serv[256]: %PKT_INFRA-FM-3-FAULT_MAJOR :
ALARM_MAJOR :FPD-NEED-UPGRADE :DECLARE :0/PM0:

This (D)RP Node is not ready or active for login /configuration
.......
........
........

ios con0/RP0/CPU0 is now available

Press RETURN to get started.

!!!!!!!!!!!!!!!!!!! NO root-system username is configured. Need to configure root-system
username. !!!!!!!!!!!!!!!!!!!
```

Headless Mode

During process restarts, CPU reload, or removal of CPU, the NCS 1004 operates in headless mode for up to 72 hours. During this time, traffic is not impacted, although the control plane is not up and running. Fault propagation continues to operate for failures on client and trunk ports. However, you cannot provision anything nor view operational data with a non-functional CPU. Performance monitoring data based on 15 minutes and 24 hour intervals is not supported with a non-functional CPU.

Trail Trace Identifier

The Trail trace identifier (TTI) feature helps you to identify the signal from the source to the destination within the network. You can configure the TTI sent or expected string only in ASCII string format. When the expected TTI string does not match the received TTI trace string, the controller goes down and the OTUK-TIM alarm is raised. To configure TTI on the coherent DSP controllers, use the following commands:

configure

controller coherentDSP *R/S/I/P* **tti** {**sent | expected**} **ascii** *tti-string*

commit

Note The *tti-string* can have a maximum of 64 characters.

The following sample displays how to configure TTI on a coherent DSP controller with the sent and expected strings set to the same ASCII string. The state of the controller is up.

```
RP/0/RP0/CPU0:ios#config
Fri Mar 15 08:03:02.094 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/1/0/1 tti sent ascii 1234
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/1/0/1 tti expected ascii 1234
```

```
RP/0/RP0/CPU0:ios(config)#commit
Fri Mar 15 08:03:49.725 UTC
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/1/0/1
Fri Mar 15 08:04:06.290 UTC

Port                                          : CoherentDSP 0/1/0/1
Controller State                              : Up
Inherited Secondary State                     : Normal
Configured Secondary State                    : Normal
Derived State                                 : In Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable

Alarm Information:
LOS = 0 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 1 TIM = 0
FECMISMATCH = 0 FEC-UNC = 0
Detected Alarms                               : None

Bit Error Rate Information
PREFEC  BER                                   : 7.7E-03
POSTFEC BER                                   : 0.0E+00

OTU TTI Sent
     OPERATOR SPECIFIC  ASCII                 : 1234
                                              :
     OPERATOR SPECIFIC HEX                    : 31323334000000000000000000000000
                                              : 00000000000000000000000000000000
OTU TTI Received
     OPERATOR SPECIFIC  ASCII                 : 1234
                                              :
     OPERATOR SPECIFIC HEX                    : 31323334000000000000000000000000
                                              : 00000000000000000000000000000000
OTU TTI Expected
     OPERATOR SPECIFIC  ASCII                 : 1234
                                              :
     OPERATOR SPECIFIC HEX                    : 31323334000000000000000000000000
                                              : 00000000000000000000000000000000
FEC mode                                      : Soft-Decision 27

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

The following example shows how to configure TTI on a coherent DSP controller with the sent and expected strings set to different ASCII strings. The state of the controller goes down and the TIM alarm is raised.

```
RP/0/RP0/CPU0:ios#config
Fri Mar 15 08:54:29.780 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/1/0/1 tti sent ascii 1234
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/1/0/1 tti expected ascii 5678
RP/0/RP0/CPU0:ios(config)#commit
Fri Mar 15 08:56:12.293 UTC
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/1/0/1
Fri Mar 15 08:56:33.910 UTC

Port                                          : CoherentDSP 0/1/0/1
Controller State                              : Down
Inherited Secondary State                     : Normal
```

```
Configured Secondary State                    : Normal
Derived State                                 : In Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable

Alarm Information:
LOS = 1 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 3 TIM = 1
FECMISMATCH = 0 FEC-UNC = 0
Detected Alarms                               : BDI TIM

Bit Error Rate Information
PREFEC  BER                                   : 8.2E-03
POSTFEC BER                                   : 0.0E+00

OTU TTI Sent
     OPERATOR SPECIFIC  ASCII                 : 1234
                                              :
     OPERATOR SPECIFIC HEX                    : 31323334000000000000000000000000
                                              : 00000000000000000000000000000000
OTU TTI Received
     OPERATOR SPECIFIC  ASCII                 : 1234
                                              :
     OPERATOR SPECIFIC HEX                    : 31323334000000000000000000000000
                                              : 00000000000000000000000000000000
OTU TTI Expected
     OPERATOR SPECIFIC  ASCII                 : 5678
                                              :
     OPERATOR SPECIFIC HEX                    : 35363738000000000000000000000000
                                              : 00000000000000000000000000000000
FEC mode                                      : Soft-Decision 27

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

Configure TTI on OTN-XP Card

You can configure the TTI sent or expected string in the full ASCII format, or Source Access Point Identifier (SAPI)/Destination Access Point Identifier (DAPI) format on OTU, ODU, ODU-flex, ODUCn, and coherentDSP controllers for the OTN-XP card.

From R7.3.1 onwards, coherentDSP controller supports only the full ASCII string format.

From R7.3.2 onwards, coherentDSP controller supports SAPI/DAPI string format in addition to the full ASCII string format.

You can configure TTI for the following muxponder modes:

- 10G-Grey-MXP
- 4x100G-MXP-400G-TXP

The following table lists the ASCII format that is supported on each muxponder mode for TTI:

Table 10: ASCII Format Supported on Each Muxponder Mode

Muxponder Mode	ASCII with Character String	Controller
10G Grey	Full ASCII 64-character	OTU2, OTU2E, OTU4, ODU4, ODU2E (10G mapper)
	SAPI ASCII 15-character	OTU2, OTU2E, OTU4, ODU4, ODU2E (10G mapper)
	DAPI ASCII 15-character	OTU2, OTU2E, OTU4, ODU4, ODU2E (10G mapper)
	Operator-specific ASCII 32-character	OTU2, OTU2E, OTU4, ODU4, ODU2E (10G mapper)
4x100G-MXP-400G-TXP	Full ASCII 64-character	OTU4, coherentDSP, ODUC4, ODU4 (100G mapper), and ODU-FLEX (400G mapper)
	SAPI ASCII 15-character	OTU4, coherentDSP, ODUC4, ODU4 (100G mapper), and ODU-FLEX (400G mapper)
	DAPI ASCII 15-character	OTU4, coherentDSP, ODUC4, ODU4 (100G mapper), and ODU-FLEX (400G mapper)
	Operator-specific ASCII 32-character	OTU4, coherentDSP, ODUC4, ODU4 (100G mapper), and ODU-FLEX (400G mapper)

To configure TTI, use the following commands:

configure

controller *controller-type R/S/I/P* **tti** {**sent | expected**} {**ascii | sapi ascii | dapi ascii | operator-specific ascii** } *tti-string*

commit

Note We recommend that you configure TTI in the SAPI/DAPI ASCII format.

Restriction

- For OC192 and STM 64 payloads, configure both sides for ASCII and hex on mapper ODU2.
- For OC192 and STM 64 payloads, do not edit operator specific hex on mapper ODU2. Instead, delete and create the operator specific hex.

The following is a sample configuration on ODU4 controller:

```
RP/0/RP0/CPU0:ios#configure
Thu Sep 30 17:19:11.804 UTC
Current Configuration Session  Line       User     Date                      Lock
00001000-00005c15-00000000     vty0       root     Thu Sep 30 11:50:12 2021
RP/0/RP0/CPU0:ios(config)#controller odU4 0/1/0/12/7 tti sent sapi ascii cisco123
RP/0/RP0/CPU0:ios(config)#controller odU4 0/1/0/12/7 tti expect sapi ascii 123cisco
RP/0/RP0/CPU0:ios(config)#controller odU4 0/1/0/12/7 tti sent dapi ascii dapistring123
RP/0/RP0/CPU0:ios(config)#controller odU4 0/1/0/12/7 tti expected dapi ascii 123stringdapi
RP/0/RP0/CPU0:ios(config)#controller odU4 0/1/0/12/7 tti sent operator-specific ascii
operation123
RP/0/RP0/CPU0:ios(config)#controller odU4 0/1/0/12/7 tti expected operator-specific ascii
123operator
RP/0/RP0/CPU0:ios(config)#commit
Thu Sep 30 17:21:49.521 UTC
RP/0/RP0/CPU0:ios(config)#end
```

The following is a sample output of the TTI configuration on the ODU4 controller:

```
RP/0/RP0/CPU0:ios#show controllers odU4 0/1/0/12/7
Thu Sep 30 17:22:30.658 UTC

Port                                        : ODU4 0/1/0/12/7
Controller State                            : Down
Inherited Secondary state                   : Normal
Configured Secondary state                  : Normal
Derived State                               : In Service
Loopback mode                               : None
BER Thresholds                              : SF = 1.0E-6  SD = 1.0E-7

Performance Monitoring                      : Enable

Path Monitoring Mode                        : Operational
PM TIM-CA state                             : Disable

Alarm Information:
AIS = 3 IAE = 0 BIAE = 0
SF_BER = 0      SD_BER = 0      BDI = 1
OCI = 0 LCK = 2 PTIM = 0
TIM = 1 CSF = 0 GFP LFD = 0
GFP LOCS = 0    GFP LOCCS = 0   GFP UPM = 0

Detected Alarms                             : TIM

ODU TTI Sent
     SAPI  ASCII                            : c i s c o 1 2 3
     SAPI  HEX                              : 00636973636F31323300000000000000000
     DAPI  ASCII                            : d a p i s t r i n g 1 2 3
     DAPI  HEX                              : 006461706973747269 6E673132330000
     OPERATOR SPECIFIC ASCII                : operation123
     OPERATOR SPECIFIC HEX                  :
6F7065726174696F6E3132330000000000000000000000000000000000000000
ODU TTI Received

ODU TTI Expected
     SAPI  ASCII                            : 1 2 3 c i s c o
     SAPI  HEX                              : 00313233636973636F00000000000000
     DAPI  ASCII                            : 1 2 3 s t r i n g d a p i
     DAPI  HEX                              : 00313233737472696E67646170690000
     OPERATOR SPECIFIC ASCII                : 123operator
     OPERATOR SPECIFIC HEX                  :
3132336F70657261746F72000000000000000000000000000000000000000000
```

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

Private Line Emulation(PLE) supported           : No
```

You can configure TTI on OTUCn-REGEN mode on the OTN-XP Card.

The following sample displays how to configure TTI on a coherent DSP controller port 12 on the OTUCn-REGEN mode.

```
Mon Dec 27 12:03:53.642 UTC
RP/0/RP0/CPU0:ios(config)#controller CoherentDSP 0/3/0/12 tti sent ascii 1234cisco
RP/0/RP0/CPU0:ios(config)#commit
Mon Dec 27 12:03:54.333 UTC
RP/0/RP0/CPU0:ios(config)#end
Mon Dec 27 12:03:55.434 UTC
RP/0/RP0/CPU0:ios(config)#controller CoherentDSP 0/3/0/12 tti expected ascii cisco1234
RP/0/RP0/CPU0:ios(config)#commit
Mon Dec 27 12:03:56.137 UTC
RP/0/RP0/CPU0:ios(config)#end
```

The following sample verifies the TTI configuration on the inverse muxponder configured on the OTUCn-REGEN mode.

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/12
Tue May 24 17:49:14.301 UTC

Port                                            : CoherentDSP 0/0/0/12
Controller State                                : Up
Inherited Secondary State                       : Normal
Configured Secondary State                      : Normal
Derived State                                   : In Service
Loopback mode                                   : None
BER Thresholds                                  : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                          : Enable
Bandwidth                                       : 400.0Gb/s

Alarm Information:
LOS = 0 LOF = 0 LOM = 0
OOF = 0 OOM = 0 AIS = 0
IAE = 0 BIAE = 0        SF_BER = 0
SD_BER = 0      BDI = 1 TIM = 1
FECMISMATCH = 0 FEC-UNC = 0     FLEXO_GIDM = 0
FLEXO-MM = 0    FLEXO-LOM = 0   FLEXO-RDI = 0
FLEXO-LOF = 0
Detected Alarms                                 : None

Bit Error Rate Information
PREFEC  BER                                     : 1.55E-04
POSTFEC BER                                     : 0.00E+00
Q-Factor                                        : 11.10 dB

Q-Margin                                        : 4.70dB

OTU TTI Sent
     FULL TTI ASCII                             : cisco123
                                                :
     FULL TTI HEX                               : 636973636F3132330000000000000000
                                                : 00000000000000000000000000000000
OTU TTI Received
     FULL TTI ASCII                             : 123cisco
                                                :
     FULL TTI HEX                               : 313233636973636F0000000000000000
```

```
                                                    : 00000000000000000000000000000000
OTU TTI Expected
     FULL TTI ASCII                                 : 123cisco
                                                    :
     FULL TTI HEX                                   : 313233636973636F0000000000000000
                                                    : 00000000000000000000000000000000
FEC mode                                            : O_FEC

Flexo-Mode                                          : Enable
Flexo Details:
        Tx GID                                      : 1
        TX IID                                      : 1, 2, 3, 4,
        Rx GID                                      : 1
        RX IID                                      : 1, 2, 3, 4,

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


RP/0/RP0/CPU0:ios#
RP/0/RP0/CPU0:ios#show running-config controller coherentDSP 0/0/0/12
Tue May 24 17:49:21.749 UTC
controller CoherentDSP0/0/0/12
tti
  expected ascii 123cisco
  sent ascii cisco123
!
!
```

Configure TTI on Inverse Muxponder Configuration on the OTN-XP Card

The following sample displays how to configure TTI on a coherent DSP controller port 12 on the OTN-XP in inverse muxponder configuration mode.

Note TTI configuration is not supported on the DSP controller port 13.

```
RP/0/RP0/CPU0:ios#configure
Thu Sep 30 14:18:13.288 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/2/0/12
RP/0/RP0/CPU0:ios(config-CoDSP)#tti sent sapi ascii cisco
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

The following sample verifies the TTI configuration on the inverse muxponder configured on the OTN-XP Card.

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/2/0/12
Thu Sep 30 14:19:05.367 UTC

Port                                                : CoherentDSP 0/2/0/12
Controller State                                    : Up
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                                           : 200.0Gb/s

Alarm Information:
```

```
LOS = 2 LOF = 0 LOM = 0
OOF = 1 OOM = 0 AIS = 1
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 = 1
FLEXO-LOF = 0
Detected Alarms                                 : None

Bit Error Rate Information
PREFEC  BER                                     : 4.11E-09
POSTFEC BER                                     : 0.00E+00
Q-Factor                                        : 14.90 dB

Q-Margin                                        : 8.60dB

OTU TTI Sent
     SAPI  ASCII                                : c i s c o
     SAPI  HEX                                  : 00636973636F00000000000000000000
     DAPI  ASCII                                :
     DAPI  HEX                                  :
     OPERATOR SPECIFIC ASCII                    :
     OPERATOR SPECIFIC HEX                      :
CDCDCDCDED00DBBE2100000000000000050D9D29AD7F00007603BADC7698BADC
OTU TTI Received
     SAPI  ASCII                                : c i s c o
     SAPI  HEX                                  : 00636973636F00000000000000000000
FEC mode                                        : O_FEC

Flexo-Mode                                      : Enable
Flexo Details:
        Tx GID                                  : 1
        TX IID                                  : 1, 2,
        Rx GID                                  : 1
        RX IID                                  : 1, 2,

Flexo Peers Information:
        Controller                              : CoherentDSP0_2_0_13
        OTUCn rate                              : OTUC2


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

Enable TIM CA on Path Monitoring Layer

You can enable Trace Identifier Mismatch (TIM) consequent action (CA) on the Path Monitoring (PM) layer using the **pm-tim-ca** command on mapper ODUs for Ethernet controller. The TTI transmit string in the SAPI/DAPI format is not configurable on ODUs that are transparent.

For example, the clients that are supported are ODU4, ODU2, and ODU2E, and lower-order ODUs such as ODU2 or ODU2E.

You can configure **pm-tim-ca** only on mapper ODUs such as ODU2E (10G mapper), ODU4 (100G mapper), and ODU-FLEX (400G mapper).

To configure **pm-tim-ca** on mapper ODU in the 4x100G-MXP-400G-TXP muxponder mode, use the following commands

configure

controller *controller-type R/S/I/P*

pm-tim-ca

commit

Configure TTI on QXP Card

From R7.10.1, you can configure the TTI sent or expected string in the full ASCII format, or Source Access Point Identifier (SAPI)/Destination Access Point Identifier (DAPI) format on ODU-flex, ODU4, and coherentDSP controllers for the QXP card.

Note TTI operates only in **trunk mode OR**.

The following table lists the ASCII format that is supported for TTI:

ASCII with Character String	Controller
Full ASCII 64-character	CoherentDSP,odu4,odu-flex
SAPI ASCII 15-character	CoherentDSP,odu4,odu-flex
DAPI ASCII 15-character	CoherentDSP,odu4,odu-flex
Operator-specific ASCII 32-character	CoherentDSP,odu4,odu-flex

To configure TTI, use the following commands:

configure

controller *controller-type R/S/I/P* **tti** {**sent | expected**} {**ascii | sapi ascii | dapi ascii | operator-specific ascii** } *tti-string*

commit

The following is a sample configuration for FULL TTI for coherentDSP controller

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/8
RP/0/RP0/CPU0:ios(config-CoDSP)#tti sent ascii cisco
RP/0/RP0/CPU0:ios(config-CoDSP)#tti  expected ascii cisco123
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

The following is a sample configuration for TTI HEX for coherentDSP controller

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/8
RP/0/RP0/CPU0:ios(config-CoDSP)#tti sent hex 6E6E6E2A2A2A
RP/0/RP0/CPU0:ios(config-CoDSP)#tti  expected hex 3F4B4B4B3D3E3A
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

The following is a sample configuration for Operator specific TTI for coherentDSP controller

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/8
RP/0/RP0/CPU0:ios(config-CoDSP)#tti sent operator-specific ascii hellooo
```

```
RP/0/RP0/CPU0:ios(config-CoDSP)#tti expected operator-specific ascii hellooo
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

The following is a sample configuration for Operator specific TTI HEX for coherentDSP controller

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/8
RP/0/RP0/CPU0:ios(config-CoDSP)#tti  sent operator-specific hex
6E6E6E2A2A2A3D3E3A3A6E6E6E2A2A2A3D
RP/0/RP0/CPU0:ios(config-CoDSP)#tti  expected operator-specific hex 5A5A6D3A3B3C3F4B4B4B3D3E3A
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

The following is a sample configuration for SAPI for coherentDSP controller

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/8
RP/0/RP0/CPU0:ios(config-CoDSP)#tti sent operator-specific ascii hellooo
RP/0/RP0/CPU0:ios(config-CoDSP)#tti expected operator-specific ascii hellooo
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

The following is a sample configuration for DAPI for coherentDSP controller

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/8
RP/0/RP0/CPU0:ios(config-CoDSP)#tti sent dapi ascii cisco123
RP/0/RP0/CPU0:ios(config-CoDSP)#tti  expected dapi ascii hello
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

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 the minimum difference between the configured values is equal to or greater than 1500 ps/nm.

The following table lists the default CD search range.

Data Rate	BPS	Card Support	Default CD Search Range
200G to 500G	BPS < = 3	1.2T, 1.2TL	-10,000 to 100,000 ps/nm
	3 < BPS <= 4	1.2T, 1.2TL	-10,000 to 80,000 ps/nm
	4 < BPS <=5	1.2T	-5,000 to 20,000 ps/nm
600G	BPS=5.2578125	1.2T	-2000 to 2,000 ps/nm
400G for 400G CFP2 DCO	BPS=4	OTN-XP	-24,000 to 24,000 ps/nm
400GE for ZRP	BPS=4	OTN-XP	For CFEC, -2,400 to 2,400 ps/nm For OFEC, -13,000 to 13,000 ps/nm
200G to 400G	3 < BPS <= 6	2-QDD-C	-350000 to +350000 ps/nm

Data Rate	BPS	Card Support	Default CD Search Range
400GE for ZRP	BPS=4	QXP	For CFEC, -2,400 to 2,400 ps/nm For OFEC, -160000 to 160000 ps/nm

Note The cd-min and cd-max values must be set for BPS values that are greater than 4 in the 1.2T card.

Note When the user provisions the cd-min and cd-max values that are outside the range through CLI, the provisioned values are accepted; however, only the actual values supported by the hardware are applied.

The following is a sample where chromatic dispersion is configured on the optics controller.

```
RP/0/RP0/CPU0:ios#configure
Mon Aug 19 19:31:42.115 UTC
RP/0/RP0/CPU0:ios(config)#controller  optics 0/1/0/1
RP/0/RP0/CPU0:ios(config-Optics)#cd-max 4000
RP/0/RP0/CPU0:ios(config-Optics)#cd-min -1000
RP/0/RP0/CPU0:ios(config-Optics)#commit
Mon Aug 19 19:35:24.697 UTC
RP/0/RP0/CPU0:ios(config-Optics)#exit
RP/0/RP0/CPU0:ios(config)#exit
RP/0/RP0/CPU0:ios#show run controller optics 0/1/0/*
Mon Aug 19 19:57:41.859 UTC
controller Optics0/1/0/0
 transmit-power -15
 dwdm-carrier 50GHz-grid itu-ch 55
 enh-sop-tol-mode 1
 cross-pol-gain-mode 10
 lbc-high-threshold 5
!
controller Optics0/1/0/1
 description trunk power UP
 cd-min -1000
 cd-max 4000
 enh-colorless-mode 2
 enh-sop-tol-mode 3
 nleq-comp-mode 4
 cross-pol-gain-mode 2
 cross-pol-weight-mode 3
 cpr-win-mode 3
 cpr-ext-win-mode 8
 rx-voa fixed-ratio 1200
 filter-roll-off-factor 0.035
!
controller Optics0/1/0/5
 soak-time 10
!
```

Transmit Power

From Release 7.3.1 onwards, you can configure transmit power on the CFP2 DCO optics for the OTN-XP card. The value ranges from -10 to +1 dBm.

From Release 7.3.2 onwards, you can configure transmit power on the QDD ZRP optics for the OTN-XP card. The following are the value ranges for OFEC and CFEC:

FEC Types	Transmit Power (dBm)
OFEC	-13 to -9
CFEC	-10 to -6

To configure transmit power on the CFP2 DCO optics for the OTN-XP card, use the following commands:

```
RP/0/RP0/CPU0:ios#configure
Mon Aug 19 19:31:42.115 UTC
RP/0/RP0/CPU0:ios(config)#controller optics 0/1/0/12
RP/0/RP0/CPU0:ios(config-Optics)#transmit-power -1.50
RP/0/RP0/CPU0:ios(config-Optics)#commit
Mon Aug 19 19:35:24.697 UTC
RP/0/RP0/CPU0:ios(config-Optics)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

The following is a sample in which transmit power of -1.50 dBm is configured on the CFP2 DCO optics for the OTN-XP card.

```
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#do show controllers optics 0/1/0/12
Mon Jan 18 19:05:26.009 UTC

Controller State: Down

Transport Admin State: In Service

Laser State: On

LED State: Green

Optics Status

Optics Type: CFP2 DWDM
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 %
Actual TX Power = -1.47 dBm
RX Power = -0.86 dBm
RX Signal Power = 0.86 dBm
Frequency Offset = 0 MHz

Performance Monitoring: Enable

THRESHOLD VALUES
----------------

Parameter High Alarm Low Alarm High Warning Low Warning
---------------------- ---------- --------- ------------ -----------
Rx Power Threshold(dBm) 4.9 -12.0 0.0 0.0
Tx Power Threshold(dBm) 3.5 -10.1 0.0 0.0
LBC Threshold(mA) N/A N/A 0.00 0.00

LBC High Threshold = 98 %
Configured Tx Power = -1.50 dBm
Configured CD High Threshold = 180000 ps/nm
Configured CD lower Threshold = -180000 ps/nm
Configured OSNR lower Threshold = 0.00 dB
Configured DGD Higher Threshold = 180.00 ps
Baud Rate = 63.0999984741 GBd
Bits per Symbol = 4.0000000000 bits/symbol
Modulation Type: 16QAM
Chromatic Dispersion 0 ps/nm
Configured CD-MIN -26000 ps/nm CD-MAX 26000 ps/nm
Polarization Mode Dispersion = 0.0 ps
Second Order Polarization Mode Dispersion = 156.00 ps^2
Optical Signal to Noise Ratio = 35.80 dB
SNR = 10.50 dB
Polarization Dependent Loss = 0.00 dB
Polarization Change Rate = 0.00 rad/s
Differential Group Delay = 1.00 ps
Filter Roll Off Factor : 0.000
Rx VOA Fixed Ratio : 0.00 dB
Enhanced Colorless Mode : 0
Enhanced SOP Tolerance Mode : 0
```

Transmit Power on QDD ZRP Optics

To configure transmit power on the QDD ZRP optics for the OTN-XP card, use the following commands:

```
RP/0/RP0/CPU0:ios#configure
Mon Aug 19 19:31:42.115 UTC
RP/0/RP0/CPU0:ios(config)#controller optics 0/1/0/9
RP/0/RP0/CPU0:ios(config-Optics)#transmit-power -8
RP/0/RP0/CPU0:ios(config-Optics)#commit
Mon Aug 19 19:35:24.697 UTC
RP/0/RP0/CPU0:ios(config-Optics)#
```

The following is a sample in which transmit power of -8 dBm is configured on the QDD ZRP optics for the OTN-XP card:

```
RP/0/RP0/CPU0:ios#show controller optics 0/1/0/9
Wed Sep 15 00:36:24.383 UTC
```

```
Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Green

Optics Status

        Optics Type:  QSFP-DD DWDM
        DWDM carrier Info: C BAND, MSA ITU Channel=49, Frequency=193.70THz,
        Wavelength=1547.715nm

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


        LOS/LOL/Fault Status:

        Alarm Statistics:

        -------------
        HIGH-RX-PWR = 0            LOW-RX-PWR = 1
        HIGH-TX-PWR = 0            LOW-TX-PWR = 1
        HIGH-LBC = 0               HIGH-DGD = 0
        OOR-CD = 0                 OSNR = 1
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 0
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = -8 dBm
        RX Power = -7.31 dBm
        RX Signal Power = -7.67 dBm
        Frequency Offset = 81 MHz
Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)          3.0      -23.5           0.0          0.0
        Tx Power Threshold(dBm)          0.0      -16.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 90 %
        Configured Tx Power = -7.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 24.00 dB
        Configured DGD Higher Threshold = 40.00 ps
        Baud Rate =  59.8437500000 GBd
        Bits per Symbol = 4.0000000000  bits/symbol
        Modulation Type: 16QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -2400 ps/nm  CD-MAX 2400 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.40 dB
        SNR = 17.30 dB
        Polarization Dependent Loss = 0.40 dB
        Polarization Change Rate = 0.00 rad/s
```

```
        Differential Group Delay = 3.00 ps

Transceiver Vendor Details

        Form Factor            : QSFP-DD
        Name                   : CISCO
        Part Number            : 10-3496-01
        Rev Number             : 11
        Serial Number          : 210153241
        PID                    : QDD-400G-ZRP-S
        VID                    : ES04
        Date Code(yy/mm/dd)    : 20/21/01
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set
Transceiver Temperature : 57 Celsius
AINS Soak               : None
AINS Timer              : 0h, 0m
AINS remaining time     : 0 seconds
```

Laser Bias Current High Threshold

You can configure the threshold of the laser bias current flowing on the phusical pluggable port on the trunk optics controller. The range is 0 to 100%

To configure the laser bias current threshold, use the following command:

configure

controller optics *R/S/I/P*

lbc-high-threshold *lbc-value*

commit

The following sample configures the high laser bias threshold on the controller optics:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller optics 0/0/0/12
RP/0/RP0/CPU0:ios(config-Optics)#lbc-high-threshold 55
RP/0/RP0/CPU0:ios(config-Optics)#commit
```

The following sample shows the high rlaser bias threshold configured on the controller optics:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Fri Nov 12 10:58:50.595 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Yellow

Optics Status

        Optics Type:  CFP2 DWDM
        DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
        Wavelength=1552.524nm

        Alarm Status:
```

```
             -------------
             Detected Alarms:
                     HIGH-RX-PWR   LOW-TX-PWR
                     HIGH-DGD

             LOS/LOL/Fault Status:

             Alarm Statistics:

             -------------
             HIGH-RX-PWR = 1            LOW-RX-PWR = 0
             HIGH-TX-PWR = 0            LOW-TX-PWR = 1
             HIGH-LBC = 0               HIGH-DGD = 6
             OOR-CD = 0                 OSNR = 0
             WVL-OOL = 0                MEA  = 0
             IMPROPER-REM = 1
             TX-POWER-PROV-MISMATCH = 0
             Laser Bias Current = 0.0 %
             Actual TX Power = 0.97 dBm
             RX Power = -0.53 dBm
             RX Signal Power = -1.20 dBm
             Frequency Offset = 63 MHz

             Performance Monitoring: Enable

             THRESHOLD VALUES
             ----------------

             Parameter                 High Alarm  Low Alarm  High Warning  Low Warning
             ------------------------  ----------  ---------  ------------  -----------
             Rx Power Threshold(dBm)         -2.0       -3.0           0.0          0.0
             Tx Power Threshold(dBm)          4.0        2.0           0.0          0.0
             LBC Threshold(mA)                N/A        N/A          0.00         0.00

             LBC High Threshold = 55 %
             Configured Tx Power = 1.00 dBm
             Configured CD High Threshold = 2400 ps/nm
             Configured CD lower Threshold = -2400 ps/nm
             Configured OSNR lower Threshold = 0.40 dB
             Configured DGD Higher Threshold = 0.30 ps
             Baud Rate =  63.1394679230 GBd
             Bits per Symbol = 3.0000000000  bits/symbol
             Modulation Type: 8QAM
             Chromatic Dispersion 0 ps/nm
             Configured CD-MIN -48000 ps/nm  CD-MAX 48000 ps/nm
             Polarization Mode Dispersion = 0.0 ps
             Second Order Polarization Mode Dispersion = 29.00 ps^2
             Optical Signal to Noise Ratio = 36.10 dB
             SNR = 17.50 dB
             Polarization Dependent Loss = 0.50 dB
             Polarization Change Rate = 0.00 rad/s
             Differential Group Delay = 1.00 ps

Transceiver Vendor Details

             Form Factor            : CFP2
             Name                   : CISCO-ACACIA
             Part Number            : 10-3500-01
             Rev Number             : 01
             Serial Number          : ACA24480037
             PID                    : ONS-CFP2D-400G-C
             VID                    : VES1
             Date Code(yy/mm/dd)    : 20/11/10
             Fiber Connector Type: LC
```

```
         Otn Application Code: Not Set
         Sonet Application Code: Not Set
         Ethernet Compliance Code: Not set

Transceiver Temperature : 46 Celsius



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

Differential Group Delay Threshold

You can configure the threshold value for the maximum acceptable differential group delay (DGD) on the trunk optics controllers. The DGD alarm is raised if DGD exceeds this value.

The range is 0–18000 (in the units of 0.01 ps).

To configure the maximum acceptable DGD, use the following command:

configure

controller optics *R/S/I/P*

dgd-high-threshold *dgd-value*

commit

The following sample configures the minimum acceptable DGD on the controller optics:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller optics 0/0/0/12
RP/0/RP0/CPU0:ios(config-Optics)#dgd-high-threshold 30
RP/0/RP0/CPU0:ios(config-Optics)#commit
```

The following sample shows the maximum acceptable DGD configured on the controller optics:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Fri Nov 12 10:58:50.595 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Yellow

Optics Status

         Optics Type:  CFP2 DWDM
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm

         Alarm Status:
         -------------
         Detected Alarms:
                 HIGH-RX-PWR   LOW-TX-PWR
                 HIGH-DGD

         LOS/LOL/Fault Status:
```

```
        Alarm Statistics:

        -------------
        HIGH-RX-PWR = 1            LOW-RX-PWR = 0
        HIGH-TX-PWR = 0            LOW-TX-PWR = 1
        HIGH-LBC = 0               HIGH-DGD = 6
        OOR-CD = 0                 OSNR = 0
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 1
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = 0.97 dBm
        RX Power = -0.53 dBm
        RX Signal Power = -1.20 dBm
        Frequency Offset = 63 MHz

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.0       -3.0           0.0          0.0
        Tx Power Threshold(dBm)          4.0        2.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 55 %
        Configured Tx Power = 1.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 0.40 dB
        Configured DGD Higher Threshold = 0.30 ps
        Baud Rate =  63.1394679230 GBd
        Bits per Symbol = 3.0000000000  bits/symbol
        Modulation Type: 8QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -48000 ps/nm  CD-MAX 48000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.10 dB
        SNR = 17.50 dB
        Polarization Dependent Loss = 0.50 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : CFP2
        Name                   : CISCO-ACACIA
        Part Number            : 10-3500-01
        Rev Number             : 01
        Serial Number          : ACA24480037
        PID                    : ONS-CFP2D-400G-C
        VID                    : VES1
        Date Code(yy/mm/dd)    : 20/11/10
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 46 Celsius
```

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

Optical Signal to Noise Ratio

You can configure the minimum acceptable Optical Signal to Noise ratio (OSNR) value. The OSNR alarm is raised if OSNR goes below this value.

The range is 0–4000 (in units of 0.01db).

To configure the minimum acceptable OSNR, use the following command:

configure

controller optics *R/S/I/P*

osnr-low-threshold *osnr-value*

commit

The following sample configures the minimum acceptable OSNR on the controller optics:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller optics 0/0/0/12
RP/0/RP0/CPU0:ios(config-Optics)#osnr-low-threshold 40
RP/0/RP0/CPU0:ios(config-Optics)#commit
```

The following sample shows the minimum acceptable OSNR configured on the controller optics:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Fri Nov 12 10:58:50.595 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Yellow

Optics Status

         Optics Type:  CFP2 DWDM
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm

         Alarm Status:
         -------------
         Detected Alarms:
                 HIGH-RX-PWR   LOW-TX-PWR
                 HIGH-DGD

         LOS/LOL/Fault Status:

         Alarm Statistics:

         -------------
         HIGH-RX-PWR = 1            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 1
         HIGH-LBC = 0               HIGH-DGD = 6
         OOR-CD = 0                 OSNR = 0
```

```
        WVL-OOL = 0                MEA  = 0
        IMPROPER-REM = 1
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = 0.97 dBm
        RX Power = -0.53 dBm
        RX Signal Power = -1.20 dBm
        Frequency Offset = 63 MHz

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.0       -3.0           0.0          0.0
        Tx Power Threshold(dBm)          4.0        2.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 55 %
        Configured Tx Power = 1.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 0.40 dB
        Configured DGD Higher Threshold = 0.30 ps
        Baud Rate =  63.1394679230 GBd
        Bits per Symbol = 3.0000000000  bits/symbol
        Modulation Type: 8QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -48000 ps/nm  CD-MAX 48000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.10 dB
        SNR = 17.50 dB
        Polarization Dependent Loss = 0.50 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : CFP2
        Name                   : CISCO-ACACIA
        Part Number            : 10-3500-01
        Rev Number             : 01
        Serial Number          : ACA24480037
        PID                    : ONS-CFP2D-400G-C
        VID                    : VES1
        Date Code(yy/mm/dd)    : 20/11/10
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 46 Celsius



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

Chromatic Dispersion Threshold

You can configure the minimum and maximum acceptable chromatic dispersion for the trunk optics controllers. The CD alarm is raised if the chromatic dispersion goes below the minimum or exceeds the maximum value.

The following is a sample of configuring the minimum and maximum chromatic dispersion threshold:

To configure the maximum nd minimum acceptable CD, use the following command:

configure

controller optics *R/S/I/P*

cd-high-threshold *cd-high*

cd-low-threshold *cd-low*

commit

The following sample configures the maximum and minimum acceptable CD on the controller optics:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller optics 0/0/0/12
RP/0/RP0/CPU0:ios(config-Optics)#cd-high-threshold 2400
RP/0/RP0/CPU0:ios(config-Optics)#cd-low-threshold -2400
RP/0/RP0/CPU0:ios(config-Optics)#commit
```

The following sample shows the maximum and minimum acceptable CD configured on the controller optics:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Fri Nov 12 10:58:50.595 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Yellow

Optics Status

        Optics Type:  CFP2 DWDM
        DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
        Wavelength=1552.524nm

        Alarm Status:
        -------------
        Detected Alarms:
                HIGH-RX-PWR   LOW-TX-PWR
                HIGH-DGD

        LOS/LOL/Fault Status:

        Alarm Statistics:

        -------------
        HIGH-RX-PWR = 1             LOW-RX-PWR = 0
        HIGH-TX-PWR = 0             LOW-TX-PWR = 1
        HIGH-LBC = 0                HIGH-DGD = 6
        OOR-CD = 0                  OSNR = 0
        WVL-OOL = 0                 MEA  = 0
        IMPROPER-REM = 1
```

```
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = 0.97 dBm
        RX Power = -0.53 dBm
        RX Signal Power = -1.20 dBm
        Frequency Offset = 63 MHz

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.0       -3.0           0.0          0.0
        Tx Power Threshold(dBm)          4.0        2.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 55 %
        Configured Tx Power = 1.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 0.40 dB
        Configured DGD Higher Threshold = 0.30 ps
        Baud Rate =  63.1394679230 GBd
        Bits per Symbol = 3.0000000000  bits/symbol
        Modulation Type: 8QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -48000 ps/nm  CD-MAX 48000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.10 dB
        SNR = 17.50 dB
        Polarization Dependent Loss = 0.50 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : CFP2
        Name                   : CISCO-ACACIA
        Part Number            : 10-3500-01
        Rev Number             : 01
        Serial Number          : ACA24480037
        PID                    : ONS-CFP2D-400G-C
        VID                    : VES1
        Date Code(yy/mm/dd)    : 20/11/10
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 46 Celsius


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

Receive Power Threshold

You can configure the high and low threshold of the total optical signal power of the received signal on the trunk optics controller.

The range is –400 to 300 (in the units of 0.1 dBm).

To configure the high and low receive power threshold, use the following command:

configure

controller optics *R/S/I/P*

rx-high-threshold *rx-high*

rx-low-threshold *rx-low*

commit

The following sample configures the high receive power threshold on the controller optics:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller optics 0/0/0/12
RP/0/RP0/CPU0:ios(config-Optics)#rx-high-threshold -20
RP/0/RP0/CPU0:ios(config-Optics)#rx-low-threshold -30
RP/0/RP0/CPU0:ios(config-Optics)#commit
```

The following sample shows the high receive power threshold configured on the controller optics:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Fri Nov 12 10:58:50.595 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Yellow

Optics Status

         Optics Type:  CFP2 DWDM
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm

         Alarm Status:
         -------------
         Detected Alarms:
                 HIGH-RX-PWR   LOW-TX-PWR
                 HIGH-DGD

         LOS/LOL/Fault Status:

         Alarm Statistics:

         -------------
         HIGH-RX-PWR = 1            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 1
         HIGH-LBC = 0               HIGH-DGD = 6
         OOR-CD = 0                 OSNR = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 1
```

```
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = 0.97 dBm
        RX Power = -0.53 dBm
        RX Signal Power = -1.20 dBm
        Frequency Offset = 63 MHz

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.0       -3.0           0.0          0.0
        Tx Power Threshold(dBm)          4.0        2.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 55 %
        Configured Tx Power = 1.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 0.40 dB
        Configured DGD Higher Threshold = 0.30 ps
        Baud Rate =  63.1394679230 GBd
        Bits per Symbol = 3.0000000000  bits/symbol
        Modulation Type: 8QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -48000 ps/nm  CD-MAX 48000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.10 dB
        SNR = 17.50 dB
        Polarization Dependent Loss = 0.50 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : CFP2
        Name                   : CISCO-ACACIA
        Part Number            : 10-3500-01
        Rev Number             : 01
        Serial Number          : ACA24480037
        PID                    : ONS-CFP2D-400G-C
        VID                    : VES1
        Date Code(yy/mm/dd)    : 20/11/10
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 46 Celsius



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

Transmit Power Threshold

You can configure the high and low threshold of the total optical signal power of the transmitted signal on the trunk optics controller.

The range is –400 to 300 (in the units of 0.1 dBm).

To configure the high and low transmit power threshold, use the following command:

configure

controller optics *R/S/I/P*

tx-high-threshold *tx-high*

tx-low-threshold *tx-low*

commit

The following sample configures the high transmit power threshold on the controller optics:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller optics 0/0/0/12
RP/0/RP0/CPU0:ios(config-Optics)#tx-high-threshold 40
RP/0/RP0/CPU0:ios(config-Optics)#tx-low-threshold 20
RP/0/RP0/CPU0:ios(config-Optics)#commit
```

The following sample shows the high transmit power threshold configured on the controller optics:

```
RP/0/RP0/CPU0:ios#show controllers optics 0/0/0/12
Fri Nov 12 10:58:50.595 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

LED State: Yellow

Optics Status

         Optics Type:  CFP2 DWDM
         DWDM carrier Info: C BAND, MSA ITU Channel=61, Frequency=193.10THz,
         Wavelength=1552.524nm

         Alarm Status:
         -------------
         Detected Alarms:
                 HIGH-RX-PWR   LOW-TX-PWR
                 HIGH-DGD

         LOS/LOL/Fault Status:

         Alarm Statistics:

         -------------
         HIGH-RX-PWR = 1            LOW-RX-PWR = 0
         HIGH-TX-PWR = 0            LOW-TX-PWR = 1
         HIGH-LBC = 0               HIGH-DGD = 6
         OOR-CD = 0                 OSNR = 0
         WVL-OOL = 0                MEA  = 0
         IMPROPER-REM = 1
```

```
        TX-POWER-PROV-MISMATCH = 0
        Laser Bias Current = 0.0 %
        Actual TX Power = 0.97 dBm
        RX Power = -0.53 dBm
        RX Signal Power = -1.20 dBm
        Frequency Offset = 63 MHz

        Performance Monitoring: Enable

        THRESHOLD VALUES
        ----------------

        Parameter                High Alarm  Low Alarm  High Warning  Low Warning
        -----------------------  ----------  ---------  ------------  -----------
        Rx Power Threshold(dBm)         -2.0       -3.0           0.0          0.0
        Tx Power Threshold(dBm)          4.0        2.0           0.0          0.0
        LBC Threshold(mA)                N/A        N/A          0.00         0.00

        LBC High Threshold = 55 %
        Configured Tx Power = 1.00 dBm
        Configured CD High Threshold = 2400 ps/nm
        Configured CD lower Threshold = -2400 ps/nm
        Configured OSNR lower Threshold = 0.40 dB
        Configured DGD Higher Threshold = 0.30 ps
        Baud Rate =  63.1394679230 GBd
        Bits per Symbol = 3.0000000000  bits/symbol
        Modulation Type: 8QAM
        Chromatic Dispersion 0 ps/nm
        Configured CD-MIN -48000 ps/nm  CD-MAX 48000 ps/nm
        Polarization Mode Dispersion = 0.0 ps
        Second Order Polarization Mode Dispersion = 29.00 ps^2
        Optical Signal to Noise Ratio = 36.10 dB
        SNR = 17.50 dB
        Polarization Dependent Loss = 0.50 dB
        Polarization Change Rate = 0.00 rad/s
        Differential Group Delay = 1.00 ps

Transceiver Vendor Details

        Form Factor            : CFP2
        Name                   : CISCO-ACACIA
        Part Number            : 10-3500-01
        Rev Number             : 01
        Serial Number          : ACA24480037
        PID                    : ONS-CFP2D-400G-C
        VID                    : VES1
        Date Code(yy/mm/dd)    : 20/11/10
        Fiber Connector Type: LC
        Otn Application Code: Not Set
        Sonet Application Code: Not Set
        Ethernet Compliance Code: Not set

Transceiver Temperature : 46 Celsius


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

Frequency

You can configure the frequency on trunk ports of the line card.

The following table lists the frequency range with grid spacing supported on the line card:

Line Card	Frequency Range (THz)	Default Frequency (THz)	Grid Spacing
1.2T	191.25 to 196.1	193.1	50GHz and 100MHz
1.2TL [1]	186.1 to 190.85	188.5	100MHz
OTN-XP CFP2 trunk	191.275 to 196.125	193.1	50GHz and 100MHz
OTN-XP QDD ZRP	191.275 to 196.125	193.70	6.25GHz, 50GHz, and 100MHz
2-QDD-C	191.15 to 196.1	193.1	50GHz and 100MHz

[1] Only non-ITU channels are supported

To configure the wavelength, use the following commands:

configure

controller optics *Rack/Slot/Instance/Port*

dwdm-carrier {**100MHz-grid frequency** *frequency*} | {**50GHz-grid** [**frequency** *frequency*}

commit

Pseudo Random Binary Sequence

Table 11: Feature History

Feature Name	Release Information	Feature Description
PRBS (Pseudo Random Binary Sequence) on ODU4	Cisco IOS XR Release 7.3.1	1.2T card supports PRBS on the ODU4 controller. This feature allows you to test whether the traffic is error free during link bring up without depending on the peer port.

The Pseudo Random Binary Sequence (PRBS) feature allows you to perform data integrity checks between the NCS1004 trunk links without enabling the actual client traffic.

You need to enable PRBS feature on both the transmitting and receiving NCS 1004 trunk ports. The transmitting trunk port generates a bit pattern and sends it to the peer NCS 1004 device. The device detects if the sent bit pattern is received.

From R7.3.1 onwards, you can configure PRBS on the NCS 1004 trunk port for the 2-QDD-C card.

You can configure NCS 1004 trunk port in any one of the following modes for PRBS on the 1.2T card:

- **Source mode —** The NCS 1004 at trunk port generates PRBS signal on the line continuously as per the configured PRBS pattern.
- **Sink mode —** The NCS 1004 at trunk port gets locked to the ingress signal according to the configured pattern, analyzes and reports the errors.
- **Source-Sink mode —** The NCS 1004 at trunk port acts as both the PRBS transmitter and receiver, that is, it generates PRBS signal as per the configured pattern, and also gets locked to the ingress signal with the same pattern, and reports the errors.

Note From R7.3.1 onwards, the 1.2T card supports PRBS on ODU4.

NCS 1004 trunk port supports the following PRBS patterns:

- **PRBS31 —** Sequence length is from 2^31 -1 bits.
- **PRBS23 —** Sequence length is from 2^23 -1 bits.
- **PRBS15 —** Sequence length is from 2^15 -1 bits.
- **PRBS7 —**Sequence length is from 2^7 -1 bits.

Tip We recommend that for higher datarates like 100G and 400G:

- use high sequence length PRBS patterns and
- use PRBS inverted pattern.

Limitations of PRBS

There are following limitations with the PRBS feature:

- There is no SNMP support to fetch the PRBS status or Performance Monitoring (PM).
- TTI functionality is not supported with PRBS.
- Loopback and PRBS configurations cannot coexist on a coherentDSP controller. Loopback configuration will be rejected if PRBS is already configured.
- PRBS on ODU4 is supported only when the slice is provisioned in OTN client mode.

PRBS on OTN-XP Card

From R7.2.1 onwards, the OTN-XP card supports PRBS on the mapper optical data unit (ODU2e).

Note ODU2e PRBS is not supported for OTU2E client rates.

NCS 1004 with the OTN-XP card, supports the following PRBS mode:

- **Source mode —** The NCS 1004 at trunk port generates PRBS signal on the line continuously as per the configured PRBS pattern.
- **Sink mode —** The NCS 1004 at trunk port gets locked to the ingress signal according to the configured pattern, analyzes and reports the errors.
- **Source-Sink mode —** The NCS 1004 at trunk port acts as both the PRBS transmitter and receiver, that is, it generates PRBS signal as per the configured pattern, and also gets locked to the ingress signal with the same pattern, and reports the errors.
- **invertedpn31 —**Inverted pattern. Sequence length is from 2^31 -1 bits.

NCS 1004 trunk port supports the following PRBS patterns:

- **PRBS31 —** Sequence length is from 2^31 -1 bits.
- **PRBS23 —** Sequence length is from 2^23 -1 bits.
- **PRBS15 —** Sequence length is from 2^15 -1 bits.
- **PRBS7 —**Sequence length is from 2^7 -1 bits.

Configuring Pseudo Random Binary Sequence

The secondary admin state of the coherentDSP or ODU4 controller must be set to maintenance before enabling PRBS.

To enable the PRBS on the trunk port, use the following configuration command at the coherentDSP controller:

controller coherentDSP *R/S/I/P* **prbs mode** {**source | sink | source-sink**} **pattern** {**pn31 | pn23 | pn15 | pn7**}

To enable the PRBS on the trunk port, use the following configuration command at the ODU4 controller:

controller odu4 *R/S/I/P/L* **opu prbs mode** {**source | sink | source-sink**} **pattern** {**pn31 | pn23 | pn15 | pn7**}

When the PRBS is enabled on the trunk ports, you can view the following impacts in the corresponding client ports:

- Client traffic is dropped in the direction of source to sink as the frames are overwritten by the PRBS pattern.
- Remote fault is raised on the client ports nearer to the PRBS sink.

The following are the ODU4 PRBS combinations. The client ports must have physical loop back in all the combinations.

- Near End client and Near End trunk ODU4
- Near End client and Far End client ODU4
- Near End client and Far End trunk ODU4
- Near End trunk and Far End trunk ODU4

The following sample diagram describes the ODU4 PRBS combination for Near End client and Near End trunk.

Verifying PRBS

You can monitor the status of Pseudo Random Binary Sequence (PRBS) on the CoherentDSP or ODU4 controller using the following command:

show controllers coherentDSP | ODU4 *R/S/I/P* **prbs-details**

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/1/0/0 prbs-details
Wed Nov  6 23:12:22.464 UTC

----------------------PRBS details------------------
PRBS Test               : Enable
PRBS Mode               : Source
PRBS Pattern            : PN7
PRBS Status             : Not Applicable

-----------------------------------------------------

RP/0/RP0/CPU0:ios#show controllers ODU4 0/3/0/8 prbs-details
Mon Jan 11 05:29:12.436 UTC

 -------------------------PRBS details----------------------------------
PRBS Test                       : Enable
PRBS Mode                       : Source
PRBS Pattern                    : PN7
PRBS Status                     : Not Applicable

-----------------------------------------------------

RP/0/RP0/CPU0:ios#show controllers ODU4 0/3/0/1/1 prbs-details
Mon Jan 11 05:27:56.370 UTC

 -------------------------PRBS details----------------------------------
PRBS Test                       : Enable
PRBS Mode                       : Sink
PRBS Pattern                    : PN7
PRBS Status                     : Locked

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

- You cannot view any details, if the PRBS is not enabled on the trunk.
- PRBS status is shown as **Not Applicable**, when the mode is **Source**.
- PRBS status is shown as **unlocked**, when the signal is not locked on the receiving side in the **Sink** or **Source-Sink** mode.

Viewing PRBS Performance Monitoring Parameters

PRBS PM parameters are not available for the controllers in Source mode. PRBS PM parameters are reset when PRBS configuration changes on the controller.

To view the PRBS PM parameters on the coherentDSP controller, use the following command:

show controllers coherentDSP | ODU4 *R/S/I/P* **pm** {**current | history** }{**15-min|24-hour**} **prbs**

The following tables describes the fields of PRBS PM parameters.

Table 12: PRBS PM Parameters

PM Parameter	Description
EBC	Cumulative count of PRBS bit errors in the sampling interval (15-minute or 24-hour). PRBS bit errors are accumulated only if PRBS signal is locked.
FOUND-COUNT	Number of state transitions from signal unlocked state to signal locked state in the sampling interval. If state change is not observed in the interval, the count is 0.
LOST-COUNT	Number of state transitions from signal locked state to signal unlocked state in the sampling interval. If state change is not observed in the interval, the count is 0.
FOUND-AT-TS	Latest timestamp when the PRBS state moves from unlocked state to locked state in the sampling interval. If state change is not observed in the interval, the value is null.
CONFIG-PTRN	Configured PRBS pattern on the port.

```
RP/0/RP0:ios#show controllers coherentDSP 0/0/0/1 pm current 15-min prbs
Mon Feb 13 00:58:48.327 UTC

PRBS in the current interval [00:45:00 - 00:58:48 Mon Feb 13 2019]
PRBS current bucket type : Valid
EBC                      : 40437528165
FOUND-COUNT              : 1 FOUND-AT-TS : 00:51:22 Mon Feb 13 2019
LOST-COUNT               : 1 LOST-AT-TS  : 00:52:52 Mon Feb 13 2019
CONFIG-PTRN              : PRBS_PATTERN_PN31
Last clearing of "show controllers OTU" counters never
```

```
RP/0/RP0:ios#show controllers ODU4 0/3/0/1/1 pm current 15-min prbs
Mon Jan 11 00:58:48.327 UTC

PRBS in the current interval [00:45:00 - 00:58:48 Mon Jan 11 2021]
PRBS current bucket type : Valid
EBC                      : 40437528165
FOUND-COUNT              : 1 FOUND-AT-TS : 00:51:22 Mon Jan 11 2021
LOST-COUNT               : 1 LOST-AT-TS  : 00:52:52 Mon Jan 11 2021
CONFIG-PTRN              : PRBS_PATTERN_PN7
Last clearing of "show controllers ODU" counters never
```

Configuring PRBS on OTN-XP Card

To configure PBRS mode on the ODU2e controller, you must configure Optical Channel Payload Unit (OPU) on the ODU2e controller followed by the PRBS mode and the pattern. The PRBS supported pattern on the OTN-XP card is invertedPN31.

From R7.3.1 onwards, you can configure PRBS on client or mapper ODU4 and ODU flex controllers.

For fiber channel controllers, PRBS is supported on mapper ODU flex controllers.

Note ODU2e PRBS is not supported for OTU2E client rates.

To configure PRBS mode on the ODU2e controller, enter the following commands:

configure

controller odu2e | oduflex *R/S/I/P/client-port/lane-number*

secondary-admin-state maintenance

opu

prbs mode {**source | sink | source-sink**} **pattern invertedpn31** {**direction {system | line}**}

end

commit

The following example shows how to configure PRBS mode as source-sink with pattern as invertedpn31:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller odu2e0/2/0/12/3/2
RP/0/RP0/CPU0:ios(config-odu2e)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-odu2e)#opu
RP/0/RP0/CPU0:ios(config-Opuk)#prbs mode source-sink pattern invertedpn31
RP/0/RP0/CPU0:ios(config-Opuk)#end
RP/0/RP0/CPU0:ios(config-odu2e)#commit
```

The following is a sample output of **show controller odu2e** command.

```
RP/0/RP0/CPU0(config-odu2e)#show controller odu2e 0/2/0/12/3/2 prbs-details
Mon Mar 14 21:33:02.293 UTC

 -------------------------PRBS details----------------------------------
PRBS Test                       : Enable
PRBS Mode                       : Source-Sink
PRBS Pattern                    : INVERTED PN31
PRBS Status                     : Locked
PRBS Lock Time(in seconds)      : 1190
PRBS Bit Errors                 : 0

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

The following example shows how to configure PRBS mode as source-sink with pattern as invertedpn31 with direction as system:

```
RP/0/RP0/CPU0:ios#configure
Wed Nov 11 00:38:11.789 UTC
RP/0/RP0/CPU0:ios(config)#controller odu4 0/2/0/5
RP/0/RP0/CPU0:ios(config-odu4)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-odu4)#opu prbs mode source-sink pattern invertedpn31 direction
system
RP/0/RP0/CPU0:ios(config-odu4)#commit
Wed Nov 11 00:38:26.391 UTC
```

The following example shows how to configure PRBS mode as source-sink with pattern as invertedpn31 with direction as line:

```
RP/0/RP0/CPU0:ios#configure
Wed Nov 11 00:38:11.789 UTC
```

```
RP/0/RP0/CPU0:ios(config)#controller odu4 0/2/0/5
RP/0/RP0/CPU0:ios(config-odu4)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-odu4)#opu prbs mode source-sink pattern invertedpn31 direction
line
RP/0/RP0/CPU0:ios(config-odu4)#commit
Wed Nov 11 00:38:26.391 UTC
```

The following example shows how to configure PRBS on the mapper controller:

```
RP/0/RP0/CPU0:ios#configure
Thu Oct 7 13:17:27.267 UTC
RP/0/RP0/CPU0:ios(config)#controller odu4 0/2/0/13/8
RP/0/RP0/CPU0:ios(config-odu4)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-odu4)#opu prbs mode source-sink pattern invertedpn31
RP/0/RP0/CPU0:ios(config-odu4)#commit
```

The following example shows how to configure PRBS on the mapper controller with PRBS mode as source-sink and pattern as invertedpn31 with direction as line:

```
RP/0/RP0/CPU0:ios(config)#controller odu4 0/3/0/7
RP/0/RP0/CPU0:ios(config-odu4)#secondary-admin-state maintenance
RP/0/RP0/CPU0:ios(config-odu4)#opu prbs mode source-sink pattern invertedpn31 direction
line
RP/0/RP0/CPU0:ios(config-odu4)#commit
Tue Oct 12 13:17:07.840 UTC
```

Verifying PRBS on OTN-XP Card

You can monitor the status of PRBS on the ODU2e controller using the following command:

show controllers odu2e *R/S/I/P/client-port/client-lane* **prbs-details**

The following example displays the output of the PRBS configuration with PRBS mode as sink:

```
RP/0/RP0/CPU0:ios#show controllers odu2e 0/2/0/12/3/2 prbs-details
-------------------------PRBS details----------------------------------
PRBS Test               : Enable
PRBS Mode               : Sink
PRBS Pattern            : INVERTED PN31
PRBS Status             : Locked
```

The following example displays the output of the PRBS configuration with PRBS mode as source-sink:

```
RP/0/RP0/CPU0:ios#show controllers odu2e 0/2/0/12/3/2 prbs-details
-------------------------PRBS details----------------------------------
PRBS Test               : Enable
PRBS Mode               : Source-Sink
PRBS Pattern            : INVERTED PN31
PRBS Status             : Locked
```

The following example displays the output of the PRBS configuration on the mapper controller:

```
RP/0/RP0/CPU0:ios#show controllers odu4 0/2/0/13/8 prbs-details
Thu Oct 7 13:21:19.444 UTC

-------------------------PRBS details----------------------------------
PRBS Test : Enable
PRBS Mode : Source-Sink
PRBS Pattern : INVERTED PN31
```

```
PRBS Status : Locked

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

The following example displays the output of the PRBS configuration on the mapper controller with PRBS mode as source-sink and pattern as invertedpn31 with direction as line:

```
RP/0/RP0/CPU0:ios#show controllers odu4 0/3/0/7 prbs-detailsTue Oct 12 13:17:22.748 UTC
Tue Oct 12 13:17:22.748 UTC
------------------------PRBS details----------------------------------
PRBS Test : Enable
PRBS Mode : Source-Sink
PRBS Pattern : INVERTED PN31
PRBS Status : Unlocked
PRBS Direction : Line
PRBS Bit Errors : 0

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

Clearing Bit Errors and Lock Time for PRBS

Lock time is the time that is elapsed since the last PRBS lock is detected.

The following sample shows that bit errors are observed during the PRBS test:

```
RP/0/RP0/CPU0:ios#show controllers odu4 0/2/0/5 prbs-details
Fri Nov 13 03:21:44.191 UTC

------------------------PRBS details----------------------------------
PRBS Test : Enable
PRBS Mode : Source-Sink
PRBS Pattern : INVERTED PN31
PRBS Status : Locked
PRBS Direction : Line
PRBS Lock Time(in seconds) : 28
PRBS Bit Errors : 23776

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

To clear the lock time and bit errors before the PRBS test, use the **clear** command:

```
RP/0/RP0/CPU0:ios#clear controller odu4 0/2/0/5 prbs-details
Fri Nov 13 03:21:50.726 UTC
PRBS bit errors cleared
```

The following sample displays the bit errors and lock time are removed.

```
RP/0/RP0/CPU0:ios#show controllers odu4 0/2/0/5 prbs-details
Fri Nov 14 03:21:44.191 UTC
------------------------PRBS details----------------------------------
PRBS Test : Enable
PRBS Mode : Source-Sink
PRBS Pattern : INVERTED PN31
PRBS Status : Locked
PRBS Direction : Line
PRBS Lock Time(in seconds) : 2
PRBS Bit Errors : 0
```

FlexO GID and IID

In the 4x100G-MXP-400G-TXP LC mode, the OTN-XP card uses flexible OTN (flexO) interfaces on trunk ports. These flexO interfaces provide a flexible and interoperable mechanism to transport OTUCn signals by grouping standard lower rate interfaces. Each flexO interface group is identified by a flexO group identification (GID) number, which ranges 1–1,048,576. Each member of a flexO group is identified by a flexO instance identification (IID) number, which ranges 1–254.

From Release 7.3.1 onwards, flexO GID and IID configurations are supported on CoherentDSP controller for the OTN-XP card.

From Release 7.10.1 onwards, flexO GID and IID configurations are supported on CoherentDSP controller for the QXP card.

Configuring FlexO GID and IID

To configure flexO GID and IID on the coherentDSP controller, enter the following commands:

configure

controller coherentDSP *R/S/I/P*

flexo

gid <*gid-no*> **iid** <*iid-no*>

commit

Note You must configure the iid number based on the trunk bandwidth. You must add 1, 2, 3, and 4 iid numbers for 100G, 200G, 300G, and 400G respectively.

The following sample shows how to configure flexO GID and IID on the CoherentDSP controller:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller coherentDSP0/2/0/12
RP/0/RP0/CPU0:ios(config-CoDSP)#flexo
RP/0/RP0/CPU0:ios(config-CoDSP)#gid 2 iid 5,6,7,8
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
```

Verifying FlexO GID and IID

The following sample shows the flexO GID and IID configuration on the CoherentDSP controller:

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/2/0/12

Tue Jan 12 11:26:08.235 UTC
Port : CoherentDSP 0/2/0/12
Controller State : Up
Inherited Secondary State : Normal
Configured Secondary State : Normal
Derived State : In Service
Loopback mode : None
```

```
BER Thresholds : SF = 1.0E-5 SD = 1.0E-7
Performance Monitoring : Enable
Bandwidth : 400.0Gb/s

Alarm Information:
LOS = 0 LOF = 3 LOM = 0
OOF = 3 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 = 1
FLEXO-MM = 1 FLEXO-LOM = 0 FLEXO-RDI = 3
FLEXO-LOF = 0
Detected Alarms : None

Bit Error Rate Information
PREFEC BER : 6.43E-04
POSTFEC BER : 0.00E+00

TTI :
Remote hostname : ios
Remote interface : CoherentDSP 0/0/0/13
Remote IP addr : 0.0.0.0

FEC mode : O_FEC

Flexo-Mode : Enable
Flexo Details:
Tx GID : 2
TX IID : 5,6,7,8,
Rx GID : 2
RX IID 5,6,7,8,

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

Flexo Parameter Update on Inverse Muxponder Configuration on the OTN-XP Card

By default, the value of flexo parameters for the coherentDSP controllers in the 400G inverse muxponder, are as follows:

- CoherentDSP 0/0/0/12—GID is 1 and IID is 1, 2.
- CoherentDSP 0/0/0/13—GID is 1 IID is 3, 4.

The following example displays the default configurations on the transmission side:

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/13
Wed Jun  9 23:17:30.794 UTC

Port                                          : CoherentDSP 0/0/0/13
Controller State                              : Admin Down
Inherited Secondary State                     : Normal
Configured Secondary State                    : Normal
Derived State                                 : Out Of Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 200.0Gb/s
```

```
Alarm Information:
LOS = 0 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 = 0
Detected Alarms                                 : None

Bit Error Rate Information
PREFEC  BER                                     : 0.00E+00
POSTFEC BER                                     : 0.00E+00
Q-Factor                                        : 0.00 dB

Q-Margin                                        : 0.00dB

TTI :
        Remote IP addr                          : 0.0.0.0

FEC mode                                        : O_FEC

Flexo-Mode                                      : Enable
Flexo Details:
        Tx GID                                  : 1
        TX IID                                  : 3, 4,
        Rx GID                                  : 0
        RX IID                                  : 0, 0,

Flexo Peers Information:
        Controller                              : CoherentDSP0_0_0_12
        OTUCn rate                              : OTUC2


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

For 400G inverse muxponder, the flexo configuration on these coherent DSP controllers must be such that GID is the same on coherentDSP controllers on both port 12 and port 13, and IIDs are in the incremental order. In case if one of the node configurations is invalid, the Provisioning Failed alarm is raised on that particular controller. The Provisioning Failed alarm moves to the slice level in case you perform a line card reload.

The following sample configures the same IID on the coherentDSP 0/0/0/12 as that of coherentDSP 0/0/0/13 and shows the resulting Provisioning Failed alarm.

```
RP/0/RP0/CPU0:ios#configure
Wed Jun  9 23:19:28.101 UTC
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/12
RP/0/RP0/CPU0:ios(config-CoDSP)#flexo gid 1 iid 3,4
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Wed Jun  9 23:20:08.971 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#end
RP/0/RP0/CPU0:ios#show alarms brief system active
Wed Jun  9 23:20:11.940 UTC

------------------------------------------------------------------------------------
Active Alarms
------------------------------------------------------------------------------------
Location Severity Group     Set Time                Description
```

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

0/0      Major  Controller 06/09/202123:20:10 UTC CoherentDSP0/0/0/12-Provisioning Failed
```

The following sample configures incremental IIDs in the coherentDSP 0/0/0/12 and coherent DSP 0/0/0/13 and verifies that the Provisioning Failed alarms cleared:

```
RP/0/RP0/CPU0:ios(config)#controller coherentDSP 0/0/0/12
RP/0/RP0/CPU0:ios(config-CoDSP)#flexo gid 1 iid 5,6
RP/0/RP0/CPU0:ios(config-CoDSP)#controller coherentDSP 0/0/0/13
RP/0/RP0/CPU0:ios(config-CoDSP)#flexo gid 1 iid 7,8
RP/0/RP0/CPU0:ios(config-CoDSP)#commit
Wed Jun  9 23:21:06.335 UTC
RP/0/RP0/CPU0:ios(config-CoDSP)#end
```

The following sample verifies the IID configurations in the coherentDSP 0/0/0/12 and coherentDSP 0/0/0/13:

```
RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/12
Wed Jun  9 23:21:15.321 UTC

Port                                          : CoherentDSP 0/0/0/12
Controller State                              : Admin Down
Inherited Secondary State                     : Normal
Configured Secondary State                    : Normal
Derived State                                 : Out Of Service
Loopback mode                                 : None
BER Thresholds                                : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                        : Enable
Bandwidth                                     : 200.0Gb/s

Alarm Information:
LOS = 0 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 = 0
Detected Alarms                               : None

Bit Error Rate Information
PREFEC  BER                                   : 0.00E+00
POSTFEC BER                                   : 0.00E+00
Q-Factor                                      : 0.00 dB

Q-Margin                                      : 0.00dB

TTI :
        Remote IP addr                        : 0.0.0.0

FEC mode                                      : O_FEC

Flexo-Mode                                    : Enable
Flexo Details:
        Tx GID                                : 1
        TX IID                                : 5, 6,
        Rx GID                                : 0
        RX IID                                : 0, 0,
```

```
Flexo Peers Information:
        Controller                                : CoherentDSP0_0_0_13
        OTUCn rate                                : OTUC2


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


RP/0/RP0/CPU0:ios#show controllers coherentDSP 0/0/0/13
Wed Jun  9 23:21:20.348 UTC

Port                                              : CoherentDSP 0/0/0/13
Controller State                                  : Admin Down
Inherited Secondary State                         : Normal
Configured Secondary State                        : Normal
Derived State                                     : Out Of Service
Loopback mode                                     : None
BER Thresholds                                    : SF = 1.0E-5  SD = 1.0E-7
Performance Monitoring                            : Enable
Bandwidth                                         : 200.0Gb/s

Alarm Information:
LOS = 0 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 = 0
Detected Alarms                                   : None

Bit Error Rate Information
PREFEC  BER                                       : 0.00E+00
POSTFEC BER                                       : 0.00E+00
Q-Factor                                          : 0.00 dB

Q-Margin                                          : 0.00dB

TTI :
        Remote IP addr                            : 0.0.0.0

FEC mode                                          : O_FEC

Flexo-Mode                                        : Enable
Flexo Details:
        Tx GID                                    : 1
        TX IID                                    : 7, 8,
        Rx GID                                    : 0
        RX IID                                    : 0, 0,

Flexo Peers Information:
        Controller                                : CoherentDSP0_0_0_12
        OTUCn rate                                : OTUC2


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

The following sample verifies that the Provisioning Failed alarm was cleared:

```
RP/0/RP0/CPU0:ios#show alarms brief system history
```

```
--------------------------------------------------------------------------------
History Alarms
--------------------------------------------------------------------------------
---------------------------------
Location Severity Group       Set Time                Description
       Clear Time




--------------------------------------------------------------------------------------------------------------
0/2      Major   Controller  09/30/2021 14:42:01 UTC  CoherentDSP0/2/0/12 - Provisioning
Failed 09/30/2021 14:42:25 UTC
```

FPD

FPD command enables you to verify the status of the installed QDD ZRP pluggables. The following is the sample output for verifying the FPD status of the installed QDD ZRP pluggables.

```
RP/0/RP0/CPU0:ios#sh hw-module fpd
Fri Jul 23 12:47:52.106 UTC

Auto-upgrade:Disabled
                                                                          FPD Versions
                                                                          ==============
Location   Card type              HWver FPD device       ATR Status     Running   Programd
--------------------------------------------------------------------------------------------
0/0        NCS1K4-OTN-XPL         3.0   LC_CPU_MOD_FW        CURRENT     21.27     21.27
0/0        NCS1K4-OTN-XPL         7.0   LC_DP_MOD_FW         CURRENT      3.10      3.10
0/0        NCS1K4-OTN-XPL         2.0   LC_QSFPDD_PORT_11    CURRENT   161.2009  161.2009
0/0        NCS1K4-OTN-XPL         2.0   LC_QSFPDD_PORT_9     CURRENT   161.2009  161.2009
```

In the above sample output, `LC_QSFPDD_PORT_11` and `LC_QSFPDD_PORT_9` indicate the provisioning of the QDD ZRP pluggables in the trunk ports 11 and 9. To resume traffic, the FPDs must be in `CURRENT` state. For more details on the FPD command, see Command Reference for Cisco NCS 1004.

Automatic Protection Switching (APS) on OTN XP Card

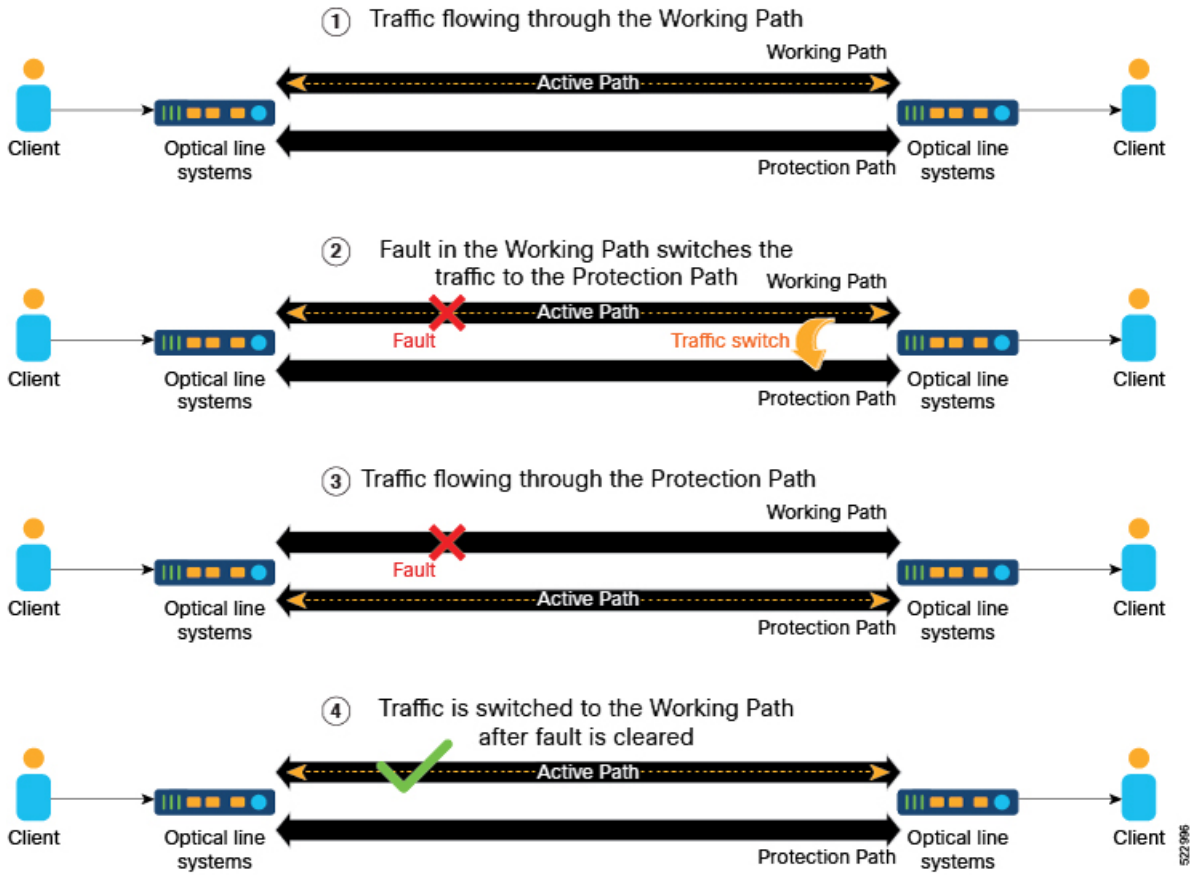
Table 13: Feature History

Feature Name	Release Information	Description
APS Support for 100G and 200G Trunk Bandwidth on OTN XP Cards	Cisco IOS XR Release 7.9.1	In addition to the 400G trunk bandwidth, you can now configure Automatic Protection Switching (APS) for the following trunk bandwidth combinations: • 200G DWDM with 2x100G clients • 100G QSFP28 Grey and 10x10G clients
Automatic Protection Switching (APS) on OTN XP Card	Cisco IOS XR Release 7.8.1	APS provides protection mechanism against optical fiber faults or signal failure. In case a failure is detected, live traffic is automatically moved from the working path to the protection path to prevent any data loss. Following trunk bandwidth combinations are supported: • 400G DWDM with 4x100G clients • 400G DWDM with 400G clients You can enable this feature using the **protected** keyword of the hw-module command.

APS allows you to configure protection switching on trunk ports of NCS1K4-OTN-XP Cards. Protection switching automatically switches traffic from one path to another working path if any signal failure occurs. This requires configuring working and protection paths on trunk ports where the protection path works as backup for the working path. Usually, the working path is the active path and carries traffic. The traffic immediately switches to the protection path if a signal failure occurs on the working path.

The following figure explains the working of APS where the traffic is immediately switched from working path to the protection path in case of a signal failure.

Figure 4: Automatic Protection Switching



If an electrical(TP1) or optical(TP3) signal is interrupted or disturbed at the client pluggable and the CDR inside the QDD loses the Rx lock, then the QDD pluggable requires 1.5 to 2 seconds to recover from the Rx loss.

You can employ both the GL-1 and GL-2 pluggable trunk protection features. The GL-2 pluggable supports both Flexcoh and Termination modes. The GL-2 Termination mode offers a shorter switching time compared to the Flexcoh mode, and supports both GL-2 and GL-1 pluggables.

The Pluggables Switching Time table lists the 100G and 400G client pluggables that either support or do not support switching from the active path to the protection path within 50 milliseconds.

Table 14: Pluggables Switching Time

Pluggables Supporting Switching within 50 ms		**Pluggables not Supporting Switching within 50 ms**	
100G	**400G**	**100GE**	**400GE**
ONS-QSFP28-LR4	-	QSFP-100G-FR-S	QDD-400G-DR4-S
QSFP-100G-LR-S	-	-	QDD-400G-FR4-S
QSFP-100G-SR4-S	-	-	-
QSFP-100G-DR-S	-	-	-

Pluggables Supporting Switching within 50 ms		Pluggables not Supporting Switching within 50 ms	
QSFP-100G-CWDM4-S	-	-	-

Note According to the QDD pluggable standard, if an electrical (TP1) or optical (TP3) signal is interrupted or disturbed at a client pluggable, and the Clock and Data Recovery (CDR) inside the QDD loses the lock, the QDD pluggable requires some time to recover the signal. Hence, when a fault is identified on the trunk port, the client port Rx loses the lock. The recovery takes between 1.5 to 2 s depending on the pluggable standard.

To configure APS on trunk ports, perform these tasks:

- Enable APS on Trunk
- Define the Working and Protecting Resources in an ODU Group Controller
- Configure Protection Attributes of an ODU Group Controller

Enable APS on Trunk

Before configuring APS, it must be enabled on the trunk ports of the NCS1K4-OTN-XP cards. Trunk protection on the NCS1K4-OTN-XP card supports 400G, 200G, and 100G bandwidth. For more details, see Client and Trunk Port Mapping on NCS1K4-OTN-XP Cards, on page 125.

To enable protection switching and configure the client and trunk bandwidth for DWDM, use the following commands:

hw-module location *location*

mxponder

protected

trunk-rate *trunk rate*

client-port-rate [*0* | *4* | *5* | *8*] **client-type** [*100GE* | *400GE*]

commit

To enable protection switching and configure the client and trunk bandwidth for 10G-Grey-MXP, use the following commands:

hw-module location *location*

mxponder

protected

trunk-rate *trunk rate*

client-port-rate [*4* | *5* | *2* | *8*] **lane** *lane number* **client-type** [*10GE* | *otu2* | *otu2e*]

commit

For more information about these commands, see Command Reference for Cisco NCS 1004.

Example 1

The following example shows how to configure protection datapath on slot 0 of the NCS1K4-OTN-XP card. This example also shows how you can configure client port at *400GE* to achieve a total bandwidth of 400G at the trunk port.

```
RP/0/RP0/CPU0:ios(config)#hw-module location 0/0
RP/0/RP0/CPU0:ios(config-hwmod)# mxponder
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#  protected
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#  trunk-rate 400G
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#  client-port-rate 8 client-type 400GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
```

Example 2

The following example shows how to configure protection datapath on slot 2 of the NCS1K4-OTN-XP card. This example also shows how you can configure client ports *0*, *4*, *5* and *8* with a bandwidth of *100GE* each to achieve a total bandwidth of *400G* at the trunk port.

```
RP/0/RP0/CPU0:ios(config)#hw-module location 0/2
RP/0/RP0/CPU0:ios(config-hwmod)#mxponder
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#protected
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#trunk-rate 400G
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 0 client-type 100GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 client-type 100GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 client-type 100GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 8 client-type 100GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
```

Example 3

The following example shows how to configure protection datapath on slot 2 of the NCS1K4-OTN-XP card. This example also shows how you can configure client ports *5* and *8* with a bandwidth of *100GE* or *otu4* each to achieve a total bandwidth of *200G* at the trunk port.

```
RP/0/RP0/CPU0:ios(config)#hw-module location 0/2
RP/0/RP0/CPU0:ios(config-hwmod)#mxponder
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#protected
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#trunk-rate 200G
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 client-type 100GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 8 client-type otu4
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
```

Example 4

The following example shows how to configure protection datapath on slot 2 of the NCS1K4-OTN-XP card. This example also shows how you can configure client port *2* of *lane 3* and *lane 4*. This examples also shows how to configure client port *4* and *5* of *lane 1*, *lane 2*, *lane 3*, and *lane 4* with a bandwidth of *10GE* each to achieve a total bandwidth of *100G* at the trunk port.

```
RP/0/RP0/CPU0:ios(config)#hw-module location 0/2
RP/0/RP0/CPU0:ios(config-hwmod)#mxponder
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#protected
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#trunk-rate 100G
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 1 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 2 client-type 10GE
```

```
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 3 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 4 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 1 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 2 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 3 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 4 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 2 lane 3 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 2 lane 4 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
```

Example 5

The following example shows how to configure protection datapath on slot 2 of the NCS1K4-OTN-XP card. This example shows how you can configure different client ports with mixed bandwidth on different lanes.

```
RP/0/RP0/CPU0:ios(config)#hw-module location 0/2
RP/0/RP0/CPU0:ios(config-hwmod)#mxponder
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#protected
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#trunk-rate 100G
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 1 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 2 client-type OTU2
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 3 client-type OTU2E
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 4 lane 4 client-type OTU2E
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 1 client-type OTU2
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 2 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 3 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 5 lane 4 client-type OTU2
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 2 lane 3 client-type OTU2E
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#client-port-rate 2 lane 4 client-type 10GE
RP/0/RP0/CPU0:ios(config-hwmod-mxp)#commit
```

Client and Trunk Port Mapping on NCS1K4-OTN-XP Cards

The following table displays the port mapping that can be used to map client and trunk port bandwidth:

Table 15: Client/Trunk Port Mapping for NCS1K4-OTN-XP Cards

Trunk Bandwidth	Trunk Ports	Client Bandwidth	Client Ports (Slice 1)
400G	12, 13	400GE	8
400G	12, 13	4x100G	0, 4, 5 and 8
200G	12, 13	2x100G	5 and 8
100G	0, 1	10x10G	• Client Port 4 - Lanes 1, 2, 3, and 4 • Client Port 5 - Lanes 1, 2, 3, and 4 • Client Port 2 - Lanes 3 and 4

Define the Working and Protecting Resources in an ODU Group Controller

Before configuring the protection attributes, you must create an ODU group controller and configure the ports 12 or 13 as the working and/or protection paths.

Use the following commands to first create an ODU group controller and define the working and protection paths inside the group:

controller odu-group-mp *Group-ID* **signal** *client-signal-type* **odu-type** *type-of-the-odu*

protecting-controller [*ODUk Rack/Slot/Instance/Port*]

working-controller [*ODUk Rack/Slot/Instance/Port*]

Example

The following example shows how to create an ODU group *MP 2* with ODU type *ODUC4*. This example also shows how to configure the port numbers 12 and 13 as working and protection paths respectively.

```
RP/0/RP0/CPU0:ios(config)# controller Odu-Group-Mp 2 signal Otn odu-type ODUC4
RP/0/RP0/CPU0:ios(config)# protecting-controller ODUC4 0/2/0/13
RP/0/RP0/CPU0:ios(config)# working-controller ODUC4 0/2/0/12
```

Note If both APS and L1 Encryption are configured on the same ODU group controller, configure the GCC2 interface and the corresponding IP addresses for each trunk port separately. This ensures that any service impact on a trunk port does not affect the encryption functionality and also the independent working and protected paths for 1+1 trunk protection are maintained. For more details about configuring GCC interface, see Configuring the GCC Interface

Configure Protection Attributes of an ODU Group Controller

To configure the recommended protection attributes of an ODU group controller, use the following commands:

protection-attributes timers [**hold-off-time**] *timer*

protection-attributes protection-type [*APSbidi*]

protection-attributes protection-mode [**revertive wait-to-restore-time**] *timer*

protection-attributes connection mode [*snc-n*]

commit

Note

- *hold-off-time* is an optional parameter. If this parameter is not specified, the default parameter value is used.
- The recommended parameters for configuring protection attributes of an ODU Group Controller are *snc-n*, *APSbidi*, and *wait-to-restore-time*.

Example

The following example shows how to configure protection attributes **protection type**, **protection mode**, **connection mode**, and **timers** on the ODU group **MP 2**.

```
 RP/0/RP0/CPU0:ios(config)# protection-attributes timers hold-off-time 1000
 RP/0/RP0/CPU0:ios(config)# protection-attributes protection-type APSbidi
 RP/0/RP0/CPU0:ios(config)# protection-attributes protection-mode revertive
wait-to-restore-time 400
 RP/0/RP0/CPU0:ios(config)# protection-attributes connection-mode snc-n
```

For more details about these commands, see Command Reference for Cisco NCS 1004.

Manual Protection Switching

Protection switching is usually triggered automatically when a signal failure is detected. However, you can trigger a switch manually as well using the protection switching commands. The following table describes these switching commands and their priority levels that can be used to triggered a switch manually:

Table 16: Manual Protection Switching Commands Priority Levels

Priority	Priority Request	Description
1	lockout	Use this command to lockout the working path and prevent switching to the protection path. When lockout is configured, traffic is not switched to the protection path even if a failure is detected. This command has the highest priority level and overrides all the other protection switching commands. This means that if lockout is configured, you cannot trigger **force** and **manual** commands.
2	force	Use this command to trigger a force-switch from the working path to the protection path and vice-versa. This command cannot be triggered if **lockout** is configured.
3	manual	Use this to manually switch from the working path to the protection path or vice-versa in case a maintenance is scheduled on any of the paths. This command cannot be triggered if **lockout** and **force** is configured.

Perform a Lockout

If there is a signal failure on the protection path, you can prevent the switching of traffic from the working path to the protection path by locking out the working path. Lockout command has the highest priority and overrides all other switching commands.

To perform a lockout, use these commands:

odu-group-mp *Group-ID* **signal** *client-signal-type* **odu-type** *type-of-the-odu*

protection-switching operate lockout odu-dest [*ODUk Rack/Slot/Instance/Port*]

commit

Note The *ODUk Rack/Slot/Instance/Port* must be the working path.

Example

The following example shows how to configure lockout on an *ODUC4* on the working path *0/2/0/13*:

```
RP/0/RP0/CPU0:ios(config)#Odu-Group-Mp2 signal Otn odu-type ODUC4
RP/0/RP0/CPU0:ios(config-Odu-Group-Mp2)#protection-switching operate lockout odu-dest ODUC4
 0/2/0/13
RP/0/RP0/CPU0:ios(config-Odu-Group-Mp2)#commit
```

Perform a Manual Switch

If there are changes to be done during a scheduled maintenance window on the working or protection paths, you can perform a manual switch from the working path to the protection path or the opposite way. This command is overridden by the **force** and **lockout** commands.

To perform a manual switch, use the following commands:

odu-group-mp *Group-ID* **manual odu-dest** *ODUk Rack/Slot/Instance/Port*

Note The **manual** switch command works irrespective of the working or protection path *Rack/Slot/Instance/Port* and uses only the *Group-ID* to switch the traffic.

Example

The following example shows how to manually switch traffic:

```
RP/0/RP0/CPU0: odu-group mp 1 manual odu-dest ODUC4 0/2/0/13
```

Perform a Forced Switch

You can also perform a forced switch of traffic from the working path to the protection path and also, conversely, using the following commands:

odu-group-mp *Group-ID* **forced odu-dest** *ODUk Rack/Slot/Instance/Port*

Note The **forced** switch command works irrespective of the working or protection path *Rack/Slot/Instance/Port* and uses only the *Group-ID* to switch the traffic.

Example

The following example shows how to force switch the traffic:

```
RP/0/RP0/CPU0: odu-group mp 1 forced odu-dest ODUC4 0/2/0/13
```

Verify the APS Details on ODU Group Controller

You can verify the APS configuration details on ODU group controller such as, ODU group name, working path, protection path, and protection parameters, using the following command:

show controllers odu-group-mp *Group-ID*

Example

The following example shows how to verify the APS configuration details of the ODU group **MP 2**:

```
RP/0/RP0/CPU0:ios# show controllers odu-group-mp 2

ODU  Group Information
---------------------------------------------------------------
ODU GROUP ID                                  :  2
Controller State                              :  Up

 WORKING CONTROLLER

ODU NAME                                      :  ODUC4 0/0/0/12
ODU ROLE                                      :  WORKING
ODU STATE                                     :  Active_tx
Local Failure                                 :  Yes
Remote Failure                                :  Yes

 PROTECTED CONTROLLER

ODU NAME                                      :  ODUC4 0/0/0/13
ODU ROLE                                      :  PROTECT
ODU STATE                                     :  Active
Local Failure                                 :  No
Remote Failure                                :  No

PROTECTION PARAMETERS :
Connection Mode                               :  SNC_N
Protection Type                               :  1+1 Bidirectional Protection
Tcmid                                         :  0
Protection Mode                               :  Revertive
Hold off timer                                :  1000
Wait-to-restore timer                         :  400000 ms


Detected Alarms                               :  Switched To Protection
```

View the ODU Group Controller Hardware Details

To verify the hardware details of the ODU group controller, use these commands:

show controllers odu-group-mp *Group-ID* **protection-detail**

Example

The following example shows how to view the ODU group controller *2* hardware details:

```
RP/0/RP0/CPU0:ios#show  controllers odu-group-mp 2 protection-detail

ODU  Group Information
--------------------------------------------------------------
LOCAL
                Request State                   : Signal Failed
                Request signal                  : 0
                Bridge signal                   : 1
                Bridge Status                   : 1+1
REMOTE
                Request State                   : Signal Failed
                Request signal                  : 0
                Bridge signal                   : 1
                Bridge Status                   : 1+1
WORKING
                Controller Name                 : ODUC40_0_0_12
                ODU STATE                       : Active_tx
                Local Failure                   : Signal Failure
                Remote Failure                  : Signal Failure
                WTR Left                        : 0 ms

PROTECT
                Controller Name                 : ODUC40_0_0_13
                ODU STATE                       : Active
                Local Failure                   : State Ok
                Remote Failure                  : State Ok
                WTR Left                        : 0 ms

Client
                Controller Name                 : ODUC40_0_0_0
                ODU STATE                       : Not Present


Wait to restore                                 : 400000 ms
Hold-off-timer                                  : 1000 ms
Current State                                   : Signal failed on Working
Previous State                                  : No Request State
```