



Cisco NCS 1010 Datapath Configuration Guide, IOS XR Release 7.7.x

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CONTENTS

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CHAPTER 1

[NCS 1010 Datapath Orchestration](#) 1

[Document Objective](#) 1

[Document Organization - Data Path Guide](#) 1

CHAPTER 2

[Configure Controllers](#) 3

[OTS Controllers](#) 4

[Configure OTS Controllers](#) 22

[OTS-OCH Controllers](#) 33

[Create OTS-OCH Controllers](#) 33

[DFB Controllers](#) 39

[Configure DFB Controllers](#) 40

[OSC Controllers](#) 42

[Configure OSC Controllers](#) 44

[Gigabit Ethernet Interfaces](#) 46

[OCH Controller](#) 48

[OMS Controller](#) 52

[AINS](#) 53

[Soak Time Period](#) 54

[Displaying the AINS Configuration](#) 54

[Headless Mode](#) 59

[ASE Loading](#) 59

[How ASE Operates](#) 60

[How ASE Is Managed](#) 60

[Optical Channel Monitoring](#) 61

View OCM Data 63

CHAPTER 3

Monitor Performance 67

Monitor Performance 67

Configure and View PM Parameters 72

CHAPTER 4

Connection Verification 79

Power Data Reading 79

Connection Verification 80

Line Card and Passive Modules Connection Verification 81

Side-to-Side Connection Verification 81

Verify Connection for Side-to-Side Nodes 83

Line Card and Optical Interfaces Connection Verification 84

Verify Connection for NCS 1000 32-Channel Mux/Demux Patch Panel 84

Verify Connection for NCS1K-BRK-8 Panel 86

Connection Verification on OTS Controller 89

CHAPTER 5

Smart Licensing 91

Understanding Smart Licensing 91

Benefits of Smart Licensing 94

License Entitlements of NCS 1010 94

Create a Token 95

Configure Smart Licensing 95

Configure Smart Transport 97

Reserve Specific Licenses for NCS 1010 97

Reserve Licenses Using Cisco Smart Software Manager 99

Reuse Licenses Using SLR Deactivation Method 100

Verify Smart Licensing Configuration 101

APPENDIX A

Cisco NCS 1010 Topologies 107

Multidegree Support 107

NCS 1010 Sample Topologies 108

Omnidirectional Support 114



CHAPTER 1

NCS 1010 Datapath Orchestration

This chapter gives a brief overview of the datapath orchestration that is required for NCS 1010.

For an overview of the NCS 1010 OLS and passive modules, please refer to [Cisco NCS 1010 Optical Line System -An Overview](#).

- [Document Objective, on page 1](#)
- [Document Organization - Data Path Guide, on page 1](#)

Document Objective

Cisco Network Convergence System (NCS) 1010 platform has the following configuration guides.

- The *Cisco NCS 1010 System Setup and Software Installation Guide* describes how to bring up the NCS 1010 system and perform the required software installation.
- The *Cisco NCS 1010 Datapath Configuration Guide* describes how to configure various datapaths on NCS 1010.
- The *Cisco NCS 1010 Optical Applications Configuration Guide* describes multiple optical applications on NCS 1010, that help to bring up the link and maintain traffic on the link.

Document Organization - Data Path Guide

This document is organized into the following chapters:

Chapter	Description
Configure Controllers, on page 3	Describes the tasks to configure and view the parameters of the OTS, OTS-OCH, OSC, DFB, OCH, and OMS controller types.
Monitor Performance, on page 67	Describes the setting and retrieval of PM counters for the OTS, OTS-OCH, OSC, DFB, OCH, and OMS controllers in flex-bin, 30-second, 15-minute, or 24-hour intervals.

Chapter	Description
Connection Verification, on page 79	Checks the connection between the OLT-C line card and all the other passive modules to find broken links or loops.
Cisco NCS 1010 Topologies, on page 107	Provides examples of a few NCS 1010 topologies for colored, colorless, and hybrid solutions.



CHAPTER 2

Configure Controllers

There are six types of controllers for Cisco NCS 1010. The controllers are the OTS, OTS-OCH, OSC, DFB, OCH, and OMS controllers. This chapter describes the tasks that are used to configure and view these controllers.

Table 1: Controllers

Controller Types	Description
Optical Transport Section (OTS)	The OTS controller holds all the optical parameters for the OTS optical interfaces.
OTS-OCH	The OTS-OCH controller is created on the LINE side of the OLT and ILA nodes using the <code>hw-module</code> command in Flex-Grid configuration. OTS-OCH controller supports optical cross-connection between the LINE side and ADD/DROP side of the OLT nodes only. The channel IDs must be the same for both LINE side and COM side OTS-OCH controllers.
Optical Service Channel (OSC)	The OSC controller represents the optical layer of the OSC channel. Line ports host the OSC controller.
Distributed Feedback (DFB)	The DFB controller represents the dedicated DFB laser on the line side of the OLT and ILA nodes with a RAMAN module for link continuity. The line ports host the DFB controller along with the OSC controller.
Optical Channel (OCH)	By default, the OCH controllers are automatically configured when Mux/Demux panels and breakout panels are brought up.
Optical Multiplex Section (OMS)	By default, the OMS controllers are automatically configured when Mux/Demux panels and breakout panels are brought up.

- [OTS Controllers, on page 4](#)
- [OTS-OCH Controllers, on page 33](#)
- [DFB Controllers, on page 39](#)

- [OSC Controllers, on page 42](#)
- [OCH Controller, on page 48](#)
- [OMS Controller, on page 52](#)
- [AINS, on page 53](#)
- [Headless Mode, on page 59](#)
- [ASE Loading, on page 59](#)
- [Optical Channel Monitoring, on page 61](#)

OTS Controllers

There are two types of controller models supported on Cisco NCS 1010. They are:

ILA Controller Model

When the NCS1K-ILA-2R-C, NCS1K-ILA-R-C and NCS1K-ILA-C cards are brought up, four OTS controllers are created by default. The OTS controllers are:

- OTS controllers for side 1:
 - LINE 0 port: ots 0/0/0/0 (band line OTS controller)
 - L-BAND 1 port: ots 0/0/0/1 (L band line OTS controller)
- OTS controllers for side 2:
 - LINE 2 port: ots 0/0/0/2 (band line OTS controller)
 - L-BAND 3 port: ots 0/0/0/3 (L band line OTS controller)

The following figures and tables show the three ILA variants and the mapping between physical ports and controllers:

Figure 1: NCS1K-ILA-2R-C

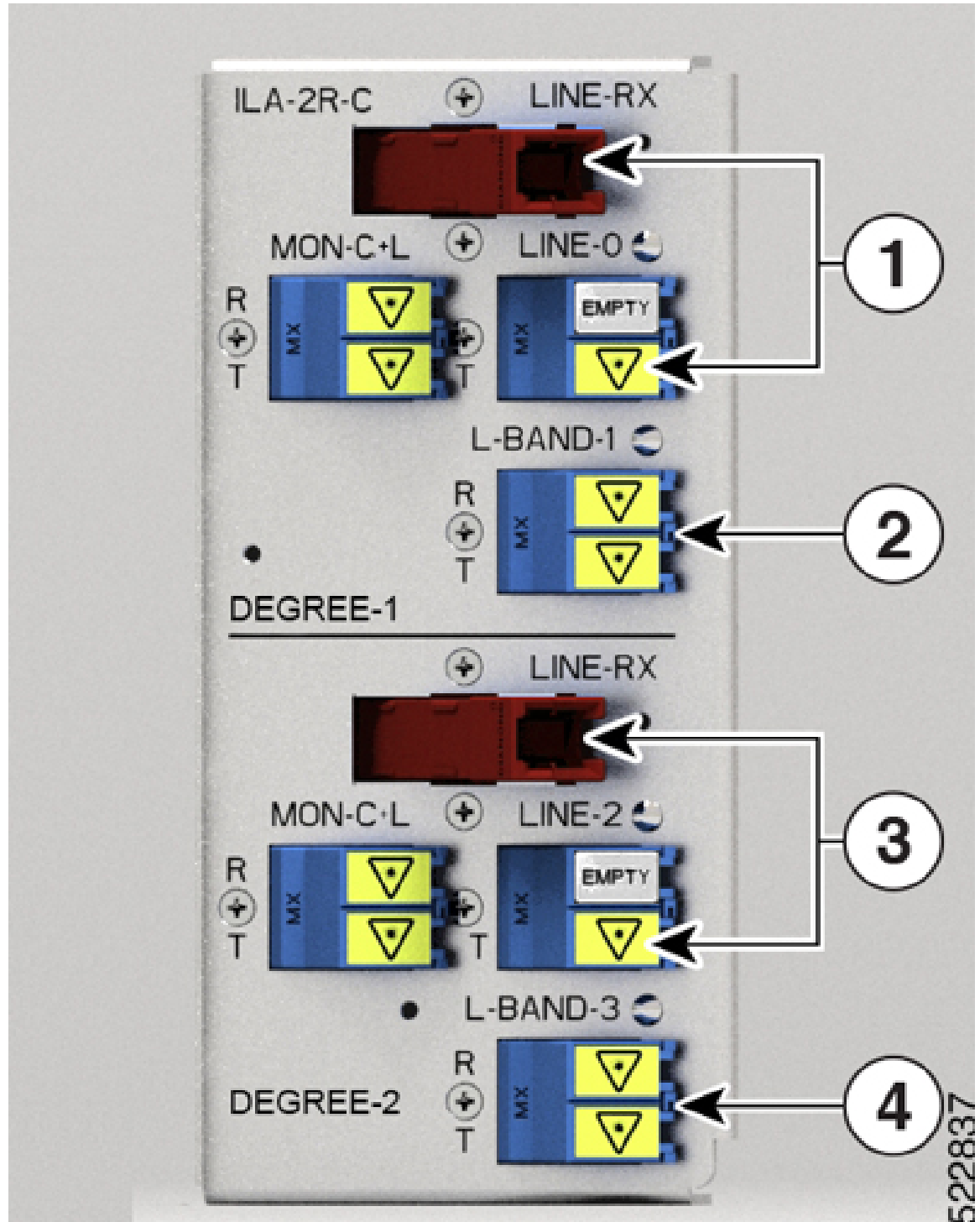


Table 2: NCS1K-ILA-2R-C Port Mapping

1	Parent Controller: OTS0/0/0/0 Child Controller: OSC0/0/0/0, DFB0/0/0/0, Line OTS-OCH 0/0/0/0/x
2	Parent Controller: OTS0/0/0/1
3	Parent Controller: OTS0/0/0/2 Child Controller: OSC0/0/0/2, DFB0/0/0/2, Line OTS-OCH 0/0/0/2/x
4	Parent Controller: OTS0/0/0/3

Figure 2: NCS1K-ILA-R-C

Table 3: NCS1K-ILA-R-C Port Mapping

1	Parent Controller: OTS0/0/0/0 Child Controller: OSC0/0/0/0, DFB0/0/0/0, Line OTS-OCH 0/0/0/0/x
2	Parent Controller: OTS0/0/0/1
3	Parent Controller: OTS0/0/0/2 Child Controller: OSC0/0/0/2, Line OTS-OCH 0/0/0/2/x
4	Parent Controller: OTS0/0/0/3

Figure 3: NCS1K-ILA-C

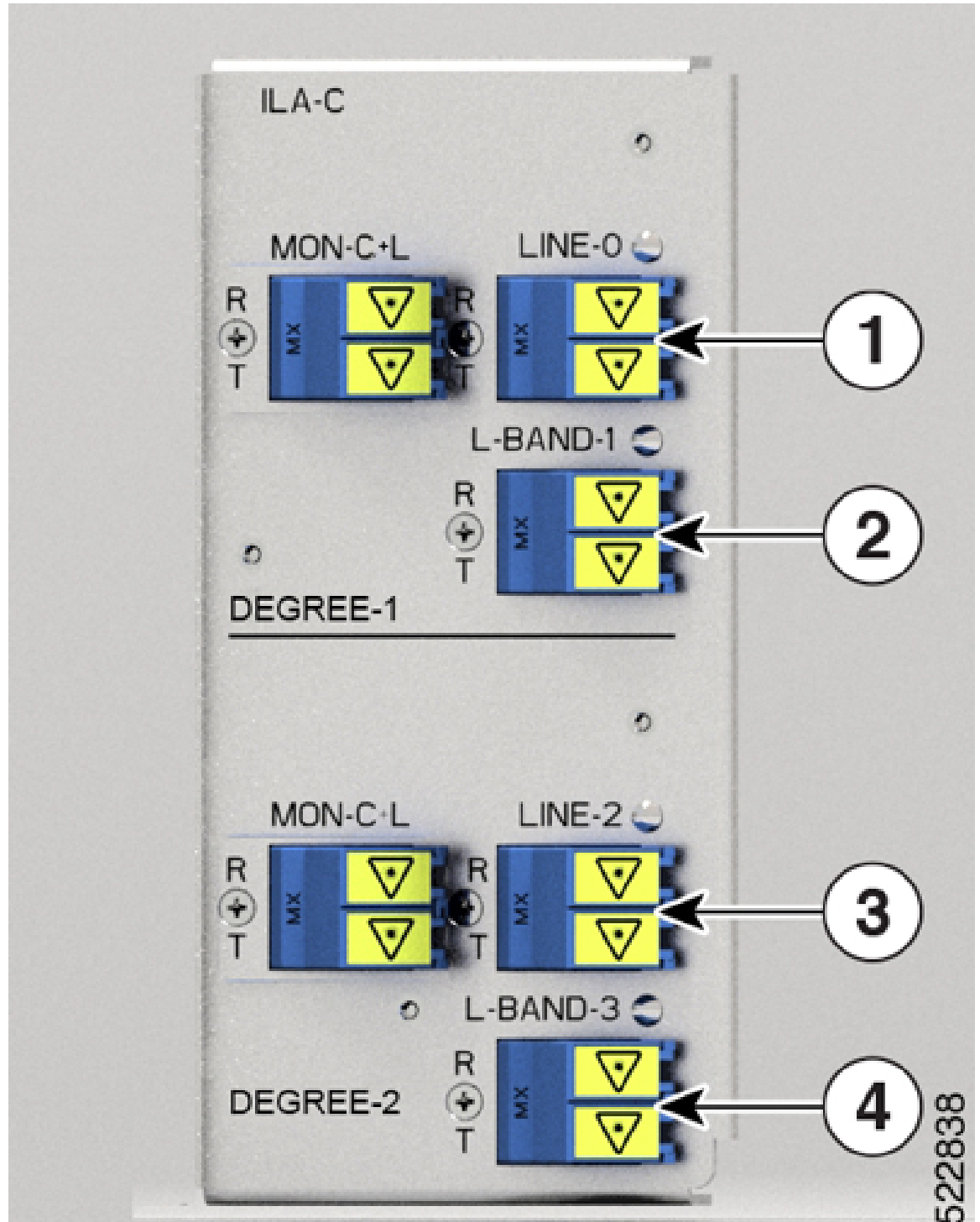


Table 4: NCS1K-ILA-C Port Mapping

1	Parent Controller: OTS0/0/0/0 Child Controller: OSC0/0/0/0, Line OTS-OCH 0/0/0/0/x
2	Parent Controller: OTS0/0/0/1
3	Parent Controller: OTS0/0/0/2 Child Controller: OSC0/0/0/2, Line OTS-OCH 0/0/0/2/x
4	Parent Controller: OTS0/0/0/3

To view the card type, use the following command:

```
RP/0/RP0/CPU0:ios#show platform
```

The following output highlights the *NCS1K-ILA-C* card type for the ILA controller model.

```
Fri Mar 25 09:23:43.417 UTC
Node           Type                               State           Config state
-----
0/RP0/CPU0     NCS1010-CNTLR-K9 (Active)         IOS XR RUN      NSHUT, NMON
0/PM0          NCS1010-AC-PSU                    OPERATIONAL     NSHUT, NMON
0/PM1          NCS1010-AC-PSU                    OPERATIONAL     NSHUT, NMON
0/FT0          NCS1010-FAN                       OPERATIONAL     NSHUT, NMON
0/FT1          NCS1010-FAN                       OPERATIONAL     NSHUT, NMON
0/0/NXR0      NCS1K-ILA-C                       OPERATIONAL     NSHUT, NMON
0/2            NCS1K-BRK-SA                      OPERATIONAL     NSHUT, NMON
RP/0/RP0/CPU0:ios#
```

The following output highlights the *NCS1K-E-ILA-R-C* card type for the ILA controller model.

```
Fri Jun 9 07:04:19.710 UTC
Node           Type                               State           Config state
-----
0/RP0/CPU0     NCS1010-CNTLR-K9 (Active)         IOS XR RUN      NSHUT, NMON
0/PM0          NCS1010-AC-PSU                    OPERATIONAL     NSHUT, NMON
0/PM1          NCS1010-AC-PSU                    OFFLINE         NSHUT, NMON
0/FT0          NCS1010-FAN                       OPERATIONAL     NSHUT, NMON
0/FT1          NCS1010-FAN                       OPERATIONAL     NSHUT, NMON
0/0/NXR0      NCS1K-E-ILA-R-C                   OPERATIONAL     NSHUT, NMON
```

To view the OTS controller status on the ILA cards, use the `show controller description` command.

```
RP/0/RP0/CPU0:ios#show controller description
```

The following output highlights the status of the OTS controller interfaces (*ots0/0/0/0...ots0/0/0/3*) on the ILA cards

```
Fri Mar 25 09:24:53.386 UTC
Interface           Status           Description
-----
Osc0/0/0/0         up
Osc0/0/0/2         up
Ots0/0/0/0         up
Ots0/0/0/1         up
Ots0/0/0/2         up
Ots0/0/0/3         up
RP/0/RP0/CPU0:ios#
```

To view the parameters of the LINE 0 OTS controller, use the following command:

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

The following output displays the parameters of the LINE 0 OTS controller *ots 0/0/0/0*.

```
Fri Mar 25 09:27:44.146 UTC

Controller State: Up

Transport Admin State: In Service

LED State: Green

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

Alarm Statistics:
-----
LOW-TX-PWR = 0
RX-LOS-P = 0
RX-LOC = 0
TX-POWER-FAIL-LOW = 0
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 0
EGRESS-AMPLI-GAIN-HIGH = 0
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
-----
Total RX Power(C+L) = 20.00 dBm
Total TX Power(C+L) = 20.00 dBm
Total RX Power = 20.00 dBm
Total TX Power = 23.01 dBm
RX Signal Power = -30.00 dBm
TX Signal Power = 20.00 dBm
TX Voa Attenuation = 0.0 dB
Egress Ampli Gain = 8.0 dB
Egress Ampli Tilt = 0.0 dB
Egress Ampli Gain Range = Normal
Egress Ampli Safety Control mode = auto
Egress Ampli Osri = OFF
Egress Ampli Force Apr = OFF

Configured Parameters:
-----
TX Voa Attenuation = 0.0 dB
Egress Ampli Gain = 8.0 dB
Egress Ampli Tilt = 0.0 dB
Egress Ampli Gain Range = Normal
Egress Ampli Safety Control mode = auto
Egress Ampli Osri = OFF
Egress Ampli Force Apr = OFF
```

To view the parameters of the LINE 2 OTS controller, use the following command:

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

The following output displays the parameters of the LINE 2 OTS controller *ots 0/0/0/2*.

```
Wed Jun 29 15:54:05.699 UTC
```

```
Controller State: Up
```

```
Transport Admin State: In Service
```

```
LED State: Green
```

```
Alarm Status:
```

```
-----
```

```
Detected Alarms: None
```

```
Alarm Statistics:
```

```
-----
```

```
RX-LOS-P = 0
```

```
RX-LOC = 0
```

```
TX-POWER-FAIL-LOW = 0
```

```
INGRESS-AUTO-LASER-SHUT = 0
```

```
INGRESS-AUTO-POW-RED = 0
```

```
INGRESS-AMPLI-GAIN-LOW = 0
```

```
INGRESS-AMPLI-GAIN-HIGH = 0
```

```
EGRESS-AUTO-LASER-SHUT = 0
```

```
EGRESS-AUTO-POW-RED = 0
```

```
EGRESS-AMPLI-GAIN-LOW = 0
```

```
EGRESS-AMPLI-GAIN-HIGH = 0
```

```
HIGH-TX-BR-PWR = 0
```

```
HIGH-RX-BR-PWR = 0
```

```
SPAN-TOO-SHORT-TX = 0
```

```
SPAN-TOO-SHORT-RX = 0
```

```
Parameter Statistics:
```

```
-----
```

```
Total RX Power(C+L) = 20.00 dBm
```

```
Total TX Power(C+L) = 20.00 dBm
```

```
Total RX Power = 20.00 dBm
```

```
Total TX Power = 23.01 dBm
```

```
RX Signal Power = -30.00 dBm
```

```
TX Signal Power = 20.00 dBm
```

```
TX Voa Attenuation = 0.0 dB
```

```
Egress Ampli Gain = 8.0 dB
```

```
Egress Ampli Tilt = 0.0 dB
```

```
Egress Ampli Gain Range = Normal
```

```
Egress Ampli Safety Control mode = auto
```

```
Egress Ampli Osri = OFF
```

```
Egress Ampli Force Apr = OFF
```

```
Configured Parameters:
```

```
-----
```

```
TX Voa Attenuation = 0.0 dB
```

```
Egress Ampli Gain = 8.0 dB
```

```
Egress Ampli Tilt = 0.0 dB
```

```
Egress Ampli Gain Range = Normal
```

```
Egress Ampli Safety Control mode = auto
```

```
Egress Ampli Osri = OFF
```

```
Egress Ampli Force Apr = OFF
```


The following output displays the parameters of the LINE 1 OTS controller *ots 0/0/0/1*.

```
RP/0/RP0/CPU0:OLT-C-14#show controllers ots 0/0/0/1
Mon Feb 27 20:34:00.257 UTC
```

```
Controller State: Up
```

```
Transport Admin State: In Service
```

```
LED State: Green
```

```
Alarm Status:
```

```
-----
```

```
Detected Alarms: None
```

```
Alarm Statistics:
```

```
-----
```

```
RX-LOS-P = 1
```

```
RX-LOC = 0
```

```
TX-POWER-FAIL-LOW = 2
```

```
INGRESS-AUTO-LASER-SHUT = 0
```

```
INGRESS-AUTO-POW-RED = 0
```

```
INGRESS-AMPLI-GAIN-LOW = 0
```

```
INGRESS-AMPLI-GAIN-HIGH = 0
```

```
EGRESS-AUTO-LASER-SHUT = 0
```

```
EGRESS-AUTO-POW-RED = 0
```

```
EGRESS-AMPLI-GAIN-LOW = 0
```

```
EGRESS-AMPLI-GAIN-HIGH = 0
```

```
HIGH-TX-BR-PWR = 0
```

```
HIGH-RX-BR-PWR = 0
```

```
SPAN-TOO-SHORT-TX = 0
```

```
SPAN-TOO-SHORT-RX = 0
```

```
Parameter Statistics:
```

```
-----
```

```
Total Rx Power = 19.39 dBm
```

```
Total Tx Power = 3.99 dBm
```

```
Configured Parameters:
```

```
-----
```

OLT Controller Model

When the NCS1K-OLT-R-C, and NCS1K-OLT-C cards are brought up, 34 and OTS controllers are created by default for C band OLT cards respectively.

- LINE 0 port: *ots 0/0/0/0* (C band line OTS controller)
- L-BAND 1 port: *ots 0/0/0/1* (L band line OTS controller)
- LC port: *ots 0/0/0/2* (Add1 Rx/Drop1 Tx OTS controller)
- LC port: *ots 0/0/0/3* (Add2 Rx/Drop2 Tx OTS controller)
- MPO ports: *ots 0/0/0/4* to *ots 0/0/0/11*
- MPO ports: *ots 0/0/0/12* to *ots 0/0/0/19*
- MPO ports: *ots 0/0/0/20* to *ots 0/0/0/27*
- MPO ports: *ots 0/0/0/28* to *ots 0/0/0/33*

The following figures and tables show the two OLT variants and the mapping between physical ports and controllers:

Figure 4: NCS1K-OLT-R-C

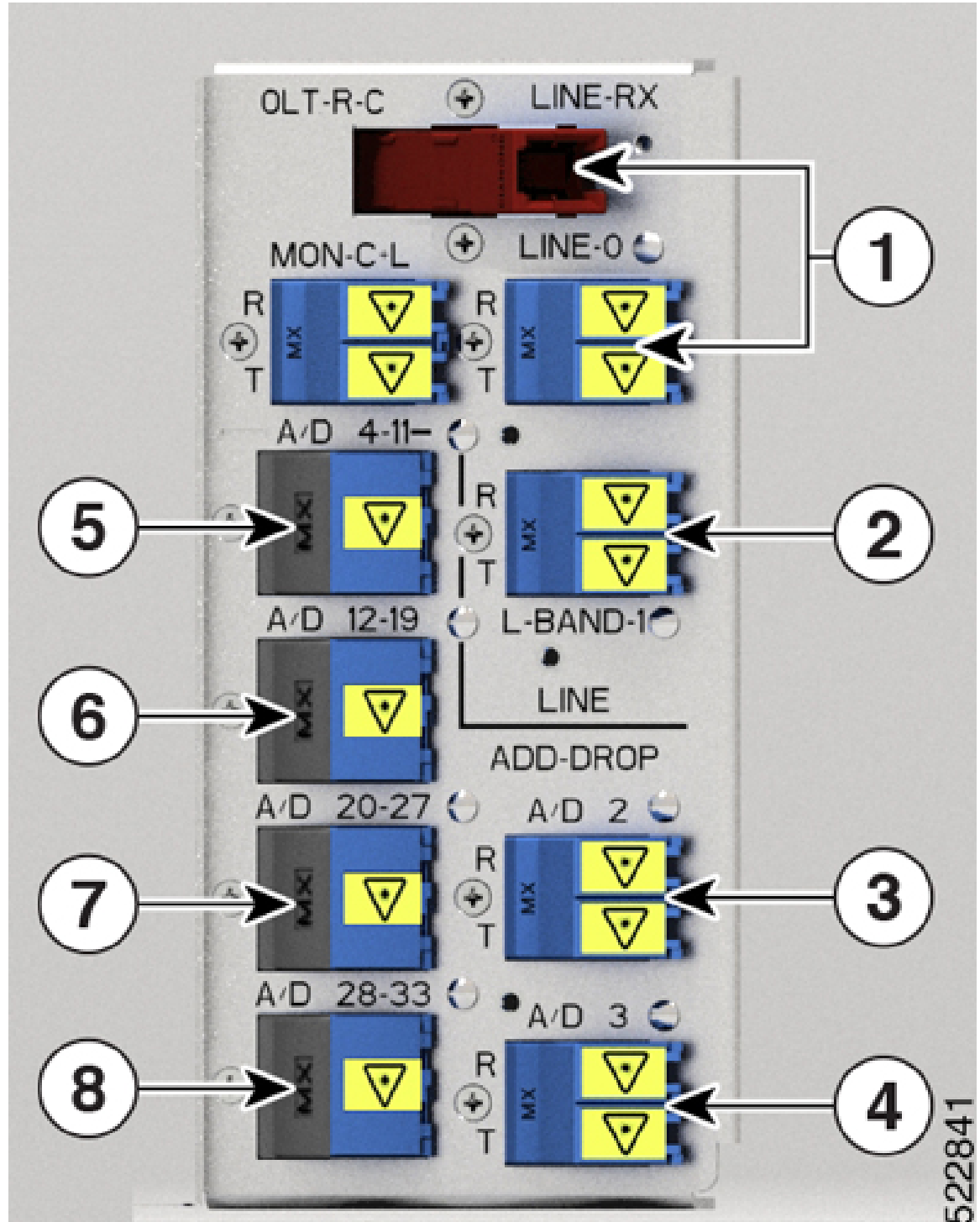


Table 5: NCS1K-OLT-R-C Port Mapping

1	Parent Controller: OTS0/0/0/0 Child Controller: OSC0/0/0/0, DFB0/0/0/0, Line OTS-OCH 0/0/0/0/x
2	Parent Controller: OTS0/0/0/1
3	Parent Controller: OTS0/0/0/2 Child Controller: COM OTS-OCH 0/0/0/2/x
4	Parent Controller: OTS0/0/0/3 Child Controller: COM OTS-OCH 0/0/0/3/x
5	Parent Controller: OTS0/0/0/4-11 Child Controller: COM OTS-OCH 0/0/0/4-11/x
6	Parent Controller: OTS0/0/0/12-19 Child Controller: COM OTS-OCH 0/0/0/12-19/x
7	Parent Controller: OTS0/0/0/20-27 Child Controller: COM OTS-OCH 0/0/0/20-27/x
8	Parent Controller: OTS0/0/0/28-33 Child Controller: COM OTS-OCH 0/0/0/28-33/x

Figure 5: NCS1K-OLT-C

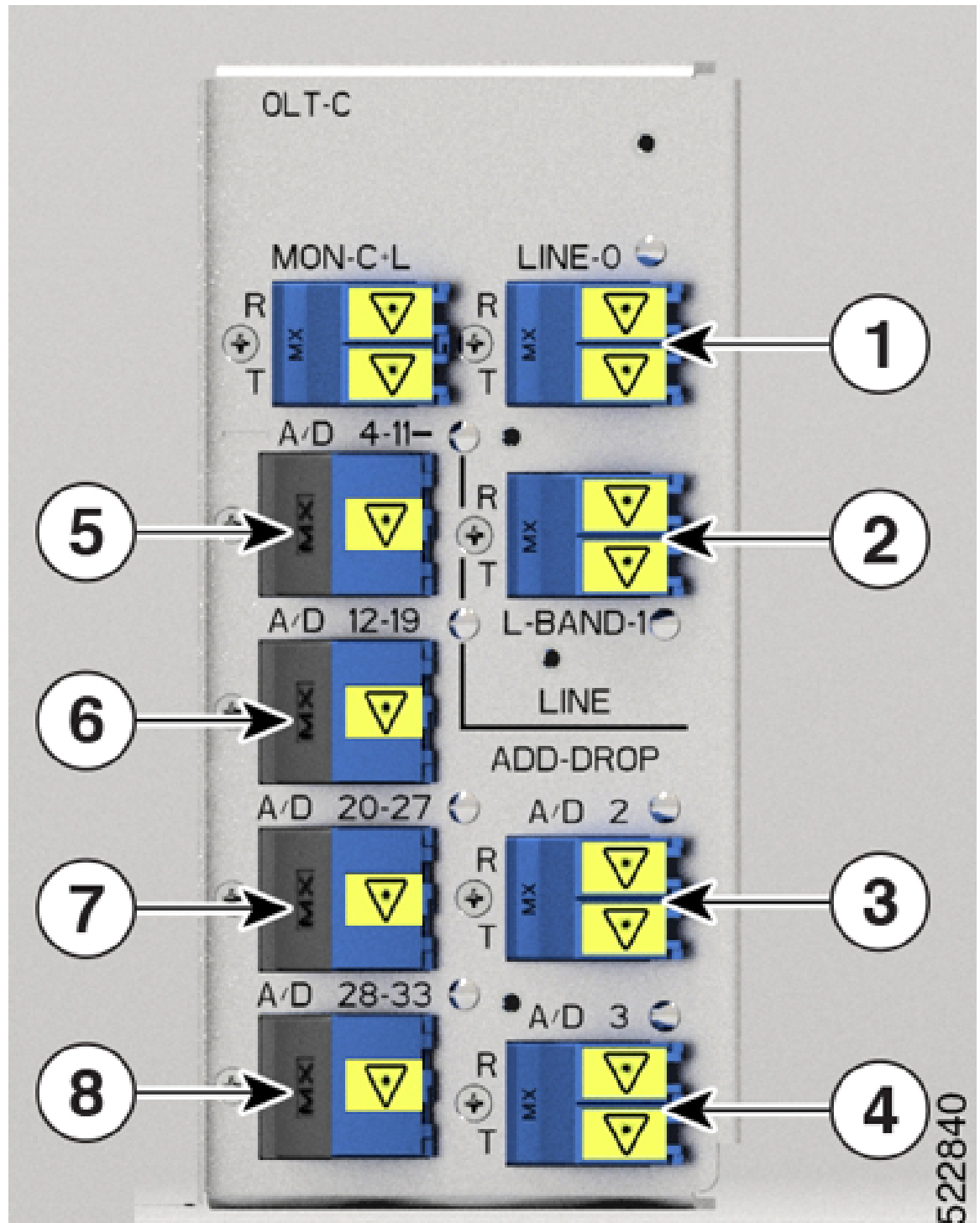


Table 6: NCS1K-OLT-C Port Mapping

1	Parent Controller: OTS0/0/0/0 Child Controller: OSC0/0/0/0, Line OTS-OCH 0/0/0/0/x
2	Parent Controller: OTS0/0/0/1
3	Parent Controller: OTS0/0/0/2 Child Controller: COM OTS-OCH 0/0/0/2/x
4	Parent Controller: OTS0/0/0/3 Child Controller: COM OTS-OCH 0/0/0/3/x
5	Parent Controller: OTS0/0/0/4-11 Child Controller: COM OTS-OCH 0/0/0/4-11/x
6	Parent Controller: OTS0/0/0/12-19 Child Controller: COM OTS-OCH 0/0/0/12-19/x
7	Parent Controller: OTS0/0/0/20-27 Child Controller: COM OTS-OCH 0/0/0/20-27/x
8	Parent Controller: OTS0/0/0/28-33 Child Controller: COM OTS-OCH 0/0/0/28-33/x

To view the platform information, use the following command:

```
RP/0/RP0/CPU0:ios#s
```

The following output highlights the *NCS1K-OLT-R-C* card type for the OLT controller model.

```
Wed Jun 29 16:00:14.373 UTC
Node              Type                               State                               Config state
-----
0/RP0/CPU0        NCS1010-CNTRLR-K9(Active)         IOS XR RUN                          NSHUT, NMON
0/PM0             NCS1010-AC-PSU                    OPERATIONAL                         NSHUT, NMON
0/PM1             NCS1010-AC-PSU                    OPERATIONAL                         NSHUT, NMON
0/FT0             NCS1010-FAN                       OPERATIONAL                         NSHUT, NMON
0/FT1             NCS1010-FAN                       OPERATIONAL                         NSHUT, NMON
0/0/NXR0         NCS1K-OLT-R-C                   OPERATIONAL                     NSHUT, NMON
0/2               NCS1K-BRK-SA                      OPERATIONAL                         NSHUT, NMON
0/2/0             NCS1K-BRK-8                      OPERATIONAL                         NSHUT, NMON
0/2/1             NCS1K-BRK-16                     OPERATIONAL                         NSHUT, NMON
0/2/2             NCS1K-BRK-24                     OPERATIONAL                         NSHUT, NMON
RP/0/RP0/CPU0:ios#
```

To view the OTS controller status on the NCS1K-OLT-R-C line card, use the `show controller description` command.

```
RP/0/RP0/CPU0:ios#show controller description
```

The following output highlights the status of the OTS controller interfaces (*ots0/0/0/0...ots0/0/0/33*) on the OLT cards

Wed Jun 29 16:03:59.914 UTC

Interface	Status	Description
Dfb0/0/0/0	up	
Osc0/0/0/0	up	
Ots0/0/0/0	up	
Ots0/0/0/1	up	
Ots0/0/0/2	up	
.		
.		
Output snipped		
.		
.		
Ots0/0/0/30	up	
Ots0/0/0/31	up	
Ots0/0/0/32	up	
Ots0/0/0/33	up	

To view the parameters of the LINE 0 OTS controller, use the following command:

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

The following output displays the parameters of the LINE 0 OTS controller *ots 0/0/0/0*.

Wed Jun 29 16:07:16.771 UTC

Controller State: Up

Transport Admin State: In Service

LED State: Green

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

```
Alarm Statistics:
-----
RX-LOS-P = 0
RX-LOC = 0
TX-POWER-FAIL-LOW = 0
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 0
EGRESS-AMPLI-GAIN-HIGH = 0
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0
```

```
Parameter Statistics:
-----
Total RX Power(C+L) = -10.00 dBm
Total TX Power(C+L) = 20.00 dBm
Total RX Power = 20.00 dBm
Total TX Power = 20.00 dBm
RX Signal Power = 20.00 dBm
TX Signal Power = 20.00 dBm
TX Voa Attenuation = 0.0 dB
```

```

Ingress Ampli Gain = 12.0 dB
Ingress Ampli Tilt = 0.0 dB
Ingress Ampli Gain Range = Normal
Ingress Ampli Safety Control mode = auto
Ingress Ampli Osri = OFF
Ingress Ampli Force Apr = OFF
Egress Ampli Gain = 16.0 dB
Egress Ampli Tilt = 0.0 dB
Egress Ampli Safety Control mode = auto
Egress Ampli Osri = OFF
Egress Ampli Force Apr = OFF

```

Configured Parameters:

```

TX Voa Attenuation = 0.0 dB
Ingress Ampli Gain = 12.0 dB
Ingress Ampli Tilt = 0.0 dB
Ingress Ampli Gain Range = Normal
Ingress Ampli Safety Control mode = auto
Ingress Ampli Osri = OFF
Ingress Ampli Force Apr = OFF
Egress Ampli Gain = 16.0 dB
Egress Ampli Tilt = 0.0 dB
Egress Ampli Safety Control mode = auto
Egress Ampli Osri = OFF
Egress Ampli Force Apr = OFF

```

To view the Raman parameters of the LINE 0 OTS controller, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 raman-info
```

The following output displays the Raman parameters of the LINE 0 OTS controller *ots 0/0/0/0*.

```
Wed Mar 23 06:02:41.093 UTC
```

Alarm Status:

Detected Alarms: None

Alarm Statistics:

```

RAMAN-AUTO-POW-RED = 0
RAMAN-1-LOW-POW = 0
RAMAN-2-LOW-POW = 0
RAMAN-3-LOW-POW = 0
RAMAN-4-LOW-POW = 0
RAMAN-5-LOW-POW = 0
RAMAN-1-HIGH-POW = 0
RAMAN-2-HIGH-POW = 0
RAMAN-3-HIGH-POW = 0
RAMAN-4-HIGH-POW = 0
RAMAN-5-HIGH-POW = 0

```

Parameter Statistics:

```

Raman Safety Control mode = auto
Raman Osri = OFF
Raman Force Apr = OFF
Composite Raman Power = 10.40 mW

```

RAMAN Pump Info:

```

-----
Instance      Wavelength (nm)  Power (mW)
1             1424.00          0.00
2             1438.00          0.10
3             1457.00          10.00
4             1470.00          0.20
5             1495.00          1.20
    
```

```

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

```

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

To view the parameters on OTS port 2 or 3, use the following command:

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

The following output displays the parameters of the OTS port 2 controller *ots 0/0/0/2*.

```

Wed Mar 23 06:14:53.465 UTC

Controller State: Down

Transport Admin State: In Service

LED State: Red

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P
    TX-POWER-FAIL-LOW

Alarm Statistics:
-----
LOW-TX-PWR = 0
RX-LOS-P = 1
RX-LOC = 0
TX-POWER-FAIL-LOW = 1
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 0
EGRESS-AMPLI-GAIN-HIGH = 0
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
    
```



```

-----
Total RX Power = -50.00 dBm
Total TX Power = -50.00 dBm
Ingress Ampli Gain = 0.0 dB
Ingress Ampli Tilt = 0.0 dB

Configured Parameters:
-----
Ingress Ampli Gain = 16.0 dB
Ingress Ampli Tilt = 0.0 dB

RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/1
Wed Mar 23 06:17:57.475 UTC

Controller State: Down

Transport Admin State: In Service

LED State: Red

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P
    TX-POWER-FAIL-LOW

Alarm Statistics:
-----
LOW-TX-PWR = 0
RX-LOS-P = 1
RX-LOC = 0
TX-POWER-FAIL-LOW = 1
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 0
EGRESS-AMPLI-GAIN-HIGH = 0
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
-----

Configured Parameters:
-----

```

To view the parameters on the MPO port, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/33
```

The following output displays the paramters for the MPO port *ots 0/0/0/33*.

```

Sun Apr 10 14:04:40.513 UTC

Controller State: Up

Transport Admin State: In Service

```

```

LED State: Green

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

Alarm Statistics:
-----
RX-LOS-P = 0
RX-LOC = 0
TX-POWER-FAIL-LOW = 0
INGRESS-AUTO-LASER-SHUT = 0
INGRESS-AUTO-POW-RED = 0
INGRESS-AMPLI-GAIN-LOW = 0
INGRESS-AMPLI-GAIN-HIGH = 0
EGRESS-AUTO-LASER-SHUT = 0
EGRESS-AUTO-POW-RED = 0
EGRESS-AMPLI-GAIN-LOW = 0
EGRESS-AMPLI-GAIN-HIGH = 0
HIGH-TX-BR-PWR = 0
HIGH-RX-BR-PWR = 0
SPAN-TOO-SHORT-TX = 0
SPAN-TOO-SHORT-RX = 0

Parameter Statistics:
-----
Total RX Power = -5.00 dBm
Total TX Power = -10.50 dBm

Configured Parameters:
-----

```

Configure OTS Controllers

The Optical Transport Section (OTS) controller holds all the optical parameters for the OTS optical interfaces. The optical interface has different capabilities depending on its hardware components such as photodiode, VOA, amplifier, and OCM.

There are multiple parameters for the OTS controllers. You can configure the parameters that are required for the different configuration for an OTS controller on an ILA node by using the following commands in the Ots controller configuration mode:

- **tx-voa-attenuation** *value*
- **egress-ampli-gain-range** {normal | extended}
- **egress-ampli-gain** *value*
- **egress-ampli-tilt** *value*
- **egress-ampli-osri** {on | off}
- **egress-ampli-safety-control-mode** {auto | disabled}
- **egress-ampli-force-apr** {on | off}
- **raman-tx-power** *Raman-transmit-pump-instance power power-value*

- **raman-tx-power-disable** *Raman-transmit-pump-instance*
- **raman-force-apr** {on | off}
- **raman-osri** {on | off}
- **raman-safety-control-mode** {auto | disabled}

There are multiple parameters for the OTS controllers. You can configure the parameters that are required for the different configuration for an OTS controller on an OLT node by using the following commands in the Ots controller configuration mode:

- **tx-voa-attenuation** *value*
- **egress-ampli-gain** *value*
- **egress-ampli-tilt** *value*
- **egress-ampli-osri** {on | off}
- **egress-ampli-safety-control-mode** {auto | disabled}
- **egress-ampli-force-apr** {on | off}
- **egress-channel-slice** *channel-slice attn attenuation-value*
- **ingress-ampli-gain-range** {normal | extended}
- **ingress-ampli-gain** *value*
- **ingress-ampli-tilt** *value*
- **ingress-ampli-osri** {on | off}
- **ingress-ampli-safety-control-mode** {auto | disabled}
- **ingress-ampli-force-apr** {on | off}
- **ingress-channel-slice** *channel-slice attn attenuation-value*
- **raman-tx-power** *Raman-transmit-pump-instance power power-value*
- **raman-tx-power-disable** *Raman-transmit-pump-instance*
- **raman-force-apr** {on | off}
- **raman-osri** {on | off}
- **raman-safety-control-mode** {auto | disabled}

OTS Controller Configuration Parameters

Table 7: OTS Controller Configuration Parameters

Parameter	Description	Hardware Capability	Range	Default	Notes
tx-voa-attenuation	TX VOA attenuation set point	VOA	<ul style="list-style-type: none"> • OLT: 0–20 dB • ILA: 0–15 dB 	0.0	—
ampli-safety-control-mode (ingress/egress)	Amplifier control mode	Amplifier	auto and disabled	automatic	—

Parameter	Description	Hardware Capability	Range	Default	Notes
ampli-gain-range (ingress/egress)	Amplifier gain range	Amplifier	normal and extended	normal	

Parameter	Description	Hardware Capability	Range	Default	Notes
					<p>If you change the gain range from Normal to Extended or the opposite way, without updating the proper gain value for the new gain range, then the following may happen:</p> <ul style="list-style-type: none"> • The EDFA switches to the preconfigured or default value of the gain causing a mismatch between the operational and configured gain. • The gain configuration is lost during the reload of software or line card, as the configured gain mismatches with the latest gain-range. This may result in traffic interruption during these reload operations. <p>Hence, we recommend that you explicitly configure the gain range mode as normal or extended, and the corresponding gain values for each mode to get the expected results.</p> <p>The following are a few example scenarios that may not work as expected:</p> <ul style="list-style-type: none"> • Scenario 1: Current running config: <pre>controller Ots R/S/I/P egress-ampli-gain-range extended egress-ampli-gain <gain value in extended mode></pre> New applied config: <pre>controller Ots R/S/I/P no egress-ampli-gain-range extended commit</pre> • Scenario 2: Current running config: <pre>controller Ots R/S/I/P egress-ampli-gain-range extended egress-ampli-gain <gain value in extended mode></pre> New applied config: <pre>controller Ots R/S/I/P egress-ampli-gain-range Normal commit</pre>

Parameter	Description	Hardware Capability	Range	Default	Notes
					<ul style="list-style-type: none"> Scenario 3: <p>Current running config:</p> <pre>controller Ots R/S/I/P egress-ampli-gain <gain value in normal mode></pre> <p>New applied config:</p> <pre>controller Ots R/S/I/P egress-ampli-gain-range extended commit</pre> <p>The following is another example scenario that involves commit-replace command where you replace the existing gain configuration that does not have explicitly configured gain-range, with new gain-range and gain value.</p> <p>Scenario 4:</p> <p>Current running config:</p> <pre>controller Ots R/S/I/P egress-ampli-gain <gain value in normal mode></pre> <p>New applied config:</p> <pre>..... controller Ots R/S/I/P egress-ampli-gain-range extended egress-ampli-gain <gain value in extended mode> commit replace</pre>
ampli-gain (ingress/egress)	Amplifier gain set point	Amplifier	80–380	OLT ingress: 12, egress: 16 ILA: 8	<p>The actual range of amplifier gain set point depends on amplifier gain range.</p> <p>Note Gain is calibrated to line port and so the supported range varies in Raman variants (OLT-C-R, ILA-C-R, and ILA-C-2R) due to insertion loss by Raman amplifier.</p>
ampli-tilt (ingress/egress)	Amplifier tilt	Amplifier	–5 to +5	0.0	—
osri (ingress/egress)	Optical safety remote interlock	Amplifier	on and off	off	When osri is on, the EDFA is in shut state and vice versa.

Parameter	Description	Hardware Capability	Range	Default	Notes
ampli-force-apr (ingress/egress)	—	Amplifier	on and off	off	When ampli-force-apr is set to <i>on</i> , the EDFA output power is clamped to 8 dBm.
channel-slice <i>channel-slice</i> attn <i>attenuation</i> (ingress/egress)	Channel slice attenuation set point	—	1–1548 (channel slice) OLT: 0–250 (attenuation value in 0.1 dB) ILA: 0–50 (attenuation value in 0.1 dB)	0.0	—
raman-tx-power <i>pump instance</i> value <i>value</i>	Tx power	Raman amplifier	1–5 (pump instance) The values are: • Pmp1: 45-30 • Pump 2: 40-30 • Pump 3: 40-20 • Pump 4: 40-20 • Pump 5: 35-10	—	—
raman-tx-power-disable <i>pump instance</i>	Tx power	Raman amplifier	—	—	—

Parameter	Description	Hardware Capability	Range	Default	Notes
raman-force-apr	—	Raman amplifier	on and off	off	When raman-force-apr is set to <i>on</i> , the Raman pump maximum output power is clamped to 10 mW.
raman-osri	Optical safety remote interlock	Raman amplifier	on and off	off	When raman-osri is set to <i>on</i> , the Raman pumps are switched off.

Channel Slice Attenuation

The attenuation for the channel slices is automatically configured by APC.

To view the channel slice attenuation information, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 channel-slice-attenuation-info
```

The following sample output shows the channel slice attenuation information:

```
Sun Mar 27 15:27:27.600 UTC

Attenuation Slices spacing      :          3.125 GHz
Attenuation Slices Range       :          1 - 1548
Slice start wavelength         :         1566.82 nm
Slice start frequency          :         191337.50 GHz

Sub Channel Attenuation information :
Ingress Channel Slice Attenuation :
-----
spectrum-slice num              Attenuation values (dB)
-----
 1 - 12      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
13 - 24      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
25 - 36      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
37 - 48      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
49 - 60      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
61 - 72      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
.
.
output snipped
.
.
1501 - 1512  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1513 - 1524  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1525 - 1536  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1537 - 1548  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
-----
Egress Channel Slice Attenuation :
```

```

-----
spectrum-slice num                Attenuation values (dB)
-----
  1 - 12      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 13 - 24      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 25 - 36      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 37 - 48      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 49 - 60      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 61 - 72      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
.
.
output snipped
.
.
1501 - 1512   25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1513 - 1524   25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1525 - 1536   25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1537 - 1548   25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0

```

To modify the attenuation values manually, APC must be disabled first using the following commands:

```

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

```

For more information on APC commands, see the section, "[Configure APC](#)".

To modify the attenuation value for an egress channel slice, use the following commands:



Note The OTS controller commands do not support decimal inputs. The OTS controller commands consider the inputs to one decimal place for the parameter values. In the following example, the *attn* value for the *egress-channel-slice 10* is provided as *100* to configure the *attn* value for the *egress-channel-slice 10* to *10.0 dB*.

```

RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0 egress-channel-slice 10 attn 100
RP/0/RP0/CPU0:ios(config)#commit
Sun Apr 10 14:47:37.849 UTC
RP/0/RP0/CPU0:ios(config)#end

```

To view the modified attenuation value for egress channel slice 10, use the following command:

```

RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 channel-slice-attenuation-info

```

The following output highlights the modified attenuation value for *egress channel slice 10* that is set to *10.0 dB*.

```

Sun Apr 10 14:47:47.050 UTC

Attenuation Slices spacing      :          3.125 GHz
Attenuation Slices Range       :          1 - 1548
Slice start wavelength         :        1566.82 nm
Slice start frequency          :       191337.50 GHz

```

Sub Channel Attenuation information :
 Ingress Channel Slice Attenuation :

```
-----
spectrum-slice num          Attenuation values (dB)
-----
  1 - 12      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 13 - 24      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 25 - 36      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 37 - 48      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 49 - 60      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 61 - 72      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
.
.
output snipped
.
1501 - 1512  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1513 - 1524  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1525 - 1536  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1537 - 1548  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
-----
```

Egress Channel Slice Attenuation :

```
-----
spectrum-slice num          Attenuation values (dB)
-----
  1 - 12      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  10.0  25.0
25.0
 13 - 24      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 25 - 36      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 37 - 48      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 49 - 60      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
 61 - 72      25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
.
.
output snipped
.
1501 - 1512  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1513 - 1524  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1525 - 1536  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
1537 - 1548  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0  25.0
25.0
-----
```

RP/0/RP0/CPU0:ios#

Examples

In the following example, the tx-voa-attenuation is set to 10 dB.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#tx-voa-attenuation 100
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the egress-ampli-gain is set to 20 dB.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-gain 200
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the egress-ampli-tilt is set to 2.5 dB.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-tilt 25
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following examples, the egress-ampli-gain-range is set to extended and Normal.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-gain-range extended
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-gain 360
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-gain-range normal
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-gain 150
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the egress-ampli-safety-control-mode is set to auto.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-safety-control-mode auto
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the egress-ampli-osri is set to on.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-osri on
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the egress-ampli-force-apr is set to on.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-ampli-force-apr on
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the egress-channel-slice attenuation is set to 20 dB.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#egress-channel-slice 1 attn 200
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the raman-tx-power is set to 55 mW.

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

```
RP/0/RP0/CPU0:ios(config-Ots)#raman-tx-power 1 value 5500
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the raman-force-apr is set to on.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#raman-force-apr on
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

In the following example, the raman-osri is set to on.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-Ots)#raman-osri on
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

OTS-OCH Controllers

The OTS-OCH controllers are not created by default when the cards (NCS1K-ILA-2R-C, NCS1K-ILA-R-C, NCS1K-ILA-C, NCS1K-OLT-R-C, and NCS1K-OLT-C) are brought up. The LINE OTS-OCH controllers can be created using the **hw-module** command.

Optical Cross Connections

Optical Cross Connections can be configured only on OLT nodes. In these nodes, the OTS-OCH controller is not created automatically on the Add/Drop ports (COM side). The optical cross connect configuration defines the line side OTS-OCH channel as the source and creates an OTS-OCH controller on the Add/Drop port to which the cross connection is made. The channel ID must be the same for both the LINE side and COM side OTS-OCH controllers.

Flex Grid Validation

The following validations are performed before the **hw-module** configurations are committed:

- The channel ID is any value 1–194.
- The center frequency must be within the C-band spectrum . The frequency range is 191.3375-196.1750 THz.
- The supported channel width range is 25.000GHz to 4837.500 GHz. Overlap of channels is not permitted.

Create OTS-OCH Controllers

To create the OTS-OCH controllers on the LINE side of the ILA-C, ILA-R-C, or ILA-2R-C node, use the following commands in the configuration mode:

- **hw-module location** *location* **inline-ampli grid-mode** *mode*
- **channel-id** *channel-id* **centre-freq** *frequency* **width** *channel-width*

To create the OTS-OCH controllers on the LINE side of the ILA-C node, use the following commands:

```
RP/0/RP0/CPU0:ios#configure
Thu Apr 7 13:14:49.841 UTC
RP/0/RP0/CPU0:ios(config)#
RP/0/RP0/CPU0:ios(config)#hw-module location 0/0/NXR0 inline-ampli grid-mode flex
RP/0/RP0/CPU0:ios(config-hwmod-ila-flexi)#channel-id 1 centre-freq 196.1 width 75
RP/0/RP0/CPU0:ios(config-hwmod-ila-flexi)# commit
```

The OTS-OCH controller is created on both the LINE 0 and LINE 2 ports of the ILA-C node. To view the OTS-OCH controllers, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots-och ?
```

The following output displays the OTS-OCH controller is created on both the LINE 0 and LINE 2 ports of the ILA-C node.

```
0/0/0/0/1          Ots-Och Interface Instance
0/0/0/2/1          Ots-Och Interface Instance
R/S/I/P/B or R/S/I/P Forward interface in Rack/Slot/Instance/Port/Breakout format or
R/S/I/P format
```

To view the parameters of the OTS-OCH controller, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots-och 0/0/0/0/1
```

The following output displays the parameters of the OTS-OCH controller.

```
Thu Apr  7 13:22:29.125 UTC

Controller State: Up

Transport Admin State: In Service

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

Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
Total RX Power = -10.50 dBm
Total TX Power = -10.50 dBm

Configured Parameters:
-----
```

To create the OTS-OCH controller on the LINE side of the OLT-C or OLT-R-C node, use the following commands in the configuration mode:

- **hw-module location** *location* **terminal-ampli grid-mode** *mode*
- **channel-id** *channel-id* **centre-freq** *frequency* **width** *channel-width*

To configure the optical cross-connect, use the following command in the configuration mode:

```
controller ots-och Rack/Slot/Instance/Port/Channel-id-number add-drop-channel ots-och
Rack/Slot/Instance/Port/Channel-id-number
```

To create the OTS-OCH controller on the LINE side of an OLT-R-C node, use the following commands:

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#hw-module location 0/0/nxr0 terminal-ampli grid-mode flex
RP/0/RP0/CPU0:ios(config-hwmod-olt-flexi)#channel-id 1 centre-freq 196.1 width 75
RP/0/RP0/CPU0:ios(config-hwmod-olt-flexi)#commit
```

To view the OTS-OCH controller that is created on the LINE side, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots-och ?
```

The following output highlights the OTS-OCH controller that is created on the LINE side.

```

0/0/0/0/1          Ots-Och Interface Instance
R/S/I/P/B or R/S/I/P Forward interface in Rack/Slot/Instance/Port/Breakout format or
R/S/I/P format

```

To configure the optical cross-connect, use the following commands:

```

RP/0/RP0/CPU0:ios#configure
Mon Apr  4 14:54:32.834 UTC
RP/0/RP0/CPU0:ios(config)#controller ots-och 0/0/0/0/1 add-drop-channel ots-och 0/0/0/33/1
RP/0/RP0/CPU0:ios(config)#commit

```

The OTS-OCH controller is created on the Add/Drop port to which the cross-connection is made on the COM side. To view the OTS-OCH controller, use the following command:

```
RP/0/RP0/CPU0:ios#show controller ots-och ?
```

The following output highlights the OTS-OCH controller that is created on the Add/Drop port to which the cross-connection is made on the COM side.

```

0/0/0/0/1          Ots-Och Interface Instance
0/0/0/33/1         Ots-Och Interface Instance
R/S/I/P/B or R/S/I/P Forward interface in Rack/Slot/Instance/Port/Breakout format or
R/S/I/P format

```

You can also use python-based configuration script to automatically create 75 or 150 GHz fixed grid channels on ports 2 and 3 using the following commands:

```

RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#load script /pkg/script/flexgrid_config_builder.py args -w75 -c
terminal-ampli
Loading.
6839 bytes parsed in 1 sec (6835)bytes/sec
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end

```



Note This script can be used only for a colored solution that uses the NCS1K-MD-320/E-C patch panel with fixed channel width.

To view the OTS-OCH controllers, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots-och ?
```

The following output displays the OTS-OCH controller interfaces:

```

0/0/0/0/1          Ots-Och Interface Instance
0/0/0/0/10         Ots-Och Interface Instance
.
.
output snipped
.
.
0/0/0/0/29         Ots-Och Interface Instance
0/0/0/0/3          Ots-Och Interface Instance
0/0/0/0/49         Ots-Och Interface Instance
0/0/0/0/5          Ots-Och Interface Instance
.
.
output snipped
.

```

```

.
0/0/0/0/64      Ots-Och Interface Instance
0/0/0/0/7      Ots-Och Interface Instance
0/0/0/0/8      Ots-Och Interface Instance
0/0/0/0/9      Ots-Och Interface Instance
R/S/I/P/B or R/S/I/P Forward interface in Rack/Slot/Instance/Port/Breakout format or
R/S/I/P format

```

To view the flex grid information on the OLT node, use the following command:

```
RP/0/RP0/CPU0:ios#show hw-module location 0/0/NXR0 terminal-ampli
```

The following output displays the flex grid information on the OLT node.

```
Tue Jun 28 15:46:07.026 UTC
```

Legend:

```

NXC      - Channel not cross-connected
ACTIVE   - Channel cross-connected to data port
ASE      - Channel filled with ASE
FAILED   - Data channel failed, pending transition to ASE

```

```
Location:          0/0/NXR0
```

```
Status:           Provisioned
```

Flex Grid Info

Channel Number	Centre Frequency (THz)	Channel Width (GHz)	Channel Status
1	196.100000	75.000	NXC
2	196.025000	75.000	NXC
3	195.950000	75.000	NXC
4	195.875000	75.000	NXC
5	195.800000	75.000	NXC
6	195.725000	75.000	NXC
7	195.650000	75.000	NXC
8	195.575000	75.000	NXC
9	195.500000	75.000	NXC
10	195.425000	75.000	NXC
11	195.350000	75.000	NXC
12	195.275000	75.000	NXC
13	195.200000	75.000	NXC
14	195.125000	75.000	NXC
15	195.050000	75.000	NXC
16	194.975000	75.000	NXC
17	194.900000	75.000	NXC
18	194.825000	75.000	NXC
19	194.750000	75.000	NXC
20	194.675000	75.000	NXC
21	194.600000	75.000	NXC
22	194.525000	75.000	NXC
23	194.450000	75.000	NXC
24	194.375000	75.000	NXC
25	194.300000	75.000	NXC
26	194.225000	75.000	NXC
27	194.150000	75.000	NXC
28	194.075000	75.000	NXC
29	194.000000	75.000	NXC
30	193.925000	75.000	NXC
31	193.850000	75.000	NXC
32	193.775000	75.000	NXC
33	193.700000	75.000	NXC
34	193.625000	75.000	NXC
35	193.550000	75.000	NXC

36	193.475000	75.000	NXC
37	193.400000	75.000	NXC
38	193.325000	75.000	NXC
39	193.250000	75.000	NXC
40	193.175000	75.000	NXC
41	193.100000	75.000	NXC
42	193.025000	75.000	NXC
43	192.950000	75.000	NXC
44	192.875000	75.000	NXC
45	192.800000	75.000	NXC
46	192.725000	75.000	NXC
47	192.650000	75.000	NXC
48	192.575000	75.000	NXC
49	192.500000	75.000	NXC
50	192.425000	75.000	NXC
51	192.350000	75.000	NXC
52	192.275000	75.000	NXC
53	192.200000	75.000	NXC
54	192.125000	75.000	NXC
55	192.050000	75.000	NXC
56	191.975000	75.000	NXC
57	191.900000	75.000	NXC
58	191.825000	75.000	NXC
59	191.750000	75.000	NXC
60	191.675000	75.000	NXC
61	191.600000	75.000	NXC
62	191.525000	75.000	NXC
63	191.450000	75.000	NXC
64	191.375000	75.000	NXC



Note The legend provides information about the channel's status. By default, the channels are brought up with NXC channel status.

To view the flex grid information on the ILA node, use the following command:

```
RP/0/RP0/CPU0:ios#show hw-module location 0/0/nxr0 inline-ampli
```

The following output displays the flex grid information on the ILA node.

```
Sat Jul 2 02:46:33.657 UTC
Location:          0/0/NXR0
Status:            Provisioned
Flex Grid Info
Channel Number    Centre Frequency (THz)    Channel Width (GHz)
1                 191.375000                75.000
2                 191.450000                75.000
3                 191.525000                75.000
4                 191.600000                75.000
5                 191.675000                75.000
6                 191.750000                75.000
7                 191.825000                75.000
8                 191.900000                75.000
9                 191.975000                75.000
10                192.050000                75.000
11                192.125000                75.000
12                192.200000                75.000
13                192.275000                75.000
14                192.350000                75.000
15                192.425000                75.000
16                192.500000                75.000
17                192.575000                75.000
```

18	192.650000	75.000
19	192.725000	75.000
20	192.800000	75.000
21	192.875000	75.000
22	192.950000	75.000
23	193.025000	75.000
24	193.100000	75.000
25	193.175000	75.000
26	193.250000	75.000
27	193.325000	75.000
28	193.400000	75.000
29	193.475000	75.000
30	193.550000	75.000
31	193.625000	75.000
32	193.700000	75.000
33	193.775000	75.000
34	193.850000	75.000
35	193.925000	75.000
36	194.000000	75.000
37	194.075000	75.000
38	194.150000	75.000
39	194.225000	75.000
40	194.300000	75.000
41	194.375000	75.000
42	194.450000	75.000
43	194.525000	75.000
44	194.600000	75.000
45	194.675000	75.000
46	194.750000	75.000
47	194.825000	75.000
48	194.900000	75.000
49	194.975000	75.000
50	195.050000	75.000
51	195.125000	75.000
52	195.200000	75.000
53	195.275000	75.000
54	195.350000	75.000
55	195.425000	75.000
56	195.500000	75.000
57	195.575000	75.000
58	195.650000	75.000
59	195.725000	75.000
60	195.800000	75.000
61	195.875000	75.000
62	195.950000	75.000
63	196.025000	75.000
64	196.100000	75.000

To view the parameters of the OTS-OCH controller (LINE side), use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots-och 0/0/0/0/1
```

The following output displays the parameters of the OTS-OCH controller on the LINE side.

```
Tue Apr 5 06:32:29.696 UTC
```

```
Controller State: Up
```

```
Transport Admin State: In Service
```

```
Alarm Status:
```

```
-----
```

```
Detected Alarms: None
```

```

Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
Total RX Power = -10.50 dBm
Total TX Power = -10.50 dBm

Cross Connect Info:
-----
Add-Drop Channel = Ots-Och0/0/0/33/1

```

```

Configured Parameters:
-----

```



Note The Add/Drop channel that is cross-connected to the line port, 0/0/0/1 is displayed in the output.

DFB Controllers

The line port in the NCS1K-OLT-R-C, NCS1K-ILA-R-C, and NCS1K-ILA-2R-C line cards have a DFB (Distributed Feedback) controller in addition to the OSC controller. The DFB laser at 191.1 THz is used to perform a link continuity check on the Raman span for optical safety. The power of DFB laser can be regulated with a VOA.

To view the parameters of the LINE 0 DFB controller, use the following command:

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

The following output displays the parameters of the LINE 0 DFB controller.

```

Wed Mar 23 06:05:09.074 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

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

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 106

Parameter Statistics:
-----
Total TX Power = 6.79 dBm
Total RX Power = -8.30 dBm

```

```
TX Voa Attenuation = 0.0 dB
```

```
Configured Parameters:
```

```
-----
TX Voa Attenuation = 0.0 dB
```

Configure DFB Controllers

There are multiple parameters for the DFB controllers. You can configure the following parameters for a DFB controller on a NCS1K-OLT-R-C, NCS1K-ILA-R-C, or NCS1K-ILA-2R-C node by using the following commands in the configuration mode:

- **controller dfb** *Rack/Slot/Instance/Port*
- **tx-voa-attenuation** *value*
- **tx-low-threshold** *value*
- **sec-admin-state** {normal | maintenance}
- **transmit-shutdown**
- **shutdown**

Examples

In the following example, the *tx-voa-attenuation* is set to 2 dB.



Note The DFB controller commands do not support decimal inputs. The DFB controller commands consider the inputs to one decimal place for the parameter values. In this example, the *tx-voa-attenuation* value for the DFB controller *dfb 0/0/0/0* is provided as 20 to configure the *tx-voa-attenuation* value for *dfb 0/0/0/0* to 2.0 dB.

```
RP/0/RP0/CPU0:ios#configure
Thu Apr 21 17:00:57.654 UTC
RP/0/RP0/CPU0:ios(config)#
RP/0/RP0/CPU0:ios(config)#controller dfb 0/0/0/0 tx-voa-attenuation 20
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end
```

To view the configured *tx-voa-attenuation* value, use the following command:

```
RP/0/RP0/CPU0:ios#show controller dfb 0/0/0/0
```

The following output highlights the *tx-voa-attenuation* of the DFB controller that is set to 2.0 dB.

```
Thu Apr 21 17:02:06.316 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

Alarm Status:
-----
```

```

Detected Alarms: None

Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
Total TX Power = 20.00 dBm
Total RX Power = 10.00 dBm
TX Voa Attenuation = 2.0 dB

Configured Parameters:
-----
TX Voa Attenuation = 2.0 dB

```

The DFB laser power is attenuated based on the updated value and the TX power changes accordingly.

In the following example, the *sec-admin-state* is set to *maintenance*.

```

P/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller dfb 0/0/0/0 sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end

```

To view the configured *sec-admin-state* value, use the following command:

```

RP/0/RP0/CPU0:ios#show controllers dfb 0/0/0/0

```

The following output highlights the *sec-admin-state* set to *maintenance*.

```

Thu Apr 21 17:05:41.311 UTC

Controller State: Up

Transport Admin State: Maintenance

Laser State: On

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

Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
Total TX Power = 20.00 dBm
Total RX Power = 10.00 dBm
TX Voa Attenuation = 2.0 dB

Configured Parameters:
-----
TX Voa Attenuation = 2.0 dB

```

In the following example, the DFB controller is shut down.

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller dfb 0/0/0/0 shutdown
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end
```

To view the configured value, use the following command:

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

The following output highlights the *Controller State*, *Transport Admin State*, and *Laser State* set to *shut down*.

```
Thu Apr 21 17:08:40.211 UTC
```

```
Controller State: Administratively Down
```

```
Transport Admin State: Out Of Service
```

```
Laser State: Off
```

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

```
Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0
```

```
Parameter Statistics:
-----
Total TX Power = -50.00 dBm
Total RX Power = 10.00 dBm
TX Voa Attenuation = 2.0 dB
```

```
Configured Parameters:
-----
TX Voa Attenuation = 2.0 dB
```

OSC Controllers

The Optical Service Channel (OSC) controller is used to represent the optical capabilities, configuration, and monitoring of the OSC laser. The corresponding Gigabit Ethernet interface is the child interface that represents Ethernet capabilities, configuration, and monitoring.

OSC provides a communication channel for traffic coming from a UDC port. OSC serves as a channel probe to check fiber continuity between two nodes. OSC provides remote node management functionality. OSC is generated and terminated on each line side. OSC-C operates at a frequency of 198.50 THz.

Nodes with NCS1K-OLT-R-C or NCS1K-OLT-C cards have one OSC controller. To view the status of the OSC controller, use the following command:

```
RP/0/RP0/CPU0:ios#show controller description
```

The following output highlights the status of the OSC controller for the NCS1K-OLT-R-C or NCS1K-OLT-C cards.

```
Tue Apr 12 17:17:51.306 UTC
```

Interface	Status	Description
-----------	--------	-------------

```

-----
Osc0/0/0/0          up
Ots0/0/0/0          up
Ots0/0/0/1          up
Ots0/0/0/2          up
.
.
output snipped
.
.
Ots0/0/0/31         up
Ots0/0/0/32         up
Ots0/0/0/33         up

```

Nodes with NCS1K-ILA-2R-C, NCS1K-ILA-R-C or NCS1K-ILA-C card have two OSC controllers. To view the OSC controllers, use the following command:

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

The following output highlights the status of the OSC controller for the NCS1K-ILA-2R-C, NCS1K-ILA-R-C or NCS1K-ILA-C card.

```
Tue Apr 12 17:20:20.667 UTC
```

Interface	Status	Description
Osc0/0/0/0	up	
Osc0/0/0/2	up	
Ots0/0/0/0	up	
Ots0/0/0/1	up	
Ots0/0/0/2	up	
Ots0/0/0/3	up	

To view the parameters of the LINE 0 OSC controller, use the following command:

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

The following output shows the parameters of the LINE 0 OSC controller.

```
Wed Mar 23 06:04:18.565 UTC
```

```
Controller State: Down
```

```
Transport Admin State: In Service
```

```
Laser State: Off
```

```
Alarm Status:
```

```
-----
```

```
Detected Alarms:
```

```
    RX-LOS-P
```

```
Alarm Statistics:
```

```
-----
```

```
RX-LOS-P = 369
```

```
TX-POWER-FAIL-LOW = 0
```

```
Parameter Statistics:
```

```
-----
```

```
Total TX Power = -50.00 dBm
```

```
Total RX Power = -50.00 dBm
```

```
Configured Parameters:
```

```
-----
```

Configure OSC Controllers

There are multiple parameters for the OSC controllers. You can configure the parameters that are required for the different configuration for an OSC controller on an ILA or OLT node by using the following commands in the configuration mode:

- **transmit-power** *value*
- **sec-admin-state** {**normal** | **maintenance**}
- **tx-low-threshold**
- **shutdown**

Examples

In the following example, the transmit-power is set to 2 dBm. The OSC Tx power can be changed by configuring the OSC transmit power attribute. This attribute internally regulates the OSC Tx VOA.



Note The OSC controller commands do not support decimal inputs. The OSC controller commands consider the inputs to one decimal place for the parameter values. In this example, the transmit-power parameter is provided as *20* to configure the transmit-power parameter to *2 dBm*.

```
RP/0/RP0/CPU0:ios(config)#controller osc 0/0/0/0 transmit-power 20
Fri May 13 11:26:53.445 UTC
WARNING! Changing TX power can impact traffic
RP/0/RP0/CPU0:ios(config)#commit
Fri May 13 11:26:55.127 UTC
RP/0/RP0/CPU0:ios(config)#end
```

To view the parameters of the OSC controller, use the following command:

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

The following output shows the parameters of the OSC controller.

```
Fri May 13 11:26:59.542 UTC

Controller State: Up

Transport Admin State: In Service

Laser State: On

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

Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
Total TX Power = 1.89 dBm
Total RX Power = -17.30 dBm
```



```
Configured Parameters:
-----
```

In the following example, the *sec-admin-state* is set to *maintenance*.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller osc 0/0/0/0 sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end
```

To view the parameters of the OSC controller, use the following command:

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

The following output highlights the *Transport Admin State* of the OSC controller that is set to *Maintenance*.

```
Fri Apr 22 15:55:36.324 UTC
```

```
Controller State: Up
```

```
Transport Admin State: Maintenance
```

```
Laser State: On
```

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

```
Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0
```

```
Parameter Statistics:
-----
Total TX Power = -10.00 dBm
Total RX Power = -30.00 dBm
```

```
Configured Parameters:
-----
```

In the following example, the OSC controller is *shut down*.

```
P/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller osc 0/0/0/0 shutdown
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end
```

To view the parameters of the OSC controller that is *shut down*, use the following command:

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

The following output highlights the *Controller State*, *Transport Admin State*, and *Laser State* of the OSC controller that is *shut down*.

```
Tue Apr 12 17:33:12.998 UTC
```

```
Controller State: Administratively Down
```

```
Transport Admin State: Out Of Service
```

```
Laser State: Off
```

```

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

Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
Total TX Power = -50.00 dBm
Total RX Power = -30.00 dBm

Configured Parameters:
-----

```

Gigabit Ethernet Interfaces

A Gigabit Ethernet interface represents the packet layer of an OSC channel.

To view the parameters of a Gigabit Ethernet interface, use the following command:

```
RP/0/RP0/CPU0:ios#show interfaces gigabitEthernet 0/0/0/0
```

The following output shows the parameters of a Gigabit Ethernet interface.

```

Tue Apr 19 10:57:18.251 UTC
GigabitEthernet0/0/0/0 is up, line protocol is up
  Interface state transitions: 1
  Hardware is GigabitEthernet, address is 38fd.f866.096c (bia 38fd.f866.096c) - IP of the
  OSC controller
  Internet address is 10.7.1.1/24
  MTU 1514 bytes, BW 1000000 Kbit (Max: 1000000 Kbit)
    reliability 255/255, txload 0/255, rxload 0/255
  Encapsulation ARPA,
  Full-duplex, 1000Mb/s, unknown, link type is force-up
  output flow control is off, input flow control is off
  loopback not set,
  Last link flapped 01:14:28
  ARP type ARPA, ARP timeout 04:00:00
  Last input Unknown, output Unknown
  Last clearing of "show interface" counters Unknown
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec

```

To view the IPv4 address of a Gigabit Ethernet interface, use the following command:

```
RP/0/RP0/CPU0:ios#show ipv4 interface brief
```

The following output highlights the interface, IPv4 address (*IP-Address*), status, operational status of the routing protocol (*Protocol*), VPN routing and forwarding (VRF) instance name (*Vrf-Name*) of the Gigabit Ethernet interface.

```

Tue Apr 19 10:58:02.951 UTC

Interface                IP-Address      Status      Protocol Vrf-Name
Loopback0                10.3.3.11      Up          Up       default

```

```

Loopback3                10.1.1.1           Up                Up                default
GigabitEthernet0/0/0/0  10.7.1.1          Up                Up                default
MgmtEth0/RP0/CPU0/0     10.33.0.61        Up                Up                default
PTP0/RP0/CPU0/0         unassigned         Shutdown          Down              default
MgmtEth0/RP0/CPU0/1     unassigned         Shutdown          Down              default
PTP0/RP0/CPU0/1         unassigned         Shutdown          Down              default
MgmtEth0/RP0/CPU0/2     unassigned         Shutdown          Down              default

```

The Gigabit Ethernet interface must be in *Up* state for the OSC laser to turn up. When the node comes up, the Gigabit Ethernet interface turns to *Down* state. Run the following commands on the Gigabit Ethernet interface to bring it up.

```

RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#no interface gigabitEthernet 0/0/0/0 shutdown
RP/0/RP0/CPU0:ios(config)#commit

```

The UDC ports on the OLT and ILA nodes carry 100 Mbps traffic. To see the port parameters, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers switch summary
```

The following output highlights the *UDC0* and *UDC1* ports values including their 100 Mbps traffic speed.

```
Mon May 9 07:30:03.726 UTC
```

```

Rack  Card  Switch  Rack Serial Number
-----
  0   RP0   RP-SW   FCB2546B08L

```

Port	Phys State	Admin State	Port Speed	Protocol State	Forward State	Connects To
0	Up	Up	10-Gbps	-	Forwarding	CPU0
1	Up	Up	10-Gbps	-	Forwarding	CPU1
2	Down	Down	1-Gbps	-	Forwarding	DEWEY
3	Down	Down	Unknown	-	Forwarding	UnUsed
4	Up	Up	1-Gbps	-	Forwarding	MGMT0
5	Down	Up	1-Gbps	-	Forwarding	MGMT1
6	Down	Up	1-Gbps	-	Forwarding	MGMT2
7	Down	Down	1-Gbps	-	Forwarding	UnUsed
8	Down	Up	1-Gbps	-	Forwarding	PTP0
9	Down	Up	1-Gbps	-	Forwarding	PTP1
10	Up	Up	100-Mbps	-	Forwarding	UDC0
11	Up	Up	100-Mbps	-	Forwarding	UDC1
12	Up	Up	100-Mbps	-	Forwarding	OSC0
13	Up	Up	100-Mbps	-	Forwarding	OSC1
14	Down	Down	10-Mbps	-	Forwarding	UnUsed
15	Down	Down	Unknown	-	Forwarding	UnUsed

The Tx and Rx drops counters do not increment on the node when the fiber is removed from the *UDC0* or *UDC1* port of the neighboring node. To view the statistics, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers switch statistics
```

The following output highlights the Tx and Rx drops counters on the node when the fiber is removed from the *UDC0* and *UDC1* ports.

```
Mon May 9 07:30:10.164 UTC
```

```

Rack  Card  Switch  Rack Serial Number
-----
  0   RP0   RP-SW   FCB2546B08L

```

Phys	State	Tx	Rx	Tx Drops/	Rx Drops/

Port	State	Changes	Packets	Packets	Errors	Errors
Connects To						
0	Up	1	8250025	3171592	0	0
CPU0						
1	Up	1	6380049	10790031	0	0
CPU1						
2	Down	0	0	0	0	0
DEWEY						
3	Down	0	0	0	0	0
UnUsed						
4	Up	2	3171749	8319773	49	0
MGMT0						
5	Down	0	0	0	0	0
MGMT1						
6	Down	0	0	0	0	0
MGMT2						
7	Down	0	0	0	0	0
UnUsed						
8	Down	2	0	0	0	0
PTP0						
9	Down	2	0	0	0	0
PTP1						
10	Up	0	0	0	0	0
UDC0						
11	Up	0	497065830	3937555205	0	0
UDC1						
12	Up	0	0	0	0	0
OSC0						
13	Up	0	508219613	503446049	3440127611	1218
OSC1						
14	Down	0	0	0	0	0
UnUsed						
15	Down	0	0	0	0	0
UnUsed						

OCH Controller

When nodes with Mux/Demux panels and breakout panels are brought up, OCH controllers are created by default. The OCH controllers for the patch panels are:

Table 8: Supported Interfaces

Patch Panel	Port Type	OCH Ports	Interfaces
NCS1K-BRK-8	LC Ports	8	och R/S/I/0 to och R/S/I/7
NCS1K-BRK-24	LC Ports	24	och R/S/I/0 to och R/S/I/23
NCS1K-MD-320/E-C	LC Ports	32	och R/S/I/0 to och R/S/I/31



Note R/S/I/P stands for Rack/Slot/Instance/Port.

The following table displays the C-band odd and even channel plans for the NCS1K-MD-320/E-C patch panel.

Table 9: NCS1K-MD-320/E-C Channel Plan

Port	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)
0	196.100	1528.77	196.025	1529.36
1	195.950	1529.94	195.875	1530.53
2	195.800	1531.12	195.725	1531.70
3	195.650	1532.29	195.575	1532.88
4	195.500	1533.47	195.425	1534.05
5	195.350	1534.64	195.275	1535.23
6	195.200	1535.82	195.125	1536.41
7	195.050	1537.00	194.975	1537.59
8	194.900	1538.19	194.825	1538.78
9	194.750	1539.37	194.675	1537.59
10	194.600	1540.56	194.525	1541.15
11	194.450	1541.75	194.375	1541.34
12	194.300	1542.94	194.225	1543.53
13	194.150	1544.13	194.075	1544.72
14	194.00	1545.32	193.925	1545.92
15	193.850	1546.52	193.775	1547.12
16	193.700	1547.72	193.625	1548.31
17	193.550	1548.91	193.475	1549.52
18	193.400	1550.12	193.325	1550.72
19	193.250	1551.32	193.175	1551.92
20	193.100	1552.52	193.025	1553.13
21	192.950	1553.73	192.875	1554.34
22	192.800	1554.94	192.725	1555.55
23	192.650	1556.15	192.575	1556.76
24	192.500	1557.36	192.425	1557.97

Port	Frequency (THz)	Wavelength (nm)	Frequency (THz)	Wavelength (nm)
25	192.350	1558.58	192.275	1559.19
26	192.200	1559.79	192.125	1560.40
27	192.050	1561.01	191.975	1561.62
28	191.900	1562.23	191.825	1562.84
29	191.750	1563.45	191.675	1564.07
30	191.600	1564.68	191.525	1565.29
31	191.450	1565.90	191.375	1566.52

To view the status of the OCH controller, use the following command:

```
RP/0/RP0/CPU0:ios#show controller description
```

The following shows the status of the OCH controller.

```
Tue Apr 12 17:17:51.306 UTC
```

```

Interface                Status      Description
-----
Och0/1/0/0                up
Och0/1/0/1                up
Och0/1/0/2                up
Och0/1/0/3                up
Och0/1/0/4                up
Och0/1/0/5                up
Och0/1/0/6                up
.
.
Output snipped
.
.
Och0/1/0/28               up
Och0/1/0/29               up
Och0/1/0/30               up
Och0/1/0/31               up
Oms0/1/0/32               up
Och0/3/0/0                up
Och0/3/0/1                up
Och0/3/0/2                up
Och0/3/0/3                up
Och0/3/0/4                up
Och0/3/0/5                up
Och0/3/0/6                up
Och0/3/0/7                up
.
.
Output snipped
.
.
Och0/3/0/28               up
Och0/3/0/29               up
Och0/3/0/30               up
Och0/3/0/31               up
Oms0/3/0/32               up

```

To view the parameters of the OCH controller for the NCS1K-BRK-8 panel, use the following command:

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

The following output shows the parameters of the OCH controller for the NCS1K-BRK-8 panel.

```
Tue May 10 11:27:31.354 UTC

Controller State: Down

LED State: Red

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
TX Power = -50.00 dBm
RX Power = -50.00 dBm
```

To view the parameters of the OCH controller for the Mux/Demux panel, use the following command:



Note The parameters of the OCH controller for the Mux/Demux panel contain information about the Channel Width, Frequency, and Wavelength.

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

The following output highlights the Channel Width, Frequency, and Wavelength parameters of the OCH controller for the Mux/Demux panel.

```
Wed May 25 11:50:03.481 UTC

Controller State: Down

LED State: Red

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
TX Power = -50.00 dBm
RX Power = -50.00 dBm
channel Frequency = 196.025 THz
Maximum Channel Width = 150.0 GHz
Channel Wavelength = 1529.36 nm
```

OMS Controller

When nodes with Mux/Demux panels and breakout panels are brought up, OMS controllers are created by default. The OMS controllers for the patch panels are:

Table 10: Supported Interfaces

Patch Panel	Port Type	OMS Ports	Interfaces
NCS1K-BRK-8	MPO Ports	8	oms R/S/I/8 to oms R/S/I/15
NCS1K-BRK-24	MPO Ports	8	oms R/S/I/24 to oms R/S/I/31
NCS1K-MD-32O/E-C	LC Ports	1	oms R/S/I/32



Note R/S/I/P stands for Rack/Slot/Instance/Port.

To view the status of the OMS controller, use the following command:

```
RP/0/RP0/CPU0:ios#show controller description
```

The following output shows the status of the OMS controller.

Tue Apr 12 17:17:51.306 UTC

```
Interface                Status      Description
-----
Och0/1/0/0                up
Och0/1/0/1                up
Och0/1/0/2                up
.
.
Output snipped
.
.
Och0/1/0/29               up
Och0/1/0/30               up
Och0/1/0/31               up
Oms0/1/0/32              up
Och0/3/0/0                up
Och0/3/0/1                up
.
.
Output snipped
.
.
Och0/3/0/29               up
Och0/3/0/30               up
Och0/3/0/31               up
Oms0/3/0/32              up
```

To view the parameters of the OMS controller for the BRK-24 panel, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/1/0/25
```


The following output shows the parameters of the OMS controller for the BRK-24 panel.

```
Thu Jul 14 11:05:50.419 UTC

Controller State: Down

Transport Admin State: Automatic In Service

LED State: Red

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
TX Power = -7.40 dBm
RX Power = -50.00 dBm
```

To view the parameters of the OMS controller for the Mux/Demux panel, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/32
```

The following output shows the parameters of the OMS controller for the Mux/Demux panel.

```
Tue May 10 11:28:02.856 UTC

Controller State: Down

LED State: Red

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
TX Power = -50.00 dBm
RX Power = -50.00 dBm
```

Insertion loss for each port is calculated and the power values are displayed on the OMS controller for NCS1K-BRK-8 and OCH controller for NCS1K-BRK-24. Insertion loss per port for NCS1K-BRK-24 is 5.9 dBm and NCS1K-BRK-8 is 0.6 dBm. The NCS1K-MD-320/E-C panels have a maximum insertion loss of 6.2 dBm for the respective Mux and Demux sections.

AINS

The Automatic-In-Service (AINS) feature allows the OTS, OMS and OCH controllers to automatically move to the automatic-in-service state after the system boots up. A soak time period is associated with the AINS

state. By default, the soak time period is one minute. The controllers 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.

Soak Time Period

Soak time period for the controllers to move from AINS to In-Service state is 1 minute. You cannot configure the soak time.

The AINS soak time period restarts when there are line card cold reloads or power cycles.

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 port remains in the AINS state. These alarms are not displayed in the output of the **show alarms brief system active** command but these alarms are displayed in the output of the **show alarms brief system conditions** command. When all the alarms clear, the port moves to IS state.

Displaying the AINS Configuration

AINS is supported for the COM side controllers on the OTS port. It is not supported for the line side OTS-OCH controllers on OLT and ILA cards. After the optical cross connections are configured, the COM side OTS-OCH controller boot ups in AINS state.

This example displays the OTS controller statistics with AINS Soak time running.

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

```
Wed Jun 22 09:43:04.356 UTC
```

```
Controller State: Down
```

```
Transport Admin State: Automatic In Service
```

```
LED State: Red
```

```
Alarm Status:
```

```
-----
```

```
Detected Alarms:
```

```
RX-LOS-P
```

```
TX-POWER-FAIL-LOW
```

```
Alarm Statistics:
```

```
-----
```

```
RX-LOS-P = 1
```

```
RX-LOC = 0
```

```
TX-POWER-FAIL-LOW = 1
```

```
INGRESS-AUTO-LASER-SHUT = 0
```

```
INGRESS-AUTO-POW-RED = 0
```

```
INGRESS-AMPLI-GAIN-LOW = 0
```

```
INGRESS-AMPLI-GAIN-HIGH = 0
```

```
EGRESS-AUTO-LASER-SHUT = 0
```

```
EGRESS-AUTO-POW-RED = 0
```

```
EGRESS-AMPLI-GAIN-LOW = 0
```

```
EGRESS-AMPLI-GAIN-HIGH = 0
```

```
HIGH-TX-BR-PWR = 0
```

```
HIGH-RX-BR-PWR = 0
```

```
SPAN-TOO-SHORT-TX = 0
```

```
SPAN-TOO-SHORT-RX = 0
```

```
Parameter Statistics:
```

```
-----
```

```

Total RX Power = -50.00 dBm
Total TX Power = -50.00 dBm
Ingress Ampli Gain = 0.0 dB
Ingress Ampli Tilt = 0.0 dB

```

```
Configured Parameters:
```

```

-----
Ingress Ampli Gain = 16.0 dB
Ingress Ampli Tilt = 0.0 dB

```

The following example displays the OTS-OCH cross-connect controller statistics with AINS Soak time running.

```
RP/0/RP0/CPU0:ios#show controllers ots-och 0/0/0/13/20
```

```
Tue Jul 12 10:19:48.838 UTC
```

```
Controller State: Down
```

```
Transport Admin State: Automatic In Service
```

```
Alarm Status:
```

```

-----
Detected Alarms:
    RX-LOS-P
    TX-POWER-FAIL-LOW

```

```
Alarm Statistics:
```

```

-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 1

```

```
Parameter Statistics:
```

```

-----
Total RX Power = -50.00 dBm
Total TX Power = -50.00 dBm

```

```
Cross Connect Info:
```

```

-----
line Channel = Ots-Och0/0/0/0/20

```

```
Configured Parameters:
```

```

-----
Rx Low Threshold = -50.0 dBm
Tx Low Threshold = -50.0 dBm

```

The following example displays the OCH controller statistics in AINS state.

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

```
Wed Jul 6 14:28:12.500 UTC
```

```
Controller State: Down
```

```
Transport Admin State: Automatic In Service
```

```
LED State: Red
```

```
Alarm Status:
```

```

-----
Detected Alarms:
RX-LOS-P

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
TX Power = -50.00 dBm
RX Power = -20.72 dBm

```

The following example displays the OCH controller statistics after AINS Soak time expiry. When the soak time expires, the Transport Admin State of OCH controller changes from *Automatic In Service* to *In Service*.

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

```
Wed Jul 6 14:29:59.242 UTC
```

```
Controller State: Up
```

```
Transport Admin State: In Service
```

```
LED State: Off
```

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

```
Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:
-----
TX Power = -50.00 dBm
RX Power = 2.79 dBm

```

The following example displays the OMS controller statistics in *AINS state*.

```
RP/0/RP0/CPU0:ios#show controllers oms 0/1/0/25
```

```
Tue Jul 12 10:32:05.258 UTC
```

```
Controller State: Down
```

```
Transport Admin State: Automatic In Service
```

```
LED State: Red
```

```

Alarm Status:
-----
Detected Alarms:
    RX-LOS-P

Alarm Statistics:
-----
RX-LOS-P = 1
TX-POWER-FAIL-LOW = 0

Parameter Statistics:

```

```

-----
TX Power = -7.40 dBm
RX Power = -19.91 dBm

```

All the alarms reported for the controllers in AINS state are displayed in the output of the **show alarms brief system conditions** command.

The following example displays the controller alarms in *AINS state*.

```
RP/0/RP0/CPU0:ios#show alarms brief system conditions
```

```
Mon Jul 25 05:43:50.073 UTC
```

```
-----
Conditions
-----
```

Location	Severity	Group	Set Time	Description
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/1 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/2 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/4 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/5 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/6 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/7 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/8 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/9 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/10 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/11 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/12 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/13 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/14 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/15 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/16 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/17 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/18 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/19 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/21 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Och0/1/0/22 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Oms0/1/0/31 - Loss
0/1 of Signal - Payload	Critical	Controller	07/21/2022 11:11:54 UTC	Oms0/1/0/26 - Loss

```

0/1          Critical      Controller      07/21/2022 11:11:54 UTC    Oms0/1/0/27 - Loss
of Signal - Payload
0/1          Critical      Controller      07/21/2022 11:11:54 UTC    Oms0/1/0/28 - Loss
of Signal - Payload
0/1          Critical      Controller      07/21/2022 11:11:54 UTC    Oms0/1/0/29 - Loss
of Signal - Payload
0/1          Critical      Controller      07/21/2022 11:11:54 UTC    Oms0/1/0/30 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/33 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/33 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/9 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/9 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/8 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/8 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/7 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/7 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/6 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/6 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/5 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/5 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/4 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/4 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/3 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/3 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/2 - Output
OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/2 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/32 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/32 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/31 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/31 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/30 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/30 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/29 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/29 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/28 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/28 - Loss
of Signal - Payload

```

```

0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/25 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/25 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/10 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/10 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/11 -
Output OTS Power Reading Below The Fail-Low Threshold
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/11 - Loss
of Signal - Payload
0/0          Critical      Controller      07/21/2022 11:12:00 UTC    Ots0/0/0/12 -
Output OTS Power Reading Below The Fail-Low Threshold

```

Headless Mode

The headless mode of operation allows Cisco NCS 1010 to operate errorless during software upgrades and when the controller card is either physically absent or in a failed state. For example, NCS 1010 operates in headless mode for up to 72 hours, during process restarts, controller reload, line card warm reload, line card FPD upgrade, or removal of the controller (Online Insertion and Removal (OIR)). During this time, traffic is not impacted, although the control plane is not up and running. However, you cannot provision anything nor view operational data with a nonfunctional controller. Performance monitoring data based on 15 minutes and 24-hour intervals are not supported with a nonfunctional controller.

OIR is done during the upgrade or replacement of controller cards. When you initiate an OIR, you cannot reach the NCS 1010 through any medium. When the OIR completes, the NCS 1010 becomes reachable.

You can initiate OIR on the controller unit for the following scenarios:

- FPD upgrade failure
- Software image update failure
- Bootup failure

ASE Loading

The OLT card includes a Noise Loader (NL) EDFA, which acts as an Amplified Spontaneous Emission (ASE) or noise source. The NL connected to the 2x33 ports Wavelength Selective Switch (WSS) loads optical noise. The optical noise fills the Line-TX optical spectrum, when the provisioned optical channels are not available on the ADD- 1 RX, ADD- 2 RX, or COM (OTS0/0/0/2 - OTS0/0/0/33) ports. For more details about the ports, see [OLT Functional Layout](#).

Benefits of ASE Loading:

- Completely populates the transmission spectrum at LINE-TX independent of the actual system traffic load, thereby easing the system regulation starting from the Day-1 of the installation.
- The same channel load is maintained during channel failures or channel deletion, which makes the system tolerant to power transients.
- System performances can be verified efficiently because the ASE pattern emulates the full spectrum load also for the nonlinear interaction in the fibers, such as Four Wave Mixing (FWM), Cross Phase

Modulations (XPM), and Stimulated Raman Scattering (SRS). Also, gradual fiber degradation that affects utilization of full-fiber capacity can be tracked.

- Keeps the system running the full-channel configuration, which makes the system be intrinsically stable and provide optimal performance.

How ASE Operates

The following is the list of operations that are performed as part of the ASE loading:

1. The NL emits a total power of 16 dBm, and generates a power-spectral density (PSD) that is approximately equal to -10 dBm/12.5 GHz at the WSS input port. The OCM7 port monitors profile of the generated ASE channel. A Variable Optical Attenuator (VOA) available between the NL and the WSS input port regulates the ASE channel level properly.
2. The Cisco NCS 1010 controller sets a predefined value for the VOA so that the ASE channels that are obtained at the COM TX-1 port are equalized to the actual traffic channels to fill out the spectrum at the input of the fixed gain amplifier.
3. When the controller detects a missing channel, for example any failure on the ADD/ EXP ports, it sends an updated attenuation value to the OLT. The OLT applies this value as a new attenuation setpoint and executes the transition from ADDs/EXPs path to ASE in the impacted wavelengths, thus ensuring fast recovery of the initial total optical power on the LINE-TX port.
4. When the optical power is restored, the controller sends a restoration command to the OLT. The OLT executes the transition from ASE to ADDs/EXPs in the impacted wavelengths ensuring minimal total optical power disturbance on the LINE-TX port, thus allowing a smooth fade-out of the ASE.

How ASE Is Managed

The default target ASE Load Spectral Density (AL_SD) is set to 81%. This default AL_SD is defined based on the frequency grid at 75 GHz with the first channel centered at 191.375 THz. The spectrum is allocated through logical bins with 3.125-GHz width such that each physical slice is associated to two bins. Based on the above, the first ASE channel has:

- Bins 1 and 2 blocked (frequency range 191.33750 – 191.34375 THz)
- Bins 3–22 opened (frequency range 191.34375 to 191.40625 THz)
- Bins 23 and 24 blocked (frequency range 191.40625 – 191.4125 THz)

All the other ASE channels are defined similarly by shifting all the settings by 75 GHz (24 bins).



Note The ASE channels on the bins 1537–1548 are retained as blocked for Automatic VOA Shutdown (AVS). In this AVS mode, the VOA is set at maximum attenuation value, when the channel is not provisioned to ensure the system reliability in case power is accidentally inserted.

Static ASE—At the system startup, without any channel provisioned, the complete ASE Load pattern is forwarded to the OLT LINE-TX port.

Dynamic ASE—When a traffic channel fails (for example, the PSD within the set of slices that are dedicated to the traffic channel is below a given threshold) an equivalent temporary ASE channel is inserted to maintain the spectral density on the line port. This dynamic ASE channel fills the original traffic channel with only a single slice guard band, at the beginning and the end. When the original traffic channel is restored, the temporary ASE channel is removed, and the original routing on the WSS is reestablished.

Optical Channel Monitoring

The Optical Channel Monitor (OCM) blocks in the OLT and ILA cards provide per-channel optical power monitoring.

The OLT-C card has a single OCM device with 37 OCM measuring points (OCM1 - OCM37). You can read the OCM data for the all the OCM blocks through the IOS-XR commands, except OCM1, OCM4, and OCM7.

The measuring points in the OLT-C card are:

- LINE-TX
- LINE-RX
- 2x33 ports of WSS in the multiplexer section of the OLT-C card

See [OLT Functional Layout](#) for details of the ports.

Table 11: Optical Specifications for OCM in OLT-C

Parameter	Unit	Minimum	Typical	Maximum	Note
Dynamic ranges	dBm/12.5GHz	-10		10	Ports: LINE-TX, COM-RX-1 and internal Noise Loader port
		-30		0	Port LINE-RX
		-35		0	Ports: ADD-RX-1 and ADD-RX-2
		-35		5	Ports ADD/DROP-i (i=3..32) (on DROP ports OCM is virtual)
Accuracy	dB	± 0.5		± 2	Depending on the adjacent channel relative power

Parameter	Unit	Minimum	Typical	Maximum	Note
Frequency range	THz	191.175 191.150		196.175	Out-of-band channel frequency 191.150 - 191.3375 THz are available only as row-data values.
Frequency accuracy (absolute)	GHz			± 5	
Frequency accuracy (relative)	GHz			+/-3	
Resolution Bandwidth	GHz		12.5		
Frequency step	GHz	3.125			
Scan Time	ms			250	Single port

The ILA-C card has a single OCM device with 4 OCM measuring points.

The measuring points in the ILA-C card are:

- Input port of EDFA1
- Input port of EDFA2
- Output port of EDFA1
- Output port of EDFA2

See [ILA Functional Layout](#) for details of the ports.

Table 12: Optical Specifications for OCM in ILA-C

Parameter	Unit	Min.	Typical	Max	Note
Dynamic ranges	dBm/12.5GHz	-30		0	LINE-RX ports
		-10		10	LINE-TX ports
Accuracy	dB	± 0.5		± 2	Depending on the adjacent channel relative power
Frequency range	THz	191.175		196.175	
Frequency accuracy (absolute)	GHz			± 5	

Parameter	Unit	Min.	Typical	Max	Note
Frequency accuracy (relative)	GHz			± 3	
Resolution Bandwidth	GHz		12.5		
Frequency step	GHz	3.125			
Scan Time	ms			250	Single port

View OCM Data

You can view the raw OCM data (slice level channel power) using the following commands:

```
RP/0/RP0/CPU0:ios#sh controllers ots 0/0/0/0 spectrum-info
Fri Feb 4 13:12:49.841UTC
Spectrum Slices spacing      :          3.125 GHz
Spectrum Slices Range       :          1 - 1548
Slice start wavelength       :          1566.82 nm
Slice start frequency        :          191337.50 GHz
Spectrum power information :
Rx power :
-----
spectrum-slice num          Rx-power values (dBm)
-----
  1 - 12                    -88.8 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8
-88.8 -88.8 -88.8 -88.8
 13 - 24                    -88.8 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8
-88.8 -88.8 -88.8 -88.8
.....
.....
.....
1537 - 1548                 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8 -88.8
-88.8 -88.8 -88.8 -88.8
-----
Tx power :
-----
spectrum-slice num          Tx-power values (dBm)
-----
 1 - 12                    -9.5 -7.3 -6.0 -5.2 -4.9 -4.8 -4.6 -4.4 -4.4
-4.4 -4.4 -4.4
13 - 24                    -4.4 -4.5 -4.6 -4.8 -5.1 -5.5 -6.4 -7.7 -9.6
-12.0 -13.2 -11.4
25 - 36                    -9.2 -7.7 -6.7 -6.2 -6.0 -5.9 -5.7 -5.6 -5.6
-5.5 -5.4 -5.4
37 - 48                    -5.3 -5.3 -5.4 -5.5 -5.8 -6.1 -6.6 -7.3 -8.6
-10.4 -12.2 -11.8
.....
.....
.....
1525 - 1536                 -2.4 -2.4 -2.4 -2.4 -2.4 -2.3 -2.3 -3.0
-4.2 -6.5 -10.3 -14.9
1537 - 1548                 -19.3 -22.6 -24.3 -25.3 -26.1 -26.6 -27.1 -27.6
-27.9 -28.2 -28.4 -28.6
```

The preceding sample displays the Rx-power values (OCM3 raw data) and Tx-power values (OCM2 raw data) at the line sides. Similarly, you can view the OCM raw data for the COM side controllers OTS0/0/0/2 to 0/0/0/33.

You can also view the grid OCM data (per channel power level) for a particular channel in the ILA-C and OLT-C cards. By default, the channels are not created. Create a channel using the following commands:

configure

hw-module location *location* **terminal-ampli grid-mode** *mode*

channel-id *channel id* **centre-freq** *frequency* **width** *channel-width*

commit

The following is a sample to configure the channel on an OLT-C card:

```
RP/0/RP0/CPU0:ios#config
Fri Feb 4 13:14:49.841 UTC
RP/0/RP0/CPU0:ios(config)#
RP/0/RP0/CPU0:ios(config)#hw-module location 0/0/NXR0 terminal-ampli grid-mode flex
RP/0/RP0/CPU0:ios(config-hwmod-olt-flexi)#channel-id 1 centre-freq 196.1 width 75
RP/0/RP0/CPU0:ios(config-hwmod-olt-flexi)# commit
Fri Feb 4 13:15:12.841 UTC
```

```
RP/0/RP0/CPU0:ios(config-hwmod-olt-flexi)#end
```

The following sample shows the OTS OCH controller channel parameters such as Total Rx power and Total Tx power.

```
RP/0/RP0/CPU0:ios#sh controllers ots-och 0/0/0/0/1
Fri Feb 4 13:15:59.125 UTC
Controller State: Up
Transport Admin State: In Service
LED State: Yellow
Parameter Statistics:
-----
Total RX Power = -10.50 dBm
Total TX Power = -10.50 dBm
Configured Parameters:
-----
RP/0/RP0/CPU0:ios#
```

To view the grid OCM data for a particular channel in the ILA-C card, create a channel using the following commands:

configure

hw-module location *location* **inline-ampli grid-mode** *mode*

channel-id *channel id* **centre-freq** *frequency* **width** *channel-width*

commit

The following is a sample to a configure the OTS-OCH controller on an ILA-C card:

```
RP/0/RP0/CPU0:ios#config
Fri Feb 4 13:15:49.841 UTC
RP/0/RP0/CPU0:ios(config)#
RP/0/RP0/CPU0:ios(config)#hw-module location 0/0/NXR0 inline-ampli grid-mode flex
RP/0/RP0/CPU0:ios(config-hwmod-ila-flexi)#channel-id 1 centre-freq 196.1 width 75
RP/0/RP0/CPU0:ios(config-hwmod-ila-flexi)# commit
Fri Feb 4 13:15:12.841 UTC
```

```
RP/0/RP0/CPU0:ios(config-hwmod-olt-flexi)#end
```

The following sample shows the OTS OCH controller channel parameters such as Total Rx power and Total Tx power.

```
RP/0/RP0/CPU0:ios#sh controllers ots-och 0/0/0/2/1
Fri Feb 4 13:15:59.125 UTC
Controller State: Up
Transport Admin State: In Service
Alarm Status:
-----
Detected Alarms: None
Alarm Statistics:
-----
RX-LOS-P = 0
TX-POWER-FAIL-LOW = 0
Parameter Statistics:
-----
Total RX Power = -10.50 dBm
Total TX Power = -10.50 dBm
Configured Parameters:
-----
RP/0/RP0/CPU0:ios#
```




CHAPTER 3

Monitor Performance

Performance monitoring (PM) parameters are used by service providers to gather, store, set thresholds for, and report performance data for early detection of network issues. You can configure and retrieve PM counters for the various controllers in flex-bin, 30-second, 15-minute, or 24-hour intervals. These parameters simplify troubleshooting operations and enhance data that can be collected directly from the equipment.

- [Monitor Performance, on page 67](#)
- [Configure and View PM Parameters, on page 72](#)

Monitor Performance

You can set and retrieve PM counters for the OTS, OTS-OCH, OSC, DFB, OCH, and OMS controllers for various intervals.

The OCH and OMS controllers are created when the Mux/Demux panel and breakout panels are powered up using the USB 2.0 connection from the NCS 1010 EITU card. You can only view the current and historical PM parameters for the panels. You cannot configure the PM parameters for these controllers.

This table lists the PM parameters, their descriptions, and precision levels.

Table 13: PM Parameters for Controllers

PM Parameter (Unit of Measure)	Description	Resolution
OPT [dBm]	Total Tx(C+OSC) power	1/100
OPR [dBm]	Total Rx(C+OSC) power	1/100
OPT(C+L) [dBm]	Total Tx(C+L+OSC) power	1/100
OPR(C+L) [dBm]	Total Rx(C+L+OSC) power	1/100
OPR(S) [dBm]	C Band Received Signal Power	1/100
OPT(S) [dBm]	C Band Transmitted Signal Power	1/100
OPBR [dBm]	Back Reflection Power	1/100
EAGN [dB]	Egress Amplifier Gain	1/100
EATL [dB]	Egress Amplifier Tilt	1/100

IAGN [dB]	Ingress Amplifier Gain	1/100
IATL [dB]	Ingress Amplifier Tilt	1/100
RAMAN-TOT [mW]	Raman Total Pump power	1/10
RAMAN-1 [mW]	Raman 1 Pump power	1/10
RAMAN-2 [mW]	Raman 2 Pump power	1/10
RAMAN-3 [mW]	Raman 3 Pump power	1/10
RAMAN-4 [mW]	Raman 4 Pump power	1/10
RAMAN-5 [mW]	Raman 5 Pump power	1/10

The following tables list the maximum and minimum thresholds that can be set for the PM parameters for OLT nodes

Table 14: PM Thresholds for OLT OTS Controller (0/0/0/0)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-2000	4000
OPR	-3000	1800
OPT(C+L)	-2000	6085
OPR(C+L)	-3000	3600
OPR(S)	-3000	1800
OPT(S)	-500	2800
OPBR	-3000	-1400
EAGN	1390	3100
EATL	-500	500
IAGN	1030	3800
IATL	-500	500
RAMAN-TOT	2000	14100
RAMAN-1	450	3900
RAMAN-2	400	3900
RAMAN-3	400	2200
RAMAN-4	400	2200
RAMAN-5	350	1900

Table 15: PM Thresholds for OLT OTS Controller (0/0/0/2 and 0/0/0/3)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-3000	1500
OPR	-2500	1800
IAGN	1300	1900
IATL	-500	500

Table 16: PM Thresholds for OLT OTS Controller (0/0/0/4 to 0/0/0/33)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-3000	1500
OPR	-1500	1000

Table 17: PM Thresholds for OLT OTS-OCH Controller

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-3000	1500
OPR	-3000	1500

Table 18: PM Thresholds for OLT OSC Controller (0/0/0/0)

Parameter	Threshold Min	Threshold Max
OPT	-2000	1200
OPR	-3000	0

Table 19: PM Thresholds for OLT DFB Controller (0/0/0/0)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-2000	1000
OPR	-3000	1500

The following tables list the maximum and minimum thresholds that can be set for the PM parameters for ILA nodes.

Table 20: PM Thresholds for ILA OTS Controller (0/0/0/0)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-3000	4000

OPR	-3000	2000
OPT(C+L)	-3000	6085
OPR(C+L)	-3000	4000
OPR(S)	-3000	2800
OPT(S)	-3000	2000
OPBR	-3000	-1400
EAGN	590	3600
EATL	-500	500
RAMAN-TOT	2000	14100
RAMAN-1	450	3900
RAMAN-2	400	3900
RAMAN-3	400	2200
RAMAN-4	400	2200
RAMAN-5	350	1900

Table 21: PM Thresholds for ILA OTS Controller (0/0/0/2)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-3000	4000
OPR	-3000	2000
OPT(C+L)	-3000	6085
OPR(C+L)	-3000	4000
OPR(S)	-3000	2800
OPT(S)	-3000	2000
OPBR	-3000	-1400
EAGN	590	3600
EATL	-500	500
RAMAN-TOT	2000	14100
RAMAN-1	450	3900
RAMAN-2	400	3900

RAMAN-3	400	2200
RAMAN-4	400	2200
RAMAN-5	350	1900

Table 22: PM Thresholds for ILA OSC Controller (0/0/0/0 and 0/0/0/2)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-2000	1200
OPR	-3000	0

Table 23: PM Thresholds for ILA OTS-OCH Controllers

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-3000	1500
OPR	-3000	1500

Table 24: PM Thresholds for ILA DFB Controllers (0/0/0/0 and 0/0/0/2)

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-2000	1000
OPR	-3000	1500

This table lists the maximum and minimum thresholds that are set for the PM parameters for OCH controllers.

Table 25: PM Thresholds for OCH Controllers

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-30	15
OPR	-30	15

This table lists the maximum and minimum thresholds that are set for the PM parameters for OMS controllers.

Table 26: PM Thresholds for OMS Controllers

PM Parameter	Minimum Threshold	Maximum Threshold
OPT	-30	15
OPR	-30	15

Configure and View PM Parameters

You can configure the performance monitoring parameters for the controllers. To configure PM parameters, use the following commands in the configuration mode:

Examples

The following example sets the reporting status to maximum TCA for the *eagn* parameter of the OTS controller for a 15-minute interval.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0 pm 15-min ots report eagn max-tca enable
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end
```

The following example configures the maximum threshold for the *eagn* parameter of the OTS controller to 20 dB.



Note The OTS controller commands accept PM parameter values in two decimal places. In this example, the *eagn* parameter is entered as *2000* to configure the *eagn* parameter to *20 dB*.

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0 pm 15-min ots threshold eagn max 2000
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#end
```

To view the current PM parameters on an OTS controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 pm current 15-min optics 1
```

The following output shows the current PM parameters on an OTS controller for a 15-minute interval and highlights the *maximum threshold* set for the *eagn* parameter that is configured for *20 dB*.

```
Tue May 17 06:37:00.529 UTC

Optics in the current interval [06:30:00 - 06:37:00 Tue May 17 2022]

Optics current bucket type : Valid

Configured  TCA      MIN      AVG      MAX      Operational  Configured  TCA      Operational
Threshold(max) Threshold(max(max)
OPT[dBm] : 20.00    20.00    20.00    -20.00    NA          NO      40.00    NA
NO
OPR[dBm] : 20.00    20.00    20.00    -30.00    NA          NO      18.00    NA
NO
OPT(C+L) [dBm]: 20.00    20.00    20.00    -20.00    NA          NO      60.85    NA
NO
OPR(C+L) [dBm]: -10.00   -10.00   -10.00   -30.00    NA          NO      36.00    NA
NO
OPT(S) [dBm] : 20.00    20.00    20.00    -5.00     NA          NO      28.00    NA
NO
OPR(S) [dBm] : 20.00    20.00    20.00    -30.00    NA          NO      18.00    NA
NO
OPBR[dBm] : -30.00   -30.00   -30.00   -30.00    NA          NO      -14.09   NA
NO
EAGN[dB] : 30.00    30.00    30.00    16.00     NA          NO      20.00    20.00
```

```

YES
EATL [dB]      : -4.80    -4.80    -4.80    -5.00    NA        NO    5.00    NA
                NO
IAGN [dB]      : 25.00    25.00    25.00    12.00    NA        NO    25.00    NA
                NO
IATL [dB]      : -2.40    -2.40    -2.40    -5.00    NA        NO    5.00    NA
                NO
RAMAN-TOT [mW] : 300.00    300.00    300.00    200.00    NA        NO    1410.00  NA
                NO
RAMAN-1 [mW]   : 45.00    45.00    45.00    45.00    NA        NO    390.00   NA
                NO
RAMAN-2 [mW]   : 40.00    40.00    40.00    40.00    NA        NO    390.00   NA
                NO
RAMAN-3 [mW]   : 40.00    40.00    40.00    40.00    NA        NO    220.00   NA
                NO
RAMAN-4 [mW]   : 40.00    40.00    40.00    40.00    NA        NO    220.00   NA
                NO
RAMAN-5 [mW]   : 35.00    35.00    35.00    35.00    NA        NO    190.00   NA
                NO

```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters on an OTS controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/0 pm history 15-min optics 1 bucket 1
```

The following output shows the historical PM parameters on an OTS controller for a 15-minute interval.

Tue May 17 07:02:26.911 UTC

Optics in interval 1 [06:45:00 - 07:00:00 Tue May 17 2022]

Optics history bucket type : Valid

```

                MIN      AVG      MAX
OPT [dBm]      : 20.00    20.00    20.00
OPR [dBm]      : 20.00    20.00    20.00
OPT (C+L) [dBm]: 20.00    20.00    20.00
OPR (C+L) [dBm]: -10.00   -10.00   -10.00
OPT (S) [dBm]  : 20.00    20.00    20.00
OPR (S) [dBm]  : 20.00    20.00    20.00
OPBR [dBm]     : -30.00   -30.00   -30.00
EAGN [dB]      : 30.00    30.00    30.00
EATL [dB]      : -4.80    -4.80    -4.80
IAGN [dB]      : 25.00    25.00    25.00
IATL [dB]      : -2.40    -2.40    -2.40
RAMAN-TOT [mW] : 300.00    300.00    300.00
RAMAN-1 [mW]   : 45.00    45.00    45.00
RAMAN-2 [mW]   : 40.00    40.00    40.00
RAMAN-3 [mW]   : 40.00    40.00    40.00
RAMAN-4 [mW]   : 40.00    40.00    40.00
RAMAN-1 [mW]   : 35.00    35.00    35.00

```

To view the current PM parameters on an OTS-OCH controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers ots-och 0/0/0/0/1 pm current 15-min optics 1
```

The following output shows the current PM parameters on an OTS-OCH controller for a 15-minute interval.

Tue May 17 10:27:20.387 UTC

Optics in the current interval [10:15:00 - 10:27:20 Tue May 17 2022]

Optics current bucket type : Valid

```

                MIN  AVG  MAX Operational   Configured   TCA   Operational   Configured

```

```

TCA
Threshold(max) (max)      Threshold(min)  Threshold(min) (min)  Threshold(max)
OPT[dBm] : 1.20 1.30  1.30  -30.00          NA          NO          15.00
NA      NO
OPR[dBm] :-12.31-12.25-12.20  -30.00          NA          NO          15.00
NA      NO
Last clearing of "show controllers OPTICS" counters never

```

To view the current PM parameters on an OSC controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controller osc 0/0/0/0 pm current 15-min optics 1
```

The following output shows the current PM parameters on an OSC controller for a 15-minute interval.

```

Tue May 17 08:24:32.642 UTC

Optics in the current interval [08:15:00 - 08:24:32 Tue May 17 2022]

Optics current bucket type : Valid
Configured      MIN      AVG      MAX      Operational  Configured      TCA      Operational
Configured      TCA
Threshold(max) Threshold(max) (max)      Threshold(min)  Threshold(min) (min)
OPT[dBm]      : -10.00  -10.00  -10.00  -20.00          NA          NO      12.00
NA            NO
OPR[dBm]      : -30.00  -30.00  -30.00  -30.00          NA          NO      0.00
NA            NO

```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters on a DFB controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controller dfb 0/0/0/0 pm current 15-min optics 1
```

The following output shows the current PM parameters on a DFB controller for a 15-minute interval.

```

Tue May 17 08:28:37.455 UTC

Optics in the current interval [08:15:00 - 08:28:37 Tue May 17 2022]

Optics current bucket type : Valid
MIN  AVG  MAX  Operational  Configured  TCA  Operational  Configured  TCA
Threshold  Threshold  Threshold  Threshold  Threshold
(min)      (min)      (min)      (max)      (max)      (max)
OPT[dBm]: 20.00 20.00 20.00  -25.23  NA  NO  18.00  NA  NO
OPR[dBm]: 10.00 10.00 10.00  -30.00  NA  NO  12.00  NA  NO

```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters for an OCH controller for a 30-second interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers och 0/1/0/0 pm current 30-sec optics 1
```

The following output shows the current PM parameters for an OCH controller for a 30-second interval.

```

Tue May 10 11:28:29.896 UTC

Optics in the current interval [11:28:00 - 11:28:29 Tue May 10 2022]

Optics current bucket type : Valid
MIN  AVG  MAX  Operational  Configured  TCA  Operational
Configured  TCA
Threshold(max) Threshold(max) (max)      Threshold(min)  Threshold(min) (min) Threshold(max)
OPT[dBm]      : -50.00  -50.00  -50.00  -30.00          NA          NO      15.00
NA            NO

```

```
OPR[dBm]      : -50.00   -50.00   -50.00   -30.00           NA           NO   15.00
                NA           NO
```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters on an OCH controller for a 30-second interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers och 0/1/0/0 pm history 30-sec optics 1 bucket 1
```

The following output shows the historical PM parameters on an OCH controller for a 30-second interval.

Mon Jul 25 05:35:52.176 UTC

Optics in interval 1 [05:35:00 - 05:35:30 Mon Jul 25 2022]

```
Optics history bucket type : Valid
                MIN      AVG      MAX
OPT[dBm]      : -50.00   -50.00   -50.00
OPR[dBm]      : -50.00   -50.00   -50.00
```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters for an OCH controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers och 0/1/0/0 pm current 15-min optics 1
```

The following output shows the current PM parameters for an OCH controller for a 15-minute interval.

Tue May 10 11:28:50.952 UTC

Optics in the current interval [11:15:00 - 11:28:50 Tue May 10 2022]

```
Optics current bucket type : Valid
                MIN      AVG      MAX      Operational      Configured      TCA      Operational
                Configured      TCA
                Threshold(max) (max)      Threshold(min)      Threshold(min) (min) Threshold(max)
OPT[dBm]      : -50.00   -50.00   -50.00   -30.00           NA           NO   15.00
                NA           NO
OPR[dBm]      : -50.00   -50.00   -50.00   -30.00           NA           NO   15.00
                NA           NO
```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters for an OCH controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers och 0/1/0/0 pm history 15-min optics 1 bucket 1
```

The following output shows the historical PM parameters for an OCH controller for a 15-minute interval.

Mon Jul 25 05:36:12.167 UTC

Optics in interval 1 [05:15:00 - 05:30:00 Mon Jul 25 2022]

```
Optics history bucket type : Valid
                MIN      AVG      MAX
OPT[dBm]      : -50.00   -50.00   -50.00
OPR[dBm]      : -50.00   -50.00   -50.00
```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters on an OCH controller for a 24-hour interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers och 0/1/0/0 pm current 24-hour optics 1
```

The following output shows the current PM parameters on an OCH controller for a 24-hour interval.

```
Tue May 10 11:29:09.270 UTC
Optics in the current interval [00:00:00 - 11:29:09 Tue May 10 2022]

Optics current bucket type : Invalid
      MIN      AVG      MAX      Operational      Configured      TCA      Operational
      Configured      TCA
      Threshold(max)      Threshold(max)      Threshold(max)
OPT[dBm] : -50.00      -50.00      -50.00      -30.00      NA      NO      15.00
      NA      NO
OPR[dBm] : -50.00      -50.00      -50.00      -30.00      NA      NO      15.00
      NA      NO
```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters on an OCH controller for a 24-hour interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers och 0/1/0/0 pm history 24-hour optics 1
```

The following output shows the historical PM parameters on an OCH controller for a 24-hour interval.

```
Mon Jul 25 05:36:35.165 UTC
Optics in interval 1 [00:00:00 - 24:00:00 Sun Jul 24 2022]

Optics history bucket type : Valid
      MIN      AVG      MAX
OPT[dBm] : -50.00      -50.00      -50.00
OPR[dBm] : -50.00      -50.00      -50.00
```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters for an OMS controller for a 30-second interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/8 pm current 30-sec optics 1
```

The following output shows the current PM parameters for an OMS controller for a 30-second interval.

```
Mon Jul 25 07:24:38.319 UTC
Optics in the current interval [07:24:30 - 07:24:38 Mon Jul 25 2022]

Optics current bucket type : Valid
MIN AVG MAX Operational Configured TCA Operational Configured TCA
Threshold(min) Threshold(min) (min) Threshold(max) Threshold(max) (max)
OPT[dBm] : -50.00 -50.00 -50.00 -30.00 NA NO 15.00 NA NO
OPR[dBm] : -50.00 -50.00 -50.00 -30.00 NA NO 15.00 NA NO
```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters on an OMS controller for a 30-second interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/8 pm history 30-sec optics 1 bucket 1
```

The following shows the historical PM parameters on an OMS controller for a 30-second interval.

```
Mon Jul 25 07:13:51.228 UTC
Optics in interval 1 [07:13:00 - 07:13:30 Mon Jul 25 2022]

Optics history bucket type : Valid
      MIN      AVG      MAX
OPT[dBm] : -50.00      -50.00      -50.00
```



```
OPR[dBm] : -50.00 -50.00 -50.00
```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters for an OMS controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/8 pm current 15-min optics 1
```

The following output shows the current PM parameters for an OMS controller for a 15-minute interval.

```
Mon Jul 25 07:25:00.183 UTC
```

```
Optics in the current interval [07:15:00 - 07:25:00 Mon Jul 25 2022]
```

```
Optics current bucket type : Valid
MIN AVG MAX Operational Configured TCA Operational Configured TCA
Threshold(min) Threshold(min) (min) Threshold(max) Threshold(max) (max)
OPT[dBm] : -50.00 -50.00 -50.00 -30.00 NA NO 15.00 NA NO
OPR[dBm] : -50.00 -50.00 -50.00 -30.00 NA NO 15.00 NA NO
```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters for an OMS controller for a 15-minute interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/8 pm history 15-min optics 1 bucket 1
```

The following output shows the historical PM parameters for an OMS controller for a 15-minute interval.

```
Mon Jul 25 07:14:03.090 UTC
```

```
Optics in interval 1 [06:45:00 - 07:00:00 Mon Jul 25 2022]
```

```
Optics history bucket type : Valid
          MIN          AVG          MAX
OPT[dBm] : -50.00    -50.00    -50.00
OPR[dBm] : -50.00    -50.00    -50.00
```

Last clearing of "show controllers OPTICS" counters never

To view the current PM parameters on an OMS controller for a 24-hour interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/8 pm current 24-hour optics 1
```

The following output shows the historical PM parameters for an OMS controller for a 15-minute interval.

```
Mon Jul 25 07:26:09.817 UTC
```

```
Optics in the current interval [00:00:00 - 07:26:09 Mon Jul 25 2022]
```

```
Optics current bucket type : Valid
MIN AVG MAX Operational Configured TCA Operational Configured TCA
Threshold(min) Threshold(min) (min) Threshold(max) Threshold(max) (max)
OPT[dBm] : -50.00 -50.00 -50.00 -30.00 NA NO 15.00 NA NO
OPR[dBm] : -50.00 -50.00 -50.00 -30.00 NA NO 15.00 NA NO
```

Last clearing of "show controllers OPTICS" counters never

To view the historical PM parameters on an OMS controller for a 24-hour interval, use the following command:

```
RP/0/RP0/CPU0:ios#show controllers oms 0/3/0/8 pm history 24-hour optics 1
```

The following output shows the historical PM parameters on an OMS controller for a 24-hour interval.

```
Mon Jul 25 07:18:13.532 UTC
```

```
Optics in interval 1 [00:00:00 - 24:00:00 Sun Jul 24 2022]
```

```
Optics history bucket type : Valid
      MIN      AVG      MAX
OPT[dBm] : -50.00  -50.00  -50.00
OPR[dBm] : -50.00  -50.00  -50.00

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



CHAPTER 4

Connection Verification

This chapter describes the tasks related to verify connection between NCS 1010 line cards, line card and breakout panel, and line card and Mux/Demux panel.

- [Power Data Reading, on page 79](#)
- [Connection Verification, on page 80](#)
- [Connection Verification on OTS Controller, on page 89](#)

Power Data Reading

Photodiodes (PDs) are optical power monitors that are present on all input and aggregated output ports to monitor power levels. Some PD monitors are enabled with tone-detection capability.

Table 27: NCS1K-BRK-8 Calibrated Port References

Photodiode	Port Calibrated	Port Label (Direction)	Minimum Power	Maximum Power	Dynamic Range
PD 1 to PD 8	MPO-16 input ports	0 to 7 (TX)	-20	10	30
PD 9 to PD 16	MPO-16 output ports	0 to 7 (RX)	-20	10	30
PD 17	MPO input fiber 1	COM	-30	10	40

Table 28: NCS1K-BRK-24 Calibrated Port References

Photodiode	Port Calibrated	Port Label (Direction)	Minimum Power	Maximum Power	Dynamic Range
PD 1 to PD 8	MPO-16 input ports	0 to 23 (TX)	-20	10	30

Photodiode	Port Calibrated	Port Label (Direction)	Minimum Power	Maximum Power	Dynamic Range
PD 9 to PD 11	MPO-16 output ports	0 to 2 (RX)	-20	10	30
PD 12 to PD 14		3 to 5 (RX)			
PD 15 to PD 17		6 to 8 (RX)			
PD 18 to PD 20		9 to 11 (RX)			
PD 21 to PD 23		12 to 14 (RX)			
PD 24 to PD 26		15 to 17 (RX)			
PD 27 to PD 29		18 to 20 (RX)			
PD 30 to PD 32		21 to 23 (RX)			
PD 33	MPO input fiber 1	COM	-30	10	40

Table 29: NCS1K-MD-32x-y Calibrated Port References

Photodiode	Port Calibrated	Port Label (Direction)	Minimum Power	Maximum Power	Dynamic Range
PD 1 to PD 32	32 LC input ports	0 to 31 (RX)	-30	10	40
PD 33	COM-RX	COM (RX)	-10	23	33
PD 34	COM-TX	COM (TX)	-35.5	20	55.5
PD 35	COM-RX	COM (TX)	-40	0	40
PD 36 ¹	COM-RX	COM (RX)	-24	5	30

¹ This Photo diode refers only to OOB (191.175GHz) frequency

Connection Verification

Connection verification checks the connection between the OLT-C line card and all the other passive modules to avoid miscabling during the node installation. This task generates a specific probe signal from the dedicated Connection Verification Tunable Laser (CV-TL) available at COM-RX-2 (at a given frequency and power) and detects the probe signal on:

- The same OLT-C line card
- The passive modules (Mux/Demux panel or breakout panel) connected to the OLT-C line card
- A different unit (OLT-C line card or passive module) belonging to the same NE
- An optical interface (Router ports or Transponder) connected to the OLT-C line card

Connection verification uses a probe signal or adds a low frequency ON/OFF modulation tone transmitting a given tone pattern at 5 Hz (200 ms bit time). The tone pattern length ranges 4–32 bytes (including an alignment byte) and it includes the Cable-IDs of the cables in the connection and in case also the optical frequency of the specific connection.

The Cable-ID is generated by the Optical Node Controller supervising the complete NE.

The connection verification process uses the out-of-band (OOB) WSS frequencies (191.150–191.3375 THz) to reach the Optical Interfaces connected to the OLT-C line card via Mux/Demux panel.

Line Card and Passive Modules Connection Verification

This section describes the connection verification between OLT-C line card and passive modules that are connected to ADD/DROP-i ports and the association between each passive modules and the related OLT-C line card USB management port.

Connection verification is performed using the OOB channel with CV-TL tuned at 191.175 THz. To univocally identify the optical path under test, the CV-TL is modulated with a low-frequency pattern including the Cable-ID of the connection.

For connection verification toward Mux/Demux panel, the CV-TL at COM-RX-2 port is routed to the DROP-1 or DROP-2 ports. The CV-TL is checked at the PD 36 inside the Mux/Demux panel. CV-TL verifies the correspondence between the specific module and management USB port. The connection verification loopback performs verification of the full optical path. The loopback checks the connection verification signal at PD 24/25 filtered monitors available on OLT-C line card ADD-1 or ADD-2 ports.

To detect the tone pattern on the connection verification signal, the following thresholds are set on the different monitors points:

- Mux/Demux panel at PD 36 ON-threshold = -3dBm
- Breakout panel loopback PD ON-threshold = -3dBm
- OLT-C line card ADD ports at PD 24/25 ON-threshold = -5dBm
- OLT-C line card COM-TX-2 port ON-threshold = -21dBm

For connection verification toward the breakout panels, the CV-TL at the COM-RX-2 port is routed to the first fiber of the specific MPO connector (port DROP-i with i=4, 12, 20, 28). The connection verification signal is checked at the monitors present in the breakout panels on the loopback path. This verifies the correspondence between the specific module and management USB port. The verification of the full optical path is performed by checking the connection verification signal at the COM-TX-2 port.

All the monitors receiving a connection verification signal detects and buffers the Cable-ID pattern encoded in the tone to allow the connection verification process by the node controller.

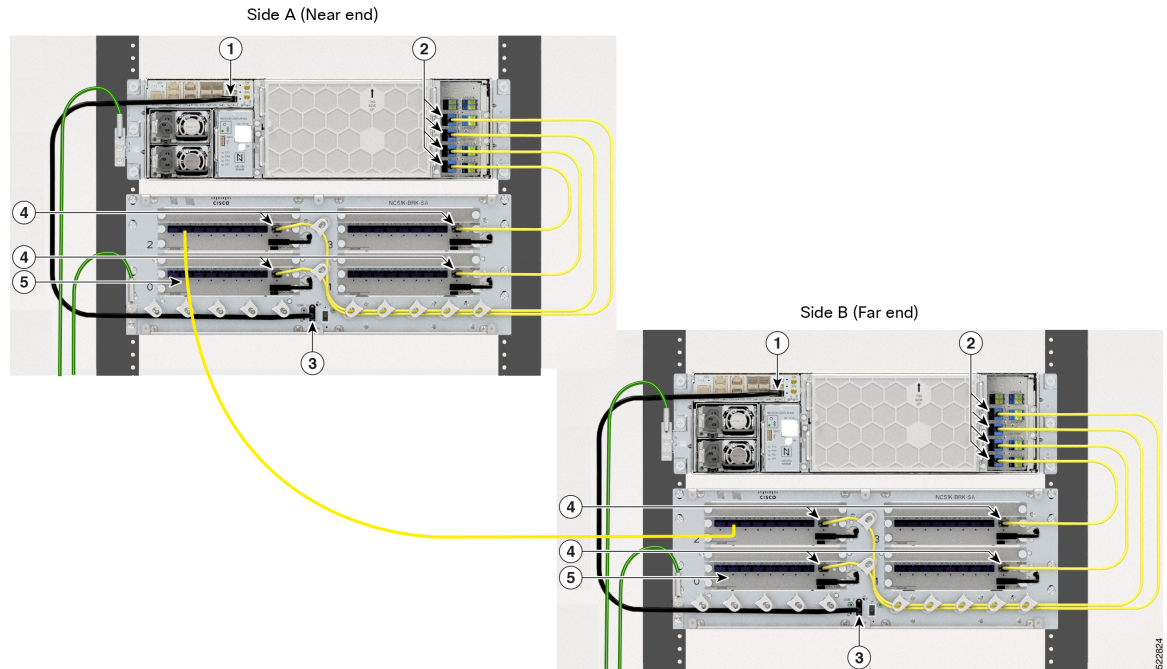
The connection verification signal loopback inside the breakout panel is replicated on all the output port on the MPO connector. In this way, it is possible to verify the loss of the MPO cable on the different fibers checking the connection verification signal power levels at the different ADD-i ports. This function requires a “diverse routing” between WSS Mux and Demux sections.

Side-to-Side Connection Verification

This section describes the connection verification between the different OLT units that are deployed on different sides of a multidegree ROADM node. The interconnection between the different OLT faced on the

different sides of a multidegree ROADM is performed via LC patch-cords interconnection between the MPO ports of NCS1K-BRK-8 modules. The following figure shows the Side-to-Side connection between the OLT nodes through NCS1K-BRK-8 modules.

Figure 6: NCS 1010 Optical Line System Side-to-Side Connection



1	EITU USB 2.0 Port
2	OLT-C Line Card Add/Drop MPO Ports
3	NCS1K-BRK-8 USB 2.0 Port
4	NCS1K-BRK-8 MPO Ports
5	NCS1K-BRK-8 LC Cable

The connection verification process is performed using the OOB channel with CV-TL tuned at frequency 191.17 THz. To univocally identify the optical path under test, the CV-TL is modulated with a low-frequency pattern including the Cable-ID of the connection.

The connection verification signal that is generated by the CV-TL is routed to the specific WSS DROP-i ports used for the side-to-side interconnection. It is verified at the monitors available at the NCS1K-BRK-8 input ports that are connected to the OLT-C line card at the other side.

All the monitors receiving a connection verification signal detects and buffers the Cable-ID pattern encoded in the tone. This method allows the proper connection verification process by the node controller.

The side-to-side connection verification is performed after the connection verification between the OLT-passive units to have a complete view of the interconnection between the OLT and each specific NCS1K-BRK-8 module.

The side-to-side connection verification check is performed without any traffic present on the path.

To properly detect the tone pattern on the side-to-side connection verification signal, an ON-threshold of -5dBm is provisioned on all PDs at the DIR-i-RX ports of the NCS1K-BRK-8 module.

Verify Connection for Side-to-Side Nodes

This task describes how to verify connection between different NCS 1010 OLT nodes on different sides of the multidegree ROADM nodes.

Step 1 Start tone-pattern on OTS controller.

```
RP/0/RP0/CPU0:ios#tone-pattern controller ots 0/0/0/5 start
Tue May 10 11:37:51.597 UTC
Tone pattern started
```

Note The following alarm is raised after the tone-pattern is started.

```
0/0 Minor Controller 07/13/2022 21:21:02 UTC
Ots0/0/0/5 - Tone Generation In Progress
```

Step 2 Start tone-pattern-detect on OMS controller on one side.

```
RP/0/RP0/CPU0:ios#tone-pattern-detect controller oms 0/2/0/9 start
Tue May 10 11:38:03.775 UTC
Tone pattern detect started
```

Step 3 Start tone-pattern-detect on OCH controller on the other side.

```
RP/0/RP0/CPU0:ios#tone-pattern-detect controller och 0/2/0/1 start
Tue May 10 11:38:03.775 UTC
Tone pattern detect started
```

Step 4 Use the **tone-info** command to check for successful connection verification on OMS controller.

```
RP/0/RP0/CPU0:ios#show controllers oms 0/2/0/9 tone-info
```

Step 5 Use the **tone-info** command to check for successful connection verification on OCH controller.

```
RP/0/RP0/CPU0:ios#show controllers och 0/2/0/1 tone-info
```

Step 6 Stop the tone-pattern-detect on the OCH controller.

```
RP/0/RP0/CPU0:ios#tone-pattern-detect controller och 0/2/0/1 stop
Tue May 10 11:50:36.185 UTC
Tone pattern detect stoped
```

Step 7 Stop the tone-pattern-detect on the OMS controller.

```
RP/0/RP0/CPU0:ios#tone-pattern-detect controller oms 0/2/0/9 stop
Tue May 10 11:50:36.185 UTC
Tone pattern detect stoped
```

Step 8 Stop the tone-pattern-detect on the OTS controller.

```
RP/0/RP0/CPU0:ios#tone-pattern controller ots 0/0/0/5 stop
Tue May 10 11:50:45.837 UTC
Tone pattern stoped
```

Line Card and Optical Interfaces Connection Verification

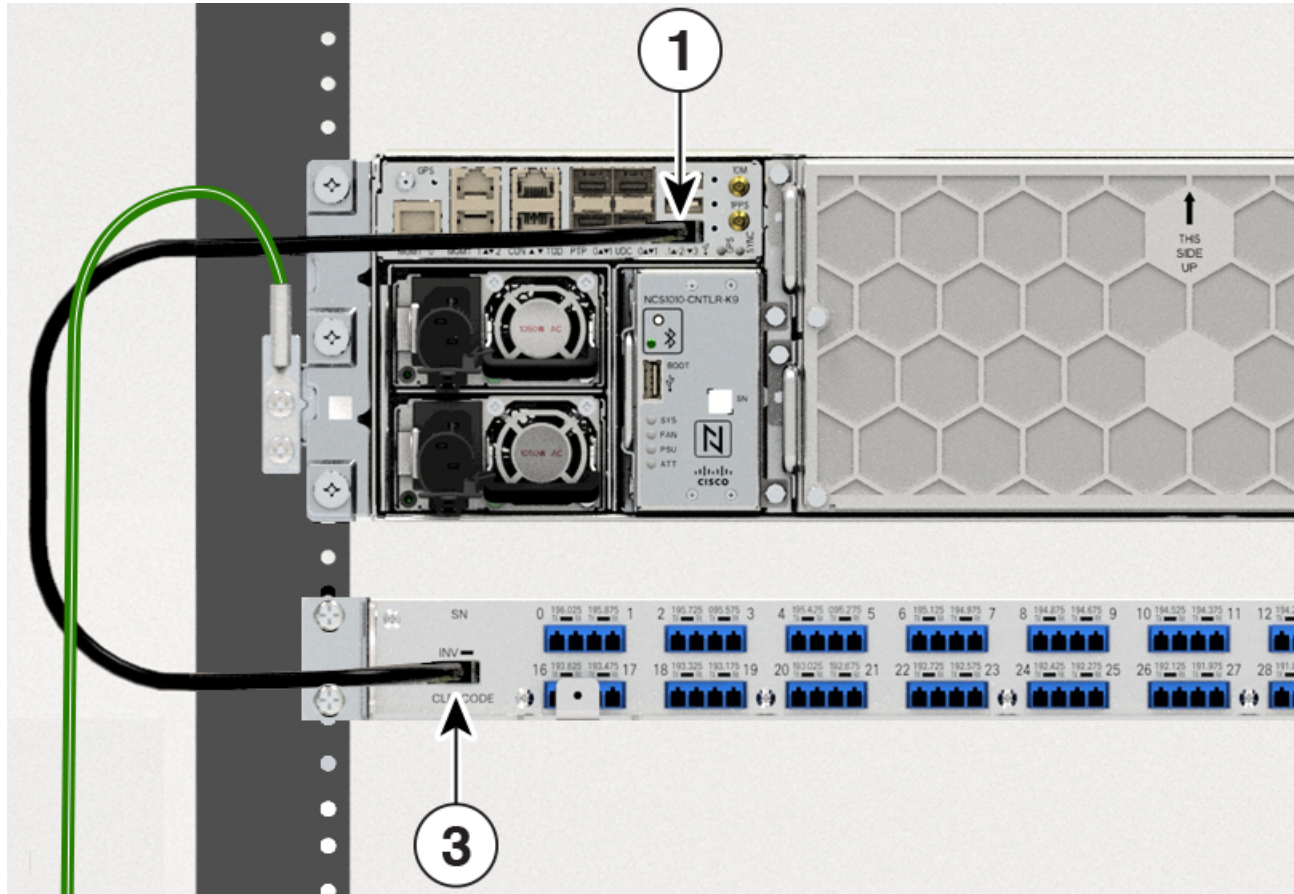
This section describes the connection verification between OLT nodes and the optical interfaces that are connected to Mux/Demux panel and breakout modules.

Verify Connection for NCS 1000 32-Channel Mux/Demux Patch Panel

The connection verification procedure checks the connection between OLT-C line card and the two Mux/Demux panels.

The OLT-C line card and the Mux/Demux panels are connected as shown in the following image:

Figure 7: NCS 1010 and NCS 1000 32-Channel Mux/Demux Patch Panel Connection



1	EITU USB 2.0 Port
2	OLT-C Line Card Add/Drop 3 LC Port
3	Mux/Demux Panel USB 2.0 Port
4	Mux/Demux Panel COM Port

The identification/verification of the two Mux/Demux panels is performed by checking the connection verification signal at the monitor present on the OOB loop (PD 36 signal). The monitor detects and buffers the Cable-ID encoded in the tone pattern.

In Mux/Demux panel, the PD monitors available on the CH-i-RX ports of each module check the connection verification signal coming from the optical interfaces TX port on the Add path.

The tone detection capability is available on the PD monitors at the CH-i-RX ports and on the loopback path and it is “armed” provisioning on the Mux/Demux panels:

- ON threshold (to determine the “1” or “0” bit)
- the sampling rate
- the pattern lengths (number of bytes)
- the list of PD to be “armed”

Parallel tone acquisitions are allowed on whole ports of the Mux/Demux panel.

Once the bit-pattern encoded in the tone is detected, the information is stored to be retrieved by the node controller and the tone acquisition is stopped until the next “rearm”.

Default ON-threshold to detect the tone pattern on the Mux/Demux signal are:

- -15dBm on all PDs at CH-i-RX ports
- -3dBm on the PD33 on the loopback path

This task describes on how to verify connection between the NCS 1010 OLT-C line card and Mux/Demux panel.

Step 1 Configure the OTS controller to generate the tone for connection verification.

Example:

```
RP/0/RP0/CPU0: (config) #controller ots 0/0/0/3
RP/0/RP0/CPU0: (config-Ots) #tone-rate 25
RP/0/RP0/CPU0: (config-Ots) #tone-frequency 191.175 ( OOB frequency )
RP/0/RP0/CPU0: (config-Ots) #tone-pattern abcd1234
RP/0/RP0/CPU0: (config-Ots) #commit
```

tone-pattern length must be 4–32 hexadecimal characters.

Step 2 Configure the OMS controller to detect the tone for connection verification.

Example:

```
RP/0/RP0/CPU0: (config) #controller oms 0/2/0/32
RP/0/RP0/CPU0: (config-Oms) #tone-rate 25
RP/0/RP0/CPU0: (config-Oms) #tone-pattern-expected abcd1234
RP/0/RP0/CPU0: (config-Oms) #tone-detect-ooob
RP/0/RP0/CPU0: (config-Oms) #commit
```

tone-pattern-expected value must be the same as the **tone-pattern** value.

tone-detect-ooob must be configured on the OMS x/x/x/32 for Mux/Demux panel.

Step 3 Start **tone-pattern** on the OTS controller.

Example:

```
RP/0/RP0/CPU0: #tone-pattern controller ots 0/0/0/3 start
Tue May 10 11:37:51.597 UTC
Tone pattern started
```

When tone generation is in progress on the OTS interface, the tone generation on other OTS interfaces is not allowed until the current tone generation is stopped.

Step 4 Use the **tone-pattern-detect** command to start the detection of tone pattern.

Example:

The following is a sample on starting the tone pattern detection on the OMS controller.

```
RP/0/RP0/CPU0:#tone-pattern-detect controller oms 0/2/0/32 start
Tue May 10 11:38:03.775 UTC
Tone pattern detect started
```

Step 5 Use the **tone-info** command to check for successful connection verification.

Example:

The following is a sample to view the Tone Info for successful connection verification on the OMS controller.

```
RP/0/RP0/CPU0:#show controllers oms 0/2/0/32 tone-info
Tue May 10 11:41:18.847 UTC
```

Tone Info:

Tone Rate : 25 bits/second

Tone Pattern Expected(Hex value) : abcd1234

Tone Pattern Received(Hex value) : abcd1234

Tone Detected OOB : Enabled

Detection State: Success

Step 6 After successful connection verification, stop **tone-pattern-detect** on the OMS controller and **tone-pattern** on the OTS controller.

Example:

```
RP/0/RP0/CPU0:#tone-pattern-detect controller oms 0/2/0/32 stop
Tue May 10 11:50:36.185 UTC
Tone pattern detect stoped
```

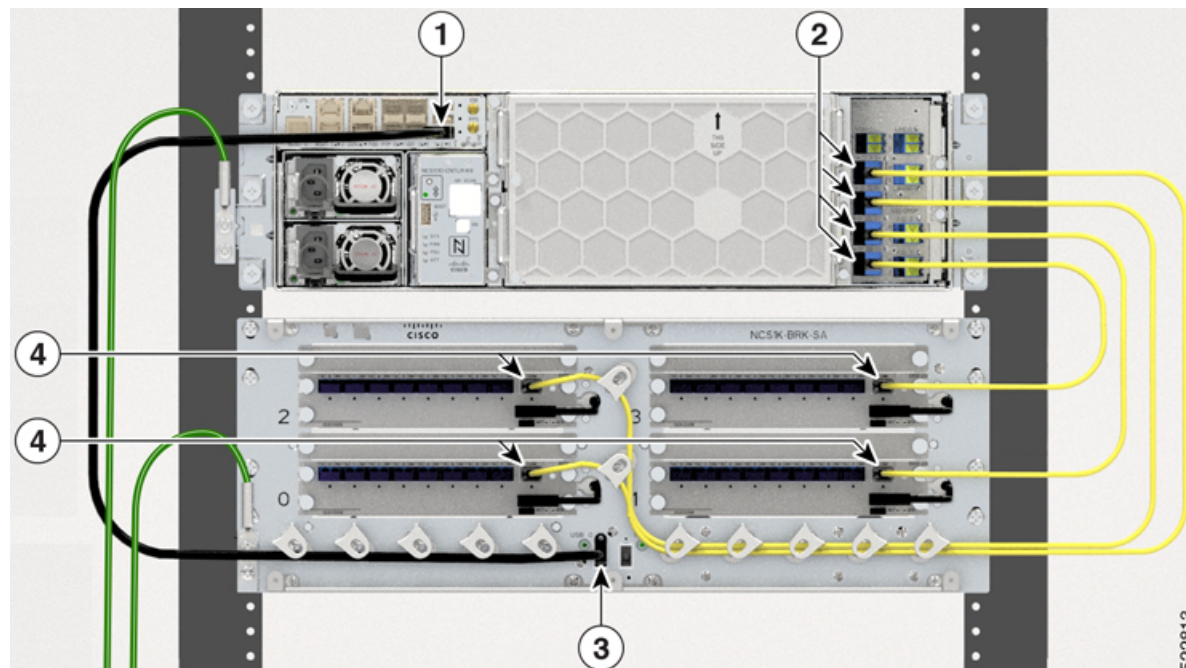
```
RP/0/RP0/CPU0:#tone-pattern controller ots 0/0/0/3 stop
Tue May 10 11:50:45.837 UTC
Tone pattern stopped
```

Verify Connection for NCS1K-BRK-8 Panel

The connection verification procedure checks the connection between the OLT-C line card and each NCS1K-BRK-8 panel to match the different module instances with respect to the OLT-C MPO connectors.

The OLT-C line card and the NCS1K-BRK-8 module are connected as shown in the following image:

Figure 8: NCS 1010 and NCS1K-BRK-8 Connection



1	EITU USB 2.0 Port
2	OLT-C Line Card Add/Drop MPO Ports
3	NCS1K-BRK-8 USB 2.0 Port
4	NCS1K-BRK-8 MPO Ports

The OLT-C line card performs connection verification between the OLT-C Line Card and the NCS1K-BRK-8 panels as described in [Line Card and Passive Modules Connection Verification, on page 81](#).

The identification/verification of the NCS1K-BRK-8 panel is performed by checking the connection verification signal at the monitor present on the OOB loop (PD17 for the NCS1K-BRK-8 module).



Note Connection verification is not supported for NCS1K-BRK-16 and NCS1K-BRK-24 panels.

Each pair of OLT-C line cards that are deployed on two different sides of a multidegree ROADM performs connection verification on Side-to-Side interface as described in [Side-to-Side Connection Verification, on page 81](#). In this case, the PD monitors available on the DIR-i-RX ports of the NCS1K-BRK-8 module detect the connection verification signal coming from the OLT-C Line Card on the other side.

In the NCS1K-BRK-8 panel, the PD monitors available on the CH-i-RX ports of each NCS1K-BRK-8 panel checks the connection verification signal coming from the optical interfaces TX port on the Add path.

The tone detection capability is available on all the PD monitors present on the input and output ports and on the loopback path of the NCS1K-BRK-8 panel. It is “armed” provisioning on the modules:

- ON threshold (to determine the “1” or “0” bit)

- Sampling rate
- Pattern lengths (number of bytes)
- List of PD to be “armed”

Parallel tone acquisitions are allowed on whole ports of the modules.

Once the bit-pattern encoded in the tone is detected, the information is stored to be retrieved by the node controller and the tone acquisition is stopped until the next “rearm.”

Default ON-threshold to detect the tone pattern on the connection verification signal are:

- -5dBm on all PDs at DIR-i-RX or CH-i-RX ports
- -3dBm on the PDs on the loopback path of each module

This task describes on how to verify the connection between the NCS 1010 OLT-C line card and NCS1K-BRK-8 panel.

Step 1 Configure the OTS controller to generate the tone for connection verification.

Example:

```
RP/0/RP0/CPU0:(config)#controller ots 0/0/0/4
RP/0/RP0/CPU0:(config-Ots)#tone-rate 25
RP/0/RP0/CPU0:(config-Ots)#tone-frequency 191.175 ( OOB frequency )
RP/0/RP0/CPU0:(config-Ots)#tone-pattern abcd1234
RP/0/RP0/CPU0:(config-Ots)#commit
```

tone-pattern length must be 4–36 hexadecimal characters.

Step 2 Configure the OMS controller to detect the tone for connection verification.

Example:

```
RP/0/RP0/CPU0:(config)#controller oms 0/2/0/8
RP/0/RP0/CPU0:(config-Oms)#tone-rate 25
RP/0/RP0/CPU0:(config-Oms)#tone-pattern-expected abcd1234
RP/0/RP0/CPU0:(config-Oms)#tone-detect-ooob
RP/0/RP0/CPU0:(config-Oms)#commit
```

tone-pattern-expected value must be same as the **tone-pattern** value.

tone-detect-ooob must be configured on the OMS x/x/x/8 for NCS1K-BRK-8.

Step 3 Start **tone-pattern** on the OTS controller.

Example:

```
RP/0/RP0/CPU0:#tone-pattern controller ots 0/0/0/4 start
Tue May 10 11:37:51.597 UTC
Tone pattern started
```

When tone generation is in progress on the OTS interface, the tone generation on other OTS interfaces is not allowed until the current tone generation is stopped.

Step 4 Use the **tone-pattern-detect** command to start the detection of tone pattern.

Example:

The following is a sample on starting the tone pattern detection on the OMS controller.

```
RP/0/RP0/CPU0:#tone-pattern-detect controller oms 0/2/0/8 start
Tue May 10 11:38:03.775 UTC
Tone pattern detect started
```

Step 5 Use the **tone-info** command to check for successful connection verification.

Example:

The following is a sample to view the Tone Info for successful connection verification on the OMS controller.

```
RP/0/RP0/CPU0:#show controllers oms 0/2/0/8 tone-info
Tue May 10 11:41:18.847 UTC
```

Tone Info:

Tone Rate : 25 bits/second

Tone Pattern Expected(Hex value) : abcd1234

Tone Pattern Received(Hex value) : abcd1234

Tone Detected OOB : Enabled

Detection State: Success

Step 6 After successful connection verification, stop **tone-pattern-detect** on the OMS controller and **tone-pattern** on the OTS controller.

Example:

```
RP/0/RP0/CPU0:#tone-pattern-detect controller oms 0/2/0/8 stop
Tue May 10 11:50:36.185 UTC
Tone pattern detect stoped
```

```
RP/0/RP0/CPU0:#tone-pattern controller ots 0/0/0/4 stop
Tue May 10 11:50:45.837 UTC
Tone pattern stopped
```

Connection Verification on OTS Controller

This task describes how to check OTS interface connectivity on OLT nodes.

Step 1 Start tone-pattern on OTS controller.

Example:

```
RP/0/RP0/CPU0:ios#tone-pattern controller ots 0/0/0/2 start
Wed May 25 11:59:51.040 UTC
Tone pattern started
```

Step 2 Start tone-pattern-detect on OTS controller on one side.

Example:

```
RP/0/RP0/CPU0:ios#tone-pattern-detect controller ots 0/0/0/2 start
Wed May 25 12:00:03.271 UTC
Tone pattern detect started
```

Step 3 Check for successful connection verification on the Line 2 OTS controller.

Example:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/2 tone-info
Wed May 25 12:00:11.393 UTC
```

Tone Info:

Tone Frequency : 191.1750000 THz

Tone Rate : 20 bits/second

Tone Pattern(Hex value) : abcd1234

Tone Pattern Expected(Hex value) : abcd1234

Tone Pattern Received(Hex value) : abcd1234

Tone Detected OOB : Enabled

Detection State: Success

Step 4 Stop the tone-pattern-detect on the OTS controller.

Example:

```
RP/0/RP0/CPU0:ios#tone-pattern-detect controller ots 0/0/0/2 stop
Wed May 25 12:00:56.540 UTC
Tone pattern detect stoped
```

Step 5 Stop the tone-pattern on the OTS controller.

Example:

```
RP/0/RP0/CPU0:ios#tone-pattern controller ots 0/0/0/2 stop
Wed May 25 12:01:04.226 UTC
Tone pattern stopped
```



CHAPTER 5

Smart Licensing

This chapter describes the smart licensing configuration on Cisco NCS 1010.

- [Understanding Smart Licensing, on page 91](#)
- [License Entitlements of NCS 1010, on page 94](#)
- [Create a Token, on page 95](#)
- [Configure Smart Licensing, on page 95](#)
- [Configure Smart Transport, on page 97](#)
- [Reserve Specific Licenses for NCS 1010, on page 97](#)
- [Reuse Licenses Using SLR Deactivation Method , on page 100](#)
- [Verify Smart Licensing Configuration, on page 101](#)

Understanding Smart Licensing

Smart Licensing is a cloud-based, software license management solution that enables you to automate time-consuming, manual licensing tasks. The solution allows you to easily track the status of your license and software usage trends.

Smart Licensing helps you simplify three core functions:

- **Purchasing:** The software that you have installed in your network can be registered, without Product Activation Keys (PAKs).
- **Management:** You can automatically track activations against your license entitlements. Also, there is no need to install the license file on every node. You can create license pools (logical grouping of licenses) to reflect your organization structure. Smart Licensing offers you Cisco Smart Software Manager, a centralized portal that enables you to manage all your Cisco software licenses from one centralized website.
- **Reporting:** Through the portal, Smart Licensing offers an integrated view of the licenses you have purchased and what has been deployed in your network. You can use this data to make better purchasing decisions, based on your consumption.

Smart Licensing Features

- Your device initiates a call home and requests the licenses it needs.

- Pooled licenses - Licenses are company account-specific, and can be used with any compatible device in your company. You can activate or deactivate different types of licenses on the device without actually installing a license file on the device.
- Licenses are stored securely on Cisco servers.
- Licenses can be moved between product instances without license transfer. This greatly simplifies the reassignment of a software license as part of the Return Material Authorization (RMA) process.
- It provides a complete view of all the Smart Software Licenses used in the network using a consolidated usage report of software licenses and devices in one easy-to-use portal.

Cisco Smart Account

Cisco Smart Account is an account where all products enabled for Smart Licensing are deposited. Cisco Smart Account allows you to manage and activate your licenses to devices, monitor license use, and track Cisco license purchases. Through transparent access, you have a real-time view into your Smart Licensing products. IT administrators can manage licenses and account users within your organization's Smart Account through the Smart Software Manager.

When creating a Smart Account, you must have the authority to represent the requesting organization. After you submit the request, it goes through a brief approval process. Access <http://software.cisco.com> to learn about, set up, or manage Smart Accounts.

Cisco Smart Software Manager enables you to manage all your Cisco Smart software licenses from one centralized website. With Cisco Smart Software Manager, you organize and view your licenses in groups called virtual accounts (collections of licenses and product instances). Use the Cisco Smart Software Manager to do the following tasks:

- Create, manage, or view virtual accounts.
- Create and manage Product Instance Registration Tokens.
- Transfer licenses between virtual accounts or view licenses.
- Transfer, remove, or view product instances.
- Run reports against your virtual accounts.
- Modify your email notification settings.
- View overall account information.

Virtual Accounts

A Virtual Account exists as a subaccount within the Smart Account. Virtual Accounts are a customer-defined structure based on organizational layout, business function, geography, or any defined hierarchy. They are created and maintained by the Smart Account administrator. Smart Licensing allows you to create multiple license pools or virtual accounts within the Smart Software Manager portal. Using the Virtual Accounts option that you can aggregate licenses into discrete bundles that are associated with a cost center so that one section of an organization cannot use the licenses of another section of the organization. For example, if you segregate your company into different geographic regions, you can create a virtual account for each region to hold the licenses and product instances for that region.

All new licenses and product instances are placed in the default virtual account in the Smart Software Manager, unless you specify a different one during the order process. After you access the default account, you may choose to transfer them to any other account, provided you have the required access permissions.

Use the Smart Software Manager portal to create license pools or transfer licenses.

Product Instance Registration Tokens

A product requires a registration token until you have registered the product. On successful registration, the device receives an identity certificate. This certificate is saved and automatically used for all future communications with Cisco. Registration tokens are stored in the Product Instance Registration Token Table that is associated with your enterprise account. Registration tokens can be valid 1–365 days.

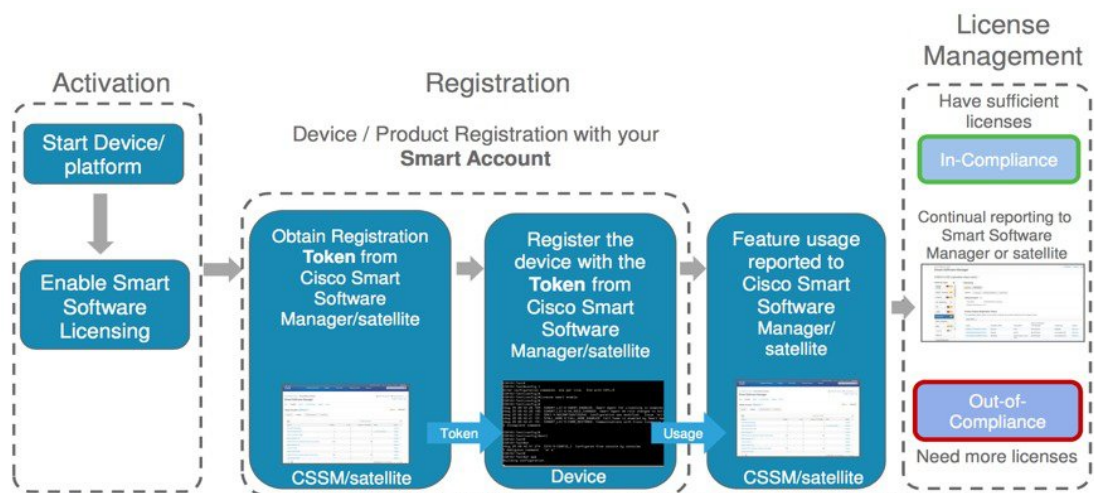
Product Instances

A product instance is an individual device with a unique device identifier (UDI) that is registered using a product instance registration token (or registration token). You can register any number of instances of a product with a single registration token. Each product instance can have one or more licenses residing in the same virtual account. Product instances must periodically connect to the Cisco Smart Software Manager servers during a specific renewal period. If you remove the product instance, its licenses are released and made available within the virtual account.

Smart Licensing Work Flow

The following figure depicts a working model of smart licensing that involves a three-step procedure.

Figure 9: Smart Licensing Work Flow



1. **Setting up Smart Licensing:** You can place the order for Smart Licensing, to manage licenses on the Cisco.com portal. You agree to the terms and conditions governing the use and access of Smart Licensing in the Smart Software Manager portal.
2. **Enabling and Use Smart Licensing:** Smart Licensing is enabled by default. You can use either of the following options to communicate:
 - **Smart Call Home:** The Smart Call Home feature is automatically configured when Smart Licensing is enabled. Smart Call Home is used by Smart Licensing as a medium for communication with the Cisco license service. Call Home feature allows Cisco products to periodically call-home and perform an audit and reconciliation of your software usage information. This information helps Cisco efficiently track your install base, keep them up and running, and effectively pursue service and support contract renewals. For more information on Smart Call Home feature, see http://www.cisco.com/c/dam/en/us/td/docs/switches/lan/smart_call_home/SCH_Deployment_Guide.pdf.

3. **Manage and Report Licenses:** You can manage and view reports about your overall software usage in the Smart Software Manager portal. Compliance reporting describes the types of Smart Licensing reports.

Benefits of Smart Licensing

- Licenses are not locked to perform configurations using Cisco NCS 1010 even if the license limit exceeds the paid license limit. You are notified with out-of-compliance notification to buy additional licenses when the license limit exceeds the paid license limit. This saves time with the ability to transfer licenses across the organization.
- Licenses can be pooled across the entire organization, enabling them to be reused across organizational boundaries.
- Provides software asset management information so that you can plan and track the licenses.

License Entitlements of NCS 1010

Cisco NCS 1010 supports the Vortex model for smart licensing software, and has the following Essential and Advantage licenses:

- ILA Essentials—One per ILA card (Maximum one license)
- OLT Essentials—One per WSS port per OLT card (Maximum 32 licenses).
- ILA Advantage—One per ILA card for Timing access and OTDR access features (Maximum 1 license).
- OLT Advantage—One per WSS port per OLT card for Timing access, OTDR access, Connection Verification features (Maximum 32 licenses)

The following table lists the various licenses that can be enabled on Cisco NCS 1010.

Table 30: NCS 1010 License Entitlements

Display Name in CSSM Server	Description
NCS1010_ADV_ILA_RTU	NCS 1010 ILA Advantage Right-to-Use (RTU)
NCS1010_ADV_ILA_SIA	NCS 1010 ILA Advantage Software Innovation Access (SIA)
NCS1010_ADV_OLT_RTU	NCS 1010 OLT Advantage RTU (per port)
NCS1010_ADV_OLT_SIA	NCS 1010 OLT Advantage SIA (per port)
NCS1010_ESS_ILA_RTU	NCS 1010 ILA Essentials RTU
NCS1010_ESS_ILA_SIA	NCS 1010 ILA Essentials SIA
NCS1010_ESS_OLT_RTU	NCS 1010 OLT Essentials RTU (per port)
NCS1010_ESS_OLT_SIA	NCS 1010 OLT Essentials SIA (per port)

Create a Token

To create a new token using Cisco Smart Software Manager, perform the following tasks:

Before you begin

-
- Step 1** Log in to the Cisco Smart Software Manager.
<https://software.cisco.com/software/cs/ws/platform/home#SmartLicensing-Inventory>
- Step 2** Click the **Inventory** tab, and select your virtual account from the **Virtual Account** drop-down list.
- Step 3** Click the **General** tab, and click **New Token**.
 The **Create Registration Token** window is displayed.
- Step 4** Enter the token description. Specify the number of days the token must be active.
- Step 5** Check the **Allow export-controlled functionality on the products registered with this token** check box.
- Step 6** Click **Create Token**.
- Step 7** Copy the token and register NCS1010 with the same token ID.
 An example of the token ID: YzY2ZjYyNjktY2NlOS00NTc4LWlxNTAtMjZkNmNiNzMxMTY1LTE2NjAzNjQ3%0ANzY4Njl8ZVJSckxKN2pFV2tleHV0MUkxbGxTazFDVm9kc1B5MGIHQmlFWUJi%0Ac3VNRT0%3D%0A
-

Configure Smart Licensing

To configure smart licensing in Cisco NCS 1010, perform the following steps:

-
- Step 1** Configure the domain name server for the smart license server.
Example:
- ```
RP/0/RP0/CPU0:ios#configure
Sat Dec 15 15:25:14.385 IST
RP/0/RP0/CPU0:ios(config)#domain name-server 198.51.100.1
```
- Step 2** Set up the CiscoTAC-1 profile and destination address for Smart Call Home, using the following commands:
- ```
call-home
service active
contact smart-licensing
profile CiscoTAC-1
active
destination address http {http|https}://{FQDN}/its/service/oddce/services/DDCEService
destination transport-method http
```

Note FQDN must be either Cisco Smart Software Manager FQDN (tools.cisco.com) or Smart Licensing satellite server FQDN. You must configure the DNS server before setting-up the call-home destination address as FQDN. Use the **domain name-server {DNS server IP}** command to configure the DNS server on the device.

Example:

```
RP/0/RP0/CPU0:ios#domain name-server 198.51.100.1
RP/0/RP0/CPU0:ios#call-home
RP/0/RP0/CPU0:ios#service active
RP/0/RP0/CPU0:ios#contact smart-licensing
RP/0/RP0/CPU0:ios#profile CiscoTAC-1
RP/0/RP0/CPU0:ios#active
RP/0/RP0/CPU0:ios#destination address http
https://tools.cisco.com/its/service/oddce/services/DDCEService
RP/0/RP0/CPU0:ios#destination transport-method http
```

Note CiscoTAC-1 profile is the default profile for smart licensing and it must not be deleted.

Step 3 Configure the crypto ca Trust point profile, if CRL distribution point is not defined in the Satellite server certificate or if the device is not able to reach the host mentioned in the CRL distribution point.

Example:

```
RP/0/RP0/CPU0:ios(config)#crypto ca trustpoint Trustpool crl optional
```

Step 4 Create and copy the registration token ID using Cisco Smart Software Manager.

For more details about creating a token, see [Create a Token, on page 95](#).

Step 5 In the privileged EXEC mode, register the token ID in Cisco NCS 1010, using the following command:

license smart register idtoken *token-ID*

The registration may fail if the token is invalid or there is communication failure between the device and the portal. If there is a communication failure, there is a wait time of 24 hours before the device attempts to register again. To force the registration, use the **license smart register idtoken *token-ID* force** command.

When your device is taken off the inventory, shipped elsewhere for redeployment, or returned to Cisco for replacement using the return merchandise authorization (RMA) process, you can use the **license smart deregister** command to cancel the registration on your device. All smart licensing entitlements and certificates on the platform are removed.

ID certificates are renewed automatically after six months. In case, the renewal fails, the product instance goes into unidentified state. You can manually renew the ID certificate using the **license smart renew id** command.

Authorization periods are renewed by the Smart Licensing system every 30 days. As long as the license is in an 'Authorized' or 'Out-of-Compliance' (OOC), the authorization period is renewed. Use the **license smart renew auth** command to make an on-demand manual update of your registration. Thus, instead of waiting 30 days for the next registration renewal cycle, you can issue this command to instantly find out the status of your license.

After 90 days, the authorization period expires and the status of the associated licenses display "AUTH EXPIRED". Use the **license smart renew auth** command to retry the authorization period renewal. If the retry is successful, a new authorization period begins.

Configure Smart Transport

You can use the smart transport as an alternative option to Call Home, to connect to the CSSM. To configure smart transport in Cisco NCS 1010, perform the following steps:

Step 1 Remove the Call Home configuration by deregistering the device.

Example:

```
RP/0/RP0/CPU0:ios#license smart deregister
```

Step 2 Configure smart transport registration:

Example:

```
RP/0/RP0/CPU0:ios#license smart transport smart
RP/0/RP0/CPU0:ios#commit
```

Step 3 Restart the license process.

Example:

```
RP/0/RP0/CPU0:ios(config)#process restart smartlicserver location 0/RP0/CPU0
```

Note Use the process restart option only when you change between Call Home and Smart Transport options. It is not required when you configure Smart Transport at the time of fresh bring-up.

Step 4 Register the token ID in Cisco NCS 1010.

Example:

```
RP/0/RP0/CPU0:ios(config)#license smart register ODZhNmQ4MjMtYWUzYS00Yjg5LTk5NjgtYmU1NTJkMW
NhMGM4LTE2OTQwNjcxc%0AOTE2OTN8OUFVtMl2NUt0emVkUHVTallYdXVFWGx0R3dLSHZDNGFFa3RBVGfa%0AY095Yz0%3D%0A
```

Reserve Specific Licenses for NCS 1010

Specific License Reservation (SLR) lets you reserve a license for your product instance from the CSSM. To reserve specific licenses for NCS 1010, perform the following steps:

Step 1 Deregister the device, if it was already registered for the license, using the **license smart deregister** command.

Example:

```
RP/0/RP0/CPU0:iso#license smart deregister
Thu Jul 19 13:33:30.048 UTC
RP/0/RP0/CPU0:iso# Jul 19 13:17:33.126 UTC: http_client[232] %SECURITY-XR_SSL-6-CERT_VERIFY_INFO :
  SSL Certificate verification:
  Certificate can be used for purpose it was meant to be
License command "license smart deregister " completed successfully.
```

Step 2 Generate the request code using the **license smart reservation request local** command.

Example:

```
RP/0/RP0/CPU0:iso#license smart reservation request local
Thu Jul 19 13:33:47.241 UTC
```

Enter this request code in the Cisco Smart Software Manager portal:
CB-ZNCS1010-SA:FCB2546B08T-BBTQDthRu-BA

Step 3 Use the generated code and generate the authorization code through Cisco Smart Software Manager. See [Reserve Licenses Using Cisco Smart Software Manager, on page 99](#).

Step 4 Enter the **run** command to launch the iso XR Linux bash shell.

Example:

```
RP/0/RP0/CPU0:iso#run
```

```
RP/0/RP0/CPU0:Jul 19 13:35:20.236: run_cmd[67213]: %INFRA-INFRA_MSG.5-RUN_LOGIN : User Cisco logged
into shell from con0/RP0/CP0
```

Step 5 Create a file using the **vim file name** command.

Example:

```
[node0_RP0_CPU0:~]$vim smart1
```

Step 6 Copy the authorization code in the file and type **:wq** to save and exit the file.

Step 7 Use the **exit** command to exit the shell.

Example:

```
[node0_RP0_CPU0:~]$exit
logout
```

```
RP/0/RP0/CPU0:Jul 19 13:45:21.146 UTC run-cmd[67213] %INFRA_MSG-5-LOGOUT : User cisco logged out
of shell from con0/RP0/CPU0
```

Step 8 Install the authorization code using the **license smart reservation install file** command.

Example:

```
RP/0/RP0/CPU0:iso#license smart reservation install file /disk0:/smart1
Thu Jul 19 13:46:22.877 UTC
RP/0/RP0/CPU0:Jul 19 13:46:22.946 UTC: plat_sl_client[368]: %LICENSE-PLAT_CLIENT-6-STATE_CHANGE :
Licensing platform state changing from UNREGISTERED to REGISTERED
RP/0/RP0/CPU0:Jul 19 13:46:22.946 UTC: smartlicserver[247]: %LICENSE-SMART_LIC-6-AGENT_REG_SUCCESS
: Smart Agent for Licensing Registration successful. udi PID:NCS1010-SA,SN:FCB2546B08T
Reservation install file successful
Last Confirmation code 8572aa81
```

Note You can verify the number of reservations in the Cisco smart software manger portal and can view the product instance name changed to a UDI.

Step 9 Verify the udi using the **show license udi** command.

Example:

```
RP/0/RP0/CPU0:iso#show license udi
Thu Jul 19 13:43:19.731 UTC
UDI: PID:NCS1010-SA,SN:FCB2546B08T
```

Step 10 Verify the license reservation using the command **show license status**.

Example:

```
RP/0/RP0/CPU0:P2A_DT_08#show license status
Thu Jul 19 15:45:27.137 UTC

Smart Licensing is ENABLED

Utility:
  Status: DISABLED
License Reservation is ENABLED

Data Privacy:
  Sending Hostname: yes
  Callhome hostname privacy: DISABLED
  Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Transport Off

Registration:
  Status: REGISTERED - SPECIFIC LICENSE RESERVATION
  Export-Controlled Functionality: ALLOWED
  Initial Registration: SUCCEEDED on Jul 19 2022 15:21:24 UTC

License Authorization:
  Status: AUTHORIZED - RESERVED on Jul 19 2022 15:21:24 UTC

Export Authorization Key:
  Features Authorized:
    <none>

Miscellaneous:
  Custom Id: <empty>
```

Reserve Licenses Using Cisco Smart Software Manager

To reserve the required number of licenses using the Cisco Smart Software Manager, perform the following steps:

-
- Step 1** Log in to the Cisco Smart Software Manager.
<https://software.cisco.com/software/csws/ws/platform/home#SmartLicensing-Inventory>
 - Step 2** Click the **Inventory** tab. From the **Virtual Account** drop-down list, select your smart account.
 - Step 3** Click **Licenses** and click **License Reservation**.
The **Smart License Reservation** wizard is displayed.
 - Step 4** In the **Enter Request Page** tab, paste the reservation code that you had generated from NCS 1010 in the **Reservation Request Code** area and click **Next**.
 - Step 5** In the **Select Licenses** tab, click the **Reserve a specific License** radio button.
The list of surplus licenses available in your virtual account is displayed.
 - Step 6** Enter the number of licenses that you want to reserve for the required license, in the **Quantity to Reserve** field, and click **Next**.
 - Step 7** In the **Review and Confirm** tab, click **Generate Authorization Code**.

Step 8 Click **Download as File** to download the authorization code and use the code to register the NCS 1010 device.

Reuse Licenses Using SLR Deactivation Method

You can release some of the purchased licenses belonging to a common license pool, and reuse the same to upgrade new devices that are added into your network, for a temporary period. Later on, you must purchase the licenses for the new devices.

Step 1 Deregister the device for which you want to release the licenses, and enable Flexible Consumption Model (FCM) (if not enabled)

Example:

```
RP/0/RP0/CPU0:ios#smart license deregister
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#license smart flexible-consumption enable
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios#end
```

Step 2 Generate the request code using the **license smart reservation request local** command.

Example:

```
RP/0/RP0/CPU0:ios(config)#license smart reservation request local
Fri Jul 1 07:11:56.541 UTC
Enter this request code in the Cisco Smart Software Manager portal:
CC-ZNCS1010-SA:FCB2530B11E-BBTQDthRu-BE
```

Step 3 Use the generated code and generate the authorization code through Cisco Smart Software Manager. See [Reserve Licenses Using Cisco Smart Software Manager, on page 99](#).

Note While reserving licenses in CSSM, under the **Select Licenses** tab, enter the number of licenses only for the RTU licenses, and leave the number of licenses as 0 for SIA licenses.

Step 4 Enter the **run** command to launch the iso XR Linux bash shell.

Example:

```
RP/0/RP0/CPU0:iso#run
RP/0/RP0/CPU0:Jul 1 7:35:20.281: run_cmd[67213]: %INFRA-INFRA_MSG.5-RUN_LOGIN : User Cisco logged
into shell from con0/RP0/CP0
```

Step 5 Create a file using the **vim file name** command.

Example:

```
[node0_RP0_CPU0:~]$vim smart1
```

Step 6 Copy the authorization code in the file and type **:wq** to save and exit the file.

Step 7 Use the **exit** command to exit the shell.

Example:

```
[node0_RP0_CPU0:~]$exit
logout
```



```
RP/0/RP0/CPU0:Jul 1 7:45:21.146 UTC run-cmd[67213] %INFRA_MSG-5-LOGOUT : User cisco logged out of shell from con0/RP0/CPU0
```

Step 8 Install the authorization code using the **license smart reservation install file** command.

Example:

```
RP/0/RP0/CPU0:iso#license smart reservation install file /disk0:/smart1
Thu Jul 19 13:46:22.877 UTC
RP/0/RP0/CPU0:Jul 1 7:46:22.946 UTC: plat_sl_client[368]: %LICENSE-PLAT_CLIENT-6-STATE_CHANGE :
Licensing platform state changing from UNREGISTERED to REGISTERED
RP/0/RP0/CPU0:Jul 1 7:46:22.946 UTC: smartlicserver[247]: %LICENSE-SMART_LIC-6-AGENT_REG_SUCCESS :
Smart Agent for Licensing Registration successful. udi PID:NCS1010-SA,SN:FCB2546B08T
Reservation install file successful
Last Confirmation code 8572aa81
```

Note You can verify the number of reservations in the Cisco smart software manger portal.

Step 9 Verify the license reservation using the command **show license platform summary**.

Example:

```
RP/0/RP0/CPU0:test#show license platform summary
Fri Jul 1 07:24:07.016 UTC
Collection: LAST: Fri Jul 01 2022 07:48:34 UTC
            NEXT: Fri Jul 01 2022 07:48:34 UTC
Reporting:  LAST: Fri Jul 01 2022 07:48:34 UTC
            NEXT: Fri Jul 01 2022 07:48:34 UTC
SIA Status: Node is in deactivated state
```

Step 10 After the node is deactivated and the licenses are freed on the CSSM server, use those licenses to perform software upgrade on another node for a temporary period.

Verify Smart Licensing Configuration

After enabling Smart Licensing, you can use the **show** commands to verify the default Smart Licensing configuration. If any issue is detected, take corrective action before making further configurations.

- **show license all**
- **show license trace all**
- **show license status**
- **show license summary**
- **show license tech**
- **Show license udi**
- **show license usage**
- **show license platform detail**
- **show license platform summary**
- **show license platform trace**
- **Show license platform trace all**

- **show tech-support smartlic**
- **show call-home detail**
- **show call-home trace all**
- **show tech-support call-home**

The following table defines the available license authorization status in Cisco NCS 1010:

Table 31: License Authorization Status

License Authorization Status	Description
Unconfigured	Smart Software Licensing is not configured.
Unidentified	Smart Software Licensing is enabled but is not registered.
Registered	Device registration is completed and an ID certificate is received that is used for future communication with the Cisco licensing authority.
Authorized	Registration is completed with a valid Smart Account and license consumption has begun. This indicates compliance.
Out of Compliance	Consumption exceeds available licenses in the Smart Account.
Authorization Expired	The device is unable to communicate with the Cisco Smart Software Manager for an extended period. This state occurs after 90 days of expiry. The device attempts to contact the CSSM every hour to renew the authorization until the registration period expires.

Example 1:

The following example shows the sample output of the **show license all** command.

```
RP/0/RP0/CPU0:iso#show license all
Fri Jul 15 05:32:02.678 UTC

Smart Licensing Status
=====

Smart Licensing is ENABLED

Registration:
  Status: REGISTERED
  Smart Account: InternalTestDemoAccount8.cisco.com
  Virtual Account: NCS1010-PROD
  Export-Controlled Functionality: ALLOWED
  Initial Registration: SUCCEEDED on Jul 15 2022 04:58:24 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 11 2023 04:58:23 UTC
  Registration Expires: Jul 15 2023 04:53:20 UTC

License Authorization:
  Status: AUTHORIZED on Jul 15 2022 04:58:40 UTC
  Last Communication Attempt: SUCCEEDED on Jul 15 2022 04:58:40 UTC
  Next Communication Attempt: Aug 14 2022 04:58:40 UTC
  Communication Deadline: Oct 13 2022 04:53:41 UTC
```

```

Export Authorization Key:
  Features Authorized:
    <none>

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
  Callhome hostname privacy: DISABLED
  Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

Transport:
  Type: Callhome

Miscellaneous:
  Custom Id: <empty>

License Usage
=====

NCS1010 - Essentials - OLT RTU (NCS1010_ESS_OLT_RTU):
  Description: NCS1010 - Essentials Tier - Optical Line Terminal RTU (Per Port)
  Count: 2
  Version: 1.0
  Status: AUTHORIZED
  Export status: NOT RESTRICTED

NCS1010 - Essentials - OLT SIA (NCS1010_ESS_OLT_SIA):
  Description: NCS1010 - Essentials Subscription - Optical Line Terminal - SIA
    (Per Port)
  Count: 2
  Version: 1.0
  Status: AUTHORIZED
  Export status: NOT RESTRICTED

Product Information
=====
UDI: PID:NCS1010-SA, SN:FCB2546B08T

Agent Version
=====
Smart Agent for Licensing: 5.4.16_rel/63

Reservation Info
=====
License reservation: DISABLED

```

Example 2:

The following example shows the sample output of the **show license platform detail** command.

```

RP/0/RP0/CPU0:iso#show license platform detail
Fri Jul 15 06:56:41.353 UTC
Collection: LAST: Fri Jul 15 2022 06:56:14 UTC
           NEXT: Fri Jul 15 2022 06:58:14 UTC
Reporting:  LAST: Fri Jul 15 2022 06:56:14 UTC
           NEXT: Fri Jul 15 2022 06:58:14 UTC
SIA Status: In Compliance
Parameters: Collection interval:          2 minute(s)
           Reporting interval:          2 minute(s)
           Throughput gauge:          1000000 Kbps

```

```

=====
Feature/Area 'FCM'
  Name: FCM
  Status: ACTIVE
  Flags:

  [ 1] Name: NCS1010 - Essentials Tier - In-Line Amplifier RTU
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ESS_ILA_RTU,1.0_9b4322b1-bff3-4ddf-944c-16ec9aaablcc
        Count: Last reported: 0
        Next report: 0
  [ 2] Name: NCS1010 - Essentials Subscription - In-Line Amplifier - SIA
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ESS_ILA_SIA,1.0_67243ac7-1a7c-41e4-a160-f13df80fd0e4
        Count: Last reported: 0
        Next report: 0
  [ 3] Name: NCS1010 - Essentials Tier - Optical Line Terminal RTU (Per Port)
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ESS_OLT_RTU,1.0_e4309530-2085-40e6-9aa6-5f3137ff49b2
        Count: Last reported: 3
        Next report: 0
  [ 4] Name: NCS1010 - Essentials Subscription - Optical Line Terminal - SIA (Per Port)
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ESS_OLT_SIA,1.0_b3c976c1-e509-474f-8cac-b9db62f28f2b
        Count: Last reported: 3
        Next report: 0
  [ 5] Name: NCS1010 - Advantage Tier- In-Line Amplifier RTU
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ADV_ILA_RTU,1.0_cf1746b7-def4-4c0e-ab90-de30614507d8
        Count: Last reported: 0
        Next report: 0
  [ 6] Name: NCS1010 - Advantage Subscription - In-Line Amplifier - SIA
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ADV_ILA_SIA,1.0_ea769b05-9363-47dd-9991-2122c37479eb
        Count: Last reported: 0
        Next report: 0
  [ 7] Name: NCS1010 - Advantage Tier - Optical Line Terminal RTU (Per Port)
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ADV_OLT_RTU,1.0_7a6ce8f3-3336-4ce2-8803-431227dabfff
        Count: Last reported: 0
        Next report: 0
  [ 8] Name: NCS1010 - Advantage Subscription - Optical Line Terminal - SIA (Per Port)
        Entitlement Tag:
regid.2022-05.com.cisco.NCS1010_ADV_OLT_SIA,1.0_5f283f1c-143e-4c6e-9af7-73e088fb77a5
        Count: Last reported: 0
        Next report: 0

```

Example 3:

The following example shows the sample output of the **show license status** command.

```

RP/0/RP0/CPU0:iso#show license status
Fri Jul 15 08:17:14.004 UTC

Smart Licensing is ENABLED

Utility:
  Status: DISABLED

Data Privacy:
  Sending Hostname: yes
  Callhome hostname privacy: DISABLED
  Smart Licensing hostname privacy: DISABLED
  Version privacy: DISABLED

```

```

Transport:
  Type: Callhome

Registration:
  Status: REGISTERED
  Smart Account: InternalTestDemoAccount8.cisco.com
  Virtual Account: NCS1010-PROD
  Export-Controlled Functionality: ALLOWED
  Initial Registration: SUCCEEDED on Jul 15 2022 04:58:24 UTC
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 11 2023 04:58:24 UTC
  Registration Expires: Jul 15 2023 04:53:21 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 15 2022 07:01:00 UTC
  Last Communication Attempt: SUCCEEDED on Jul 15 2022 07:06:52 UTC
  Next Communication Attempt: Jul 15 2022 19:06:51 UTC
  Communication Deadline: Oct 13 2022 07:01:52 UTC

Export Authorization Key:
  Features Authorized:
    <none>

Miscellaneous:
  Custom Id: <empty>
  RP/0/RP0/CPU0:P2A_DT_08#show license summary
  Fri Jul 15 08:17:23.752 UTC

Smart Licensing is ENABLED

```

```

Registration:
  Status: REGISTERED
  Smart Account: InternalTestDemoAccount8.cisco.com
  Virtual Account: NCS1010-PROD
  Export-Controlled Functionality: ALLOWED
  Last Renewal Attempt: None
  Next Renewal Attempt: Jan 11 2023 04:58:23 UTC

License Authorization:
  Status: OUT OF COMPLIANCE
  Last Communication Attempt: SUCCEEDED
  Next Communication Attempt: Jul 15 2022 19:06:51 UTC

```

```

License Usage:
  License                               Entitlement Tag                               Count Status
  -----
  NCS1010 - Essentials... (NCS1010_ESS_OLT_RTU) 32 OUT OF COMPLIANCE
  NCS1010 - Essentials... (NCS1010_ESS_OLT_SIA) 32 OUT OF COMPLIANCE

```

Example 4:

The following example shows the sample output of the **show license platform summary** command.

```

RP/0/RP0/CPU0:iso#show license platform summary
Tue Jul 19 14:09:06.919 UTC
Collection: LAST: Tue Jul 19 2022 14:08:07 UTC
           NEXT: Tue Jul 19 2022 14:10:07 UTC
Reporting: LAST: Tue Jul 19 2022 14:08:07 UTC
           NEXT: Tue Jul 19 2022 14:10:07 UTC
*****IMPORTANT*****
SIA Status: Out of Compliance(Remaining Grace Period: 90 days, 0 hours)
           SIA license(s) status is Not Authorized.
           SW Upgrade will still be allowed as SIA Grace Period is remaining
*****

```

Feature/Area	Entitlement	Count	
		Last	Next
FCM	NCS1010 - Essentials Tier - Optical Line Terminal R	3	0
FCM	NCS1010 - Essentials Subscription - Optical Line Te	3	0
FCM	NCS1010 - Advantage Tier - Optical Line Terminal RT	3	0
FCM	NCS1010 - Advantage Subscription - Optical Line Ter	3	0

Example 5:

The following example shows the sample output of the **show license summary** command.

```
RP/0/RP0/CPU0:iso#show license usage
Fri Jul 15 08:17:40.048 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 15 2022 07:01:00 UTC

NCS1010 - Essentials - OLT RTU (NCS1010_ESS_OLT_RTU):
  Description: NCS1010 - Essentials Tier - Optical Line Terminal RTU (Per Port)
  Count: 32
  Version: 1.0
  Status: OUT OF COMPLIANCE
  Export status: NOT RESTRICTED

NCS1010 - Essentials - OLT SIA (NCS1010_ESS_OLT_SIA):
  Description: NCS1010 - Essentials Subscription - Optical Line Terminal - SIA
              (Per Port)
  Count: 32
  Version: 1.0
  Status: OUT OF COMPLIANCE
  Export status: NOT RESTRICTED
```

Example 6:

The following example shows the sample output of the **show license usage** command.

```
RP/0/RP0/CPU0:iso#show license usage
Fri Jul 15 08:17:40.048 UTC

License Authorization:
  Status: OUT OF COMPLIANCE on Jul 15 2022 07:01:00 UTC

NCS1010 - Essentials - OLT RTU (NCS1010_ESS_OLT_RTU):
  Description: NCS1010 - Essentials Tier - Optical Line Terminal RTU (Per Port)
  Count: 32
  Version: 1.0
  Status: OUT OF COMPLIANCE
  Export status: NOT RESTRICTED

NCS1010 - Essentials - OLT SIA (NCS1010_ESS_OLT_SIA):
  Description: NCS1010 - Essentials Subscription - Optical Line Terminal - SIA
              (Per Port)
  Count: 32
  Version: 1.0
  Status: OUT OF COMPLIANCE
  Export status: NOT RESTRICTED
```



APPENDIX A

Cisco NCS 1010 Topologies

This appendix describes multidegree support on NCS 1010 and has examples of a few NCS 1010 topologies.

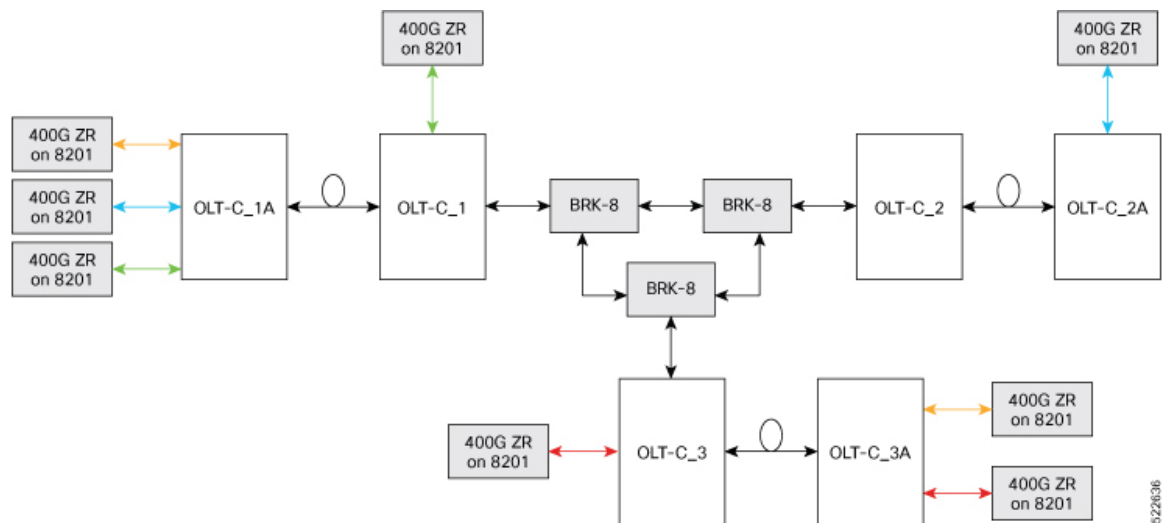
- [Multidegree Support, on page 107](#)
- [Omnidirectional Support, on page 114](#)

Multidegree Support

NCS1010 OLT devices support up to 8 degrees of ROADM express. You can set up multidegree connections using NCS1K-BRK-8 modules. Use BRK-8 modules for MPO breakout for express interconnect. For a multidegree topology, you must use as many BRK-8 modules and OLT devices as there are degrees. The BRK-8 modules help NCS 1010 nodes to achieve multidegree capability.

The following diagram represents a sample 3-degree topology. The diagram represents three point-to-point multispan optical networks - OLT-C_1A to OLT-C_1, OLT-C_2A to OLT-C_2, and OLT-C_3A to OLT-C_3. These multispan networks can have ILA nodes between the OLT endpoints. We connect OLT-C_1, OLT-C_2, and OLT-C_3 to each other using three BRK-8 modules. Each BRK-8 module must have connections to each of the other BRK-8 modules. This express interconnect enables multidegree support. Configure the optical cross-connects on each OLT device such that the signal gets to the target OLT.

Figure 10: Typical 3-Degree Topology



NCS 1010 Sample Topologies

The following section describes three sample topologies of specific hardware deployments.

- Point-to-point topology
- Multidegree topology: Colored solution
- Multidegree topology: Colorless solution
- Multidegree topology: Hybrid solution

Point-to-point Topology

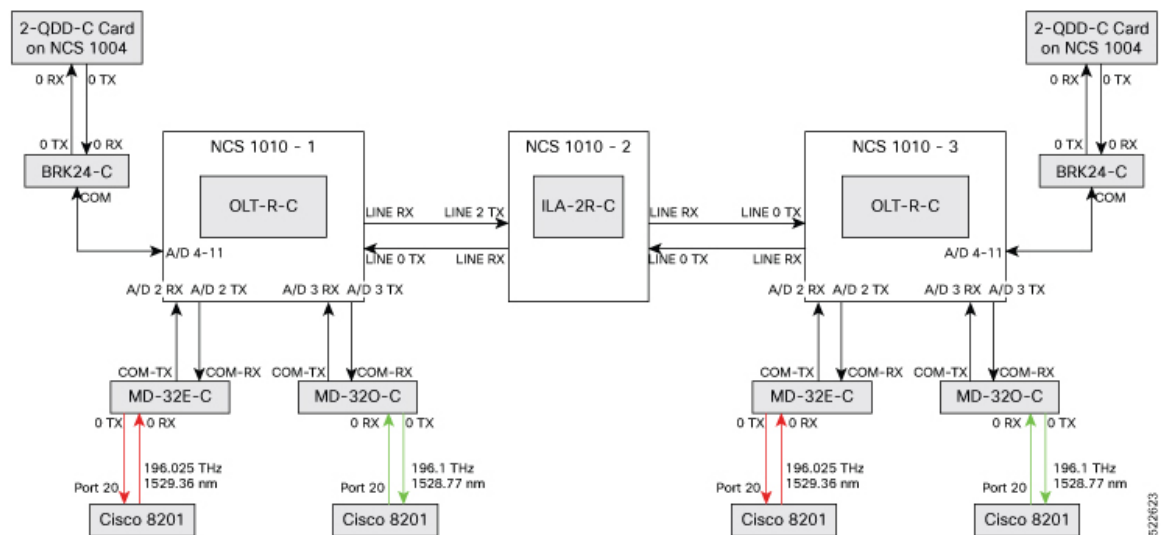
This sample topology is a simple point-to-point topology with no more than 2 degrees per site. You can use it for point-to-point optical links.

Topology Components

To build this topology, you need the following hardware:

- Cisco NCS 1010 devices
- NCS1K-MD32E-C modules
- NCS1K-MD32O-C modules
- NCS1K-BRK-24 modules
- QDD-400G-ZR-S transceiver
- LC/LC cables

Figure 11: Point-to-point Topology



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Multidegree Topology: Colored Solution

This sample topology is a three-degree topology. You can use similar topologies for multidegree optical links that have:

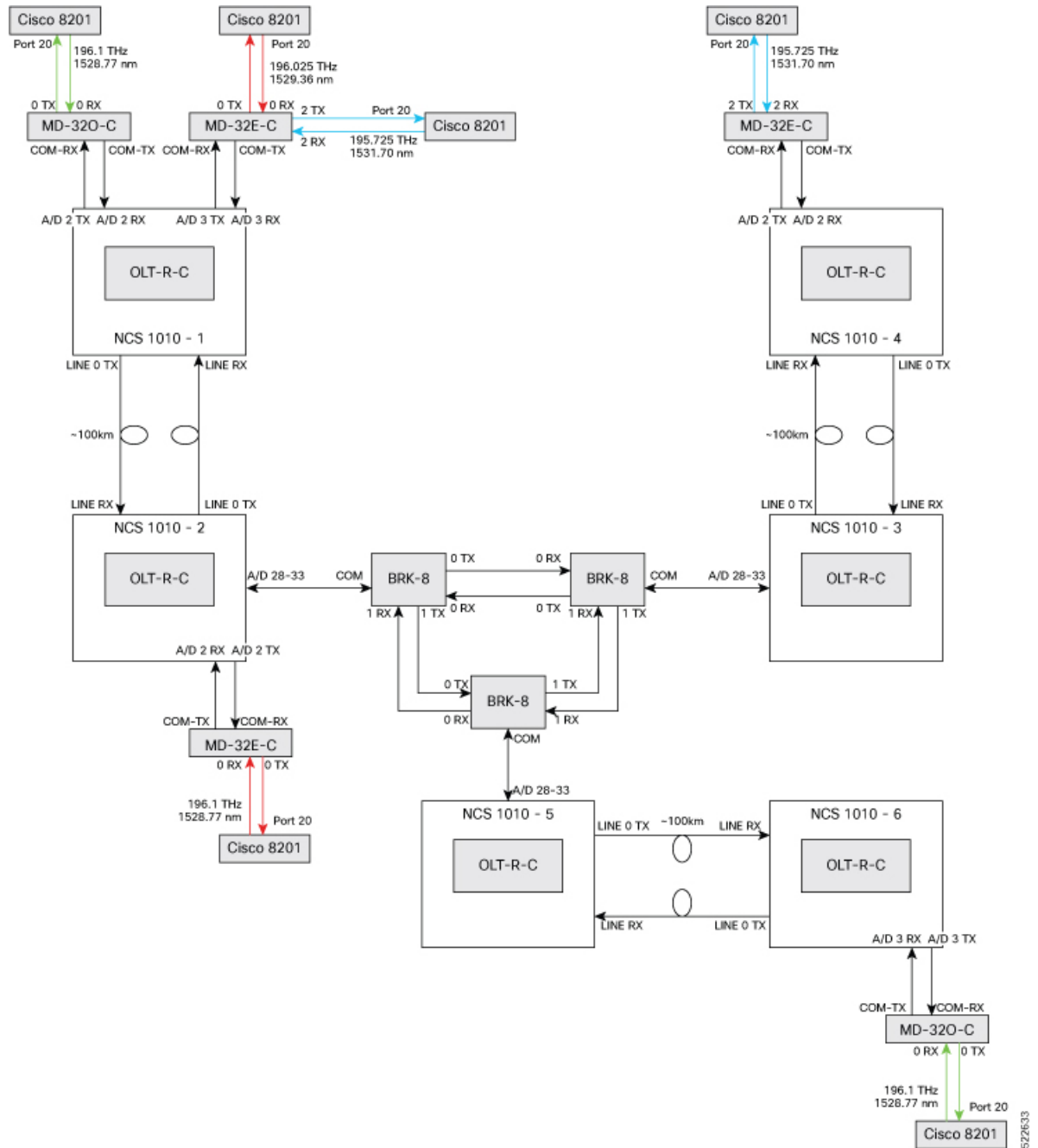
- Optical channels from low TX power transponders like the ZR or ZR+ pluggable optical modules
- Optical channels with TX power spectral density between -21dBm/12.5GHz and -14dBm/12.5GHz

Topology Components

To build this topology, you need the following hardware:

- Cisco NCS 1010 devices
- NCS1K-MD32E-C modules
- NCS1K-MD32O-C modules
- NCS1K-BRK-8 modules
- Cisco 8201 routers
- QDD-400G-ZR-S transceivers
- LC/LC cables
- MPO cables

Figure 12: Colored Solution



Multidegree Topology: Colorless Solution

This sample topology is a three-degree topology. You can use similar topologies for multidegree optical links that have:

- Optical channels from high TX power transponders like 1.2T line card on NCS 1004 or line cards with CFP2-400G-DCO as the trunk interface.

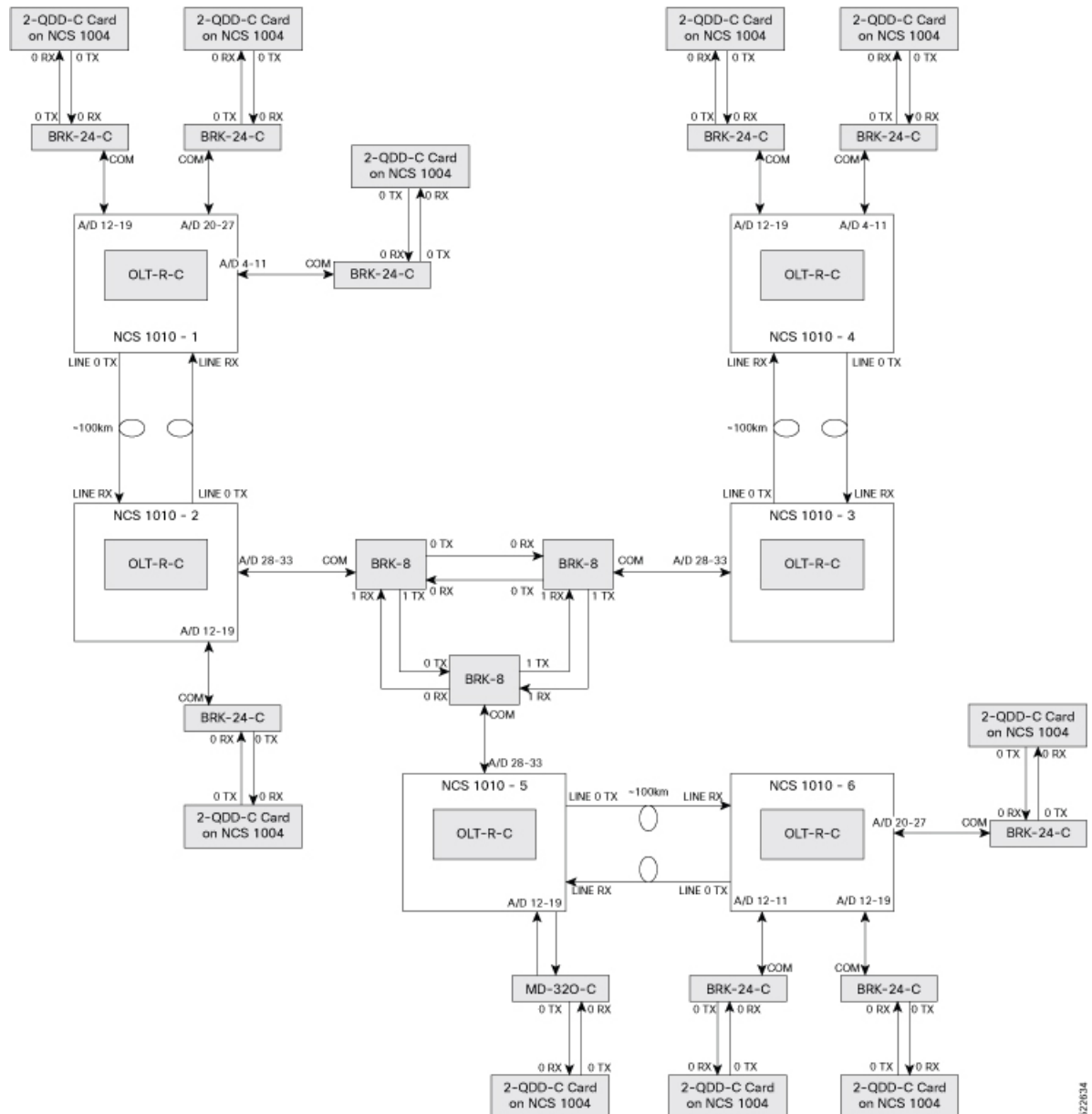
- Optical channels with TX power spectral density not lower than -7dBm/12.5GHz

Topology Components

To build this topology, you need the following hardware:

- Cisco NCS 1010 devices
- NCS1K-BRK-8 modules
- NCS1K-BRK-24 modules
- CFP2-400G-DCO transceivers
- Cisco NCS 1004 devices
- NCS1K4-2-QDD-C-K9 line card
- LC/LC cables
- MPO cables

Figure 13: Colorless Solution



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Multidegree Topology: Hybrid Solution

This sample topology is a three-degree topology. You can use similar topologies for multidegree optical links that have

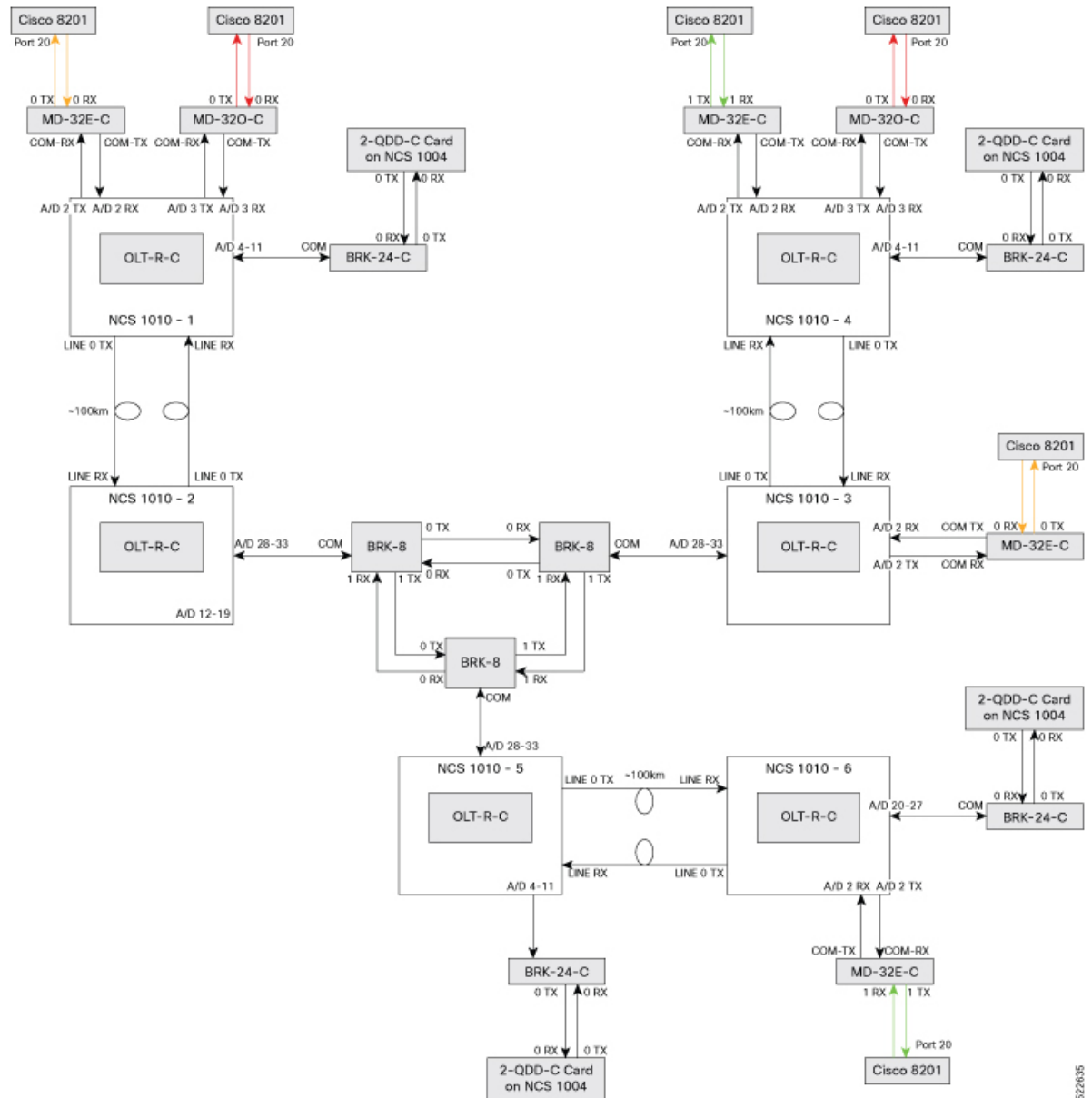
- Optical channels from both high and low TX power transponders
- Optical channels with TX power spectral density that you use in both colored and colorless solutions

Topology Components

To build this topology, you need the following hardware:

- Cisco NCS 1010 devices
- NCS1K-MD32E-C modules
- NCS1K-MD32O-C modules
- NCS1K-BRK-8 modules
- NCS1K-BRK-24 modules
- Cisco 8201 routers
- QDD-400G-ZR-S transceivers
- CFP2-400G-DCO transceivers
- Cisco NCS 1004 devices
- NCS1K4-2-QDD-C-K9 line card
- LC/LC cables
- MPO cables

Figure 14: Colorless Solution



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Omnidirectional Support

You can design multiple OLT-based omnidirectional add/drop stages. This configuration gives flexibility to the multidegree topology to route channels through any of the optical degrees during fiber cut without the need for changing the physical fiber connections.

NCS2K-MF-4x4-COFS Based Colorless Omnidirectional Topology

In Release 7.7.1, the omnidirectional add/drop stage is designed using the NCS 2000 passive module, 4x4 colorless omnidirectional flex spectrum (COFS) add/drop module (NCS2K-MF-4x4-COFS) and NCS2K-MF-MPO-8LC. The channels from different degrees are aggregated at the MF-MPO-8LC. The MF-4x4-COFS adds the channels. Similarly, the channels from the MF-4x4-COFS can be routed to any of the degree through the MF-MPO-8LC, thus achieving the omnidirectional functionality. This colorless omnidirectional topology gives flexibility to retune the frequency or wavelength of the channel coming from the transponder or muxponder without any physical changes.

Topology Components

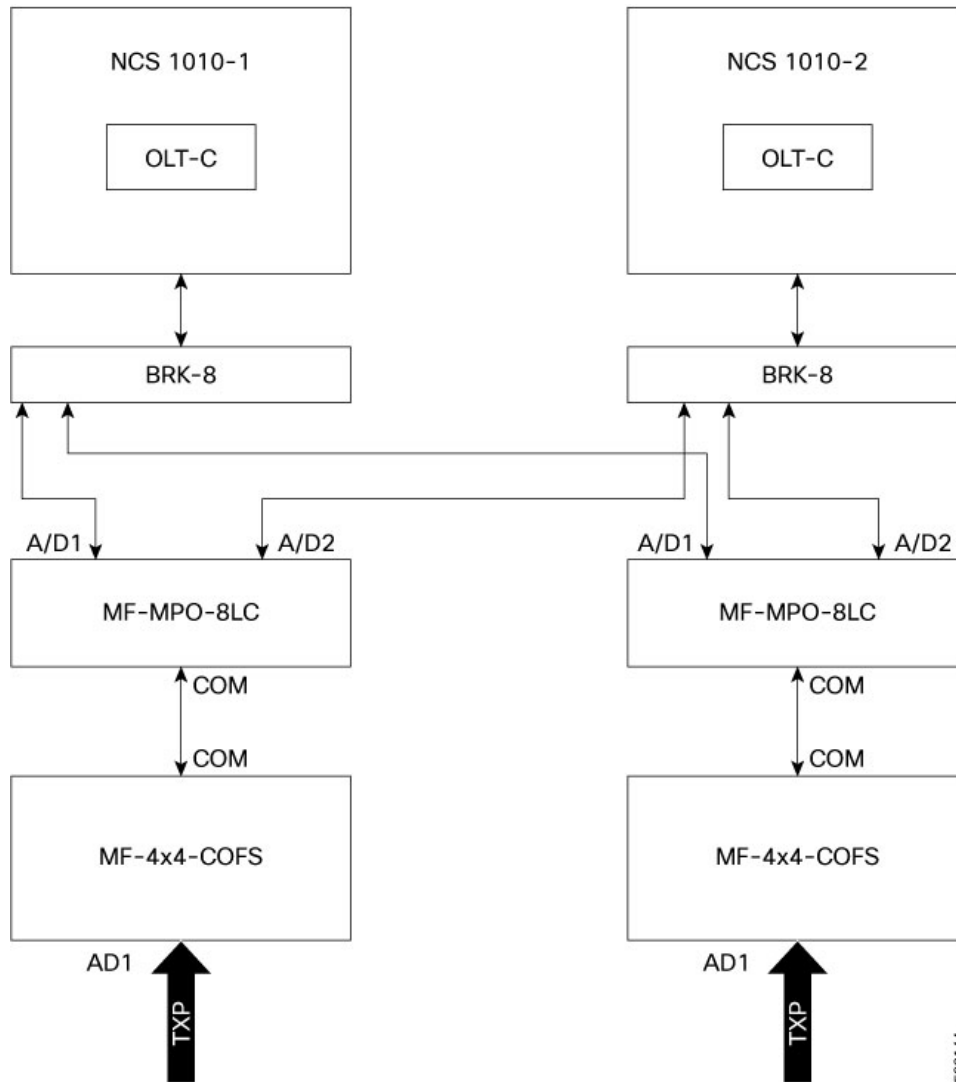
To build this topology, you need the following hardware:

- NCS 1010 OLT devices
- NCS2K-MF-4x4-COFS modules
- NCS2K-MF-MPO-8LC modules
- NCS1K-BRK-8 modules

Following are the specific cable configurations for interconnecting the modules:

- The MF-4x4-COFS modules are interconnected using standard MPO 8 or 12 fibers (15454-MPO-MPO-x or ONS-12MPO-MPO-x)
- The MF-4x4-COFS modules and NCS1K-BRK-8 module are interconnected using standard LC-LC fibers.

Figure 15: MF-4x4-COFS Based Colorless Omnidirectional Topology



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Limitations

- This configuration is supported only for C-band ROADMs.
- This configuration is scalable only up to a maximum of 4 degrees. More OSNR penalty is induced by the MF-4x4-COFS as you add more degrees.
- One MF-4x4-COFS module can support up to only four channels. To scale up to 32 channels, you would require 8 MF-4x4-COFS modules.
- The terminal node in this configuration can be connected only to NCS 1004 line cards, line cards with CFP2-400G-DCO as a trunk interface, and DP04QSDD pluggable.