

Configuration Guide for Cisco NCS 1001, IOS XR Release 7.3.x

First Published: 2021-02-28

Last Modified: 2025-03-04

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CONTENTS

CHAPTER 1 **Configure Management Interfaces** 1

Dual IP Address 1

Link Layer Discovery Protocol (LLDP) Support on Management Interface 2

CHAPTER 2 **Configure Controllers** 7

Controllers 7

Configure OTS Controller 7

Display Parameters of OTS Controllers 10

Span Loss Calculation 12

Display Span Loss Calculation 13

Dual IP Address 13

Configure OTS OCH Controller 14

Display Parameters of OTS OCH Controllers 15

LLDP over OSC 18

CHAPTER 3 **Configure Optical Modules** 21

Optical Amplifier Module 22

Amplifier Configuration 24

Configure Amplifier Module 25

Configure Flex Channels on the Amplifier Module 27

Modify Central Frequency and Channel Width on the Amplifier Module 29

In-Line Amplifier 29

Configure Amplifier Module in ILA Manual Mode 30

Configure Amplifier Module in ILA Automatic Mode 31

Gridless OCM Support 33

Protection Switching Module 33

Configure Protection Switching Module 34
Autothreshold for Protection Switching Module 37
Configure rx-low-threshold for PSM 37
Enable Autothreshold for PSM 40
Configure Relative Switch Threshold for PSM 41
Automated OTS-OCH Thresholds on Amplifier 41
PSM Virtual Photodiode 43
PSM 3-way Protection 44
PSM Revertive Switch 44
Configure PSM Revertive Switch 45
OSC 47
Remote Management 47
Network Topology Discovery 47
Configure Management and OSC Interfaces 48
Configure Static Routes 48
Configure OSPF Routes 49
Verify OSPF Routing Table 49
Troubleshooting Network Issues 50

CHAPTER 4 **Configure OTDR Module** 51
OTDR 52
Cabling Considerations for Terminal Node 55
Cabling Considerations for ILA Node 56
Configure OTDR 58
Display Status of OTDR Measurement 61
Configure OTDR in Automatic Mode 62
Start OTDR Measurement in Automatic Mode 64
OTDR Measurement in Automatic Mode Based on Events 64
Configure OTDR in Expert Mode 71
Start OTDR Measurement in Expert Mode 74
Display List of OTDR Measurements 74
Stop OTDR Measurement 76
View the Logical Ports and the Photodiode Power Levels 76
OTDR ML Events 77

Enable ML on the OTDR Card 77
View Scan Output with ML Enabled 78

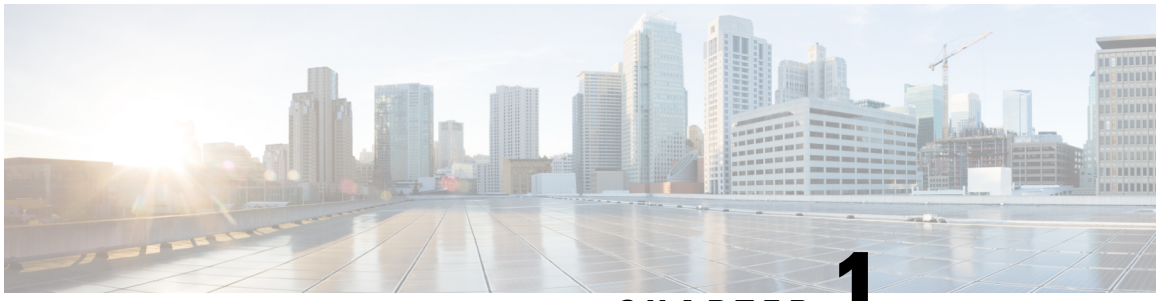
CHAPTER 5 Configure Performance Monitoring 81
Configure PM Parameters 81
View PM Parameters 82

CHAPTER 6 USB Automount 85
USB Automount 85

CHAPTER 7 Fault Profiles 87
Fault Profiles 87
Limitations of Fault Profiles 88
Configure Fault Profiles 88

CHAPTER 8 Configure AAA 91
Understanding of AAA 91
Admin Access for NETCONF and gRPC 92
User Profile Mapping from XR VM to System Admin VM 92
How to Allow Read Access to Administration Data for NETCONF and gRPC Clients 93

APPENDIX A Configuring SNMP 95



CHAPTER 1

Configure Management Interfaces

This chapter describes how to configure management interfaces.

- Dual IP Address, on page 1
- Link Layer Discovery Protocol (LLDP) Support on Management Interface, on page 2

Dual IP Address

Dual independent XR interfaces allows you to connect the two ethernet interfaces to two different switches of different subnet and also of the same subnet. From release 6.5.1, there are different ports from the ethernet switch MGMT RJ45, and Optical SFP MGMT to the CPU.

The two different Management Ethernet interfaces in to XR are:

- MgmtEth 0/RP0/CPU0/0 (already existing) representing the RJ45 port.
- MgmtEth 0/RP0/CPU0/1 (new one) representing the SFP port.

iPXE is not supported at power-on over the new optical interface.

Upgrades from previous releases using only SFP loses MGMT connectivity. In this case, you must configure through Console port.

Before using the two different interfaces, you must upgrade the BIOS and reload the 0/RP0 location.

The following example shows the output of the *show running-config* command:

Example

```
RP/0/RP0/CPU0:MYST-144#show running-config
….
 interface MgmtEth0/RP0/CPU0/0
 ipv4 address xxx.xxx.xxx.xxx yyy.yyy.yyy.yyy
!
interface MgmtEth0/RP0/CPU0/1
 ipv6 address xxxx:xxxx:xxxx:xxxx::xxx:xxx/yy
 ipv6 enable
!
interface MgmtEth0/RP0/OSC1/0
 shutdown
!
interface MgmtEth0/RP0/OSC2/0
 shutdown
!
interface MgmtEth0/RP0/OSC3/0
```

```
 shutdown
!
```

Link Layer Discovery Protocol (LLDP) Support on Management Interface

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

Advantages of LLDP

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

Cisco Discovery Protocol (CDP) versus LLDP

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

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

Interoperability between non-Cisco devices using LLDP

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

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

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

Neighbor Discovery

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

Prerequisites to Configure LLDP

- LLDP full stack functionality is supported on all the three management interfaces supported in NCS 1001 system.
- Users can selectively enable or disable LLDP on any of the management interfaces on demand.
- Users can selectively enable or disable LLDP transmit or receive functionality at the management interface level.
- Information gathered using LLDP can be stored in the device Management Information Database (MIB) and queried with the Simple Network Management protocol (SNMP).
- LLDP operational data are available in both Command Line Interface and netconf-yang interface.

Enabling LLDP Globally

When the user enables LLDP globally, all interfaces that support LLDP are automatically enabled for both transmit and receive operations.



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

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

Table 1:

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

The following example shows the commands to configure LLDP globally. The global LLDP configuration enables LLDP on both mgmtEth 0/RP0/CPU0/0 and mgmtEth 0/RP0/CPU0/1 management interfaces.

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

Verification

The user can verify the LLDP configuration using the `show running-config lldp` command.

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

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

The user can verify the LLDP data using the `show lldp interface` and `show lldp neighbors` commands.

The output of `Show lldp interface` command is as follows:

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


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


MgmtEth0/RP0/CPU0/1:
        Tx: enabled
        Rx: enabled
        Tx state: IDLE
        Rx state: WAIT FOR FRAME
```

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

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

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

Enabling LLDP on Each Management Interface

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

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

Disabling LLDP Transmit and Receive Operations

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

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

```
RP/0/RP0/CPU0:ios(config-if)#commit
RP/0/RP0/CPU0:ios(config-if)#end
```

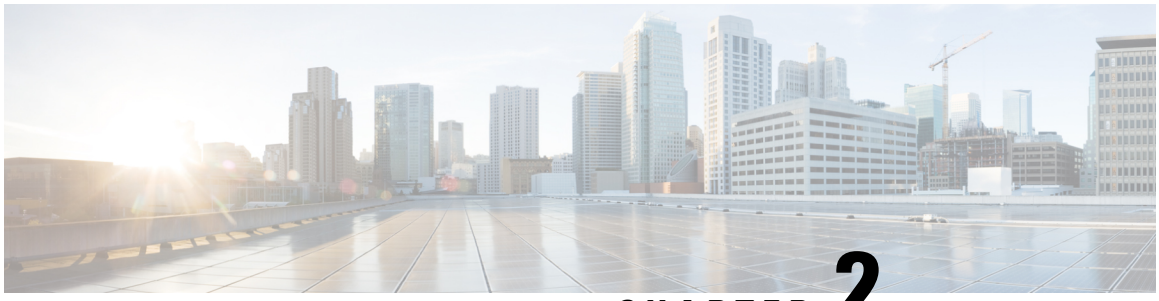
The following example shows the commands to disable the LLDP receive operations at the specified management interface.

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

Debugging LLDP Issues

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

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



CHAPTER 2

Configure Controllers

This chapter describes how to configure OTS and OTS OCH controllers.

- Controllers, on page 7
- Configure OTS Controller, on page 7
- Display Parameters of OTS Controllers, on page 10
- Span Loss Calculation, on page 12
- Display Span Loss Calculation, on page 13
- Dual IP Address, on page 13
- Configure OTS OCH Controller, on page 14
- Display Parameters of OTS OCH Controllers, on page 15
- LLDP over OSC, on page 18

Controllers

Controllers are represented in the Rack/Slot/Instance/Port format; for example, 0/1/0/1.

Rack	0
Slot	1 to 3. Slots for pluggable optical modules.
Instance	0
Port	Depends on the specific pluggable optical module.

Configure OTS Controller

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. Hence, the parameters enabled or disabled on the OTS controller depend on the actual hardware capability on the specific optical interface. Each parameter might refer to RX or TX section. For example, if a photodiode is present, the OTS controller can read the total optical power. When the controller is created, each hardware capability is enabled or disabled.

You can configure parameters such as low power threshold, VOA attenuation setpoint, amplifier gain range, amplifier tilt, and amplifier gain set point for the OTS controller. The description on OTS interfaces cannot

be added as they are on the optical amplifier module. To configure the OTS controller, use the following commands.

configure

controller *controllertype Rack/Slot/Instance/Port*

rx enable

rx-low-threshold *value*

tx enable

tx-low-threshold *value*

rx-voa-attenuation *value*

tx-voa-attenuation *value*

ampli-control-mode {**automatic** | **manual**}

ampli-gain-range {**normal** | **extended**}

ampli-gain *value*

ampli-tilt *value*

ampli-channel-power *value*

channel-power-max-delta *value*

osri {**on** | **off**}

safety-control-mode {**auto** | **disabled**}

commit

end

Example

The following is a sample in which the amplifier gain range is set to extended and amplifier gain set point is set to 29.0 dB.

```
configure
    controller ots 0/3/0/0
    ampli-gain-range extended
    ampli-gain 290
    commit
end
```

The following is a sample in which the safety control mode of the pre-amplifier is set to auto.

```
configure
    controller ots 0/3/0/0
    safety-control-mode auto
    commit
end
```

The following is a sample in which the safety control mode of the booster amplifier is set to disabled.

```
configure
    controller ots 0/3/0/1
```

```
    safety-control-mode disabled
    commit
end
```

OTS Controller Configuration Parameters

Table 2: OTS Controller Configuration Parameters

Parameter	Description	Hardware Capability	Range	Default	Notes
rx-low-threshold (0.1 dBm)	Low receive power threshold	Photodiode	-400 to +300	-40.0	
tx-low-threshold (0.1 dBm)	Low transmit power threshold	Photodiode	-400 to +300	-20.0	
rx-voa-attenuation (0.1 dBm)	RX VOA attenuation set point	VOA	0 to 200	0.0	
tx-voa-attenuation (0.1 dBm)	TX VOA attenuation set point	VOA	0 to 200	0.0	
ampli-control-mode	Amplifier control mode	Amplifier	automatic and manual	automatic	The Automatic value is compatible only when the grid is specified through the hw-module configuration.
ampli-gain-range	Amplifier gain range	Amplifier	normal and extended	normal	The amplifier gain range is configurable only when the controller is in shutdown state.
ampli-gain (0.1 dBm)	Amplifier gain set point	Amplifier	0 to 500	0.0	The actual range of amplifier gain set point depends on amplifier gain range.
ampli-tilt (0.1 dBm)	Amplifier tilt	Amplifier	-50 to +50	0.0	
channel-power-max-delta (0.1 dBm)	Maximum difference among all measured channel powers	Amplifier	0 to 200	3.0	

Parameter	Description	Hardware Capability	Range	Default	Notes
ampli-channel-power (0.1 dBm)	Amplifier per channel power set point	Amplifier	-400 to +300	0.0	
osri	Optical safety remote interlock	Amplifier	on and off	off	When osri is on, the laser is off and vice versa.
safety-control-mode	Safety control mode	Amplifier	auto and disabled	auto	If the safety control mode is disabled, the amplifier optical power is less than 20dB for safety.

Display Parameters of OTS Controllers

Use this procedure to display the parameters of OTS controllers.

show controllers *controllertype Rack/Slot/Instance/Port* [**summary**]

- The **show controllers** command displays all the configuration parameters, PM thresholds and alarms when keywords are not provided.
- The **show controllers** command displays the rx/tx power value and minimal information to understand port status when **summary** keyword is provided.
- A * wild card can be used to display all the controllers associated with a slot. For example, **show controllers ots 0/1/0/* summary**

Example

RP/0/RP0/CPU0:ios#**show controllers ots 0/3/0/1**

```
Wed Aug 23 09:08:27.962 UTC

 Controller State: Up

 Transport Admin State: In Service

 Port Type: Line

 Laser State: Off

 Optics Status::


 Alarm Status:
 -------------
 Detected Alarms:
 RX-LOC
```

```
Alarm Statistics:
-----------------
LOW-RX-PWR = 0
LOW-TX-PWR = 0
RX-LOS-P = 0
RX-LOC = 1
AMPLI-GAIN-DEG-LOW = 0
AMPLI-GAIN-DEG-HIGH = 0
AUTO-LASER-SHUT = 0
AUTO-POW-RED = 89
AUTO-AMPLI-CTRL-DISABLED = 0
AUTO-AMPLI-CFG-MISMATCH = 0
SWITCH-TO-PROTECT = 0
AUTO-AMPLI-CTRL-RUNNING = 0

Parameter Statistics:
---------------------
TX Power = -40.00 dBm
RX Power = -40.00 dBm
Ampli Gain = -1.00 dB
Ampli Tilt = 0.00
Total TX Power = -40.00 dBm
Total RX Power = -40.00 dBm

Configured Parameters:
-------------
Rx Low Threshold = -25.0 dBm
Tx Low Threshold = -20.0 dBm
Ampli Gain = 1.00 dB
Ampli Tilt = 0.00
Ampli Channel power = 0.00 dBm
Channel Power Max Delta = 3.00 dBm
Ampli Control mode = Manual
Ampli Gain Range = Normal
Ampli Safety Control mode = auto
Osri = OFF
```

Example

RP/0/RP0/CPU0:ios#**show controllers ots 0/1/0/1**

```
Controller State: Down

Transport Admin State: In Service

Port Type: Line

Laser State: Apr

Optics Status::


         Alarm Status:
         -------------
         Detected Alarms:
                 AUTO-POW-RED

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

```
RX-LOC = 1
AMPLI-GAIN-DEG-LOW = 0
AMPLI-GAIN-DEG-HIGH = 0
AUTO-LASER-SHUT = 0
AUTO-POW-RED = 1
AUTO-AMPLI-CTRL-DISABLED = 0
AUTO-AMPLI-CFG-MISMATCH = 0
SWITCH-TO-PROTECT = 0
AUTO-AMPLI-CTRL-RUNNING = 0

Parameter Statistics:
---------------------
TX Power = -40.00 dBm
RX Power = -11.90 dBm
Ampli Gain = -1.00 dB
Ampli Tilt = -90.00
Total TX Power = 7.99 dBm
Total RX Power = -11.90 dBm
Ampli Gain Range = Normal
Ampli Safety Control mode = disabled
Osri = OFF
TX Enable = Enabled
RX Enable = Enabled
RX Span Loss = N/A
TX Span Loss = N/A
Rx Low Threshold Current = -25.0 dBm
Back Reflection = -6.40 dBm

Configured Parameters:
-------------
Rx Low Threshold = -25.0 dBm
Tx Low Threshold = -20.0 dBm
Ampli Gain = 12.00 dB
Ampli Tilt = 0.00
Ampli Channel power = 0.00 dBm
Channel Power Max Delta = 3.00 dBm
Ampli Channel Psd = 31.250 nW/MHz
Rx Low Threshold Psd = 0.099 nW/MHz
Ampli Control mode = Manual
Ampli Safety Control mode = disabled
Osri = OFF
TX Enable = Enabled
RX Enable = Enabled
```

The **Back Reflection** parameter in 0.1 dBm is raised only on port 1. This parameter is raised on the line TX port of the booster amplifier.

Span Loss Calculation

The Span Loss Calculation is an automatic calculation of span losses between NCS 1001 systems. This feature applies to each topology such as protected or non-protected, linear with or without ILA nodes in the middle.

The Span Loss Calculation is a software functionality available for OTS controller and it can be statically enabled or disabled through `hw-module` configuration. Span Loss calculation is made using the TX and RX total power on EDFA ports.

For this feature 2 new parameters are managed in the show controller ots command for EDFA cards:

- RX Span Loss
- TX Span Loss

The Span Loss Calculation runs automatically every 5 minutes and when there is a configuration change. In the order of priority, the possible configurations are:

- Remote node.
- OSC through OSPF.

Limitation

- Span Loss calculation is done by considering the total power of the transmission end and receiver end on the EDFA ports. If the PSM card is connected to the span (for example, in case of Path Protection Topology), the span boundaries are assumed to be the closer EDFA ports.

Display Span Loss Calculation

Once the feature is enabled and after the first span loss calculation, the loss calculated (for both IPv4 and IPv6) can be retrieved using the `show controller ots` command. In the output RX Span Loss and TX Span Loss are added. RX Span Loss and TX Span Loss are obtained as a result of difference between **TX Total Power** and **RX Total Power** read on the edge of the span.

In case of a TERM node, the command is applied to LINE port. For example, in case of EDFA in slot 1, the span loss calculated are shown in the output of the following command:

```
#show controllers ots 0/1/0/1
…
…
 RX Span Loss = 15.20 dB
 TX Span Loss = 14.80 dB
…
…
```

In case of an ILA node, the command is applied to LINE port (`controller ots 0/slot/0/1`) to obtain RX Span Loss of related span, and to COM port (`controllers ots 0/slot/0/0`) to obtain TX Span Loss of related span.

For example, in case of an EDFA of ILA site equipped in slot 3:

```
show controllers ots 0/3/0/1
…
 RX Span Loss = 12.40 dB
show controllers ots 0/3/0/0
…
 TX Span Loss = 11.90 dB
```

Dual IP Address

Dual independent XR interfaces allows you to connect the two ethernet interfaces to two different switches of different subnet and also of the same subnet. From release 6.5.1, there are different ports from the ethernet switch MGMT RJ45, and Optical SFP MGMT to the CPU.

The two different Management Ethernet interfaces in to XR are:

- MgmtEth 0/RP0/CPU0/0 (already existing) representing the RJ45 port.
- MgmtEth 0/RP0/CPU0/1 (new one) representing the SFP port.

iPXE is not supported at power-on over the new optical interface.

Upgrades from previous releases using only SFP loses MGMT connectivity. In this case, you must configure through Console port.

Before using the two different interfaces, you must upgrade the BIOS and reload the 0/RP0 location.

The following example shows the output of the *show running-config* command:

Example

```
RP/0/RP0/CPU0:MYST-144#show running-config
….
 interface MgmtEth0/RP0/CPU0/0
 ipv4 address xxx.xxx.xxx.xxx yyy.yyy.yyy.yyy
!
interface MgmtEth0/RP0/CPU0/1
 ipv6 address xxxx:xxxx:xxxx:xxxx::xxx:xxx/yy
 ipv6 enable
!
interface MgmtEth0/RP0/OSC1/0
 shutdown
!
interface MgmtEth0/RP0/OSC2/0
 shutdown
!
interface MgmtEth0/RP0/OSC3/0
 shutdown
!
```

Configure OTS OCH Controller

The Optical Transport Section OCH (OTS OCH) controller represents the OCM device available on the OTS optical interface. This controller is created to have channel granularity over the OTS interface. The OTS OCH controller contains the wavelength information. The controller number starts from 1 and matches with the ITU channel identifier.

Several OTS OCH controllers are created for each OTS Controller depending on the grid configuration (ITU 100GHz or 50GHz Grid). 48 OTS OCH controllers are created for a 100GHz grid and 96 OTS OCH controllers are created for a 50GHz grid.

You can configure the parameters such as RX low power threshold and TX low power threshold for the OTS OCH controller. To configure the OTS OCH controller, use the following commands.

configure

controller *controllertype Rack/Slot/Instance/Port*

rx-low-threshold *value*

tx-low-threshold *value*

commit

end

Example

```
configure
    controller ots-och 0/1/0/0
```

```
    rx-low-threshold  -30
    tx-low-threshold  -35
    commit
end
```

OTS OCH Controller Configuration Parameters

Table 3: OTS OCH Controller Configuration Parameters

Parameter	Description	Hardware Capability	Range	Default
rx-low-threshold (0.1 dBm)	Low receive power threshold	OCM	-500 to +300	-25.0
tx-low-threshold (0.1 dBm)	Low transmit power threshold	OCM	-500 to +300	-25.0

Display Parameters of OTS OCH Controllers

Use this procedure to display the parameters of OTS OCH controllers.

show controllers *controllertype Rack/Slot/Instance/Port/Channel-number* [**summary**]

- The **show controllers** command displays all the configuration parameters, PM thresholds and alarms when keywords are not provided.
- The **show controllers** command displays the rx/tx power value and wavelength when **summary** keyword is provided.
- A * wild card can be used to display all the OTS OCH controllers associated with a OTS controller. For example, **show controllers ots-och 0/1/0/* summary**

Example

RP/0/RP0/CPU0:ios#**show controllers ots-och 0/3/0/1/1**

```
Fri Feb 24 13:20:18.456 CET

 Controller State: Up

 Transport Admin State: Maintenance

 Port Type: Line

 Laser State: On

 Optics Status::


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

         Alarm Statistics:
         -----------------
```

```
 LOW-RX-PWR = 219
 LOW-TX-PWR = 5
 RX-LOS-P = 0
 RX-LOC = 0
 AMPLI-GAIN-DEG-LOW = 0
 AMPLI-GAIN-DEG-HIGH = 0
 AUTO-LASER-SHUT = 0
 AUTO-POW-RED = 0
 AUTO-AMPLI-CTRL-DISABLED = 0
 AUTO-AMPLI-CFG-MISMATCH = 0
 SWITCH-TO-PROTECT = 0

Parameter Statistics:
---------------------
TX Power = 4.10 dBm
RX Power = -30.70 dBm


Configured Parameters:
----------
Rx Low Threshold = -25.0 dBm
Tx Low Threshold = -25.0 dBm
```

RP/0/RP0/CPU0:ios#**show controllers ots-och 0/2/0/0/* summary**

```
Fri Oct  9 10:37:50.109 CEST

 Port               Type    Status       TX Power     RX Power      TX psd        RX psd
  Central Frequency Channel Width
                                               (dBm)        (dBm)      nW/MHz)     (nW/MHz)
      (GHz)             (GHz)
 -----------------  ----    -------      ---------    ---------     ---------     -------
    ---------------   -------------
  Ots-Och0_2_0_0_1    Com      N/A      -18.30       -19.30         0.392         0.333
      196100.0          75.0
  Ots-Och0_2_0_0_2    Com      N/A      -19.10       -19.80         0.094         0.068
      196025.0          75.0
  Ots-Och0_2_0_0_3    Com      N/A      -18.00       -18.90         0.450         0.392
      195950.0          75.0
  Ots-Och0_2_0_0_4    Com      N/A      -16.90       -17.60         0.318         0.290
      195875.0          75.0
  Ots-Och0_2_0_0_5    Com      N/A      -18.10       -19.20         0.326         0.290
      195800.0          75.0
  Ots-Och0_2_0_0_6    Com      N/A      -19.50       -19.90         0.059         0.041
      195725.0          75.0
  Ots-Och0_2_0_0_7    Com      N/A      -18.60       -19.00         0.471         0.450
      195650.0          75.0
  Ots-Och0_2_0_0_8    Com      N/A      -17.00       -17.60         0.304         0.318
      195575.0          75.0
  Ots-Och0_2_0_0_9    Com      N/A      -18.50       -19.20         0.318         0.297
      195500.0          75.0
 Ots-Och0_2_0_0_10    Com      N/A      -17.60       -18.00         0.318         0.297
      195425.0          75.0
 Ots-Och0_2_0_0_11    Com      N/A      -18.50       -19.00         0.401         0.374
      195350.0          75.0
 Ots-Och0_2_0_0_12    Com      N/A      -17.70       -18.00         0.188         0.253
      195275.0          75.0
 Ots-Och0_2_0_0_13    Com      N/A      -18.90       -19.70         0.304         0.271
      195200.0          75.0
 Ots-Och0_2_0_0_14    Com      N/A      -20.50       -20.90         0.242         0.236
      195125.0          75.0
 Ots-Och0_2_0_0_15    Com      N/A      -24.00       -27.40         0.031         0.011
      195050.0          75.0
 Ots-Och0_2_0_0_16    Com      N/A      -17.80       -18.40         0.215         0.242
```

194975.0	75.0					
Ots-Och0_2_0_0_17	Com	N/A	-18.50	-19.10	0.318	0.290
194900.0	75.0					
Ots-Och0_2_0_0_18	Com	N/A	-16.90	-17.30	0.333	0.297
194825.0	75.0					
Ots-Och0_2_0_0_19	Com	N/A	-18.10	-18.90	0.410	0.366
194750.0	75.0					
Ots-Och0_2_0_0_20	Com	N/A	-17.00	-17.50	0.357	0.366
194675.0	75.0					
Ots-Och0_2_0_0_21	Com	N/A	-18.50	-19.30	0.326	0.290
194600.0	75.0					
Ots-Och0_2_0_0_22	Com	N/A	-17.20	-17.70	0.259	0.265
194525.0	75.0					
Ots-Och0_2_0_0_23	Com	N/A	-18.40	-19.10	0.410	0.392
194450.0	75.0					
Ots-Och0_2_0_0_24	Com	N/A	-16.50	-16.90	0.450	0.430
194375.0	75.0					
Ots-Och0_2_0_0_25	Com	N/A	-24.30	-28.90	0.040	0.000
194300.0	75.0					
Ots-Och0_2_0_0_26	Com	N/A	-16.60	-16.90	0.326	0.297
194225.0	75.0					
Ots-Och0_2_0_0_27	Com	N/A	-18.10	-18.70	0.420	0.410
194150.0	75.0					
Ots-Och0_2_0_0_28	Com	N/A	-16.80	-16.90	0.383	0.392
194075.0	75.0					
Ots-Och0_2_0_0_29	Com	N/A	-19.10	-19.80	0.333	0.311
194000.0	75.0					
Ots-Och0_2_0_0_30	Com	N/A	-16.90	-17.10	0.284	0.311
193925.0	75.0					
Ots-Och0_2_0_0_31	Com	N/A	-18.70	-19.20	0.374	0.383
193850.0	75.0					
Ots-Och0_2_0_0_32	Com	N/A	-17.20	-17.40	0.374	0.392
193775.0	75.0					
Ots-Och0_2_0_0_33	Com	N/A	-18.60	-19.10	0.410	0.410
193700.0	75.0					
Ots-Och0_2_0_0_34	Com	N/A	-17.30	-17.60	0.311	0.311
193625.0	75.0					
Ots-Och0_2_0_0_35	Com	N/A	-18.90	-19.10	0.392	0.401
193550.0	75.0					
Ots-Och0_2_0_0_36	Com	N/A	-18.00	-18.20	0.265	0.265
193475.0	75.0					
Ots-Och0_2_0_0_37	Com	N/A	-19.50	-20.00	0.304	0.318
193400.0	75.0					
Ots-Och0_2_0_0_38	Com	N/A	-17.80	-17.90	0.265	0.311
193325.0	75.0					
Ots-Och0_2_0_0_39	Com	N/A	-18.60	-19.00	0.383	0.392
193250.0	75.0					
Ots-Och0_2_0_0_40	Com	N/A	-16.80	-17.00	0.383	0.392
193175.0	75.0					
Ots-Och0_2_0_0_41	Com	N/A	-18.70	-19.10	0.440	0.450
193100.0	75.0					
Ots-Och0_2_0_0_42	Com	N/A	-16.80	-17.10	0.374	0.349
193025.0	75.0					
Ots-Och0_2_0_0_43	Com	N/A	-18.90	-19.40	0.401	0.420
192950.0	75.0					
Ots-Och0_2_0_0_44	Com	N/A	-17.00	-17.40	0.450	0.440
192875.0	75.0					
Ots-Och0_2_0_0_45	Com	N/A	-18.50	-18.80	0.392	0.392
192800.0	75.0					
Ots-Och0_2_0_0_46	Com	N/A	-17.40	-17.60	0.284	0.271
192725.0	75.0					
Ots-Och0_2_0_0_47	Com	N/A	-24.40	-31.50	0.064	0.000
192650.0	75.0					
Ots-Och0_2_0_0_48	Com	N/A	-19.20	-19.60	0.410	0.430

```
     192575.0          75.0
Ots-Och0_2_0_0_49    Com      N/A      -18.70        -19.40         0.392          0.383
     192500.0          75.0
Ots-Och0_2_0_0_50    Com      N/A      -17.10        -17.60         0.374          0.326
     192425.0          75.0
Ots-Och0_2_0_0_51    Com      N/A      -19.10        -19.50         0.401          0.401
     192350.0          75.0
Ots-Och0_2_0_0_52    Com      N/A      -20.40        -20.50         0.357          0.311
     192275.0          75.0
Ots-Och0_2_0_0_53    Com      N/A      -24.70        -34.20         0.042          0.000
     192200.0          75.0
Ots-Och0_2_0_0_54    Com      N/A      -17.60        -18.10         0.201          0.236
     192125.0          75.0
Ots-Och0_2_0_0_55    Com      N/A      -18.50        -19.10         0.401          0.392
     192050.0          75.0
Ots-Och0_2_0_0_56    Com      N/A      -17.20        -17.80         0.341          0.284
     191975.0          75.0
Ots-Och0_2_0_0_57    Com      N/A      -25.60        -30.40         0.050          0.000
     191900.0          75.0
Ots-Och0_2_0_0_58    Com      N/A      -17.40        -17.90         0.220          0.188
     191825.0          75.0
Ots-Och0_2_0_0_59    Com      N/A      -19.40        -20.40         0.333          0.290
     191750.0          75.0
Ots-Och0_2_0_0_60    Com      N/A      -27.10        -38.90         0.023          0.000
     191675.0          75.0
Ots-Och0_2_0_0_61    Com      N/A      -26.00        -38.90         0.031          0.000
     191600.0          75.0
Ots-Och0_2_0_0_62    Com      N/A      -19.50        -20.10         0.133          0.045
     191525.0          75.0
Ots-Och0_2_0_0_63    Com      N/A      -19.20        -19.90         0.401          0.392
     191450.0          75.0
Ots-Och0_2_0_0_64    Com      N/A      -17.30        -17.60         0.333          0.333
     191375.0          75.0
```

From R7.3.1, a decimal place is introduced for Central Frequency and Channel Width columns.

LLDP over OSC

Table 4: Feature History

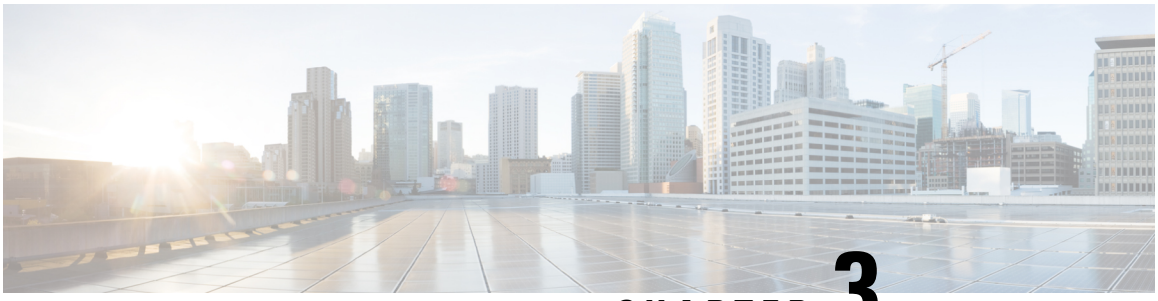
Feature Name	Release	Description
LLDP over OSC	Cisco IOS XR Release 7.3.1	LLDP is supported on the OSC management interface for point-to-point local link discovery through OSC channel. This helps you to gather information about the neighboring devices in the network.

The output of **show lldp neighbors** command, when you enable LLDP on a OSC interface is as follows:

```
RP/0/RP0/CPU0:MYS-130#show lldp neighbors
Mon Feb 22 08:29:20.189 UTC
Capability codes:
(R) Router, (B) Bridge, (T) Telephone, (C) DOCSIS Cable Device
(W) WLAN Access Point, (P) Repeater, (S) Station, (O) Other

Device ID Local Intf Hold-time Capability Port ID
```

```
MYS-131 MgmtEth0/RP0/OSC3/1 120 R MgmtEth0/RP0/OSC1/0
```



CHAPTER 3

Configure Optical Modules

This chapter describes how to configure the Optical Amplifier Module and Protection Switching Module (PSM).

Note When you plan to replace a configured optical module with a different type of optical module, you must clear the configurations of the old module before you install the new module. For example, when replacing a configured EDFA module with a PSM in the same slot, clear the EDFA configurations.

In general, configurations in a card equipped in an NCS 1001 slot include:

- Card configuration—hw-module parameters configuration related to the slot *S* where the card is equipped
- OTS controller configurations
- Optics controller configurations—only for EDFA cards

The following commands clear the configurations in the previous card.

1. `no hw-module location 0/RP0/CPU0 slot <S>`

   Clear the card parameters configuration.

2. `no controller ots Rack/Slot/Instance/Port`

   Clear each OTS controller configuration.

3. `no controller optics Rack/Slot/Instance/Port`

   (Optional) Clear the controller optics configurations. This must be done only if the card previously equipped in slot *S* was an EDFA.

- Optical Amplifier Module, on page 22
- Amplifier Configuration, on page 24
- Configure Amplifier Module, on page 25
- Configure Flex Channels on the Amplifier Module, on page 27
- Modify Central Frequency and Channel Width on the Amplifier Module, on page 29
- In-Line Amplifier, on page 29
- Configure Amplifier Module in ILA Manual Mode, on page 30
- Configure Amplifier Module in ILA Automatic Mode, on page 31
- Gridless OCM Support, on page 33

• Protection Switching Module, on page 33
• Configure Protection Switching Module, on page 34
• Autothreshold for Protection Switching Module , on page 37
• Configure rx-low-threshold for PSM, on page 37
• Enable Autothreshold for PSM, on page 40
• Configure Relative Switch Threshold for PSM, on page 41
• Automated OTS-OCH Thresholds on Amplifier, on page 41
• PSM Virtual Photodiode, on page 43
• PSM 3-way Protection, on page 44
• PSM Revertive Switch, on page 44
• Configure PSM Revertive Switch, on page 45
• OSC, on page 47
• Remote Management, on page 47
• Network Topology Discovery, on page 47
• Configure Management and OSC Interfaces, on page 48
• Configure Static Routes, on page 48
• Configure OSPF Routes, on page 49
• Verify OSPF Routing Table, on page 49
• Troubleshooting Network Issues, on page 50

Optical Amplifier Module

Table 5: Feature History

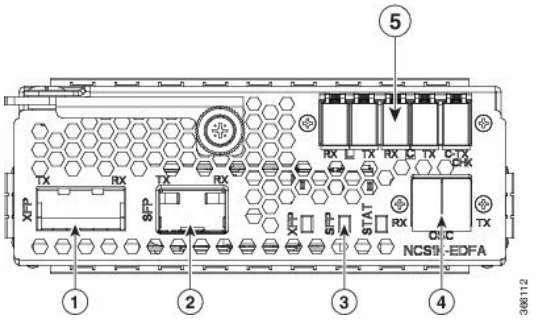
Feature Name	Release Information	Feature Description
Amplifier Behaviour	Cisco IOS XR Release 7.3.1	Grid mode configuration for the optical amplifier has been extended to support 75GHz spaced channels. You can optimize the optical spectrum and granularity using the gridless configuration. You can provision channels with arbitrary channel frequencies and channel widths. Up to 96 channels can be configured using the gridless configuration. Commands modified: • hw-module • show controllers

The optical amplifier module (NCS1K-EDFA) has pre-amplifier and booster amplifier.

The optical amplifier module provides the following functionality.

- Preamplifier (LINE-RX to COM-TX) - Single preamplifier variant, with switchable gain ranges, according to link loss:
  - Range # 1: 0 to 24 dB gain, Tilt control: 24 to 27 gain, with tilt uncontrolled
  - Range # 2: 20 to 34 dB gain, Tilt control: 34 to 37 dB gain, with tilt uncontrolled
  - 23dBm output power @ COM-TX port
- Booster amplifier (COM-RX to LINE-TX) - True variable gain booster amplifier
  - Gain range: 1 to 20. 20 to 25 uncontrolled tilt.
  - 23dBm output power @ LINE-TX port
- ADD/DROP OSC channel supports both 1510nm and 1610nm +/-10nm
- OCM assesses channel presence and Gain regulation and per channel power monitoring.

Figure 1: EDFA Front View



1	XFP for OSC and additional OTDR feature
2	SFP for OSC (Optical Service Channel)
3	Status LED
4	Service Channel input and output port [OSC - RX, TX]
5	PRE and BST amplifier inputs and output ports [L (LINE) - RX, TX] [C (COM) - RX, TX] [COM - TX CHECK]

The following table describes the mapping of controllers and optical ports for the optical amplifier module.

Controller	Optical Ports
Ots 0/slot/0/0	• COM-RX (booster input) • COM-TX (preamplifier output)

Controller	Optical Ports
Ots 0/slot/0/1	• LINE-RX (preamplifier input) • LINE-TX (booster output)
Ots 0/slot/0/2	• OSC-RX • OSC-TX
Ots 0/slot/0/3	COM-CHECK

Amplifier Configuration

NCS 1001 supports two methods to control amplifiers.

- Manual-All the amplifier settings are controlled by the user.
- Automatic-All the amplifier settings are controlled by the internal amplifier power regulator.

UDC Port Configuration

There are three UDC RJ-45 ports on the faceplate of NCS 1001. Each port is statically associated with a slot (UDC1 to slot 1, UDC2 to slot 2 and UDC3 to slot3). UDC ports are one Gigabit Ethernet ports and the user can transmit any Ethernet traffic into these ports.

UDC traffic flows through the line, added and dropped by the OSC add/drop filters in the optical amplifier module (NCS1K-EDFA). UDC traffic flows through the line tagged. The tagging and untagging operations are performed by NCS 1001, based on the UDC VLAN specified in the configuration, without any limit on the transmitted traffic. The traffic can be tagged, multiple tagged, or untagged. However, 100% utilization cannot be achieved because four bytes of tag are added to each packet.

UDC Application for Remote Management

The following diagrams describe the application of UDC that can be used by EPNM to manage NCS 1000 series at the remote site.

Figure 2: UDC Application for Remote Management - Scenario One

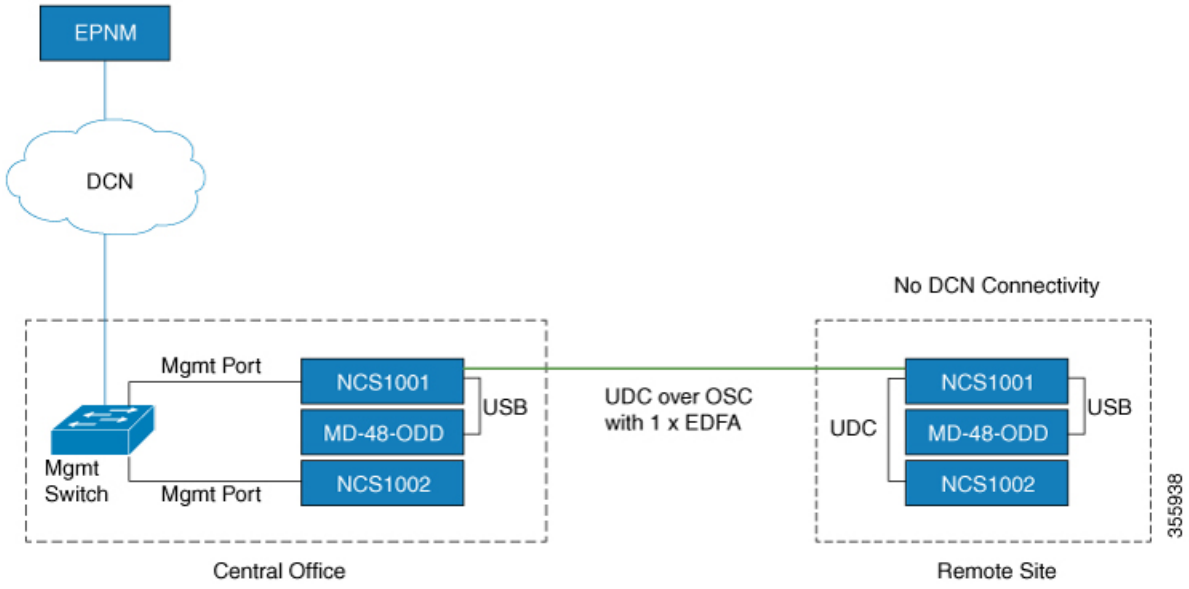
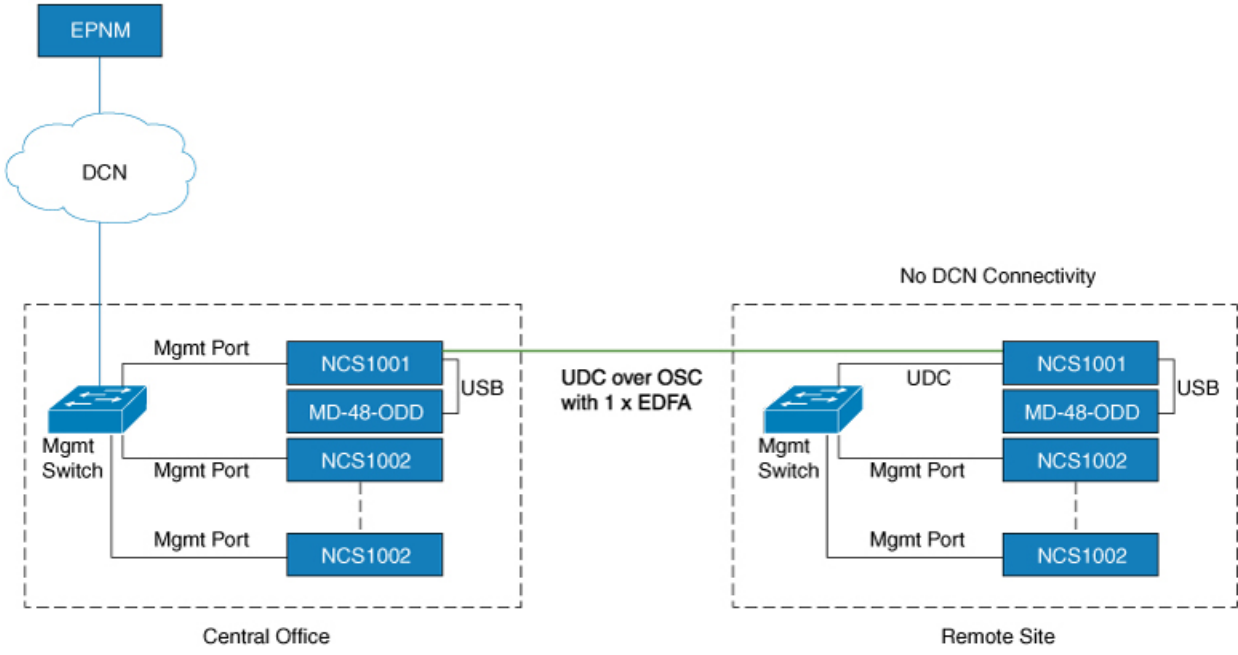


Figure 3: UDC Application for Remote Management - Scenario Two



Configure Amplifier Module

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli**

node-type *value*

grid-mode *value*

udc-vlan *value*

commit

end

Example

The following is a sample in which the amplifier module is inserted in slot 3 and udc-vlan is set to 4000.

```
configure
hw-module location 0/RP0/CPU0 slot 3 ampli
   [
       grid-mode 100GHz
       udc-vlan 4000
   ]
```

Amplifier Module Configuration Parameters

Table 6: Amplifier Module Configuration Parameters

Parameter	Description	Range/Values	Default
grid-mode	Defines the optical spectrum on the interfaces of the amplifier module.	• 100GHz-Configures the amplifier with 100GHz grid of channels with 48 channel spacing. • 50GHz-Configures the amplifier with 50GHz grid of channels with 96 channel spacing. • 75GHz-Configures the amplifier with 75GHz grid of channels with 64 channel spacing. **Note** The new optical passive multiplexer and de-multiplexer module, NCS1K-MD-64-C, introduced in R7.3.1, allows you to configure the amplifier with 75GHz grid of channels. • gridless-Configures the amplifier in the flex spectrum.	50GHz

Parameter	Description	Range/Values	Default
node-type	Defines the type of the node in which the amplifier is set to work.	TERM, ILA	TERM
udc-vlan	Defines the VLAN associated to the selected slot and its UDC port.	2 to 4080	

Configure Flex Channels on the Amplifier Module

You can optimize the optical spectrum and granularity using the gridless configuration. In gridless configuration, the fixed ITU-T grid that defines specific channel frequencies and channel widths is not taken into account. You can provision channels with arbitrary channel frequencies and channel widths. You can configure up to 96 channels using the gridless configuration.

Note Automatic Power Control (APC) regulation in gridless configuration is based on controller **ampli-channel-psd** parameter.

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli flex-mode**

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli grid-mode gridless**

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli flex-chan-id** *channel-id* **chan-central-freq** *frequency* **chan-width** *width*

commit

end

Note The new channel is configured only if it does not overlap with the existing channel.

Table 7: Flex Channel Configuration Parameters

Parameter	Description	Range/Values
flex-chan-id	Defines the channel identifier.	1 to 96
chan-central-freq	Defines central frequency of the channel.	191350 to 196100 in multiples of 125
chan-width	Defines the width of the channel.	500 (50.0 GHz) to 8000 (800.0 GHz) in multiples of 12.5 GHz

Example

The following is a sample in which the amplifier module is configured in flex spectrum.

```
configure
hw-module location 0/RP0/CPU0 slot 2 ampli flex-mode
hw-module location 0/RP0/CPU0 slot 2 ampli grid-mode gridless
hw-module location 0/RP0/CPU0 slot 2 ampli flex-channel-id 5
chan-central-freq 1931750 chan-width 6500
commit
end
```

The following sample shows the configured channel with its frequency and width.

RP/0/RP0/CPU0#**show controllers ots-och 0/2/0/0/5 summary**

```
Fri Oct  9 10:43:44.002 CEST
 Port         Type   Status   TX Power   RX Power
                                (dBm)       (dBm)
----------------- -----   -------   ----------  ----------
Ots-Och0_2_0_0_5    Com     N/A     -8.60       -8.90
TX psd     RX psd         Central         Channel Width
(nW/MHz)   (nW/MHz)       Frequency(GHz)    (GHz)
---------  ------------   -------------    --------------
  0.410       0.450         193175.0         650.0
```

RP/0/RP0/CPU0#**show controllers ots-och 0/2/0/0/5**

```
Fri Oct  9 10:46:33.046 CEST

 Controller State: Up

 Transport Admin State: Maintenance

 Port Type: Com

 Laser State: Unknown

 Optics Status::


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


         Alarm Statistics:
         -----------------
         LOW-RX-PWR = 0
         LOW-TX-PWR = 0
         RX-LOS-P = 0
         RX-LOC = 0
         AMPLI-GAIN-DEG-LOW = 0
         AMPLI-GAIN-DEG-HIGH = 0
         AUTO-LASER-SHUT = 0
         AUTO-POW-RED = 0
         AUTO-AMPLI-CTRL-DISABLED = 0
         AUTO-AMPLI-CFG-MISMATCH = 0
         SWITCH-TO-PROTECT = 0
         AUTO-AMPLI-CTRL-RUNNING = 0

         Parameter Statistics:
         ---------------------
```

```
TX Power = -8.60 dBm
RX Power = -8.90 dBm
TX psd = 0.440 nW/MHz
RX psd = 0.450 nW/MHz
Channel Central Frequency = 193175.0 GHz
Channel Width = 650.0 GHz

Configured Parameters:
-----------------------
Rx Low Threshold = -25.0 dBm
Tx Low Threshold = -25.0 dBm
```

Modify Central Frequency and Channel Width on the Amplifier Module

You can change the central frequency, channel width, or both for a configured channel ID. The channel ID cannot be arbitrarily changed before unconfiguring the channel.

Example

The following sample changes the central frequency of the channel.

```
hw-module location 0/RP0/CPU0 slot 1 ampli flex-channel-id 24
chan-central-freq 1949000 chan-width 500
```

The following sample changes the channel width for the same channel.

```
hw-module location 0/RP0/CPU0 slot 1 ampli flex-channel-id 24
chan-central-freq 1949000 chan-width 1500
```

The following sample changes both the central frequency and channel width of the channel.

```
hw-module location 0/RP0/CPU0 slot 1 ampli flex-channel-id 24
chan-central-freq 1932625 chan-width 6125
```

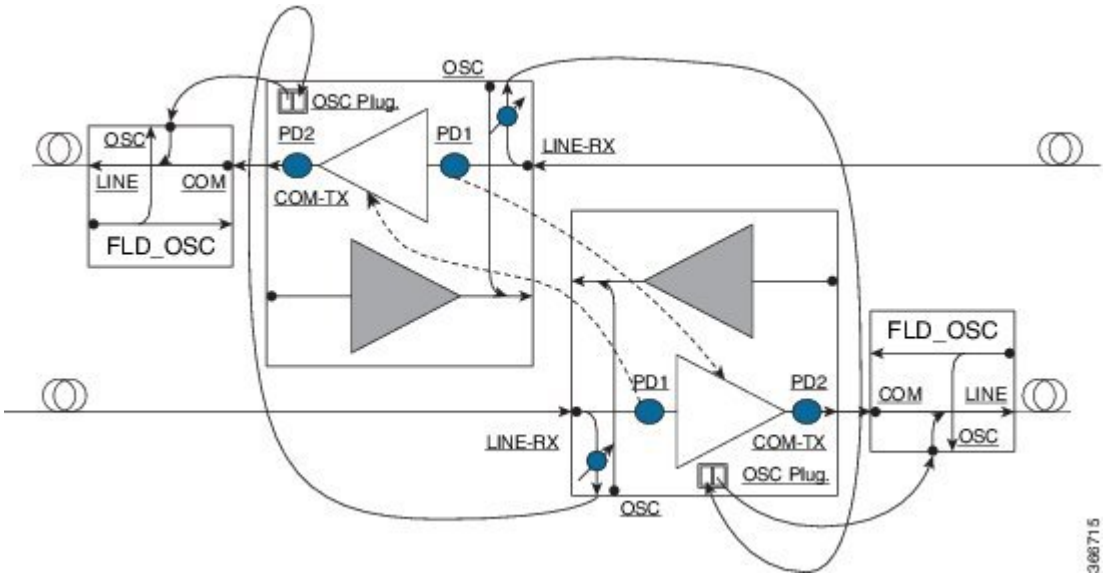
In-Line Amplifier

The optical amplifier module (NCS1K-EDFA) can be configured in In-line amplifier (ILA) mode. ILA mode is used when it is not possible to connect to terminal nodes with a single span. ILA mode is supported only in slots 1 and 3.

ILA mode supports only the operation of preamplifier in the two directions. The booster module is switched off in ILA mode. ILA mode supports gain range 1 and 2 of the preamplifier and provides 23dBm output power pre-amplification.

In the ILA mode, the LINE-RX and COM-TX ports of the optical amplifier module are enabled whereas the LINE-TX and COM-RX ports of the optical amplifier module are disabled. OCM reports LINE-RX and COM-TX port values whereas LINE-TX and COM-RX port values are set to -40.00 dBm. In the ILA mode, the LINE-RX terminates on the LINE-RX on the optical amplifier module whereas the LINE-TX terminates on the external OSC module (15216-FLD-OSC=).

Figure 4: ILA Optical Diagram



Configure Amplifier Module in ILA Manual Mode

When the amplifier is set to ILA, all the configurations are performed only on the pre-amplifier. After the node is set to ILA, the amplifier gain, RX-low threshold, and the amplifier tilt can be configured on the pre-amplifier.

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli node-type** *value*

commit

end

controller *controllertype Rack/Slot/Instance/Port*

ampli-control-mode {**automatic** | **manual**}

ampli-gain *value*

rx-low-threshold *value*

ampli-tilt *value*

commit

end

Example

The following is a sample in which the amplifier module is configured in ILA manual mode. The node type is set to ILA. This parameter switches off the booster side and activate safety between slots 1 and 3.

```
configure
      hw-module location 0/RP0/CPU0 slot 3 ampli node-type iLA
```

```
      commit
      end
      controller ots 0/3/0/0
      ampli-control-mode manual
      ampli-gain 200
      rx-low-threshold -300
      ampli-tilt -10
      commit
end
```

Configure Amplifier Module in ILA Automatic Mode

The configurations performed on the amplifier module in ILA automatic mode are similar to the configurations performed on the terminal node. The configurations are performed only on the pre-amplifier as the booster is switched off in ILA mode.

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli**

grid-mode *value*

node-type *value*

commit

end

controller *controllertype Rack/Slot/Instance/Port*

ampli-control-mode {**automatic** | **manual**}

ampli-channel-power *value*

ampli-tilt *value*

rx-low-threshold *value*

channel-power-max-delta *value*

ampli-gain *value*

ampli-gain-range {**normal** | **extended**}

commit

end

Example

The following is a sample in which the amplifier module is configured in ILA automatic mode.

```
configure
      hw-module location 0/RP0/CPU0 slot 3 ampli
      grid-mode 50GHz
      node-type iLA
      commit
      end
      controller ots 0/3/0/0
      ampli-control-mode automatic
      ampli-channel-power 30
```

```
      ampli-tilt -10
      rx-low-threshold -331
      ampli-gain 220
      ampli-gain-range extended
      commit
end
```

The following is a sample of **show running-config** command.

```
line console
exec-timeout 0 0
!
line default
exec-timeout 0 0
session-timeout 0
!
ntp
server 10.58.228.1
update-calendar
!
hw-module location 0/RP0/CPU0 slot 1
ampli udc-vlan 11
ampli grid-mode 50GHz
ampli node-type ILA
!
hw-module location 0/RP0/CPU0 slot 3
ampli udc-vlan 10
ampli grid-mode 50GHz
ampli node-type ILA
!
interface MgmtEth0/RP0/CPU0/0
ipv4 address 10.58.229.143 255.255.252.0
!
interface MgmtEth0/RP0/OSC1/0
shutdown
!
interface MgmtEth0/RP0/OSC2/0
shutdown
!
interface MgmtEth0/RP0/OSC3/0
shutdown
!
controller Ots0/1/0/0
ampli-tilt -12
ampli-control-mode automatic
ampli-channel-power 22
channel-power-max-delta 45
!
controller Ots0/1/0/1
rx-low-threshold -250
!
controller Ots0/3/0/0
ampli-tilt -12
ampli-control-mode automatic
ampli-channel-power 22
channel-power-max-delta 45
!
controller Ots0/3/0/1
rx-low-threshold -250
!
router static
address-family ipv4 unicast
  0.0.0.0/0 10.58.228.1
```

```
!
!
netconf-yang agent
ssh
!
ssh server v2
end
```

Gridless OCM Support

Overview

The Gridless OCM (Optical Channel Monitor) support feature is introduced to support transponders with channel width between 50GHz to 100GHz. In R7.1.1, the channel width can be set between 50GHz to 800GHz in multiples of 25GHz. In the gridless mode, the amplifier gain is calculated using the power spectral density parameter and not the per channel power parameter. The flex grid provides the capability to support 600G interface of NCS 1004.

Limitation

- The setting of a channel width disables the nearest channels.

Configure the Channel Width

The channel width can be set between 1000 and 8000.

The following command configures the channel width as 100GHz. This means that the channels are spaced on eight slices at 12.5GHz each.

```
hw-module location 0/RP0/CPU0 slot 1 ampli flex-mode
channel-id 1 channel-width 1000
```

The following command configures the channel width as 800GHz. This means that the channels are spaced on eight slices at 100GHz each.

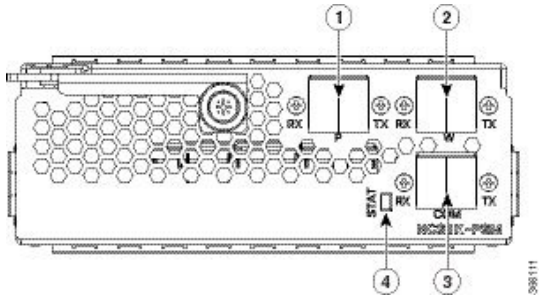
```
hw-module location 0/RP0/CPU0 slot 1 ampli flex-mode
channel-id 10 channel-width 8000
```

Protection Switching Module

The protection switching module (NCS1K-PSM) provides the following functionality.

- In TX section:
  - Splits input optical channels to both working and protection lines.
  - Forces the switch in the remote site by opening one of the two line paths (by putting the related VOA in AVS).
- In RX section:
  - Selects the signals from working or protection line. Each line is monitored through a PD.
  - Balances the two line losses by changing the VOA attenuation value at the same time of the switch change of state.

Figure 5: PSM Front View



1	Protected path input and output port [P - RX, TX]
2	Working path input and output port [W - RX, TX]
3	COM input and output port [COM - RX, TX]
4	Status LED

The following table describes the mapping of controllers and optical ports for the protection switching module.

Controller	Optical Ports
Ots 0/slot/0/0	COM-TX
Ots 0/slot/0/1	Working path input and output port [W - RX, TX]
Ots 0/slot/0/2	Protected path input and output port [P - RX, TX]

Configure Protection Switching Module

The following table explains the possible configuration on Protection Switching Module:

PSM Module Configuration Parameters

Table 8: PSM Module Configuration Parameters

Parameter	Description	Range/Values
lockout-from	Excludes the selected port from protection. Triggers a switch when the active port is specified in the lockout. For example, configuring a lockout-from working port triggers a switch to protect when working port is the active one. While lockout-from protected port triggers a switch to working when protected port is the active one.	Working and Protected
path-protection	Enables the PSM path protection.	
section-protection	Enables the PSM section protection.	
uni-dir	Enables the PSM uni directional (in switches only).	
auto-threshold	Enables the PSM auto threshold setting.	

Example

The following is an example of configuration of a lockout from working in which the PSM is inserted in slot 2.

```
conf t
#hw-module location 0/RP0/CPU0 slot 2 psm lockout-from "working"
commit
```

You can apply manual switching by using the following command:

hw-module slot *slot number* **manual-switch-to working | protected**

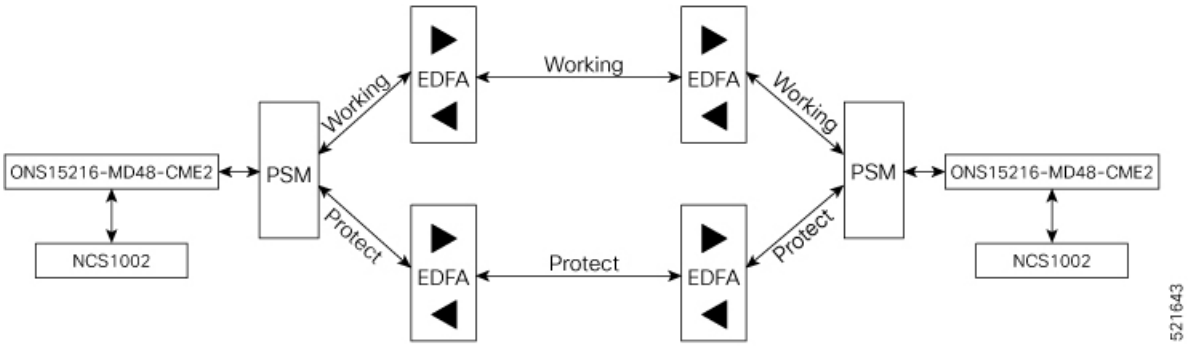
The switch by user command from the path without the ILA node in the middle is performed bi-directionally. If the ILA and terminal nodes are in section-protection, the manual and lockout switch command from the path with ILA node in the middle are performed uni-directionally.



Note FPD upgrade on FW_PSMv1 from FW 1.43 and FW 1.44 to FW 1.45 affects the traffic.

(From R6.2.1) **Section Protection**

Figure 6: Section Protection Topology

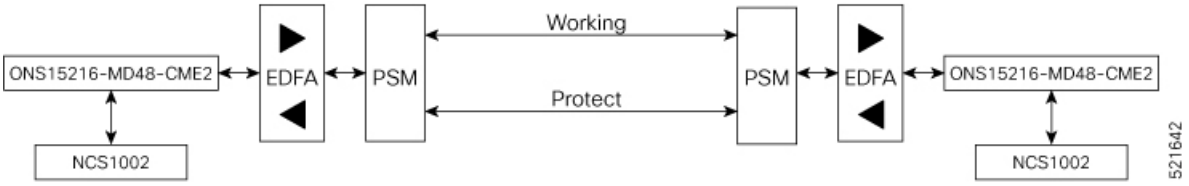


See the PSM Module Configuration Parameters section to set the section-protection parameter on both the PSMs. Ensure that the PSM in a section protection topology is inserted in slot 2. Connect the EDFA in slot 1 to the Protected port of the PSM and EDFA in slot 3 to the Working port of the PSM.

Note To measure the correct switching time while testing the section protection topology, we recommend you to wait for 120 seconds between two subsequent switching events (or between a switching event and the restoration). This waiting period allows the EDFAs to stabilize after the first switching occurrence, thus avoiding the power at the PSM to oscillate around the threshold.

(From R6.3.2) **Path Protection**

Figure 7: Path Protection Topology



See the PSM Module Configuration Parameters section to set the path-protection parameter on both the PSMs.

Protection Switching Module with Manual Threshold

The switch can operate in all conditions, if it is set in Autothreshold.

When the path protection is configured with a manual threshold, you must ensure that:

- During the first installation, the value on the PSM RX-low Threshold should be set as 3 dB below the minimum power for a single channel. The value must ensure that the PSM is able to switch on with a single channel or when the EDFA is in APR (+8 dBm).
- When the system is up and running with the final number of channels, the PSM RX-low Threshold must be set 3 dB below the target power.
- After a fiber cut and restore, in order to ensure that the PSM is able to switch on, it is necessary to set the value of PSM RX-low Threshold similar to the value set during the first installation.

The PSM Auto-threshold configuration is highly recommended for a three-way topology.

In a three-way topology, when the path protection is configured with a manual threshold, you must follow the above steps. If you did not configure all the above steps properly, you may encounter the following issues:

- Switch may not be bidirectional.
- Double switch on PSM in path protection, when set in three-way configuration.

It is possible to configure parameters such as rx-enable, tx-enable in OTS controllers (1 or 2, i.e. working or protected port) of PSM card.

For more information on OTS controllers, see Configure OTS Controller, on page 7.

Autothreshold for Protection Switching Module

When auto-threshold is not enabled, the RX-low threshold value active on PSM working and protected RX-ports can either be set by the user or the default values can be used.

The current threshold is the configured parameter if the values set are available in the show controller command output. The current value is -38dBm (default values), if the user doesn't have configured any value for those parameters.

If auto-threshold is enabled on the PSM, the RX-low thresholds values for port 1 and 2 configured by the user are ignored (current thresholds is not the configured parameter). When the auto threshold is enabled on the PSM card:

- If optical Power at Working-RX and Protected-RX port is stable (+/- 1 dB) for 2 minutes, related RX-Low threshold is automatically set to RX power – 3dB.
- If power is not stable, the releated thresholds do not change.
- W-RX and P-RX are regulated independently.

The LOS-P behavior on the auto-threshold are:

- When a LOS-P alarm is detected on the working or protected RX-port, in case of auto-threshold is enabled, the related threshold remains the same. This behavior happens when the RX power is less than the related threshold on the RX-port working or protected.
- When the LOS-P alarm is cleared in the first 30 seconds, the ordinary auto-threshold mechanism is applied. This behavior happens after 2 minutes of stable RX-power and when the RX-low threshold is changed to the new RX power -3 dB.
- When the LOS-P is present after 30 seconds, the RX-low threshold is automatically moved to the values set by the user.
- When the LOS-P is cleared, the ordinary auto-threshold mechanism is applied again. This behavior happens when the RX power is higher than the related current threshold.

Configure rx-low-threshold for PSM

You must configure the **rx-low-threshold** parameter before enabling auto-threshold on PSM.

PSM auto-threshold feature monitors the W-RX/P-RX ports of the PSM module for actual received power. When the received power is stable, the feature sets the **rx-low-threshold** value of the W-RX/P-RX ports with

the current power value. The current value of the threshold is set to 3 dB lower than the received power. If there is LOS at the W-RX/P-RX ports due to fiber cut or temporary disruption of received power, the feature restores the **rx-low-threshold** value of the W-RX/P-RX ports to the configured value.

```
RP/0/RP0/CPU0:ios#show controllers ots 0/2/0/1
Parameter Statistics:
-----------------------
         RX Power = -4.00 dBm
         Rx Low Threshold Current = -7.0 dBm   <<< current value (auto-threshold)

Configured Parameters:
-----------------------
         Rx Low Threshold = -38.0 dBm <<< configured value (user configured)
```

We recommend to configure both the **rx-low-threshold** and **auto-threshold** values of the PSM module according to the following guidelines:

Configure PSM W/RX Threshold (Ots0_2_0_1/Working) with Amplifier Control Mode as Manual

1. **show hw-module slot 3 channel-trail-view active**

```
Channel Trail View - Active - dBm
=========================================
                                                                    BST: 0/COM=>1/LINE
       PRE: 1/LINE=>0/COM
Och Name       Wavelength(nm)Freq(GHz) Width(GHz)Rx pwr(dBm) Tx pwr(dBm) Rx pwr(dBm)
Tx pwr(dBm)
-------------------------------------------------------------------------------------------
Ots-Och0_2_0_0_1  1528.77    196100.0    50.0     -6.10       -4.90       -2.50
 6.20
Ots-Och0_2_0_0_2  1529.16    196050.0    50.0     -5.90       -4.60       -2.20
 6.50
Ots-Och0_2_0_0_3  1529.55    196000.0    50.0     -6.00       -4.80       -2.30
 6.30
Ots-Och0_2_0_0_4  1529.94    195950.0    50.0     -6.10       -4.90       -2.40
 6.20
Ots-Och0_2_0_0_5  1530.33    195900.0    50.0     -6.30       -5.20       -2.60
 6.00
Ots-Och0_2_0_0_6  1530.72    195850.0    50.0     -6.50       -5.30       -2.80
 5.90
```

   Examine the **PRE: 1/LINE=>0/COM** column in the command output and choose the lowest channel **Tx pwr** value from all the active channels.

2. **configure**
3. **controller ots 0/2/0/1 rx-low-threshold 49**

   Set the threshold value manually to (lowest channel Tx power – 1 dBm). In the above example, channel Ots-Och0_2_0_0_6 is at the lowest Tx power 5.90 dBm. Hence, the threshold value on PSM W/RX port will be 5.90 – 1 = 4.90 dBm.

If the system works without any grid mode configuration, the channel-trail-view command is not available because channel mapping configuration is not available.

To identify the lowest channel Tx pwr value, use the following show command.

show controllers ots0/3/0/0 spectrum-info

```
Tx power :
 ---------------------------------------------------------------------------------
```

```
spectrum-slice num                          Tx-power values (dBm)
-------------------------------------------------------------------------------
  1 - 8               -47.20 -47.20 -47.20 -36.40     -47.20 -47.20 -47.20 -47.20
  9 - 16              -47.20 -47.20 -43.70 -43.70     -47.20 -36.60 -47.20 -43.20
 17 - 24              -47.20 -35.80 -47.20 -47.10     -41.90 -43.20 -42.20 -40.30
 25 - 32              -40.30 -47.20 -41.70 -41.70     -37.50 -47.20 -47.20 -41.90
 33 - 40              -41.90 -47.20 -45.90 -42.10     -42.10 -46.30 -41.60 -39.10
 41 - 48              -41.20 -47.20 -35.80 -45.10     -45.30 -45.30 -40.10 -40.10
 49 - 56              -45.50 -42.60 -45.30 -47.20     -47.20 -40.50 -47.20 -45.80
 57 - 64              -38.60 -40.30 -40.30 -47.20     -47.20 -39.40 -43.10 -43.10
 65 - 72              -42.20 -42.20 -47.20 -47.20     -38.80 -47.20 -47.20 -41.30
 73 - 80              -47.20 -43.00 -40.10 -40.10     -47.20 -36.10 -39.40 -45.70
 81 - 88              -47.20 -41.50 -39.00 -42.50     -47.20 -47.20 -34.30 -47.20
 89 - 96              -47.20 -47.20 -39.90 -39.70     -47.20 -47.20 -47.20 -47.20
 97 - 104             -47.20 -45.10 -39.90 -41.30     -47.20 -39.80 -37.80 -42.00
```

All the slice power values are expressed in PSD (Power Spectral Density) units of measure [dBm/12.5GHz]. Each slice value is converted to linear mWatt using the formula 10^(N/10). For example, -20 dBm = 10^(-20/10) = 0.01 mWatt and 0 dBm = 10^0 = 1 mWatt.

Each slice group that composes a channel will be algebraically added to obtain the integral channel power. For example, the first channel of 50GHz occupies the slice range [1-4], 2nd channel [5-8] and so on. The first channel of 75GHz occupies the slice range [1-5],[6-11] and so on. The first channel of 100 GHz occupies the slice range [1-6],[7-14] and so on.

Each channel power that falls below the **rx-low-threshold** value is excluded from the list of active channels. The channel that has the least value above the **rx-low-threshold** value is chosen.

Configure PSM P/RX Threshold (Ots0_2_0_2/Protected) with Amplifier Control Mode as Manual

1. **show hw-module slot 1 channel-trail-view active**

```
Channel Trail View - Active - dBm
=========================================
                                                                  BST: 0/COM=>1/LINE
       PRE: 1/LINE=>0/COM
Och Name      Wavelength(nm)Freq(GHz) Width(GHz)Rx pwr(dBm) Tx pwr(dBm)  Rx pwr(dBm)
Tx pwr(dBm)
-------------------------------------------------------------------------------------
Ots-Och0_2_0_0_1 1528.77    196100.0    50.0     -6.10       -4.90        -2.50
 5.00
Ots-Och0_2_0_0_2 1529.16    196050.0    50.0     -5.90       -4.60        -2.20
 5.20
Ots-Och0_2_0_0_3 1529.55    196000.0    50.0     -6.00       -4.80        -2.30
 5.10
Ots-Och0_2_0_0_4 1529.94    195950.0    50.0     -6.10       -4.90        -2.40
 5.00
Ots-Och0_2_0_0_5 1530.33    195900.0    50.0     -6.30       -5.20        -2.60
 5.00
Ots-Och0_2_0_0_6 1530.72    195850.0    50.0     -6.50       -5.30        -2.80
 4.80
```

   Examine the **PRE: 1/LINE=>0/COM** column in the command output and choose the lowest channel **Tx pwr** value from all the active channels.

2. **configure**
3. **controller ots 0/2/0/2 rx-low-threshold 38**

Set the threshold value manually to (lowest channel Tx power – 1 dBm). In the above example, channel Ots-Och0_2_0_0_6 is at the lowest Tx power 4.80 dBm. Hence, the threshold value on PSM W/RX port will be 4.80 – 1 = 3.80 dBm.

Configure PSM W/RX Threshold (Ots0_2_0_1/Working) with Amplifier Control Mode as Automatic

1. **show controllers ots 0/3/0/0**

```
Configured Parameters:

-------------------------
         Ampli Channel power = 0.00 dBm
```

   Examine the **ampli-channel-power Tx** value in the command output.

2. **configure**
3. **controller ots 0/2/0/1 rx-low-threshold -10**

   Set the threshold value manually to (ampli-channel-power – 1 dBm). In the above example, **ampli-channel-power Tx** value is 0 dBm. Hence, the threshold value on PSM W/RX port will be 0 – 1 = -1 dBm.

Configure PSM P/RX Threshold (Ots0_2_0_2/Protected) with Amplifier Control Mode as Automatic

1. **show controllers ots 0/1/0/0**

```
Configured Parameters:

-------------------------
         Ampli Channel power = 2.00 dBm
```

   Examine the **ampli-channel-power Tx** value in the command output.

2. **configure**
3. **controller ots 0/2/0/2 rx-low-threshold 10**

   Set the threshold value manually to (ampli-channel-power – 1 dBm). In the above example, **ampli-channel-power Tx** value is 2 dBm. Hence, the threshold value on PSM W/RX port will be 2 – 1 = 1 dBm.

Enable Autothreshold for PSM

Before You Begin

Configure rx-low-threshold for PSM, on page 37

This procedure enables automatic thresholds for PSM. The configuration to set auto threshold mechanism are:

configure

hw-module location 0/RP0/CPU0 slot *slot number* **psm auto-threshold**

commit

end

slot number is the slot where the PSM is inserted.

Example

The following is a sample for enabling autothreshold on a PSM equipped in slot 1.

```
RP/0/RP0/CPU0:MYS-237#configure terminal
RP/0/RP0/CPU0:MYS-237(config)#hw-module location 0/RP0/CPU0 slot 1 psm auto-threshold
RP/0/RP0/CPU0:MYS-237(config)#commit
eRP/0/RP0/CPU0:MYS-237(config)#end
```

Configure Relative Switch Threshold for PSM

Relative switch threshold allows you to manually configure the delta threshold on PSM at which the working path switches to the protected path. Relative switch threshold can be configured on PSM only if **auto-threshold** or **revertive wtr** are not configured. You can configure the relative switch threshold using the following commands:

configure terminal

hw-module location 0/RP0/CPU0 slot *slot number* **psm relative-switch-threshold** *value* **relative-switch-threshold-offset** *value*

commit

end

For more information about these commands, see Command Reference for Cisco NCS 1001.

Example

```
RP/0/RP0/CPU0:MYS-237#configure terminal
RP/0/RP0/CPU0:MYS-237(config)#hw-module location 0/RP0/CPU0 slot 1 psm
relative-switch-threshold 120 relative-switch-threshold-offset -150
RP/0/RP0/CPU0:MYS-237(config)#commit
eRP/0/RP0/CPU0:MYS-237(config)#end
```

Automated OTS-OCH Thresholds on Amplifier

The automated OTS-OCH thresholds can be enabled or disabled on each EDFA (Erbium Doped Fiber Amplifier) card equipped on the node itself. It applies on the EDFA OTS controllers and on all the related OTS-OCH controller ports.

When the automatic threshold function is enabled on the amplifier, the threshold value to set is determined using the following formula:

rx-low-threshold = (Remote AmplChannel - RXSpanloss)-User Threshold Offset.

Where

Remote AmplChannel is the ampli channel power set on the remote node for ots controller tx port of remote EDFA.

RXSpanloss is the RX Span Loss calculated on the local node.

User Threshold Offset is the ampli-auto-rxlow-threshold threshold-offset set on the local node for EDFA in slot 1.

Any modification to each of the parameters included in the formula does not automatically account for the calculation of the rx-low threshold value. To calculate a different rx-low-threshold value correspondingly, you must execute the following CLI command:

hw-module slot<*n*>**ampli-auto-rxlow-threshold threshold-offset** <*value*>

Example: hw-module slot 1ampli-auto-rxlow-threshold threshold-offset 400

Command Parameters:

- <*n*> (**1,2 3**): This parameter designates the specific slot where the EDFA card is installed within the device.
- <*value*> (**0-800**): This parameter represents the desired adjustment to the Amplifier RX-LOW threshold, specified in tenths of dBm.

Limitations

- This feature works, only if the user has configured span loss calculation. Refer Span Loss Calculation section in the Configure Controllers chapter of the configuration guide.

Configure Automatic Thresholds

This procedure enables automatic thresholds for EDFA. The configuration to set automatic threshold mechanism are:

configure terminal

hw-module location 0/RP0/CPU0 slot *slot number* **ampli auto-threshold**

commit

end

slot number is the slot where the EDFA is inserted.

Example

The following is a sample for enabling autothreshold on an EDFA inserted in slot 1.

```
RP/0/RP0/CPU0:MYS-237#configure terminal
RP/0/RP0/CPU0:MYS-237(config)#hw-module location 0/RP0/CPU0 slot 1 ampli auto-threshold
RP/0/RP0/CPU0:MYS-237(config)#commit
eRP/0/RP0/CPU0:MYS-237(config)#end
```

Verification

The following is a sample for checking whether the auto-threshold is configured.

```
#show running hw-module location 0/RP0/CPU0 slot 1 ampli
….
 ampli span-loss
 ampli node-type TERM
 ampli remote-node local-ipv4 10.58.xxx.xxx remote-ipv4 10.58.xxx.xxx remote-slot-id 3
 ampli auto-threshold
```

PSM Virtual Photodiode

Protection Switching Module (PSM) Virtual diode provides an optical power reading even if photodiodes are not available. PSM does not have photodiode on COM-RX. There are two photodiodes on Working-TX and Protected-TX present after the VOA.

The value of power on Com-RX is real, if at least one value between the W-TX and the P-TX power is not equal to -40 dB (related port in AVS).

When both the power of W-TX and P-TX are equal to -40dB (both related VOA in AVS-Automatic VOA Shutdown), it is impossible to calculate the real power on Com-RX port, and the value will be shown as -40dB.

The feature does not require any configuration. There is a change only in the *show controllers ots 0/<slot>/0/0* command, which shows the RX power on Com-RX port. RX low power alarm is not managed on Com-RX port.

Example for show controller

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

```
Wed Jan 24 14:33:22.898 CET

 Controller State: Up

 Transport Admin State: In Service

 Port Type: Com

 Laser State: Unknown

 Optics Status::


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


 Alarm Statistics:
 -----------------
 LOW-RX-PWR = 0
 LOW-TX-PWR = 0
 RX-LOS-P = 0
 RX-LOC = 0
 AMPLI-GAIN-DEG-LOW = 0
 AMPLI-GAIN-DEG-HIGH = 0
 AUTO-LASER-SHUT = 0
 AUTO-POW-RED = 0
 AUTO-AMPLI-CTRL-DISABLED = 0
 AUTO-AMPLI-CFG-MISMATCH = 0
 SWITCH-TO-PROTECT = 0
 AUTO-AMPLI-CTRL-RUNNING = 0

 Parameter Statistics:
 ---------------------
 TX Power = 15.30 dBm
 RX Power = 5.30 dBm
 tx-enable = 1
 rx-enable = 1
```

```
Configured Parameters:
----------
tx-enable = 1
rx-enable = 1
```

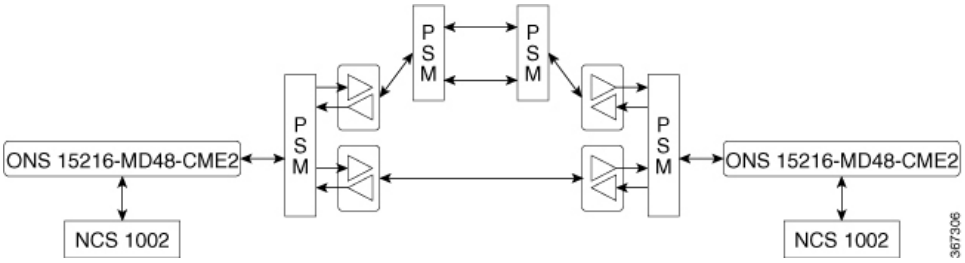
PSM 3-way Protection

NCS 1001 supports Protection Switching Module (PSM) 3-way protection scheme formed by combining a Section Protection scheme with a Path Protection scheme. There is no confiugration change required in PSM to implement the PSM 3- way protection scheme. The Path Protection scheme is in the middle of one of the two paths of Section Protection scheme.

For the outer section protection it is suggested to use the PSM automatic threshold configuration.

Figure 8: 3-way Protection Network Topology

Figure 9: 3-way Protection Network Topology



The 3-way Protection Scheme has the following limitations:

- For each PSM switching the bi-directionality is not definite.
- The manual switching used to change the active path is sometimes unsuccessful.

The lockout configuration is recommended to control the switching operation from one path to another on all the 4 PSMs of the protection scheme. The lockout configuration must be applied on both local and corresponding remote PSM to ensure the bi-directionality.

PSM Revertive Switch

When an LOS (Loss of Signal – Payload) alarm occurs on the primary path due to fiber cut, traffic moves from primary to secondary path. PSM revertive switch features allows the traffic to move to the primary path from secondary path when the fiber cut is resolved and the LOS alarm is cleared on the primary path. The traffic switch to the primary path is not immediate and depends on the following parameters.

Parameters of PSM Revertive Switch

- WTR (Wait To Restore Time): WTR is the time delay (in seconds) introduced after LOS alarm on the primary path is cleared. When WTR timer elapses, traffic moves to the primary path.
- Threshold hysteresis: Threshold hysteresis parameter is required to avoid transient or flipping power readings in the region near the threshold which is monitoring the primary rx port.

Threshold hysteresis parameter, if set, works in combination with WTR timer. After the fiber cut is fixed and alarm is cleared, the system starts the WTR timer only when the power on primary rx port becomes higher than the sum of rx-low-threshold and threshold hysteresis (rx-low-threshold-delta) values. When WTR timer elapses, traffic moves to the primary path.

Note The suggested values for WTR and threshold hysteresis parameters are 120 seconds and 1.0 dBm respectively. Both the parameter values must be properly chosen based on different conditions such as power received, type of PSM protection scheme, manual threshold values provisioned on PSM or auto-threshold enabled, and so on.

Limitations

- PSM revertive switch feature is supported only on section protection or path protection schemes.
- PSM revertive switch feature is not supported on PSM 3-way protection scheme.
- PSM revertive switch feature is not supported on section protection or path protection schemes involving one or more ILA nodes.
- PSM revertive switch feature works only in case of switch from primary to secondary path due to fiber cut and not in case of switch from primary to secondary path due to user commands such as manual-to or lock-out-from.

Configure PSM Revertive Switch

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **psm**

revertive wtr *wtr-value*

primary-path *path*

commit

end

wtr-value must be an integer. The primary path is set to WORKING by default. The user can change this path from WORKING to PROTECTED but cannot delete it.

Example

The following is a sample of configuring the WTR parameter of PSM revertive switch in which the PSM module is inserted in slot 2 and primary path is set to working.

```
configure
hw-module location 0/RP0/CPU0 slot 2 psm
revertive wtr 120
primary-path WORKING
commit
end
```

The following is a sample of configuring the threshold hysteresis parameter of PSM revertive switch.

```
configure terminal
controller 0/2/0/1 rx-low-threshold-delta 10
commit
end
```

rx-low-threshold-delta is the threshold hysteresis. The value 10 is expressed in units of 0.1 dBm. In the above example, the value of threshold hysteresis is set as 1.0 dBm.

Example of show controller

RP/0/RP0/CPU0:ios# **show controllers ots 0/2/0/1**

```
Controller State: Up

 Transport Admin State: In Service

 Port Type: Working

 Port Status: Standby

 Laser State: Unknown

 Optics Status::

         Alarm Status:
         -------------
         Detected Alarms:

         Alarm Statistics:
         -----------------
         LOW-RX-PWR = 0
         LOW-TX-PWR = 0
         RX-LOS-P = 735
         RX-LOC = 0
         AMPLI-GAIN-DEG-LOW = 0
         AMPLI-GAIN-DEG-HIGH = 0
         AUTO-LASER-SHUT = 0
         AUTO-POW-RED = 0
         AUTO-AMPLI-CTRL-DISABLED = 0
         AUTO-AMPLI-CFG-MISMATCH = 0
         SWITCH-TO-PROTECT = 4
         AUTO-AMPLI-CTRL-RUNNING = 0

         Parameter Statistics:
         ---------------------
         TX Power = -16.70 dBm
         RX Power = -21.00 dBm
         RX Voa Attenuation = 0.00 dB
         TX Voa Attenuation = 0.00 dB
         TX Enable = Enabled
         RX Enable = Enabled
         Rx Low Threshold Current = -38.0 dBm
         Wait Time to Restore = 120 secs


         Configured Parameters:
         ----------
         Rx Low Threshold = -38.0 dBm
         RX Voa Attenuation = 0.0 dB
         TX Voa Attenuation = 0.0 dB
```

```
TX Enable = Enabled
RX Enable = Enabled
Rx Low Threshold Delta = 1.0 dBm
```

OSC

OSC (Optical Service Channel) is an out-band channel added and dropped into the optical amplifier module. The wavelengths supported by OSC are 1510 nm and 1610 nm.

OSC provides a communication channel for the following types of traffic.

- Traffic coming from a UDC port
- Traffic for remote management of NCS 1001

Remote Management

Remote Management feature, introduced in R6.3.1, allows to configure the IP addresses of the local and remote nodes, to remotely manage NCS 1001.

Three OSC interfaces are configured to support remote management. The OSC interfaces are configured to provide static routes to remote nodes. Each OSC interface is statically associated with a slot (OSC1 to slot 1, OSC2 to slot 2, and OSC3 to slot3).

Configuration Steps

1. Configure management and OSC interfaces
2. Configure static routes

Network Topology Discovery

Network topology discovery feature based on OSPF protocol, introduced in R6.3.2, allows to discover NCS 1001 nodes connected to each other through OSC links without configuring the static routes. This feature checks for compatibility only between NCS 1001 nodes.

OSPF must be properly configured on the NCS 1001 nodes by defining the name, router ID, interfaces in the Area 0 section, and optionally, configuring the interfaces as passive. OSPF and OSPFv3 protocols are supported.

The following network topologies are supported.

- Point to Point
- Point to Point with ILA nodes (up to three ILA nodes)

Configuration Steps

1. Configure management and OSC interfaces
2. Configure OSPF routes

Configure Management and OSC Interfaces

configure

interface mgmtEth *rack/slot/instance/port*

ipv4 address *ipv4-address subnet-mask*

shutdown

exit

Example

The following are samples of configuring the management and OSC interfaces.

```
configure
interface MgmtEth 0/RP0/CPU0/0
ipv4 address 10.58.227.198 255.255.255.0
shutdown
exit
```

```
configure
interface MgmtEth 0/RP0/OSC1/0
ipv4 address 10.1.1.1 255.255.255.0
shutdown
exit
```

```
configure
interface MgmtEth 0/RP0/OSC2/0
ipv4 address 10.1.2.1 255.255.255.0
shutdown
exit
```

```
configure
interface MgmtEth 0/RP0/OSC3/0
ipv4 address 10.1.3.1 255.255.255.0
shutdown
exit
```

Configure Static Routes

This procedure configures all the static routes into the NCS 1001 node.

configure

router static address-family ipv4 unicast 0.0.0.0/0 *default-gateway*

exit

Example

The following sample shows the NCS 1001 node connected to three different nodes using static routes.

```
configure
```

```
router static address-family ipv4 unicast
0.0.0.0/0 MgmtEth 0/RP0/CPU0/0 10.58.227.1
10.1.1.0/24 MgmtEth 0/RP0/OSC1/0 10.1.1.2
10.1.2.0/24 MgmtEth 0/RP0/OSC2/0 10.1.2.2
10.1.3.0/24 MgmtEth 0/RP0/OSC3/0 10.1.3.2
exit
```

Configure OSPF Routes

configure

router ospf *process-id*

router-id *ip-address*

area *area-id*

exit

Example

The following is a sample of configuring OSPF routes.

```
configure
interface MgmtEth0/RP0/CPU0/0
 ipv4 address 10.1.1.2 255.255.255.0
!
interface MgmtEth0/RP0/OSC1/0
 shutdown
!
interface MgmtEth0/RP0/OSC2/0
 ipv4 address 10.1.3.2 255.255.255.0
!
interface MgmtEth0/RP0/OSC3/0
 ipv4 address 10.1.4.2 255.255.255.0
!
router ospf remote
 router-id 10.1.1.2
 area 0
  interface MgmtEth0/RP0/CPU0/0
   passive enable
  !
  interface MgmtEth0/RP0/OSC2/0
  !
  interface MgmtEth0/RP0/OSC3/0
  !
 !
!
end
```

Verify OSPF Routing Table

RP/0/RP0/CPU0:ios# **show ospf routes**

```
Sat Jul 29 09:54:25.937 UTC

Topology Table for ospf local with ID 10.1.4.1
```

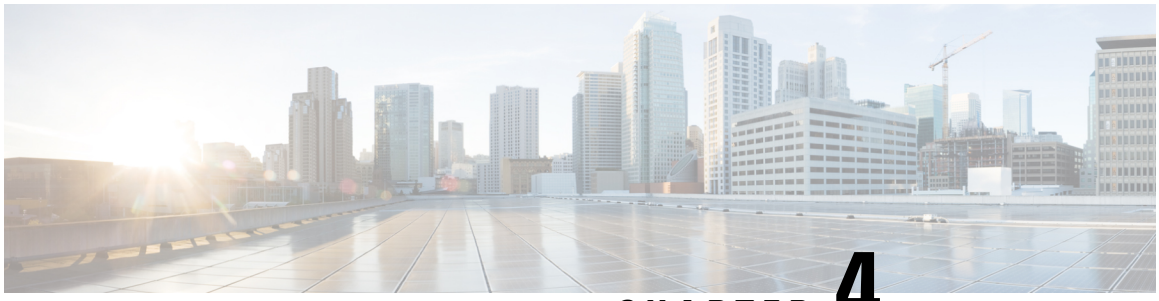
```
Codes: O - Intra area, O IA - Inter area
       O E1 - External type 1, O E2 - External type 2
       O N1 - NSSA external type 1, O N2 - NSSA external type 2

O    10.1.1.0/24, metric 1
       10.1.1.2, directly connected, via MgmtEth0/RP0/CPU0/0
O    10.1.3.0/24, metric 1
       10.1.3.2, directly connected, via MgmtEth0/RP0/OSC2/0
O    10.1.7.0/24, metric 2
       10.1.3.1, from 10.58.227.198, via MgmtEth0/RP0/OSC2/0
O    10.58.227.0/24, metric 1
       10.1.3.1, from 10.58.227.198, via MgmtEth0/RP0/OSC2/0
```

Troubleshooting Network Issues

Troubleshooting must be performed by checking the status of the interfaces, subnets, static routing, and OSPF sections.

Problem	Command
Interfaces are in down state	**show interfaces MgmtEth** *rack/slot/instance/port*
Route to default gateway is not defined	**show running-config**
Wrong IP addresses or subnet are planned in design phase	**show running-config**
Wrong static routes are defined that overwrite OSPF routes	Compare the output of **show ip route** command with **show ospf routes** command
Interfaces are not added in the OSPF section configured	**show running-config**
Interfaces are in passive mode in the OSPF section configured	**show running-config**



CHAPTER 4

Configure OTDR Module

This chapter describes how to configure the Optical Time Domain Reflectometer (OTDR) module.

Note When you plan to replace a configured optical module with a different type of optical module, you must clear the configurations of the old module before you install the new module. For example, when replacing a configured EDFA module with an OTDR in the same slot, clear the EDFA configurations.

In general, configurations in a card equipped in an NCS 1001 slot include:

- Card configuration—hw-module parameters configuration related to the slot *S* where the card is equipped
- OTS controller configurations
- Optics controller configurations—only for EDFA cards

The following commands clear the configurations in the previous card.

1. `no hw-module location 0/RP0/CPU0 slot <S>`

   Clear the card parameters configuration.

2. `no controller ots Rack/Slot/Instance/Port`

   Clear each OTS controller configuration.

3. `no controller optics Rack/Slot/Instance/Port`

   (Optional) Clear the controller optics configurations. This must be done only if the card previously equipped in slot *S* was an EDFA.

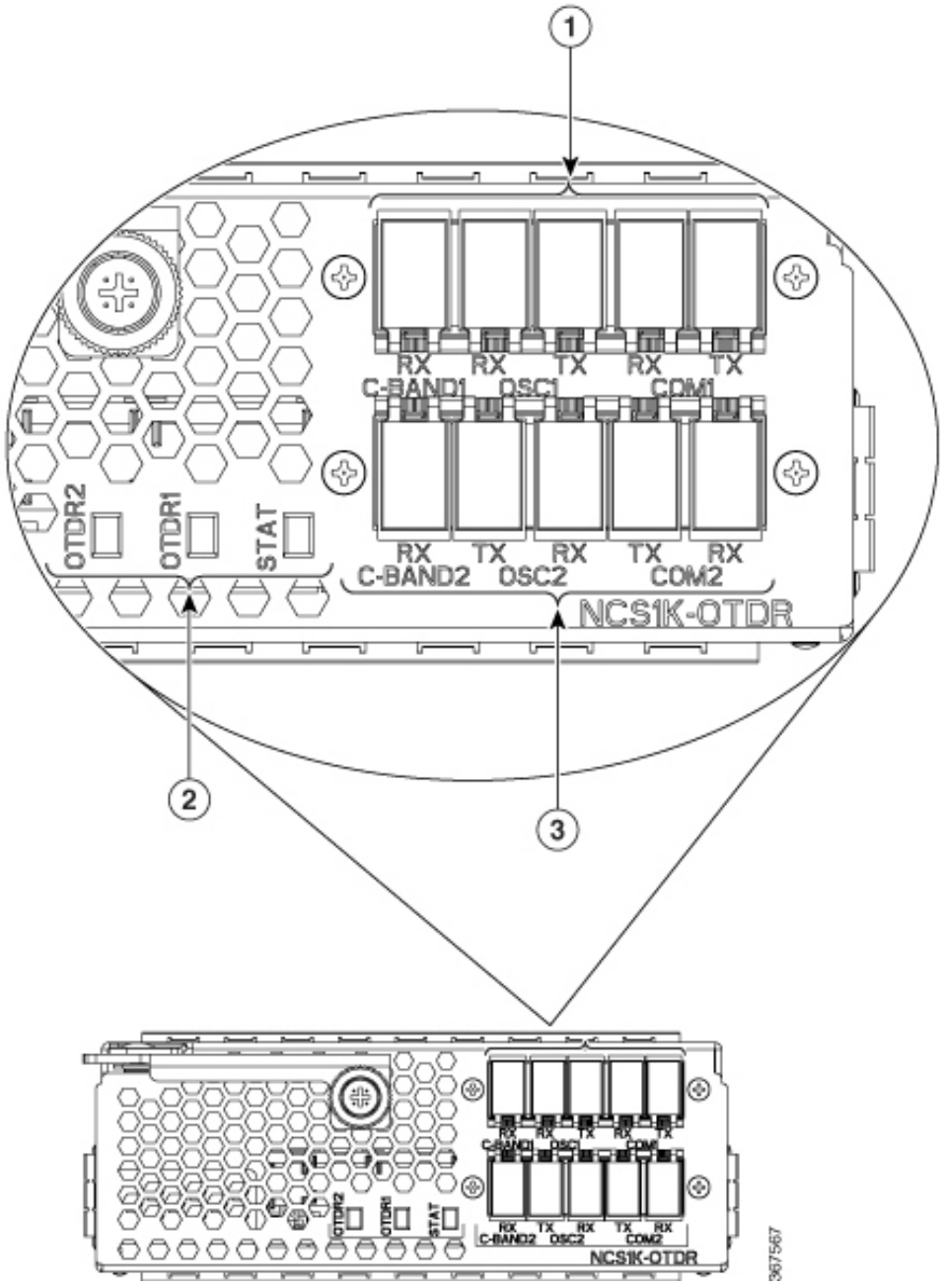
- OTDR, on page 52
- Cabling Considerations for Terminal Node, on page 55
- Cabling Considerations for ILA Node, on page 56
- Configure OTDR, on page 58
- Display Status of OTDR Measurement, on page 61
- Configure OTDR in Automatic Mode, on page 62
- Start OTDR Measurement in Automatic Mode, on page 64
- OTDR Measurement in Automatic Mode Based on Events, on page 64
- Configure OTDR in Expert Mode, on page 71

- Start OTDR Measurement in Expert Mode, on page 74
- Display List of OTDR Measurements, on page 74
- Stop OTDR Measurement, on page 76
- View the Logical Ports and the Photodiode Power Levels, on page 76
- OTDR ML Events, on page 77
- Enable ML on the OTDR Card, on page 77
- View Scan Output with ML Enabled, on page 78

OTDR

The optical Time Domain Reflectometer (OTDR) is a line card supported in NCS 1001. The line card contains 2x bidirectional OTDRs and 2x filter that combines C-band, OSC, and OTDR filters and splits OSC and OTDR. Each internal OTDR can perform measurements on both TX and RX fibers by using an internal optical switch. The OTDR line card is connected to the OSC port on the optical amplifier. The OTDR measurement is available in a .SOR file and it can be exported from NCS 1001 using SCP, TFTP, and SFTP. The OTDR line card can be inserted in any slot of NCS 1001.

Figure 10: Front View of OTDR Card



1	OTDR1 interface
2	LED status
3	OTDR2 interface

The following table lists the logical ports (OTS controller ports) that are associated with the physical ports in the OTDR card.

Table 9: OTDR Physical Ports and the Associated Logical Ports

OTDR Ports	Logical Ports Corresponding to the Ports
C-Band-1 RX	controller OTS 0/slot/0/0
COM1 (RX, TX)	controller OTS 0/slot/0/1
OSC1 (RX, TX)	controller OTS 0/slot/0/2
C-Band-2 RX	controller OTS 0/slot/0/3
COM2 (RX, TX)	controller OTS 0/slot/0/4
OSC2 (RX, TX)	controller OTS 0/slot/0/5

You can also view the logical ports details available in the table Table 9: OTDR Physical Ports and the Associated Logical Ports, on page 54 using the CLI command. See View the Logical Ports and the Photodiode Power Levels, on page 76.

The OTDR line card allows the user to perform the following:

- Provides information about basic characteristics of the optical fiber among optical nodes, such as Insertion Loss and concentrate point of reflection.
- Inspects the transmission fiber.
- Identifies discontinuities or defects on the fiber.
- Measures the distance and magnitude of defects like insertion loss, reflection loss, and so on.
- Improves scan performance using specific scan parameters targeted on the characteristics of the fiber plant such as span length, reflection contributions, and major events.



Note When an EDFA module is connected to the OTDR module without an OSC channel between them, an LOS-P alarm is raised on the OTS 0/x/0/2 port of the EDFA module. To suppress this alarm and resume normal OTDR operation, we recommend you perform one of the following configurations on the port 0/x/0/2 of the EDFA module:

- Configure the OTS controller to be under maintenance.

  Example:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller ots 0/3/0/2
RP/0/RP0/CPU0:ios(config-ots)#sec-admin-state maintenance
RP/0/RP0/CPU0:ios(config-ots)#commit
```

- Shut down the EDFA port in receive direction.

  Example:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#controller ots 0/3/0/2
RP/0/RP0/CPU0:ios(config-ots)#rx-enable 0
RP/0/RP0/CPU0:ios(config-ots)#commit
```

OTDR Modes

OTDR can be configured in two modes.

- Auto-This mode has two internal phases: Training and Measurement. These two phases are fully automated and proceed in sequence. The training phase has two internal steps. The first step measures the Optical Return Loss (ORL) and the second step prepares internal parameters for OTDR measurement. The actual OTDR measurement starts after the training phase.
- Expert-In this mode, the user must configure all the OTDR scan parameters with the proper values required by OTDR measurement. Automatic adjustments are not performed in expert mode configuration. There is no training phase in this mode. There is no prerequisite to run OTDR scan in expert mode apart from proper configuration.

Limitations of OTDR

- When NCS 1001 uses the OTDR line card, the OSC channel is on 1610 nm, and OTDR is on 1518 nm.
- OTDR supports up to 20 dB span loss or 100 km length of fiber.
- It is not recommended to start OTDR measurement simultaneously from two different nodes; the results and graph will not be valid.
- OTDR measurement performed in the presence of the OTDR-HIGH-REFLECTION alarm (reflections roughly greater than -25dB) may provide a low event accuracy.
- OTDR graph may be truncated if the measurements are performed on a fiber spool with the following length.
  - 1.00km to 1.05km
  - 25.0km to 25.6km
  - 80.0km to 83.9km
- OTDR can support up to -14 dB of reflection. OTDR-HIGH-REFLECTION alarm is raised when R(dB) – 2*NL(dB) > -20 dB where R is the reflectivity and NL is the loss.
-

Cabling Considerations for Terminal Node

In the terminal node configuration, EDFA and OTDR line cards are plugged into the same NCS 1001 system. The filter on OTDR card will combine OSC SFP signal from EDFA port with OTDR and feed into OSC input of EDFA card.

The sequence of fiber connection for port 1 is the following:

1. Connect a LC/LC fiber from OTDR COM TX port to EDFA OSC RX port
2. Connect a LC/LC fiber from EDFA OSC TX port to OTDR COM RX port
3. Connect a LC/LC fiber from OTDR OSC TX port to pluggable RX port inserted into EDFA
4. Connect a LC/LC fiber from pluggable TX port inserted into EDFA to OTDR OSC RX port

Repeat the same sequence to connect the second OTDR port if required.

Figure 11: Cabling for Terminal Configuration with One EDFA Module

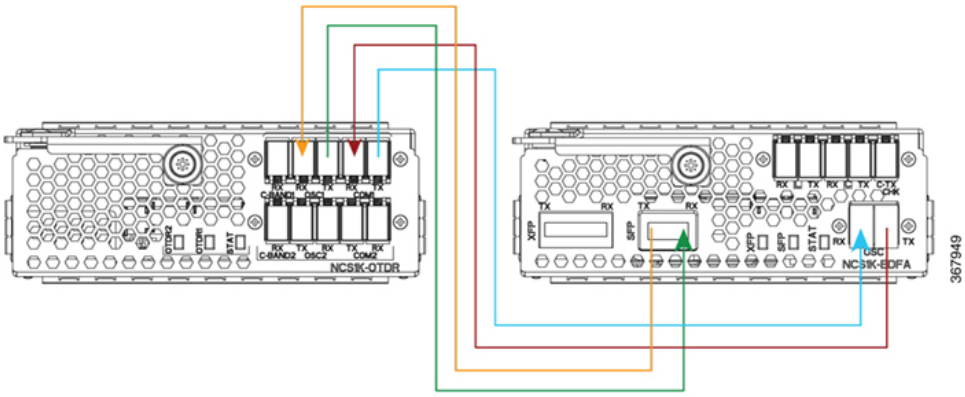
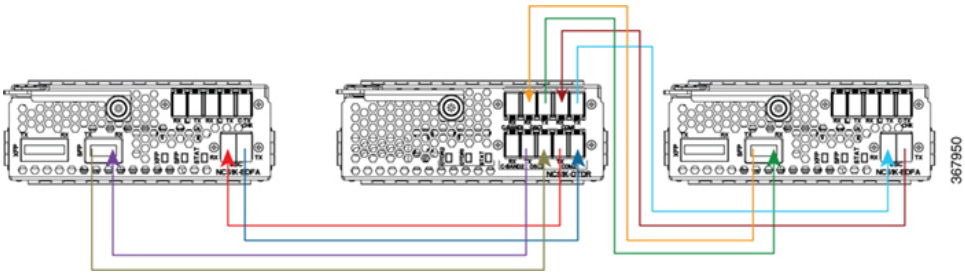


Figure 12: Cabling for Terminal Configuration with Two EDFA Modules



Cabling Considerations for ILA Node

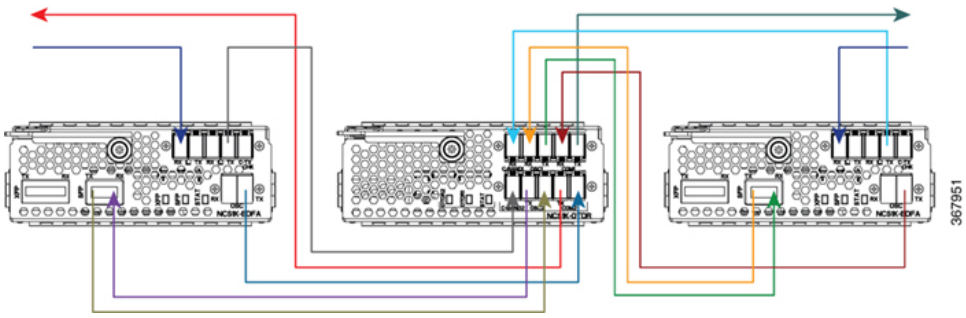
In the ILA node configuration, only one OTDR card is required to support both the directions of ILA node. Two EDFA cards and a single OTDR line card are plugged into the same NCS 1001 system. It is recommended to connect the OTDR port 1 to EDFA in slot 1 and the OTDR port 2 to EDFA in slot 3.

The sequence of fiber connection is the following:

1. Connect a LC/LC fiber from OTDR port 1 COM TX port to fiber span Line TX that is facing EDFA slot 1.
2. Connect a LC/LC fiber from EDFA slot 1 port COM TX to C-band 1 RX port.
3. Connect a LC/LC fiber from OTDR OSC TX port 1 to pluggable RX port inserted into EDFA slot 1.
4. Connect a LC/LC fiber from OSC pluggable TX port inserted into EDFA slot 1 to OTDR OSC RX port 1.
5. Connect a LC/LC fiber from EDFA slot 1 port OSC TX to OTDR COM RX port 1.
6. Connect a LC/LC fiber from OTDR port 2 COM TX port to fiber span Line TX that is facing EDFA slot 3.
7. Connect a LC/LC fiber from EDFA slot 3 port COM TX to C-band 2 RX port.

8. Connect a LC/LC fiber from OTDR OSC TX port 2 to OSC pluggable RX port inserted into EDFA slot 3.
9. Connect a LC/LC fiber from OSC pluggable TX port inserted into EDFA slot 3 to OTDR OSC RX port 2.
10. Connect a LC/LC fiber from from EDFA slot 3 port OSC TX to OTDR COM RX port 2.

Figure 13: Cabling for ILA Configuration

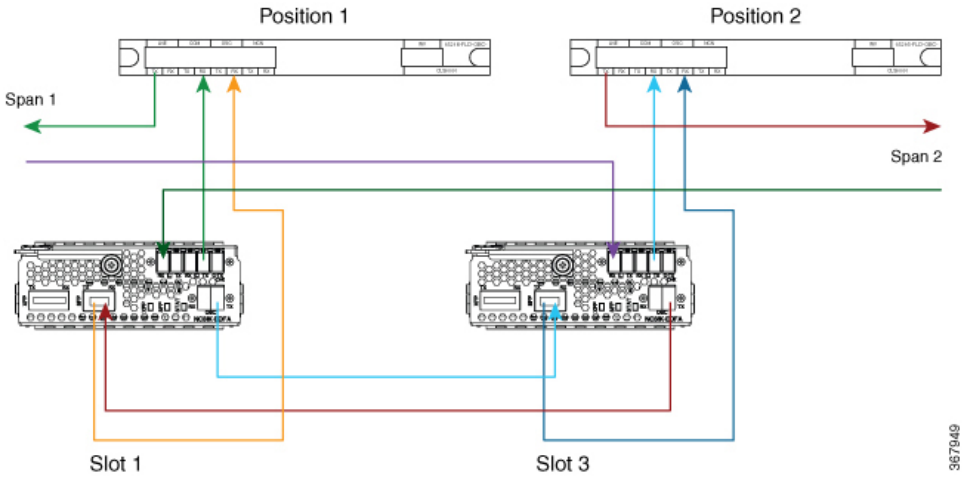


Cabling for ILA Configuration with 15216-FLD-OSC

The sequence of fiber connection is the following:

1. Connect a LC/LC fiber from RX-span 2 to LINE RX port of EDFA slot 1.
2. Connect a LC/LC fiber from COM TX port of EDFA slot 1 to COM RX port of 15216-FLD-OSC position 1.
3. Connect a LC/LC fiber from TX-span 1 to LINE TX port of 15216-FLD-OSC position 1.
4. Connect a LC/LC fiber from OSC pluggable TX port inserted into EDFA slot 1 to OSC RX port of 15216-FLD-OSC position 1.
5. Connect a LC/LC fiber from OSC TX port of EDFA slot 1 to OSC pluggable RX port inserted into EDFA slot 3.
6. Connect a LC/LC fiber from OSC TX port of EDFA slot 3 to OSC pluggable RX port inserted into EDFA slot 1.
7. Connect a LC/LC fiber from RX-span 1 to LINE RX port of EDFA slot 3.
8. Connect a LC/LC fiber from COM TX port of EDFA slot 3 to COM RX port of 15216-FLD-OSC position 2.
9. Connect a LC/LC fiber from TX-span 2 to LINE TX port of 15216-FLD-OSC position 2.
10. Connect a LC/LC fiber from OSC pluggable TX port inserted into EDFA slot 3 to OSC RX port of 15216-FLD-OSC position 2.

Figure 14: Cabling for ILA Configuration with 15216-FLD-OSC



The usage of NCS1K-OTDR module replaces the need of 15216-FLD-OSC module as recommended in the ILA configuration.

Configure OTDR

When the OTDR card is inserted, it has a set of default optical parameters for both ports and both directions. The default parameters are the same for both ports in TX and RX directions.

configure

hw-module location 0/RP0/CPU0 slot *slot-number*

otdr port *port-number* **direction tx total-loss** *value*

otdr port *port-number* **direction tx back-scattering** *value*

otdr port *port-number* **direction tx refractive-index** *value*

otdr port *port-number* **direction tx mode-expert pulse-width** *value*

otdr port *port-number* **direction tx mode-expert measure-time** *value*

otdr port *port-number* **direction tx mode-expert capture-length** *value*

otdr port *port-number* **direction tx mode-expert capture-offset** *value*

otdr port *port-number* **direction tx mode-expert fiber-resolution** *value*

otdr port *port-number* **direction tx loss-relative-threshold** *value*

otdr port *port-number* **direction tx reflection-relative-threshold** *value*

otdr port *port-number* **direction rx total-loss** *value*

otdr port *port-number* **direction rx mode-expert pulse-width** *value*

otdr port *port-number* **direction rx mode-expert measure-time** *value*

otdr port *port-number* **direction rx mode-expert capture-length** *value*

otdr port *port-number* **direction rx mode-expert capture-offset** *value*

otdr port *port-number* **direction rx mode-expert fiber-resolution** *value*

otdr port *port-number* **direction rx loss-relative-threshold** *value*

otdr port *port-number* **direction rx reflection-relative-threshold** *value*

otdr port *port-number* **orl-abs-threshold** *value*

otdr port *port-number* **loss-abs-threshold** *value*

otdr port *port-number* **reflection-abs-threshold** *value*

commit

end

Example

```
configure
hw-module location 0/RP0/CPU0 slot 2
otdr port 1 direction tx total-loss 200
otdr port 1 direction tx back-scattering -820
otdr port 1 direction tx refractive-index 1498962
otdr port 1 direction tx mode-expert pulse-width 1000
otdr port 1 direction tx mode-expert measure-time 180
otdr port 1 direction tx mode-expert capture-length 80
otdr port 1 direction tx mode-expert capture-offset 0
otdr port 1 direction tx mode-expert fiber-resolution 25
otdr port 1 direction tx mode-expert loss-relative-threshold 20
otdr port 1 direction tx mode-expert reflection-relative-threshold 20
otdr port 1 direction rx total-loss 200
otdr port 1 direction rx mode-expert pulse-width 1000
otdr port 1 direction rx mode-expert measure-time 180
otdr port 1 direction rx mode-expert capture-length 80
otdr port 1 direction rx mode-expert capture-offset 0
otdr port 1 direction rx mode-expert fiber-resolution 25
otdr port 1 direction rx mode-expert loss-relative-threshold 20
otdr port 1 direction rx mode-expert reflection-relative-threshold 20
otdr port 1 orl-abs-threshold 280
otdr port 1 loss-abs-threshold 15
otdr port 1 reflection-abs-threshold -300
commit
end
```

OTDR Configuration Parameters

Table 10: OTDR Configuration Parameters

Parameter	Description	Range	Default
total-loss (in 0.1dB)	Loss from the near end OTDR port to far end OTDR port including span loss and additional EDFA filter loss.	+0 to +500	200

Parameter	Description	Range	Default
back-scattering	The back scattering value in TX direction.	–100.0 to 0.0 **Note** NCS 1001 SW accepts any value within the defined range. You shall set actual back scattering value depending on the fiber characteristics.	–82.0 **Note** Default value fits most fiber types. You may adjust the value based on the optimal values for the specific fiber type in your network.
refractive-index	The refractive index value in TX direction.	1.000000 to 2.000000 **Note** NCS 1001 SW accepts any value within the defined range. You shall set actual refractive index value depending on the fiber characteristics.	1.498962 **Note** Default value fits most fiber types. You may adjust the value based on the optimal values for the specific fiber type in your network.
mode-expert pulse-width (in ns)	Pulse duration during the measurement.	8 to 100000	1000
mode-expert measure-time (in sec)	Time required to perform a complete optical scan.	1 to 360	180
mode-expert capture-length (in km)	Distance of end point of the measure.	1 to 150	80
mode-expert capture-offset (in km)	Start point.	0 to 150	0
mode-expert fiber-resolution (in m)	Distance from measurement steps.	0 to 100	25
orl-abs-threshold (in 0.1dB)	Threshold to compare with the ORL measurement returned by OTDR run.	+140 to +400	280

Parameter	Description	Range	Default
loss-abs-threshold (in 0.1dB)	Threshold to compare with the loss events returned by OTDR run.	+1 to +300	15
reflection-abs-threshold (in 0.1dB)	Threshold to compare with the reflection events returned by OTDR run.	–500 to 0	–300
loss-sensitivity (in 0.1dB)	Limit under which the loss is not considered as a real loss.	+4 to +50	6
reflection-sensitivity (in 0.1dB)	Limit under which the reflection is not considered as a real reflection.	–400 to –140	–300
loss-relative-threshold (in 0.1dB)	Threshold to compare the loss value read from the OTDR module plus the relative loss threshold with the baseline value.	+1 to +300	2
reflection-relative-threshold (in 0.1dB)	Threshold to compare the reflection value read from the OTDR module plus the relative reflection threshold with the baseline value.	+1 to +300	2

Display Status of OTDR Measurement

The following command displays a table with the status for all the OTDR ports and directions.

show hw-module slot *slot-number* otdr status

Example

show hw-module slot 2 otdr status

Automatic Mode

```
Wed Oct 16 09:06:46.148 CEST
  Port | Rx/Tx |  Date/Time|     Training |   OTDR Measurement| Next scan (min)
-------+-------+-----------------------+--------------------+----------------------+-
   1   |   Tx  |           |     UNKNOWN  |       UNKNOWN     |       0
   1   |   Rx  |           |     UNKNOWN  |       UNKNOWN     |       0
   2   |   Tx  |           |     UNKNOWN  |       UNKNOWN     |       0
   2   |   Rx  |           |     UNKNOWN  |       UNKNOWN     |       0
```

The next scan is related to the periodic scan. When the periodic scan is not set, the next scan value is 0.

Expert Mode

```
Port | Rx/Tx |      Date/Time        |     Training       |   OTDR Measurement
----------+-------+-----------------------+--------------------+-------------------

   1   |   Tx  |   20180503-181159   |     UNKNOWN         | PROGRESS    10%

   1   |   Rx  |                     |     UNKNOWN         |       UNKNOWN

   2   |   Tx  |                     |     UNKNOWN         |       UNKNOWN

   2   |   Rx  |                     |     UNKNOWN         |       UNKNOWN
```

Configure OTDR in Automatic Mode

The following parameters must be configured to have correct OTDR measurement in automatic mode. The default values for these parameters are provided by this configuration.

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **otdr port** *port-number* **direction** *direction* **mode-auto**

loss-sensitivity *value*

loss-relative-threshold *value*

reflection-sensitivity *value*

reflection-relative-threshold *value*

total-loss *value*

periodic-scan minutes *value*

commit

end

OTDR Configuration Parameters in Automatic Mode

Table 11: OTDR Configuration Parameters in Automatic Mode

Parameter	Description	Range	Default
loss-sensitivity (in 0.1dB)	Limit under which the loss is not considered as a real loss.	+4 to +50	6
loss-relative-threshold (in 0.1dB)	Threshold to compare the loss value read from the OTDR module plus the relative loss threshold with the baseline value.	+1 to +300	2
reflection-sensitivity (in 0.1dB)	Limit under which the reflection is not considered as a real reflection.	-400 to -140	-300
reflection-relative-threshold (in 0.1dB)	Threshold to compare the reflection value read from the OTDR module plus the relative reflection threshold with the baseline value.	+1 to +300	2
total-loss (in 0.1dB)	Loss from the near end OTDR port to far end OTDR port including span loss and additional EDFA filter loss.	+0 to +500	200
periodic scan (in minutes)	OTDR scan is automatically started. The scan is also performed each time after the elapse of the periodic scan time.	30 to 600000	30

Start OTDR Measurement in Automatic Mode

hw-module slot *slot-number* **otdr port** *port-number* **direction** *direction* **scan auto**

Example

The following example starts the OTDR measurement in automatic mode in TX direction.

```
hw-module slot 3 otdr port 1 direction tx scan auto
```

The user receives a message as "Otdr action will continue in the background". To see the status of OTDR measurement, use the **show hw-module slot slot-number otdr status** command.

OTDR Measurement in Automatic Mode Based on Events

The OTDR measurement in automatic mode is automatically started between two nodes on both the TX and RX directions under the following events:

- The automatic scan starts when a LOS alarm is raised or cleared on the line port of an EDFA (controller ots0/x/0/1)
    - If an automatic scan is still running, a subsequent LOS alarm state change will immediately abort the current scan and trigger a new scan.
- The automatic scan starts when the difference between the actual value of span loss and the previous sample of span loss exceeds the configurable span loss delta value given by the following configuration:
    - hw-module location 0/RP0/CPU0 slot <n> ampli span-loss span-loss-delta 20

OTDR Automatic Events System Setup

OTDR modules can be deployed in 4 different scenarios:

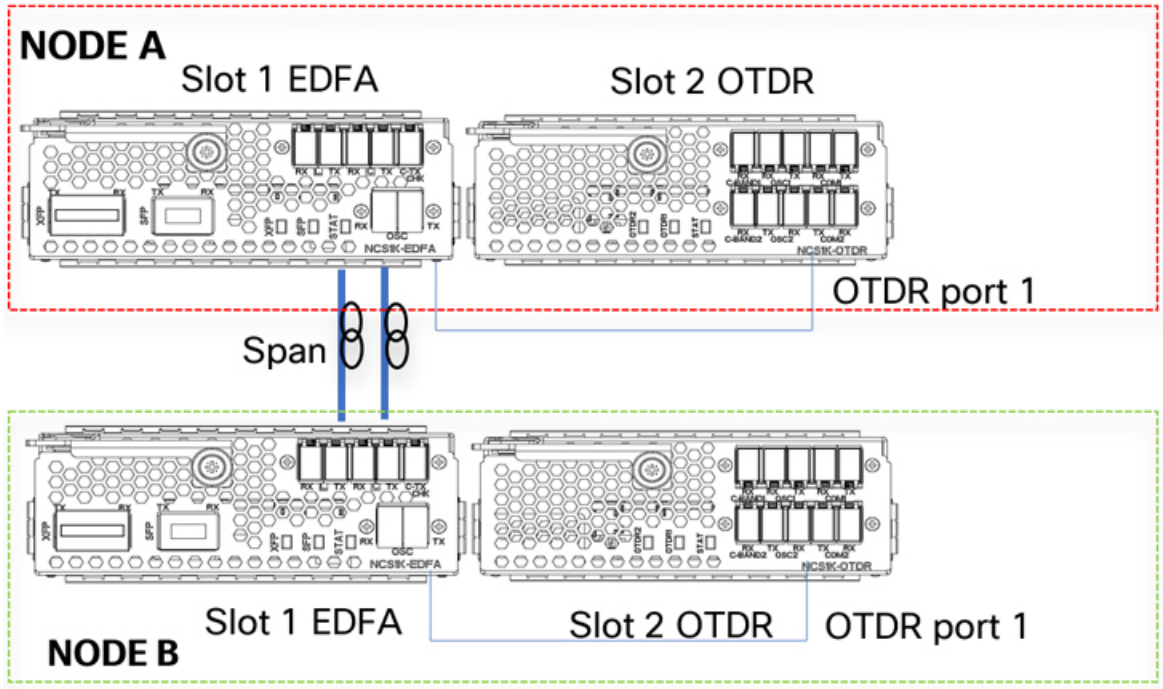
1. Scenario 1: Node A connected to Node B and each node has its own OTDR module
2. Scenario 2: Node A connected to Node B with single OTDR module in one of the two nodes (A or B)
3. Scenario 3: Node A connected to Node B with single OTDR module installed in a different Node C
4. Scenario 4: Node A connected to Node B with OTDR modules installed in different Nodes C and D

Note Nodes A and B can be of any type, terminal, or ILA.

Scenario 1

OTDR modules are installed in each of the two nodes, each OTDR is connected to its own local EDFA, EDFAs are facing the same fiber span (OTDR in node A and B)

Figure 15: EDFA hw-module remote_node Configuration



For each EDFA module it is necessary to configure remote node feature by using the following CLI commands:

Node A:

*hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 <**IP Node A**>aremote-ipv4 <**IP Node B**> remote-slot-id 1*

Node B:

*hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 <**IP Node B**>a remote-ipv4 <**IP Node A**> remote-slot-id 1*

EDFA hw-module otdr_autoscan configuration

For each EDFA module it is necessary to configure OTDR autoscan feature using the following CLI commands:

Node A:

*hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr <**IP Node A**> otdr-slot-id 2 otdr-port-id 1 ampli-far-end-ipv4-addr <**IP Node B**> ampli-far-end-slot-id 1 scan-type AUTO*

Node B:

*hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr <**IP Node B**> otdr-slot-id 2 otdr-port-id 1 ampli-far-end-ipv4-addr <**IP Node A**> ampli-far-end-slot-id 1 scan-type AUTO*

OTDR hw-module otdr_autoscan Configuration

For each OTDR module, it is necessary to configure remote node OTDR autoscan feature using the following CLI by commands:

Node A:

hw-module location 0/RP0/CPU0 slot 2 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node A>*** *ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

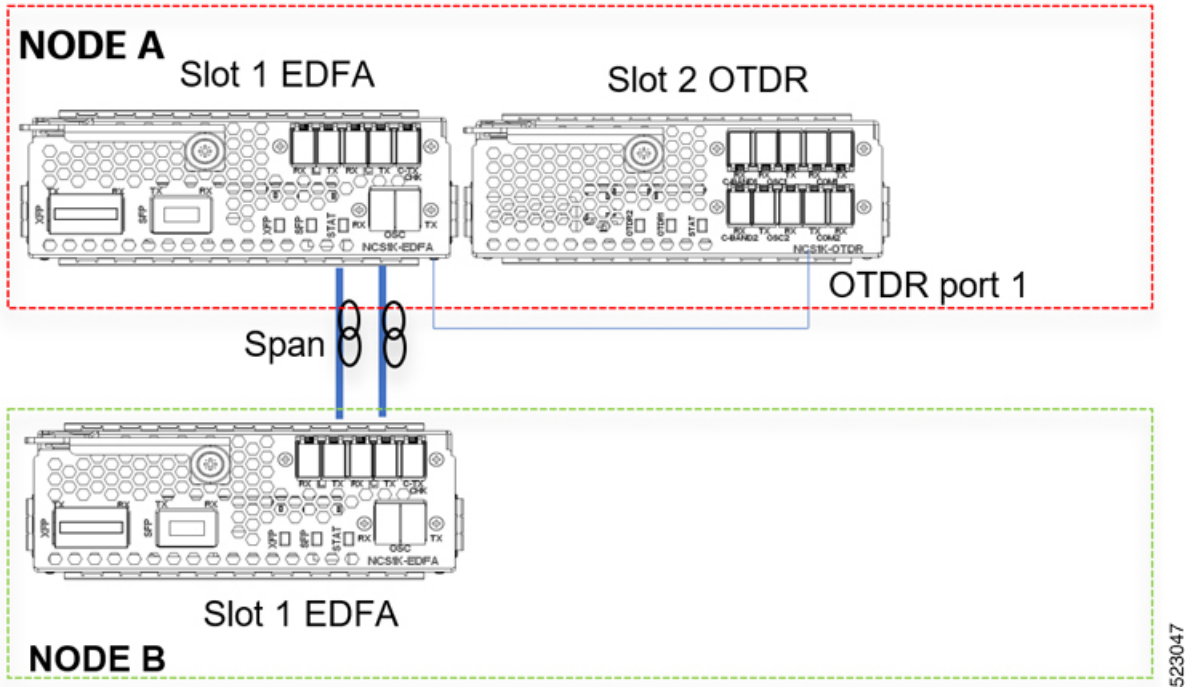
Node B:

hw-module location 0/RP0/CPU0 slot 2 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node B>*** *ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 1 scan-type AUTO*

Scenario 2

The Single OTDR module is installed only in one node, OTDR is connected to only one EDFA facing the fiber span (OTDR in node A)

Figure 16: EDFA hw-module remote_node Configuration



For each EDFA module, it is necessary to configure remote node feature by using the following CLI commands:

Node A:

hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 ***<IP Node A>****a remote-ipv4* ***<IP Node B>*** *remote-slot-id 1*

Node B:

hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 ***<IP Node B>****a remote-ipv4* ***<IP Node A>*** *remote-slot-id 1*

EDFA hw-module OTDR autoscan configuration

For the EDFA connected to the single OTDR module in the same node, it is necessary to configure OTDR autoscan feature using the following CLI command:

Node A:

hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node A>*** *otdr-slot-id 2 otdr-port-id 1 ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

OTDR hw-module otdr_autoscan Configuration

For the single OTDR module, it is necessary to configure otdr autoscan feature using the following CLI command:

Node A:

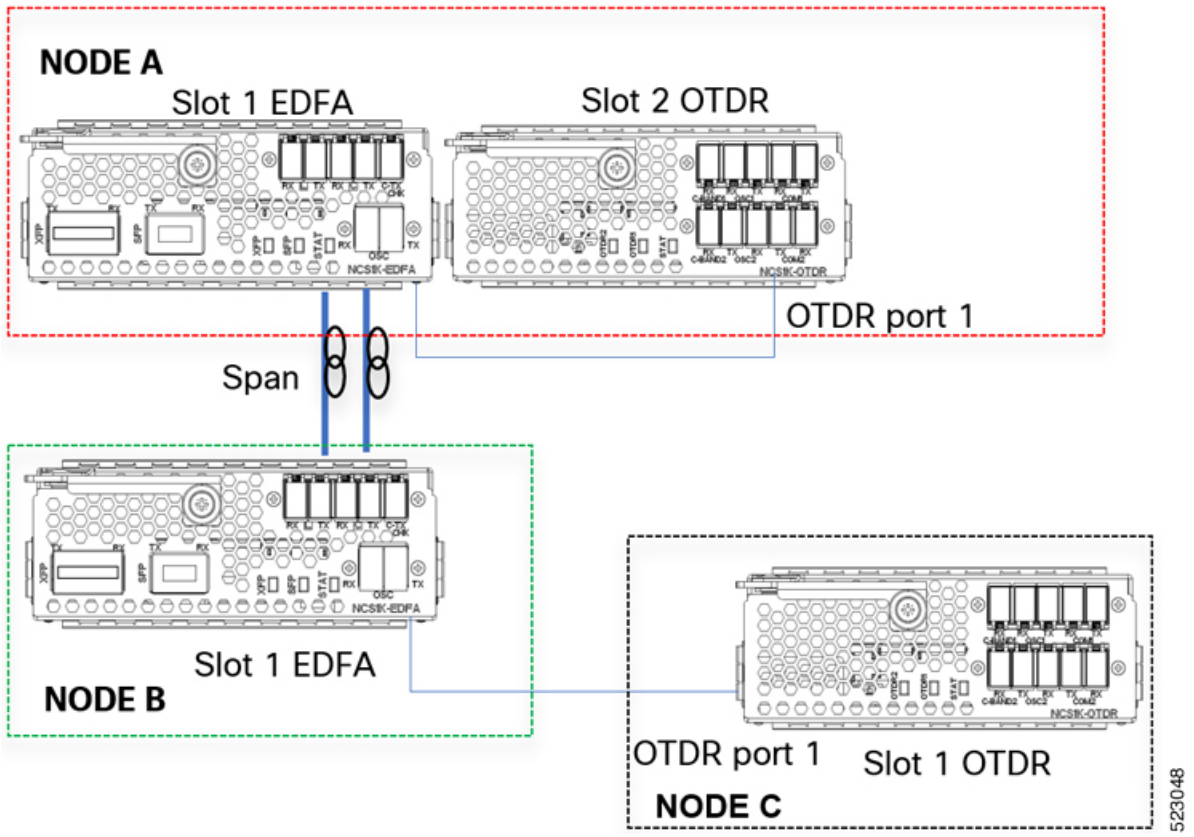
hw-module location 0/RP0/CPU0 slot 2 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node A>*** *ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

Note Both the EDFA and OTDR configurations share the same IP address as there is only one OTDR module connected to one single EDFA in the same node.

Scenario 3

The Single OTDR module is installed in a third node, OTDR is connected to EDFA in different nodes(EDFA in node B, OTDR in node C)

Figure 17: EDFA HW-module remote_node Configuration



For each EDFA module, it is necessary to configure remote node feature by using the following CLI commands:

Node A:

hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 ***<IP Node A>****a remote-ipv4* ***<IP Node B>*** *remote-slot-id 1*

Node B:

hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 ***<IP Node B>****a remote-ipv4* ***<IP Node A>*** *remote-slot-id 1*

EDFA hw-module otdr_autoscan Configuration

Node A:

hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node A>*** *otdr-slot-id 2 otdr-port-id 12 ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 1 scan-type AUTO*

Node B:

hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node C>*** *otdr-slot-id 1 otdr-port-id 12 ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

OTDR hw-module otdr_autoscan Configuration

Node A:

hw-module location 0/RP0/CPU0 slot 2 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node A>*** *ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

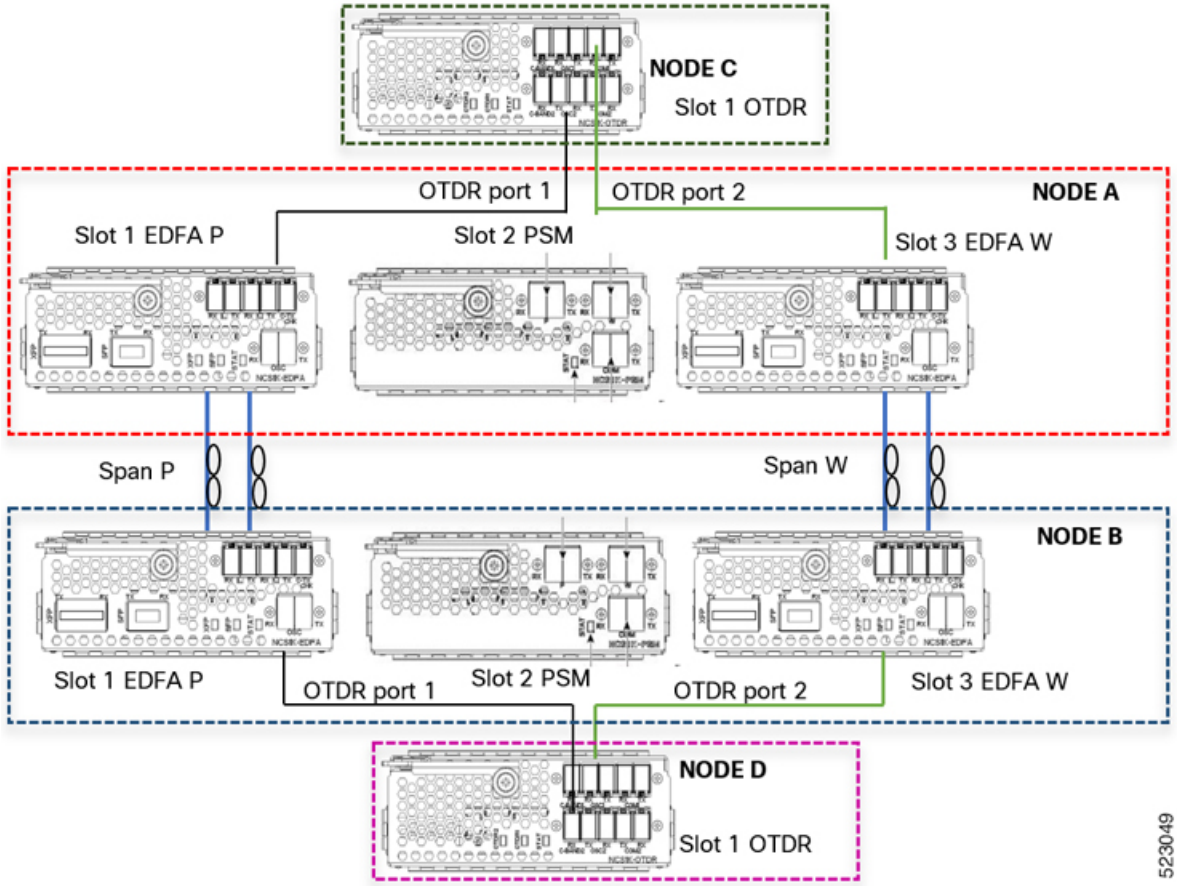
Node C:

hw-module location 0/RP0/CPU0 slot 1 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node C>*** *ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 1 scan-type AUTO*

Scenario 4

Two OTDR modules are installed in dedicated nodes C and D. Each OTDR node is connected to its own Section Protection (EDFA node A <> OTDR node C, EDFA node B <> OTDR node D)

Figure 18: EDFA hw-module remote_node Configuration



For each EDFA module, it is necessary to configure remote node feature using the following CLI commands:

Node A:

hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 ***<IP Node A>*** *remote-ipv4* ***<IP Node B>*** *remote-slot-id 1*

hw-module location 0/RP0/CPU0 slot 3 ampli remote-node local-ipv4 ***<IP Node A>*** *remote-ipv4* ***<IP Node B>*** *remote-slot-id 3*

Node B:

hw-module location 0/RP0/CPU0 slot 1 ampli remote-node local-ipv4 ***<IP Node B>*** *remote-ipv4* ***<IP Node A>*** *remote-slot-id 1*

hw-module location 0/RP0/CPU0 slot 3 ampli remote-node local-ipv4 ***<IP Node B>*** *remote-ipv4* ***<IP Node A>*** *remote-slot-id 3*

EDFA hw-module otdr_autoscan Configuration

Node A:

hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node C>*** *otdr-slot-id 1 otdr-port-id 1 ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 1 scan-type AUTO*

hw-module location 0/RP0/CPU0 slot 3 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node C>*** *otdr-slot-id 1 otdr-port-id 2 ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 3 scan-type AUTO*

Node B:

hw-module location 0/RP0/CPU0 slot 1 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node D>*** *otdr-slot-id 1 otdr-port-id 1 ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

hw-module location 0/RP0/CPU0 slot 3 ampli otdr-autoscan otdr-module-ipv4-addr ***<IP Node D>*** *otdr-slot-id 1 otdr-port-id 2 ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 3 scan-type AUTO*

OTDR hw-module otdr_autoscan Configuration

Node C:

hw-module location 0/RP0/CPU0 slot 1 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node C>*** *ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

hw-module location 0/RP0/CPU0 slot 1 otdr port 2 otdr-autoscan otdr-module-ipv4-addr ***<IP Node C>*** *ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 3 scan-type AUTO*

Node D:

hw-module location 0/RP0/CPU0 slot 1 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node D>*** *ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 1 scan-type AUTO*

hw-module location 0/RP0/CPU0 slot 1 otdr port 2 otdr-autoscan otdr-module-ipv4-addr ***<IP Node D>*** *ampli-far-end-ipv4-addr* ***<IP Node B>*** *ampli-far-end-slot-id 3 scan-type AUTO*

Sample CLI Configuration for Typical OTDR in Automatic Mode Based on Events

The following configurations must be performed on both the near end and far end nodes. The following configurations assume that both the EDFA and the OTDR modules are present on the same node.

The following parameters must be configured on the EDFA module to start an OTDR measurement in automatic mode.

hw-module location 0/RP0/CPU0 slot *slot-number* **ampli**

otdr-autoscan

otdr-module-ipv4-addr *otdr-ip-address*

otdr-slot-id *otdr-slot-number*

otdr-port-id *otdr-port-number*

ampli-far-end-ipv4-addr *far-end-edfa-ip-address*

ampli-far-end-slot-id *far-end-edfa-slot-number*

scan-type auto

The following parameters must be configured on the OTDR module to start an OTDR measurement in automatic mode.

hw-module location 0/RP0/CPU0 slot *slot-number* **otdr port** *otdr-port-number*

otdr-autoscan

otdr-module-ipv4-addr *otdr-ip-address*

ampli-far-end-ipv4-addr *far-end-edfa-ip-address*

ampli-far-end-slot-id *far-end-edfa-slot-number*

scan-type auto

Example

The following is a sample of EDFA module configuration to start an OTDR measurement in automatic mode.

```
configure
hw-module location 0/RP0/CPU0 slot 3 ampli
otdr-autoscan
otdr-module-ipv4-addr 192.0.2.1
otdr-slot-id 2
otdr-port-id 1
ampli-far-end-ipv4-addr 198.51.100.10
ampli-far-end-slot-id 3
scan-type auto
commit
end
```

The following is a sample of OTDR module configuration to start an OTDR measurement in automatic mode.

```
configure
hw-module location 0/RP0/CPU0 slot 2 otdr port 1
otdr-autoscan
otdr-module-ipv4-addr 192.0.2.1
ampli-far-end-ipv4-addr 198.51.100.10
ampli-far-end-slot-id 3
scan-type auto
commit
end
```

Configure OTDR in Expert Mode

configure

hw-module location 0/RP0/CPU0 slot *slot-number* **otdr port** *port-number* **direction** *direction* **mode-expert**

capture-length *value*

capture-offset *value*

fiber-resolution *value*

loss-sensitivity *value*

measure-time *value*

pulse-width *value*

reflection-sensitivity *value*

span-length *value*

loss-relative-threshold *value*

reflection-relative-threshold *value*

commit

end

Examples

The following samples provide a guideline to configure OTDR in expert mode in certain typical cases with a varying span-length parameter. The configuration might need to be modified depending on the fiber status in the field.

Sample configuration for fiber span 1 km:

```
configure
hw-module location 0/RP0/CPU0 slot 2
otdr port 1 direction tx mode-expert pulse-width 10
otdr port 1 direction tx mode-expert span-length 1
otdr port 1 direction tx mode-expert measure-time 180
otdr port 1 direction tx mode-expert capture-length 1
otdr port 1 direction tx mode-expert capture-offset 0
otdr port 1 direction tx mode-expert fiber-resolution 4
otdr port 1 direction tx mode-expert loss-sensitivity 4
otdr port 1 direction tx mode-expert reflection-sensitivity -300

otdr port 1 direction tx mode-expert loss-relative-threshold 20
otdr port 1 direction tx mode-expert reflection-relative-threshold 20
```

Sample configuration for fiber span 25 km:

```
configure
hw-module location 0/RP0/CPU0 slot 2
otdr port 1 direction tx mode-expert pulse-width 100
otdr port 1 direction tx mode-expert span-length 25
otdr port 1 direction tx mode-expert measure-time 180
otdr port 1 direction tx mode-expert capture-length 25
otdr port 1 direction tx mode-expert capture-offset 0
otdr port 1 direction tx mode-expert fiber-resolution 5
otdr port 1 direction tx mode-expert loss-sensitivity 6
otdr port 1 direction tx mode-expert reflection-sensitivity -300
otdr port 1 direction tx mode-expert loss-relative-threshold 20
otdr port 1 direction tx mode-expert reflection-relative-threshold 20
```

Sample configuration for fiber span 80 km:

```
configure
hw-module location 0/RP0/CPU0 slot 2
otdr port 1 direction tx mode-expert pulse-width 1000
otdr port 1 direction tx mode-expert span-length 80
otdr port 1 direction tx mode-expert measure-time 180
otdr port 1 direction tx mode-expert capture-length 80
otdr port 1 direction tx mode-expert capture-offset 0
otdr port 1 direction tx mode-expert fiber-resolution 250
otdr port 1 direction tx mode-expert loss-sensitivity 15
otdr port 1 direction tx mode-expert reflection-sensitivity -300
otdr port 1 direction tx mode-expert loss-relative-threshold 20
otdr port 1 direction tx mode-expert reflection-relative-threshold 20
```

Sample configuration for fiber span 100 km:

```
configure
hw-module location 0/RP0/CPU0 slot 2
otdr port 1 direction tx mode-expert pulse-width 7000
otdr port 1 direction tx mode-expert span-length 100
otdr port 1 direction tx mode-expert measure-time 180
otdr port 1 direction tx mode-expert capture-length 100
otdr port 1 direction tx mode-expert capture-offset 0
otdr port 1 direction tx mode-expert fiber-resolution 50
```

```
otdr port 1 direction tx mode-expert loss-sensitivity 15
otdr port 1 direction tx mode-expert reflection-sensitivity -300
otdr port 1 direction tx mode-expert loss-relative-threshold 20
otdr port 1 direction tx mode-expert reflection-relative-threshold 20
```

OTDR Configuration Parameters in Expert Mode

Table 12: OTDR Configuration Parameters in Expert Mode

Parameter	Description	Range	Default
capture-length (in km)	Distance of end point of the measure.	1 to 150	100
capture-offset (in km)	Start point.	0 to 150	0
fiber-resolution (in m)	Distance from measurement steps.	0 to 100	25
loss-sensitivity (in 0.1dB)	Limit under which the loss is not considered as a real loss.	+4 to +50	6
measure-time (in sec)	Time required to perform the complete optical scan.	1 to 360	180
pulse-width (in ns)	Pulse duration during the measurement.	8 to 100000	1000
reflection-sensitivity (in 0.1dB)	Limit under which the reflection is not considered as a real reflection.	-400 to -140	-300
span-length (in km)	Length of span.	1 to 150	100
loss-relative-threshold (in 0.1dB)	Threshold to compare the loss value read from the OTDR module plus the relative loss threshold with the baseline value.	+1 to +300	2

Parameter	Description	Range	Default
reflection-relative-threshold (in 0.1dB)	Threshold to compare the reflection value read from the OTDR module plus the relative reflection threshold with the baseline value.	+1 to +300	2

Start OTDR Measurement in Expert Mode

hw-module slot *slot-number* **otdr port** *port-number* **direction** *direction* **scan expert**

Example

The following example starts the OTDR measurement in expert mode in TX direction.

```
hw-module slot 3 otdr port 1 direction tx scan expert
```

The user receives a message as "Otdr action will continue in the background". To see the status of OTDR measurement, use the **show hw-module slot slot-number otdr status** command.

Display List of OTDR Measurements

show hw-module slot *slot-number* **otdr scan**

Example

The following example shows the list of OTDR measurements.

```
show hw-module slot 3 otdr scan

  #| otdr#| Rx/Tx|Mode|  Date/Time    |       SOR filename
-----+-------+-------+--------+--------------------+-----------------------
  0|   1  |  Tx  |AUTO|20180504-092810|ncs1001_slot3_otdr1_TX.20180504-092810.sor
  1|   1  |  Tx  |AUTO|20180504-114239|ncs1001_slot3_otdr1_TX.20180504-114239.sor
```

The following table describes the significant fields shown in the above example.

Field	Description
#	Number of OTDR measurements.
otdr#	Port where OTDR measurement is done.
Rx/Tx	Direction of OTDR measurement.
Mode	Type of scan (auto or expert).

Field	Description
Date/Time	Date and time of OTDR measurement.
SOR filename	Number of files with measurement data.

The following example shows data for OTDR measurement stored in position number 0.

```
show hw-module slot 3 otdr scan 0


Measurement on: 20180504-151351

OTDR device number: 1
Scan direction: Tx
Scan mode: Auto
Directory location: /harddisk:/otdr
File name: ncs1001_slot3_otdr1_TX.20180504-151351.sor

Total ORL: 29.86 dB
Distance (estimate): 38.996 km

Total number of event detected: 3

Event# |       TYPE           | LOCATION(km) | ACCURACY(m) | MAGNITUDE(dB) | TH-CROSSING
-------+--------------------+--------------+-------------+---------------+------------
   0   |      LOSS            |    0.000     |    5.62     |    -1.09      |    NO
   1   |      LOSS            |    23.840    |    114.06   |    -0.44      |    NO
   2   |    END OF FIBER      |    38.996    |    249.00   |               |    NO
```

The following table describes the significant fields shown in the above example.

Field	Description
OTDR device number	Port number.
Scan direction	Direction of scan.
Scan mode	Mode of scan (auto or expert).
Directory location	Location where the SOR file is stored.
File name	Name of SOR file.
Total ORL	Optical return loss in dB.
Distance (estimate)	Distance in km.
Total number of event detected	Event detected during OTDR measurement.
Event#	Number of events.
TYPE	Type of event if the event is a LOSS or END of Fiber.
LOCATION(km)	Location where the event is into the span.
ACCURACY(m)	Accuracy where the event is into the span.
MAGNITUDE(dB)	Magnitude LOSS of event.

Field	Description
TH-CROSSING	loss-abs-threshold value.

Stop OTDR Measurement

Use this command to stop the OTDR measurement in automatic and expert modes.

hw-module slot *slot-number* **otdr port** *port-number* **scan abort**

Example

The following command displays the status of OTDR measurement in automatic mode after the cancel operation.

show hw-module slot 3 otdr status

```
Port |   Rx/Tx |      Date/Time     |     Training  |   OTDR Measurement|Next scan (min)
-------+-------+--------------------+---------------+-------------------+--------
   1   |  Tx   |   20190927-102727  |     ABORTED   |      UNKNOWN      |    0
```

The following command displays the status of OTDR measurement in expert mode after the cancel operation.

show hw-module slot 3 otdr status

```
Port | Rx/Tx |      Date/Time        |     Training     |   OTDR Measurement
     -------+-------+--------------------+------------------+-------------------

   1   |   Tx  |   20180503-181159   | UNKNOWN          |      ABORTED
```

View the Logical Ports and the Photodiode Power Levels

Use the command **show controllers otssummary** to display the power values of the photodiodes and the logical ports associated with the physical ports of the OTDR module.

Example:

```
RP/0/RP0/CPU0:IOS#show controllers ots 0/2/0/*  summary
Tue Jan 23 13:49:41.604 CET

Port         Type   Status   TX Power   TX Total Power  RX Power  RX Total Power  RX Voa
Attenuation   TX Voa Attenuation   Ampli Gain     Ampli Tilt
                             (dBm)     (dBm)            (dBm)     (dBm)               (dBm)
            (dBm)
 ----                ----    ------     -----------      --------   ----------
---------------   ------------------     -------------   ----------
Ots0_2_0_0   Com    N/A      -40.00     Unavailable      -40.00    Unavailable
Unavailable        Unavailable         Unavailable    Unavailable
Ots0_2_0_1   Com    N/A       0.60      Unavailable      -16.60    Unavailable
Unavailable        Unavailable         Unavailable    Unavailable
Ots0_2_0_2   Osc    N/A      -17.60     Unavailable       1.30     Unavailable
Unavailable        Unavailable         Unavailable    Unavailable
Ots0_2_0_3   Com    N/A      -40.00     Unavailable      -40.00    Unavailable
Unavailable        Unavailable         Unavailable    Unavailable
Ots0_2_0_4   Com    N/A       0.20      Unavailable      -22.20    Unavailable
Unavailable        Unavailable         Unavailable    Unavailable
```

```
Ots0_2_0_5   Osc    N/A      -23.60     Unavailable       1.30     Unavailable
Unavailable        Unavailable         Unavailable    Unavailable
```

Note The parameters such as Status, RX Total power, TX Total power, RX Attenuation, TX Attenuation, Amplifier Gain, and Amplifier Tilt on each of the corresponding OTS controller are not available for the OTDR card.

OTDR ML Events

Table 13: Feature History

Feature Name	Release Information	Feature Description
OTDR ML (Machine Learning) Model	Cisco IOS XR Release 7.3.2	The OTDR ML (Machine Learning) model is updated for this release to Version 4. This new model improves performance on events recognition.

Table 14: Feature History

Feature Name	Release	Description
OTDR ML (Machine Learning)	Cisco IOS XR Release 7.3.1	OTDR ML (Machine Learning) can be enabled on the OTDR card. When ML is enabled, the OTDR measurement shows more information about the events present on the fiber.

You can enable Machine Learning (ML) parameter on the OTDR card for displaying additional events present on the fiber.

The four new event types that are displayed in the scan output, when ML parameter is set to 1 (enable) are:

Event	Description
FIBER TERMINATED	The fiber is correctly plugged in to the far-end node.
OPEN CONNECTOR	The fiber is not correctly plugged in to the far-end node.
FACE PLATE	This is the beginning of the fiber.
PASS THROUGH	This is the connection between two fibers.

Enable ML on the OTDR Card

You can enable ML on the OTDR card by executing the following command in the configuration mode:

hw-module location *location* **slot** *slot number* **otdr port** *port number* **direction** *direction* **ml-enabled** 1

Example

The following example shows how to enable ML on the OTDR card on slot 1, port 1, and direction tx:

```
RP/0/RP0/CPU0(config)#hw-module location 0/RP0/CPU0 slot 1 otdr port 1 direction tx ml-enabled
 1
RP/0/RP0/CPU0(config)#commit
```

View Scan Output with ML Enabled

Use the following command to view the output of a scan file in position 0 after enabling ML on the OTDR card:

```
RP/0/RP0/CPU0:156-ML#show hw-module slot 1 otdr scan 0
Tue Oct  6 11:26:53.514 CEST
Measurement on: 20200916-171424
ODTR device number: 1
Scan direction: Tx
Scan mode: Auto
Directory location: /harddisk:/otdr
File name: 156-ML_ncs1001_slot1_otdr1_TX.20200916-171424.sor

Total ORL: 31.37 dB
Distance (estimate): 61.275 km

High Reflection Location: 0.00 km

Total number of event detected: 2

Event# |       TYPE         | LOCATION(km) | ACCURACY(m) | MAGNITUDE(dB) | ABS TH-CROSSING
 | REL TH-CROSSING
-------+------------------+-------------+------------+--------------+----------------+---------------

   0   |      REFLECTION    |    61.275    |    50.00    |    -16.32     |        YES
 |      NO
   1   |    END OF FIBER    |    61.275    |    50.00    |               |        NO
 |      NO


ML graph analysis:

Total number of event detected: 3

Event# |        TYPE          | LOCATION(km) |
-------+---------------------+--------------+
   A   |   FACE PLATE         | 0.001
   B   |   PASS THROUGH       | 11.876
   C   |   OPEN CONNECTOR     | 61.285
```

The **OPEN CONNECTOR** event type in the above scan output shows that the fiber span is not connected to a far end node.

Use the following command to view the output of a scan file in position 6 after enabling ML on the OTDR card:

```
RP/0/RP0/CPU0:156-ML#show hw-module slot 1 otdr scan 6
Tue Oct  6 11:27:12.476 CEST
Measurement on: 20200917-140822
ODTR device number: 1
Scan direction: Tx
```

```
Scan mode: Auto
Directory location: /harddisk:/otdr
File name: 156-ML_ncs1001_slot1_otdr1_TX.20200917-140822.sor

Total ORL: 31.29 dB
Distance (estimate): 61.279 km

High Reflection Location: 0.00 km

Total number of event detected: 1

Event# |       TYPE          | LOCATION(km) | ACCURACY(m) | MAGNITUDE(dB) | ABS TH-CROSSING
 | REL TH-CROSSING
-------+-------------------+-------------+------------+--------------+----------------+---------------

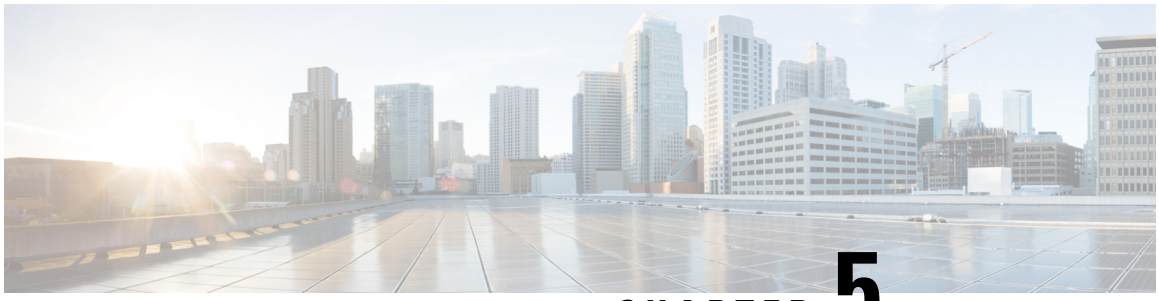
   0   |    END OF FIBER    |    61.279    |    50.00    |               |       NO
 |      NO


ML graph analisys:

Total number of event detected: 3

Event# |        TYPE          | LOCATION(km) |
-------+---------------------+--------------+
   A   |   FACE PLATE         | 0.001
   B   |   PASS THROUGH       | 11.876
   C   |   FIBER TERMINATED   | 61.622
```

The **FIBER TERMINATED** event type in the above scan output shows that the fiber span is properly connected to a far end node.



CHAPTER 5

Configure Performance Monitoring

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

PM for optical parameters include laser bias current, transmit and receive optical power, mean polarization mode dispersion, accumulated chromatic dispersion, and received optical signal-to-noise ratio (OSNR). These parameters simplify troubleshooting operations and enhance data that can be collected directly from the equipment.

- Configure PM Parameters, on page 81
- View PM Parameters, on page 82

Configure PM Parameters

You can configure the performance monitoring parameters for the OTS controllers. To configure PM parameters, use the following commands.

configure

controller *controllertype R/S/I/P* { **pm** { **15-min** | **24-hour** | **30-sec** } **ots** { **report** | **threshold** } { **opr** | **opt** }*value* }

commit

Examples

The following is a sample in which the performance monitoring parameters of OTS controller is configured in 24 hour intervals.

```
configure
controller ots 0/1/0/0 pm 24-hour ots report opr max-tca enable
commit
```

The above command enables the maximum TCA (Threshold Crossing Alert) for opr (optical power received) of ots 0/1/0/0 controller in 24 hour intervals.

```
configure
controller ots 0/1/0/0 pm 24-hour ots threshold opr max 4000
commit
```

The above command sets the maximum TCA for opr of ots 0/1/0/0 controller in 24 hour intervals.

The PM collector starts and collects controller data at the following intervals.

- 30 seconds interval - 30 samples jitter provision of 6 seconds
- 15 minutes interval - 32 samples jitter provision of 45 seconds
- 24 hours interval - 1 sample jitter provision of 45 seconds

The jitter provides for any computation delay for data collected at the data provider PM engine.

View PM Parameters

Table 15: Feature History

Feature Name	Release Information	Feature Description
10sec PM buckets	Cisco IOS XR Release 7.3.1	Performance monitoring parameters for the OTS and OTS OCH controllers in 10 second intervals are available. This new bucket for performance monitoring allows you to gather, store, and report performance data with higher granularity. Commands modified: • controller ots • show controllers

Use this procedure to view the performance monitoring parameters for OTS controllers.

Procedure

show controllers *controllertype R/S/I/P* { **pm** { **current** | **history** } { **15-min** | **24-hour** | **30-sec** | **flex-bin** } { **optics** *lane-number* } { **bucket** *bucket-number* }

flex-bin corresponds to a bucket of 10 seconds.

The **bucket** parameter must be specified for **pm history**.

Example:

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

Displays the current performance monitoring parameters of the Optics controller in 15 minute intervals.

```
Thu Mar 16 15:07:21.093 CET

Optics in the current interval [15:00:00 - 15:07:21 Thu Mar 16 2017]
```

```
Optics current bucket type : Valid
MIN AVG MAX Threshold TCA Threshold TCA
(min) (enable) (max) (enable)
LBC[% ] : 0.2 4.5 18.6 0.0 NO 0.0 NO
OPT[dBm] : -40.00 -0.40 8.00 -50.00 NO 10.00 NO
OPR[dBm] : -17.52 -17.01 -16.90 -50.00 NO 10.00 NO

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

The **show controllers** command occasionally returns the wrong bucket. For example, the following command query at "Mon May 29 15:02:05.697 CEST" must have returned the bucket for the interval [15:01:30 - 15:02:00 Mon May 29 2017] while it returned the previous bucket [15:01:00 - 15:01:30 Mon May 29 2017].

```
RP/0/RP0/CPU0:ios# show controllers optics 0/1/0/4 pm history 30-sec optics 1 bucket 5
```

Displays the current performance monitoring parameters of the Optics controller in 15 minute intervals related to bucket 5.

```
Mon May 29 15:02:05.697 CEST

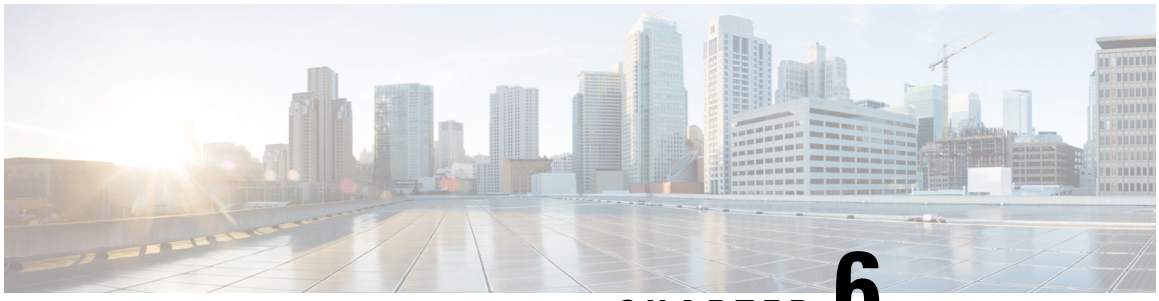
Optics in interval 1 [15:01:00 - 15:01:30 Mon May 29 2017]

Optics history bucket type : Valid
              MIN       AVG       MAX
LBC[% ]     : 335.3     341.3     352.3
OPT[dBm]    : 1.90      2.01      2.10
OPR[dBm]    : -12.20    -12.16    -12.10

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

The following table describes the bucket values for each time interval.

PM Time Interval	Bucket Value
15 minutes	[1,32]
24 hours	No value
30 seconds	[1,30]
flex-bin (10 seconds)	1



CHAPTER 6

USB Automount

This chapter describes USB Automount configuration on NCS 1000.

- USB Automount, on page 85

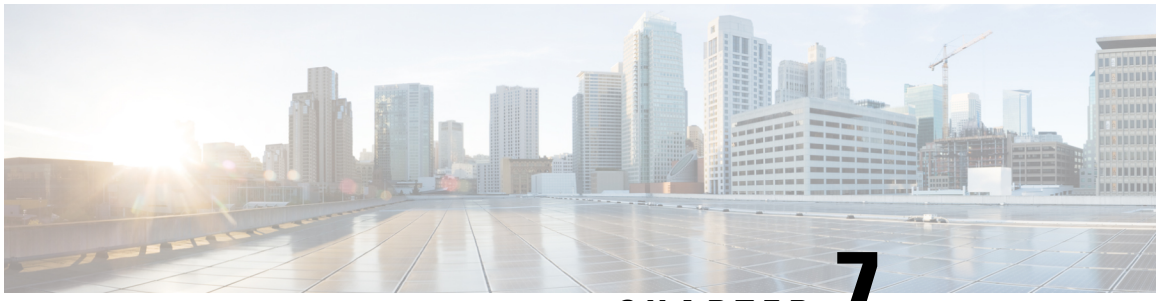
USB Automount

The USB automount feature allows the user to read from or write files and folders onto the USB device without explicitly mounting it. The mounted USB device can be accessed as disk2: file system.

In NCS 1001, the USB device is automatically mounted in both sysadmin-vm and XR.

The user must unmount the USB device from sysadmin-vm or XR before it is removed from NCS 1000. If the USB device must be mounted again after the device is unmounted but before removing the device, it can be done using the **mount** command.

USB Automount



CHAPTER 7

Fault Profiles

This chapter describes how to configure and manage fault profiles.

Table 16: Feature History

Feature Name	Release Information	Feature Description
Fault Profiles	Cisco IOS XR Release 7.3.1	This feature allows you to create a fault profile for faults on the system or on the line card. Each fault profile can contain one or more faults with user-defined severities. Commands added: • fault-profile • fault-profile apply

• Fault Profiles, on page 87
• Configure Fault Profiles, on page 88

Fault Profiles

The default fault list in a system captures all the possible types of faults that the system generates, along with the associated default severity values, for each fault type. This default severity value is the severity of the fault that is generated in a system when no other fault profile is defined and applied in that system. Based on your requirement, you can create new fault profiles and change the severity of fault.

The Fault Profiling feature enables you to create a fault profile for faults on the system or the line card. Each fault profile can contain one or more faults with user-defined severities. The highest precedence is maintained at the port level and the lowest precedence is maintained at the system (node) level. For example, if the system profile is already attached and if you want to have a separate fault profile for a node, you can create a node profile and attach it to that node. The node inherits the properties of the node profile.

The available severity levels are:

- Major
- Minor

- Critical
- Non-Faulted
- Non-Reported

The defined set of actions for a fault profile are:

- Create and delete a fault profile
- Add alarms to a fault profile
- Remove alarms from a fault profile
- Modify severity of alarm in an existing fault profile

Limitations of Fault Profiles

The following are the limitations for fault profiles:

- Fault profiling is available only on data path alarms—Ethernet, GFP, Optics, OTS, SDH, SONET, G709, and CPRI.
- You can create a maximum of 61 profiles.
- You can have only one fault profile for each level. Hence, you cannot apply more than one fault profile to node level and port level.

Configure Fault Profiles

This task performs the following:

- Creates a fault profile with a unique name and a fault type.
- Adds one or more alarms to the fault profile with a severity different from the default profile.
- Applies the fault profile at port or slot level or node level.

configure terminal

fault-profile *fault-profile-name*

fault identifier subsystem XR fault-type { **HW_GFP** | **HW_ETHERNET** | **HW_SDH_CONTROLLER** | **HW_SONET** | **HW_OPTICS** | **HW_G709** | **HW_CPRI** | **HW_OTS** } **fault-tag** *fault-name* **sas** *severity-level* **nsas** *severity-level*

commit

fault-profile *fault-profile-name* **apply rack** *0* **slot** { **ALL** | **LC1** | **LC2** | **LC3** } **port** *port-id*

commit

exit

severity-level (both sas and nsas) can take one of these values: CRITICAL, MAJOR, MINOR, NONFAULTED, or NONREPORTED.

For each **fault-type**, there is a list of *fault-name* corresponding to alarms that could be raised on the node. For example, the list of *fault-name* values for HW_OTS **fault-type** is OTS_AS_MT, OTS_APC_RUNNING, OTS_SWITCH_TO_PROTECT, OTS_APC_CONFIG_MISMATCH, OTS_APC_DISABLED, OTS_AUTO_POW_RED, OTS_AUTO_LASER_SHUT, OTS_AMPLI_GAIN_HIGH, OTS_AMPLI_GAIN_LOW, OTS_RX_LOC, OTS_RX_LOS_P, OTS_RX_POWER_FAIL_LOW, and OTS_TX_POWER_FAIL_LOW.

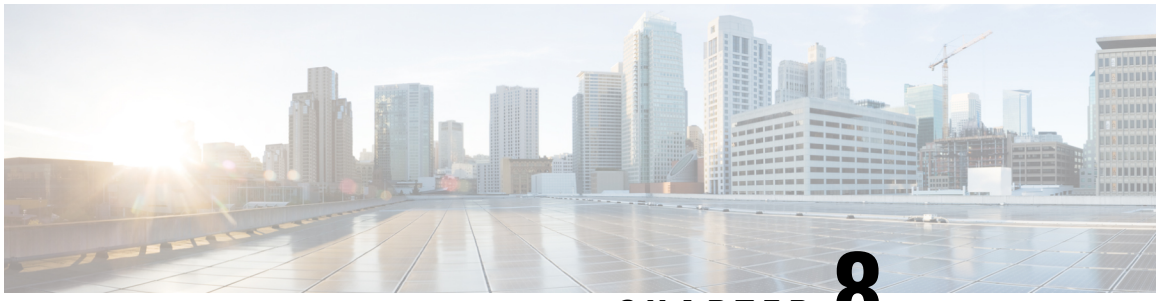
Examples

The following sample creates a fault profile and applies at port or slot level.

```
RP/0/RP0/CPU0:ios#configure terminal
RP/0/RP0/CPU0:ios(config)#fault-profile FpSystem fault-identifier subsystem XR
fault-type HW_OTS fault-tag OTS_SWITCH_TO_PROTECT sas NONFAULTED nsas NONFAULTED
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#fault-profile FpSystem apply rack 0 slot LC2 port 1
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
```

The following sample creates a fault profile and applies at node level.

```
RP/0/RP0/CPU0:ios#configure terminal
RP/0/RP0/CPU0:ios(config)#fault-profile FpNode fault-identifier subsystem XR
fault-type HW_OTS fault-tag OTS_RX_LOS_P sas CRITICAL nsas CRITICAL
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#fault-profile FpNode apply rack 0 slot ALL
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
```



CHAPTER 8

Configure AAA

This chapter describes the implementation of the administrative model of task-based authorization used to control user access in the software system.

Table 17: Feature History

Feature Name	Release Information	Feature Description
OC support for AAA user	Cisco IOS XR Release 7.3.2	This feature allows all authorized users on XR VM to access administration data on the router through NETCONF or gRPC interface, similar to accessing the CLI. This functionality works by internally mapping the task group of the user on XR VM to a predefined group on System Admin VM. Therefore, the NETCONF and gRPC users can access the administrative information on the router even if their user profiles do not exist on System Admin VM. Command added: • **aaa authorization (System Admin-VM)**

- Understanding of AAA, on page 91
- Admin Access for NETCONF and gRPC, on page 92

Understanding of AAA

User groups and task groups are configured through the software command set used for authentication, authorization and accounting (AAA) services. Authentication commands are used to verify the identity of a user or principal. Authorization commands are used to verify that an authenticated user (or principal) is granted permission to perform a specific task. Accounting commands are used for logging of sessions and to create an audit trail by recording certain user- or system-generated actions.

AAA is part of the software base package and is available by default.

To configure authentication, authorization, and accounting (AAA) authentication at login, use the **aaa authentication login** command in global configuration mode.

Admin Access for NETCONF and gRPC

This feature allows all authorized users on XR VM to access administration data on the router through NETCONF or gRPC interface, similar to accessing the CLI. This functionality works by internally mapping the task group of the user on XR VM to a predefined group on System Admin VM. Therefore, the NETCONF and gRPC users can access the admin-related information on the router even if their user profiles do not exist on System Admin VM.

NETCONF is an XML-based protocol used over Secure Shell (SSH) transport to configure a network. Similarly, gRPC is an open-source remote procedure call framework. The client applications can use these protocols to request information from the router and make configuration changes to the router. Prior to Cisco IOS XR Software Release 7.3.2, users who use NETCONF, gRPC or any other configuration interface, other than CLI, to access the admin-related information on the router, had to belong to user groups that are configured on System Admin VM. Otherwise, the router would issue an UNAUTHORIZED access error message and deny access through that client interface.

By default, XR VM synchronizes only the first configured user to System Admin VM. If you delete the first user in XR VM, the system synchronizes the next user in the **root-lr** group (which is the highest privilege group in XR VM for Cisco IOS XR 64-bit platforms) to System Admin VM only if there are no other users configured in System Admin VM. The system does not automatically synchronize the subsequent users to System Admin VM. Therefore, in earlier releases, users whose profiles did not exist in System Admin VM were not able to perform any NETCONF or gRPC operations on System Admin VM.

From Cisco IOS XR Software Release 7.3.2, the system internally maps the users who are authorized on XR VM to System Admin VM of the router, based on the task table of the user on XR VM. With this feature, the NETCONF and gRPC users can access admin-related information on the router even if their user profiles do not exist on System Admin VM. By default, this feature is enabled.

User Profile Mapping from XR VM to System Admin VM

User privileges to execute commands and access data elements on the router are usually specified using certain command rules and data rules that are created and applied on the user groups.

When the internal process for AAA starts or when you create the first user, the system creates the following set of predefined groups, command rules and data rules in System Admin VM. These configurations are prepopulated to allow users of different groups (such as root-system, admin-r and aaa-r) in System Admin VM

You can use the **show running-configuration aaa** command to view the AAA configurations.

```
aaa authentication groups group aaa-r gid 100 users %%__system_user__%%
!
aaa authentication groups group admin-r gid 100 users %%__system_user__%%
!
aaa authentication groups group root-system gid 100 users "%%__system_user__%% "
!
aaa authorization cmdrules cmdrule 1 context * command * group root-system ops rx action
accept
!
aaa authorization cmdrules cmdrule 2 context * command "show running-config aaa" group aaa-r
```

```
ops rx action accept
!
aaa authorization cmdrules cmdrule 3 context * command "show tech-support aaa" group aaa-r
ops rx action accept
!
aaa authorization cmdrules cmdrule 4 context * command "show aaa" group aaa-r ops rx
action accept
!
aaa authorization cmdrules cmdrule 5 context * command show group admin-r ops rx action
accept
!
aaa authorization datarules datarule 1 namespace * context * keypath * group root-system
ops rwx action accept
!
aaa authorization datarules datarule 2 namespace * context * keypath /aaa group aaa-r ops
r action accept
!
aaa authorization datarules datarule 3 namespace * context * keypath /aaa group admin-r ops
rwx action reject
!
aaa authorization datarules datarule 4 namespace * context * keypath / group admin-r ops r
action accept
```

The admin CLI for the user works based on the above configurations. The root-system is the group with the highest privilege in System Admin VM. The admin-r group has only read and execute access to all data. The aaa-r group has access only to AAA data. With the introduction of the admin access feature for all users, the NETCONF and gRPC applications can also access the admin data based on the above rules and groups.

How to Allow Read Access to Administration Data for NETCONF and gRPC Clients

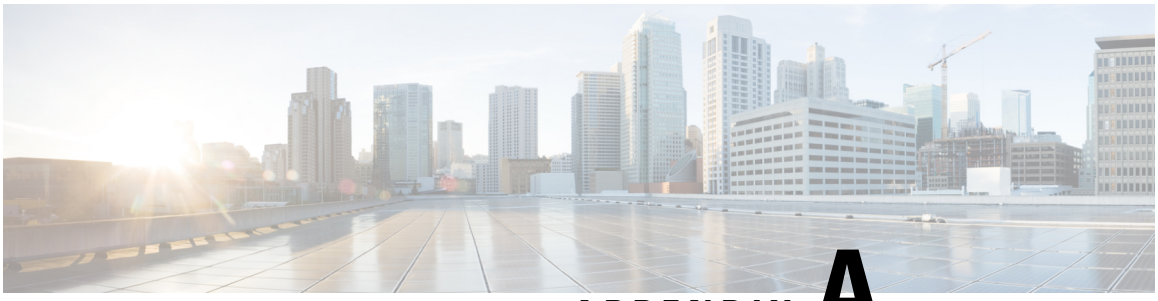
NETCONF and gRPC users access the administration data on the router through GET operations as defined by the respective protocols. To allow this read access to administration data for users belonging to admin-r group, you must configure a new command rule specifically for the NETCONF or gRPC client.

Configuration Example

```
Router#admin
sysadmin-vm:0_RP0#configure
sysadmin-vm:0_RP0(config)#aaa authorization cmdrules cmdrule 6
sysadmin-vm:0_RP0(config-cmdrule-6)#context netconf
sysadmin-vm:0_RP0(config-cmdrule-6)#command get
sysadmin-vm:0_RP0(config-cmdrule-6)#group admin-r
sysadmin-vm:0_RP0(config-cmdrule-6)#ops rx
sysadmin-vm:0_RP0(config-cmdrule-6)#action accept
sysadmin-vm:0_RP0(config)#commit
```

Running Configuration

```
aaa authorization cmdrules cmdrule 6
context netconf
command get
group admin-r
ops rx
action accept
!
```



APPENDIX A

Configuring SNMP

The following MIBs are supported in NCS 1001.

- CISCO-OPTICAL-OTS-MIB
- CISCO-CONFIG-MAN-MIB
- CISCO-FLASH-MIB
- CISCO-ENTITY-REDUNDANCY-MIB
- CISCO-SYSTEM-MIB
- CISCO-ENTITY-ASSET-MIB
- EVENT-MIB
- DISMAN-EXPRESSION-MIB
- CISCO-FTP-CLIENT-MIB
- NOTIFICATION-LOG-MIB
- CISCO-RF-MIB
- CISCO-TCP-MIB
- UDP-MIB
- CISCO-OTN-IF-MIB
- CISCO-ENHANCED-MEMPOOL-MIB
- CISCO-PROCESS-MIB
- CISCO-SYSLOG-MIB
- ENTITY-MIB
- CISCO-ENTITY-FRU-CONTROL-MIB
- CISCO-IF-EXTENSION-MIB
- RMON-MIB
- CISCO-OPTICAL-MIB

- CISCO-ENTITY-SENSOR-MIB

Note

- CISCO-OPTICAL-OTS-MIB contains the SNMP traps for all the specific NCS 1001 alarms that are not related to other platforms. These alarms are reported through SNMP traps with appropriate severity and hardware port notification. Other MIBs such as CISCO-OPTICAL-MIB contains the SNMP traps for alarms that can also be raised on other platforms, for example, NCS 1002.
- **Configuring SNMP Traps**

  To configure SNMP traps follow the steps given below.

  1. **configure**
  2. **snmp-server traps optical-ots**
  3. **commit**

Example:

```
RP/0/RP0/CPU0:NCS1001#config
Thu Apr 27 10:24:05.868 UTC
RP/0/RP0/CPU0:NCS1001(config)#snmp-server traps optical-ots
RP/0/RP0/CPU0:NCS1001(config)#commit
Thu Apr 27 10:24:15.176 UTC
RP/0/RP0/CPU0:NCS1001(config)#
```

The following table provides more information about SNMP MIBs and the documentation links.

Task	Link
Determine the MIB definitions	SNMP Object Navigator
Configure SNMP	Configure SNMP
Understand the SNMP best practices regarding the recommended order of SNMP query, maximum cache hit, and SNMP retry and timeout recommendation	SNMP Best Practices