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New and Changed Information


This table summarizes new and changed information for configuration guide for Release 6.3.2, and lists where the features are documented.

Table 1: New and Changed Features - R6.3.2

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Where Documented</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cisco ONS 15216-MD48-CME2</td>
<td>Cisco ONS 15216-MD48-CME2 is a 2x2 dual coupler and splitter module, that have the MUX and the DEMUX functions implemented as two different sections. The DEMUX section includes an optical splitter to split the optical signal evenly into two different output ports: EVEN-TX port and ODD-TX port. The optical coupler provides the MUX section and combines even and odd channels signals at 100 GHz spacing (EVEN-RX and ODD-RX ports respectively) into a signal of 50 GHz channel spacing. The DEMUX section also provides the input signal to dual monitor ports. The MUX section also duplicates the combined spectrum on two output ports.</td>
<td>Installing the Cisco ONS 15216-MD-48-CM Interleaver and Deinterleaver Pluggable and Cisco ONS 15216-MD-48-CME, 15216-MD48-CME2 Coupler and Splitter Pluggable</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Where Documented</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>ILA Configuration</td>
<td>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.</td>
<td>In-Line Amplifier, on page 13</td>
</tr>
<tr>
<td>Event Driven Telemetry</td>
<td>NCS 1001 supports Event-based telemetry. Several sensor paths are supported for Event-based telemetry in NCS 1001.</td>
<td>Telemetry Configuration Guide for Cisco NCS 1000 Series</td>
</tr>
<tr>
<td>Network Topology Discovery</td>
<td>Network topology discovery feature based on OSPF protocol, allows to discover NCS 1001 nodes connected to each other through OSC links without configuring the static routes.</td>
<td>Network Topology Discovery, on page 23</td>
</tr>
</tbody>
</table>
| Open Config Optical Model     | The Open Config Optical Model is a cross-connect model that provides a unique way to provision Cisco NCS 1001 using YANG models that are defined for configuration data and operational data. The gRPC (google-defined Remote Procedure Calls) and NETCONF (Network Configuration Protocol) communication protocols are used to establish connection between the client and Cisco NCS 1001. Cisco NCS 1001 supports open config models according to the optical transport functions available on system. The following are the open config supported models.  
  - Amplifier model, supported by NCS1001 EDFA modules.  
  - Transport Line Protection model, supported by NCS 1001 PSM modules.  
  - Channel Monitoring model, supported by NCS1001 EDFA by means of its OCM capability. | Data Models Configuration Guide for the Cisco NCS 1001 |
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Where Documented</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSM Autothreshold</td>
<td>NCS 1001 supports autothreshold for Protection Switching Module (PSM). RX Power is the optical power reading from a photodiode, and is a total power on the path where the photodiode is placed. The RX-low-threshold is available in the show controller stats Parameter Statistics. Two RX low thresholds can be set on the PSM-one for RX working port (W-RX), and another for RX protected port (P-RX). When auto-threshold is not enabled, the RX-low threshold value active on PSM working and protected RX-ports are the default values or the values set by the user manually. If auto-threshold is enabled on the PSM, the RX-low thresholds values for port 1 and 2 configured by the user are ignored. The PSM Auto-threshold configuration is highly recommended for a three-way topology.</td>
<td>Autothreshold for Protection Switching Module, on page 19</td>
</tr>
<tr>
<td>PSM Virtual Diode</td>
<td>Protection Switching Module (PSM) Virtual diode provides an optical power reading even if PSM does not have a photodiode on COM-RX. The value of the virtual COM-RX is calculated using the power provided by the photodiodes on Working-TX and Protected-TX. PSM does not have photodiode on COM-RX. There are two photodiodes on Working-TX and Protected-TX present after the VOA.</td>
<td>PSM Virtual Photodiode, on page 20</td>
</tr>
<tr>
<td>Feature</td>
<td>Description</td>
<td>Where Documented</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------</td>
</tr>
</tbody>
</table>
| PSM Path Protection | NCS 1001 supports Protection Switching Module (PSM) Path Protection. 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 3dB 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 (+8dBm).  
  • When the system is up and running with the final number of channels, the PSM RX-low Threshold must be set 3dB 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 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 3 way configuration. | Configure Protection Switching Module, on page 18 |
<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
<th>Where Documented</th>
</tr>
</thead>
<tbody>
<tr>
<td>PSM 3 way Protection</td>
<td>NCS 1001 supports PSM 3 way protection scheme formed by combining a Section Protection scheme with a Path Protection scheme. There is no configuration 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.</td>
<td></td>
</tr>
</tbody>
</table>
CHAPTER 1

Configure Controllers

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

- Controllers, on page 1
- Configure OTS Controller, on page 1
- Display Parameters of OTS Controllers, on page 4
- Configure OTS OCH Controller, on page 5
- Display Parameters of OTS OCH Controllers, on page 6
- Dual IP Address, on page 7

Controllers

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

<table>
<thead>
<tr>
<th>Rack</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slot</td>
<td>1 to 3. Slots for pluggable optical modules.</td>
</tr>
<tr>
<td>Instance</td>
<td>0</td>
</tr>
<tr>
<td>Port</td>
<td>Depends on the specific pluggable optical module.</td>
</tr>
</tbody>
</table>

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.

```bash
configure
c   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.

```bash
configure
c   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.

```bash
configure
c   controller ots 0/3/0/1
   safety-control-mode disabled
   commit
end
```
### OTS Controller Configuration Parameters

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

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
Example

```
configure
c    controller ots-och 0/1/0/0
  rx-low-threshold -30
  tx-low-threshold -35
commit
dend
```

**OTS OCH Controller Configuration Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Hardware Capability</th>
<th>Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>rx-low-threshold (in dBm)</td>
<td>Low receive power threshold</td>
<td>OCM</td>
<td>-500 to +300</td>
<td>-25.0</td>
</tr>
<tr>
<td>tx-low-threshold (in dBm)</td>
<td>Low transmit power threshold</td>
<td>OCM</td>
<td>-500 to +300</td>
<td>-25.0</td>
</tr>
</tbody>
</table>

**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 * wildcard can be used to display all the OTS OCH controllers associated with a OTS controller. For example, show controllers 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

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:

- MgmtEth0/RP0/CPU0/0 (already existing) representing the RJ45 port.
- MgmtEth0/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
!
CHAPTER 2

Configure Optical Modules

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

- Optical Amplifier Module, on page 9
- Amplifier Configuration, on page 11
- Configure Amplifier Module, on page 12
- In-Line Amplifier, on page 13
- Configure Amplifier Module in ILA Manual Mode, on page 14
- Configure Amplifier Module in ILA Automatic Mode, on page 15
- Protection Switching Module, on page 17
- Configure Protection Switching Module, on page 18
- Autothreshold for Protection Switching Module, on page 19
- Configure Autothreshold for PSM, on page 20
- PSM Virtual Photodiode, on page 20
- PSM 3-way Protection, on page 21
- OSC, on page 22
- Remote Management, on page 22
- Network Topology Discovery, on page 23
- Configure Management and OSC Interfaces, on page 23
- Configure Static Routes, on page 24
- Configure OSPF Routes, on page 24
- Verify OSPF Routing Table, on page 25
- Troubleshooting Network Issues, on page 25

Optical Amplifier Module

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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>XFP for OSC and additional OTDR feature</td>
</tr>
<tr>
<td>2</td>
<td>SFP for OSC (Optical Service Channel)</td>
</tr>
<tr>
<td>3</td>
<td>Status LED</td>
</tr>
<tr>
<td>4</td>
<td>Service Channel input and output port [OSC - RX, TX]</td>
</tr>
<tr>
<td>5</td>
<td>PRE and BST amplifier inputs and output ports</td>
</tr>
<tr>
<td></td>
<td>[L (LINE) - RX, TX]</td>
</tr>
<tr>
<td></td>
<td>[C (COM) - RX, TX]</td>
</tr>
<tr>
<td></td>
<td>[COM - TX CHECK]</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Controller</th>
<th>Optical Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>OtS 0/slot/0/0</td>
<td>• COM-RX (booster input)</td>
</tr>
<tr>
<td></td>
<td>• COM-TX (preamplifier output)</td>
</tr>
<tr>
<td>OtS 0/slot/0/1</td>
<td>• LINE-RX (preamplifier input)</td>
</tr>
<tr>
<td></td>
<td>• LINE-TX (booster output)</td>
</tr>
<tr>
<td>OtS 0/slot/0/2</td>
<td>• OSC-RX</td>
</tr>
<tr>
<td></td>
<td>• OSC-TX</td>
</tr>
</tbody>
</table>
**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 RJ45 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 slot 3). 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*
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 4: Amplifier Module Configuration Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range/Values</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>grid-mode</td>
<td>Defines the optical spectrum on the interfaces of the amplifier module.</td>
<td>100GHz and 50GHz</td>
<td>100GHz</td>
</tr>
<tr>
<td>node-type</td>
<td>Defines the type of the node in which the amplifier is set to work.</td>
<td>iLA</td>
<td>iLA</td>
</tr>
<tr>
<td>udc-vlan</td>
<td>Defines the VLAN associated to the selected slot and its UDC port.</td>
<td>2 to 4080</td>
<td></td>
</tr>
</tbody>
</table>

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=).
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.

```plaintext
configure
hw-module location 0/RP0/CPU0 slot 3 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.

```plaintext
configure
  hw-module location 0/RP0/CPU0 slot 3 ampli node-type ila
```
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 3 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
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
```
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.

<table>
<thead>
<tr>
<th>Controller</th>
<th>Optical Ports</th>
</tr>
</thead>
<tbody>
<tr>
<td>OtS 0/slot/0/0</td>
<td>COM-TX</td>
</tr>
<tr>
<td>OtS 0/slot/0/1</td>
<td>Working path input and output port [W - RX, TX]</td>
</tr>
</tbody>
</table>
Configure Protection Switching Module

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

### PSM Module Configuration Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Range/Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>lockout-from</td>
<td>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.</td>
<td>Working and Protected</td>
</tr>
<tr>
<td>path-protection</td>
<td>Enables the PSM path protection.</td>
<td></td>
</tr>
<tr>
<td>section-protection</td>
<td>Enables the PSM section protection.</td>
<td></td>
</tr>
<tr>
<td>uni-dir</td>
<td>Enables the PSM uni directional (in switches only).</td>
<td></td>
</tr>
<tr>
<td>auto-threshold</td>
<td>Enables the PSM auto threshold setting.</td>
<td></td>
</tr>
</tbody>
</table>

### 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.

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 3dB 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 (+8dBm).

- When the system is up and running with the final number of channels, the PSM RX-low Threshold must be set 3dB 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 3 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 1.

---

**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 related 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. In case, if the user didn't set any value the related RX-low threshold is moved to the default value -38dBm.

- 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 Autothreshold for PSM

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

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

### 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

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 configuration 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 6: 3-way Protection Network Topology*

*Figure 7: 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.

**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

```bash
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.

```bash
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 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
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.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Command</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfaces are in down state</td>
<td>show interfaces MgmtEth rack/slot/instance/port</td>
</tr>
<tr>
<td>Route to default gateway is not defined</td>
<td>show running-config</td>
</tr>
<tr>
<td>Wrong IP addresses or subnet are planned in design phase</td>
<td>show running-config</td>
</tr>
<tr>
<td>Wrong static routes are defined that overwrite OSPF routes</td>
<td>Compare the output of show ip route command with show ospf routes command</td>
</tr>
<tr>
<td>Interfaces are not added in the OSPF section configured</td>
<td>show running-config</td>
</tr>
<tr>
<td>Problem</td>
<td>Command</td>
</tr>
<tr>
<td>----------------------------------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td>Interfaces are in passive mode in the OSPF section configured</td>
<td>show running-config</td>
</tr>
</tbody>
</table>
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 current and historical PM counters for the various controllers in 15 minutes and 1 day 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 27
- View PM Parameters, on page 28

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

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

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**

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

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

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 1

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
```
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
- CISCO-ENTITY-STATE-EXT-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

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

<table>
<thead>
<tr>
<th>Task</th>
<th>Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determine the MIB definitions</td>
<td>SNMP Object Navigator</td>
</tr>
<tr>
<td>Configure SNMP</td>
<td>Configure SNMP</td>
</tr>
<tr>
<td>Understand the SNMP best practices regarding the recommended order of SNMP query, maximum cache hit, and SNMP retry and timeout recommendation</td>
<td>SNMP Best Practices</td>
</tr>
</tbody>
</table>