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 2
- Cabling Considerations for Terminal Node, on page 5
- Cabling Considerations for ILA Node, on page 6
- Configure OTDR, on page 8
- Display Status of OTDR Measurement, on page 11
- Configure OTDR in Automatic Mode, on page 12
- Start OTDR Measurement in Automatic Mode, on page 14
- OTDR Measurement in Automatic Mode Based on Events, on page 14
- Configure OTDR in Expert Mode, on page 22

- Start OTDR Measurement in Expert Mode, on page 25
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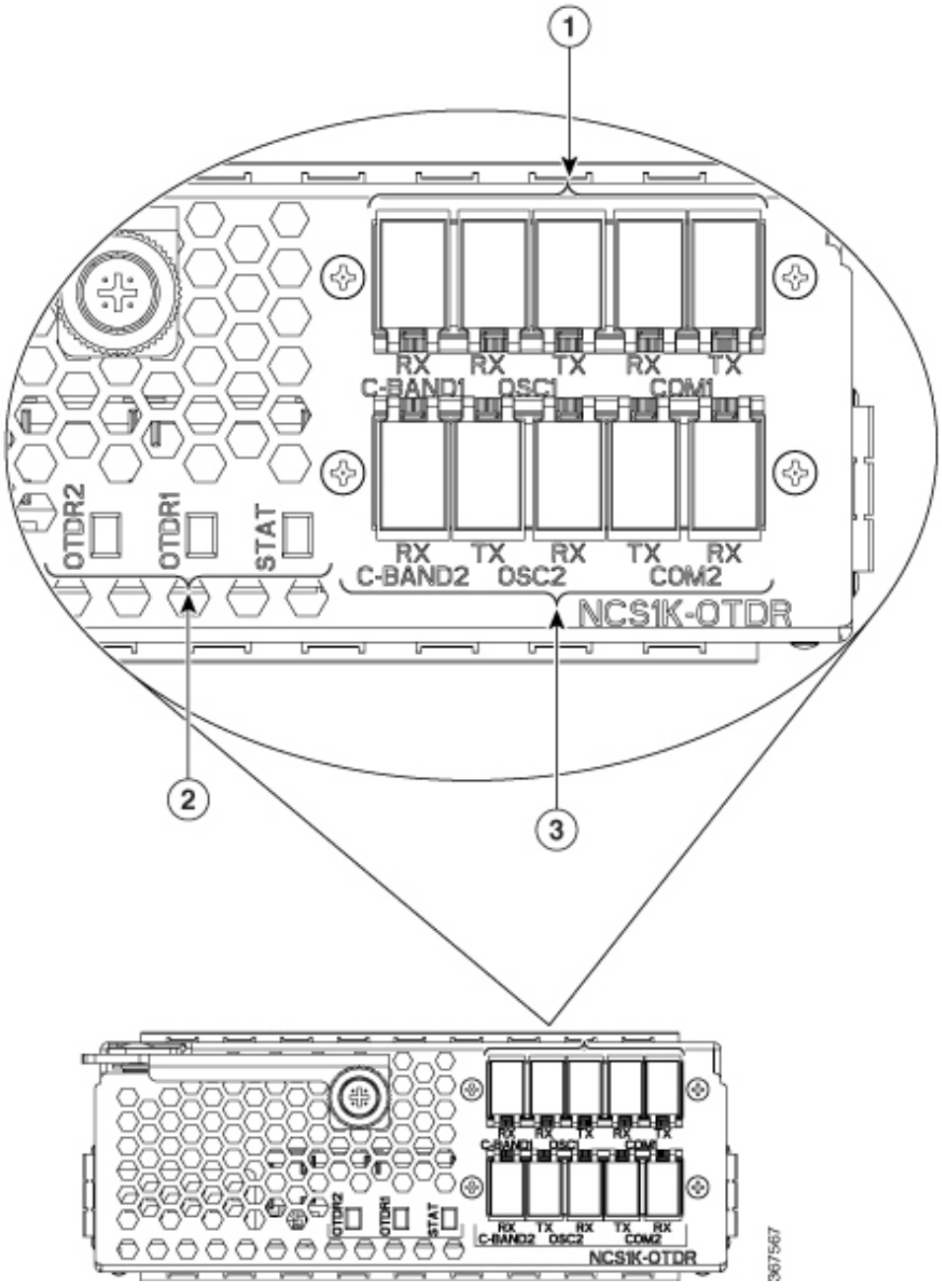
- Stop OTDR Measurement, on page 27
- View the Logical Ports and the Photodiode Power Levels, on page 28
- OTDR ML Events, on page 28
- Enable ML on the OTDR Card, on page 29
- View Scan Output with ML Enabled, on page 29

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 1: 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 1: 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 1: OTDR Physical Ports and the Associated Logical Ports, on page 4 using the CLI command. See View the Logical Ports and the Photodiode Power Levels, on page 28.

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 2: Cabling for Terminal Configuration with One EDFA Module

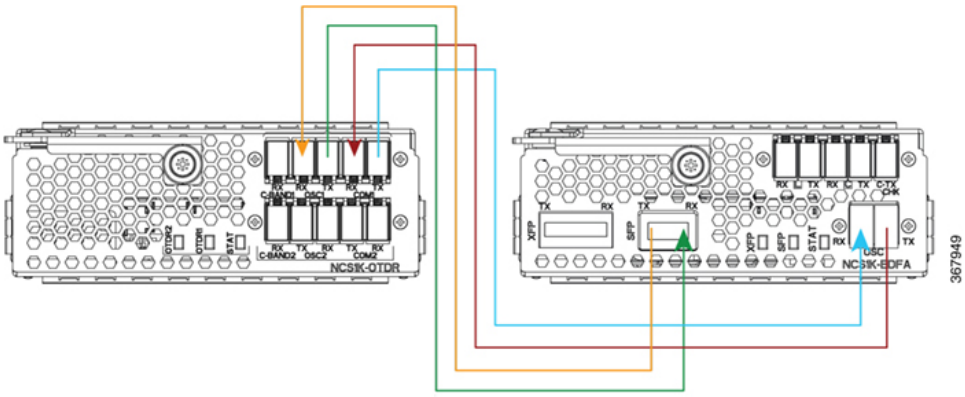
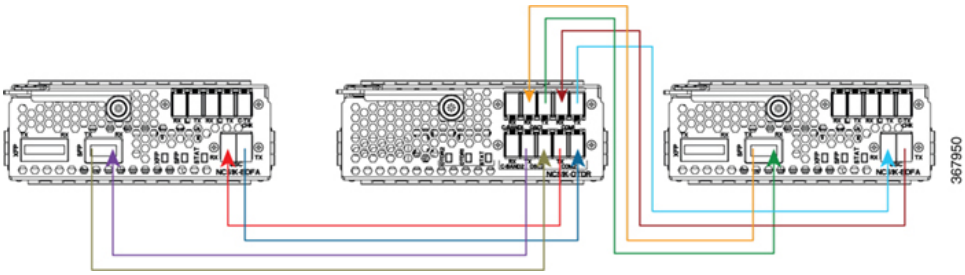


Figure 3: Cabling for Terminal Configuration with Two EDFA Modules



Cabling Considerations for ILA Node

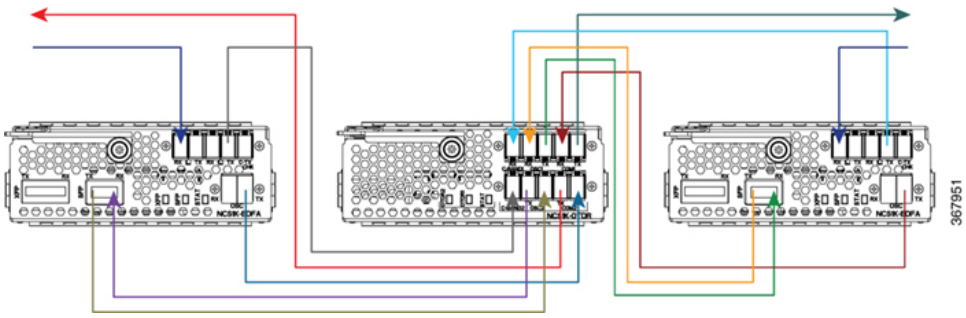
In the ILA node configuration, only one OTDR card is required to support both the directions of ILA node. Two EDFA cards and a single OTDR line card are plugged into the same NCS 1001 system. It is recommended to connect the OTDR port 1 to EDFA in slot 1 and the OTDR port 2 to EDFA in slot 3.

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 4: Cabling for ILA Configuration

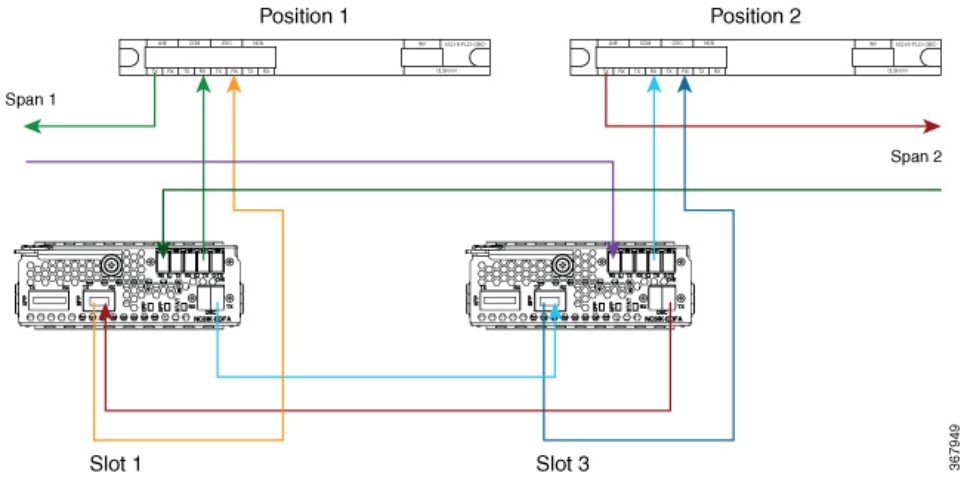


Cabling for ILA Configuration with 15216-FLD-OSC

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 5: 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 2: 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.	0 to 360	180
mode-expert capture-length (in km)	Distance of end point of the measure.	0 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[1]	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[1]	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[1]	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[1]	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[1]	2

[1] From Release 7.5.1, the + labels in the positive range values are removed in the NCS1001 CLI help description.

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 3: 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[2]	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]	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]	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.	1 to 500[2]	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

[2] From Release 7.5.1, the + labels in the positive range values are removed in the NCS1001 CLI help description.

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

Configure OTDR Measurement in Automatice Mode with IPv6

Table 4: Feature History

Feature Name	Release Information	Description
IPv6 Support for OTDR Auto Scan	Cisco IOS XR Release 7.10.1	OTDR auto scan can now be enabled on NCS 1001 nodes configured with IPv6 addresses. This extends to OTDR auto scan functionality to work on both IPv4 and IPv6 nodes.

From Release 7.10.1, you can use IPv6 addresses to perform OTDR automatic scan between the NCS 1001 nodes that are enabled with IPv6 and have IPv6 addresses configured on their management interfaces.

To configure OTDR auto scan using IPv6 addresses for different scenarios, replace the keywords **local-ipv4** and **remote-ipv4** with **local-ipv6** and **remote-ipv6** respectively, and the corresponding IPv4 address variables to IPv6 address variables in the IPv4-based commands.

Note With the IPv6 support, the OTDR auto scan must be configured using either IPv4 or IPv6 address. Both these addresses should not be used at the same time in the configuration.

Limitation

OTDR measurement with IPv6 is not supported on the OSC management interfaces because, even with the OSPFv3 protocol, the discovery of the neighbor returns the IPv4 router ID instead of the IPv6 router ID. This makes it difficult to resolve the IPv6 addressing automatically.

OTDR Automatic Events System Setup

OTDR modules can be deployed in 4 different scenarios:

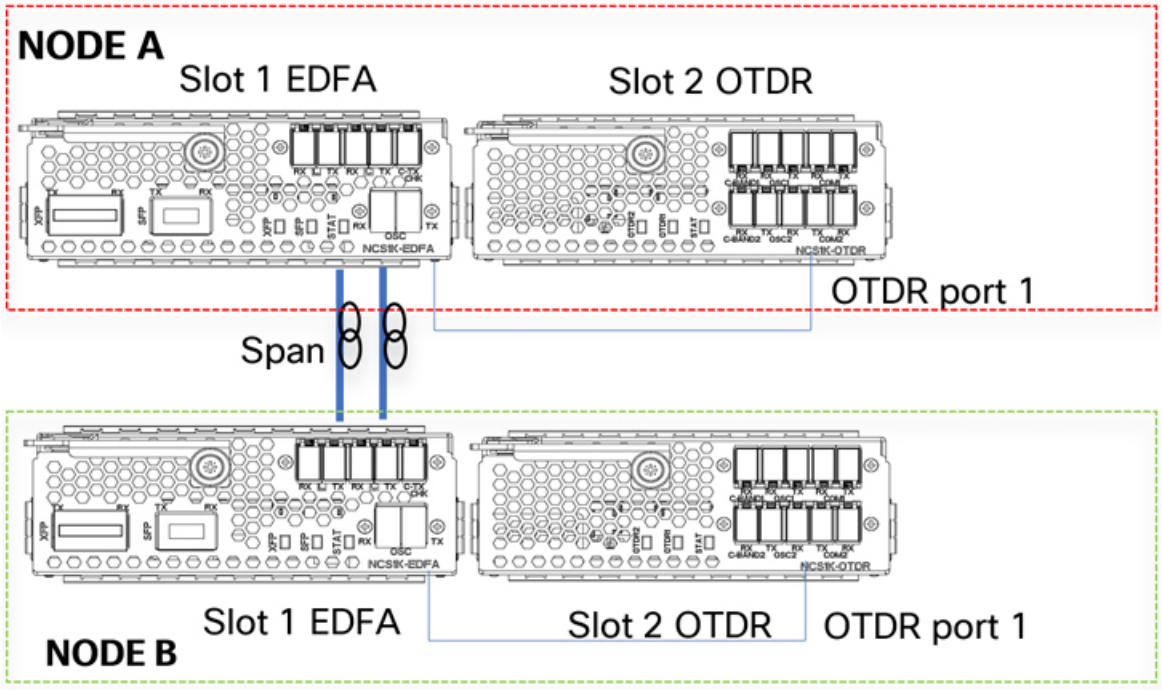
1. Scenario 1: Node A connected to Node B and each node has its own OTDR module
2. Scenario 2: Node A connected to Node B with single OTDR module in one of the two nodes (A or B)
3. Scenario 3: Node A connected to Node B with single OTDR module installed in a different Node C
4. Scenario 4: Node A connected 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 6: 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*

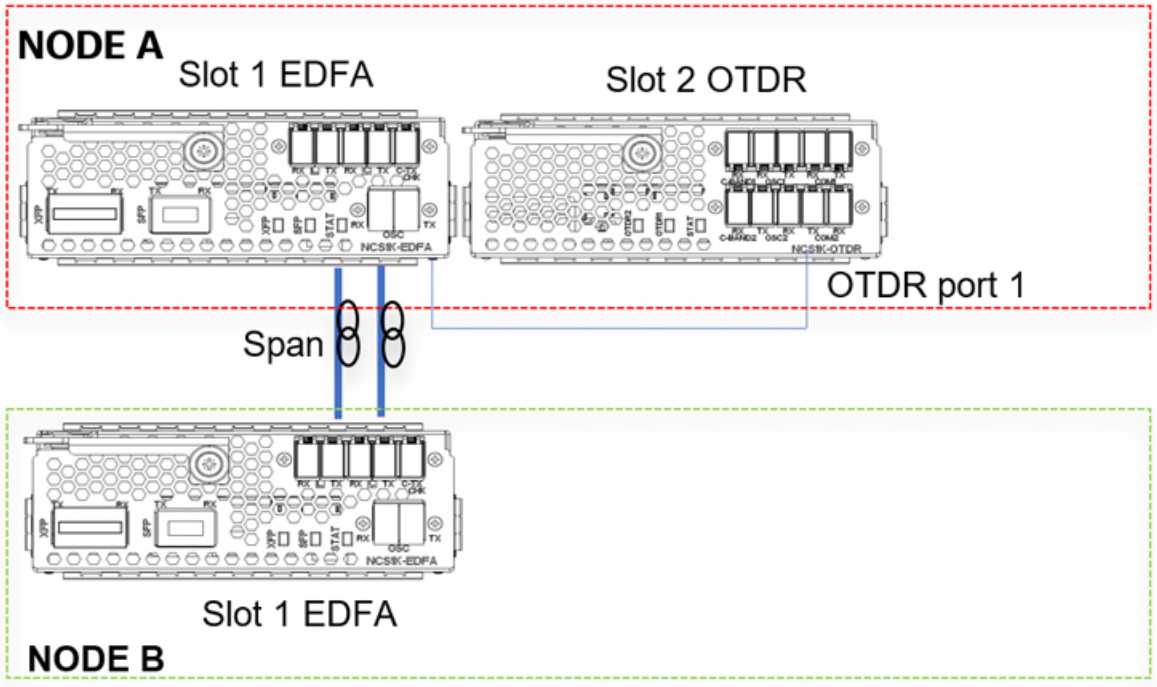
Node B:

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 7: 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:

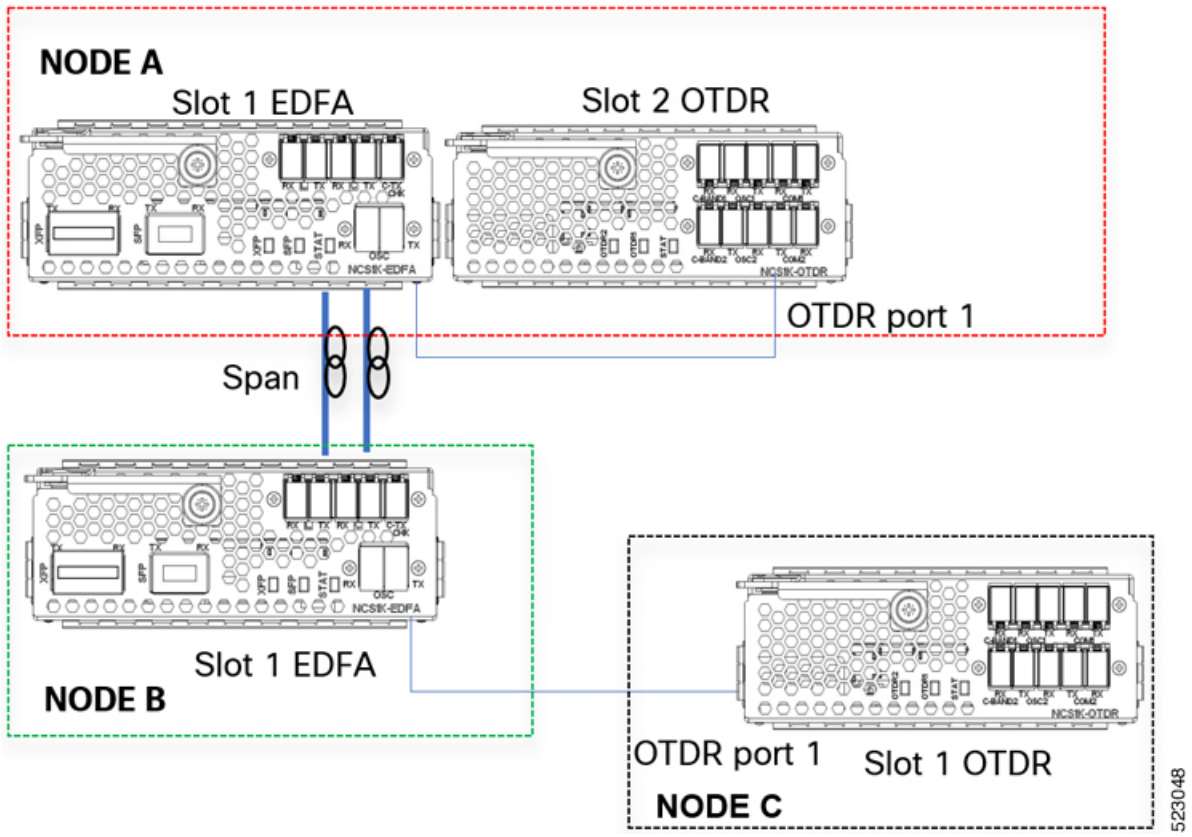
hw-module location 0/RP0/CPU0 slot 2 otdr port 1 otdr-autoscan otdr-module-ipv4-addr ***<IP Node A>*** *ampli-far-end-ipv4-addr* ***<IP Node A>*** *ampli-far-end-slot-id 1 scan-type AUTO*

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 8: 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*

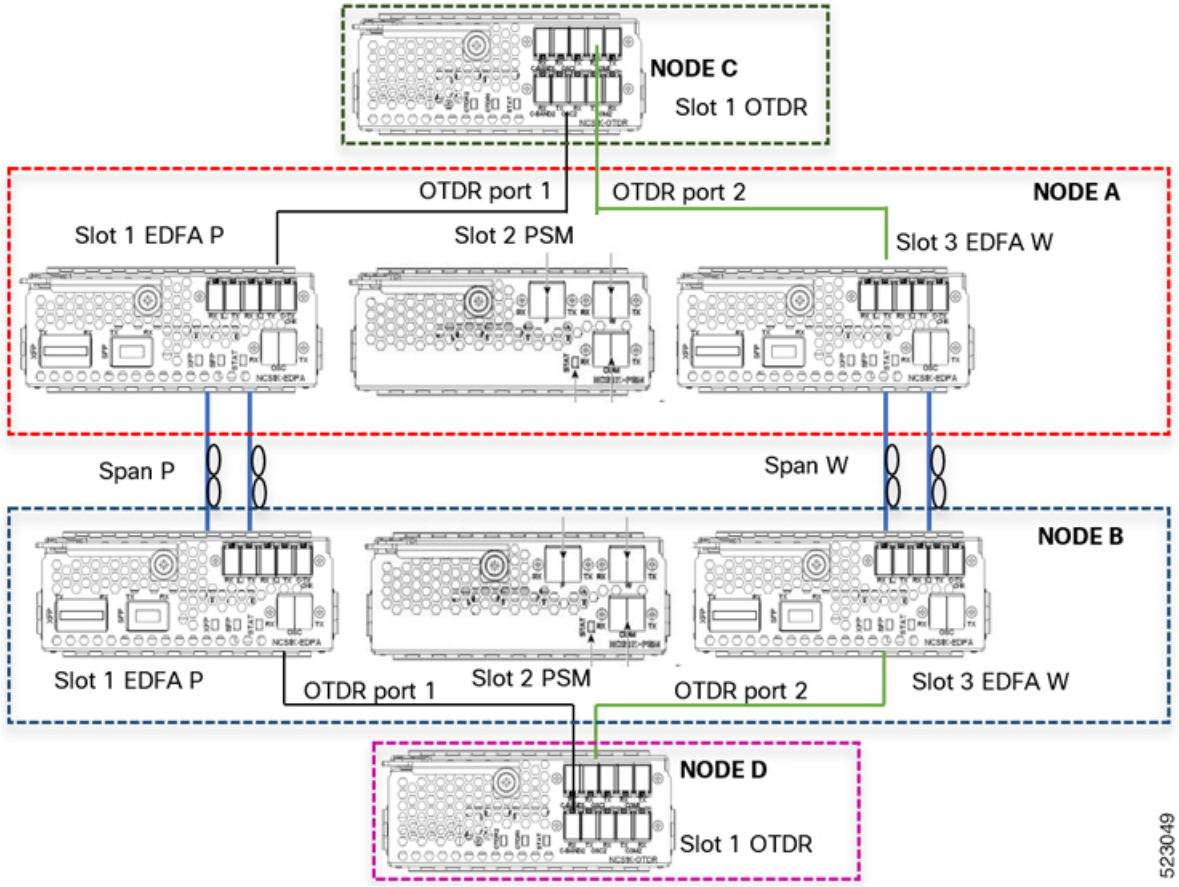
Node C:

*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 9: 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
```

```
configure
hw-module location 0/RP0/CPU0 slot 3 ampli
otdr-autoscan
otdr-module-ipv6-addr 2001:DB8:4491:2000::229:144
otdr-slot-id 2
otdr-port-id 1
ampli-far-end-ipv6-addr 2001:DB8:4491:2000::228:145
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
hw-module location 0/RP0/CPU0 slot 2 otdr port 1
otdr-autoscan
otdr-module-ipv6-addr 2001:DB8:4491:2000::229:144
ampli-far-end-ipv6-addr 2001:DB8:4491:2000::228:145
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 5: OTDR Configuration Parameters in Expert Mode

Parameter	Description	Range	Default
capture-length (in km)	Distance of end point of the measure.	0 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[3]	6
measure-time (in sec)	Time required to perform the complete optical scan.	0 to 360	180

Parameter	Description	Range	Default
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.	0 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[3]	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[3]	2

[3] From Release 7.5.1, the + labels in the positive range values are removed in the NCS1001 CLI help description.

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).
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).

Field	Description
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.
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 6: 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 7: 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.