Configure OTDR

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OTDR

Table 1: Feature History

Feature Name	Release Information	Feature Description
ONS-QSFP-OTDR pluggable	Cisco IOS XR Release 25.1.1	The ONS-QSFP-OTDR is a Q-DD form factor module that plugs into port 6 of the NCS1K14-EDFA2 line card, within the NCS1014 Chassis. With this pluggable, you can conduct a manual scan to assess and diagnose the condition and performance of an optical fiber network. CLI commands are: • **otdr-start controller ots** *R/S/I/P* **{rx|tx}** • **otdr-stop controller ots** *R/S/I/P* **{rx|tx}**

ONS-QSFP-OTDR pluggable

The ONS-QSFP-OTDR is an Optical Time-Domain Reflectometer (OTDR) for the EDFA2 card. It performs these functions:

1. Identifies events or faults along a fiber link by sending a series of very short optical pulses into the fiber under test and detecting the Rayleigh backscatter caused by these pulses at various points along the fiber.
2. Measures the strength of the returning pulses, integrates them over time, and represents the data as a function of the fiber's length.
3. Monitors real-time measurements of loss and back reflection for the fiber pair connected to the TX and RX ports.

SOR file

You can view the OTDR measurement results in the Standard OTDR Record (SOR) file. The SOR file contains the fiber trace details such as the distance, reflectance, loss, and fiber attenuation measurements.

Benefits of OTDR

The OTDR offers several key benefits, including:

- **Quality of the fiber:** Assesses the quality of the fiber during system installation, before any traffic is active.

- **Monitoring during operation:** Monitors the fiber during system operation (live traffic) and check the fiber during cable cuts and repairs.
- **Attenuation measurement:** Measures the attenuation (dB) of the entire fiber link and the attenuation of individual sections of fiber.
- **Distance and magnitude of losses:** Determine the distance and magnitude of insertion loss and reflection loss.
- **Fiber events detection:** Identify fiber events such as concentrated loss events, reflection events, events at the end of the fiber, and discontinuities or defects on the fiber such as fiber pinch, and fiber cut, loss events such as loss due to fiber splicing, patch panel, and coupler connections.

Limitations of OTDR

The pluggable has these limitations:

- The OTDR scan is supported only on the LINE OTS controller.
- The scan is conducted separately for OTS controller in the RX or TX fiber direction.

OTDR modes

In NCS 1014, OTDR works in two modes:

- Auto
- Expert

Auto mode

The device automatically selects the optimal values for OTDR pulse width, scan duration, capture start time, and capture end time parameters. This is the default mode and does not require explicit configuration. However, you can manually configure the other scan parameters if needed.

Expert mode

You must manually configure all OTDR scan parameters with the required valid values for measurement. Automatic adjustments are not performed in this mode.

OTDR negotiation

Table 2: Feature History

Feature Name	Release Information	Feature Description
OTDR negotiation	Cisco IOS XR Release 25.2.1	The OTDR scan process has been enhanced to include negotiation with a remote peer before initiating the scan. This negotiation helps prevent simultaneous scans on the same fiber, thereby avoiding measurement conflicts and ensuring accurate scan results. The force option can be used to start a scan without negotiation. However, it should be used carefully to avoid simultaneous scans between the near-end and far-end nodes on the same fiber. Command modified: The keyword **force** has been added to the **otdr-start controller ots** *R/S/I/P direction* command.

OTDR scan process enhancement

The OTDR scan process has been enhanced to incorporate negotiation with a remote peer before initiating the scan. The OTDR negotiation is a process carried out through a network message handshake between two adjacent nodes, both equipped with OTDR devices. In this procedure, a node can initiate an OTDR scan only after confirming that the adjacent node is not planning to start its own OTDR scan on the same fiber.

Advantage

The OTDR negotiation helps prevent simultaneous scans on the same fiber, thereby avoiding measurement conflicts and ensuring accurate scan results.

How OTDR negotiation works

To ensure an efficient and conflict-free OTDR scan process, the local node follows these steps:

1. Before starting any OTDR scan, the local node checks if the fiber is available for scanning.
2. The local node verifies whether there is an ongoing scan from the remote node.
3. If no scan is currently running on the fiber, the local node requests a remote span reservation.
4. If the remote node acknowledges the remote span reservation, the local node initiates the scan.

   This process prevents conflicts between peer node scans.

Note If the link between the nodes is down or OSC pluggable is missing, the negotiation cannot occur, and the scan request will fail. In this scenario, you can still initiate an OTDR scan without negotiation. See Start the OTDR scan manually, on page 7.

Configure the OTDR scan parameters for auto and expert modes

Follow these steps to configure the various parameters for the OTDR scan. If you do not configure the OTDR scan parameters, the NCS 1014 device uses the default values for OTDR scan parameters.

Procedure

Step 1 Enter the OTS controller configuration mode for the port on which you want to configure the OTDR parameters.

Example:

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

Step 2 Enter the OTDR mode.

If you want to configure the	then run the command
Expert mode	`RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert`
Auto mode	Auto mode is the default and does not require explicit configuration.

Step 3 Set the required parameters for the OTDR scan. See OTDR scan parameters for auto and expert modes, on page 5 for the complete list of OTDR parameters, commit, and exit the configuration.

Example:

```
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx auto reflectance-threshold -50
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx auto splice-loss-threshold 0.2
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx expert pulse-width 6000
RP/0/RP0/CPU0:ios(config-Ots)#commit
RP/0/RP0/CPU0:ios(config-Ots)#exit
RP/0/RP0/CPU0:ios(config)#exit
```

OTDR scan parameters for auto and expert modes

This table provides an overview of key OTDR parameters, including their definitions, measurement units, range of values and the default values for Auto and Expert modes.

Table 3: OTDR scan parameters in Auto mode

Parameter	Description	Unit	Range	Default
otdr { rx | tx} auto reflectance-threshold <*value*>	Threshold beyond which a reflective anomaly is reported as an event in the Rx or Tx direction.	dB	–50 to –10	–40
otdr { rx | tx} auto splice-loss-threshold <*value*>	Threshold beyond which a loss anomaly is reported as an event in Rx or Tx direction.	dB	0.2 to 5	0.35
otdr { rx | tx} auto excess-reflection-threshold <*value*>	Threshold beyond which a reflective event is reported as an excessive reflection event in the Rx or Tx direction.	dB	–50 to –23	–23
otdr { rx | tx} auto back-scattering <*value*>	The back scattering value in the Rx or Tx direction.	dB	–90 to –70	–81.87
otdr { rx | tx} auto refractive-index <*value*>	The refractive-index value in the Rx or Tx direction.	—	1.000 to 2.000	1.4682
otdr { rx | tx} auto excess-orl-threshold<*value*>	Threshold below which OTDR-ABS-ORL-EXCEEDED alarm is reported in the Rx or Tx direction.	dB	10 to 60	60
otdr { rx | tx} auto excess-attenuation-threshold<*value*>	Threshold beyond which a Non-Reflective event is reported as an excessive attenuation event in the Rx or Tx direction.	dB	0.5 to 99	5
otdr { rx | tx} auto end-of-fiber-loss-threshold <*value*>	Threshold based on which the OTDR identifies the fiber's end, distinguishing it from other components like splices or connectors.	dB	0.5 to 31.0	5.0

Table 4: OTDR scan parameters in Expert mode

Parameter	Description	Unit	Range	Default
otdr {rx | tx} expert pulse-width <*value*>	Pulse width to be used during the expert scan in the Rx or Tx direction.	ns	8 to 50000	20000

Parameter	Description	Unit	Range	Default
otdr {rx | tx} expert capture-end<*value*>	OTDR capture endpoint during the expert scan in the Rx or Tx direction.	cm	0 to 11900000	11900000
otdr {rx | tx} expert capture-start <*value*>	OTDR capture start point during expert scan in the Rx or Tx direction	cm	0 to 11900000	0
otdr {rx | tx} expert scan duration<*value*>	OTDR scan duration during expert scan in the Rx or Tx direction.	seconds	0 to 360	180

Start the OTDR scan manually

Follow these steps to start the OTDR scan manually to perform these procedures:

1. Identify the defect after the fiber has been cut.
2. Check the fiber quality after correcting the fiber defect.
3. Initiate an OTDR scan at the time of installation.

Before you begin

Perform the patchcord connect check before starting the manual scan.

Procedure

Step 1 Use the **otdr-start controller ots** *R/S/I/P direction* to start the OTDR scan manually.

Example:

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/3/0/0 tx
Tue Jan 7 04:14:13.712 UTC
OTS OTDR Scan Started at TX

RP/0/RP0/CPU0:ios#otdr-start controller ots 0/3/0/0 rx
Tue Jan 7 04:33:33.326 UTC
OTS OTDR Scan Started at RX
```

Step 2 Use the `force` keyword, to run the manual OTDR scan operation without negotiating with the peer or when the communication channel is not up.

Example:

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx force
Wed Sep 4 08:78:34.186 UTC
OTS OTDR Scan Started at RX
RP/0/RP0/CPU0:ios#
```

The forced **otdr-start** command can fail immediately if the OTDR is already performing a scan on any of the four possible spans associated with the ports (0-TX, 0-RX, 2-TX, 2-RX). In such cases, you may encounter the following error message:

OTDR Scan cannot be started as another scan is in progress.

To resolve this issue, we recommend waiting for the ongoing scan to complete before attempting to restart the OTDR scan.

View the OTDR measurements

Follow these steps to view the OTDR scan measurement results.

Procedure

Use the command **show controllers ots** *R/S/I/P* **otdr-info** *direction* to view the OTDR scan measurements.

Example:

```
RP/0/RP0/CPU0:ios#show controllers ots 0/3/0/0 otdr-info rx
Tue Jan  7 04:37:46.711 UTC
Scan Direction: RX
Scan Status: Data Ready
Optical Return Loss: -90.6 dB
SOR file: /harddisk:/otdr/R1_OTDR_Ots0_3_0_0_RX_20250107-043559.sor
Total Events detected: 1
Scan Timestamp: Tue Jan  7 04:33:33 2025 UTC
Event Type Legend:  NR:Non-Reflective  R:Reflective  FE:Fiber-End  ER:Excess-Reflection
EA:Excess-Attenuation
Event#      |  Detected Event(s)       |  Location(m)     |  Accuracy(m)     |  Magnitude(dB)   |
Attenuation/km(dB)
1           |  NR FE                   |  11.9100         |  34.44           |  5.53            |
0.30
```

After you upgrade the FPD of the line card, you may not be able to view the previous OTDR scan results using the **show controllers ots** *Rack/Slot/Instance/Port* **otdr-info** *direction*. To access results from previous OTDR scans, locate the .SOR files in the hard drive.

Excessive Reflection (ER) and Excess Attenuation (EA) events and alarms can be dynamically raised or cleared by modifying their respective threshold values. However, Fiber End (FE) and Reflectance (R) events can be raised or cleared by changing the respective thresholds and re-running the OTDR scan.

See OTDR scan status, on page 12 for a list of the different OTDR scan statuses and their definitions.

Stop the OTDR scan manually

Folow this step to stop the OTDR scan manually.

Procedure

Use the command **otdr-stop controller ots** *R/S/I/P direction* to stop the OTDR scan manually.

Example:

```
RP/0/RP0/CPU0:ios#otdr-stop controller ots 0/3/0/0 rx
Wed Feb  9 06:03:37.406 UTC
OTS OTDR Scan Stopped at RX
RP/0/RP0/CPU0:ios#
```

Automatic bidirectional OTDR scan

Table 5: Feature History

Feature Name	Release Information	Feature Description
Automatic OTDR scan	Cisco IOS XR Release 25.2.1	An OTDR scan is automatically triggered on both Rx and Tx directions, whenever events such as span fault, span restore, device power cycle, and line card cold reload occur. The automatic scan lets you quickly identify fiber failure type and fault location, while avoiding any collision during the bidirectional autoscan. Commands added to enable auto OTDR scan and view its results: • **otdr auto-scan {enable | disable}** • **show olc otdr-status [details]**

Automatic OTDR scan triggering events

The OTDR scan, starts automatically when events like span fault, span restoration, automatic OTDR scan enabling, device power cycling, and line card cold reload occur.

Autoscan direction and duration

The OTDR autoscan scans events in both Tx and Rx directions.

In both span up and span down events, the bidirectional OTDR scan process terminates after both Rx and Tx scans have been completed successfully. You can stop the scan sequence by disabling the autoscan feature.

The autoscan duration for Auto and Expert modes, the scan takes upto three minutes to complete. . During the autoscan, the OTDR-SCAN-IN-PROGRESS-RX and OTDR-SCAN-IN-PROGRESS-TX alarms are raised and get cleared once the scan is finished.

Autoscan behavior

The autoscan has these key behaviors:

- The autoscan reserves the span on the peer node and locks the OTDR resource to prevent manual triggering of a scan using the **otdr-start** command . However, if a manual scan is already in progress, the autoscan will wait until the manual scan is completed before proceeding.
- The **autoscan** terminates the ongoing scan and starts a new one if a change in **Span Status** is detected.

Span fault and restoration events detection

This table details how the span fault and span restore events are detected:

Table 6: Definition of span up and span down events

Events	Definition
Span Down	Raise of OSC-LOS and EDFA_RX_LOS alarms at the OSC controller
Span Up	Clearing of OSC-LOS and EDFA_RX_LOS alarms at the OSC controller

How the bidirectional autoscan works

This section explains how the bidirectional OTDR auto scan functions in the event of unidirectional and bidirectional fiber cuts, and during fiber restoration events.

Unidirectional and bidirectional fiber cuts

In a span including both broken and non-broken fibers, the scanning behavior differs based on the type of fiber cut:

- **Unidirectional Fiber Cut**:
  - The broken fiber is scanned in both the Rx and Tx directions by the Near End (NE) and Far End (FE) nodes.
  - The non-broken fiber is scanned only in the Tx direction.
- **Bidirectional Fiber Cut**:
  - Both fibers are scanned in both the Rx and Tx directions.

Span down event

For a bidirectional autoscan triggered by a span down event:

- Timeslots are used for both unidirectional and bidirectional fiber cuts as the node communication and hence negotiation is not possible.
- Timeslots are of equal duration and are alternately assigned to Rx and Tx directions. This order is consistent across both NE and FE node.
- If a scan cannot be completed inside the assigned timeslot or the scan execution failed for any reason, the execution is rescheduled at the next available timeslot for that port/direction.

Span up event

For a bidirectional autoscan triggered by a span up event:

- Rx and Tx scans are executed sequentially through negotiation with the remote node, eliminating the need for time slots.

  The OSC and associated Ethernet communication must be functioning properly to initiate the scan.

In both span up and span down events, the bidirectional OTDR scan process terminates after both Rx and Tx scans have been completed successfully. You can stop the scan sequence by disabling the autoscan feature.

Enable automatic OTDR scan

Follow these steps to enable OTDR scan to run automatically during certain events.

Procedure

Step 1 Enter the OTS controller configuration mode for the port you want to configure the automatic OTDR scan.

Example:

```
RP/0/RP0/CPU0:ios#configure
RP/0/RP0/CPU0:ios(config)#optical-line-control controller Ots 0/0/0/0
```

Step 2 Enable automatic OTDR scan.

Example:

```
RP/0/RP0/CPU0:ios(config-olc-ots)#otdr auto-scan enable
```

If you want to disable the automatic OTDR scan, use the **otdr auto-scan disable** command.

Step 3 Commit the changes and exit all the configuration modes.

Example:

```
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
```

Verify autoscan status

Use this task to verify the status of the autoscan.

Procedure

Use the command **show olc otdr-status [details]** to view the automatic OTDR scan results.

Example:

```
RP/0/RP0/CPU0:R1#show olc otdr-status
Tue Oct 10 20:15:57.359 UTC

Controller                : Ots0/0/0/0
OTDR Auto-scan Status     : RUNNING
Status Detail : Completed on Span Down.
Auto-scan Rx Start Time   : 2023-10-10 20:12:01
Rx Status Detail          : Completed on Span Down
Auto-scan Tx Start Time   : 2023-10-10 20:14:31
Tx Status Detail          : Waiting for OTDR Resource
Optical Span Status       : Up
Trigger Event             : Manual
Last Trigger Event        : Manual
```

See OTDR scan status, on page 12 for a list of the different OTDR scan statuses and their definitions.

OTDR scan status

This table explains the various status of the OTDR measurements that are displayed for the **show olc controller ots R/S/I/P otdr-status** and **show controller ots R/S/I/P otdr-info** commands.

Table 7: OTDR scan status

Scan status	Description
Measuring	OTDR scan is currently in progress.
Data Processing	OTDR is processing data just before populating the event table.
Data Ready	OTDR scan has completed and the data is ready for review
Stopped	OTDR scan is stopped by the user, when it is in progress.

Scan status	Description
Error	The OTDR status may occasionally enter an Error state due to various unpredictable reasons. One possible cause is a timeout event, which happens if the scan does not complete within five minutes. In such cases, no SOR files or event table are generated. However, it is important to note that this is a rare occurrence, and you can still reinitiate the OTDR scan to obtain the results. Another possible cause is high loss and reflection on the patch cord connecting the OTDR pluggable to the connector on the front panel.
Waiting Span Reservation	Waiting for remote OTDR span reservation (a span reservation request has been sent but no answer is received yet or the remote node is busy). **Note** This status may be visible even during the non-negotiated OTDR scan that is initiated using the `force` option.
Timeout	Scan has not ended within the expected time.
Communication Failed or Communication Failed, retrying in less than x minutes	Not able to reserve the span due to link down after a specified time, and scan will be retried after sometime.
Local Resource Not Available	Local resource is busy after a specified time.
Span Reservation Failed or Span Reservation Failed, retrying in less than x minutes	Remote resource is busy after a specified time, and scan will be retried after sometime.
OTDR Resource Not Available, or OTDR Resource Not Available, retrying in less than x minutes	Local OTDR resource is busy, and scan will be retried after sometime.

This table explains the various OTDR scan statuses that are applicable for manual and autoscan.

Table 8: OTDR scan status applicable for manual and autoscan

Type of OTDR scan	Scan Status	
	show olc controller ots R/S/I/P otdr-status	**show controller ots R/S/I/P otdr-info**
Manual	NA	• Measuring • Data Processing • Data Ready • Stopped • Error • Waiting Span Reservation • Timeout • Communication Failed • Local Resource Not Available • Span Reservation Failed • Scan Not Allowed
Autoscan	• Measuring • Data Processing • Data Ready • Stopped • Error • OTDR Resource Not Available, or OTDR Resource Not Available, retrying in less than x minutes • Waiting Span Reservation • Timeout • Communication Failed or Communication Failed, retrying in less than x minutes • Local Resource Not Available • Span Reservation Failed or Span Reservation Failed, retrying in less than x minutes • Scan Not Allowed	• Measuring • Data Processing • Data Ready • Stopped • Error • Waiting Span Reservation

OTDR baseline

Table 9: Feature History Table

Feature Name	Release Information	Description
OTDR baseline	Cisco IOS XR Release 25.2.1	OTDR saves a baseline with the scan results the first time a link is up. This baseline captures essential data about the fiber characteristics at the time of initial installation. The baseline is used as a benchmark for future OTDR scans to identify changes or degradation in the optical fiber span, facilitating maintenance and troubleshooting efforts. It helps verify the integrity and performance of the optical network over time.

An OTDR baseline is the initial set of OTDR scan results that are saved as a reference point for evaluating the condition and performance of an optical fiber span over time. It captures essential data about the fiber characteristics at the time of initial installation or configuration, including:

- **SOR filename**: The filename of the SOR file that documents the scan results.
- **Optical Return Loss (ORL)**: Measurement of the reflected optical power, indicating the quality of the fiber connection.
- **Detected events**: Any anomalies, reflections, or changes detected during the scan, such as splices, bends, or breaks.
- **Scan timestamp**: The specific date and time when the baseline scan was performed.

You can find the OTDR baseline SOR files in the `/harddisk:/otdr/baseline` directory.

Purpose of the baseline

The baseline is used as a benchmark for future OTDR scans to identify changes or degradation in the optical fiber span, facilitating maintenance and troubleshooting efforts. It helps verify the integrity and performance of the optical network over time.

Baseline creation

- The OTDR baseline is saved after the automatic OTDR scan when the link is up for the first time.
- If the OTDR-ABS-REFLECTANCE-EXCEEDED-TX or OTDR-ABS-REFLECTANCE-EXCEEDED-RX alarms are active on a link, the OTDR baseline is not saved. In such cases, clear the alarm and save the baseline manually.

Baseline storage location

Save a new OTDR baseline

You can manually set the current OTDR scan results as a baseline for several reasons:

- The OTDR-ABS-REFLECTANCE-EXCEEDED alarm is active and the system did not save the baseline during the initial scan.
- When upgrading or expanding the network, it may be necessary to save a new baseline.

You must run an OTDR scan again to save a new baseline.

Procedure

Step 1 Enter the **otdr-start controller ots** *R/S/I/P* **rx|tx** command to start the OTDR scan manually.

Example:

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx
Wed Feb 9 05:49:39.178 UTC
OTS OTDR Scan Started at RX
```

Step 2 Enter the **otdr save baseline controller ots** *R/S/I/P* **rx|tx** command to set the current OTDR scan results as the baseline.

Example:

```
RP/0/RP0/CPU0:ios#otdr save baseline controller ots 0/0/0/0 rx
```

Example:

This sample output is an example of a failure to save a baseline.

```
RP/0/RP0/CPU0:P2B_DT_04#otdr save baseline controller ots 0/0/0/0 tx
Thu Apr  3 17:38:02.833 +0530
'optics' detected the 'warning' condition 'OTDR baseline cannot be saved due to unavailability of
scan results'
```

View OTDR baseline

Follow this step to view the OTDR baseline.

Procedure

Enter the **show controller ots** *R/S/I/P* **otdr-info tx|rx baseline** command to view the OTDR baseline.

Example:

```
RP/0/RP0/CPU0:ios#show controller ots 0/1/0/0 otdr-info rx baseline
Mon May 19 16:27:41.912 IST

        Display Baseline Info:
```

```
        Scan Direction: RX

        Scan Status: Data Ready

        Optical Return Loss: 48.0 dB

        SOR file: /harddisk:/otdr/baseline/kepler-230-220_OTDR_Ots0_1_0_0_RX_20250319-093155.sor

        Total Events detected: 6

        Scan Timestamp: Wed Mar 19 09:29:19 2025 UTC

        Event Type Legend:  NR:Non-Reflective  R:Reflective  FE:Fiber-End  ER:Excess-Reflection
EA:Excess-Attenuation

        Event#      |  Detected Event(s)       |  Location(m)     |  Accuracy(m)     |  Magnitude(dB)
   |  Attenuation/km(dB)
           1           |  NR EA                   |  2106.8600       |  34.44           |  24.48
     |  0.00
           2           |  NR                      |  5250.7200       |  501.86          |  1.17
     |  0.14
           3           |  NR                      |  6416.0500       |  501.86          |  0.39
     |  0.30
           4           |  NR                      |  10208.9400      |  501.86          |  2.54
     |  0.00
           5           |  R FE                    |  22424.7200      |  1000.78         |  -26.08
     |  0.14
           6           |  NR FE                   |  22424.7200      |  4756.43         |  3.50
     |  0.14
```