

Configure OTDR

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ONS-QSFP-OTDR pluggables

An ONS-QSFP-OTDR pluggable is an optical time-domain reflectometer (OTDR) module that

- uses a Q-DD form factor and plugs into port 6 of the NCS1K14-EDFA2 line card within the NCS1014 chassis,
- enables manual scans to assess and diagnose the condition and performance of an optical fiber network, and
- identifies fiber faults and events by sending short optical pulses and measuring the Rayleigh backscatter along the fiber.

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}**

An ONS-QSFP-OTDR pluggable is designed for use with the EDFA2 card and provides real-time measurements of loss and back reflection for the fiber pair connected to the TX and RX ports.

SOR file

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

Benefits

ONS-QSFP-OTDR pluggables offer several benefits:

- Assess the quality of the fiber during system installation, before any live traffic run.
- Monitor the fiber link during operation, including live traffic. You can also monitor the fiber link during troubleshooting after cable cuts or repairs.
- Measure attenuation over the entire fiber link and across individual fiber sections.
- Determine the distance and magnitude of insertion loss and reflection loss.
- Detect fiber events, including concentrated loss events, reflection events, end-of-fiber events, and discontinuities or defects such as pinches or cuts. The OTDR pluggable can also detect loss events from splicing, patch panel connections, and couplers.

Limitations

The ONS-QSFP-OTDR pluggable has these limitations:

- The OTDR scan feature is supported only on the LINE OTS controller.

- Scans are conducted separately for the OTS controller in the RX direction or TX 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 negotiations

An OTDR negotiation is a network coordination process that

- uses a message-based handshake between two adjacent network nodes equipped with OTDR devices,
- ensures that only one node may initiate an OTDR scan at a time to prevent simultaneous scans on the same fiber, and
- helps avoid measurement conflicts to ensure accurate scan results.

You can use **force** option in the command **otdr-start controller ots** *R/S/I/P* to bypass negotiation during the OTDR scan process.

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.

Advantage

OTDR negotiations help 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

Parameter	Description	Unit	Range	Default
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
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

Parameter	Description	Unit	Range	Default
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

Use this procedure to manually initiate the OTDR scan to diagnose fiber defects, check fiber quality, or verify proper installation.

Before you begin

Perform the patch cord connection 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, this error message may appear:

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

To resolve this issue, wait before attempting to restart the OTDR scan until the ongoing scan is complete.

The OTDR scan is initiated manually on the selected direction. If a scan is already in progress, wait for it to finish before restarting.

What to do next

- Review the OTDR scan results to verify fiber integrity or detect anomalies.
- If any issues are identified, take corrective action.

View the OTDR measurements

Use this procedure 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 earlier OTDR scans, locate the .SOR files on the hard disk.

You can dynamically raise or clear Excessive Reflection (ER) and Excess Attenuation (EA) events and alarms by modifying their respective threshold values. In contrast, to raise or clear Fiber End (FE) and Reflectance (R) events, change the relevant thresholds and rerun 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

Use this procedure to stop the OTDR scan manually.

Procedure

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

Example:

```
RP/0/RP0/CPU0:ios#otdr-stop controller ots 0/0/0/0 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 section describes and explains the various OTDR statuses that appear when using 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 scan has completed, and the data is ready for review
Data Ready	OTDR scan is stopped by the user, when it is in progress.
Stopped	OTDR is processing data just before populating the event table.
Error	The OTDR status may occasionally enter an Error state for various unpredictable reasons. One possible cause is a timeout event, which occurs if the scan is not completed within five minutes. In such cases, no SOR files or event table is generated. It is important to note that this is a rare occurrence. You can still initiate the OTDR scan to obtain the scan results.
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	The scan did not finish within the expected time.

Scan status	Description
Communication Failed or Communication Failed, retrying in less than x minutes	The system cannot reserve the span due to a link failure after a specified time. The scan will be retried after some time.
Local Resource Not Available	The local resource is busy after a specified time.
Span Reservation Failed or Span Reservation Failed, retrying in less than x minutes	The 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	The 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

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
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

Set the current OTDR scan results as a baseline in these situations.

- The OTDR-ABS-REFLECTANCE-EXCEEDED alarm is active. The system did not save the baseline during the initial scan.
- OTDR scan status is:
  - **Unknown**
  - **Stopped**, or
  - **Error**
- If you upgrade or expand the network, you may need to save a new baseline.

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

Procedure

Step 1 Use 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 Use 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'
```

The system saves the current OTDR scan as the new baseline. If scan results are unavailable, the system displays an error and the baseline is not saved.

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
```