

Optical Time Domain Reflectometer

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Fiber link monitoring and diagnostics using OTDR

An Optical Time Domain Reflectometer (OTDR) is a fiber optic measurement device that

- captures real-time data on loss and back reflection across fiber links,
- performs bidirectional analysis by connecting to both transmitter (TX) and receiver (RX) ports, and
- enables assessment and ongoing monitoring of fiber quality and performance.

The NCS 1010 OLT and ILA nodes feature in-built bidirectional OTDR functionality, allowing them to measure loss and back reflection in real time for fiber pairs linked to the TX and RX ports. For the OLT device, the OTDR port can switch between LINE-TX and LINE-RX ports. For the ILA device, the OTDR port can switch among LINE-1-TX, LINE-1-RX, LINE-2-TX, and LINE-2-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.

You can export the SOR file from NCS 1010 using the command: **scp username@device-ip:filename_with_source_location destination-location**.

Example:

```
scp test@192.168.0.1:/harddisk:/otdr/ios_OTDR_Ots0_0_0_0_RX_20230301-101927.sor /users/test/
```

Benefits

The OTDR offers several key benefits, including:

- 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.

OTDR modes

OTDR modes are operational configurations that

- determine how scan parameters (like pulse width and scan duration) are selected and applied,
- optimize measurements for different user needs or fiber types, and
- support both automated and manual control for various operational scenarios.

An OTDR can operate in several modes to suit different network testing requirements. Selecting the appropriate mode helps ensure efficient, accurate fiber characterization by adapting OTDR performance to the specific task or fiber segment.

These modes are designed to address different testing needs and operational preferences:

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

Configure the OTDR scan parameters

Use this procedure to configure the parameters for the OTDR scan. If you do not configure the parameters, the NCS 1010 device uses the default values.

Procedure

Step 1 Enter the OTS controller configuration mode for the port where 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 this command
Expert mode	`RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert`
Auto mode	Auto mode is the default and you do not need to configure it

Step 3 Set the required parameters for the OTDR scan. For a complete list of OTDR parameters, refer to OTDR scan parameters, on page 3.

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 200
RP/0/RP0/CPU0:ios(config-Ots)#otdr rx expert pulse-width 6000
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

Step 4 Commit the changes and exit the configuration mode.

Example:

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

What to do next

Start the OTDR scan manually, on page 4.

OTDR scan parameters

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

Table 1: 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 –10	–20
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

Parameter	Description	Unit	Range	Default
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	5–99	5.5

Table 2: 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	5–20000	20
otdr {rx | tx} expert capture-end<*value*>	OTDR capture endpoint during the expert scan in the Rx or Tx direction.	cm	0–15000000	15000000
otdr {rx | tx} expert capture-start <*value*>	OTDR capture start point during the expert scan in the Rx or Tx direction	cm	0–10000000	0
otdr {rx | tx} expert scan duration<*value*>	OTDR scan duration during the expert scan in the Rx or Tx direction.	Seconds	30–180	60

Start the OTDR scan manually

NCS 1010 software does not support automatic start of OTDR scan.

Manually initiate the OTDR scan to diagnose fiber defects, check fiber quality, or verify proper installation.

Note The Raman tuning application locks the OTDR scan at both fiber ends before the tuning starts, and releases the lock after the tuning completes. Therefore, when you try to start the OTDR scan when Raman tuning is running, your request gets rejected.

Procedure

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 0/0/0/0 rx
Wed Feb  9 05:49:39.178 UTC
```

```
OTS OTDR Scan Started at RX
RP/0/RP0/CPU0:ios#
```

This example illustrates a rejected OTDR start request. Once an OTDR scan request has been rejected, it will not automatically run after the lock is released. You will need to create a new request to start the OTDR scan again. These examples show that OTDR scan is locked by Raman tuning:

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx
Tue Feb 28 10:25:43.379 UTC
OTDR Scan cannot be started as it is locked by Another Entity/Application.
RP/0/RP0/CPU0:ios#
```

The OTDR scan initiates and begins analyzing the fiber. If the scan cannot start, an error message states the reason.

What to do next

Review scan results to identify defects and assess fiber quality.

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 0/0/0/0 otdr-info rx
Wed Feb  9 05:55:19.791 UTC
       Scan Direction: RX
       Scan Status: Data Ready
       SOR file: /harddisk:/otdr/IOS_NCS1010_OTDR_Ots0_0_0_0_RX_20220209-055045.sor
       Total Events detected: 11
       Scan Timestamp: Wed Feb  9 05:50:45 2022 UTC
       Event Type Legend:  NR:Non-Reflective  R:Reflective  FE:Fiber-End  ER:Excess-Reflection
      Event#  | Detected Event(s) | Location(km) | Accuracy(m) | Magnitude(dB)| Attenuation/km(dB)
      1       | R                 | 50.4709      | 52.47       | -39.87       |  0.18
      2       | NR                | 50.4709      | 52.47       | 1.17         |  0.18
      3       | R                 | 100.9261     | 102.92      | -37.73       |  0.21
      4       | NR                | 100.9261     | 102.92      | 1.01         |  0.21
      5       | R                 | 105.9500     | 107.94      | -38.52       |  0.24
      6       | NR                | 105.9500     | 107.94      | 0.85         |  0.24
      7       | R                 | 112.7458     | 114.74      | -40.56       |  0.00
      8       | NR                | 112.7458     | 114.74      | 1.48         |  0.00
      9       | NR                | 117.9873     | 119.98      | 0.66         |  -0.02
      10      | R FE              | 120.1206     | 122.12      | -35.55       |  0.00
      11      | NR FE             | 120.1206     | 122.12      | 21.65        |  0.00
```

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.

Stop the OTDR scan manually

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#
```