



## Configure OTDR

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This chapter describes how to configure the Optical Time Domain Reflectometer (OTDR) module in NCS 1020.

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## Overview of OTDR

The NCS 1020 OLT nodes have an in-built bidirectional Optical Time Domain Reflectometer (OTDR) functionality that can run in line with DWDM channels. The OTDR captures real-time measurements of loss and back reflection of the fiber pair linked to the Tx and Rx ports.



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**Note** For the OLT device, the OTDR port can switch between LINE-TX and LINE-RX ports.

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You can use this feature to check the fiber quality during system installation (before traffic is active), especially in case RAMAN is used. It can also be used to monitor the fiber during the system operation (live traffic) and to check the fiber if cable cut and repair events.

You can view the OTDR measurement result in the SOR file that is exported from NCS 1020.

You can determine the following characteristics using OTDR:

- The attenuation (dB) of the whole fiber link and the attenuation of separate sections of fiber.
- The distance and magnitude of insertion loss, reflection loss.
- Fiber events such as concentrated loss events (with value and position), reflection events (with value and position), events at the end of the fiber, and discontinuities or defects on the fiber including loss events.

## OTDR Modes

In NCS 1020, you can configure OTDR in the following two modes:

- Auto—The device selects the optimal values for OTDR pulse width, scan duration, capture start time, and capture end time parameters.
- Expert—You must configure all the OTDR scan parameters with valid values required for the OTDR measurement.




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**Note** Automatic adjustments are not performed in the expert mode configuration.

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Measurement and Data Processing are the two fully automated internal phases in both auto and expert modes that proceed in sequence.

## Configure OTDR

The NCS 1020 device uses the default values for OTDR scan parameters before the OTDR configuration.

You can configure the OTDR on the OTS controller. Use the following commands to configure the various OTDR parameters:

**configure**

**controller ots** *R/S/IP*

**otdr scan-mode expert**

**otdr rx auto reflectance-threshold** *value*

**otdr rx auto splice-loss-threshold** *value*

**otdr rx auto excess-reflection-threshold** *value*

**otdr rx back-scattering** *value*

**otdr rx refractive-index** *value*

**otdr tx auto reflectance-threshold** *value*

**otdr tx auto raman-setpoint** *value*

**otdr tx auto excess-reflection-threshold** *value*

**otdr tx auto splice-loss-threshold** *value*

**otdr tx back-scattering** *value*

**otdr tx refractive-index** *value*

**otdr rx auto excess-orl-threshold** *value*

**otdr tx auto excess-orl-threshold** *value*

**otdr rx auto excess-reflectance-threshold** *value*

**otdr tx auto excess-reflectance-threshold** *value*

**otdr rx auto excess-attenuation-threshold** *value*

**otdr tx auto excess-attenuation-threshold** *value*

**otdr rx expert pulse-width** *value*

**otdr rx expert capture-end** *value*

**otdr rx expert capture-start** *value*

**otdr rx expert scan duration** *value*

**otdr tx expert pulse-width** *value*

**otdr tx expert capture-end** *value*

**otdr tx expert capture-start** *value*

**otdr tx expert scan duration** *value*

**otdr tx expert scan duration** *value*

**Example:**

```
RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
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)#otdr tx auto reflectance-threshold -50
RP/0/RP0/CPU0:ios(config-Ots)#otdr tx auto splice-loss-threshold 200
RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert
RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert
RP/0/RP0/CPU0:ios(config-Ots)#commit

RP/0/RP0/CPU0:ios#config
RP/0/RP0/CPU0:ios(config)#controller ots 0/0/0/0
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)#otdr tx auto reflectance-threshold -50
RP/0/RP0/CPU0:ios(config-Ots)#otdr tx auto splice-loss-threshold 200
RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert
RP/0/RP0/CPU0:ios(config-Ots)#otdr scan-mode expert
RP/0/RP0/CPU0:ios(config-Ots)#commit
```

**Table 1: OTDR Configuration Parameters**

Parameter	Description	Range	Unit	Default
<b>otdr rx auto reflectance-threshold</b>	Threshold beyond which a reflective anomaly is reported as an event in the Rx direction.	-50 to -10	dB	-40

Parameter	Description	Range	Unit	Default
<b>otdr rx auto splice-loss-threshold</b>	Threshold beyond which a loss anomaly is reported as an event in Rx direction.	0.2 to 5	dB	0.35
<b>otdr rx excess-reflection-threshold</b>	Threshold beyond which a reflective event is reported as an excessive reflection event in the Rx direction.	-50 to -10	dB	-20
<b>otdr rx back-scattering</b>	The back scattering value in the Rx direction.	-90 to -70	dB	-81.87
<b>otdr rx refractive-index</b>	The refractive-index value in the Rx direction.	1.000 to 2.000	-	1.4682
<b>otdr tx auto reflectance-threshold</b>	Threshold beyond which a reflective anomaly is reported as an event in Tx direction.	-50 to -10	dB	-40
<b>otdr tx auto splice-loss-threshold</b>	Threshold beyond which a loss anomaly is reported as an event in Tx direction.	0-2.5	dB	0.35
<b>otdr tx auto excess-reflection-threshold</b>	Threshold beyond which a reflective event is reported as an excessive reflection event in the Tx direction.	-50 to -10	dB	-20
<b>otdr rx auto excess-orl-threshold</b>	Threshold below which an excessive ORL event is reported in the Rx direction.	10 to 60	dB	60

Parameter	Description	Range	Unit	Default
<b>otdr tx auto excess-orl-threshold</b>	Threshold below which an excessive ORL event is reported in the Tx direction.	10 to 60	dB	60
<b>otdr rx auto excess-attenuation-threshold</b>	Threshold beyond which a Non-Reflective event is reported as an excessive attenuation event in the Rx direction.	0.5 to 5	dB	5
<b>otdr tx auto excess-attenuation-threshold</b>	Threshold beyond which a Non-Reflective event is reported as an excessive attenuation event in the Tx direction.	0.5 to 5	dB	5
<b>otdr tx back-scattering</b>	Back-scattering value in the Tx direction.	-90 to -70	dB	-81.87
<b>otdr tx refractive-index</b>	Refractive-index value in the Tx direction.	1.0000 to 2.0000	Unit less	1.4682
<b>otdr rx expert pulse-width</b>	Pulse width to be used during the expert scan in the Rx direction.	5 to 2000	ns	20
<b>otdr rx expert capture-end</b>	OTDR capture endpoint during the expert scan in the Rx direction.	15000000	cm	15000000
<b>otdr rx expert capture-start</b>	OTDR capture start point during expert scan in the Rx direction	0 to 10000000	cm	0

Parameter	Description	Range	Unit	Default
<b>otdr rx expert scan duration</b>	OTDR scan duration during expert scan in the Rx direction.	0 to 180	Seconds	60
<b>otdr tx expert pulse-width</b>	Pulse width to be used during the expert scan in the Tx direction.	5 to 20000	ns	20
<b>otdr tx expert capture-end</b>	OTDR capture endpoint during expert scan in the Tx direction.	0 to 15000000	cm	15000000
<b>otdr tx expert capture-start</b>	OTDR capture start point during expert scan in the Tx direction.	0 to 10000000	cm	0
<b>otdr tx expert scan duration</b>	OTDR scan duration during expert scan in the Tx direction.	0 to 180	Seconds	60

## Start OTDR

NCS 1020 software does not support automatic start of OTDR scan. You have to start the OTDR scan manually using the **otdr-start controller ots R/S/I/P direction** command to perform the following 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.

### 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#
```

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. The following example explains the OTDR start request rejection. The OTDR scan request that has been rejected already does not run automatically after the lock is released, so you have to create a new request to start the OTDR again.

```
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#

RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 tx
Tue Feb 28 10:25:53.379 UTC
OTDR Scan cannot be started as it is locked by Another Entity/Application.
RP/0/RP0/CPU0:ios#
```

## Stop OTDR

To stop the OTDR scan function, use the following **otdr-stop controller ots R/S/I/P direction** command:

### 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#
```

## Display OTDR Scan Measurements

You can use the **show controllers ots R/S/I/P otdr-info direction** command to view the OTDR scan events and the location of the SOR file.

The SOR file contains the fiber trace details such as the distance, reflectance, loss, and fiber attenuation measurements. You can export the SOR file.



**Note** To transfer the SOR file from the source to the destination, use the following 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/
```

OTDR can detect typical fiber events such as loss due to fiber splicing, patch panel, and coupler connections, single and multiple loss events, single and multiple reflective events, fiber pinch, and fiber cut.

The following is the sample to display the OTDR scan information in the RX direction.

```
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_NCS1020_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



**Note** After the FPD upgrade of the line card, the results of previous OTDR scans may not be available using the CLI command **show controllers ots Rack/Slot/Instance/Port otdr-info direction**. However, you can get the results of previous OTDR scans in the form of .SOR files that are stored in the hard disk.

Optical Return Loss (ORL) is measured during the OTDR scan and displayed as part of the OTDR results. The ORL represents the total reflected optical power from a complete fiber link, while considering the attenuation. This includes the natural backscattered power of the fiber and the reflected power coming from optical connectors, fiber splicing, or other discontinuities along the link. ORL is expressed with a positive number. Higher ORL values are desirable for the fiber because they indicate lower back reflection. For example, an ORL of 40 dB is better than 20 dB.

The following sample displays the ORL value as part of OTDR status:

```
RP/0/RP0/CPU0:ios#show controllers Ots 0/0/0/2 otdr-info rx
Mon Oct 2 11:55:48.552 UTC
Scan Direction: RX
Scan Status: Data Ready
Optical Return Loss: 39.0 dB
SOR file: /harddisk:/otdr/NCS1020_NCS1020_OTDR_Ots0_0_0_2_RX_20231001-110754.sor
Total Events detected: 8
Scan Timestamp: Sun Oct 1 11:07:54 2023 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             | 4.4100     | 2.00         | 0.69           | 0.00
2      | NR                | 664.3200   | 2.66         | 0.21           | 0.00
3      | R ER             | 18222.3900 | 20.22        | -33.78         | 0.19
4      | NR               | 18222.3900 | 20.22        | 0.35           | 0.19
5      | R ER             | 68674.4800 | 70.67        | -32.25         | 0.20
6      | NR               | 68674.4800 | 70.67        | 0.36           | 0.20
7      | R FE ER          | 118765.2600 | 120.76       | -28.55         | 0.23
8      | NR FE            | 118765.2600 | 120.76       | 25.86          | 0.23
```

## Automatic OTDR Scan

The OTDR scan begins automatically whenever the events such as span fault, span restore, device power cycle, and line card cold reload occur. By default, this feature is disabled. You can enable this feature.



The OTDR autoscan takes less than three minutes to complete. When the autoscan is running the OTDR-SCAN-IN-PROGRESS-RX alarm is raised and this alarm gets cleared after completion of the scan.

The following table explains how the span fault and span restore events are detected:

**Table 2: Definition of Span Up and Span Down Events**

Events	Non-Raman Span	Raman Span	Raman Span with Dual Safety Configured
Span Down	Raise of RX-LOS-P alarm at OSC controller	Raise of RX-LOS-P alarm at DFB controller	Raise of RX-LOS-P alarm at both OSC and DFB controllers
Span Up	Clearing of RX-LOS-P alarm at OSC controller	Clearing of RX-LOS-P alarm at DFB controller	Clearing of RX-LOS-P alarm at OSC or DFB controller



**Note**

- The autoscan locks the OTDR resource to avoid manual trigger of scan using the **start-otdr** command. However, if the manual scan is ongoing, the autoscan waits for its completion.
- The autoscan terminates any ongoing scan triggered by another applications such as Raman turn-up.
- During autoscan, if a change in Span Status is detected the ongoing scan will be terminated, and a new autoscan will be triggered.

## Configure Automatic OTDR Scan

You can enable or disable Automatic OTDR scan using the following commands:

```
configure
optical-line-control
controller ots Rack/Slot/Instance/Port
otdr auto-scan [enable | disable]
commit
end
```

The following are the sample configurations that enable and disable the automatic OTDR scan:

```
RP/0/RP0/CPU0:ios#configure
Mon Sep 18 13:11:53.812 UTC
RP/0/RP0/CPU0:ios(config)#optical-line-control controller Ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#otdr auto-scan enable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit

RP/0/RP0/CPU0:ios#configure
Mon Sep 3 13:28:34.631 UTC
RP/0/RP0/CPU0:ios(config)#optical-line-control controller Ots 0/0/0/0
RP/0/RP0/CPU0:ios(config-olc-ots)#otdr auto-scan disable
RP/0/RP0/CPU0:ios(config-olc-ots)#commit
```

## View Automatic OTDR Results

The following samples display the status of autoscan in a non-Raman span.

```
RP/0/RP0/CPU0:ios#show olc otdr-status
Mon Sep 18 13:10:57.733 UTC
Controller                               : Ots0/0/0/0
Auto-scan Start Time                     : NA
OTDR Auto-scan Status                    : DISABLED
Status Detail                            : NA
Optical Span Status                      : UP
Trigger Event                            : NA
```

```
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:11:00.565 UTC
Controller                               : Ots0/0/0/0
Auto-scan Start Time                     : NA
OTDR Auto-scan Status                    : DISABLED
Status Detail                            : NA
Optical Span Status                      : UP
Trigger Event                            : NA
Last Trigger Event                       : NA
```

The following samples display the various status of OTDR automatic scan during span restore:

```
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:12:40.430 UTC
Controller                               : Ots0/0/0/0
Auto-scan Start Time                     : NA
OTDR Auto-scan Status                  : RUNNING
Status Detail                        : Starting on Span Up
Optical Span Status                      : Up
Trigger Event                            : Span Restore
Last Trigger Event                       : NA
```

```
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:15:06.153 UTC
Controller                               : Ots0/0/0/0
Auto-scan Start Time                     : 2023-09-18 13:12:42
OTDR Auto-scan Status                  : RUNNING
Status Detail                        : Waiting Scan Completion on Span Up
Optical Span Status                      : Up
Trigger Event                            : Span Restore
Last Trigger Event                       : NA
```

```
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:15:06.153 UTC
Controller                               : Ots0/0/0/0
Auto-scan Start Time                     : 2023-09-18 13:12:42
OTDR Auto-scan Status                  : COMPLETED
Status Detail                        : Completed on Span Up
Optical Span Status                      : Up
Trigger Event                            : Span Restore
Last Trigger Event                       : Span Restore
```

The following samples display the various status of OTDR automatic scan during span fault:

```
RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:16:16.461 UTC
Controller                               : Ots0/0/0/0
Auto-scan Start Time                     : NA
OTDR Auto-scan Status                  : RUNNING
Status Detail                            : Starting on Span Down
Optical Span Status                      : Down
```

```

Trigger Event : Span Fault
Last Trigger Event : Span Restore

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:16:33.304 UTC
Controller : Ots0/0/0/0
Auto-scan Start Time : 2023-09-18 13:16:27
OTDR Auto-scan Status : RUNNING
Status Detail : Waiting Scan Completion on Span Down
Optical Span Status : Down
Trigger Event : Span Fault
Last Trigger Event : Span Restore

```

```

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 13:18:54.154 UTC
Controller : Ots0/0/0/0
Auto-scan Start Time : 2023-09-18 13:16:27
OTDR Auto-scan Status : COMPLETED
Status Detail : Completed on Span Down
Optical Span Status : Down
Trigger Event : Span Fault
Last Trigger Event : Span Fault

```

The following sample displays the status detail of autoscan when autoscan is not able to lock OTDR resource after 30 minutes. The status detail is reported as 'Failed due to Timeout', and the autoscan will not trigger.

```

RP/0/RP0/CPU0:ios# show olc otdr-status details
Wed Sep 20 14:09:37.011 UTC
Controller : Ots0/0/0/0
Auto-scan Start Time : 2023-09-20 13:58:17
OTDR Auto-scan Status : COMPLETED
Status Detail : Failed due to Timeout
Optical Span Status : UP
Trigger Event : Span Restore

Last Trigger Event : NA

```

The following sample explains the status detail of the autoscan where the ongoing autoscan is stopped by the user.

```

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 15:08:27.370 UTC
Controller : Ots0/0/0/0
Auto-scan Start Time : 2023-09-18 15:08:09
OTDR Auto-scan Status : COMPLETED
Status Detail : Stopped by User
Optical Span Status : DOWN
Trigger Event : Span Fault
Last Trigger Event : Span Restore

```

The following sample displays the status detail where the autoscan in one port is waiting for the OTDR resource, because the autoscan is running on another port.

```

RP/0/RP0/CPU0:ios#show olc otdr-status details
Mon Sep 18 15:57:43.671 UTC
Controller : Ots0/0/0/0
Auto-scan Start Time : 2023-09-18 15:57:43
OTDR Auto-scan Status : COMPLETED
Status Detail : Waiting for OTDR Resource

Optical Span Status : UP
Trigger Event : Span Restore
Last Trigger Event : NA

```

