Optical Time Domain Reflectometer

Table 1: Feature History

Feature Name	Release Information	Feature Description
OTDR enhancements	Cisco IOS XR Release 25.4.1	These enhancements have been made to OTDR functionality: • OTDR results now include total measured loss and total measured length alongside existing measurements. • Unique names can be assigned to SOR files for easier identification. • SOR files from automatic and manual OTDR scans are organized into separate folders to differentiate between file types. CLI: The keyword **label** *string* is added to the command **otdr-start controller ots** *R/S/I/P direction*.

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/
```

From Release 25.4.1, SOR files from manual and automatic scans are stored in separate folders within the OTDR directory. Automatically generated SOR files are saved in `/harddisk:/otdr/auto/`, while manually triggered SOR files are stored in the existing `/harddisk:/otdr/` folder.

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 7.

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 2: 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
otdr { rx | tx} auto excess-orl-threshold<*value*>	Threshold below which OTDR-ABSORL-EXCEEDED alarm is reported in the Rx or Tx direction.	dB	10–60	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 5	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	5–99	5.5

Table 3: 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	0–180	60

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 4: Feature History

Feature Name	Release Information	Feature Description
OTDR negotiation	Cisco IOS XR 26.1.1	The OTDR scan process now includes a negotiation step with a remote peer before starting the scan. This enhancement prevents simultaneous scans on the same fiber, avoiding measurement conflicts and ensuring accurate results. The **force** option allows a scan to start without negotiation, but it should be used cautiously to prevent 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

OTDR scans are used to assess the quality and characteristics of optical fibers. However, if multiple scans or Raman tuning activities occur simultaneously on the same fiber, it can result in conflicts or incorrect measurements. The negotiation process is critical to ensuring that scans are conducted safely and without interference.

Summary

The OTDR negotiation process is designed to ensure that scans on optical fibers are performed efficiently and without conflict. By coordinating between local and remote nodes, the process prevents overlapping scans and interference with Raman tuning activities.

Workflow

The process involves these stages:

1. Fiber availability check: The local node first checks if the optical fiber is available for scanning. If unavailable, the scan does not proceed.
2. Conflict verification: The local node checks for an active scan initiated by the remote node or determines if Raman tuning is in progress on the same fiber.

3. Remote span reservation request: If the fiber is free from other scans or Raman tuning, the local node sends a remote span reservation request to the remote node to secure exclusive access for the scan.
4. Reservation acknowledgment and scan initiation: If the remote node acknowledges the span reservation request, the local node starts the OTDR scan. This step prevents overlapping scans or tuning conflicts with peer nodes.

Result

This process ensures that OTDR scans occur only when the fiber is available and that no risk of conflict exists with other maintenance activities.

What's next

If the negotiation fails due to a down link, see Start the OTDR scan manually, on page 7 for instructions on initiating a scan without negotiation.

Start the OTDR scan manually

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.

From Release 25.4.1, you can use the `label` keyword to append a custom substring as a prefix to the SOR file name. This substring helps you identify and retrieve specific SOR files stored in the directory.

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

The OTDR scan starts while negotiation with a remote peer.

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#
```

Step 2 If you want to request a manual OTDR scan operation without negotiating with the peer, add the `force` option.

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 in the few scenarios. Refer to Scenarios where forced start of OTDR scan may fail.

Step 3 Use the `label` *string* keyword, to append a custom substring as a prefix to the SOR file name.

Example:

```
RP/0/RP0/CPU0:ios#otdr-start controller ots 0/0/0/0 rx label Site1.ABC_xyz-1
Mon Nov 3 09:56:23.278 UTC
OTS OTDR Scan Started at RX
RP/0/RP0/CPU0:ios#
```

This example appends the string *Site1.ABC_xyz-1* to the SOR file name. For example:

```
/harddisk:/otdr/Site1.ABC_xyz-1_ios _OTDR_Ots0_0_0_0_RX_20250306-110133.sor.
```

The OTDR label must adhere to these limitations: Only the special characters dot, hyphen, and underscore are permitted. The maximum file name length is 255 characters. The maximum label length is 55 characters.

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.

Scenarios where forced start of OTDR scan may fail

The forced otdr-start command can fail immediately in a few scenarios.

Table 5: Scenarios where forced start of OTDR scan may fail

Scenarios	Error messages	Workaround
The OTDR is already in use for a scan on any of the four possible spans on the ports: 0-TX, 0-RX, 2-TX, and 2-RX.	*OTDR Scan cannot be started as another scan is in progress*	Wait until the other scan is completed, then restart the scan.
The span: 0-TX, 0-RX, 2-TX, and 2-RX is already locked by a scan running on the far-end node.	*OTDR Scan cannot be started as it is locked by Another Entity/Application*	Wait until the other scan is completed, then restart the scan.
The OTDR scan cannot run because a Raman Tuning application on a near-end or far-end node has locked the span.	*OTDR Scan cannot be started as it is locked by Another Entity/Application*	Wait until the Raman tuning is completed. Then restart the scan.

View the OTDR measurements

Use this procedure to view the OTDR scan measurement results.

Table 6: Feature History

Feature Name	Release Information	Description
Optical Return Loss Reporting	Cisco IOS XR Release 7.11.1	The Optical Return Loss (ORL) is now calculated during the OTDR scan and displayed as part of the OTDR results. You can also set the ORL threshold value. The ORL represents the total reflected optical power from a complete fiber link while accounting for fiber attenuation. When the ORL falls below a user-configured threshold value, the OTDR-ABS-ORL-EXCEEDED-TX or OTDR-ABS-ORL-EXCEEDED-RX alarm is raised. You can troubleshoot fiber transmission issues using the ORL value and OTDR results. To set the ORL threshold value, these keywords are added to the controller ots command: • otdr rx auto excess-orl-threshold *value* • otdr tx auto excess-orl-threshold *value*

From Release 25.4.1, the OTDR scan measurement results show Total Measured Loss and Total Measured Length.

From Release 7.11.1, Optical Return Loss (ORL) is measured during the OTDR scan and displayed as part of the OTDR results. ORL represents the total reflected optical power from a complete fiber link, while considering the attenuation.

This measurement 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.

Note 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.

ORL is calculated separately for each region, based on the reflection events identified during each region scan. Each scan uses parameters optimized for its target distance range: 0–8 km (office), 8–32 km (short), and 32–150 km (long). If the fiber length falls outside the designated distance range for a particular region,

the ORL calculated for that region may not be optimal. For example, calculating ORL using the long region parameters for a 2 km fiber length will not yield the most reliable 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
```

Example:

These are the sample OTDR measurement results displaying Total Measured Loss, Total Measured Length and SOR file with appended OTDR label.

```
RP/0/RP0/CPU0:ios#show controllers ots 0/0/0/2 otdr-info tx
Thu Dec  4 09:28:25.136 IST
        Scan Direction: TX
        Scan Status: Data Ready
        Total Measured Loss: 11.04 dB
        Total Measured Length: 50746.3000 m
        Optical Return Loss: 25.0 dB
        SOR file: /harddisk:/otdr/auto/ios_OTDR_Ots0_0_0_2_TX_20251203-122210.sor
        Total Events detected: 4
        Scan Timestamp: Wed Dec  3 12:22:10 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                      |  0.6800          |  2.00            |  0.66
     |  0.00
        2           |  R                       |  10.4800         |  2.01            |  -33.66
     |  0.00
        3           |  R FE ER                 |  50746.3000      |  52.74           |  -15.28
     |  0.20
        4           |  NR FE                   |  50746.3000      |  52.74           |  11.04
     |  0.20
```

Note
The output shows Total measured loss and Total measured length only if a Fiber-End (FE) event is detected.

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 measurement results, on page 11 for various examples.

OTDR scan measurement results

This 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/ios_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
```

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#
```

Automatic OTDR scans

An automatic OTDR scan is a fiber diagnostics feature that

- automatically triggers OTDR tests in response to specific events such as span fault, span restoration, device power cycling, and line card cold reload that affect the optical span,
- enables RX directionscanning for comprehensive fault detection and prevents scan collisions, and
- provides rapid fault localization by monitoring and raising relevant alarms during scan execution.

Table 7: Feature History

Feature Name	Release Information	Feature Description
Bidirectional automatic OTDR scan	Cisco Cisco IOS XR Release 26.1.1	The OTDR autoscan is now conducted in both the Rx and Tx directions for all triggering events, ensuring no collision occurs during the bidirectional autoscan. This improvement allows autoscan operations to be executed in both directions, greatly enhancing fault detection and network diagnostics while preventing interference between scans.

Table 8: Feature History

Feature Name	Release Information	Feature Description

Automatic OTDR Scan	Cisco IOS XR Release 7.11.1	An OTDR scan is automatically triggered on Rx direction, 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.
		Commands added to enable and view OTDR results:
		`otdr auto-scan [enable | disable]`
		`show olc otdr-status [details]`

Autoscan direction and duration

In Release 7.11.1, autoscan is performed only in the Rx direction, regardless of whether the span fault is unidirectional or bidirectional. From Release 26.1.1, OTDR autoscan performs scanning in the Tx direction in addition to the Rx direction for the events.

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 depends on the mode of the scan. For Auto and Expert modes, the scan takes upto three minutes to complete. For multiregion mode, it takes 8-9 minutes. The OTDR autoscan takes less than three minutes to complete. During the autoscan, the OTDR-SCAN-IN-PROGRESS-RX alarm is raised and gets cleared once the scan is finished. 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

Autoscan manages OTDR scanning by coordinating access to scanning resources and responding to interactions with manual and application-triggered scans:

Autoscan manages OTDR scanning operations in these ways:

- Autoscan locks the OTDR resource to prevent manual scan triggers using the **otdr-start** command. However, if a manual scan is already in progress, autoscan waits for its completion before proceeding.
- Autoscan terminates any ongoing scan that was triggered by other applications, such as Raman turn-up.
- During autoscan, if a change in Span Status is detected, it terminates the ongoing scan and automatically initiates a new autoscan.

Criteria for span fault and restoration events

This table lists the detection criteria for span fault and restoration events.

Table 9: 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 both OSC and DFB controllers

How bidirectional OTDR autoscan works during span down events

Summary

During a span down event, when fiber connectivity is lost, the bidirectional OTDR autoscan process starts scanning automatically. The scanning localizes and diagnoses fiber cuts without node-to-node communication.

The key components involved in the process are:

- Near End (NE) and Far End (FE) nodes: Devices at both ends of the fiber span that each conduct OTDR scans.

- Bidirectional OTDR autoscan: The feature that orchestrates time-based scan assignments when communication is unavailable.
- Timeslots: Fixed-duration windows allocated for scanning operations in each direction.

Workflow

The process involves the following stages:

1. Detection and trigger: The system detects a fiber disconnection (span down) and automatically triggers the OTDR autoscan at both NE and FE nodes.
2. Timeslot assignment: With communication between nodes unavailable, the system alternately assigns equal timeslots to Rx and Tx scan directions at both nodes. This order is synchronized at both NE and FE.
3. Scan execution:
   - For a unidirectional fiber cut, the broken fiber is scanned in both Rx and Tx directions, while the non-broken fiber is scanned in the Tx direction only.
   - For a bidirectional fiber cut, both fibers are scanned in both Rx and Tx directions.
4. Handling scan completion or failure: If a scan cannot be completed within its timeslot, or if the scan fails, it is automatically rescheduled for the next available timeslot for that port and direction.
5. Termination: The autoscan process terminates automatically after successful completion of both Rx and Tx scans on all applicable fibers, or can be stopped by disabling the autoscan feature.

Result

The span down OTDR autoscan process enables rapid, automated identification and localization of fiber faults in the absence of node-to-node communication, facilitating efficient troubleshooting and repair.

How bidirectional OTDR autoscan works during span up events

When a fiber span is restored (span up), the bidirectional OTDR autoscan process uses inter-node communication to coordinate the scan sequence and verify fiber integrity.

Summary

The key components involved in the process are:

- Near End (NE) and Far End (FE) nodes: Network elements at each side of the fiber span that communicate and coordinate scans.
- Bidirectional OTDR autoscan: The feature responsible for initiating and sequencing scans post-restoration.
- Optical Supervisory Channel (OSC) and Ethernet communication: Communication channels necessary for negotiation between nodes.

Workflow

The process involves the following stages:

1. Detection and trigger: The system detects the restoration of the fiber span (span up event) and both NE and FE nodes can now communicate.
2. Negotiation: The NE and FE nodes negotiate the scan sequence over the OSC and associated Ethernet channel, eliminating the need for predefined timeslots.
3. Sequential scan execution: Rx and Tx scans are executed sequentially as agreed during negotiation between nodes, ensuring complete verification of fiber status.
4. Scan process monitoring: The system confirms proper functioning of the OSC and Ethernet channel throughout the scan. If communication is disrupted, the process cannot proceed.
5. Termination: The autoscan process automatically terminates after both Rx and Tx scans are successfully completed, or can be stopped by disabling the autoscan feature.

Result

The span up OTDR autoscan process enables automated, coordinated verification of fiber integrity after restoration, ensuring network readiness and service continuity.

Fault and restoration scenarios in bidirectional OTDR

This reference describes how bidirectional OTDR performs automatic scans in fiber networks during both fault (cut) and restoration conditions between nodes, detailing differences for OLT and ILA node types.

Unidirectional and bidirectional failures between two OLT nodes

This image illustrates the timeslot-based OTDR automatic scans in the event of bidirectional and unidirectional fiber cuts between Node A and Node B.

Figure 1: Bidirectional autoscan during span fault scenarios

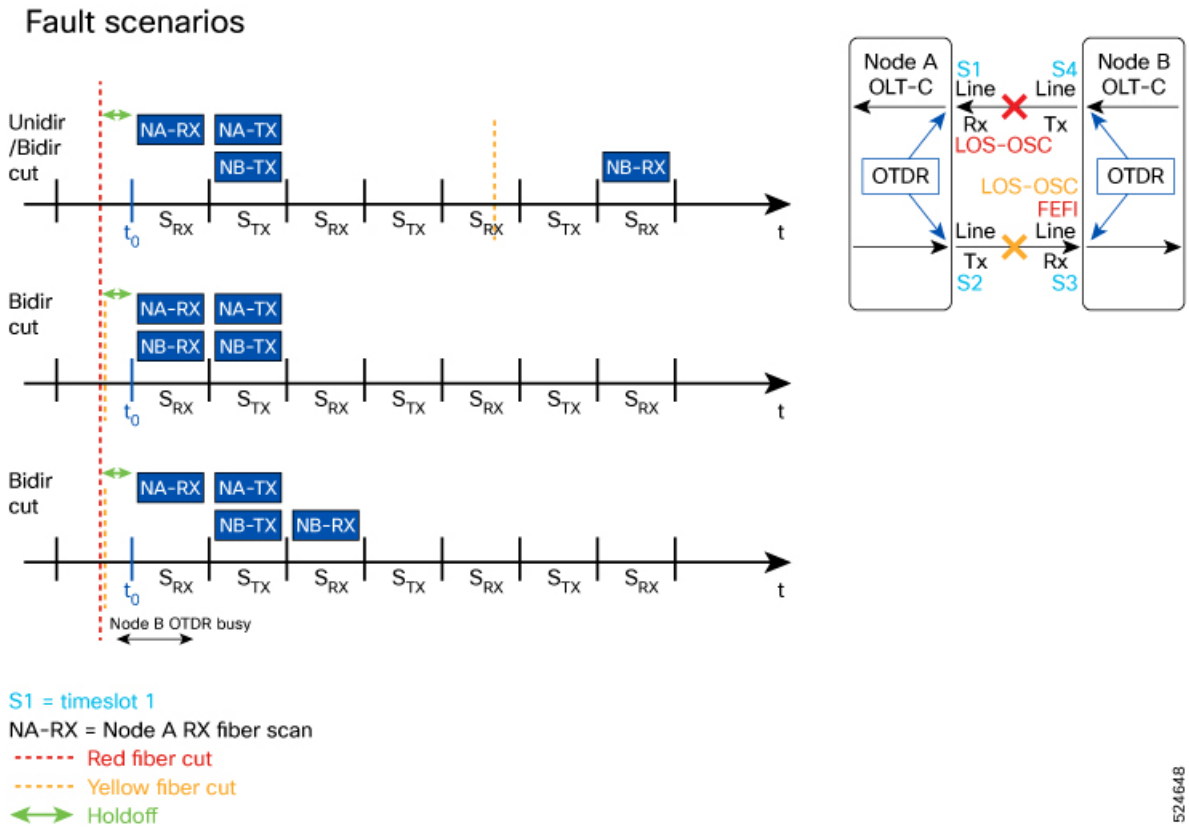

Table 10: Bidirectional autoscan during span fault scenarios

Span fault	How bidirectional scan is performed
Scenario 1:A unidirectional fiber cut occurs first, followed by a bidirectional fiber cut after some time.	The fiber cut happens in one fiber. This is marked as a red cross in the image: • In the first timeslot, Node A performs an Rx scan (NA-RX) for the cut fiber. • In the subsequent timeslot, Node A and Node B perform scan in the Tx direction (NA-TX, NB-TX). The fiber cut happens in another fiber some time after the unidirectional cut. This is marked as a yellow cross in the image. • Only Node B performs the Rx scan. Node A does not perform any scan as there are no changes detected in Node A.

Span fault	How bidirectional scan is performed
Scenario 2: Bidirectional cuts happen simultaneously	Both Node A and Node B perform the scans in the RX direction in the first timeslot (t0), and in the Tx direction for the subsequent timeslot.
Scenario 3: Node B is busy for some time when bidirectional cuts occur.	Node A performs an Rx scan in one timeslot and continues with the Tx scan in the next timeslot. While Node B waits for the current scan to complete, it starts the Tx scan in the second timeslot and continues the Rx scan in the following timeslot.

Unidirectional and bidirectional failure restoration between two OLT nodes

When a fiber fault is restored (span up), the NE and FE nodes coordinate Rx and Tx scans to prevent simultaneous scanning and scan collisions. In this process:

- Rx and Tx scans are performed sequentially, one immediately after the other.
- After restoration, both Tx and Rx scans are performed on the restored fiber, regardless of whether the original cut was unidirectional or bidirectional.

Unidirectional and bidirectional failure and restoration between two ILA nodes

Bidirectional autoscan behavior between two ILA nodes is the same as that of OLT nodes. The only difference is that the OTDR module is shared between the two line ports in an ILA node. If a simultaneous fault occurs on both sides, the two ports must serialize the scan operations. Each port performs its scan one after the other to avoid overlap and ensure accurate fault detection and restoration.

Configure automatic OTDR scan

Use this task to enable OTDR scan to run automatically during certain events.

Procedure

Step 1 Enter OTS controller configuration mode for the port on which you want to enable 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
RP/0/RP0/CPU0:ios(config)#commit
RP/0/RP0/CPU0:ios(config)#exit
```

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

Automatic OTDR scans are enabled for the selected port. The system will now run OTDR scans automatically during applicable events, allowing you to proactively monitor fiber links and detect faults without manual intervention.

Verify autoscan status

Use this procedure to verify the status of the autoscan.

Procedure

View the automatic OTDR scan results using the command **show olc otdr-status [details]**.

Example:

This sample display the status of autoscan triggered due to a span fault. See Automatic OTDR scan results, on page 18 for more examples.

```
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
```

What to do next

If events indicate potential fiber issues, review the SOR file or perform additional analysis as needed.

Automatic OTDR scan results

This table presents automatic OTDR scan results observed across different network scenarios.

Table 11: Automatic scan results

Network scenarios	Sample OTDR scan results
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
Raman span	RP/0/RP0/CPU0:ios#show olc otdr-status Mon Sep 18 13:41:05.088 UTC Controller : Ots0/0/0/0 Auto-scan Start Time : NA **OTDR Auto-scan Status : DISABLED** **Raman Turn Up Fiber Check : NA** Status Detail : NA Optical Span Status : UP Trigger Event : NA RP/0/RP0/CPU0:ios#show olc otdr-status details Mon Sep 18 13:41:08.825 UTC Controller : Ots0/0/0/0 Auto-scan Start Time : 2023-09-20 13:58:17 **OTDR Auto-scan Status : DISABLED** Status Detail : NA **Raman Turn Up Fiber Check : NA** Optical Span Status : UP Trigger Event : NA Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : NA

Network scenarios	Sample OTDR scan results
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
Autoscan is unable to lock the OTDR resource	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** Raman Turn Up Fiber Check : NA Optical Span Status : UP Trigger Event : Span Restore Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : NA

Network scenarios	Sample OTDR scan results
Autoscan on 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** Raman Turn Up Fiber Check : NA Optical Span Status : UP Trigger Event : Span Restore Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : NA
Autoscan is enabled and Raman turnup is disabled on a Raman span In this case • On the span down event, the autoscan is triggered. • On the span up event, autoscan is not triggered and OTDR Autoscan Status will be IDLE, because Raman pumps are turned on before the start of autoscan. • On the span up event, autoscan is triggered and *OTDR Autoscan Status* is displayed as RUNNING.	RP/0/RP0/CPU0:ios#show olc otdr-status details Sat Sep 23 12:42:11.304 UTC Controller : Ots0/0/0/0 Auto-scan Start Time : NA **OTDR Auto-scan Status : IDLE** Status Detail : NA Raman Turn Up Fiber Check : NA Optical Span Status : UP Trigger Event : Span Fault Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : Span Restore
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** Raman Turn Up Fiber Check : NA Optical Span Status : DOWN Trigger Event : Span Fault Last Raman Turn Up Scan Time : 2023-09-18 14:55:40 Last Raman Turn Up Fiber Check : Success Last Trigger Event : Span Restore

Network scenarios	Sample OTDR scan results
Bidirectional autoscan disabled by user	RP/0/RP0/CPU0:ios#show olc otdr-status Tue Apr 15 11:01:00.494 IST Controller : Ots0/0/0/0 **OTDR Auto-scan Status : DISABLED** Auto-scan Rx Start Time : NA Rx Status Detail : NA Auto-scan Tx Start Time : NA Tx Status Detail : NA Raman Turn Up Fiber Check : NA Optical Span Status : Up Trigger Event : NA RP/0/RP0/CPU0:ios#show olc otdr-status details Tue Apr 15 11:02:21.046 IST Controller : Ots0/0/0/0 **OTDR Auto-scan Status : DISABLED** Auto-scan Rx Start Time : NA Rx Status Detail : NA Auto-scan Tx Start Time : NA Tx Status Detail : NA Raman Turn Up Fiber Check : NA Optical Span Status : Up Trigger Event : NA Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : NA

Network scenarios	Sample OTDR scan results
Bidirectional autoscan after span fault	RP/0/RP0/CPU0:ios(config)#do show olc otdr-status Tue Apr 15 11:34:56.650 IST Controller : Ots0/0/0/0 OTDR Auto-scan Status : RUNNING Auto-scan Rx Start Time : NA **Rx Status Detail : Starting on Span Down** Auto-scan Tx Start Time : NA **Tx Status Detail : Starting on Span Down** Raman Turn Up Fiber Check : NA Optical Span Status : Down **Trigger Event : Span Fault** RP/0/RP0/CPU0:ios(config)#do show olc otdr-status details Tue Apr 15 11:34:57.818 IST Controller : Ots0/0/0/0 OTDR Auto-scan Status : RUNNING Auto-scan Rx Start Time : NA **Rx Status Detail : Starting on Span Down** Auto-scan Tx Start Time : NA **Tx Status Detail : Starting on Span Down** Raman Turn Up Fiber Check : NA Optical Span Status : Down **Trigger Event : Span Fault** Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : NA RP/0/RP0/CPU0:ios(config)#do show olc otdr-status Tue Apr 15 11:35:42.903 IST Controller : Ots0/0/0/0 OTDR Auto-scan Status : RUNNING Auto-scan Rx Start Time : 2025-04-15 11:34:59 **Rx Status Detail : Waiting Scan Completion on Span Down** Auto-scan Tx Start Time : NA **Tx Status Detail : Starting on Span Down in less than 10 minutes** Raman Turn Up Fiber Check : NA Optical Span Status : Down **Trigger Event : Span Fault** RP/0/RP0/CPU0:ios(config)#do show olc otdr-status details Tue Apr 15 11:35:44.717 IST Controller : Ots0/0/0/0 OTDR Auto-scan Status : RUNNING Auto-scan Rx Start Time : 2025-04-15 11:34:59 **Rx Status Detail : Waiting Scan Completion on Span Down** Auto-scan Tx Start Time : NA **Tx Status Detail : Starting on Span Down in less than 10 minutes** Raman Turn Up Fiber Check : NA Optical Span Status : Down **Trigger Event : Span Fault** Last Raman Turn Up Scan Time : NA Last Raman Turn Up Fiber Check : NA Last Trigger Event : NA

Network scenarios	Sample OTDR scan results
Bidirectional autoscan after span restore	RP/0/RP0/CPU0:ios(config)#do show olc otdr-status Tue Apr 15 11:03:36.584 +0530 Controller : Ots0/0/0/0 OTDR Auto-scan Status : RUNNING Auto-scan Rx Start Time : NA **Rx Status Detail : Starting on Span Up** Auto-scan Tx Start Time : NA **Tx Status Detail : Starting on Span Up** Optical Span Status : Up **Trigger Event : Span Restore** RP/0/RP0/CPU0:ios(config)#do show olc otdr-status Tue Apr 15 11:05:23.428 +0530 Controller : Ots0/0/0/0 OTDR Auto-scan Status : RUNNING Auto-scan Rx Start Time : 2025-04-15 11:03:46 **Rx Status Detail : Waiting Scan Completion on Span Up** Auto-scan Tx Start Time : NA **Tx Status Detail : Starting on Span Up in less than 9 minutes** Optical Span Status : Up **Trigger Event : Span Restore**

See OTDR scan status, on page 24 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 12: 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.

Scan status	Description
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.

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

Table 13: 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
Autoscan	• Measuring • Data Processing • Data Ready • Stopped • Error	• Measuring • Data Processing • Data Ready • Stopped • Error