

OTDR/iOLM reference poster



The evolution of OTDR testing

An optical time-domain reflectometer (OTDR) is a tool of choice to test and troubleshoot fiber networks. However, the level of complexity involved requires a great amount of knowledge and expert skills to use it efficiently. Thankfully, today's OTDRs offer a variety of automated functions helping the user perform faster, more reliable fiber characterization. This reference poster will help you stay on top of OTDR technology.

- More specifically, this poster will help you:
- Refresh OTDR fundamentals
 - Understand the main components of an OTDR trace
 - Demystify key OTDR parameters
 - Benefit from useful tips
 - Discover a revolutionary test method: EXFO's iOLM

OTDR fundamentals

The OTDR couples a laser and a detector, with an internal clock and a pulse generator. The OTDR sends a pulse of laser light into one side of the optical fiber. The light is reflected back from the fiber, connectors, splices and other components on the link to the OTDR. Each measurement in time is plotted onto a graph depicting power in function of distance. Since the speed of light in a fiber is known, we can calculate distance given the time. We can thus obtain the total length of the fiber and the location of any events on the link.

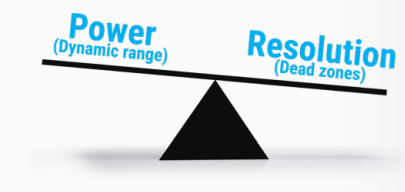
Why use an OTDR?
An OTDR is a single-ended test equipment that provides an accurate and complete end-to-end link validation. As opposed to the simple light source and power meter test method, the OTDR can identify and locate any potential faults or breaks that could impact your network performance. No additional tool or test is needed.

The OTDR measures	The OTDR provides
Total loss	Link component characterization
Event loss	Loss, reflectance and attenuation measurements
Optical return loss	Potential fault highlights
Event location	Break locations
Fiber length	

Key test parameters

The OTDR function is a balance between power (dynamic range) and resolution (dead zone). Three interacting parameters may influence test results:

- **Duration:** allows to increase signal-to-noise ratio (SNR)
- **Distance range:** sets fiber length and repetition rate
- **Pulse width:** determines acquisition power and resolution



- How to set up your OTDR**
- 1) Use the file naming and identification features.
 - 2) Use **Automode** to discover the link under test. Based on the results, you may have to manually adjust some test parameters to detect more events.
 - 3) Complete fiber characterization by using **different pulse widths** to find any hidden event undetected by Automode.
 - Use the shortest pulse width to check the **front end** including the first connector of the link.
 - Use larger pulse width to reach **longer distances** and/or to characterize optical splitter (for FTTH/PON).

Common issues	What should you do?
Noisy trace	<ul style="list-style-type: none"> • Increase averaging time (minimum 45 s) OR • Increase to the next larger pulse width
Events not visible or missing	Event might be located within the OTDR dead zone; try reducing pulse width to heighten resolution and discriminate closely spaced events
No fiber end	<ul style="list-style-type: none"> • Adjust distance range to link length • Increase pulse width for more dynamic range
OTDR connector fail	<ul style="list-style-type: none"> • Inspect OTDR port connector and clean if required • Use launch cable to measure the first connector of the link • Ensure OTDR port connector reflectance is < -45 dB

Fiber inspection – The no. 1 step to any OTDR testing

It is well known that bad or dirty connectors in the network are at the root of many problems but did you know that your OTDR/iOLM port is also critical?

Every connector must be inspected and cleaned.
A bad first connector at the OTDR port or launch cable can negatively impact all your test results. It is critical to inspect all connectors manipulated through the test to ensure they are free of any contamination. If dirty, clean properly as per best practices. If damaged, the OTDR must be returned for connector replacement and recalibration.

Quick tip
Using a fully automated probe will transform the critical inspection phase into a quick and simple one-step process.

Traditional OTDR trace

Dirty connector

iOLM link view

Element 1	0,0000 km
Type:	1/1
Loss:	0,607
Reflectance:	-29,9

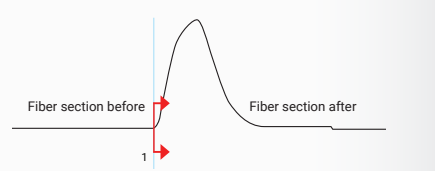
Clean connector

Launch cable

Used together with an OTDR or iOLM, the launch cable (also called a pulse suppressor box, dead zone eliminator or dummy fiber) adds a length of fiber between the OTDR and the network's first connector to cover the OTDR's connector dead zone. This enables loss measurement on the first connector of a fiber under test.

Quick tip
Using a launch cable is good practice. It increases the lifespan of the OTDR connector by reducing the number of matings, thus saving time and money on OTDR connector replacements.

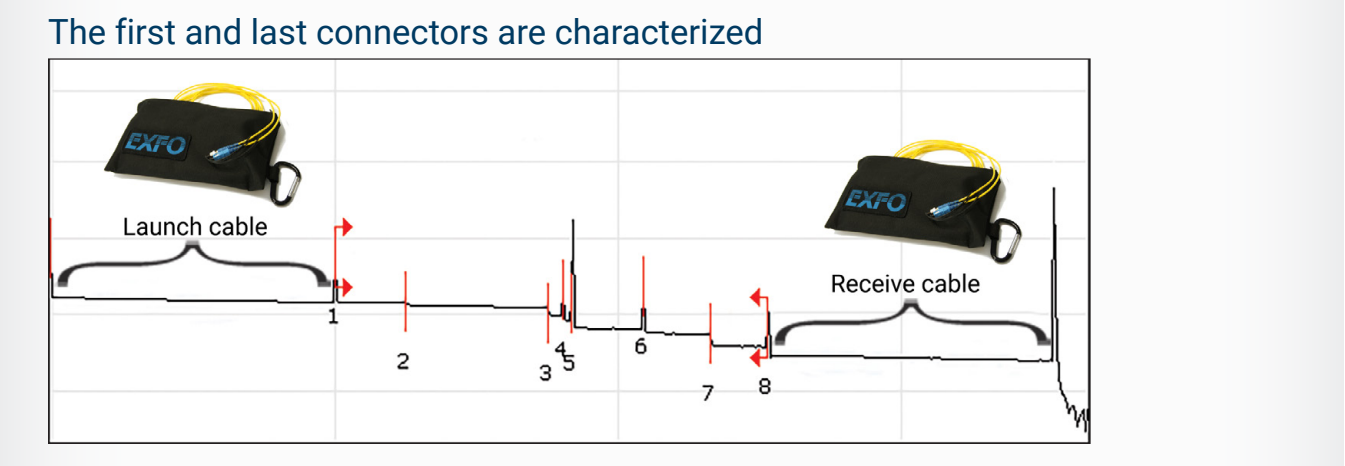
How
The OTDR measures the fiber backscattering level before and after the first connector of the link.



Length
For pulse widths of 100 ns and shorter, the minimum launch cable length recommended is 25 meters. For other pulse widths, use this simplified formula to find the minimum length of the launch cord: Pulse width in ns divided by 10. Convert to meters. Multiply by 2.

Fiber type
It is recommended to use the same type of fiber for the launch cable as the one under test. If you are testing G657 bend-insensitive fibers with a typical G652 standard fiber launch cable, there will be a gain on the first connector of the link—potentially compensating for a high loss connector. You would then get a false positive.

Receive cable
A receive cable may be used at the far end for last connector measurements. Combined to first connector loss, this gives complete end-to-end loss (equivalent to the result obtained using a light source and a power meter with one jumper reference). The continuity of the fiber under test can thus be confirmed.



Multimode (MM) testing
Multimode fibers have a larger core (50 µm or 62.5 µm) than singlemode fibers (9 µm). It is critical to properly match the same fiber core of the launch cable to the test unit and network fibers.

Multimode fibers types and their usage

- Fiber type OM3, OM4, OM5—used for data centers with high-speed links
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Multimode Encircled Flux (EF) launch conditions
For high-speed data networks running under tight loss budget, connector misalignment is a major cause of problems due to quality and tolerance of the connector. Therefore, measuring the first and last connectors of the link is mandatory. Using an external EF conditioner as a launch cable and an appropriate multimode receive cable will provide accurate end-to-end loss results.

Dead zones

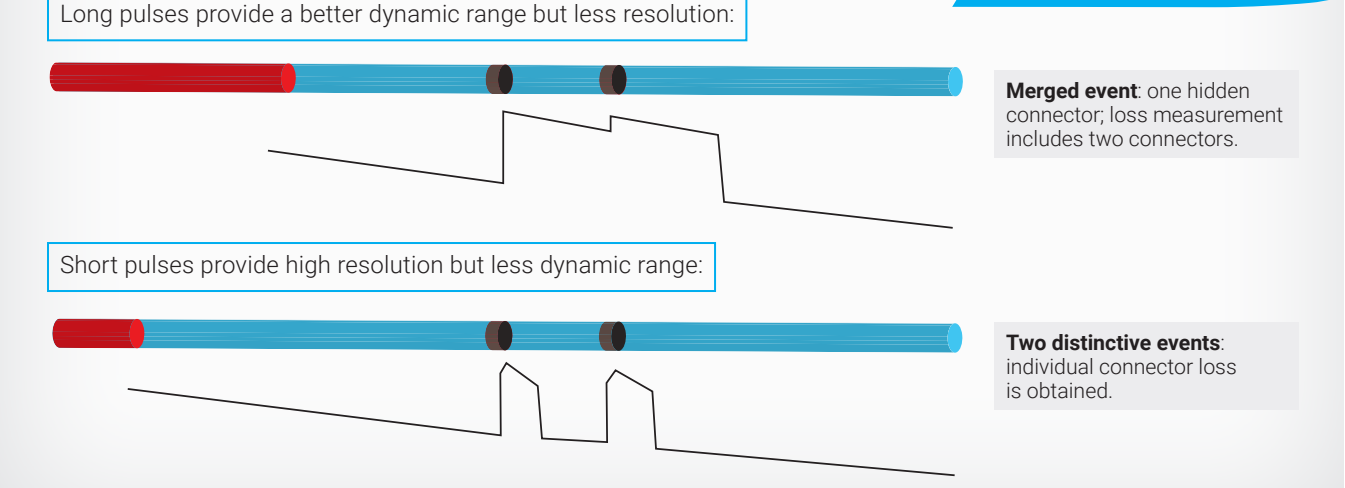
- There are two types of dead zones:
- 1) **Event dead zone:** the minimum distance after a reflective event where an OTDR can detect another event.
 - 2) **Attenuation dead zone:** the minimum distance after a reflective event where an OTDR can accurately measure the loss of a consecutive event.

Dead zones are influenced by pulse width, reflectance and OTDR response.

Reflectance: higher reflectance (i.e., -45 dB) will increase dead zones; lower reflectance (i.e., -55 dB) enables faster recovery, and hence shorter dead zones.

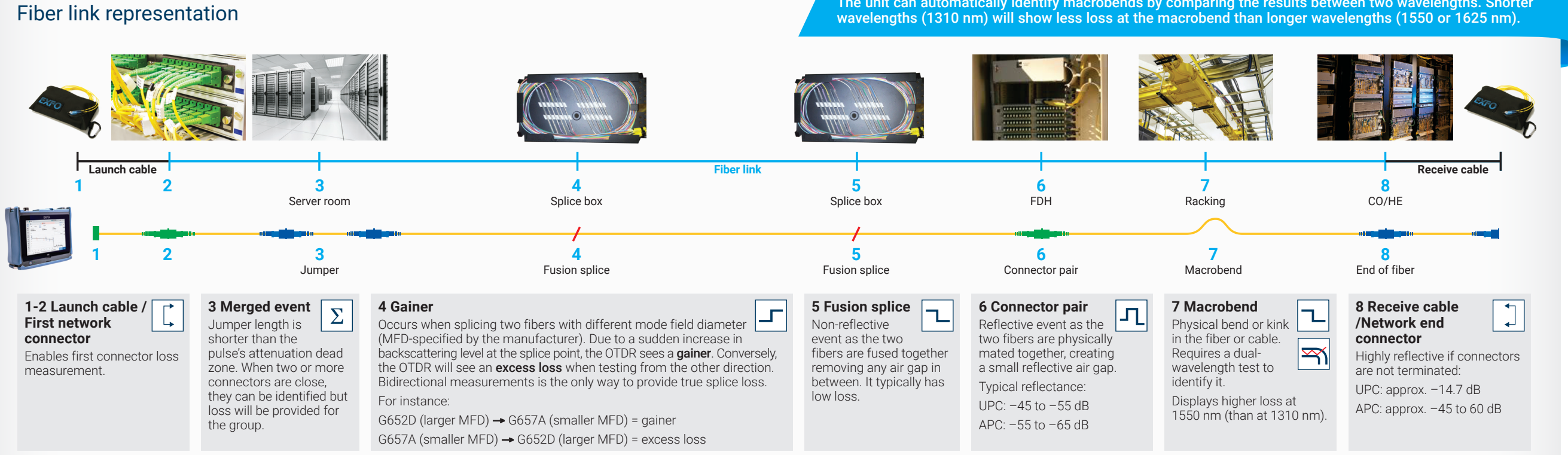


Quick tip
Clean connectors reduce reflectance, which in turn means shorter dead zones.



THERE'S THE TRADITIONAL OTDR METHOD...

Key components and trace analysis



Did you know?
The unit can automatically identify macrobends by comparing the results between two wavelengths. Shorter wavelengths (1310 nm) will show less loss at the macrobend than longer wavelengths (1550 or 1625 nm).

Key features:

- Report:** Automatically generates clear OTDR reports in PDF or XML format.
- Zoom tools:** Zoom and center to facilitate the analysis of your fibers. Draw a window around the area of interest and center in the screen quicker.
- Identification:** Properly document test files (i.e., fiber ID, color, cable ID, operator, location, etc.) before starting to test to facilitate classification and analysis of the files with business-intelligent applications.
- Test configuration:** Define link characteristics, test parameters and thresholds for pass/fail analysis.
- Template:** Define a reference trace and measurements on subsequent acquisitions will be systematically taken at the locations of all markers from reference trace. Recommended for cable commissioning.
- Real-time mode:** Activates OTDR laser in continuous shooting with selected parameters. The OTDR trace is constantly refreshed enabling fiber monitoring for a sudden change or for a quick look at the fiber under test. This mode should not replace complete acquisition due to its lower dynamic range and absence of trace analysis.

Key test parameters:

- Test wavelengths:** Use two or more wavelengths to find macrobends.
- Distance range:** Adjust the range to your link length (adding 10-15% for optimal test results).
- Pulse width:**
 - Short pulse (3 ns) → high resolution, short dead zones, lower dynamic range.
 - Long pulse (20 µs) → lower resolution, long dead zones, high dynamic range.
- Duration:** Quick five-second acquisition can be used to find fiber breaks. For more accurate results, durations of 30-45 seconds are recommended.
- Automode:** Automatically sets the distance range, duration and best compromise pulse width for the link under test. Recommended for discovering the link under test or fiber breaks.

Did you know?
You can change test parameters on the fly at any time during the current acquisition. Adjust the parameters and the unit will automatically start a new acquisition.

...AND THEN THERE'S THE iOLM

intelligent Optical Link Mapper (iOLM)



A better way to test fiber optics

iOLM
iOLM is an OTDR-based application designed to simplify OTDR testing by eliminating the need to analyze and interpret multiple complex OTDR traces. Its advanced algorithms dynamically define the testing parameters, as well as the number of acquisitions that best fit the network under test. By correlating multipulse widths on multiple wavelengths, iOLM locates and identifies faults with maximum resolution—all at the push of a single button.

How it works?

- Dynamic multipulse acquisition:** iOLM adjusts test parameters dynamically for ANY link under test—using a mix of short, medium and long pulses as needed.
- Intelligent trace analysis:** Based on the multiple acquisitions and with the help of advanced algorithms, iOLM is able to detect more events with maximum resolution.
- Combine all results in a single link view:** Results are visually displayed in an icon-based fiber-link view to quickly assess each event's pass/fail status per standard selected, eliminating any risk of misinterpretation.
- Comprehensive diagnosis:** Delivers an analysis of failed events and suggests solutions, guiding the technicians in fixing the fault quickly and successfully.

Turning traditional OTDR testing into clear, automatized, first-time-right results for any technician.

Test configuration
Create and share with your peers as many test configurations as needed for every specific job or network type. Test configurations define the pass/fail criteria, and the network type (i.e., P2P or with PON splitters).

Did you know?
iOLM can generate an OTDR trace in universal Belcore format (.sor) for use with any OTDR viewer.

iOLM testing methodologies

Bidirectional testing
Bidirectional averaging testing is used for accurate splice loss measurement and is recommended in any type of application with singlemode, P2P fiber links.

Traditional bidirectional OTDR view

Single OTDR pulse with A to B and B to A directions

Single iOLM bidirectional view

Combining multipulses, multiwavelengths and multidirections

Loopback testing (iOLM)

Loopback testing

- Loops two fibers together at one end to test both fibers at once
- Software application will distinguish between the fibers in the reporting
- Particularly efficient in short- to medium-range fiber deployments
- Allows to test both upstream and downstream links with a single port—ideal for FTTA or DAS applications

Key benefits of using loopback testing

- 50% less testing time
- Single-ended test: less test equipment is required
- Performing loopback testing with two technicians requires minimal expertise from the second technician
- Distinct results for each fiber tested in loop (both OTDR and iOLM)
- Intuitive link view (iOLM) or traditional graphical view (OTDR) to identify loop section easily

There are no ideal settings

When testing with an OTDR, it is key to determine optimum parameters providing enough dynamic range with the highest resolution possible. To compensate OTDR technology limitations, **more than one OTDR trace** is often required to find all the events on the link.

Using different pulse widths and multiple wavelengths overcomes this limitation.

- 1- SHORT PULSE**
To measure the front-end of your link high resolution, not enough dynamic range to measure through the splitter.
- 2- MEDIUM PULSE**
To measure high loss splitters: best compromise between resolution and dynamic range.
- 3- LONG PULSE**
To reach the fiber end and get an accurate end-to-end loss measurement: high dynamic range, lower resolution.

Choose the right OTDR

Each fiber optic application has its specific testing requirements. The right OTDR must be used for the right purpose. OTDRs can be manufactured to provide more resolution, more power, dedicated wavelengths or any other specific aspect to optimize your test results.

Applications	Test equipment requirements
LAN/WAN DATA CENTERS ENTERPRISE/PRIVATE NETWORKS POINT-TO-POINT (P2P) ACCESS	<ul style="list-style-type: none"> • Short dead zones to locate closely spaced events • Multimode and singlemode testing in a single unit • Encircled Flux (EF) multimode launch conditions for maximum loss measurement accuracy • Single-button certification with clear "go/no-go" status • On-board pass/fail thresholds compliant with the latest international standards (including TIA-568, ISO11801) for data center certification
FTTA REMOTE RADIO HEAD (RRH) DAS/SMALL CELLS CELL BACKHAUL CATV	<ul style="list-style-type: none"> • Dynamic range optimized for troubleshooting performance and accuracy on short links • Automated bidirectional testing feature to certify Rx/Tx cable in one go
FTTx LAST-MILE FTTH/PON FTTH/MDU PASSIVE OPTICAL LAN (POL) SHORT METRO	<ul style="list-style-type: none"> • Dynamic range and resolution optimized at intermediate pulse widths for accurate 1x28 splitter detection and measurement • In-service testing with filtered 1625 or 1650 nm wavelength • Unique in-line power meter allowing checking the optical power at 1490/1550 nm before troubleshooting with the OTDR. This on a single port with no disconnection between both measurement to ensure a smooth workflow • 39 dB dynamic range to characterize any P2P networks from access to short metro links
METRO/CORE CWDM LONGHAUL DWDM	<ul style="list-style-type: none"> • Dynamic range above 40 dB to test metro/core or longhaul links • High resolution at shortest pulse widths to account for many closely spaced splice points • Specific ITU-grid CWDM wavelengths to test through add/drop or MUX/DEMUX
ULTRA-LONGHAUL SUBMARINE CABLES	<ul style="list-style-type: none"> • Test reach up to 250 km • Highest dynamic range possible (up to 55 dB) for deploying and maintaining long fiber spans typically seen in ultra-longhaul and high-speed networks

EXchange
SHARE TEST RESULTS AND ENSURE COMPLIANCE VIA THE CLOUD

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Get started

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