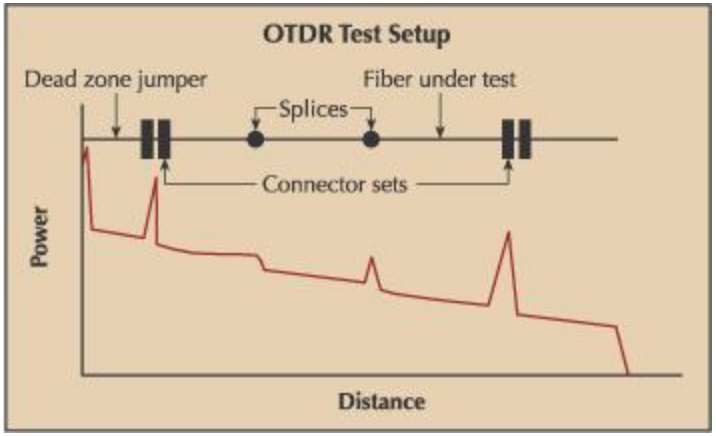
Optical Time Domain Reflectometer (OTDR)



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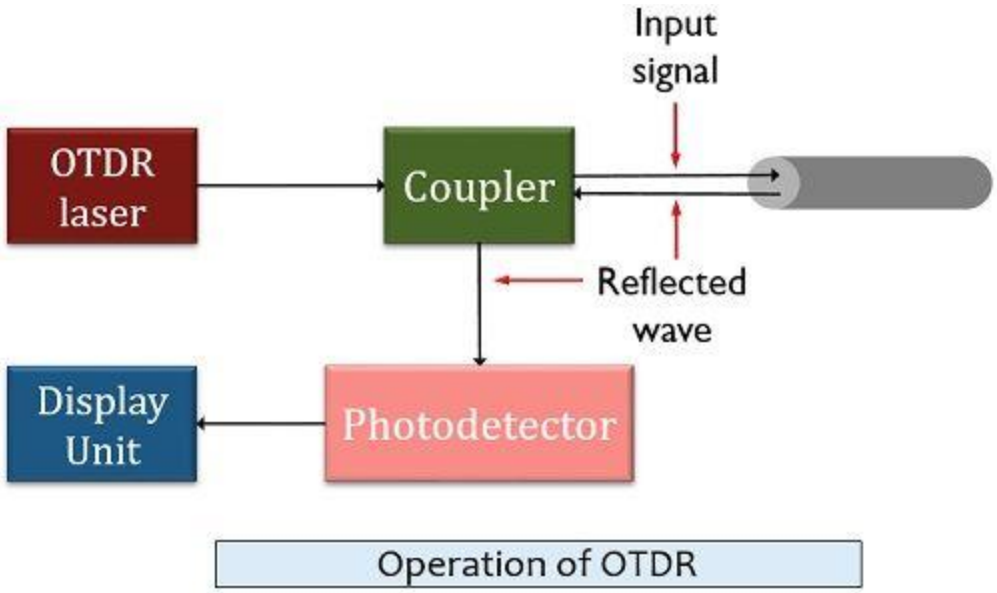
OTDR

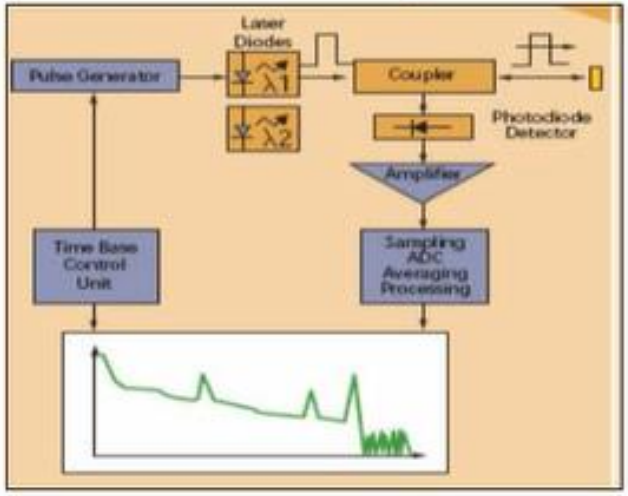
- It is a fiber optic instrument used to characterize, troubleshoot and maintain optical telecommunication networks.
- OTDR testing is performed by transmitting and analyzing pulsed laser light traveling through an optical fiber.
- The measurement is said to be unidirectional as the light is insert at extremity of a fiber optic cable link.



Operation of OTDR

- **OTDR** injects light pulse & analyzes the backscatter and reflected signal
- Received signal is plotted into a backscatter X/Y display in dB vs. distance
- Analyzes events to populate table of results

OTDR Block Diagram



Example of an OTDR trace

Most important fiber tester for installation, maintenance & troubleshooting

T-BERD/MTS 2000 indoor/outdoor screen

- **Locate event / impairments:**
  - Physical distance in m, Km, Ft, KFt, Mi
- **Detect impairments:**
  - Splice, bends, connectors, breaks
- **Measure loss:**
  - Fiber attenuation
  - Loss of connector, splice
  - Return loss & Reflectance
- **Trigger alarms:**
  - User defined thresholds
- **Easily generate report:**
  - Simplified pdf report generation

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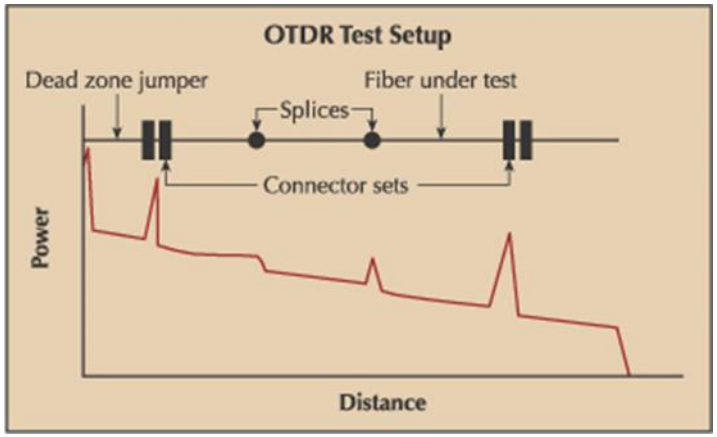
What does an OTDR Measure ?

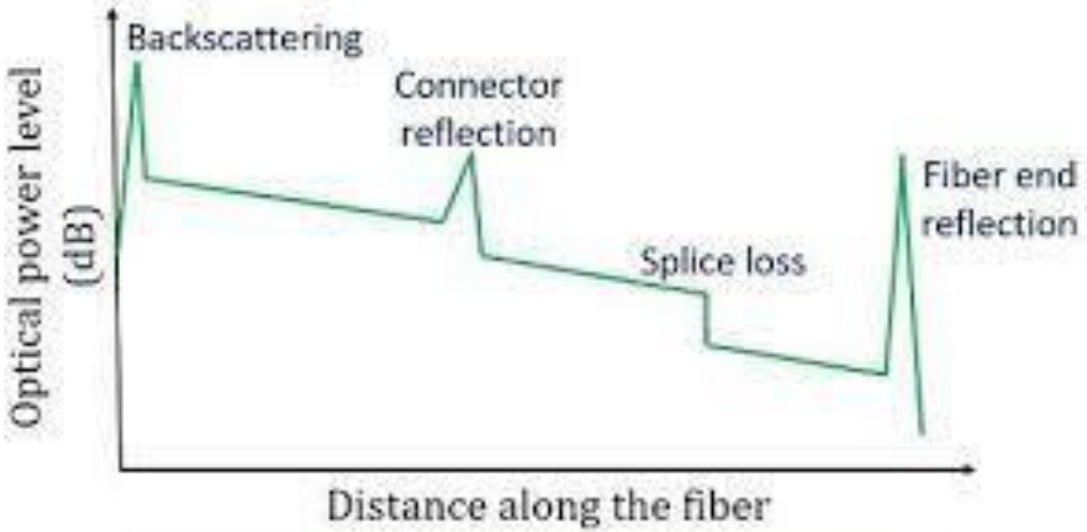
- **Distance**
  - The OTDR measurement is based on “Time”:
  - Measure round trip time of pulse
  - Known:
    - Speed of light in Vacuum
    - Index of Refraction of Fiber
  - Calculate distance

$$\text{Fiber distance} = \frac{\text{Speed of light (vacuum) X time}}{2 \times \text{IOR}}$$

Nb Evts : 4 Link Orl : 30.11 dB

Event	Distance m	Loss dB	Reflect. dB	Slope dB/km	Length m	T. Loss dB
1	484.73	0.069			484.73	1.007
2	502.64	0.200	-66.12		17.91	1.074
3	508.39		-58.66		5.76	1.076
4	2008.64		-27.95	0.231	1500.24	1.624

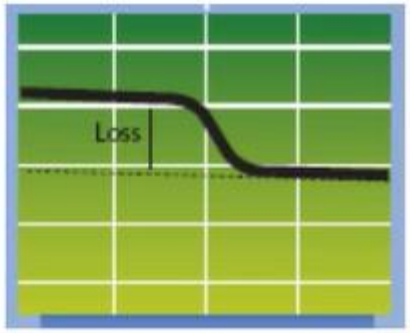




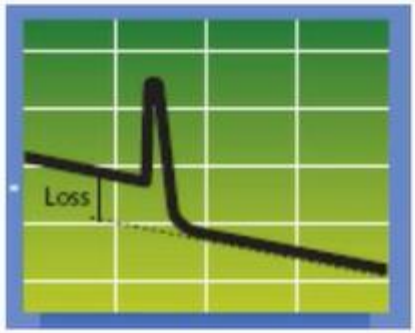
Representation of trace of OTDR

▪ Event Loss

Difference in optical power level before and after an event, expressed in dB



Fusion Splice or
Macrobend



Connector or
Mechanical Splice

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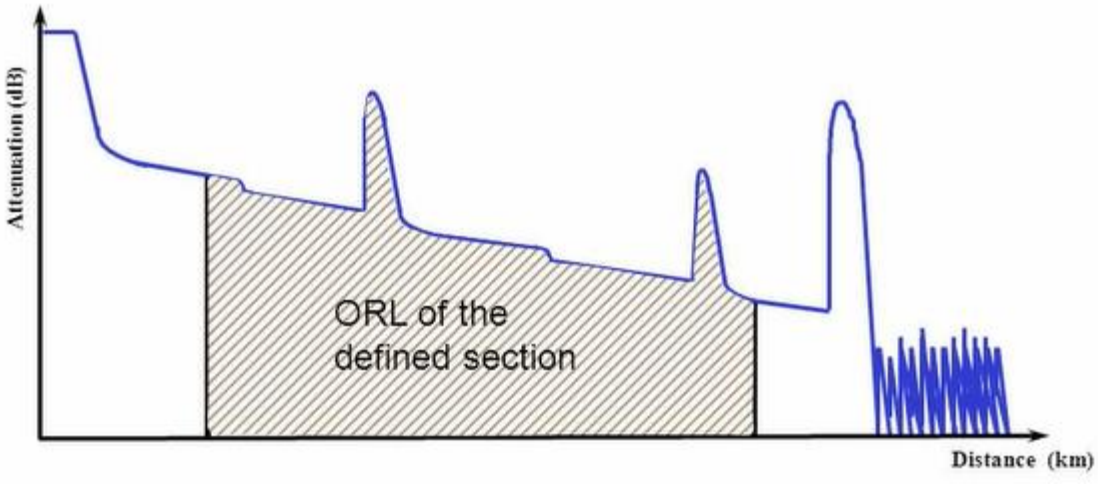
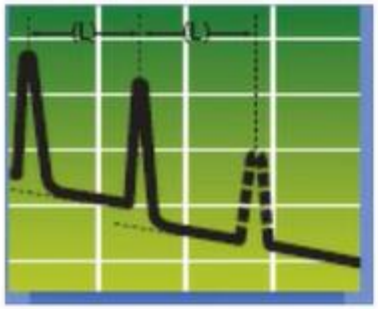
▪ Optical Return Loss (ORL)

Amount of light reflected back from a feature

OTDR is able to measure not only the total ORL of the link but also section ORL





A **Ghost** is an unexpected event resulting from a strong reflection causing "echoes" on the trace

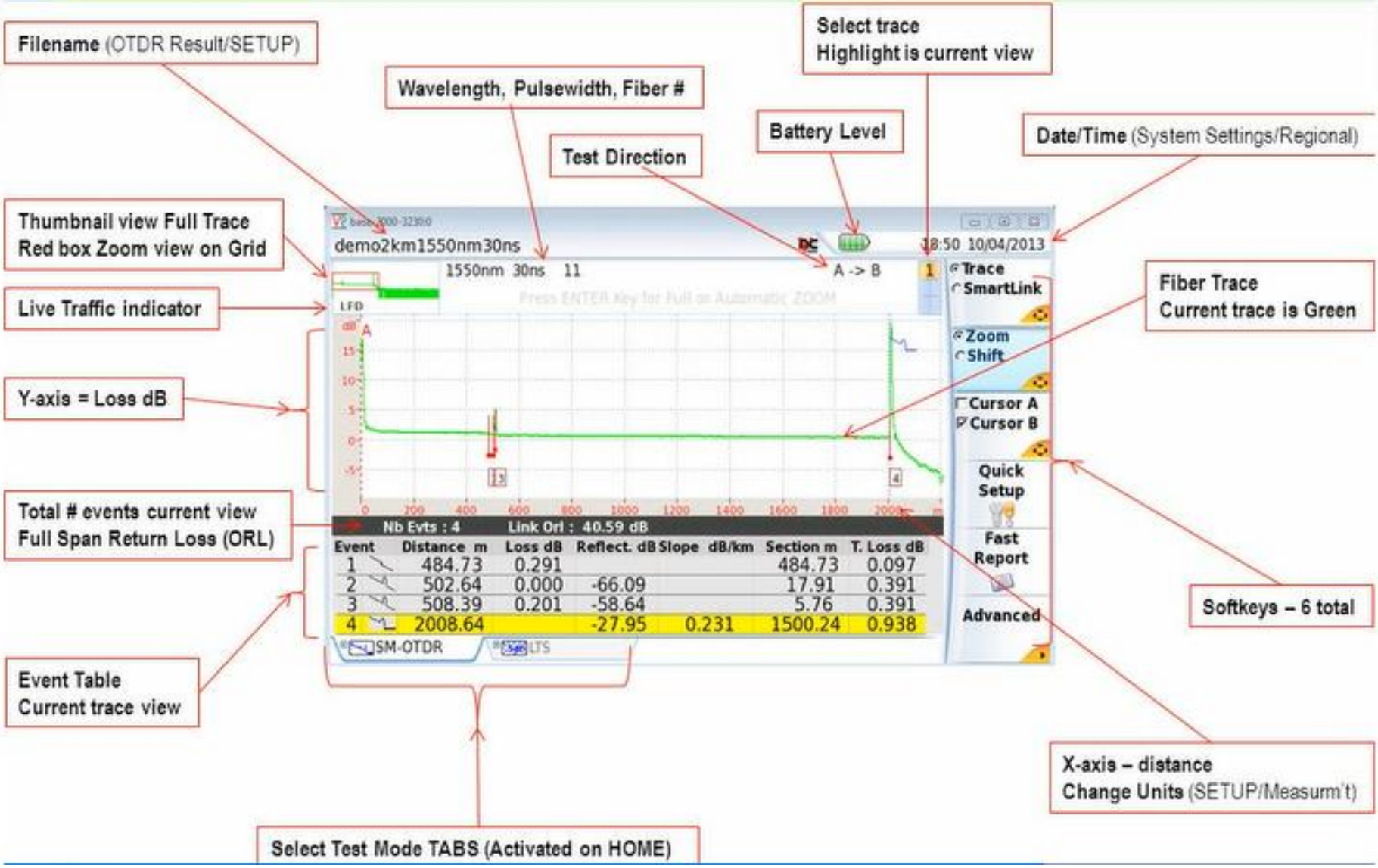
When it appears it often occurs after the fiber end.

It is always an exact duplicate distance from the incident reflection.

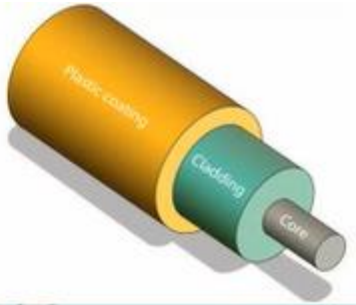
Normally seen after the end of fiber.

Reflectance: **Lower than echo source**

Insertion Loss: **None**


Filename (OTDR Result/SETUP)
Wavelength, Pulsewidth, Fiber #
Select trace
Highlight is current view
Battery Level
Date/Time (System Settings/Regional)
Test Direction
Thumbnail view Full Trace
Red box Zoom view on Grid
Live Traffic indicator
Fiber Trace
Current trace is Green
Y-axis = Loss dB
Total # events current view
Full Span Return Loss (ORL)
Softkeys – 6 total
Event Table
Current trace view
X-axis – distance
Change Units (SETUP/Measurm't)
Select Test Mode TABS (Activated on HOME)
demo2km1550nm30ns
18:50 10/04/2013
1550nm 30ns 11
A -> B
Trace
SmartLink
Zoom
Shift
Cursor A
Cursor B
Quick Setup
Fast Report
Advanced
Nb Evts : 4
Link Orl : 40.59 dB
Event Distance m Loss dB Reflect. dB Slope dB/km Section m T. Loss dB
1 484.73 0.291 484.73 0.097
2 502.64 0.000 -66.09 17.91 0.391
3 508.39 0.201 -58.64 5.76 0.391
4 2008.64 -27.95 0.231 1500.24 0.938
SM-OTDR
LTS

- 2 types:
  - Singlemode
  - Multimode



Main type	Characteristics	Typical dimensions	Lightwave propagation	Index Profile
Singlemode	- Low attenuation - 1260 to 1640 nm transmission wavelengths - Access/medium/long haul networks (>200km) - Nearly infinite bandwidth	8µm to 12µm 125µm 250 to 900µm	n1 ≈ 1.457 n2 ≈ 1.471	
Multimode (graded index)	- High attenuation - 850 to 1300 nm transmission wavelengths - Local networks (<2 km) - Limited bandwidth	50µm 62.5µm 125µm 250 to 900µm	n1 ≈ 1.540 n2 ≈ 1.540 to 1.562	

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Common Connector Type

SC Commonly referred to as Sam Charlie

ST Commonly referred to as Sam Tom

FC Commonly referred to as Frank Charlie

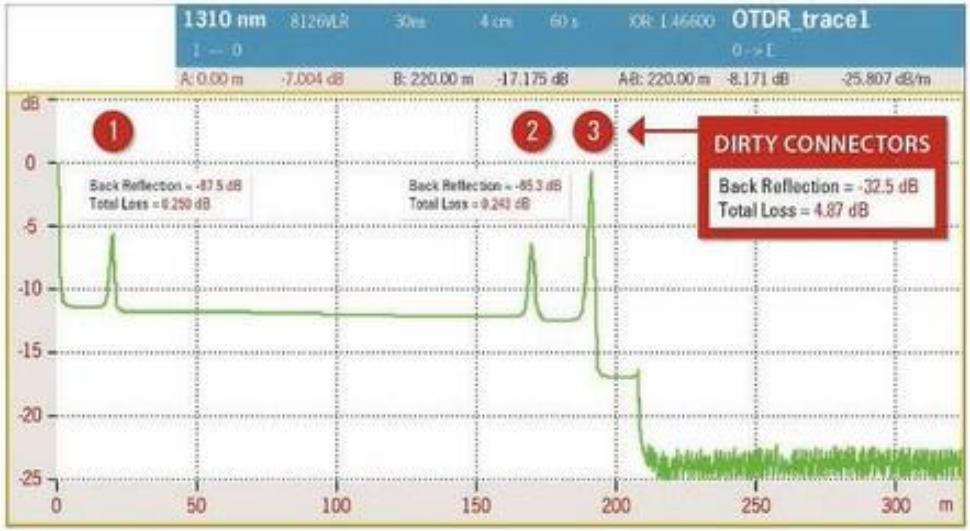
LC Commonly referred to as Lima Charlie

Contamination and Signal performance

Back Reflection = **-67.5 dB**
Total Loss = **0.250 dB**

Back Reflection = **-32.5 dB**
Total Loss = **4.87 dB**

Fiber Contamination and Its Affect on Signal Performance



Clean Connection vs. Dirty Connection

This OTDR trace illustrates a significant decrease in signal performance when dirty connectors are mated.

THANK U