การใช้งานเครื่องมือทดสอบสายเคเบิลใยแก้วนำแสง

การใช้งานเครื่องมือทดสอบสายเคเบิลใยแก้วนำแสง

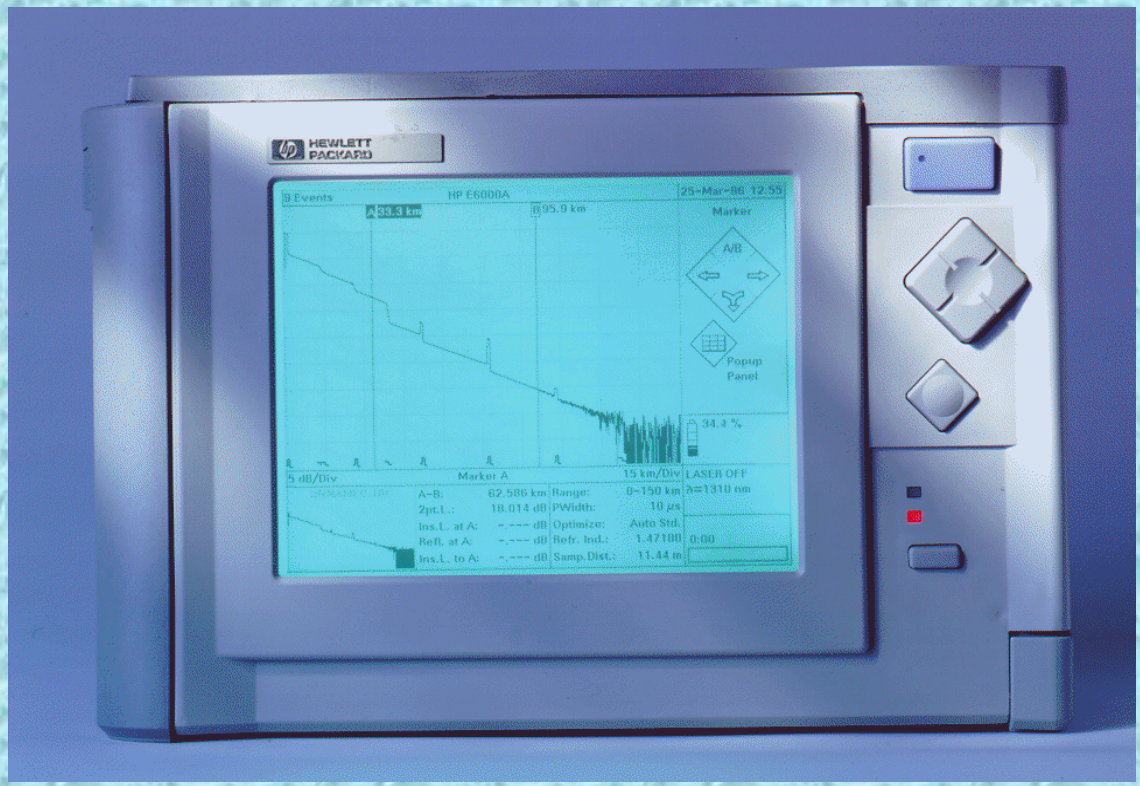
Pipat ratanakot
Senior Engineer

Lightwave Test Equipment

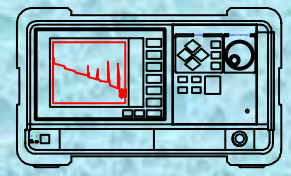
- Remote Fiber Testing Systems
- **OTDRs/Mini-OTDR's**
- Handheld Test Sets

- Optical Switches
- Power Meters
- Attenuators
- Fixed Sources/Broad and Narrowband
- Loss Test Sets
- Tunable Sources
- Optical Spectrum Analyzers
- Polarization Analyzers
- Polarization State Controllers
- Lightwave Precision Reflectometers
- Lightwave Component Analyzers
- Lightwave Signal Analyzers
- Lightwave Communication Analyzers
- Chromatic Dispersion Test Systems
- Optical Amplifier Test Systems

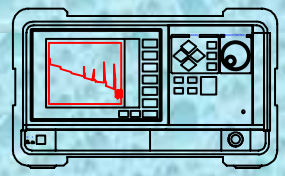
การใช้งานอุปกรณ์ทดสอบ Optical Time Domain Reflectometer



OTDR Measurements Agenda



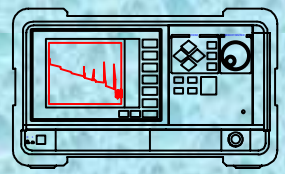
- **Basic Terms**
- Fibers and Connectors
- OTDR Measurements

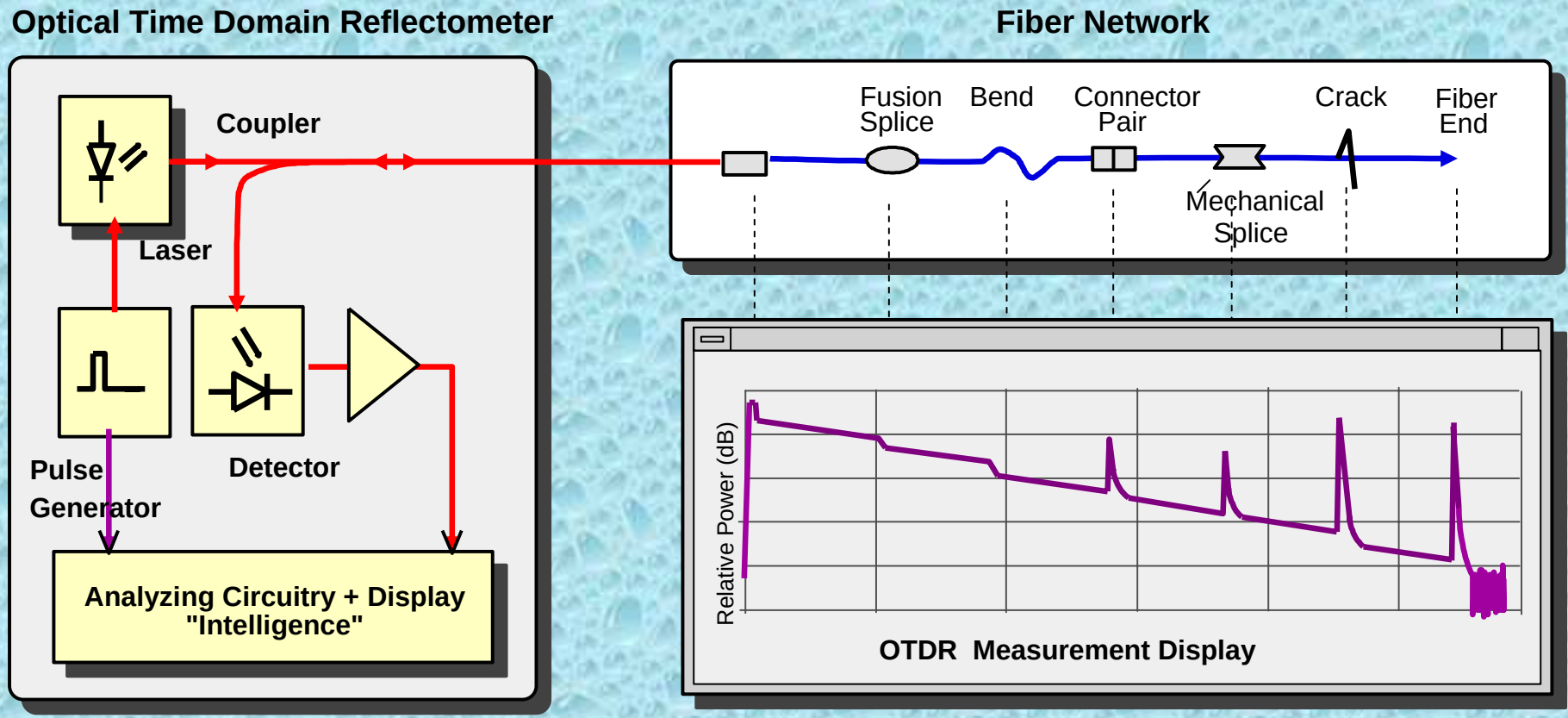


Basic Terms

- OTDRs
- Backscatter
- IOR - Index of Refraction
- Non-Reflective Events
- Reflective Events
- Fiber End

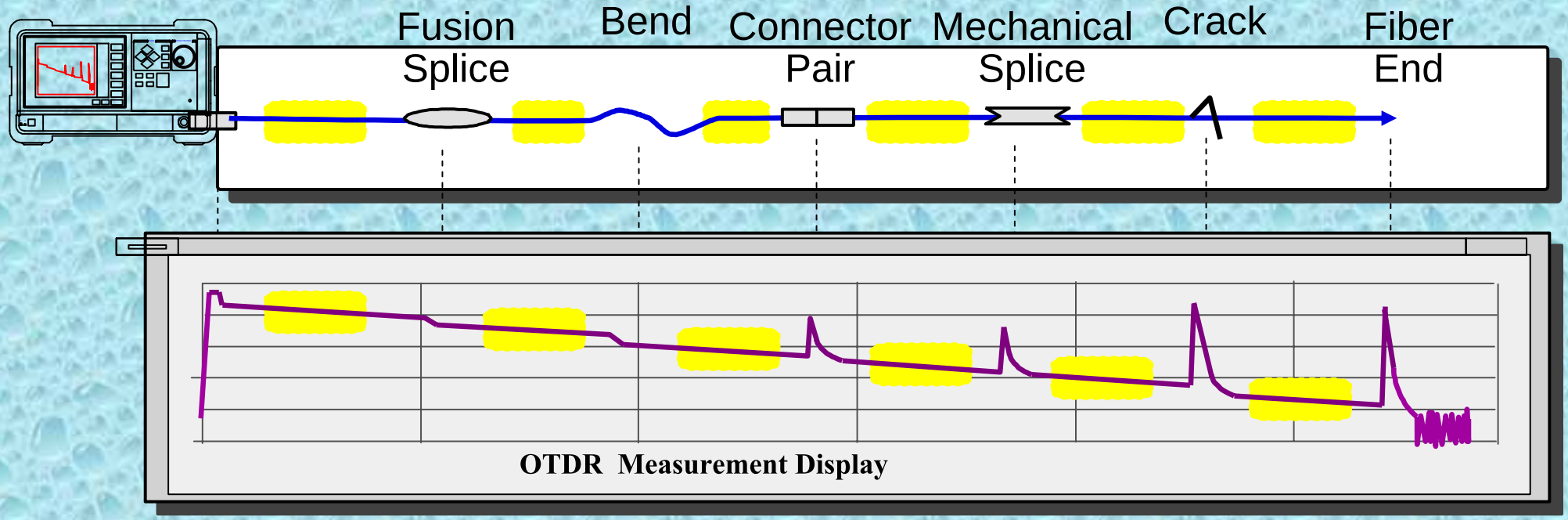
What is an OTDR ?

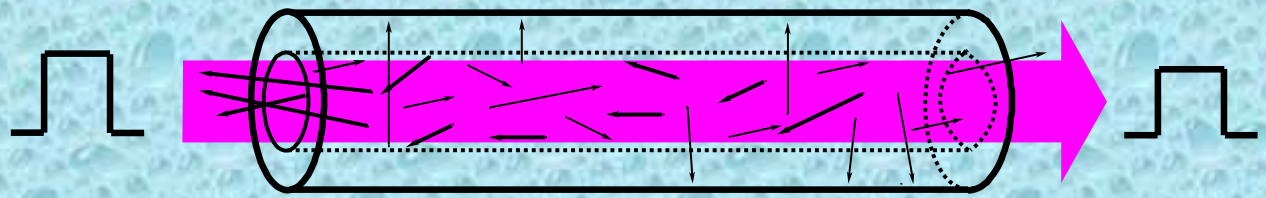




OTDR's are the primary installation and maintenance tool for optical links

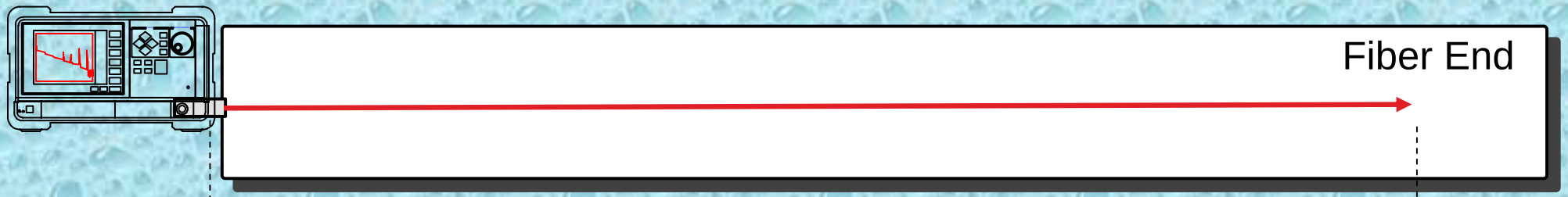
Backscatter





Backscatter is the small part of the Raleigh scattering which returns to the OTDR

Index Of Refraction - IOR

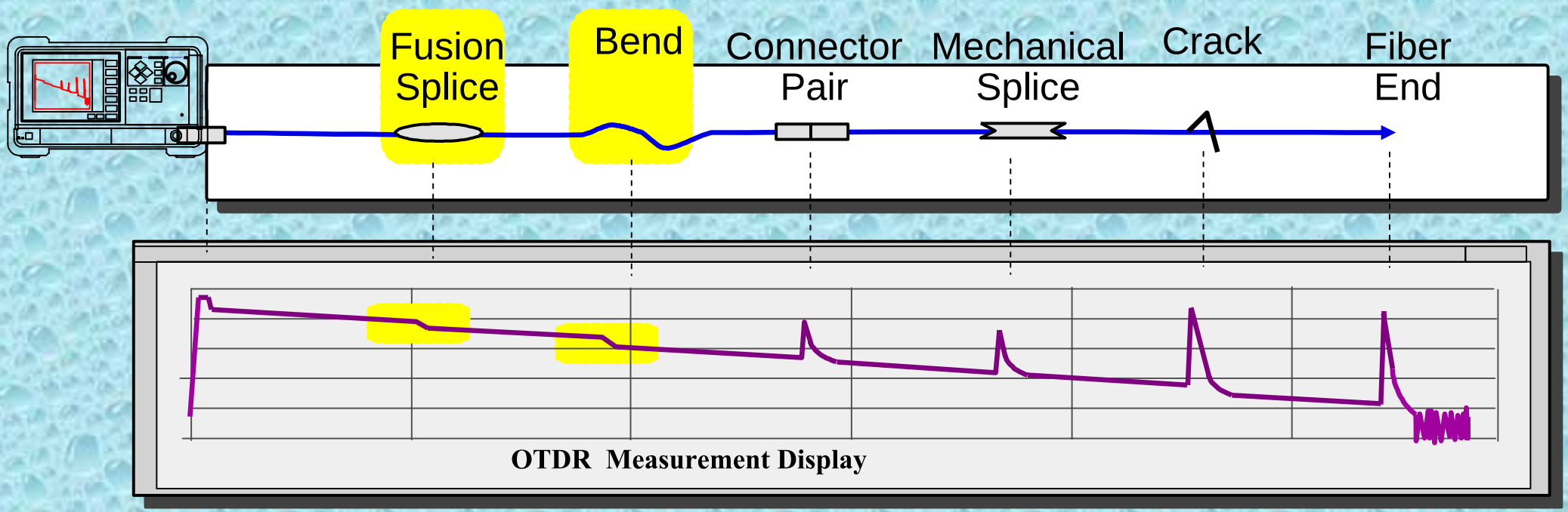


IOR for the fiber under measurement must be accurately known, and entered into the OTDR.

IOR is typically between 1.4 and 1.5.
Exact value supplied by the cable manufacturer

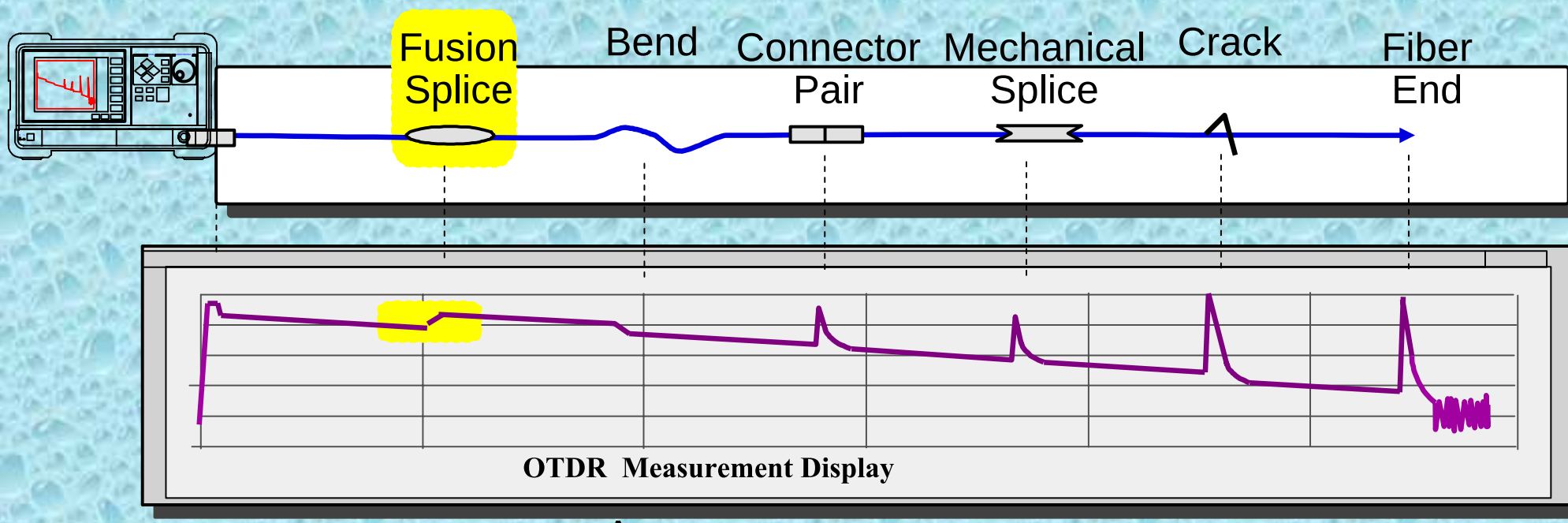
Index of refraction is a number, n, used to express the ratio of the speed of light in vacuum to the speed of light in the fiber.

Non-Reflective Events

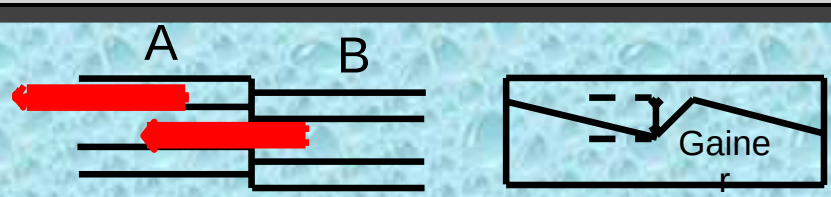


Fusion splices and bends cause loss, but no reflection.
Their signatures are similar on an OTDR display.

Gainer Phenomena

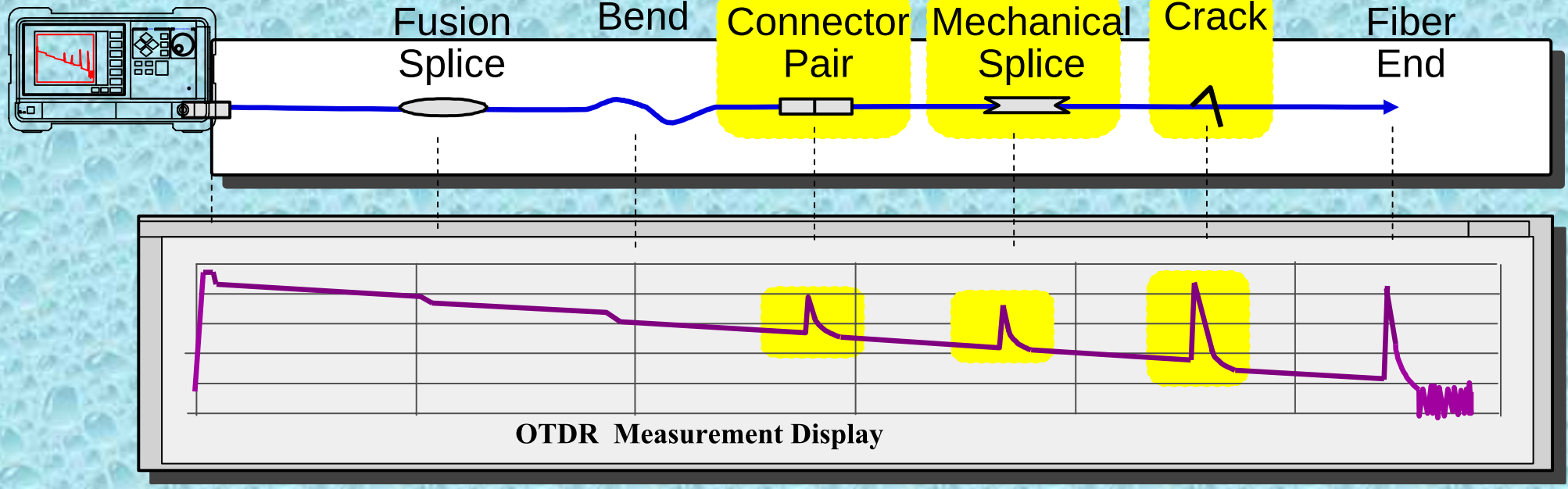


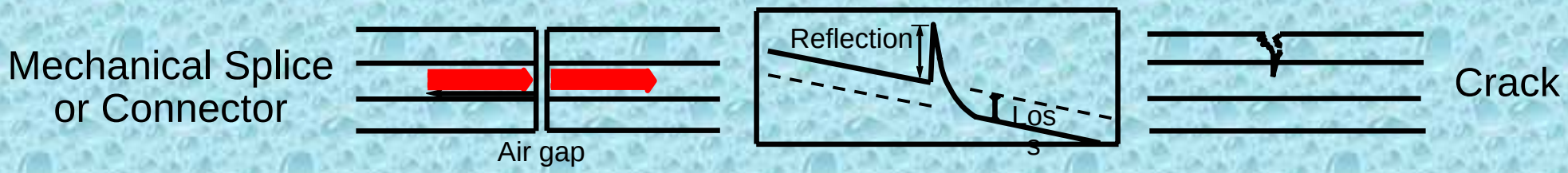
Backscatter coefficient
Fiber B > Fiber A



To find the "real" splice loss, measure the splice from both sides and take the average

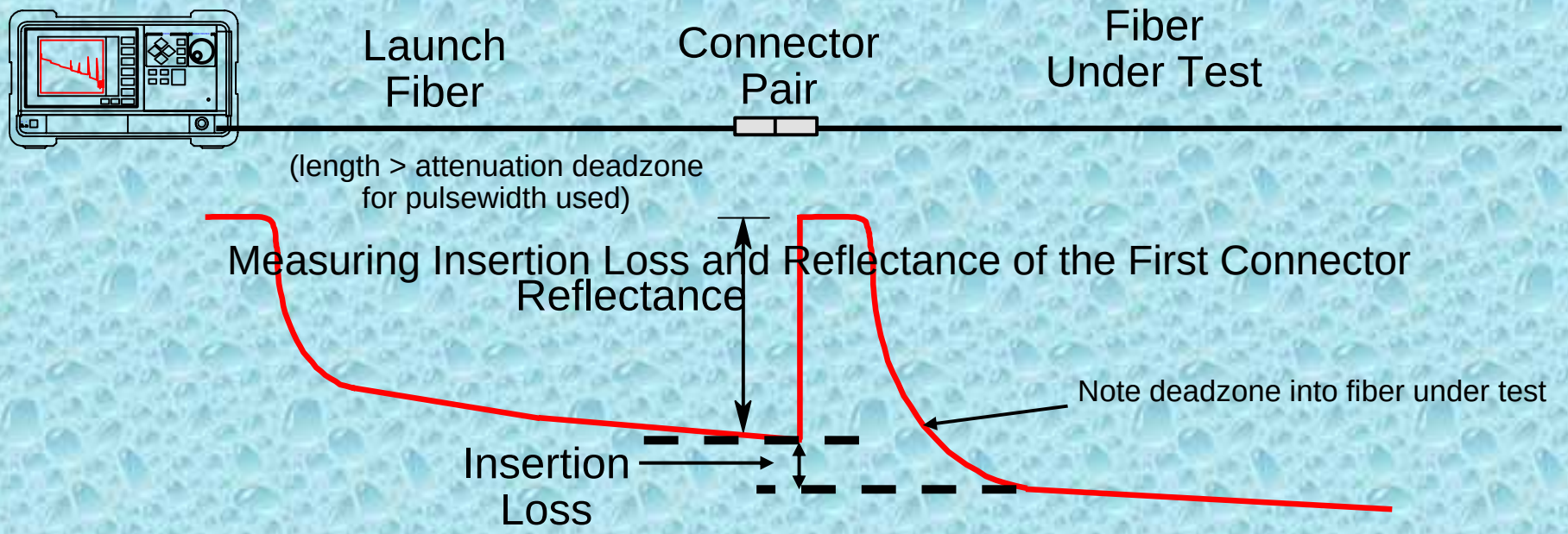
Reflective Events





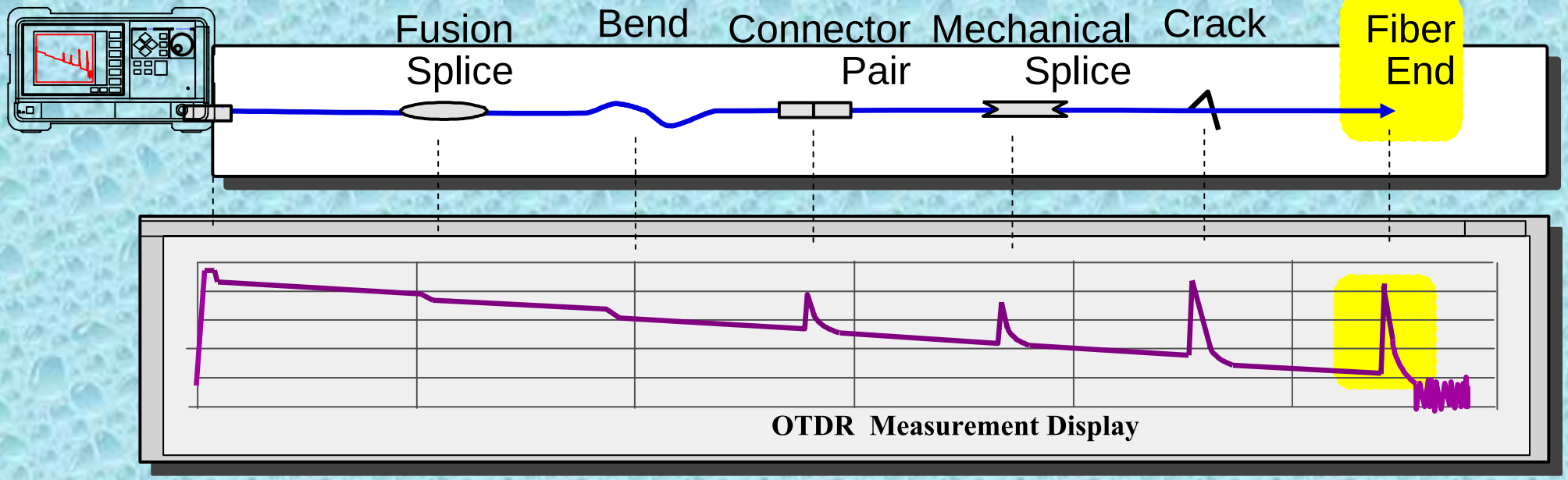
Mechanical splices, connectors and cracks cause both reflections and loss. Their signatures are similar on an OTDR display

Measuring Insertion Loss and Reflectance of the First Connector



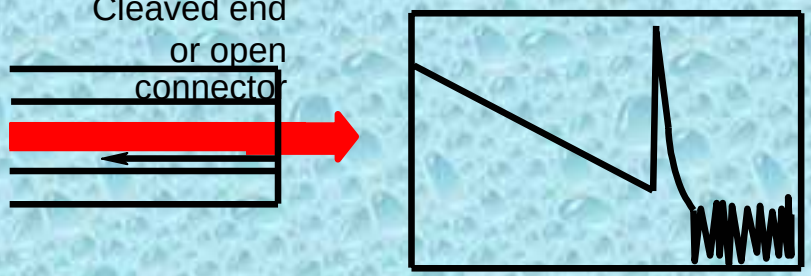
Either an external or "built-in" connectorized launch fiber can be used so that the first connector's insertion loss and reflectance can be measured

Fiber-End



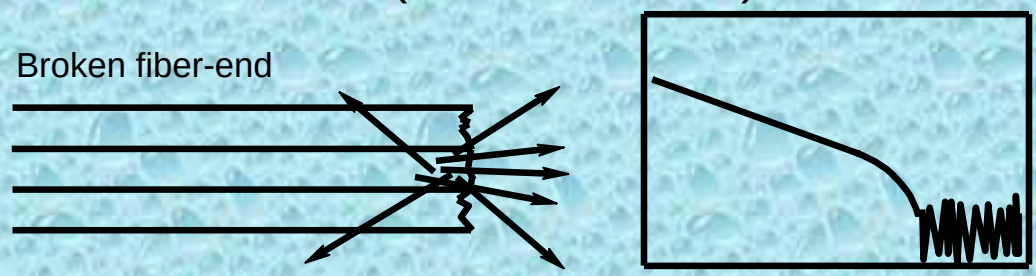
(Reflective)

Cleaved end or open connector

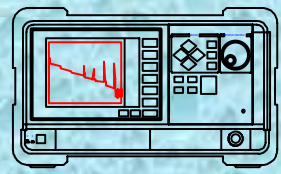


(Non-Reflective)

Broken fiber-end

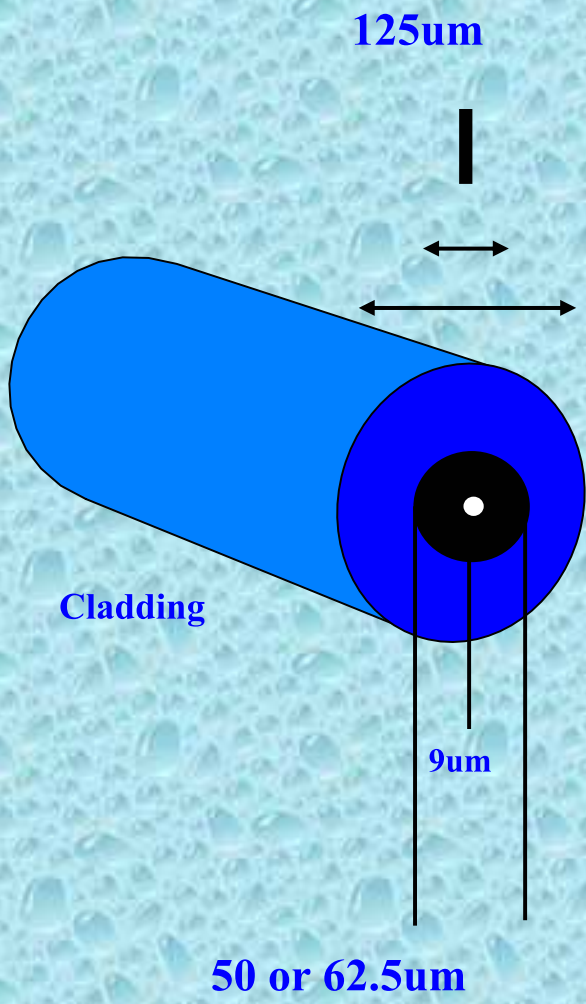


OTDR Measurements Agenda



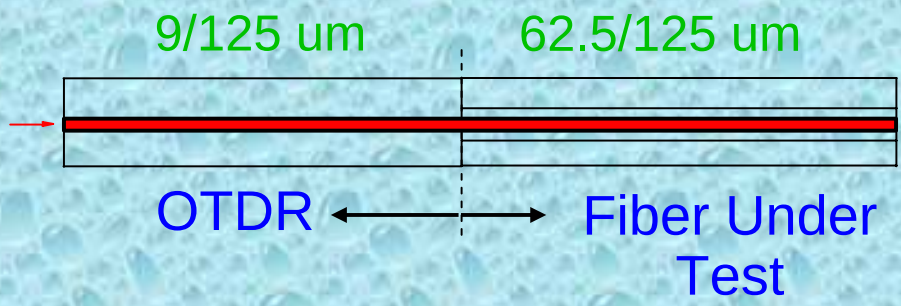
- Basic Terms
- **Fibers and Connectors**
- OTDR Measurements

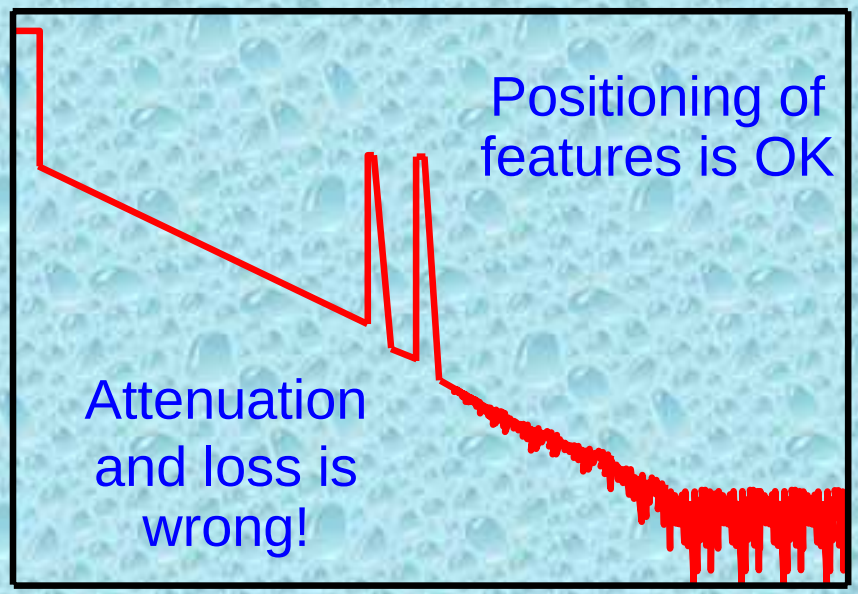
Commonly used Fibers



- Singlemode fiber 9/125um
- Multimode fiber 50/125um and 62.5/125 um

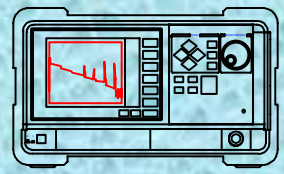
What happens if a singlemode module is used to measure a multimode fiber ?

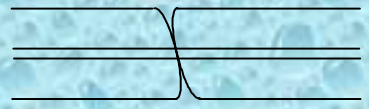




You can use the OTDR to locate features or breaks for a larger fiber core diameter, but not to measure loss accurately

Common Connector Types Used with OTDRs

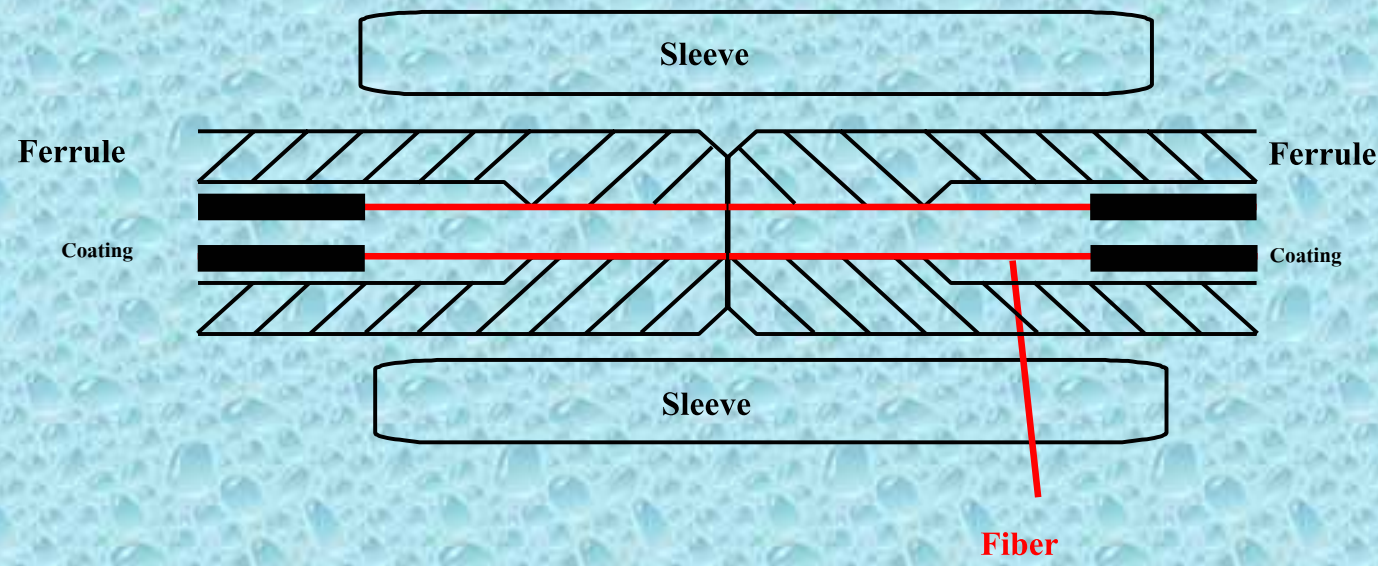


Air Gap (straight)	Physical Contact (straight)	Physical Contact (Slanted)
		
■ Worst return loss: < 14 dB (Fresnel)	■ Good return loss: > 30 dB	■ Best return loss: > 60 dB
■ Common multimode fiber connector	■ Common single-mode fiber connector	■ Used in high-speed telecom and CATV links

A physical-contact, angled-type connector on the OTDR could reduce deadzones

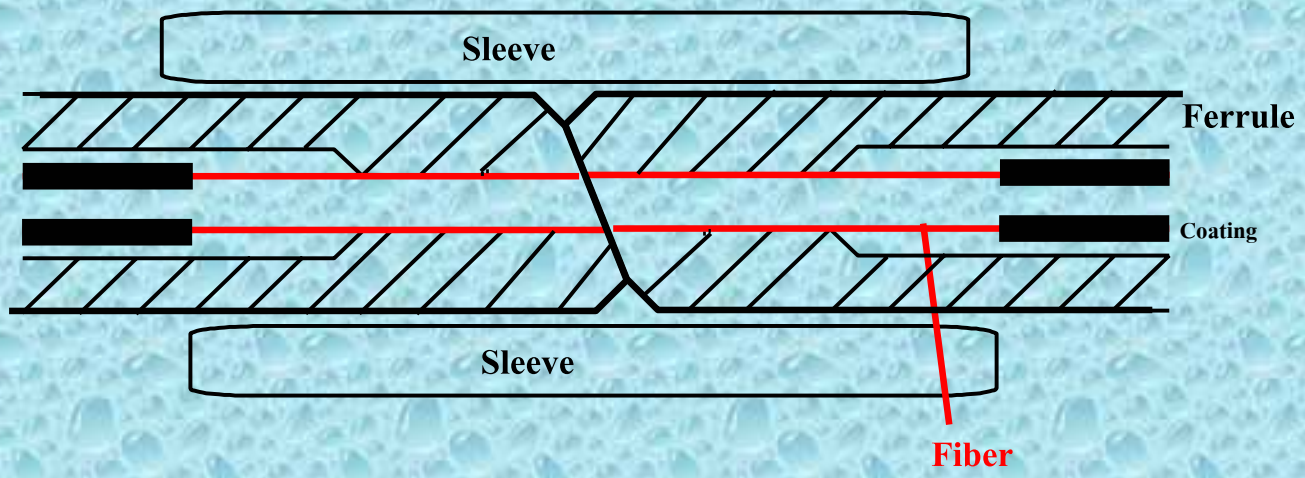
Fiber Connectors

- Fiber connector of the straight contact type, such as FC/PC.
  - insertion loss of 0.1 to 0.3 dB
  - return loss up to 45 dB



Fiber Connectors

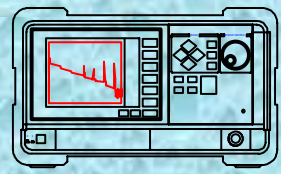
- Fiber connector of the angled - contact type, such as FC/APC
  - 8 degree angle on polished face
  - insertion loss of 0.2 to 0.5 dB
  - best return loss of 60 dB or more



Cleaning Connectors

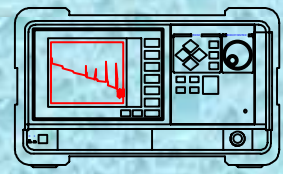
- Clean undamaged connectors are essential for good measurements !
  - Turn off the lightsource
  - Inspect all connectors, if damaged, exchange.
  - clean using good proven procedures, like those shown in the Pocket Guide.

OTDR Measurements Agenda



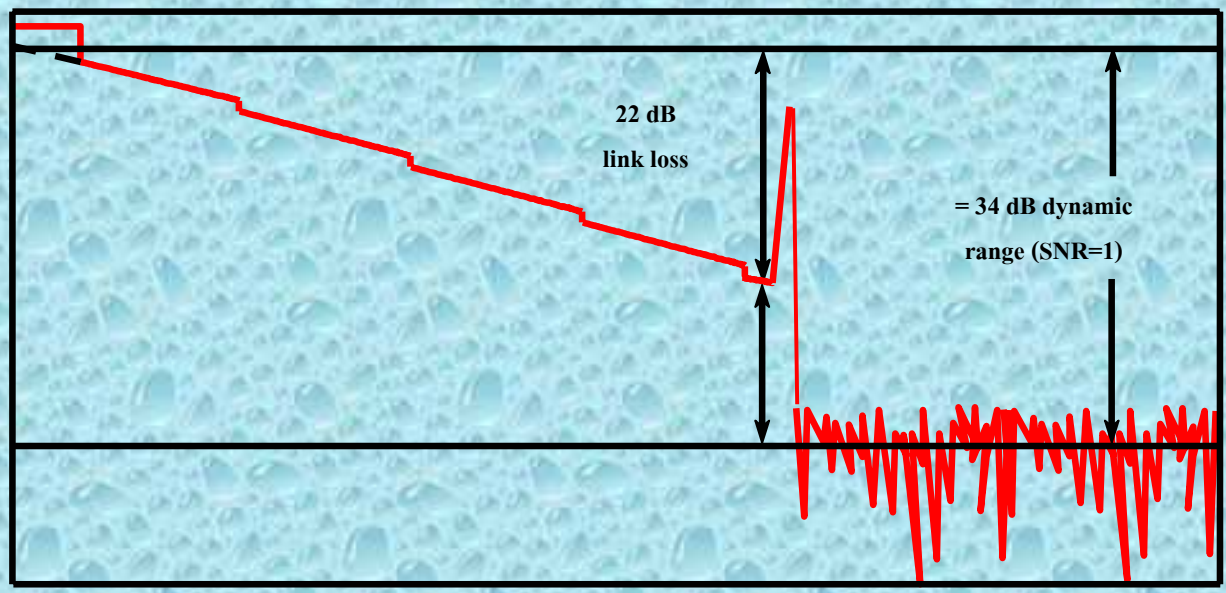
- Basic Terms
- Fibers and Connectors
- **OTDR Measurements**

Performance Parameters



- Dynamic Range
- Dead zone
- Distance Accuracy
- OTDR Design

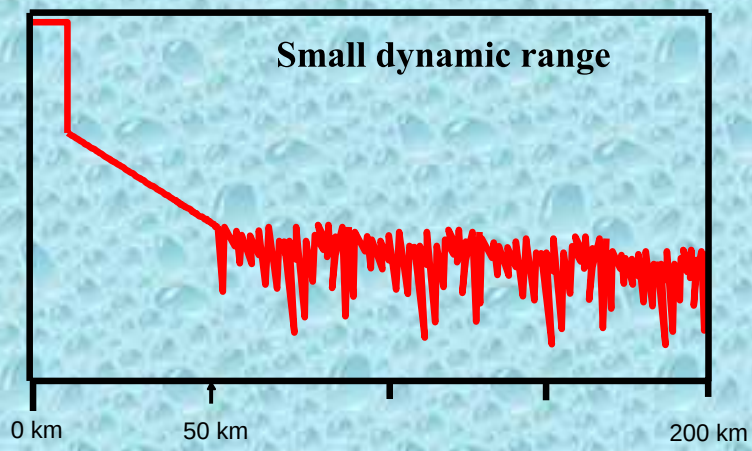
The Need for Large Dynamic Range

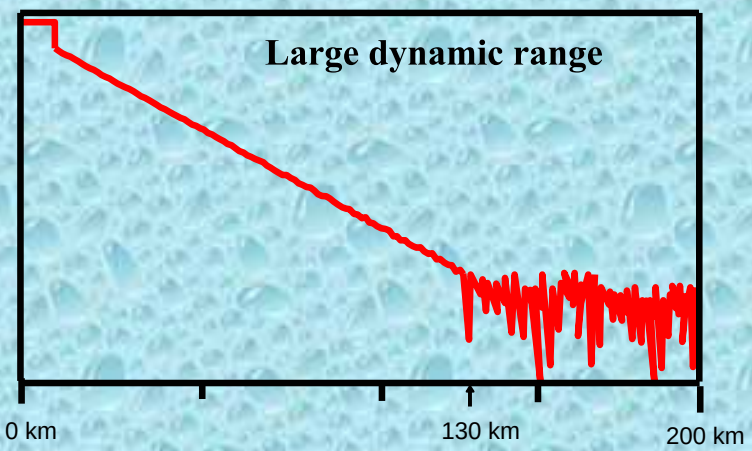


Splice Loss	Required Signal/Noise Ratio
0.1 dB	8.5 dB
0.05 dB	10.0 dB
0.02 dB	12.0 dB

Add the required Signal/Noise ratio to the total link loss to determine the dynamic range (SNR=1) required

What distance can I measure ?

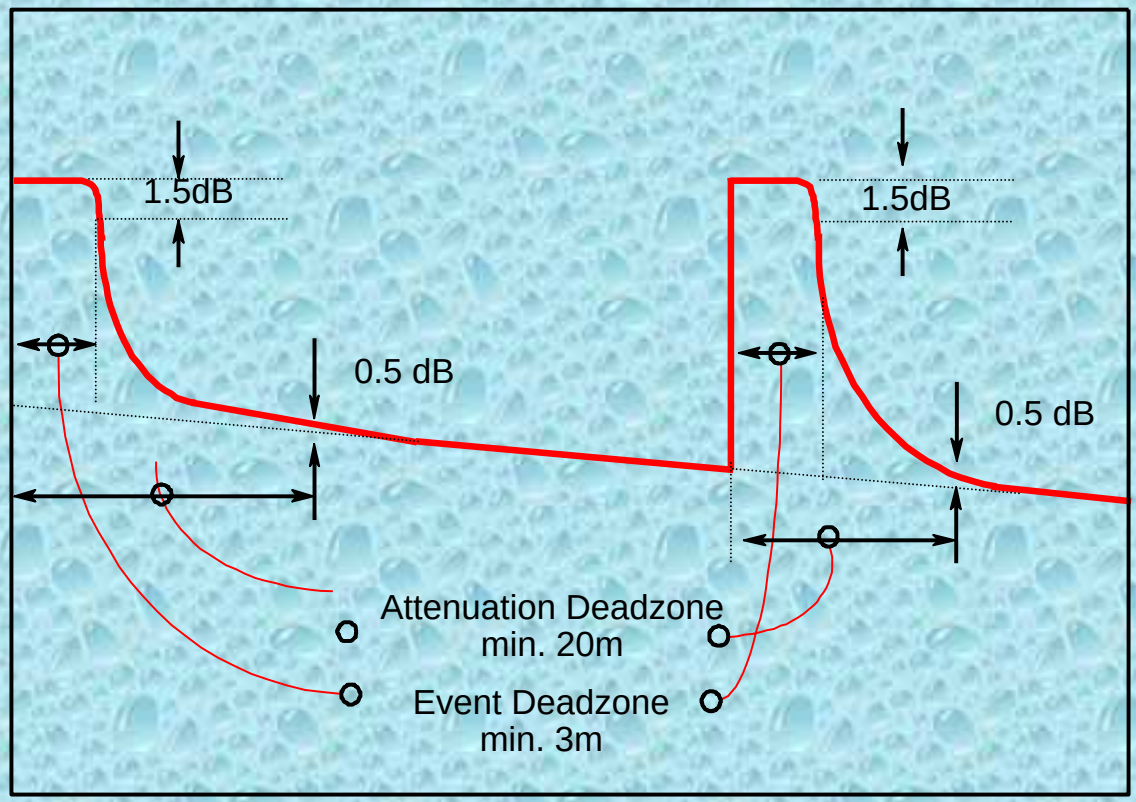




The maximum distance, you can measure, depends on the attenuation of the fiber,
and the dynamic range of your OTDR

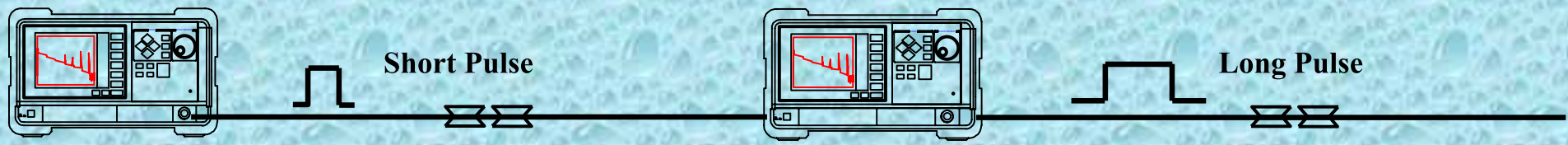
To measure long fibers, or fast measurements on short fibers, you want high dynamic range.

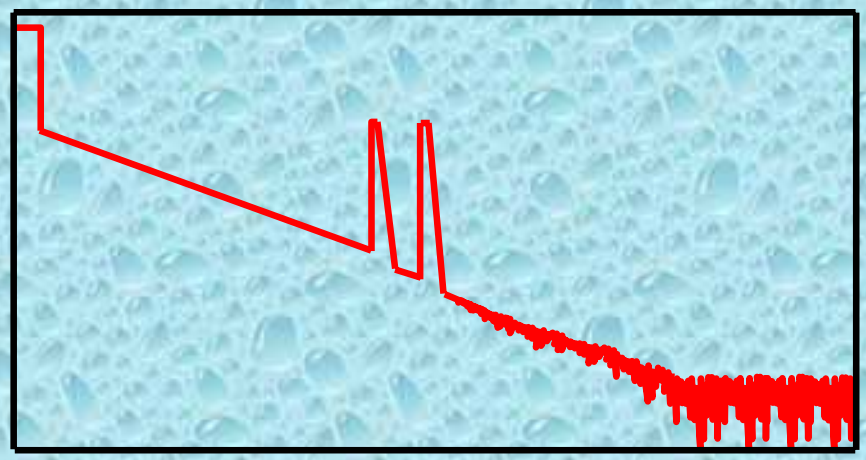
Dead zone or 2-Point Resolution

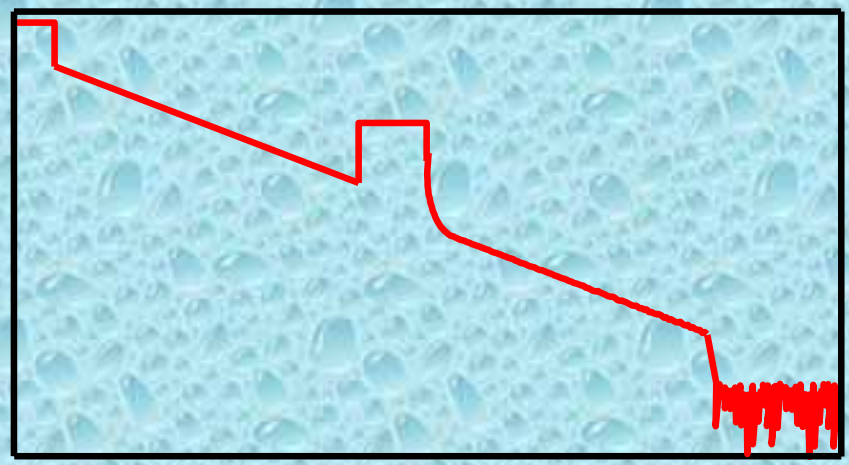


A deadzone always occurs at the front-panel connector reflection and at any other reflective event on the link

How Pulse Width Affects Dynamic Range & Dead zone

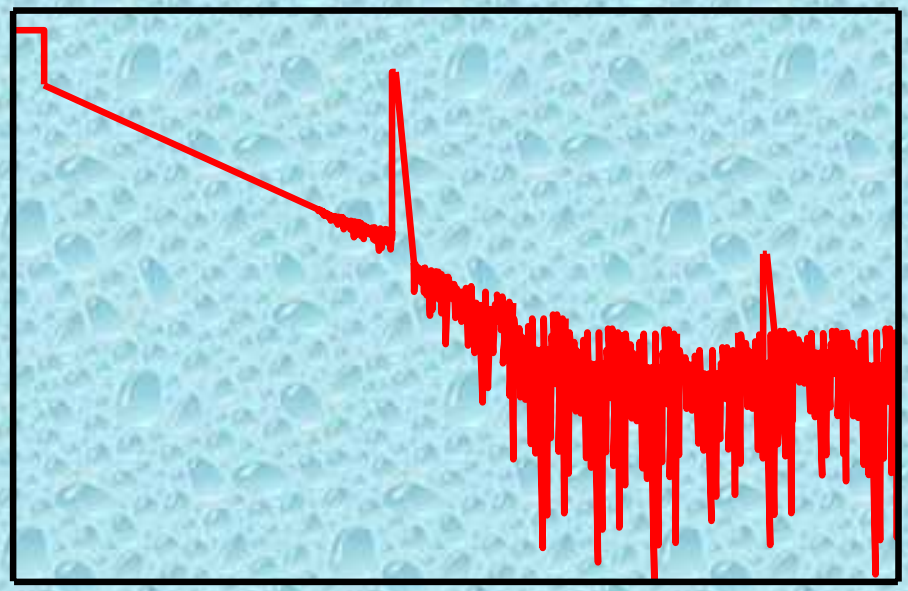




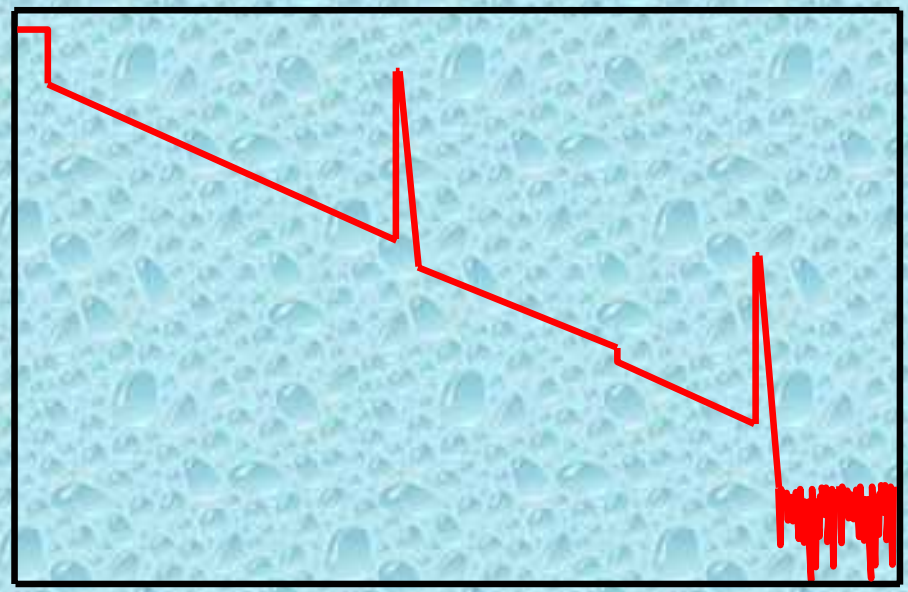


Short pulses provide better dead zones but smaller dynamic range
Long pulses provide better dynamic range but longer dead zones

How Averaging Time Affects Dynamic Range



After 10 seconds



After 3 minutes

Longer averaging time increases dynamic range by decreasing the noise floor of the OTDR