Optical Communication Experiment 3

Optical Fiber network analysis using OTDR

1. OBJECTIVES

☑ To perform OTDR investigations of network section.

☑ To identify and measure losses associated with the nature and location of faults or components degradation.

2. MATERIALS NEEDED

☑ OTDR
☑ Optical Network Analyser
☑ Optical fiber patch

3. INTRODUCTION

Optic fiber cables are increasingly deployed across the world to support the ever growing bandwidth demand by online users. In optical fiber networks, signal losses may occur in the fiber itself, or occurs at splices, connectors and within components, such as couplers and wavelength division multiplexers. Consequently, checking for losses in an optical network is essential in order to ensure proper functioning of the optical network throughout its lifetime.

Optical time domain reflectometry (OTDR) is the Industry Standard for measuring the loss characteristics of an optical fiber network. It is used to monitor the network status and to locate faults and degrading components. OTDR measures the loss for individual components of the fibre cable. OTDT can identify and measure the loss of individual components like splices or couplers, and measures the length of the optical cable and provide the location of the fault.
In operation, an OTDR launches pulses of light into the line fiber of an optical network and monitors the backscatter signal as a function of time relative to the launch time. As the pulse propagates down the fiber, it becomes weaker with increasing distance due to power loss, and the measured backscatter signal decreases accordingly.

The rate of signal decrease for a continuous section of fiber represents the fiber losses and any abrupt drops correspond to losses from the presence of components, terminations or faults which can be readily identified in the OTDR trace events. Figure 1 below shows the readily identified features on the OTDR signal referred to as events.

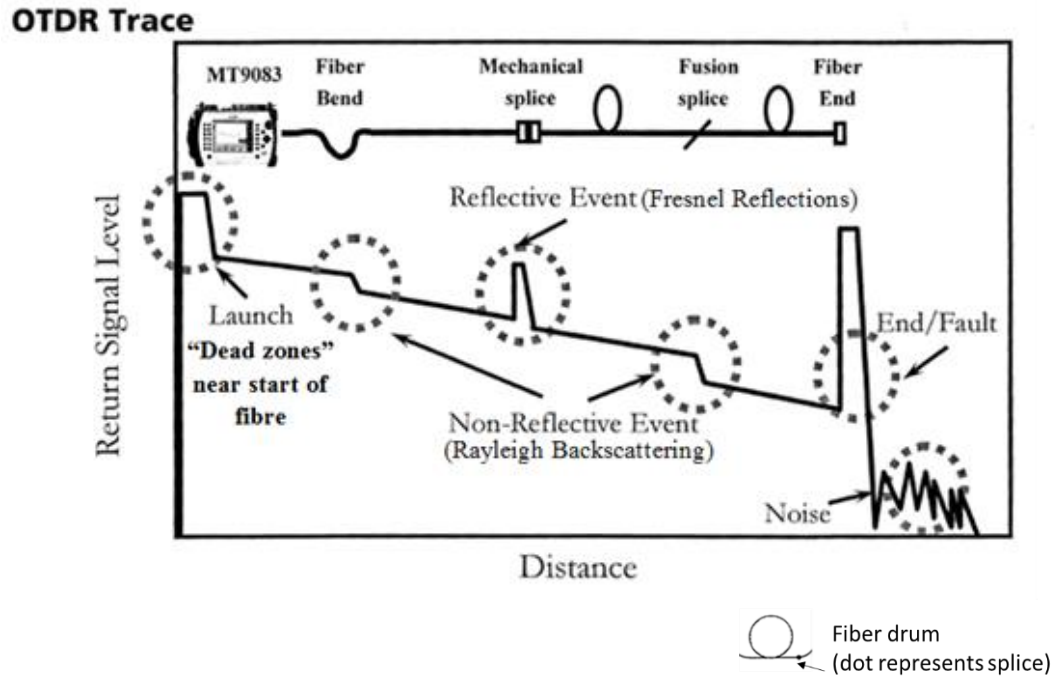


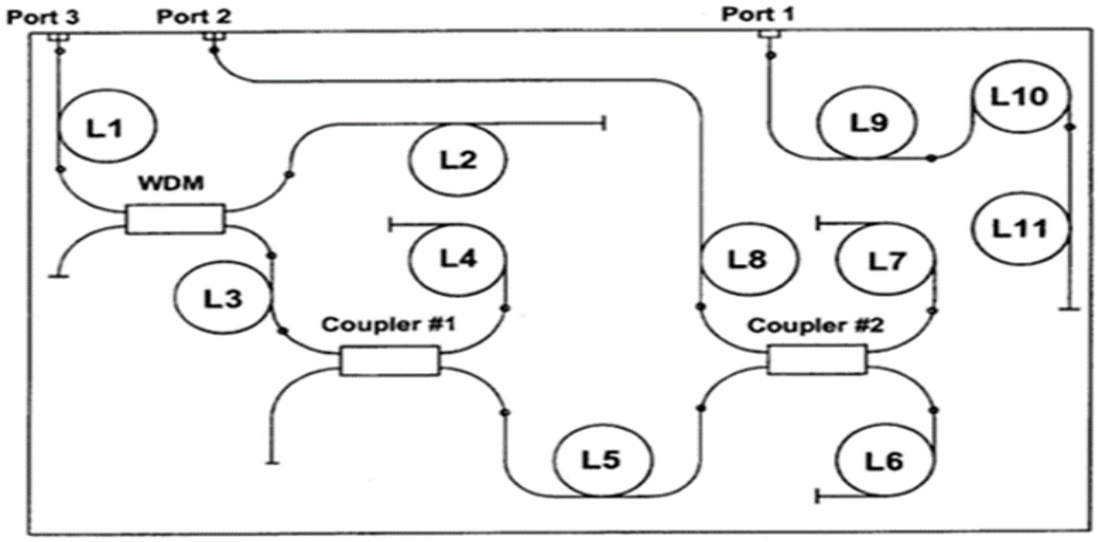
Figure 1 An illustration of OTDR Events

The following measurements may be performed by an OTDR:

For each event: Distance location & loss
For each section of fiber: Section length, section loss in dB & dB/km
For the complete terminated system: Link length & link loss in dB

4. PROCEDURES & RESULTS

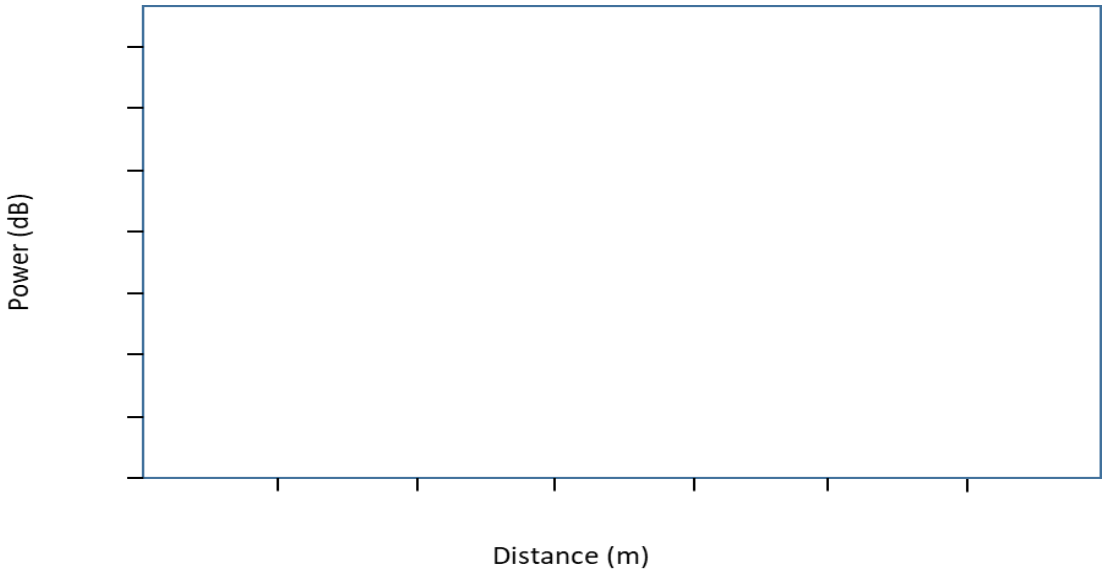
A single mode optical fiber network unit with 3 input ports is provided for investigation:



Part 1 : Investigation of connector and splice losses

Port 1 of the network unit is the input to a short length of fiber containing an average splice and a bad splice.

1. Connect the short fiber patch cord output at the OTDR to Port 1.
2. Set the OTDR wavelength to 1550nm.
3. Press the START button to begin acquiring the trace for this network at Port 1.
4. Sketch the OTDR trace.



5. Record the readings for the trace events in the Table below.

Event	Type	Distance(m)	Loss(dB)
Dead zone			
Splice 1			
Splice 2			
End of fiber			

5. Determine the total link distance and total signal loss.

6. Switch the wavelength to 1310nm and repeat the measurements. Comment on any differences observed between the two wavelengths.

Part 2: Investigation of a network section containing a fused fiber coupler

Port 2 of the network unit is linked to a length of fiber containing a fused fiber coupler which has a specified coupling ratio at 1550nm.

1. Connect the OTDR to Port 2 via the patch cord. Select OTDR Standard test.
2. Set the OTDR wavelength to 1550nm and acquire the OTDR trace of this network.
3. Record the measurements in the table below.

Event	Type	Distance(m)	Signal Loss(dB)

4. Switch the wavelength to 1310nm and repeat measurements. What is the Coupler insertion loss at 1550nm and 1310nm?

5. Compare and comment on the overall link loss at 1550nm and 1310nm.

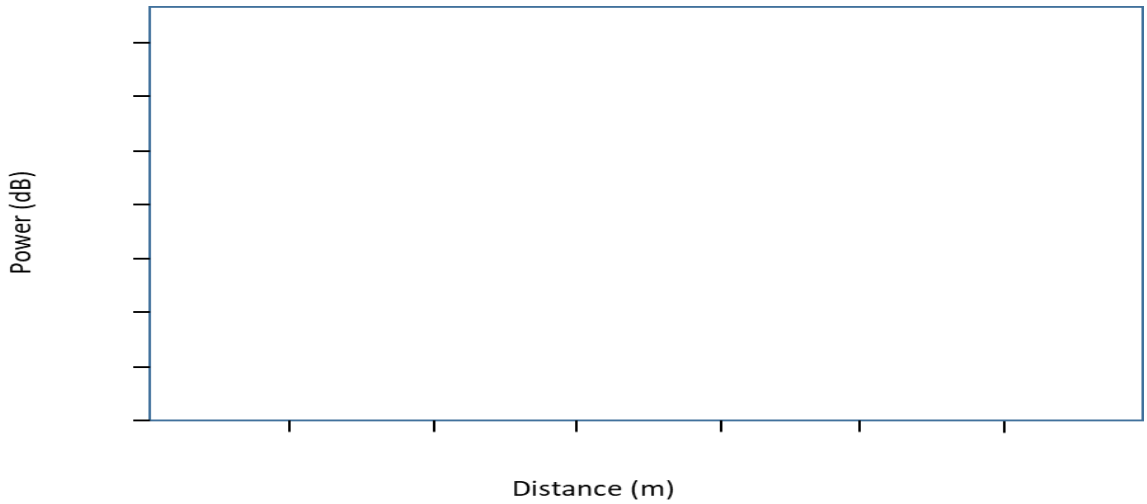
Part 3: Investigation of a simple network section

Port 3 of the network unit is linked to a length of fiber containing a wavelength division multiplexer (WDM) and two fused fiber coupler which has a specified coupling ratio at 1550nm.

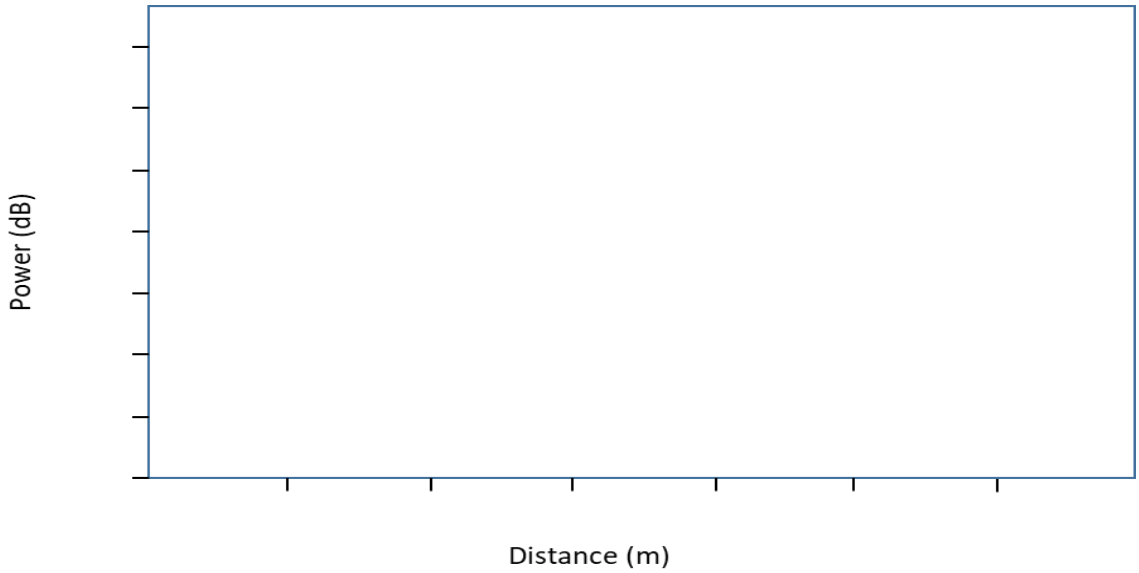
1. Connect the OTDR to Port 3 via the patch cord.

2. Set the OTDR wavelength to 1310nm and acquire the OTDR trace of this network.

3. Sketch the OTDR trace.



4. Switch the wavelength to 1550nm and sketch the OTDR trace.



5. DISCUSSIONS

Q1. What are the two operating wavelengths of the WDM?

Q2. Compare and comment on any visible differences observed between the OTDR traces of the two wavelengths for Port 3