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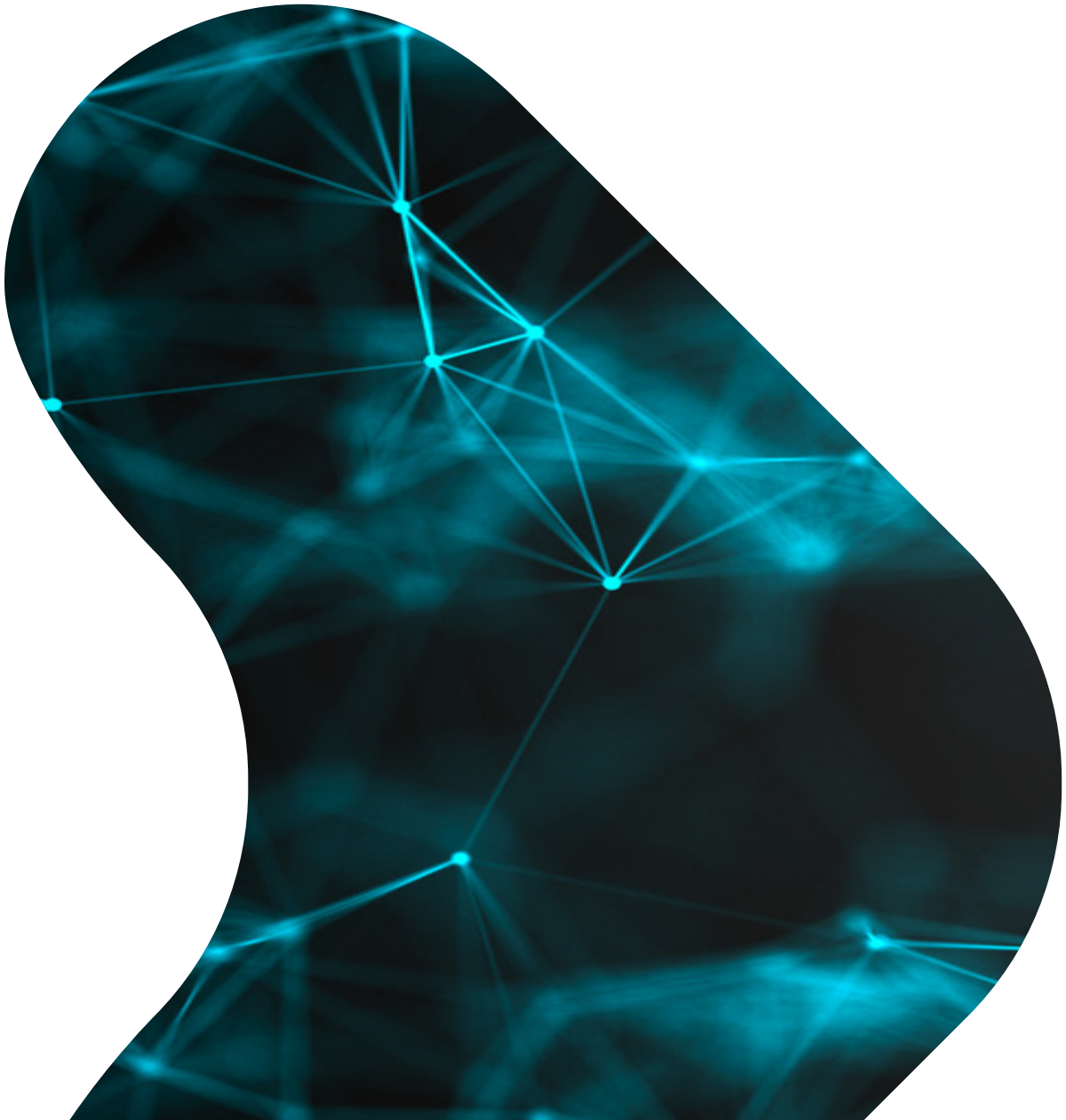
‘Ghost’ events in Optical Time Domain Reflectometer (OTDR)



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Abstract
Sometimes an anomaly called ‘ghost’ event appears in an OTDR trace that can be confused with a real reflective event. This application note explains how to distinguish an OTDR ‘ghost’ from a real event and lists techniques to eliminate ghosts from OTDR traces.

Keywords
OTDR, Ghost event

Optical Time Domain Reflectometer (OTDR) is a widely used instrument in fiber optic testing. The purpose of OTDR is to detect, locate, and measure optical events at any position in the fiber optic link. The optical events include splice loss, connector loss, fiber attenuation, and faults. The single-ended nature of OTDR testing makes it one of the most effective and versatile testing and trouble-shooting tools. An OTDR transmits a series of very short high-power light pulses from laser diodes and detects the light reflected/ back-scattered as each pulse travels down the fiber. As the light pulses travels down the fiber, a small fraction of it is scattered in different directions due to normal glass structure of optical fiber core (Rayleigh scattering) and at the points where fiber comes in contact with air or any other media like connectors, splices, joints, fiber end/break (Fresnel reflections). The OTDR uses changes in ‘Back-scatter’ light pulses to detect events. The portion of the OTDR trace between events is called “back-scatter line’. Fig. 1 shows a typical OTDR trace for an optical fiber.

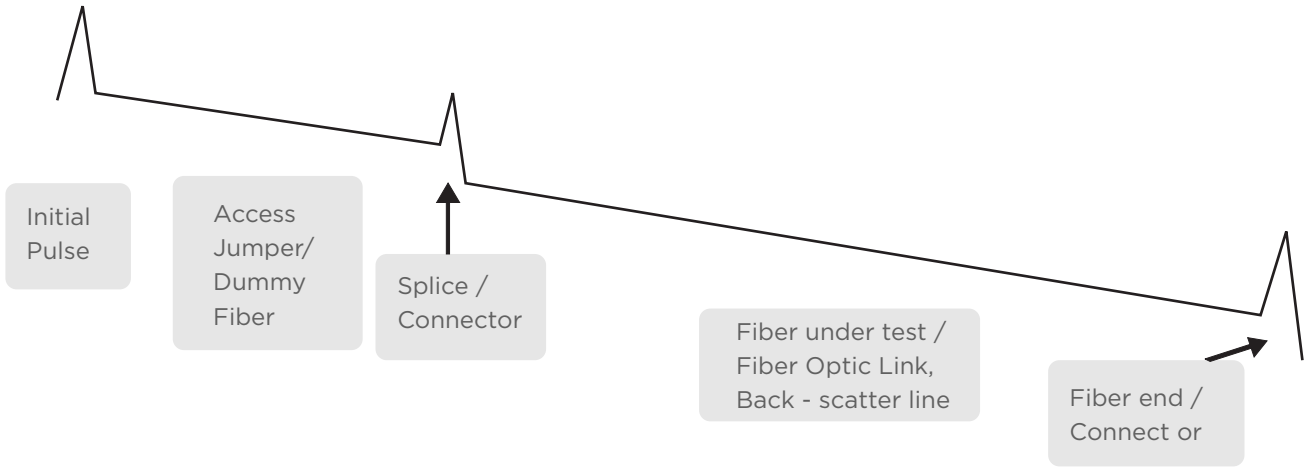

Fig. 1 Typical OTDR trace/ signature

What are OTDR ‘Ghosts’ and how can they be distinguished from real events?

Due to single-ended measurement technique where OTDR measures back-scattered light which is not the actual amount of light received at the end of the optical fiber, an OTDR trace can also show unreal events called ‘ghosts.’ Ghosts are false reflective events and can be difficult to distinguish because they are nonexistent events in the OTDR trace. The most common cause of ‘ghosts’ is an ‘echo’ of light reflected back and forth multiple times between strong real reflective events until it is attenuated to the noise level.

OTDR ‘ghosts’ (see Fig. 2) are confusing as they seem to be real reflective events and thus need to be distinguished from the real events. There are several ways to identify an OTDR ‘ghost.’

- Events that show much more dispersion (pulse broadening).
- Events that show no loss.
- Events which are repetitive at equal distances down the OTDR trace. If a highly reflective connector with high power loss is located at a distance D, the OTDR’ ghost’ will appear at 2D, and also at distances multiples of D.
- Events that change location if additional fiber is inserted after the location is suspected of being ghosts.

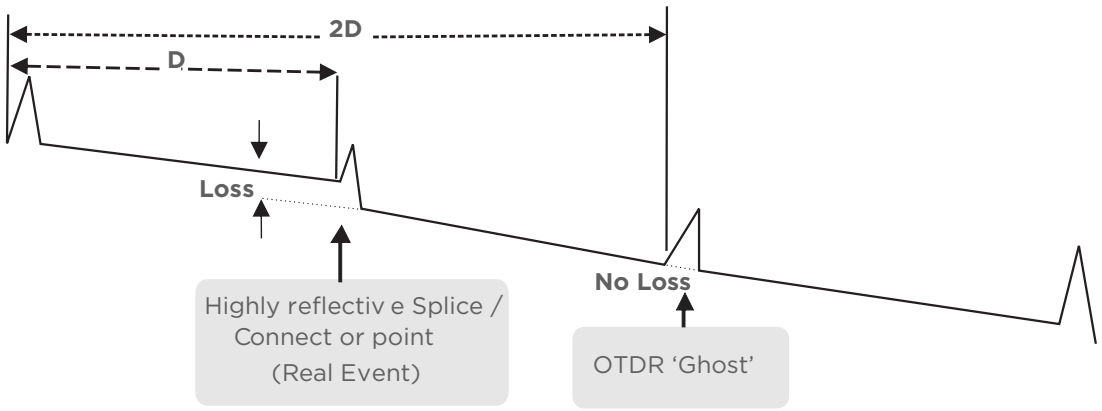

Fig. 2 OTDR real event and ‘Ghost’

How can OTDR ‘ghosts’ be eliminated?

Multiple reflections due to OTDR ‘ghost’ event are confusing particularly in short cables. Sometimes ghosted event looks like an optical break at the middle of the cable. Some OTDR analysis software can identify ‘ghost’ events and its ‘source’ reflection automatically. However, to reduce disruption caused by ‘ghosts’, the steps outlined below can be undertaken.

- Use index matching gel at the reflection / mechanical splice point to reduce reflections which are a major reason for OTDR ‘ghosts.’
- Reduce injected laser power by selecting shorter pulse width.
- Reduce injected laser power by selecting reduced power setting in the OTDR (if such an option is available).
- Reduce power by adding attenuation in the fiber before ‘ghost source’ reflective point.
- Ensure all connections in the optical fiber link are cleaned and properly spliced.
- Ensure all launch, receive and patch cables are same type of fiber having similar core size.
- If the OTDR ‘ghost’ appears at the end of the fiber link, make a few short fiber turns around a mandrel (or any other cylindrical object) at the end of the fiber. This will eliminate ‘ghost’ by reducing amount of light reflected back to the source. The mandrel should have appropriate diameter and shape to avoid any permanent damage to the cable, coated fiber or buffered fiber due to excessive bending.
- Ensure the measurement length range selected in OTDR is at least 1.5 to 2 times greater than the actual length of fiber under test.

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