TruEvent® OTDR Event Analysis

Enhanced event analysis brings accurate OTDR testing results

Abstract

Data center, enterprise and FTTx fiber networks present a number of challenges when it comes to locating and measuring events and impairments. The sheer number of fibers to be tested can prove to be a daunting task, one requiring automated event analysis. Automatic and accurate interpretation of multiple connectors, splices and splitters is a key to increase productivity. This article unveils how the AFL M series OTDR, using TruEvent algorithm to analyze OTDR traces. TruEvent helps AFL OTDR provide users with highly accurate and reliable automated event tables.

Introduction

Data center, enterprise and FTTx fiber networks present a number of challenges when it comes to locating and measuring events and impairments. These challenges include multiple connectors and splices in each fiber, numerous short jumper cables and splitters. Higher data speeds drive the need to ensure low reflectance and loss. The sheer number of fibers to be tested can prove to be a daunting task, one requiring automated event analysis. The AFL M Series OTDR uses TruEvent, a new and powerful technique to analyze OTDR traces that provides users with highly accurate and reliable automated event tables.

Why Accurate Event Analysis is Crucial

Reliable and accurate event analysis is needed to provide baseline documentation of fiber links and to effectively troubleshoot faulty networks. Events on a fiber include connectors, splices, optical splitters and macro-bends. The required measurements of events are:

- Location
- Identification of event type
- Reflectivity
- Loss

These Tier 2 measurements are required by a number of ANSI, BICSI, TIA and ISO/IEC standards. Unlike a set of black and white rules, OTDR measurements are like a moving target. 100% is ideal but not achievable. Trace interpretation is technically challenging to say the least, then there is a underline issue of the trace is not to be accurate. AFL Test and Inspection division has spent considerable time researching techniques to improve event analysis. As a result of this research, the M310 OTDR has the highest accuracy event analysis of any OTDR in the market.

Evaluating Event Analysis Performance—What To Look For

Unlike other OTDR performance specifications, such as dynamic range and dead zone, there are no industry standards to define how well event analysis performs. The tried-and-true method is to compare among different OTDR testers on a same set of known networks. The criteria used to judge the effectiveness of event analysis are:

- **Matched event rate:** Are all actual events being detected? The higher the better.
- **False event rate:** Are false events being detected? This is usually due to noise spikes. The lower the better.
- **Pass rate:** Are the results repeatable when the same network is tested multiple times? The higher the better.

The M Series is the only OTDR series that optimizes all of this providing better event analysis than any other OTDR. TruEvent technology helps M series OTDR to overcome event analysis weaknesses.

Why TruEvent® Can Help OTDRs Overcome Event Analysis Weakness

Traditional OTDR event analysis has always used techniques of event detection based on the apparent magnitude of the event's insertion loss and reflectance. The user sets an "event threshold" and if the magnitude exceeds this threshold, an event is "detected" and displayed. This method is naturally noise sensitive. Accuracy also decreases with range, since the noise increase and the magnitude of the event decreases with greater range. This leads to more missed events. A relationship between true events vs. false events can be seen in Figure 1 below for varies commercial OTDRs.

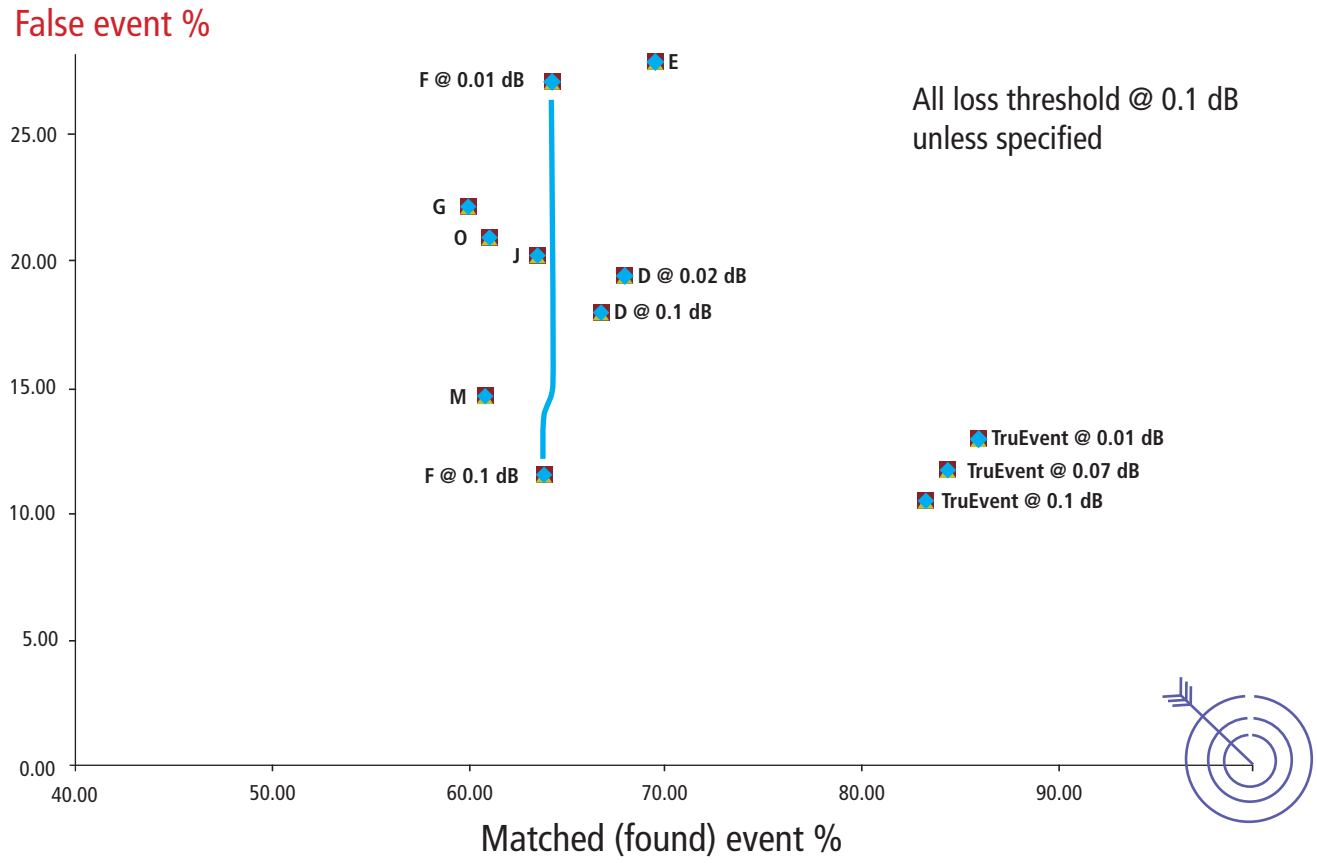


Figure 1—Event analysis accuracy comparison of OTDRs

Unlike other OTDRs, M series uses TruEvent algorithm, which is an event detection technique that permits increased sensitivity while not overly increasing the number of false events. When using TruEvent to analyze the OTDR trace, it analyzes the trace as whole. Therefore, OTDRs equipped with TruEvent technology overcomes event analysis weaknesses to provide the end users with higher rate of matched event rate without increasing false event rate. In a simplified form, TruEvent bring end users confidence on the OTDR results to be true. This will help end users eliminate guessing, re-testing and potential wrong diagnose of the fiber networks.

TruEvent® at Work—16-Event Challenge

The results in Figure 2 show the difference of event finding between M310 and a non-AFL unit. The golden network is setup with 16 known events. The traces taken by both OTDRs shows M310 is able to find all 16 events by loss and location accurately with no false events, while the non-AFL unit shows total of 29 events. As in Figure 2, there are 13 false events produced by the non-AFL unit.

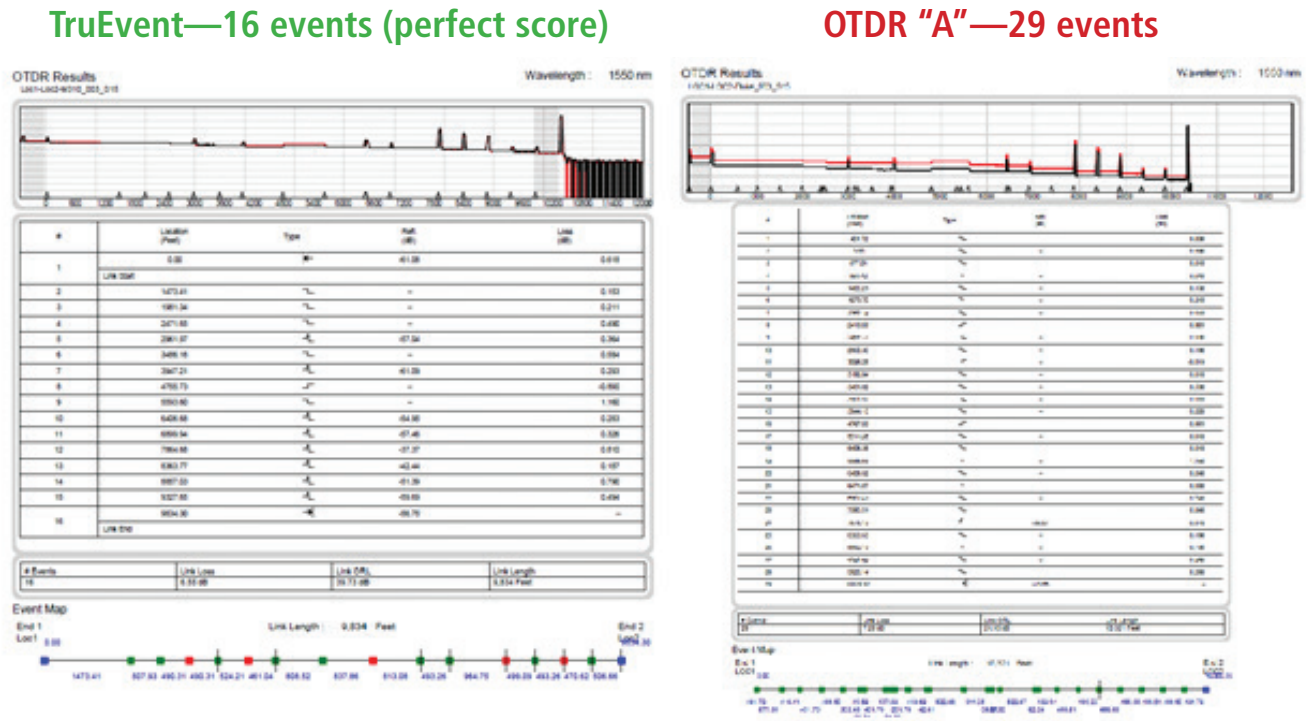


Figure 2—Event measurement results M310 vs. non-AFL OTDR for a 16-event network

TruEvent® at Work—Closely Spaced Events, 2 m Jumper Challenge

OTDRs always have problems in separating closely spaced events. Even when the OTDR's dead zone is short enough to show closely spaced events in the trace, the event analysis will not detect all of the events. After the first event, the OTDR's event table will have missed the subsequent close events entirely or classify them as "hidden" events. The problem with hidden events is that the OTDR lumps them together with the first event and it does not provide an insertion loss measurement for the hidden event. In many applications a full set of measurements is needed for every event. These deficiencies become more severe as the events get close enough to merge together due to the OTDR's dead zone. This is shown in Figure 3. In the top portion of the Figure, the two similar magnitude events are clearly visible to the eye. In the lower portion of the figure, the second event appears as just an inflection in the decaying attenuation dead zone of the first event.

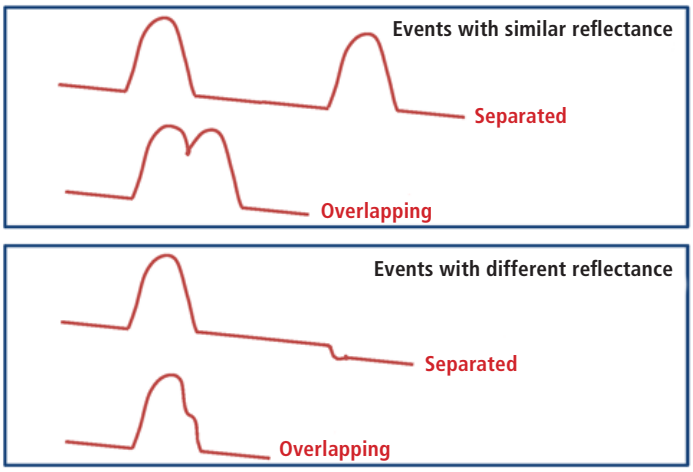
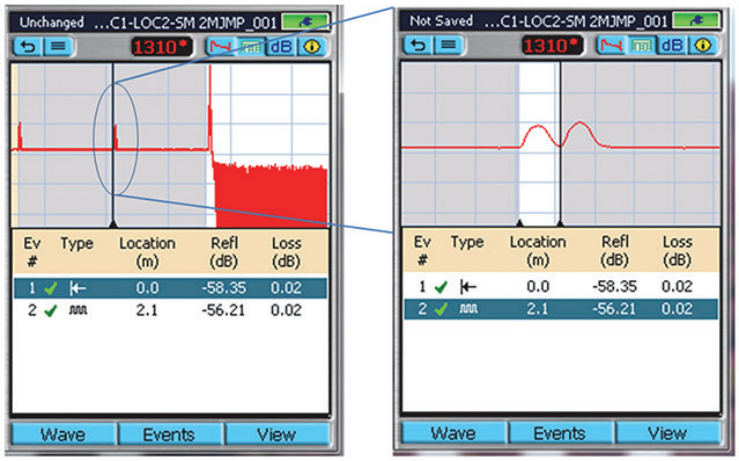


Figure 3—Separated and "overlapping" events

Unlike one widely used non-AFL OTDR, which classifies such events as "hidden", the M310 has the capability of separating and measuring these. Figure 4 shows results from testing a 2 m jumper cable on the M310, with its powerful event analysis. The reflectance and insertion loss of the connections at both end of the jumper are measured. This is a valuable tool for verifying the performance of jumper cables. High reflectance is a concern in LANs operating at 10, 40 or 100 Gb/s, for long haul networks and networks carrying analog video. Using an Optical Power Meter and Optical Light Source to check jumper cables will only provide an insertion loss measurement and other OTDRs will not be capable of measuring the loss and reflectance at both ends.



Full Trace **Zoomed Trace at 2 m**

Figure 4—Trace zoom in

Figure 5 shows the results of testing the same 2 m jumper cable on a non-AFL unit. Although the location of the two events as shown, the second connector is categorized as a "hidden" event. No loss measurements are provided and the reflectance measurements are inaccurate.

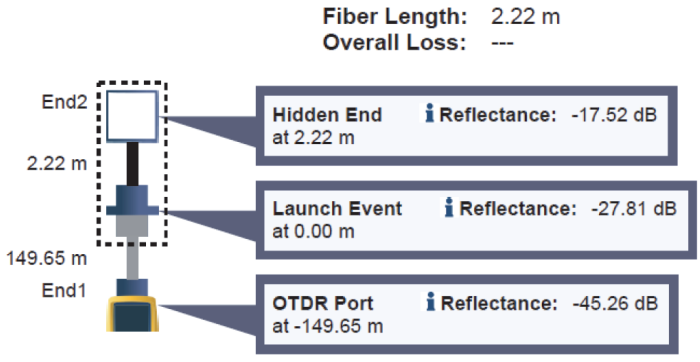


Figure 5—"Hidden" event on a non-AFL unit

One of the challenges in Data Center application is to identify closely spaced events. A typical data center network configuration in which there are multiple short jumper cables and other closely spaced events—a total of nine events. The 3 m section followed by the 2 m section at the beginning of the cable is particularly challenging. This network also contains a gainer event at 15 m, followed by a non-reflective loss event at 25 m, also challenging.

Underneath it, a figure shows a zoomed portion of the beginning of the network with the first three events successfully detected and measured, including the short jumper cables (events #2 and #3). Other OTDRs would not provide loss measurements for these events. All of the events in this network have been successfully detected and measured by the M310. Launch and receive cables were used, per standard practice, to be able to measure the loss and reflectance of the first and last events of the fiber under test.

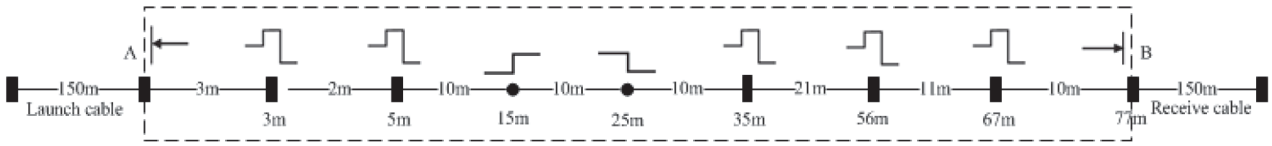


Figure 6—Typical data center network

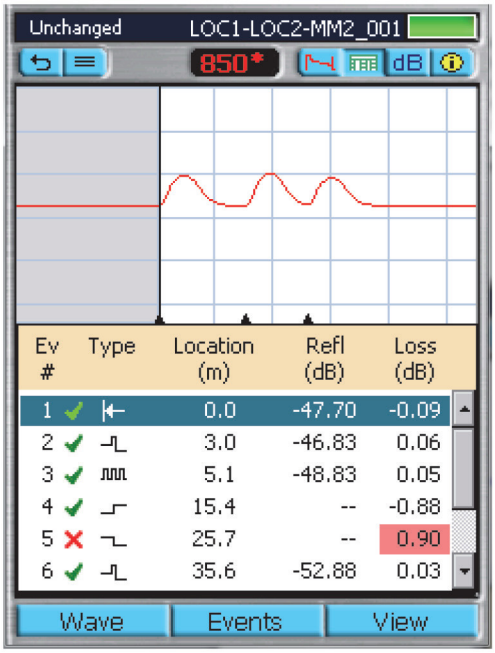


Figure 7—Test results of a data center network with short jumper cables zoomed at beginning

Event Analysis Checklist

Since event analysis is not defined by standard specifications, users often felt overwhelmed by the sheer number of 'things' they need to look at to ensure a good measurement. AFL developed the following checklist to use when choosing an ODTR for best event analysis:

- How many missed events occur when shooting a typical network?
- Are the event types correctly identified?
- How many false events occur when you set the threshold to your target level?
- Can the OTDR correctly separate closely spaced events and measure reflectance and loss?
- Do you need to perform a separate launch and receive cable calibration to accurately locate the beginning and end of fiber under test?
- Does the OTDR really provide all relevant measurements for each event

Conclusion

The release of the M series TruEvent feature is a product of extensive research into properties of fiber optic cable events and provides a major improvement in the performance of event analysis. This means that with the push of a single button users can be confident of obtaining accurate locations and measurements of all events, without the confusing introduction of false events. Many OTDRs on the market often miss key events related to the short length jumper cables used in data centers and enterprise networks, that may cause outages and at the same time introduce false events resulting in time wasted in performing additional test. With the M series OTDR, no special knowledge, training or test setups are required to achieve fast and accurate test results.

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