Testing with Greater Efficiency Using iOLM-OTDR & OLTS

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INTRODUCTION

Much has been said about the merits of using iOLM-OTDR to test connectivity; however, the results regarding its efficiency speak for themselves, especially in a context where it is used to pinpoint a specific connector that is creating a problem.

This application note will examine a specific real-life example of how the iOLM-OTDR proved its efficiency by going the extra mile to troubleshoot the root cause of an unidentified connectivity issue, especially when demanding reflectance may be an issue.

Recently, I received certain measurement files from a contractor who was working on the installation of premium pre-terminated LC/UPC connector-based assemblies. The contractor's institutional customer, which is based in the same city as the one where I live, was planning to deploy a 100G migration in the near future and was concerned with future performance.

The data center was all singlemode fiber design in order to provide a significant degree of flexibility. The links of interest tested by the contractor were 150 meters long and consisted of five, 30-meter segments of SMF fibers that featured 6 LC/UPC connections, as shown in Figure 1.

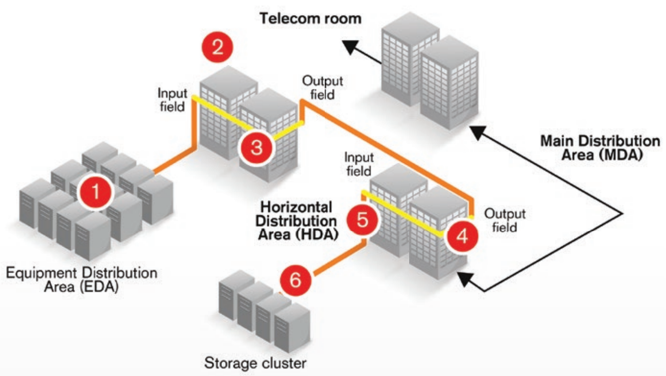

Figure 1. Intra-data center network topology (6 connections LC/UPC).

The contractor was using a MAX-945-iCERT OLTS featuring an ORL link and was using the FasTest Simplex (singlemode) configuration to perform his test. Each bidirectional measurement featuring ORL takes less than 5 seconds per fiber, including total link loss, length and ORL at two wavelengths. He sent me the following measurements:

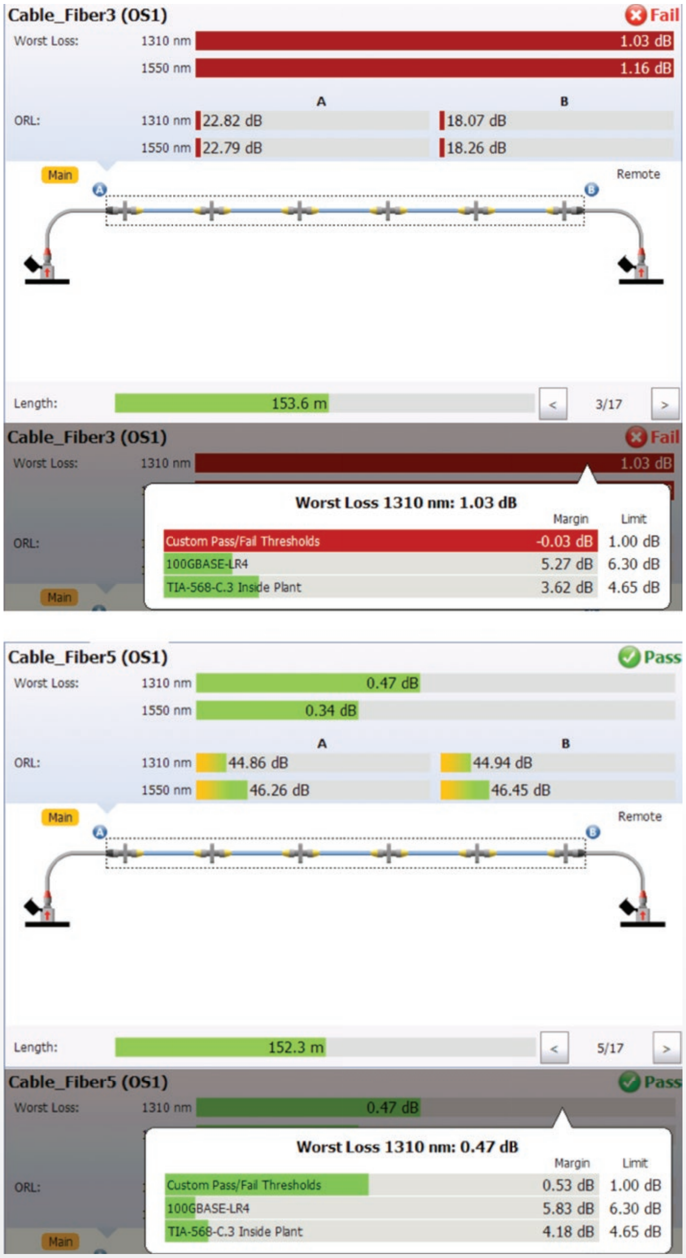

Figure 2. Measurement performed by a MAX-945-iCERT OLTS FasTest Simplex ORL (singlemode).

To obtain a pass/fail notification, the contractor had configured the instrument to compare the measurements with the TIA-568-C.3 Inside plant and 100GBASE-LRA standards. He had also configured Custom Thresholds to validate for a total link loss of maximum 1 dB for both wavelengths and a minimum total Link ORL of 42 dB.

The contractor was experiencing an issue with the fiber 3 measurement. Fiber 5 was perfect and proved to be a good representation of the dozens of fibers he had tested so far: all of them had generated a pass notification. With a few hundred fibers remaining to measure, he was still unable to explain the issue affecting fiber 3.

I went to the site with an iOLM-OTDR and proceeded to explain to the contractor that the OLTS is great when everything works fine, but when it comes to telling you where the problem is along the fiber, the effectiveness of the iOLM is simply unparalleled.

The iOLM was promptly connected to fiber 3 to identify the issue. We quickly saw that both connector 2 and connector 6 were in trouble. Connectors 3-4-5 appeared to be OK, while certain unusual elements, at position 219.4 meters and 377.9 meters respectively, were detected but unidentified.

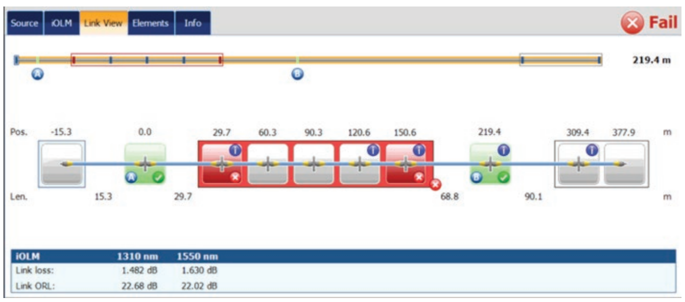

Figure 3. Measurement of fiber 3 using an iOLM-OTDR, before correct mating of connector 2.

We went over to connector 2 and gently pushed/pulled the connector until a "click" was heard; this connector was inserted into the patch panel, yet it was not pushed far enough in to be in the optimal physical contact condition. The 22 dB Link ORL was a great indicator of something close to an open connector.

Figure 4: Measurement of fiber 3 using an iOLM-OTDR, after correct mating of connector 2.

Another attempt was subsequently made with the iOLM: connectors 2 and 6 still were not OK, however, it was now clear that connectors 3-4-5 were functioning perfectly (Figure 4).

The detailed parameters measured by the iOLM-OTDR, for connectors 2 and 6 respectively, are presented in Table 1.

		Element 2	Element 6
		30.0 m	150.6 m
		Fail (possible macrobend)	**Fail** (possible macrobend)
	Type:	Fail (possible macrobend)	Fail (possible macrobend)
	Pos./Len.:	30.0	150.6
1310	Loss:	0.019	0.093
	Refl./Att.:	**–43.4**	**–34.6**
1550	Loss:	0.021	0.320
	Refl./Att.:	**–44.2**	**–35.7**

Table 1. Measurement of fiber 3 using an iOLM-OTDR, detailed parameters for connectors 2 and 6.

Element pass/fail thresholds were set at 0.75 dB for maximum connector loss and 0.3 dB for maximum splice loss. The maximum connector reflectance was then set at -45 dB—reflectance of -45 dB is an industry recognized target for intra-DC system running 100G. All of these thresholds were subsequently set for both wavelengths (1310/1550 nm).

The next step of the diagnostic involved the use of the fiber inspection probe, which would then make it possible to put the endface of connectors 2 and 6 under the microscope.

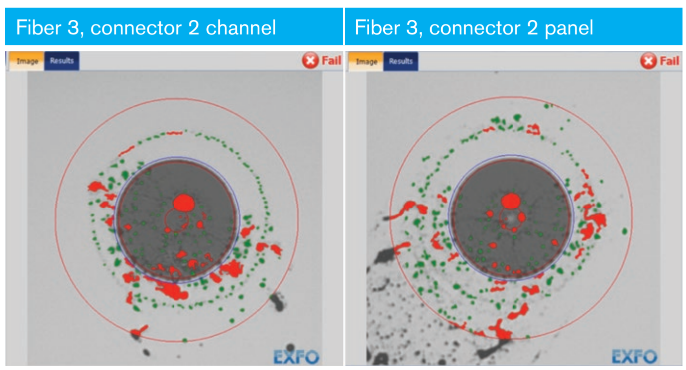

Figure 5. Measurement of fiber 3, connector 2 using an FIP-435 LC/UPC tip and ConnectorMax2 software.

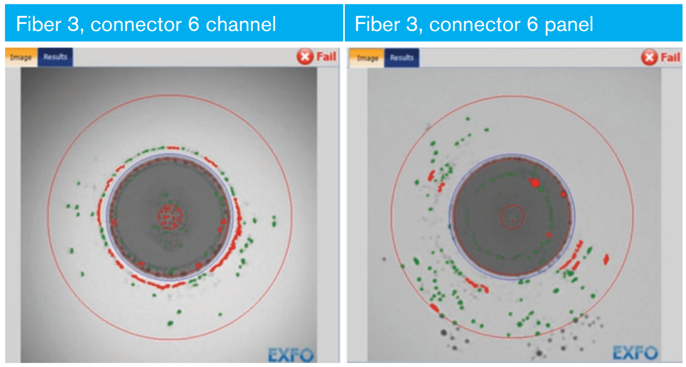

Figure 6. Measurement of fiber 3, connector 6 using an FIP-435B LC/UPC tip and ConnectorMax2 software.

A proper, dry connector cleaner was subsequently used to clean the channel and panel sides of both connectors (2 and 6).

Now that the connectors had been cleaned, a final look at the link was definitely in order. Figure 7 shows that all the connectors were clean, however, it seemed that a macrobend was hiding behind what appeared to be a dirty connector.

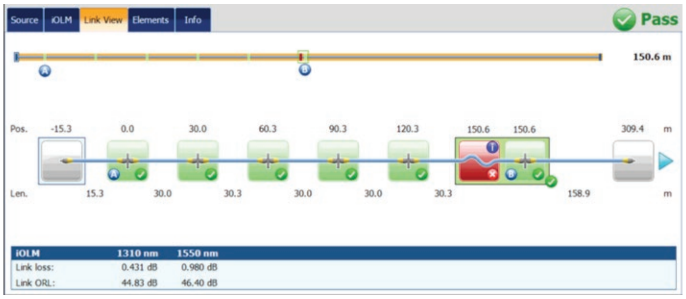

Figure 7. Measurement of fiber 3 using an iOLM-OTDR, after cleaning connectors 2 and 6.

The detailed parameters measured by the iOLM-OTDR for connector 6 are presented in Table 2.

		Group	Element 6	Element 7
			150.6 m	150.6 m
		Pass	**Fail** (possible macrobend)	Pass
	Type:	Group	Macrobend	Connector
	Pos./Len.:	150.6	30.0	150.6
1310	Loss:	0.091	–	0.091
	Refl./Att.:	–53.2	–	–53.2
1550	Loss:	0.675	–	0.675
	Refl./Att.:	–55.0	–	–55.0

Table 2: Measurement of fiber 3 using an iOLM-OTDR, detailed parameters for connector 6.

Together with the contractor, we proceeded to correctly place the fiber at the patch panel of connector 6 and gave the iOLM-OTDR another try, as shown in Figure 8. All the iOLM-OTDR measurements in this test session were performed using the Fast Short Link Optimode, thereby allowing the iOLM-OTDR to perform its measurement in under 10 seconds for two wavelengths for a link less than 2 km. It took a total of 10 seconds to obtain the precise link loss measurement for each connection, including its reflectance, in addition to the total link loss and the total ORL measurement and, finally, a pass/fail diagnostic for the measured link. The Fast Short Link Optimode will always provide less resolution than the usual Short Link Close Events Optimode (35 seconds' test time per wavelength), but when the total link is less than 2 km and events are spaced more than 10 meters apart (typical data center situation), Fast Short Link Optimode is extremely efficient and, no doubt, a second measurement using the Short Link Close Events will provide the additional resolution.

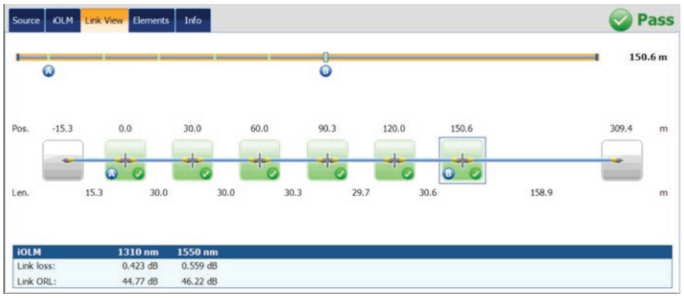

Figure 8. Measurement of fiber 3 using an iOLM-OTDR, after repairing the macrobend at connector 6.

		Element 1	Element 2	Element 3
		0.0 m	30.0 m	60.0 m
		Pass	Pass	Pass
	Type:	Connector	Connector	Connector
	Pos./Len.:	0.0	30.0	60.0
1310	Loss:	0.077	0.081	0.055
	Refl./Att.:	–54.2	–55.3	–57.3
1550	Loss:	0.067	0.079	0.064
	Refl./Att.:	–54.9	–55.8	–57.8

		Element 4	Element 5	Element 6
		90.3 m	120.0 m	150.6 m
		Pass	Pass	Pass
	Type:	Connector	Connector	Connector
	Pos./Len.:	90.3 m	120.0 m	150.6 m
1310	Loss:	0.136	0.002	0.072
	Refl./Att.:	–56.7	–55.6	–52.8
1550	Loss:	0.088	0.018	0.243
	Refl./Att.:	–57.2	–56.4	–53.8

Table 3. Measurement of fiber 3 using an iOLM-OTDR, detailed parameters for all connectors.

CONCLUSION

This paper has shown the value of the OLTS with ORL measurement and the 3 to 5 seconds' testing speed associated with this measurement. When using the OLTS, the measurement is expected to generate a pass notification, because when a fail notification is obtained, it is difficult to understand where exactly the failed elements are positioned along the fiber link.

We have also seen how effective an iOLM-OTDR is in identifying the position of the failed elements along the link and, when the failed elements are identified as being connectors, how efficient the Fiber Inspection Probe is with regards to visualizing the quality of the cleanliness of the connector endface.

The iOLM-OTDR with the Fast Short Link (FSL) allows for mapping the faulty elements or confirming that all elements generate a pass notification in under 10 seconds per measurement, for two wavelengths. This measurement will include the mapping of all elements, the loss per connections as well as the reflectance per elements. Fast Short Link Optimode can be used for singlemode fiber links with a maximum length of 2 km, which represents the clear majority of the existing links in data center, intra-connect networks.

The iOLM-OTDR and the Fiber Inspection Probe (FIP) combined are an efficient test duo, since the iOLM-OTDR tells you exactly what connector(s) is/are creating the issue(s) and the FIP makes it possible to qualify the cleanliness status of the respective connector(s') endface(s).

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