3M Science. Applied to Life.™

Case study: More speed and less cost at hyperscale.

Installation and results of hyperscale trial of 3M™ Expanded Beam Optical (EBO) Connectors

Executive Summary

In a customer field test of the technology, 3M™ Expanded Beam Optical (EBO)-12 Connectors were deployed on trunk cables at a hyperscale data center in the eastern United States. In the course of this deployment, 320 3M EBO connectors were installed and tested with zero failures and zero cleanings required. By removing the need for time-consuming cleaning, the 3M EBO solution enabled trunk cable testing of an entire cluster in about one hour compared to the current MPO solution taking up to eight hours or more. Initial results show a significant time and possibly significant cost savings for customers as a result of using the 3M EBO connectors. These EBO connectors have now supported over 180 days of data traffic with no reported errors. Additional trial deployments for the 3M EBO connectors, including additional applications, are now being considered or planned for at the same site.

Introduction

Conventional fiber optic connectors rely on physical contact between fibers for data transmission and are highly sensitive to contamination from dust and other debris, which reduces connector performance. 3M™ Expanded Beam Optical (EBO) Connectors use an innovative approach that expands the light beam between connectors and removes the need for physical contact, reducing the connector's sensitivity to dust and the need for frequent cleaning.

In a separate 3M controlled laboratory experiment comparing the testing time required to complete a 3M EBO Latched Connector vs. a standard MPO connector install, it was observed that that using 3M EBO connectors in an optical link can provide significant time savings for customers by eliminating the need for connector inspection and cleaning during link testing.

The test was setup using 48 connectors of each type to provide 24 links with 3M EBO connectors on each end and 24 links with MPO connectors on each end. The MPO links were tested using standard testing protocols which included a visual inspection of each of the panel connector and subsequent cleaning if any contamination was observed. The total time required to complete testing of the 24 MPO links was 1 hour 51 min, or 2 min 19 sec per connector. For the 3M EBO connector on the other hand, with the elimination of required visual inspections, the total time required to complete full testing of the 24 links was reduced to 16 min 38 sec, or 21 sec per connector.

To put this data into perspective a typical MOR to IDF trunk install requires 96 connectors per end, or 192 connectors in total. Using the same testing times observed in our trial, it can be expected to take up to 8 hours to complete testing of an MPO cluster install. With an average test time of 21 seconds per connector, that same testing can be completed in approx. 1 hour when installing the 3M EBO latched connector. A total time savings of 85%, or a little more than 6 hours of savings.

Field Installation

To demonstrate the value of the new approach in the field, 3M collaborated with a hyperscale data center provider at a data center location in the eastern United States to deploy fiber trunk assemblies terminated with 3M EBO ferrules between the Middle of Row (MOR, T1, leaf) and Intermediate Distribution Frame (IDF, T2, spine) within a cluster at the facility. The deployment also included the use of pigtail transceivers with 3M EBO connectors to complete the link between the MOR and IDF switches. A 3M application engineer was present at installation to observe the procedure, including cable routing and handling, connector handling, and connector link testing. An added benefit to 3M was the ability to use this installation to gather valuable feedback on the robustness and usability of the current connector design and to capture additional insights into the client's data center architecture and the potential opportunities where the 3M EBO connector might benefit future data center applications.

The installation began with the typical laying out, labeling, packaging, and routing of the trunk assemblies. Standard install procedures were used to package and pull the assemblies through the cable management infrastructure between the MOR and IDF distribution panels. Once the assembly was in place and all packaging was removed the connectors were attached to the distribution panels at both ends of the assemblies. These connections were completed with no visual inspection and no cleaning of the connectors.

Testing Procedure

The hyperscale client called for all MPOs to be inspected – and if dirty, required the connectors to be cleaned and reinspected before making connections. The installer's testing procedure is as follows:

- Mate MPO and test (using LC duplex).
- If IL test fails, clean MPO with one-click cleaner and retest. Repeat 2-3 times if test still fails.
- Clean LC connectors with one click cleaner. Repeat 2-3 times if test still fails.
- Clean LC and MPO with cleaning wipes and 99% IPA. Case study: More speed and less cost at hyperscale.
- If a channel fails, it is cleaned, and if it passes, the technicians likely won't go back and test previous channels due to the possibility of spreading contamination back to previously clean channels.

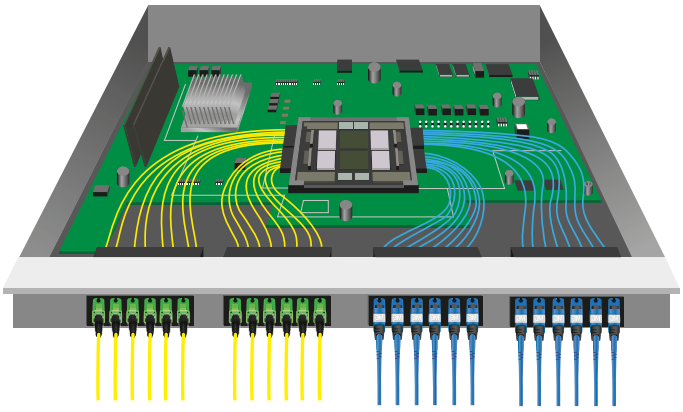
According to the hyperscale client, it typically takes an installer a full 8-hour day to test a MOR using these methods. When the majority of MPOs test well and do not need cleaning, the testing time can be significantly reduced. Other times when the majority of the MPOs need to be cleaned and retested, it can take longer than one day to complete the required testing. Both scenarios reportedly occur often with equal frequency. With the removal of cleaning requirements, the installing technicians were pleased to be able to fully complete their testing of the 3M EBO connector links in just under an hour with zero failures detected in the process.

The overall feedback from the installation team was that the 3M EBO ferrule was a much easier connector to manage than the MPO with the elimination of cleaning and potential for retesting and subsequent cleanings.

3M EBO Opportunities

As transmission speeds within data centers continue to increase in support of ever-increasing demands for Cloud data access, so will the need for reliable multifiber connectivity. The current multifiber connector solution's susceptibility to dust and damage is well understood in the industry. The concerns over packet loss and increased latency will also increase without a reliable link solution to take the place of the current MPO ferrule, potentially costing hundreds of costly hours in cleaning, inspection, and downtime to provide good optical connectivity with the rollout of new data centers and the upgrade of existing facilities.

With the inherent low sensitivity to dust of expanded beam optics combined with 90° light turn design to allow for the protection of the optical face from touching, contamination, and damage, the 3M EBO ferrule is well positioned to provide the needed connector reliability for efficient data center rollouts. The 3M EBO connector also allows for a dense, MPO footprint compatible design to support the increasing switch port density demands, and provides a reliable faceplate offering to support future co-packaged optics designs where serviceability becomes a limiting factor with the removal/elimination of pluggable transceivers.



Conclusion

In summary, the experimental deployment at the client's data center reveals great potential for 3M EBO connectors among hyperscale providers. An installation using conventional MPO cable typically takes over five hours to complete due to repeated instances of testing and cleaning, while the 3M EBO installation took less than one hour and involved far fewer steps.

The elimination of cleaning and inspection provided a significant reduction in the needed installation time and has the potential to translate into considerable cost savings for future data center customer deployments. These customer cost savings will likely grow with the continued rapid increase of optical connections within future data centers to support the adoption of 400G and 800G transmission speeds and the eventual migration of passive optics to the rack.

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