The Connector Question: Mechanical or Splice-On for Field Installation?

By Guy Swindell
Manager, Applications Engineering
OFS

For all of the high-tech gadgetry that characterizes the fiber optics industry, it is perhaps the humble connector that offers the most consternation. For the construction supervisor, it is staff training and the possibility of high installation scrap rates that threatens budgets and deadlines. For network owners and operators, it is the unfortunate status of connectors as the weak link in the passive network that causes exasperation. And, for all parties involved, the selection of a proper connector for field-installation can be a subject of mystery and debate.

There have been countless variations on connector installation techniques and recommended procedures. Most recently, however, discussion has centered on the subject of mechanical connectors and splice-on connectors. The mechanical connector is a product that evolved primarily out of the enterprise space, and offers a simpler and cleaner alternative to the epoxy-and-polish connectors which preceded it. In contrast, the fusion splice-on connector (or "SOC") evolved in the telecommunications space and offers factory-quality connector performance without the pigtails, splice trays, and space requirements that characterized conventional installation practices. Improvements in both products have steered them into the FTTH market where they now represent competing alternatives.

The appeal of a good field-installable connector for a FTTH carrier is fairly obvious. For one thing, many FTTH applications involve the deployment of fiber distribution hubs with an accompanying large number of connectors. So, if nothing else, a field-installable option is necessary just to effect repairs. Beyond that, however, the implications for the FTTH drop installation are considerable. Field-installable connectors do not require the inventory, terminals, slack storage, up-front engineering, and up-front investment of a preterminated drop solution. Additionally, they do not require customer premise equipment with splice trays and pigtail assemblies like a conventional fusion-spliced drop solution. Those are important attributes as the FTTH industry looks toward smaller customer premise equipment to support the indoor installations which are characteristic of multi-dwelling units. Likewise, those same attributes may help to address the cost concerns associated with drop installations in rural deployments.

Both mechanical and fusion splice-on connectors make use of a pre-polished fiber stub in the connector ferrule. Mechanical connectors, as the name implies, use a mechanical method to align a cleaved fiber with the pre-polished stub and then use a cam, wedge, or crimp mechanism to secure the fibers together. In essence, it is a connector end-face and a mechanical splice in one package and within a few millimeters distance of one another. The craft-dependent alignment and presence of two optical discontinuities in such close proximity to one another has always been the weakness of the mechanical connector. To adjust for this intrinsic shortcoming, vendors have used index matching gels to reduce the reflectance and attenuation associated with the mechanical splice behind the pre-polished stub. However, the lifespan of the gel and the robustness of the mechanical splice have often been questionable.

Without a doubt, mechanical connectors have improved. New index matching gels and improved alignment mechanisms have made mechanical connectors viable in areas where they would have previously never been considered. At the same time, however, advances in fusion splice-on connector technology have yielded cost reductions and craft improvements that put the two installation options on competitive footing.

The key value proposition for fusion splice-on connectors relative to mechanical connectors has always been the fusion splice itself. There is no serious debate in the industry about the quality difference between the two approaches. A fusion splice dramatically reduces attenuation, eliminates reflectance, and mitigates craft-induced error by introducing an automated alignment process. Additionally, when the fusion splice is protected by a hermitically-sealed heat shrink, a package is created which is as mechanically robust as it is optically superior. Thus, a splice-on connector yields a factory-quality connection in a field-installable format. However, the quality advantage has been a fact for over a decade. The cost and craft advantages which make the splice-on option competitive with mechanicals have only been realized in the past couple of years.

When splice-on connectors first came on the scene in the late 1990's, fusion splicers were cumbersome, complicated, and priced in the sports car range. So, in order to enable the application, vendors created proprietary splicers which were engineered solely for the purpose of installing proprietary splice-on connectors. To make this solution cost-effective, these machines replaced view screens with a microscope; replaced automated alignment with a manual process; and replaced loss estimation with a field technician's educated guess. As a result, the splice-on connector option required an investment in dedicated splicing equipment and usually yielded a high scrap rate due to the limitations of the splicing equipment.

Today's splice-on connectors are engineered to work with the removable fiber holders that are common on most fusion splicers. Thus, rather than requiring an entirely different machine, the splice-on connector merely requires an additional holder in order to work with the same machine that would be used anywhere else in the network. It follows, therefore, that the technician installing one of these connectors can use anything ranging from the ultra-compact and affordable splicers developed for FTTH to the most sophisticated core-alignment machines. And, unlike a mechanical splice, the splice-on connector installed with today's technology uses automated alignment and calibrated loss estimation features. So, not only is scrap reduced through the use of automated technology, but site revisits are dramatically reduced since the technician has a very reliable indicator of connector performance before leaving the installation site.

Over the past decade, fusion splicer technology has followed a market trajectory similar to computers in that consumers have benefited from a combination of steadily improving performance and decreasing costs. At the same time, connector performance requirements in both telecommunication networks and enterprise applications have been rising. Since the quality of a mechanical connector is largely dependent on the quality of the cleaver used to prepare the fiber for the mechanical splice, the low-cost cleavers that accompanied most mechanical connector kits are being replaced out of necessity by higher cost and higher quality products. So, while equipment costs for fusion splicers have been going down, kit costs for mechanical connectors have been going up. Granted, the cost is still not equal, but it is getting close enough to warrant stronger consideration of the quality advantages for the splice-on option.

Mechanical connectors are a relatively easy option, and they have made significant strides in quality over the past several years. However, the fact of the matter is that any entity with a significant amount of fiber is probably going to need to own a fusion splicer, and a FTTH carrier certainly falls into that category. So, in FTTH, the skill sets and equipment for fusion splicing are already a necessity and the cost to add splice-on connector capability to a fusion splicer kit are less than or equal to the mechanical alternative. When those facts are combined with the undisputed quality advantages of a fusion-spliced solution, the splice-on connector becomes the obvious FTTH field-installable alternative.