Taking PON Architecture Beyond the Cabinet

ABSTRACT

Passive Optical Network (PON) by definition uses fiber optic splitter technology to create a point-to-multipoint architecture. In today's market service providers have the option to deploy either a splice in splitter or a connectorized splitter module within their network. While both technologies are suited to build a reliable network, there are fundamental differences in the installation, troubleshooting, and economic implications for each which should be considered. This paper will review the application based differences between a splice in splitter and a connectorized splitter module while also outlining the advantages to selecting a product designed to facilitate the expanding needs of the PON architecture.

INTRODUCTION

The connectorized splitter module has brought a 'plug-and-play' approach to the deployment of PON architectures, particularly in the FTTx network. A modular approach provides an ease of initial installation along with a simplistic method for future connections; features which are noticeably enhanced by the performance attributes of the splitter technology. The connectorized splitter module employs a Planar Lightwave Circuit (PLC) splitter technology which provides accurate port uniformity, low insertion loss, and low polarization dependent loss. A PLC splitter has a standard operating temperature range of -40°C to +85°C, when constructed with an appropriate housing, the connectorized splitter module is an ideal solution for both inside and outside plant applications.

When evaluating the value proposition of a pre-connectorized splitter module versus a traditional splice in splitter there is more than just the cost per splice to be considered. Both a connectorized splitter module and a splice in splitter will require thirty three splices be performed per 1:32 splitter – one for the splitter input feed and thirty two for the distribution fibers. A more complete assessment weighs the initial installation procedure, the service activation process, and the ease of maintenance and growth for the entire splitter system.

SPLICE IN SPLITTER

A network designed to utilize a splice in splitter, in general, will have all of the current and any future splicing done during the initial installation phase of the project build. This means that each distribution leg of the splitter will be assigned and connected from day one, with no consideration of the customer's current take status. Resulting in a less effective utilization of both the PLC splitter and the network's active components; a single customer may dictate that a new Optical Line Terminal (OLT) card port be dedicated to activate the splitter as a result of the predetermined splitter configurations. The value of the PLC splitter technology is not fully realized in a PON architecture when the split ratio of the passive components is only partially consumed, oftentimes leading to multiple stranded investments.

Stranded investments due to insufficient resource allocations are not the only budgetary consideration to be made when deploying a splice in splitter system. Due to the nature of the product, implementing a 'build as you grow' approach in an effort to alleviate upfront capital cost is also difficult to manage with this technology. At the initial installation the service provider will need to have all required splitter components, housings and accessories for the entire system; including those for any planned future growth.

A PON utilizing splice in splitters significantly hinders the ease of scalability after the initial installation, hence the need for increased materials and labor upfront. In the event that a new splitter must be added after the initial installation, a trained splice technician will enter the splice closure, splice the required fibers, and reassemble the splice closure. Depending on the type of closure required for the application this may require additional resources and capital expenditure. This is not only a time consuming activation process that requires a skilled technician for every closure entry, but it also subjects the network to risk of damage/failure each time the splice closure is accessed.

Beyond the risk of network damage/failure with each closure entry, the overall integrity of the system is more difficult to evaluate and troubleshoot with a splice in splitter technology. Without a point of demarcation, a simple red light test is unable to yield any useful or timely information.

Instead, only highly specialized test equipment will be capable of determining the network viability beyond the splitter. In an effort to minimize the time and resources spent on troubleshooting and repair activities it is imperative that the engineering and installation practices be executed with the utmost accuracy because the slightest confusion could result in costly rework.

CONNECTORIZED SPLITTER MODULE

The development of a network employing pre-connectorized splitter modules will also require an initial splicing task be performed – all current and future splicing may be done at once in a centralized location. From there activating a connectorized splitter module or connecting a distribution fiber simply requires a technician to plug a jumper into the module. Through the use of jumpers, a connectorized splitter module facilitates a more efficient use of both the PLC splitter and OLT card. As new customers are added to the network the PLC splitter is systematically filled before a new connectorized splitter module and OLT card port is allocated. Optimizing the split capacity of each module allows the service provider to capitalize on the value of the PON architecture by reducing the number of stranded investments.

Furthermore, a connectorized splitter module offers an effective and scalable approach to the 'build as you grow' methodology by significantly reducing the required skill level to make each jumper connection and ultimately creating a simplistic test point for network troubleshooting. Through the use of a 'plug-and-play' module a point of demarcation is created between the splitter input port and the distribution ports. This physical connection allows a simple red light test to provide the technician with nearly instant feedback. Should further troubleshooting be required, industry standard test equipment has the ability to deliver reliable data.

In every case, it is desirable to have precise engineering and installation methods in place. However, should an error occur the steps to define and correct an inconsistency can be as simple as plugging a jumper into the appropriate splitter port. Moreover, with a connectorized splitter module the act of correcting a system fault does not threaten the integrity of the entire splitter because the individual splice points will not be exposed during the rework process.

An added benefit of the connectorized splitter module is the flexibility to meet the future needs of the network or customer with a labor effective migration path. Adapting a new split ratio, adjusting customer bandwidth, or deploying a new technology may be accommodated with the introduction of a new module into the system. Rather than absorbing the time, cost, and risk associated with re-splicing a portion of the network a simple conversion of the jumpers will facilitate the transition with minimal downtime.

AFL'S SOLUTION

The Integrated Distribution Enabling Access Apparatus (IDEAA®) Splitter Module takes a flexible and scalable approach to the deployment of PON networks. The rugged housing is built from common parts allowing for a seamless integration of all splitter configurations. The IDEAA Splitter Module is factory terminated and tested in 1:4, 1:8, 1:16, and 1:32 low reflectance SC or LC angled polish interface configurations. Additionally, multi-fiber connections are enabled through the use of the IDEAA MPO Splitter Module which will accommodate up to 96 fiber distribution in mass fiber deployment applications.

Figure 1: IDEAA Splitter Module

Once the decision to utilize a connectorized splitter module has been made the diversity of the network architecture will dictate the passive component requirements. The IDEAA Splitter Module was designed to address the notion that no two systems have the same needs in terms of components, structure, or economics. Whether building a centralized or distributive split architecture the IDEAA platform is versatile and capable of facilitating both types of construction.

The centralized split architecture is provisioned with all of the PON splitters located in a central location. The IDEAA solution is able to address this network style through the use of the IDEAA Exterior Distribution Cabinet (EDC) coupled with the IDEAA Splitter Module in order to meet the industry recognized needs of a fiber distribution hub. The EDC product family when paired with the connectorized 1:32 IDEAA Splitter Module is capable of servicing between 72 and 864 connections depending on the application requirements. A centralized split with a pre-connectorized splitter module not only allows for the flexibility to 'build as you grow' it also simplifies network troubleshooting.

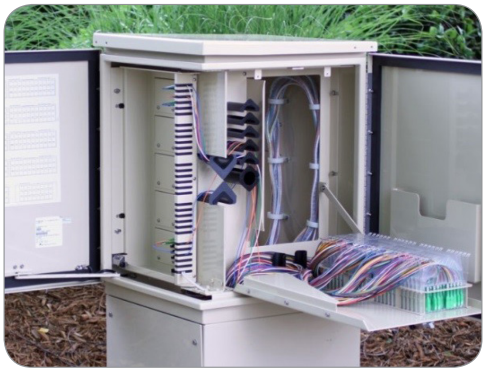

Figure 2: IDEAA EDC

The distributive split architecture pushes the splits further into the network; oftentimes by combining a series of smaller split ratios. In general, the fundamental need of this architecture no longer requires a dedicated stand-alone cabinet to house the splitter components. Rather, a series of smaller closures may be utilized to distribute the fiber into the network. A sealed splice closure outfitted with an IDEAA Splitter Module may be deployed to facilitate the distributive split architecture. The sealed splice closure may be mounted above or below grade providing additional versatility when designing a network.

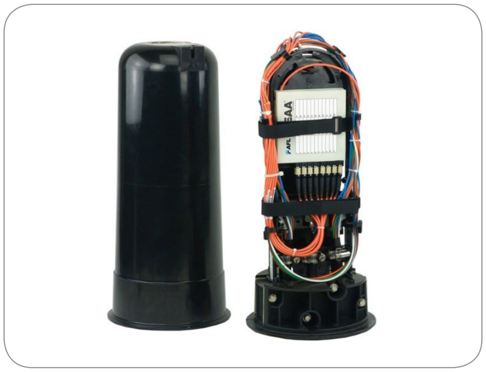

Figure 3: IDEAA Splitter Module Mounted in a Sealed Closure

The adaptability of the IDEAA Splitter Module does not stop with the EDC and sealed closure. The IDEAA platform was designed to encompass the majority of PON applications. For example, through the use of a LGX®-118 bracket the IDEAA Splitter Module may be mounted into a rack mount panel for use in a central office, headend, or other inside plant environment. The module may also be mounted directly onto an interior wall serving as an independent distribution point for a cost effective solution that required a minimal amount of space be dedicated. The IDEAA Splitter Module footprint will mount into a variety of exterior or pedestal mountable enclosures, ultimately allowing the application requirements to dictate the build constraint. The use of a single part provides uniformity throughout the network and reduces the number of unique products that must be inventoried for a job.

With the recent introduction of the Multiple Dwelling Unit (MDU) Solution, AFL has continued to expand the capabilities of the IDEAA platform. Built with the same robustness of the EDC, the IDEAA Interior Distribution Cabinet (IDC) family of products was designed to meet the specific needs of MDU applications. Whether deploying a homerun of drops from the living units back to the splitter cabinet or utilizing telco closets as a convergence point to enable mass distribution technology; the compact modular approach to a centralized split makes this the ideal solution when 32 up to 432 output connections are desired.

Figure 4: IDEAA IDC

CLOSING

When developing a PON based system it is advantageous to have the ability to specify products that meet the application needs, as opposed to designing an inferior network layout around the limited compatibility of the individual components. A connectorized splitter module utilizing a factory terminated and tested PLC splitter technology offers port uniformity with low losses in a package that is durable, reliable, and craft friendly. By utilizing a module footprint with the versatility to function within multiple build types the service provider gains the ability to design beyond the traditional 'splitter in cabinet' engineering design, ultimately expanding the benefits of the PON architecture to all areas of the fiber network.

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