FTTH – Building a Network

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FTTH is an ever evolving technology. However, the methods used to engineer and build FTTH networks are traditionally the same as those used for copper networks. These practices are cost effective and work well when building a FTTH network. The techs building the aerial or underground plant are familiar with the procedures carried over from the copper world so training is minimal and in most cases the quality of work is high.

Network differences

Even though the blue prints for fiber and copper networks are basically the same, there are some major differences. The most significant difference is the point when the tech connects the customer to the network. Copper drop cables were the weakest and most inexpensive portion of the network. They were also craft-friendly, took minimal skill to install and required no costly specialized tools. Fiber drops are uniquely different from their copper counterparts. While they are the weakest part of the network compared to their copper counterparts, they're expensive and difficult to install.

As fiber has come of age, three different methodologies have been utilized for fiber drops:

- Connectorized on both ends,
- Connector on one end and blunt on the other or
- Blunt on both ends.

The methodology selected has usually depended upon the provider's requirement -- what works for an independent may not be cost effective for a larger company. There are many different reasons for this. In most cases, at smaller companies, the installation is done by the same person that's performing the splicing. Since the tech has the splicing equipment with him, field splicing utilizing either the dual-ended blunt or connectorized to blunt option is the preferred choice. (There is also the mechanical connector option, where a connector with a pre-polished piece of fiber is mechanically attached to the blunt end of a drop.) However, with the cost of a low end fusion machine being around $7000 and a connector kit at $1500, companies new to fiber or those with multiple installers must weigh the investment in capital equipment against the convenience of field splicing. The result has been a significant trend *away* from field splicing.

The plug and play way

While there are cost challenges associated with outfitting a field team with splicing equipment, some providers have shied away from factory-terminated drops because of the added up-front costs. The approximate cost for an un-terminated fiber drop on a reel is between 10 to 20 cents a foot. At first glance, providers may see this as a better solution than the pre-terminated drops which may appear expensive. For years, service providers have bought copper drop which comes un-terminated on a reel. Since that's the deployment methodology with which they're familiar, it is a methodology that's

tempting to choose. However, there may be little or no consideration given to the “hidden” cost that a fiber drop has and copper doesn’t.

Industry studies have documented that the performance quality of a factory-termination is superior to field termination. When a drop is field terminated, the quality of the termination/connectorization is affected by numerous things.

The outside environment has a major impact on fiber – dirt, dust and humidity are just a few examples that come into play. The core of a single mode SMF-28e fiber is 8 to 10 micro meters. Specks of dirt, dust, oil from a person’s fingers or cigarette tar are all large enough to affect the transmission of light through the core of the fiber. This will degrade the signal and results in light loss which could equate into interrupted service-- this may be acceptable for voice traffic but won’t be tolerated in streams of data. Another factor is the human element. Once a tech has terminated a fiber, how does he/she know that they’ve done a good job? Loss readings should be taken on a drop once a termination has been preformed. This is a critical step and in many cases is overlooked by techs. Instead, they just plug in the drop and if the equipment comes up with green lights, the termination is declared good.

Pre-terminated fiber drops are a better solution for connecting customers to the network. The quality of the connectorization and the plug and play functionality makes for a better choice than field termination.

Environmental factors are eliminated on pre-terminated drops because they’re mass produced by trained techs in a controlled environment. Unlike the tech in the field, the tech in the factory has a single responsibility and that is to connectorize drops. The repetition of the tech performing this job and the quality controls of the manufacturer makes the end result a better product than the one produced in the field. The factory produced drops are held to a Telcordia/GR specification that the field terminated drops are not. Providers can rest assured that the product that they’re getting from a manufacturer is consistently the same. This helps eliminate potential trouble in the network, which equates to truck rolls which in turn means money.

Pre-terminated choices

Flat Drop with Standard SC/APC or SC/UPC Connectors

The first pre-terminated drop cable choice was to use a traditional flat cable with standard SC/APC or SC/UPC terminated at the factory. This solution basically replicated the drop cable that had been field terminated or field-spliced, but instead used factory personnel. The challenge with this solution was storing slack as it was difficult to know the exact length requirements and the stiffness of the flat drop cable made slack storage difficult. When the tech installs service, he/she estimates the distance to the terminal and selects what they think is the right length drop. In almost all instances the slack is stored somewhere at the customer’s residence. This requires some type of “box” to be placed on the house. The box is an added expense that most providers want to avoid and don’t want to incur.

Flat Drop with HFOC Connectors

Innovations have been made to create hardened connectors. The first and most common type of hardened fiber drop cable is the flat drop with HFOC (Hardened Fiber Optic Connectors) connectors. Corning has established a standard for the HFOC called the Opti-tap. Corning has licensed this technology to other providers including ADC (Tyco). This was the first generation of pre-terminated fiber drop cable. It is a robust and rugged connector but it has its limitations. The first is its size. If the fiber equipment is installed on the inside of the house, then the tech has one of two choices. A) Drill a ¾ to 1 inch hole into the customer's home in order to run the drop cable inside. B) Place a termination interface on the house so the drop can transition to a smaller cable that will access the home. The problem with option A is that few customers want a large hole drilled into their home. The issue with option B is that the added connection in the interface will induce more loss into the span which may affect service. Slack storage is still a problem with HFOC Connectors – Corning has suggested that engineering the exact length negates the need for slack storage devices and their associated costs. However, the additional time and cost of dedicated engineering can slow down the pace of an install which can be very costly.

Microduct with Pushable Fiber

A standard flat drop or a flat drop with HFOC Connectors is traditionally direct buried. It is possible to use Microduct to further protect this type of drop cable, the added cost of a pulling eye and associated labor was detrimental. A new, pre-terminated option brought to market by Clearfield is to run a lined Microduct with pushable fiber. The Microduct utilizes the inherent characteristics of fiber which is its small profile. Manufactured in a 10 millimeter diameter, the product is lined with a special polymer to ensure a snag resistant environment. Rather than a flat drop cable, Clearfield has introduced FieldShield drop cable, which has a grooved 3 millimeter diameter drop cable which is run through the Microduct from the terminal to the subscriber's residence. This option is attractive because a path to the home is established but the fiber isn't installed until the customer subscribes to the service. When the fiber drop is damaged, restoration is quicker than with the flat drop option. Simply remove the damaged fiber, repair the microduct and install a new drop. This comes into play now that fiber can carry all of a customer's services, telephone, data and video-- the need to restore service as rapidly as possible is critical.

The other advantages of using microduct is that it can be run from the terminal directly to the equipment inside the home, eliminating the need for some type of interface box. Since the drop is small (usually 3mm) the issue of slack storage no longer a problem. Slack can be stored at the point of connection rather than at the customer premises -- eliminating the need for another box used to store slack. The FieldShield drop cable is delivered with a patented SC-compatible connector that, while factory terminated at Clearfield, is field-assembled – allowing it to be pushed rather than pulled through the Microduct.

The microduct option is seen by some as an ineffective cost solution compared to the pre-terminated flat drop. However, when taking into consideration establishing a path to the subscriber, restoration

time, speed and logistics of installing the drop fiber, eliminating the need for transition and slack storage box, the microduct/drop option is a better solution than flat drop cables.

Pay now or pay later

As mentioned, FTTH is an evolving technology. You have to ask yourself when choosing a drop solution, "What is the best option to future proof my network?"

The following table outlines market pricing for the four drop cable options:

Component	Field spliced flat drop SC/APC to SC/APC	Pre-Terminated Flat drop SC/APC to SC/APC	Pre-Terminated Flat Drop HFOC to HFOC	Microduct with Pre-Terminated Pushable Fiber
Cable(100 feet) and associated connectors	$36.00	$62.00	$78	$50.00
Splicing Labor (hr)	$76.00	NA	NA	NA
Slack Basket	NA	$30	$30	NA
Microduct (100 feet)	NA	NA	NA	$48.00
Total	112.00	$92	$108.00	$98.00
Strengths and Weaknesses	Lowest capital equipment cost; Highest op/ex cost; High restoration and maintenance cost	Lowest upfront cost; High restoration and maintenance cost	Marketed as best for OSP environments; High restoration and maintenance costs	Lowest life-time costs due to ease of installation and restoration;

The flat drop solution may be a more attractive cost model for initial installation, Microduct establishes a path so if the fiber drop needs to be upgraded, changed or repaired at a later date, and can be done with relative ease.