Leveraging ADSS Cable Technology in Utility FTTx Networks

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ABSTRACT

Pre-terminated fiber-to-the-"x" (FTTx) solutions have existed in the marketplace for some time now with many "plug and play" fiber access terminals employing flat drop style cables. While these cables provide many advantages, including self-support capability, their primary use in aerial applications is in a lashed cable infrastructure. This paper investigates the use of alternative cable stub options and how they could be used to lower overall deployment costs in a new era of FTTx deployments.

INTRODUCTION

Electric utility companies, including both private and publicly-owned energy providers as well as cooperatives (co-ops) have a rich history of deploying fiber networks for both internal use with SCADA or traditional Ethernet systems, and/or utilizing their existing right-of-way (RoW) to install dark fiber then leasing to a variety of customers. As utilities often sell or lease the space below the neutral to various service providers, running fiber optic cables in the supply zone or neutral space, above the communications space, is key to these deployments to prevent clashing of cables.

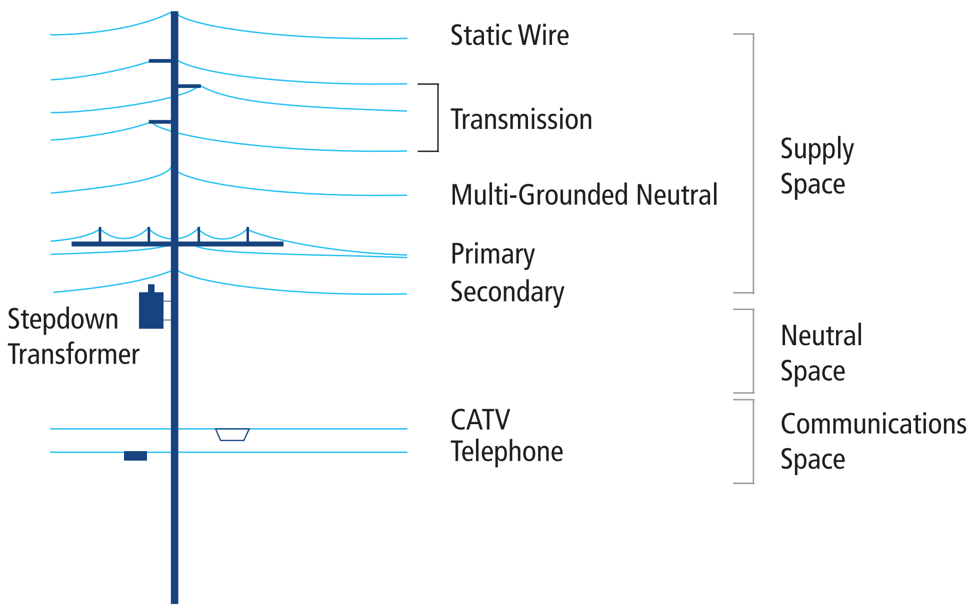

Figure 1—NESC Joint Use Pole Diagram

UTILITY FIBER OPTIC CABLE SOLUTIONS

To support these types of installations, fiber optic cable manufacturers designed all-dielectric self-supporting (ADSS) cables which, as its name implies, can span pole-to-pole without the need for a messenger wire. Due to the dielectric construction of the cable, installers don't have to worry about overhead lines inducing a charge to any metallic cable components, thus removing safety concerns without the need for grounding. Flat drop cables can self-support as well, but typically at much shorter distances than their more robust ADSS cable counterparts which can span over 1500 feet between poles depending on the cable design.

Optical ground wire (OPGW) is another cable technology used in the utility space where it is placed in the topmost position on the support structure as a shield wire while also providing a telecommunications path via fibers internal to the cable structure. Transmission lines utilize a shield/ground/earth wire to "shield" conductors from lightning strikes, so OPGW allows utilities to provide data transmission as well as shield wire capability with the same cable.

PRE-TERMINATED FTTx SOLUTIONS

Pre-terminated hardened multiport terminals have become increasingly popular in FTTx deployments over the past several years as service providers are increasing investment into their fiber infrastructures and discontinuing antiquated copper-based content and data delivery. As FTTx installations continue to scale, slower drop installation methods have proven difficult for service providers as they haven't been able to keep up with demand. For example, installing drops via fusion splicing requires accessing a splice enclosure, stripping cable and fusing the fiber with a fusion splicer. For a drop installation, this can be slow and also requires a fusion splicer machine and a technician trained to operate it. Drops pre-terminated with standard connector types such as SCAPC connectors increase deployment speeds, but these connectors are not waterproof and require some type of sealed enclosure to protect the connector from the OSP environment.

Factory-terminated hardened fiber optic connectors (HFOCs) allow for quicker drop installations that previous methods while maintaining a sealed interface between the drop and terminal. This promotes long-term reliability when installed anywhere in the network—underground, in pedestals, on poles, on aerial strand or on ADSS cables. The terminal is stubbed with a pre-configured length of cable that is run to a splice closure where the terminal is spliced into the F2 cable. As the installer now doesn't need to repeatedly access a closure containing F2 fibers to install drops, long-term reliability is enhanced versus traditional closure terminal options, especially reliability of expressed fibers serving additional terminals downstream.

UTILIZING ADSS CABLE TECHNOLOGY IN PRE-TERMINATED SOLUTIONS

Historically, pre-terminated hardened access multiports have utilized a flat drop cable design. As most of these multiport terminals are 12 ports or less, the flat drop design is a cost effective way to package the required fibers while remaining robust enough, yet low profile, for underground duct or direct bury as well as aerial lashed deployments. The cable design is also able to be self-supported in aerial applications using simple two-pair drop wire wedge clamps previously only used for copper twisted pair drops.

Self-support capability comes from the dual fiberglass-reinforced plastic strength members as well as extra fiber length (EFL) contained within the gel-filled buffer tube. EFL ensure that as the cable experiences strain due to environmental loading conditions such as ice and wind, strain on the fiber is kept near zero to avoid introducing attenuation or affecting the long-term mechanical reliability of the fiber.

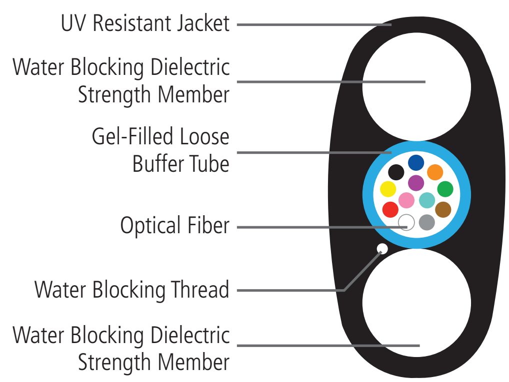

Figure 2—Cross Section of Typical Flat Drop Cable

Table 1—Flat Drop Cable Max Span Length at 1% Sag

NESC LOADING CONDITION	LIGHT	MEDIUM	HEAVY
Span Length (ft.)	550	275	150

While self-support capability of flat drop cable adds flexibility to designing pre-terminated multiport terminals into FTTx networks, its primary functionality comes into play for single-fiber drops spanning from the terminal to the customer premise. These spans are often much shorter than spans seen in the distribution space. In the cases of longer-than-recommended spans, single-fiber drop cables are often one of the lowest cost pieces of material in the network and are viewed as replaceable in the event of a seldom-seen heavy ice storm.

When attempting to use flat drop cables in a self-support capacity for multiport terminal tails, it is important not to exceed the recommended span lengths for the cable as environmental loading at beyond recommended span lengths could cause temporary outages of multiple customers connected to that terminal, or even fiber breaks requiring costly repairs or even replacement of the multiport. In NESC light loading zones, exceeding the recommended max span would be very rare in most distribution pole spans. However, in NESC medium or heavy loading zones, exceeding the 275′ or 150′ respective max spans could be much more frequent, especially in rural locations.

In order to meet the longer span length requirements at NESC medium or heavy loading in rural locations, utilities could run strand wire and lash flat drop multiport tails. This method is not preferable as metal strand is not suited for the supply space due to the conductive nature of the strand and the communications space is often reserved for leased customers such as Telco and CATV providers. Another option is to utilize multiports that have an ADSS tail option, such as AFL's TITAN RTD® multiport terminals. These terminals utilize a miniaturized ADSS cable that, due to the stranded buffer tube core and aramid yarn strength members, allow for much longer span lengths seen in rural environments, even at NESC medium or heavy loading.

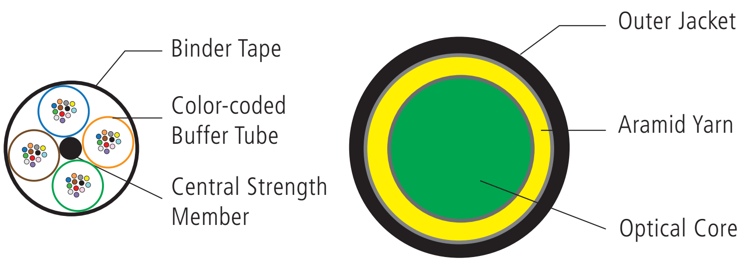

Figure 3—Cross Section of TITAN ADSS Cable

Table 2—TITAN ADSS Cable Max Span Length at 1% Sag

NESC LOADING CONDITION	LIGHT	MEDIUM	HEAVY
Span Length (ft.)	1250	800	450

While ADSS cable is advantageous to use as a multiport terminal stub as the cable can be run in the supply or neutral zone on the utility pole, it is unlikely utilities would desire the multiport terminal itself to be mounted in the supply zone. Mounting the terminal in the supply zone could be troublesome as only installers certified for work in the supply and neutral space would have access which could increase costs. In these instances, it is recommended to bring the multiport terminal further down the pole, even below the communications attachment points. This allows for access by most telecom contractors using only a ladder rather than a bucket truck.

Figure 4—Hardened Pre-terminated Multiport Terminal

COST ADVANTAGES OF ADSS VS. LASHED SOLUTIONS

While ADSS cable provides a technical advantage vs. self-support flat drop as well as lashed cables in many cases, there is also often a cost advantage to consider. When comparing ADSS and lashed cable for new builds where existing messenger is not installed or not available, it is important to understand the steps required for full cable installation as shown below.

ADSS Cable

- Pole "Make Ready" (pulley placement)
- Cable Installation
- Sagging
- Hardware Attachment

Lashed Cable

- Messenger Placement
- Messenger Pre-tensioning (creep)
- Messenger Hardware Attachment
- Cable Placement
- Lashing Wire Placement and Termination
- Bonding and Grounding

As you can see, the two-pass installation methodology of lashed cable as well as the bonding and grounding requirements of the steel messenger add considerable more steps. These additional steps often result in 30-35% longer installation times on average.

In additional to installation time, additional time and labor to maintain a lashed network should be considered. Loose "bug nuts" and lashing wires can appear and are fairly common, requiring remediation to prevent cables from freeing from the strand and placing unwanted strain on the cable during wind and ice loading. Ice loading itself is also an additional concern with lashed cables that can restrict overall span length performance. While ADSS is a small diameter circular cable, lashed cables along with the messenger wire and any additional overlashed cables can take on much larger cross-sections. These larger cross-sections are subject to more radial ice, resulting in larger loading on the strand and cable as well as the poles themselves.

Excessive ice loading is not just potentially damaging to fiber cables lashed to the messenger strand, but the increased loading can also lead to creep over time, which is a permanent stretching of the metallic messenger. Excessive sagging due to creep cannot be recovered after the ice load is removed and would require replacement of the strand in cases where vertical clearance standards are violated or too much strain is being placed on the lashed cables.

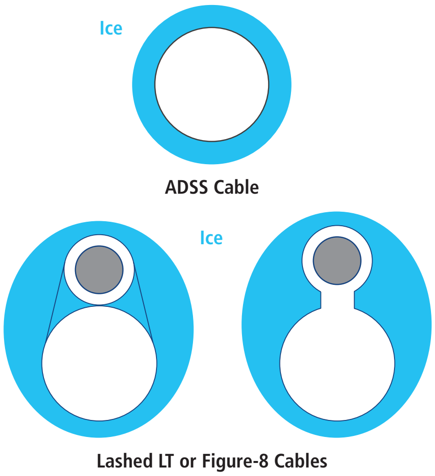

Figure 5—Comparison of Ice Loading on ADSS vs. Lashed Loose Tube or Figure-8 Cables

SUMMARY

Electric utilities are seeing the potential for additional revenue streams with a vast amount of customers in rural America largely without access to reliable, high-bandwidth internet connections. With this large under-served customer base and often complete ownership of the rights-of-way (utility poles), building FTTx networks easily, efficiently and inexpensively is possible more than ever thanks to emerging, as well as existing, battle-tested, technologies. It is important for electrical utility network operators to understand the products available today when assessing feasibility for building an FTTx network in order to fully comprehend necessary factors including, but not limited to, cost and speed of deployment.

AUTHOR

Will Miller is the Product Line Manager for outside plant connectivity products within AFL's Cable and Connectivity division. Will has over 10 years of experience in fiber optic cable and connectivity manufacturing, holding various roles in engineering and product line management.

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