Application Notes

Sterlite Tech

Selecting the correct cable type for Outside Plant Application

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Abstract

Organized selection methodology of optical cable for a specific application is important. This note will address those issues that directly impact the cable type selection process. The cable type which provides the optimal economic advantage is ultimately the methodology that will be chosen.

Keywords

All dielectric self-supporting cable, Buried cable, underground cable, aerial cable

Introduction

This Cable Planning Note is intended to provide the reader with an organized selection methodology when they must select the optimum optical cable for a specific application.

The following issues will play a role in this selection process and will enter the cable selection process at least at one decision point.

1. Service to be provided
2. Type of area being served: urban, suburban, rural.
3. Age and type of existing cable infrastructure presently serving intended area
4. Type of soil encountered
5. Terrain encountered
6. Climate (wind and ice loading)
7. Access to right-of-way
8. Ability of work area to be isolated from surface traffic and public.

This note will address those issues that directly impact the cable type selection process.

Summary of Various types of Cables for Outside Plant (OSP) Usage

While exceptions to each suitability statement can be debated, most of the generalizations given below concerning the suitability of a cable type for a specific OSP condition will be issues of general agreement.

Aerial cable is strung in the air from poles or towers that provide its support. It includes cable that is lashed to a messenger strand for support, figure 8 cable strand attached to the main cable with a plastic web, and all dielectric self-supporting cable (ADSS), a round cable manufactured with dielectric materials and uses its own strength to support itself.

Buried cable is placed in the ground without any protection from a surrounding conduit. Buried cable can be laid in an open trench, dug with a trencher, or plowed into the ground with a large plow.

Underground cable is placed into conduits which have been built into the ground. Cable is then pulled or blown into the conduit. Normally, fiber optic cables are pulled into sub-ducts which have been placed inside the standard 4-inch diameter telecommunications conduit. Using sub-ducts, it is possible to place two or three fiber cables in a single 4-inch conduit. This allows the underground space to be used much more efficiently.

Table 1- Commonly Used Cable Types for Various OSP Applications

Plant	Urban	New Suburban	Old Suburban	Campuses	Rural
Aerial					
• Strand (lashed)	🟡		🟢	🟡	🟢
• Figure 8 loose tube	🟡		🟢		
• ADSS loose tube	🟢		🟡		🟢
Buried					
• Trenched loose tube		🟢		🟢	🟢
• Plowed loose tube		🟢			
Underground					
• Conduit	🟢	🟢	🟢	🟢	

🟢 = Used often in this application

🟡 = Can be used in the application under certain circumstances

Underground cable is found in nearly every type of neighborhood. It is by far most common in urban areas and less common in rural areas. Buried cable is found mostly in suburban and rural areas where the scar in the ground surface is not an economic problem. Aerial cable is often found in older areas, and it requires the pole line and aerial cable to be acceptable to the esthetics of the surrounding area.

The economics of communications construction often depends upon not only the cost of the plant materials and labor, but also when that investment is made with respect to when it can begin to earn revenue.

All three types of cable need infrastructure investment before any cable is placed. Aerial plant requires a pole line to support itself form sagging. These poles, however, can simultaneously support several telecommunications cables, and other utility cables such as power, cable TV, and internet. As a result, the infrastructure investment in aerial cable, which is quite modest, can be shared with other utilities that occupy the same pole line. It is also possible to reduce the cost of future cable installations by using micro-ducts lashed to a messenger strand to house micro cables when new service is required.

Infrastructure cost of buried cable is generally the lowest of all three cable types. It consists of handholes and any spare conduits (if desired) placed in the ground with the initial cable needed to serve present day requirements. Each buried installation requires that most of the infrastructure construction is repeated with each new cable installation. Therefore, unless a cable to meet present service requirements is placed with one or two spare conduits to serve future needs, there is no way to take advantage of previous infrastructure investment in a buried plant installation. The lifetime of the spare ducts can be increased; however, if in the future micro-cables are blown into these ducts and a portion of the cost of a new infrastructure can be passed into the future when the additional service is required.

The cost of infrastructure for underground cable is generally the highest of all three cable types. It consists of manholes[1] and a conduit system. Underground cable is commonly located in expensive urban areas.

[1] A telecommunications manhole is a below ground structure that is large enough to house a worker and is used to access underground and buried plant, house splice closures, and store spare cable.

Conduit systems are sized to provide spare ducts to serve future demands. The capital investment in spare ducts cannot be recovered until cable is installed in these ducts. Fiber cable is placed in sub-ducts to enable a standard 4-inch conduit to house up to two or three normal size fiber cables. This approach allows conduit systems to be down sized from older copper cable systems. The lifetime of the spare ducts can be increased if in the future, micro-cables are blown into them to meet the future requirements when they emerge.

Often urban areas have power distribution lines on the same right-of-way and in close proximity to optical communications cables. In this case, the use of ADSS cable provides a transmission medium well suited for this high power environment. Also, because ADSS has no conduction pathways, bonding and grounding in such an environment is not the concern it would be with most optical cables.

ADSS cable is sometimes used when there is a transition from aerial to buried within a cable length.

The following table summarizes the economic issues that affect the three types of communications plant.

Table 2- Simple Summary of Economics of the Three Types of Communications Cable

Plant	Initial Investment on Infrastructure Required for New Cable	Deferred Investment Until Future Cables Placed	Other Issues
Aerial	Pole line built when first cable installed can be shared with telephone, power, and cable.	Several cables can be placed on same poles.	● Pole line cost may be shared with other utility companies. ● Cost of future construction may be reduced by placing cable in spare micro-ducts suspended off the pole line when service is required.
Buried	Handholes are needed for each placing operation.	One or two ducts can be placed (for future service) with cable to meet current service requirements.	● Cost of future construction can be deferred by placing cable in spare ducts when service is required. ● Micro-ducts can be used to increase the volume of future service that can be served.
Underground	Conduit system with manholes required. Proper sizing of conduit system is economically critical.	Cable is placed in spare ducts to meet future service needs at the time those needs first appear.	● Cost of future construction can be differed by placing cable in spare ducts when service is required. ● Micro-ducts can be used to increase the volume of future service that can be served.

Normally, if existing cable serves the area with the new service demand and is available to accommodate the new cable, it should be the top candidate as the cable type to be used for the new construction. However, reviewing the areas normally used and the general economics associated with the three OSP Cable Types provides considerable guidance as to the type of cable to use to meet current and future service demands. It is useful, however, to examine the strengths and weaknesses of each cable type before a final decision is made.

The table below lists some of the most prominent advantages and disadvantages of the three major OSP construction types.

Table 3- Pros and Cons of OSP Construction Types

Pros	Cons
Aerial Cable	
● Lower cost than underground cable and comparable to direct burial. ● Flexible with respect to upgrading cable. ● Usually provides most direct route between buildings. ● Can easily cross obstructions such as roads. ● Common in older residential areas and industrial park campuses. ● Right-of-way is easy to access for both installation and maintenance. ● It is suitable for the placement of long cable lengths.	● Exposed to environment and weather: ice, wind, and snow loading can be a problem. ● Shortened lifetime because of its exposure to the harsh environment. ● Exposed to traffic and public. ● Support structure maintenance is required. ● Least aesthetic of the three cable types. ● Aerial cable is usually spliced in splice closures suspended off the aerial messenger strand.
Buried Cable	
● Can be either trenched or plowed. ● Trenching provides a more gentle cable placement. ● It is often used in rocky areas. ● Plowing is usually preferred when area is either prepared with brush removed and gently rolling or flat. ● Pre-ripping the right-of-way will be required in rocky or hard soils when plowing is used. ● Fast construction in rural areas. ● Economical in rural areas without a need to cross obstructions. ● Buried cable protected from weather, traffic, and public. ● If geology and geography permit, it is suitable for the placement of long cable lengths. ● Buried cable usually spliced in pedestals or splice closures in handholes[2]. ● Popular in new residential areas. ● In good conditions, it is possible to plow more than one cable or a mix of cable and ducts in one plowing operation.	● Can be either trenched or plowed. ● Trenching provides a more gentle cable placement. ● It is often used in rocky areas. ● Plowing is usually preferred when area is either prepared with brush removed and gently rolling or flat. ● Pre-ripping the right-of-way will be required in rocky or hard soils when plowing is used. ● Fast construction in rural areas. ● Economical in rural areas without a need to cross obstructions. ● Buried cable protected from weather, traffic, and public. ● If geology and geography permit, it is suitable for the placement of long cable lengths. ● Buried cable usually spliced in pedestals or splice closures in handholes. ● Popular in new residential areas. ● In good conditions, it is possible to plow more than one cable or a mix of cable and ducts in one plowing operation.

[2] A handhole is a dielectric structure providing access to small underground systems and buried cable. Its top opens to store splice closures and spare cable. It is small in size, too small for a worker to enter. The National Electrical Code covers handhole specifications.

Pros	Cons
Underground Cable	
● Highest level of protection to cable. ● Least disruption to traffic, public, and property during cable placement once conduit is in place ● Flexible with respect to upgrading plant. ● Used almost exclusively in congested urban areas. ● Underground cables spliced in splice cases mounted in manholes. Best protection of splices.	● New conduit infrastructure construction in congested areas is expensive. ● In wet areas plant is often submerged. ● Placing cable often uses special equipment. ● Relocation of conduit plant can be expensive.

The table that follows provides an overall comparison of key factors that characterize the three OSP Cable Types.

Table 4- Summary of the Three Outside Cable Types

Plant	Pros	Cons
Aerial		
● Strand ● Figure 8 ● ADSS	● Generally most economical, if pole line is available. ● Familiar placing procedure. ● Cost of construction delayed until service is required. ● Not dependent upon soil conditions. ● Long cable lengths are possible. ● Generally easy access to right-of-way for maintenance.	● Environment plays a major role in the lifetime of aerial cable. ● Susceptible to damage from traffic accidents and public. ● Susceptible to damage from ice and wind loads. ● Least aesthetic of all cable types.
Buried		
● Trenched ● Plowed	● In good soil trenching preferred because it is easier than plowing and less costly than aerial if a pole line is not available. ● In rocky soil trenching is usually used instead of plowing. ● Several cables and a spare duct can be buried by trenching. ● In rolling terrain without crossing obstacles, buried construction is fast and gentle on the cable.	● Rocky soils present a problem for both trenching and plowing. ● Hard soil needs to be pre-ripped before plowing. ● Rocks need to be removed from backfill around cable. ● Crossing obstacles (roads or other buried or underground utilities) require special construction techniques.
Underground		
● Conduit ● Micro-Ducts	● Considerable cost to initially install conduit system. ● As long as ducts are available, placement of new cable is fast and easy. ● Most robust and secure of all cable types. ● Cables can be removed for salvage when no longer required.	● Underground is often flooded, so placing operation usually requires pumping of manholes and duct. ● Gases can collect in underground which need to be properly vented. ● Placing tension is strongly effected by large bends particularly when existing near the end of the conduit system. ● Conduit system needs to be rigged with sheaves and quadrant blocks to reduce the effect of bends.

The following table can be used to review the strengths and weaknesses of the use of micro-ducts. Micro-ducts are small diameter ducts that are used to contain micro-cables (small diameter cables) designed to be blown into the micro-ducts.

Table 5- Pros and Cons of the Use of Micro-Ducts

Pros	Cons
Micro-Ducts	
● Low investment at project start. ● Can be used with all three types of OSP construction. ● Can delay the investment in infrastructure match timing of revenue generation. ● Simple to increase the capacity of the cable. ● Uses latest cable technology. ● A variety of fiber optic cables available. ● Provides a clear separation of different cables.	● Requires the use of special cables and equipment. ● This is still a procedure many installation crews are unfamiliar with. ● Most cost effective to install cable into existing plant.

Finally, the cable type which provides the optimal economic advantage is ultimately the methodology that will be chosen. That means that it is a cable that cable installation crews and splicers are comfortable with and have the necessary equipment to construct and provide maintenance on. Also, the final cable type must be sufficiently robust to withstand the weather conditions it will encounter over its service lifetime.

Additional Information

If there are additional questions on this topic or other fiber optic issues, please contact Sterlite Technologies at:

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