# Using Emerging Technology to Reduce Fiber Deployment and Construction Costs

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Increasing broadband demands are placing a substantial load on the cellular macro-network. In some environments, particular urban areas with high demands, the load is now critical. Market data suggests that the implementation of DAS (Distributed Antenna Systems) networks will explode. A unique property of a DAS system is that the components are small and thus can be deployed in areas previously not available to system providers. An example of this is streetlight poles in metro areas. These locations typically could not support the load of a traditional cellular system. DAS systems are small enough to not overload the support structure, and are more aesthetically appealing. With this smaller size comes a smaller broadcast footprint. This means that more sites are needed per square mile to give the coverage that is expected.

But because of the high density environment where these DAS networks are most critically required, the dependence on traditional deployment and construction methods is simply too costly. Utilizing emerging technology to reduce fiber deployment and construction costs will not only reduce the time (ie. Labor) required, but will also be less disruptive to the environment in which the DAS service is being installed. The following case study illustrates the improvements these emerging technologies can deliver.

**The traditional model**

Because DAS sites are typically fiber fed, they need to have access to the traditional fiber networks that are already constructed in the underground systems (manholes) in most cities.

Traditional installations would involve cutting two slots in the pavement or concrete far enough apart to facilitate a backhoe or excavator bucket. This is normally one to two feet apart as the smallest bucket for these machines is a foot or more wide. After the cuts are made, the material is removed by breaking it into small pieces and excavating it. This also requires the use of steel plating to enable traffic movement, or closing the roadway all together, the latter normally not being acceptable. After the trench is opened, the conduit can be constructed from the manhole to the streetlight pole. Once the conduit is in place, sand, crushed stone or some other premium aggregate is placed around and over the conduit. This aggregate is then compacted and typically covered with a layer of concrete. Finally, a top coat of concrete or asphalt is laid to finish the trench. At this point the fiber can be pulled from the manhole to the DAS site.

**Emerging technology offers a lower-cost alternative**

Using the same example as above but deploying micro duct and micro-trenching you will quickly notice a significant difference: micro-trenching requires a much smaller trench to be cut from the manhole system to the streetlight pole (one inch wide vs one foot wide) and boring into the manhole vs excavation around the manhole. Because the trench is so insignificant, no material is excavated. No steel plating or road closing is required. After the micro trench is open, the conduit is placed, restoral is applied to seal the pavement and the pre-connectorized fiber is pushed or pulled to the desired location.

**Cost Modeling**

The costs for deployments are calculated using various methods across the United States, however, a generic example is one of costs per work action. Looking at the above example you have the following:

1. Saw cuts (2) from manhole to DAS location
2. Breaking of asphalt or concrete
3. Removal of debris and excavation of trench
4. Entry into Manhole (Excavation around and breaking into sidewall)
5. Plating of open trench to accommodate vehicular or pedestrian traffic
6. Placement of structure in trench (1”-2” inner duct or traditional conduit) **Note: requires a reel trailer and vehicle to transport and deploy.**
7. Backfill and compaction of trench
8. Installation of concrete cap
9. Final top coat and restoral
10. Placement of fiber from man hole to DAS location
11. Traffic control/barriers for duration of installation
12. Splicing and turn up of site.

**The same scenario using micro duct and micro-trenching:**

1. Saw cut (1) from manhole to DAS location
2. Entry into Manhole (Core drilling)
3. Placement of structure in trench (FieldShield Micro-duct) **Note: Requires a small reel stand to deploy.**
4. Installation of restoral material/including top coat (Usually done in a single pass)
5. Placement of pre-connectorized fiber to DAS site and turn up of site.
6. Traffic control/barriers during saw cut and final placement.

**Study of a recent deployment of DAS systems in a major metropolitan area:**

In a recent project, thirty-three DAS towers were erected. Nineteen sites were installed using traditional construction methods while fourteen sites were installed using micro-trenching. The length of installation varied from approximately fifty feet to six hundred feet, evenly divided between the installation types.

Installation using the traditional method required $707 of labor per linear foot and a total material cost per location of $5,210. Installation using micro trenching had a labor cost of $274 per linear foot, and a material cost of $928.57 per location.

It should also be noted that because of the added time needed for traditional construction methods, inspection costs, although not included in the above numbers, were nearly double that of a micro-trenching installation. Most micro-trench installations were completed within a 12 hour window (7 pm to 7 am) while traditional installations required two to three days to complete which requires an inspector to be on site for that time as well.

An extra benefit of micro trenching is that due to the small size there is no requirement to use extra vehicles to bring the material to the job site. Typical inner duct requires a large diameter reel to hold it thus requiring a reel trailer and a vehicle (and person) to get it to the job site and to deploy. Additionally, because the equipment required for traditional excavation is also large, a much larger worksite needs to be secured in order to perform the work. This is disruptive to both pedestrian and vehicular traffic as well as being more costly to the contractor as they must have more and larger vehicles to allow for transportation and use. The typical micro duct deployment can be brought to the job site in just two standard pickup trucks.

**All Micro duct Solutions are not the Same**

Because the trench being cut in a micro trenching installation is so much smaller, turns and bends will be much tighter. Micro duct and the optical fiber used along with it must be able to withstand the pressure of being placed in these small trenches and still function.

Because it is a saw cut, intersecting cuts 90 degrees apart are made at the location of a turn. Then a 45 degree diagonal cut is made between the two to allow for conduits to bend around a corner. What is left are two points along the corner that have somewhat sharp points left behind. This is a load point for the micro duct, and in my history in the industry, I have often witnessed the failure at these points. While not always apparent at initial installation, because it is typically placed in the roadbed, vehicle vibration and pressure can cause the some micro ducts to collapse at these corners.

FieldShield, a micro duct and pushable fiber solution from Clearfield, was designed and introduced to the market two years ago to address these varying limitations. As Clearfield is an expert in the protection of optical fiber, FieldShield's performance requirements called for high crush ratings, allowing it to be immune to these pressures. The crush rating is typically defined as SDR (Standard Dimensional Ratio) and with this, the lower the number the higher the crush rating. Looking at typical inner ducts, a rating of 13.5 is considered "standard". SDR 11 has been looked at as the heavy duty duct. The FieldShield (**10mm OD by 6mm ID)** product rates at an **SDR 5.** But even with this rating, FieldShield retains a flexibility that allow it to be able to be placed in the tight confines of a micro-trench.

It is critical in a micro trenching application, that the optical fiber being placed within it is pre-connectorized. Without the use of a pre-connectorized solution, significant labor costs would be incurred to splice on a connector in the field – negating the cost advantages gained through the micro trench solution. But because of the very small size of the micro trench, a connector specially designed for micro trenching must be used.

FieldShield optical fiber offers not only a single connectorized fiber, but with the use of a MPO connector, FieldShield can deliver 12 fibers ready for use. And because the same sheath can provide one to twelve fibers, the installer can tailor the installation without having to inventory multiple micro ducts.

**Conclusion**

Micro-duct and pre-connectorized fiber solution coupled with micro-trenching eliminates up to 60 percent of the work operations and costs in a typical installation.

1. A single 1" cut is made from the manhole to the DAS site, and because the cut is very narrow, no plating is required for vehicular crossing.

2. Using a core drill to enter the manhole eliminates the need to excavate at the manhole to gain access.
3. Restoral is usually accomplished in a single pass. No compaction or multi-layering needed.
4. Minimal traffic control is needed because vehicles can driver over the saw cut without danger of damage to vehicle or trench.
5. Minimal amount of work vehicles required. Reel trailer for conduit is eliminated, no large equipment needed on site such as backhoe, or excavator.

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*Scot Bohaychyk, Clearfield market manager, has nearly 30 years in the Telecommunications industry. Scot's background includes serving in The White House Communications Agency, providing communications infrastructure support for then President Ronald Reagan and his White House staff. Scot's private sector experience includes OSP field and engineering experience as well as market development and sales work in the fields of blown and pushable fiber for long haul fiber installations both in the United States and overseas.*