Microtrenching Accelerates Fiber

A PROVEN AND USEFUL TOOL IN THE FIBER CONSTRUCTION TOOLKIT

Fiber Broadband ASSOCIATION

When fiber leads, the future follows.

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INTRODUCTION

There are many ways to build and deploy fiber optic cables and each has pros and cons when considering cost, speed, safety, and complexity. This white paper focuses on the emergence of microtrenching – why it has become so prevalent and the many benefits it brings.

Microtrenching has been field-tested and optimized over the years, gaining popularity across the country as an advantageous deployment method and now recognized in state-driven broadband guidelines and laws. It has enabled the rapid means of building fiber networks by infrastructure and service providers like Crown Castle, Dycom, Frontier, Google Fiber, S&N Communications, Ting, and many others.

This document is not intended to promote microtrenching as the single best deployment method. This white paper was created by subject matter experts on the Fiber Broadband Association's (FBA) Deployment Specialists Committee to put to rest any residual concerns or doubts about microtrenching and position it where it belongs among its peer methods as a valuable option in the fiber broadband construction toolkit.

THE PATH TO 100% — BROADBAND FOR ALL

Before 2020, the pace of broadband deployment was generally constrained by funding, but materials, installation equipment, and labor were readily available. By 2022, the fiber industry found itself hampered, for the first time, by physical resources. With these barriers, major ISP deployment goals were missed and construction forecasts were adjusted downward.[1]

In light of these constraints, we emphasize the adoption of what is now a tried-and-true method of fiber infrastructure installation: microtrenching. Microtrenching is a proven method to accelerate the creation and installation of the symmetrical gigabit-capable networks needed to establish digital equity and close the digital divide. This method was developed in the early 2000s to enhance and improve the installation methodology toolkit and has been perfected over the last decade.

Public and private capital fuels the economic development engine that is fiber infrastructure. The investment in broadband is regularly compared to the electrification of the United States by the USDA and the Rural Electrification Administration (REA) in the early 20th century. It is therefore imperative that federal initiatives, such as the Infrastructure Investment and Jobs Act (IIJA), the Broadband Equity, Access, and Deployment (BEAD) program, and the Rural Digital Opportunity Fund (RDOF), be used in the most cost- and time-efficient manner possible. In today's digital world, high-performance networks capable of handling massive amounts of data are necessary. Businesses, hospitals, governments, school systems, universities, libraries, and other enterprises all depend on resilient and reliable connectivity. This means we must think of fiber in the same way we think of power lines – as essential to modern life.

[1] https://www.lightreading.com/broadband/warning-signs-flash-that-fiber-bubble-could-pop-analyst-says/d/d-id/781885

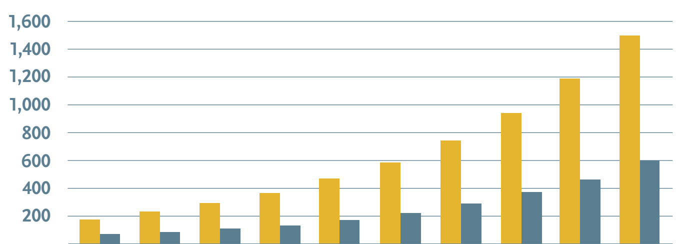
MICROTRENCHING ACCELERATES FIBER DEPLOYMENT

Urban internet users take advantage of life-changing applications like distance learning, remote work, telehealth, streaming services, security cameras, and more. These applications work because of the availability of broadband services, with major internet service providers now offering speeds of up to a gigabit or more. The chart below (Figure 1) shows that average broadband speeds in urban areas greatly exceed the 25/3 Mbps service levels common in many other areas of the country.

Over the past five years, U.S. fixed broadband download and upload speeds have increased at a compound annual growth rate of 27% and 28%, respectively. This compares to 55/19 Mbps in 2016. If these growth rates continue over the next decade, the average U.S. fixed broadband speeds will be 1500/599 Mbps by 2030 (see Figure 1).

Speed Test Data Suggest Gigabit Demand by 2030

YEAR	DOWNLOAD (Mbps)	UPLOAD (Mbps)
2016	54.97	18.88
2021	179.06	64.89
CAGR	27%	28%



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
DOWNLOAD Mbps	179	227	287	364	461	583	739	935	1,185	1,500
UPLOAD Mbps	65	83	106	136	174	223	285	365	468	599

Fig 1

*Upload speeds potentially change if AR/VR adoption increases in the market expands

Source: USources: Ookla January 2021 Speed Test Data; Vox Article on 2016 Speeds

Source: FBA Technology Committee - The Rural Digital Divide, Fiber Broadband Can Eliminate the North American Rural Digital Divide

Given the unprecedented level of fiber that will be needed, and the new physical constraints as well as federal deadlines for grant recipients, innovative methods of fiber deployment are paramount. Simply put, we are not going to get where we need to go the same way we got here. Microtrenching and other innovative fiber deployment techniques are needed to meet the critical project timelines required to deliver high-speed, reliable internet services to every household.

Accenture estimates that accelerating the deployment of communications infrastructure by only one year will result in a $100 billion impact over the next three years.[2] Installing utilities below grade brings concerns such as damage to previously installed infrastructure (such as gas lines and water pipes), restoration and reinstatement (aesthetics, stability), and disruption to neighborhoods and downtown areas. Microtrenching is unique in its capacity to minimize these concerns.

[2] The Economic Impact of 5G in the United States | Accenture

DEPLOYMENT STYLES, COMMUNITY IMPACT, AND DAMAGE PREVENTION

As mentioned, deployment speed is critical to connecting everyone to fast, reliable broadband. It is here that microtrenching has earned a somewhat preferred place among its peer technologies – specifically in urban environments.

In one day, a microtrenching crew (~10 people) typically installs a conduit system in a microtrench by cutting the trench, laying in the conduit or cable, backfilling the trench with a flowable cement or cement-like fill (low strength psi mixes in most cases, or moderately higher strength psi for certain applications), and, when required, sealing it with a hard-surface, petroleum-based sealant that will strongly adhere to the top of the microtrench and the adjacent roadway. In a residential FTTH deployment, over a mile of construction can be completed in a day, with most crews producing an average footage of around 1,500 feet per day. The speed of construction means far less disruption to residents and traffic. Horizontal directional drilling (HDD) or missile boring with the same crew size, on the other hand, yields between 300 to 1,000 feet per day (depending on soil conditions) causing those crew types to be working in the area for substantially longer than a typical microtrenching crew.

COMMUNITY IMPACT

While ISPs and construction experts have embraced microtrenching for its speed and predictability, cities, towns, and counties remain concerned about:

A. disruption to neighborhoods, traffic flow, and pedestrians;

B. damage to previously installed utilities (such as gas lines and water pipes); and

C. restoration (restoring aesthetics) and reinstatement (restoring integrity), and impact to street maintenance programs.

Microtrenching is unique in its capacity to minimize many of these concerns while also providing numerous benefits during engineering, permitting, and construction.

DEPLOYMENT STYLES

Microtrench ("MT"): a narrow trench (usually not wider than 2") is dug (usually no deeper than 18") and conduit and/or fiber cable is then laid directly into the trench within a roadway, parking lots, sidewalks, and/or driveway sub base. Conduit and/or cables are generally routed through/under the curb or into surface accessible vaults to receive the conduit and/or cables at strategic points along the path for access points and transition points to other deployment styles.

Horizontal Directional Drill Bore ("Bore" or "HDD"): a horizontal hole (usually 2" to 6" in diameter, but sometimes much larger) in the ground is drilled (usually 3' to 5' deep, but sometimes much deeper) using a steerable surface level drill with drill pipe and drill bit to create a tunnel under the roadway, parking lots, sidewalks, driveways, bodies of water, train tracks, or highways in which conduit is typically installed to create a path for fiber cables to be routed. Generally, surface accessible vaults are used to receive the conduits and/or cables at each end.

Vibratory Plow ("Plow"): a slice (usually 2" to 6" wide) is made with a blade (generally 2' to 4' deep) pulled through the ground by a tractor. Conduit or fiber cable is placed at the bottom of the slice, and immediately covered with cutting spoils. Surface accessible vaults are used to receive the conduits and/or cables at each end.

Trench: a cut (usually 2" to 6" wide, but sometimes much larger) is made with a chain blade (generally 2' to 6' deep) pulled through the ground by a tractor. Conduit or fiber cable is placed at the bottom of the cut, and the trench is later reinstated through the compaction of previously removed spoils. Surface accessible vaults are used to receive the conduits and/or cables at each end.

Missile Bore ("Missile"): a horizontal hole (usually 2" to 4" in diameter) in the ground is created (usually 3' to 5' deep) using a pneumatic ram (looks like a missile) by compacting the soil as the ram moves forward. A sending and receiving pit is dug, and the missile is initially positioned/pointed in the sending pit to reach the receiving pit, though any obstruction in the missile's path can send the missile in an unexpected direction since there is no guidance or steering system. Sending and receiving pits typically are reinstated with surface level conduit or cable receiving vaults, though the splicing of conduits is far more frequent in missile than in HDD since the range of the missile is limited.

The speed of microtrenching means that the noise disruption in any one area is also quite limited – the high-speed use of the machinery means a crew passes by a city block in as little as an hour. Microtrenching is also generally much cleaner than the alternatives – the spoil and dust created from cutting into the road is immediately removed with an industrial vacuum that trails right behind the saw minimizing any impacts to stormwater runoff. The aftereffects of microtrenching in the roadway are advantageous as it minimizes congestion in the green-scapes, is less impactful to existing roots, and generally allows for less obstruction during beautification efforts. Perhaps most importantly, the microtrench is shallower than most other utilities. This leads to far fewer utility strikes than deeper installations.

DAMAGE PREVENTION

The 2021 DIRT report (see Figure 2) published by the Common Ground Alliance (CGA) is an annual index of all subsurface damage in the utility industry (telecom, natural gas, water, electric, etc.). As shown in the chart, the use of a backhoe resulted in 76,734 damage incidents (37.69%), HDD resulted in 10,058 damage incidents (4.94%), and trenching (not specific to microtrenching) resulted in 11,701 damage incidents (5.75%).

When the data set is adjusted to reflect telecommunications projects where damages were reported, directional drilling accounts for 2,996 reported damages (17.16%) and trenching (not specific to microtrenching) was responsible for 1,101 strikes (6.3%), as shown in Figure 3.

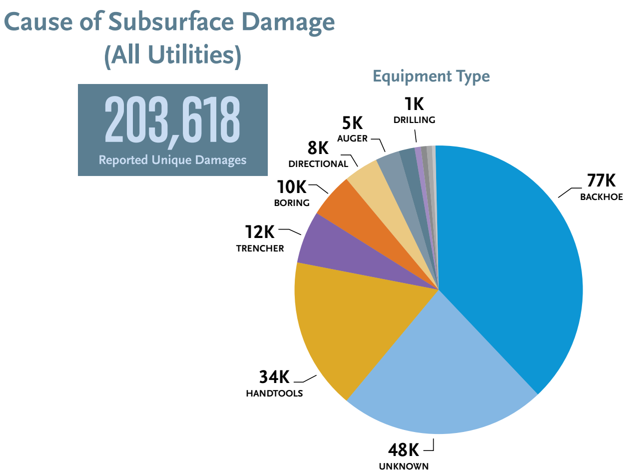


Fig 2

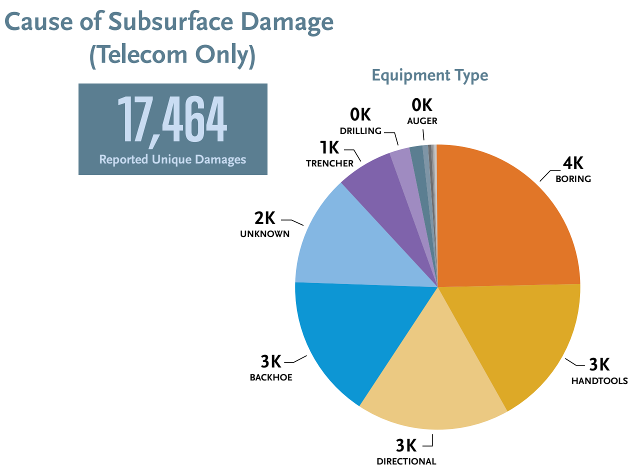


Fig 3

Source for Figures 2 and 3: 2021 DIRT Report (Common Ground Alliance)
Source: 2021 DIRT Report (CGA)

These statistics are clear: any suggestion that microtrenching is an “unsafe” or “impractical” means of deployment may have been true many years ago, but based on the current data, it is now entirely unfair to characterize it as anything but proven and practical per the unbiased damage data collected by the CGA. In fact, every carrier is relying on this quick, clean, and safe deployment method in some form or fashion given that all leased fiber providers are using it every day. Of course, the best deployment type for a given community will depend on the conditions and characteristics of that community. However, cities and municipalities should embrace and promote the benefits of microtrenching, which include speed of construction, reduced disruption to the city, expanded coverage footprints due to lower costs per foot, and substantially fewer utility strikes.

Every piece of machinery impacts the environment, deploys to specific depths, and therefore invites risk to the underground environment. Considering economic factors like the footage an installation crew achieves and the cost of labor per person per hour to install fiber infrastructure, operators and contractors can decide which method is best for a given scenario. It allows the network owner to pay the most reasonable rate and generate returns on its network investment as soon as possible.

RESTORATION AND REINSTATEMENT

Damage prevention of the road and roadbed is also critical to manage. In our industry, restoration refers to the surface characteristics, and the process by which the surface is restored for vehicular and/or pedestrian use. Reinstatement is a term that refers to the restoration of a construction site. In terms of microtrenching, these are some of the most debated aspects of this deployment style.

Much has been learned about the techniques implemented and materials used in the reinstatement process. Many companies will take advantage of these best practices as they use microtrenching to speed the fiber deployment process. In addition, forward-thinking cities have a long track record of successful microtrenching projects and have adopted construction standards that include microtrenching as an acceptable method to build future fiber networks. While local conditions should always be considered, the committee strongly recommends a few uniform “rules of the road” for successful deployments:

1. Every company may have a slightly different operating standard to accomplish the same goal. Critical decisions such as the restoration and reinstatement materials should always be agreed upon between the installer and the county or municipality even while they may differ from one application to another based on depth, intended use, surface and base materials, road maintenance programs, or other related factors.

2. For reinstatement of the base or sub-base, the committee recommends fully-compacted or self-consolidating materials to protect the conduit or cable during reinstatement.

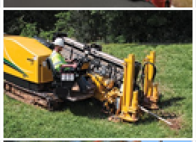
3. For reinstatement of the roadway, a low PSI cement or cement-like flowable backfill should be considered for the in-fill material. This is to ensure it hardens properly, but not so hard as to hinder mill and pave operations regularly scheduled by municipalities or highway departments. The committee recognizes that there may be some applications where a moderately higher PSI backfill will be needed, but the committee strongly discourages their use outside those special cases.

4. For restoration of the surface, it is recommended to seal the microtrench with a hard-surface, petroleum-based sealant that will strongly adhere to the top of the microtrench and the adjacent roadway.

5. Laterals should be placed beneath the curb and gutter by either saw cutting through the curb and gutter, or by water-jetting/tunneling underneath the curb and gutter. If saw cutting, the preferred location is at an existing joint in the curb and gutter. With either technique, proper reinstatement materials must be used to fill any voids, but this is particularly important when water-jetting or tunneling. Water-jetting/tunneling underneath the curb is the typical methodology for crossing the curb and gutter when installing a conduit-based system. A conduit-based system is recommended.

RISK ASSESSMENT AND DECISION-MAKING: COMPARING MICROTRENCHING TO OTHER DEPLOYMENT STYLES

Leveraging utility strike data obtained from FBA member deployments, the committee established the risk profile among the different types of equipment used in the installation of fiber cable by investigating the average strikes[3] (damage to an existing utility that causes a service failure) per mile. We then analyzed the data from footage per day for one installation crew using those methods to understand the differences in the effect on the environment and related costs (see Figure 4).

DEPLOYMENT TYPE	EQUIPMENT	SPOIL CREATION	AVG FEET PER DAY	~ MAX DEPTH (INCHES)	UTILITY (ALL) STRIKES PER MILE
Microtrench		Low	1,500	18	0.03
Directional Bore/HDD		Low	750	48	0.11
Plow/Vibratory Plow		Medium	5,000	48	0.29
Trench/ Conventional Trench		High	400	48	13.97[4]
Missile Bore		High	750	24	0.05

Source: FBA Deployment Specialists Committee

Fig 4

[3]There are two types of strikes: "at-fault" and "not-at-fault." The numbers in Figure 4 do not reflect which strikes are defined as at-fault or not-at-fault.

Per the findings in the Figure 4 chart, microtrenching causes fewer utility strikes than any other deployment type. Besides being less risky in terms of damage to utilities, microtrenching optimizes capital investment budgets. It turns cost-prohibitive projects into viable solutions. Innovative and efficient construction techniques foster deployment to communities of less density.

Simply put, more miles of fiber allow more connections. All types of communications infrastructure (wireless, wireline, etc.) are constantly being improved through innovative construction techniques that increase productivity, lower cost, and bring communications services to market faster.

[4]Conventional Trench strikes per mile in Figure 4 are largely related to its use in urban environments. The committee does not believe this method is inherently riskier than the other methods when used in rural applications.

CONCLUSION/BOTTOM LINE

As the nation builds out critical broadband infrastructure to deliver fiber to every home and business, deployment speed, safety, and cost will remain critical parameters of success. Every large-scale construction project should therefore consider all installation factors when determining the best path forward and every proven tool in the construction toolkit should be considered. Companies throughout the fiber industry are connecting America by building millions of miles of fiber every month, and they are relying on microtrenching to do it because it's cost-effective and the safest, fastest, and least disruptive building method in many cities and counties.