Deployment Best Practice Microtrenching Accelerates Fiber

FIBER BROADBAND ASSOCIATION
DEPLOYMENT SPECIALISTS COMMITTEE
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Introduction

Microtrenching has been field tested and optimized over the years. There are many ways to deploy fiber optic cables, each of which has pros and cons when assessing cost, speed, and complexity. This white paper focuses on microtrenching, the scrutiny it faces, success stories, and best practices.

Microtrenching has gained popularity across the country and has been added as an advantageous deployment method in state-driven broadband guidelines and laws. It has enabled a 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 best deployment method. However, it does intend to situate it amongst its peer methods as a valuable option in the fiber broadband construction toolkit.

A subset of subject matter experts on the Deployment Specialists Committee of the Fiber Broadband Association (FBA) created this document.

The Path to 100% - Broadband for All

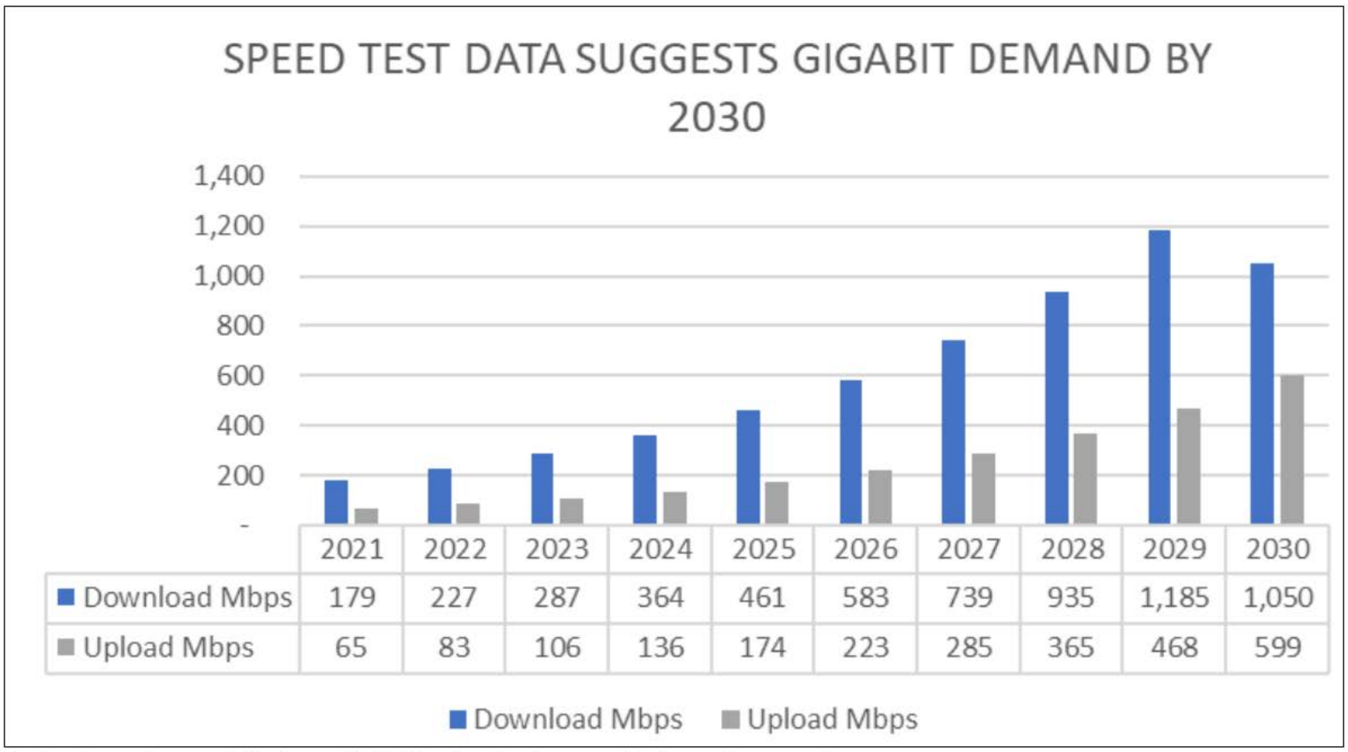
Before 2020, the pace of broadband deployment was constrained by limited funding, but materials, installation equipment, and labor were always readily available. In 2022, the fiber industry was constrained, for the first time, by physical resources. With these barriers, major ISP deployment goals were missed, and forecasts were adjusted downward to meet the realistic constraints on the market. Considering these constraints, we emphasize the adoption of a tried-and-true method of fiber infrastructure installation - microtrenching. Microtrenching has been proven to speed installation and, ultimately, the connection to the symmetrical gigabit-capable networks needed to establish digital equity and close the rural digital divide. This method was developed in the early 2000s to enhance and improve the robust installation methodology toolkit and has been perfected over the last decade.

Public and private capital fuels the economic development engine that is fiber infrastructure. This investment into our economy is regularly compared to a data-driven renaissance on par with the electrification of the United States by the USDA and the Rural Electrification Administration (REA) in the early 20th century. Therefore, it is imperative that federally funded initiatives, such as the Infrastructure Investment and Jobs Act (IIJA), Formula Grants such as the Broadband Equity, Access, and Deployment program (BEAD) and auctions such as Rural Digital Opportunity Fund (RDOF) etc., that fund the monumental broadband construction efforts be used in the most cost and time-effective 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 optic cable (fiber) in the same way we think of power lines—as essential to modern life.

Microtrenching Accelerates Fiber Deployment

Recent FBA research shows that metropolitan internet users can take advantage of life-changing internet applications like distance learning, remote work, telehealth, VPN networks, streaming services, security cameras, and more. These applications work because of the availability of robust broadband service, with many major internet service providers now offering speeds of up to a gigabit or more. The chart below shows that average broadband speeds greatly exceed the 25/3 Mbps service to which many rural areas are relegated. 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 65/19 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).

Figure 1 Speed Test Data



	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Download Mbps	179	227	287	364	461	583	739	935	1,185	1,050
Upload Mbps	65	83	106	136	174	223	285	365	468	599

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

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, it has become clear that 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 will be needed to meet critical project timelines required to take 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.

Deployment Styles and Damage Prevention

In one day, a microtrenching crew (average 4-8 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 fill (very low psi mixes in most cases up to a very high psi in some applications), and sealing it with a hard surface petroleum-based sealant that will strongly adhere to the top of the microtrench. In a residential FTTH deployment, you could get 1,000 to 2,000 feet per day microtrenching (depending on what the municipality will permit), with average footage of around 1500 feet. Directional boring could yield 300 to 1,000 feet per day (depending on soil conditions) but does not necessarily include cable installation or site restoration. There is a big difference in a community's aesthetic when the HDD equipment clogs up the neighborhood or lingers somewhere on the installation path for weeks. In comparison, the equipment from an installation using microtrenching can be moved in and out on the same day, leaving little evidence behind other than the narrow strip of sealant that becomes less apparent as time passes as the colors can be matched to the roadway. When installing conduit with a microtrencher, the spoil created from cutting into the road is removed with an industrial vacuum. In installations using HDD, the equipment is more complex to operate, and depending on the depth of the bore being created, there is a greater risk of damaging peripheral utilities (an expensive byproduct of all below-grade infrastructure installations).

According to the 2021 DIRT report (see Figure 2) published by the Common Ground Alliance (CGA), which is an annual index of all subsurface damage in the utility (telecom, natural gas, water, electric, etc.) industry, it was revealed that across 203,618 unique damage reports, 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%).

Deployment Styles

Microtrenching – a narrow trench (up to 18 inches) is dug to lay multiple conduits and/or fiber across highways, sidewalks, crosswalks, parking lots, and driveways.

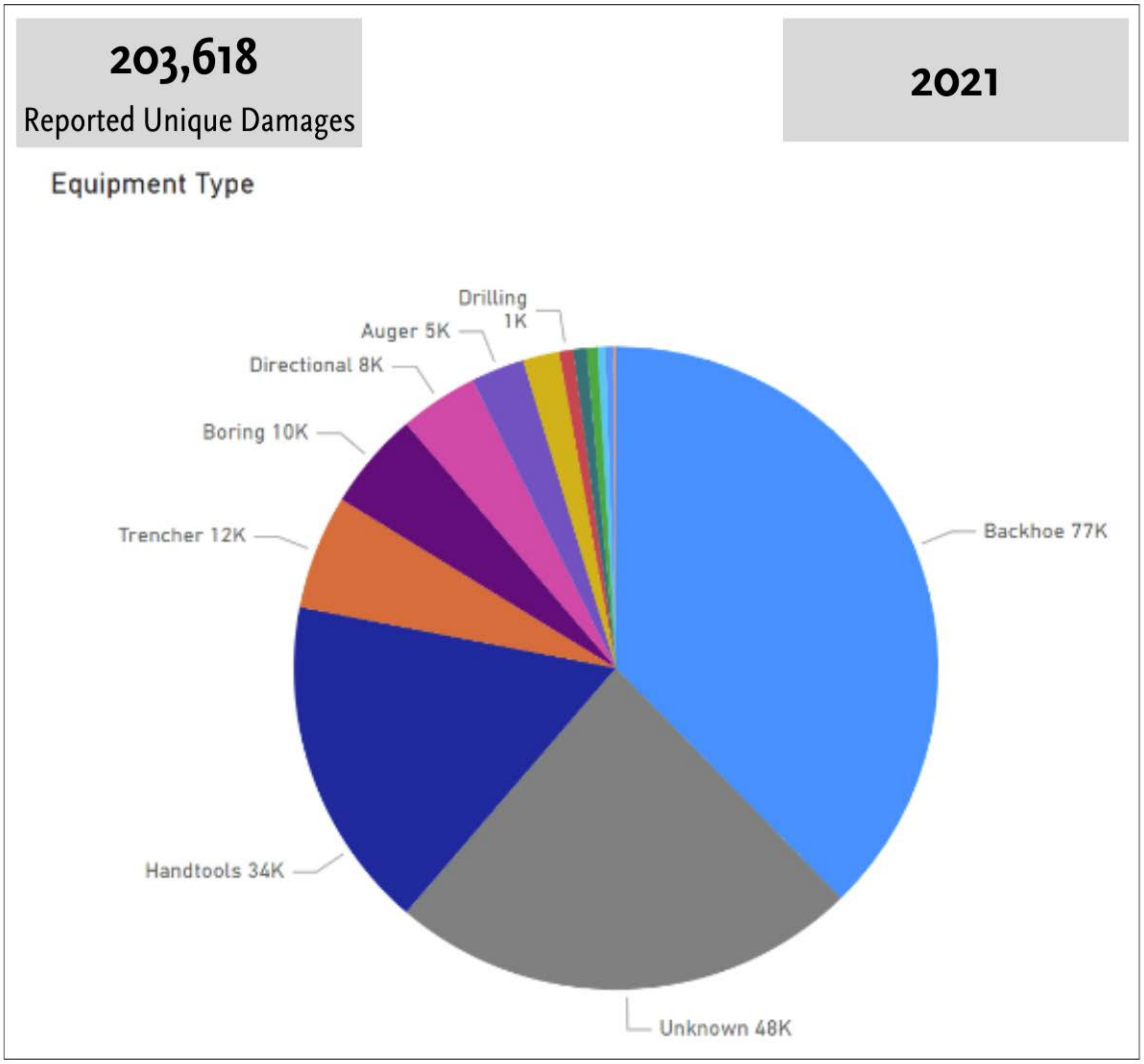
Horizontal Directional Drilling or Bore – a hole (three to five feet deep) is dug and a tunnel is created (under roadways, sidewalks, etc.) and pipes made from PVC, polyethylene, polypropylene, or ductile iron or steel are pulled through the drilled hole and the fiber or coax conduits are snaked through.

Plow (or vibratory plow) – cuts into the ground and shakes the earth so a flexible conduit can be installed at the appropriate depth creating a path to pull fiber cable through.

Trench/Conventional Trenching – involves digging a trench in the ground that is eventually deep enough and long enough to install, construct, maintain, or inspect a conduit, pipe, or tunnel.

Missile Bore – (also known as horizontal boring, underground pneumatic boring, or impact boring) is a method of point-to-point horizontal underground boring.

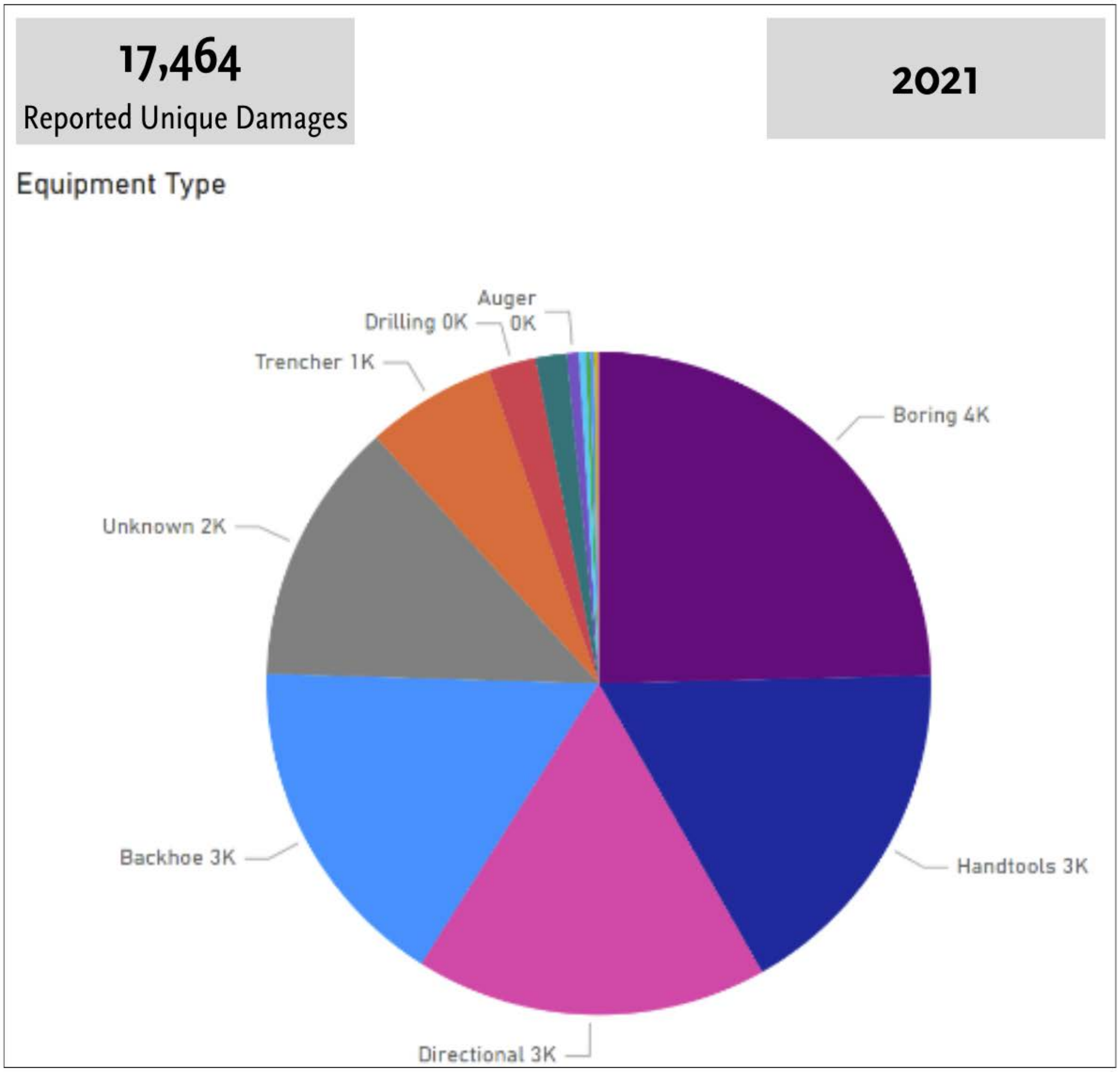
Figure 2 Utility Damage by Equipment Type



Source: 2021 DIRT Report CGA

If the data set is adjusted to reflect telecommunications projects where damages were reported, the damage by equipment type changes drastically. For example, directional drilling accounts for 2,996 reported damages (17.16%) but trenching (not specific to microtrenching) was responsible for only 1,101 strikes (6.3%), as shown in Figure 3.

Figure 3 Utility Damage by Equipment Type in Telecommunications Projects



Source: 2021 DIRT Report CGA

Interestingly, the dataset, though incomplete due to low participation rates from broadband carriers, indicates that HDD is responsible for nearly three times the number of strikes as all trenching installations (including microtrenching). However, boring is not regarded as an unreasonable installation practice. Therefore, it is the position of this committee that it should be regarded as a reasonable installation practice because it is a necessary tool in the broadband installation toolkit. It is also suggested that the stigma placed on microtrenching as 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 Common Ground Alliance (CGA).

Every carrier is using this quick, clean, and safe deployment method in some form or fashion given all leased fiber providers are using it every day. Every deployment type has a good use case and we would like cities and municipalities to embrace and promote the benefit of microtrenching due to its lower cost per foot and reduced impact on the public domain in dense areas. Every piece of machinery causes an impact on the environment, deploys to specific depths, and therefore invites risk to the underground environment. The footage an installation crew achieves and the cost of labor per person-hour to install fiber infrastructure helps operators and contractors decide which method to use so the network owner can pay the most reasonable rate and receive returns on its network investment as soon as possible.

Risk Assessment and Decision Making: Choosing the Right Method for the Project

Using data from FBA members, we established the risk profile between the different types of equipment used in the installation of fiber cable by investigating the average strikes (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. Therefore, the importance of assessing the project to ensure the proper method is being used based on conditions cannot be emphasized enough (see Figure 4).

We should highlight that there are two types of strikes: "at fault" and "not-at-fault", which we'll reference later in the paper. The numbers below do not reflect which strikes are defined as at fault or not-at-fault.

Also, although the data reported from the study indicates a high number of strikes per mile for conventional trenching, the committee doesn't believe that method is inherently orders of magnitude riskier than the other methods.

Per our findings in the chart on the next page, it is not recommended that missile boring be used in place of directional boring or plowing, as the use cases are entirely different due to the impact on the environment, or spoil creation. Note that microtrenching does not fall far outside the lines of other deployment types. It can be regarded as a deployment style with relatively high output and low utility damage risk for fiber deployment. Because microtrenching occurs primarily in the roadway, it causes the most concern for the city or state. As roads need to be moved or widened to accommodate growth in an area, roadway fiber becomes at risk. However, aerial cables also need to be moved, and damage may occur based on roadway moves. Damage and risk are unavoidable, but there are choices that can be made to minimize the financial or safety impacts of a certain installation process.

Figure 4 - Risk Assessment by Deployment Style

Deployment Type	Equipment	Spoil Creation	Avg Feet Per Day	~ Max Depth (inches)	Utility (all) Strikes Per Mile
Microtrench		Low	1,500	16	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
Missile Bore		High	750	24	0.05

Source: FBA Deployment Specialists Committee

An example of how assessing the project before touching ground proved microtrenching was the right method comes from an FBA member company. When installing fiber in a historic district of Alexandria, VA, with little to no greenscape, and historical sidewalks, microtrenching was determined to be the best method as it would have the least aesthetic impact, enabling the historic look of the community to remain intact and with little disruption. No roads needed to be closed, and no utility strikes were noted throughout the project. It is vitally important to understand that there are two types of strikes:

- At-fault
- Not at-fault

At-fault strikes are those where the fiber infrastructure installer (or other utility) damages existing utility infrastructure when proper locating and marking practices are in place. Thus, making the installer negligent and responsible for repairs.

Not-at-fault strikes are those where the fiber infrastructure (or other utility) damages existing utility infrastructure (of which there are many and very shallow in Alexandria) when proper locations were improperly marked. In the case of Alexandria, marked properly or not, the fact that this operator avoided causing any utility damage, shallow as the gas lines may be, is nothing short of remarkable, and it is nearly impossible to imagine that the outcome would have been the same if a horizontal directional drill had been used.

Microtrenching Accelerates Fiber

Microtrenching has been proven to optimize 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.

Reinstatement

Reinstatement is a term that refers to the restoration of a construction site. In terms of microtrenching, it is the most debated aspect of this deployment style. Much has been learned about the techniques implemented and materials used in the reinstatement process. Many will take advantage of them 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 included microtrenching as an acceptable method to deploy future fiber networks.

Generally, we agree on concepts that should be broadly applied to microtrenching installation and restoration. For instance, when deploying cable in the roadway, we support fully compacted or self-consolidating materials to restore the surface and roadbed to protect the subbase. Additionally, low PSI fill should be considered for the in-fill material to harden properly but not so hard as to hinder mill and pave operations regularly scheduled by municipalities or highway departments. We highly recommend that curb cuts or any cuts into concrete be done at seams to maintain the integrity of concrete structures. These are basic "rules of the road" for microtrenching.

A significant amount of research has gone into subbase and base reinstatement, and there are material applications that are emerging as universal, though they are not always applicable. Varying applications within the boundaries of a single city could dictate alternate installation and restoration strategies. Two execution methodologies could be chosen due to their effectiveness. One deployer's decision to install and restore should not dictate how another deployer resolves its challenges to complete projects. Roadway materials need to be evaluated depending on the installation locale. Every company may have a slightly different operating standard to accomplish the same goal. Critical decisions such as the restoration in-flow material utilized should always be agreed upon between the installer and the municipality. There is industry alignment that flowable fill (a self-compacting, low-strength material with a flowable consistency) with the correct PSI rating for the application is critical and is recognized as vital for long-term operation.

Realizing this is a state and national concern, legislative policies that foster regional and state frameworks serve to accelerate the rapid deployment of broadband infrastructure.

Conclusion/Bottom Line

As our nation builds out our critical broadband infrastructure to deliver fiber to every home and business, speed and cost of deployment will critical parameters of success. The bulk of the expense is in the installation and associated restoration. Because of the amount of time it takes to dig and lay fiber, not to mention coordinating with the local municipalities, departments of transportation, utility providers/public utility districts, public safety groups, and satisfying all the stakeholders of a fiber installation project, customers will be waiting for a while before they reap the benefits of high-speed internet access.

In terms of cost, traditional open trenching can be roughly 5x the cost of microtrenching. From a time perspective, microtrenching reduces 33% faster than a fiber installation using traditional methods -- and microtrenching is easily compatible and does not interfere with already scheduled street maintenance programs. Conventional methods, such as HDD, missile boring, open trenching all require roads, yards, sidewalks, and driveways to be excavated on a large scale, and can cause significant environmental harm.

There will be use cases for using a microtrencher where one of the conventional methods would not make sense and vice versa. But all installation factors need to be considered to determine the best path forward. One of the traditional methods, like boring, may seem more appropriate based on the visible environmental impact, but one would need to assume the higher risk factor for damaging underground utilities. Using a vibratory plow is one of the fastest means of installation. However, the spoil it creates is far more considerable than using a microtrencher. Outside plant construction is always an exercise in prudently weighing the pros and cons, with no single installation method right for all aspects of a project -- the question is which method is best for which circumstance.

Case Studies

[1] CTIA - 5G Promises Massive Job and GDP Growth in the U.S

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

[3] Millions of Americans are Working from Home with Unreliable Cell Signal and Internet

If It's Not Fiber, It's Not Broadband

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