



**FNT**

// simplify complexity

# LIGHTING THE PATH:

## HOW TO ACHIEVE AN EFFICIENT FIBER ROLLOUT



## IN THIS WHITE PAPER

In the rapidly evolving landscape of telecommunications, the demand for high-speed, reliable connectivity is escalating. Fiber optics are the backbone of modern communication infrastructure, offering unparalleled bandwidth and reliability. Their deployment is crucial for meeting the growing connectivity needs of communities and businesses.

This white paper presents a comprehensive guide to what's involved in achieving efficiency and success in deploying fiber optic networks. It addresses the strategic importance of FTTx initiatives, the challenges CSPs face, and offers guidance on how to overcome the biggest obstacles.

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## Introduction

Fiber optics technology is the backbone of network infrastructure. Fiber is the cable medium of choice, since it offers a much higher bandwidth compared to traditional copper or coax cables. This greater bandwidth allows for the transmission of larger amounts of data over longer distances without signal degradation, making it ideal for long-haul communication. Fiber is also substantially faster than copper, and in the competitive digital economy speed of data transmission matters. Other positive aspects of fiber are that it consumes less space, is less heavy, can be laid in much longer runs, and promotes environmental sustainability. Fiber optic cables are the eco-friendly option, consuming dramatically less energy than the copper alternative. They also have a significantly longer lifespan than copper cables, which translates into less frequent replacements. This has the added environmental benefit of consuming fewer resources for manufacturing which contributes to overall resource conservation.

Service providers are in a race to expand their fiber networks, making rapid service turnup a key priority. The

speed with which a provider can make its services operational affects competitive position, customer satisfaction, and revenue. Whether greenfield deployments, competitive overbuild, or replacement of legacy copper and coax with future-proof networks, rolling out fiber is a strategic imperative for CSPs.

The expansion of fast internet connections, i.e. fiber deployments, is in full swing in many countries. This is driven not only by the increasing consumer demand for high-speed broadband infrastructure, but also because of significant investments by governments. In the US, The Broadband Equity, Access, and Deployment (BEAD) Program provides \$42.45 billion to expand high-speed internet access by funding, among other things, infrastructure deployment. Everyone wants to claim their slice of the proverbial pie. In Europe, which is leading the world in adopting new fiber broadband infrastructure, operators are driven by the need to meet regulatory mandates set by their national governments. Whatever the motivation, the reality is that FTTx deployments are in high gear worldwide.

## Rollout challenges

There are several challenges that must be dealt with in a FTTx rollout. A big one is the investment required. Since building a fiber optic infrastructure requires a significant financial investment, the economic viability of the expansion area must be assessed. Are there enough potential subscribers to make the project viable and is there sufficient demand among them for high-speed internet services?

Technology is another big hurdle. The existing technology infrastructure in the area may affect the feasibility of the FTTx deployment. Upgrading or integrating with existing systems may be necessary and if so, this will need to be factored into the plans. If there is existing cable infrastructure you need to integrate with legacy systems, in which case you must ensure compatibility and smooth transitions in areas where there's a mix of older and newer infrastructure.

Geographic and physical infrastructure impediments are another notable challenge. You must adapt to whatever physical infrastructure exists in the area. You may have to navigate around obstacles such as highways, or deal with urban envi-

ronments, which adds to the complexity. The distance from the central office or network point to the expansion area is another consideration. How far a signal must travel affects its quality and can impact the performance of the FTTx network.

Scalability is another concern. The network must be able to accommodate future growth in data demand. Any network design must include and be able to handle increased future bandwidth requirements. Finally, power can be problematic. You'll need to ensure a reliable power supply, including backup solutions. This is critical to maintain network functionality, especially during power outages.

Once all these concerns are satisfactorily addressed, a realistic estimate of the cost to lay the new infrastructure is needed. FTTx deployments are capital-intensive and can be a significant barrier for service providers. Given how expensive laying fiber optic cables, installing equipment, ensuring proper connectivity, and other associated infrastructure expenses are, assessing the financial feasibility of the expansion project is one of the most important priorities.



## Limitations of traditional rollout methods

Every FTTx rollout is a comprehensive process. While the specific steps may vary depending on the scale of the project, local regulations, and technological considerations, all rollouts must at a minimum include the following.

### STEP 1 – ANALYSIS

This is where the target area is identified and the scope of the FTTx rollout is defined. The analysis typically includes a thorough feasibility study to assess the demand, market conditions, and potential ROI. Specific points to analyze are the size of the expansion area, required capacities, potential clients and possible routes.

Look for any coverage gaps in the target area. It's important to identify the location of white spots, or areas with inadequate or no mobile broadband coverage and therefore no access to the internet, and grey spots, or areas in which not all providers can offer their customers mobile network access. Also consider whether the area is rural, urban or suburban, and how many potential customers are in the area. Finally, it's important to understand the competitive situation. Are competitors already there, or close by? What is the impact of their presence and offerings on your ability to win customers?

Addressing all these items will ensure you establish a sound information basis right from the start on which many critical decisions will be made as the rollout unfolds.

#### **What's often missing:**

**Geodata.** This plays a crucial role in fiber network expansions by helping to identify optimal locations for network infrastructure. Geospatial information provides valuable insights, and GIS (Geographic Information System) tools play a pivotal role in assisting analyses of terrain, land use, and environmental factors. They are instrumental in planning the most efficient and cost-effective routes for fiber deployment as they give visibility into terrain conditions and factors such as streets, waterways and railways in the area. Location intelligence also helps determine the coverage areas of existing fiber networks and identify areas with underserved or unserved populations. Geodata and GIS tools are a huge asset in prioritizing expansion efforts to areas where demand is high or where network infrastructure is lacking.

**Cost calculation.** The best planned fiber rollout will never get off the ground without funding, so a reliable estimate of how much the project will cost is needed. This is no small feat. Net Present Value (NPV) calculations are quantitative assessments that are instrumental in helping you decide how to invest your money. You'll want to have multiple cost estimates for various rollout scenarios. Start with 100% rollout in your planning region, then run the calculation for various scenarios where you do not build the network for 100% of customer potential. This enables you to compare options, determine how much you can save in different scenarios, and choose the best option to move forward with.

Given the intricacies of these calculations, using software that fully automates cost optimized FTTx networks is a game-changer. Such software gives multiple build scenarios that consider how many addresses are served, how many potential customers there are, and the total cost of a certain topology. Some solutions will even compute the incremental cost from one scenario to another, which represents how much must be invested going from one percentage of customer coverage to another. The need for an accurate cost estimate for a rollout in a planning region cannot be stressed enough.

### STEP 2 – PLANNING

The analysis just described is the basis for planning. The goal is to develop initial designs to optimize the network architecture and compare alternatives. Timelines, budget estimates, and resource requirements are specified here. Detailed planning is multi-faceted. Those responsible for the network are focused on identifying the best routes, where and how to lay pipes and cables, and where to position nodes and outdoor cabinets. The active technology is specified along with cabling and backbone connection. A huge effort is required, at a significant cost, so doing this as efficiently as possible is paramount. The proposed fiber optic network layout should consider factors such as topology, capacity, and redundancy. Key areas to plan for include:

- **Routes** – Nodes, routes and other georeferenced objects. With GIS tools these can be placed directly on a map. You'll need to consider existing infrastructure, terrain, and identify if there are any potential challenges to deal with.



- **Hardware** – For the operation of FTTx access, the corresponding system technology must be calculated and planned, and the hardware placed on the planned nodes in a planned manner, including the system configuration.
- **Services** – All services that are necessary for the connection of a customer are designed, planned and administered, as are the services that are necessary for the backbone connection.

Automated design tools help significantly facilitate mass rollouts, both in greenfield scenarios where you're building the network from scratch and in brownfield settings where you're working with existing network infrastructure and detailed information about existing infrastructure and capacity is needed. It's more difficult to build upon and integrate with legacy infrastructure than to start with a fresh slate. When done right, planning time is significantly reduced, and you'll have reliable network topology and cost assessments so you can move forward with the ideal cost-optimized design. Upon completion of planning, file exports should be created for the construction phase.

#### **What's often missing:**

**Automated design.** Automating the design of a proposed FTTx network offers several important advantages that contribute to the efficiency, accuracy, and cost-effectiveness of the overall deployment. It generates high level designs quickly and with a high degree of accuracy. Automation significantly speeds up the design process thanks to algorithms and software that quickly analyzes various parameters, constraints, and requirements to generate optimal designs in a fraction of the time. Automated tools can also perform complex optimization algorithms to find the most cost-effective and efficient network design. They can consider factors such as distance, capacity, topology, and other constraints to generate designs that meet specified criteria. By optimizing the design for efficiency, automation can help reduce unnecessary costs. This includes minimizing the length of fiber optic cables, reducing the number of active equipment, and overall optimizing resource utilization.

**Network digital twin.** A digital twin, which is a virtual representation of the physical network infrastructure, provides a highly accurate and detailed representation of the FTTx network including physical assets, topologies, and their spatial relationships. This digital replica incorporates real-world data, simulations, and modeling, offering a dynamic and interactive platform for planning, design-

ing, monitoring, and managing FTTx networks. Because it is an accurate representation, it serves as a reliable basis for planning and decision-making. One of its key benefits is its simulation and analysis capabilities. Network planners can use the digital twin to evaluate various scenarios before actual deployment, for example simulate different network configurations, test the impact of changes, and analyze the performance of the network under different conditions.

**Integration with GIS data.** Many FTTx network designs require geodata. Geospatial data takes into account factors such as topography, distances, and potential obstacles. GIS tools ensure accurate mapping and planning and an optimized and reliable fiber network design. Integrating with GIS systems is the best way to consider geographical factors, environmental conditions, and other spatial data in the design for optimal network planning.

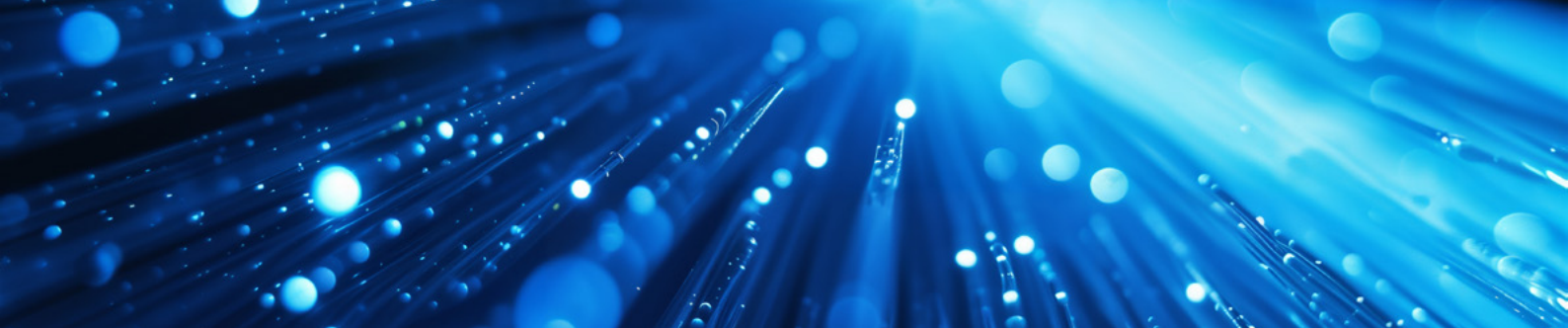
### **STEP 3 - CONSTRUCTION**

Planning is implemented by subcontractors. Construction commences when all plans, information, and work orders are handed over to crews for execution. It's critical to have access to an overview of status as construction progresses. Ongoing status updates throughout construction will inform you when parts of the new route are ready to have the first services for customers. This is critical knowledge because this is the point that the provider can begin to monetize the expansion. You'll want to begin offering services as soon as any part of the network is ready to do so. Only when services are being delivered is revenue being generated.

It's also vital for changes that occur during construction and even after acceptance to be promptly and properly documented in the master resource inventory, or network digital twin. It's vital the network inventory be updated with any new data so that the documentation always accurately reflects the as-is state of the network. Ongoing operation and future network expansions are entirely dependent on the network documentation of the as-built status of installed equipment.

#### **What's often missing:**

**Integrated work order management.** Integrating work order management into the FTTx network construction phase enables organizations to enhance coordination, improve visibility, and ensure that the construction pro-



cess is carried out efficiently. It involves the systematic coordination and tracking of various tasks, resources, and processes. It begins with the handing over of all plans, information, and work orders to the construction crew. Software tools can be used to create work orders automatically and route them to the appropriate field force. Work orders should include details such as the scope of work, location, materials required, timelines, and assigned personnel. Each work order should have assigned to it appropriate resources, including labor, equipment, and materials. This ensures that the availability of resources aligns with the project timeline to avoid delays.

Tracking and managing these work orders is required. You'll want to document important information such as work completed, materials used and changes in scope. Integrating work order management into the FTTx network construction phase enhances coordination, improves visibility, and ensures that the construction process is carried out efficiently and in compliance with project requirements. This integrated approach contributes to successful project delivery and the timely deployment of a reliable FTTx network.

**Mobile access to inventory data.** Access to real-time data from any location, including the field, is vital. You would think this would not be an issue given today's advanced digitalization, but many tools used in FTTx rollouts don't have this capability available in the way it is needed to provide field personnel the transparency required for specific tasks. When field personnel have mobile devices or tablets equipped with the necessary software to access and work with inventory data and work orders, instant communication, data collection, and task management on-site is enabled.

## STEP 4 - DOCUMENTATION

After acceptance of construction, it is imperative to document the new service in the digital twin, which is your centralized repository for documentation related to the FTTx network. All planned objects must be changed to status actual. Documentation is not static and data changes over time, so documentation must dynamically update as changes occur in the network.

### **What's often missing:**

**Integration.** As changes are made it's critical your inventory always reflects the as-built status of installed equipment, which is why a reliable means to update the data

in your network digital twin is so important. This problem is easily solved by using network inventory software with integration capabilities. You'll want extensive interfaces for bidirectional data exchange with other tools. Two-way data exchange matters, as the network digital twin must not only be able to be used as a data source for other systems and applications, but also able to be enriched with information from them.

## STEP 5 - OPERATION

After successful FTTx deployment, a fiber optic network must be operated and further expanded. When new services are ordered, they will need to be provisioned quickly. When a disruption occurs, you'll need to troubleshoot and restore network services fast. Successful business continuity is the goal, and for that you'll need reliable ways to handle incident resolution and changes within the network.

### **What's often missing:**

**Network digital twin.** As a centralized repository for documentation related to the FTTx network, they can and should be used for planning expansions, upgrades, and maintenance activities. They help in efficient resource management by providing insights into the utilization of assets, such as fiber cables, equipment, and other resources. This information aids in optimizing resource allocation and avoiding overutilization or underutilization of assets.

**Automated service order orchestration.** A digital twin is required. The combination of the unified resource repository that is the network digital twin and automation software accelerates provisioning time and reduces errors. It enables fulfillment of service requests with process driven control and workflows.

**Standardized incident management procedures.** Restoring interrupted services quickly is critically important. Software that can immediately identify which customers are affected and reroute them helps mitigate the damage while the problem is being resolved. Resolving it requires signal tracing capabilities and the ability to provide different graphical representations of the overall signal path. Visualizing the route from the central distribution building down to the final customer building entry point gives a helpful birds-eye view and, along with OTDR measurements, can identify exactly where the error is located. Attempting to do this without the right software tools unnecessarily complicates the process and extends the time service is down.



## Consequences of not doing it right

A poorly executed FTTx rollout can have multiple negative impacts.

**Wasted resources.** Delays and setbacks can increase overall costs so it's important to get it right from the get-go. Some of the many pitfalls of a poorly managed rollout include:

- Exceeding budget for unnecessary cost overruns from inefficient deployment, which may in turn require additional financial resources to complete the project
- Unnecessary equipment purchases
- Time-consuming troubleshooting, repairs, and unnecessary rework of improperly installed infrastructure
- Delays in delivering services to users, which delays revenue from the new services, which means lost revenue
- Financial losses from budget overruns due to the need for additional resources to rectify issues

**Not moving forward with the best plan.** This can have long-term implications. One such effect is the impact on energy

usage, as inefficient network designs and installations may contribute to higher energy consumption. What's more, suboptimal equipment and infrastructure may require more power to operate. A subpar FTTx rollout can impact the competitiveness of businesses and hinder their economic growth.

**Risk of further expansion based on bad data.** This is a compounding problem with far-reaching consequences. Bad data may result in inaccurate network capacity requirement estimations, in which case you will not have adequate resources for the expanded network, resulting in performance issues. You also run the risk of misallocating resources and if you under build as result, you'll have insufficient infrastructure. If you overbuild you will have wasted capital. Insufficient information about the existing network infrastructure can cause increased downtime and service disruptions. Service outages, downtime, and disruptions can occur if the expansion plan does not account for the intricacies of the current network.

**Inadequate service assurance.** Users may experience service disruptions, slow speeds, or other issues. This can lead to poor customer experience, customer dissatisfaction and breaching SLAs. To mitigate these risks, adherence to best practices in FTTx deployment is essential.

## What's needed

Network operators aiming to expedite and facilitate the FTTx rollout process should prioritize comprehensive planning, invest in automation tools for network design, and leverage the latest in technology for optimal efficiency and timely implementations. This technology should provide access to and the ability to use all necessary data, which requires integration with other systems and data sources. It should create a digital twin of the hybrid network infrastructure and use it as the basis for automated process management and service orchestration.

These best practices, when employed, help to streamline the rollout process, meet growing connectivity demands, and lay the foundation for a robust and future-ready fiber-optic network.

**Thank you** for reading our white paper on the importance of an optimized fiber rollout. At FNT Software, we understand the challenges that service providers and network managers face, and we have the expertise and solutions to help. **Contact us** directly to learn more about our services and how we can support your needs.



## About FNT

FNT GmbH, headquartered in Ellwangen (Jagst), Germany, simplifies the management of highly complex digital infrastructures in companies and public authorities with its FNT Command Platform. With the cloud-enabled “software made in Germany”, IT, telecommunications and data center infrastructures can be efficiently recorded as digital twins and documented across all levels from buildings to digital services. The software also offers open interfaces and numerous functions for planning,

implementing and automating transformations and changes in an integrated manner. FNT’s customers include more than 500 companies and government agencies worldwide, including more than half of the DAX-40 listed corporations. FNT operates offices in several locations in Germany as well as in New York, London, Singapore and Timisoara and has an international partner system with market-leading IT service providers and system integrators.

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