DELIVERING BROADBAND FROM BEGINNING TO "END"

JSI

FOUNDATION FOR RURAL SERVICE

CONTENTS

EXECUTIVE SUMMARY

High-speed broadband is an essential service. Access to broadband can increase your connectivity beyond just your internet speed; it not only facilitates communication with friends and family, but it also enables work-from-home as well as access to education, healthcare, entertainment, commerce, and the internet of things (IoT). Broadband is crucial for the deployment of AI (artificial intelligence) and XR (extended reality) as well.

The COVID-19 pandemic highlighted the deficiencies in broadband infrastructure and availability of reliable, high-speed services in many rural areas as compared to service available in the more densely populated urban areas of the United States (a difference often referred to as the "digital divide"). While some rural areas have had the benefit of investment by community-based providers, other rural areas are on the wrong side of this divide. With a sizable portion of the population in rural and tribal areas lacking access to broadband at adequate speeds, and with the pandemic highlighting the necessity of such connections– a considerable amount of funding has been made available by federal, state, and local governments to address the digital divide and expand access to broadband.

"Broadband is the backbone of modern communication, enabling high-speed internet access and supporting the growth of digital services, technologies, and connection across communities."

The journey to broadband connectivity begins with an internet service provider (ISP) using its own funds and/or leveraging government funding programs to buildout or upgrade broadband to your specific area. But as this paper will explain, funding a project is just the start of the journey to bring broadband to your home, business, or community. At times the process, from the initial decision or funding award to invest to completion of deployment, seems slow and frustrating for members of the community looking forward to a better broadband connection (or to their first opportunity to enjoy one).

The following report explains the numerous steps, and at times hurdles, that go into designing and delivering a reliable and robust broadband network and attempts to answer the often-asked question "why is this taking so long?" Additionally, this report addresses the fact that the job is hardly complete when constructing the network is "done." Because what matters most to consumers (the availability, affordability, and reliability of services) must be a central focus and require funding and attention.

Deploying a new broadband network may take anywhere from two to four years to complete. This paper describes the many steps that an ISP must take to bring that new network to your home, business, and community.

Timeline to Deploy A New Broadband Network:

Initial Opportunity & Market Analysis	**1 Month**
Rough Cost Estimates for Analysis	**1 Month+**
Detailed Business Plan	**1 Month+**
Initial Environmental & Permitting Process	**6 Months+**
Engineering	**6 Months**
Select a Contractor & Obtain Materials	**3 Months+**
Construction	**6 Months**
Testing & Turn-Up	**1 Month**

STEP ONE:
MARKET ANALYSIS

Before a broadband provider embarks on expanding service in a specific area, the ISP should complete a market analysis to make sure the project is both feasible and sustainable. The goal is to justify the investment in broadband infrastructure despite the challenges posed by rural areas, such as higher costs due to lower population density and longer distances to existing infrastructure.

The market analysis for offering broadband in a rural market involves the understanding of several critical components:

- The number of homes, businesses and multi-dwelling units that could receive new broadband service. The analysis may consider factors such as population density, income levels, and the presence and/or attractiveness of businesses and institutions that could benefit from improved internet access.

- The presence of existing providers that may be offering broadband service and the estimates of "take rates," or how many new customers will take advantage of better service.

- The existing infrastructure that could support higher bandwidth offerings and lower latency.

- Assessment of the costs and benefits associated with broadband instillation, including the potential for obtaining grants and/or low-cost financing from federal, state, or local programs. While available grants and loans can make a market analysis look good, many of these programs have numerous strings attached. For example, covenants often require certain financial metrics, and some grant programs require the ISP to include their own capital as "matching" funds, a potentially significant investment for the ISP. Broadband grants can also be taxable at the state and federal level. In addition, some grant programs have requirements about where network components are manufactured as well as labor rules that increase costs.

- ISPs must obtain permits and access to right-of-way from local, state and federal entities and privately held lands. Permits and right-of-way access can be expensive and time-consuming as they can potentially require environmental, historical preservation and archaeological surveys. Indeed, these surveys are required for every federal grant, such as those through the Broadband Equity, Access, and Deployment (BEAD) program. In instances where wireline facilities cannot be buried (or where wireless facilities are utilized), deployment requires access to electric or other utility company-owned poles and wireless towers, another process that is expensive and time-consuming. Whether buried or attached to poles, ISPs are often assessed both application fees for access in the first place and yearly fees for as long as the infrastructure remains in place.

- Building out infrastructure on tribal lands can also have challenges, as many tribes have their own restrictions regarding where a provider can build. Care needs to be taken to respect ancient burial grounds, structures, and other sacred areas.

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STEP TWO:
BUSINESS PLAN

Developing a business plan is a critical step in assessing the feasibility of building out infrastructure to a particular area and delivering services thereafter.

Deploying broadband infrastructure in rural America can be more expensive per customer due to lower population density and often difficult terrain. Moreover, once the network is built, it needs to be sustained for the benefit of the consumers in that area, and thus the provider must consider whether the services available and consumer demand for them will cover the operational costs.

A sound business plan also considers the potential technology that will be used. Broadband infrastructure can be deployed using different technologies, including fiber optics, hybrid fiber coax (HFC) cable, wireless, and satellite technology. Fiber optics and HFC offer faster speeds and more reliable connections, while wireless and satellite may be better suited for rural areas where wired networks cannot reach. Fiber optics and HFC are also better suited for adaptation of future IT applications that may require faster speeds and lower latency that wireless and satellite providers may not be able to sufficiently provide. Fiber-based networks may come with greater upfront deployment costs than wireless networks, yet the latter often have shorter useful lives and therefore require upgrades far more frequently to keep pace with consumer usage.

A Business Plan Should Incorporate:

- **Specifics of the Market Analysis**
- **Identification of Available Funding Opportunities (grants and loans)**
- **Needs of the Community**
- **Plan for Community Involvement in Planning for Deployment**
- **Potential Growth**
- **Regulatory Requirements of Building & Operating a Network**
- **Consumer Demand in the Area**
- **Assessment of the Ongoing Costs Associated with Delivering Services**

STEP THREE:
ENGINEERING

If the market analysis is favorable, the next step is engineering. The engineering component is made up of three phases: the design, the build, and the inspection.

High level Design
Feasibility Level Design of Plant

Staking
Field Verification of Design, Permitting

Detail Design
Construction Plans & Specifications

Project Management
Scope, Schedule, Budget, Contract Administration

Construction Management
Quality Control, Plant Records

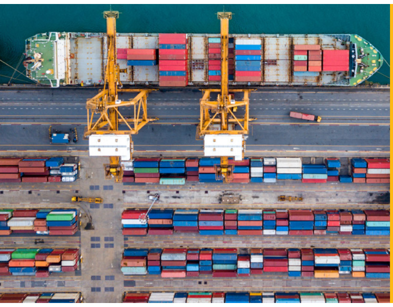
The design stage establishes a road map for the construction, inspection, and completion of a project. Initially, a high-level design may be completed for a feasibility study or a grant application. Once the project is given approval to proceed, the design work commences in accordance with the details of a grant application or feasibility study and incorporates environmental and permitting requirements. This design will be a combination of equipment engineering to include both core and access platform equipment, along with the actual layout of fiber cables, towers, electronics, etc., throughout the service area. The detailed design is a critical component for identifying all elements of the network, which allows for the next steps of the engineering process, including equipment RFPs and evaluations, price quotes, pole analysis, permitting, and establishing a Bill of Materials (BOM).

Once the high-level design (HLD) work is completed, the field staking and constructability verification for the project begins. Field staking is the process that determines the most practical physical routes for cable and pedestal, or other communication equipment placements. It also needs to determine how to overcome barriers and verify the necessary size and quantities of the various equipment to be placed. This information is used to generate Plans & Specifications (P&S), which is provided as a bid package to qualified contractors.

All federal funding, grant or loan, requires adherence to environmental regulation review. This includes Section 106 for cultural sensitivities (i.e. archeological sites), Section 7 for biological habitat analysis and for endangered species and National Environmental Policy Act (NEPA) review for all classified lands such as ancestral tribal lands. The analysis and clearance of each category under this environmental review can be time-consuming due to the coordination with multiple federal and state agencies and costly, so an adequate budget should be considered during the application process when considering the scope of work regarding the proposed routes.

While the design progresses through final review, the generation of the P&S, permitting of easements, right-of-ways, and construction corridors is initiated and submitted to the impacted agencies, such as the Department of Transportation, state or federal land offices, and even private property owners who may be affected along the construction route. This process is the final regulatory clearance necessary to begin construction of the new network.

Once the best contractors are selected, the building stage can begin. The construction contractor will convert the plan into reality, working with the network owner, engineer, equipment vendors, and agencies with jurisdiction to meet all obligations and needs. Additionally, some areas of the country have a specific construction season which can affect build timelines. Meticulous and seamless coordination between all parties is crucial.



"When building the network, providers can often face supply chain challenges that can delay project timelines and inflate costs.

Global shortages of critical materials like fiber optic cables, semiconductors, and other network equipment can severely impact procurement."

Delivery schedules should be discussed during the design phase when the initial high-level BOM is published. Additionally, the ability to hire skilled contractors for tasks such as fiber installation, tower construction, and network testing may be limited due to high demand and a shortage of qualified labor in many regions. The issues outlined above make it even more imperative for providers to plan for delays and actively manage both supply chain logistics and contractor relationships to ensure successful and timely project completion.

The final stage of the engineering process is the inspection and quality assurance. This process entails working with all parties through the deployment cycles to ensure the initial vision and the design are implemented efficiently, smoothly, and that all clean-up is properly completed. This can include all the mitigation and obligations of the permitting agencies and restoration of anything damaged in the installation process.

This process also requires close coordination of the final testing of the network elements, including integration with existing facilities. This integration can take time, from the outset during the design phase, during construction, and during what we call the testing and the turn-up of services.

Upon completion of the final inspection, the project is ready for full activation and operations. The company's operating staff needs to be included in all the initial analysis, engineering, and construction phases so that the requirements of operating the network are familiar.

STEP FOUR:

SERVICE DELIVERY, MAINTENANCE, AND UPGRADES

Once the new broadband network testing and turn-up is completed, the operational work begins for the ISP – activating your service, delivering service each month, maintaining your service, and upgrading your service from time to time in the future.

Service delivery starts with a service order via an online portal, over the phone, or even in person. ISPs need to create and maintain multiple systems and interfaces ready to take customers' orders. Once an order is received, this initiates a series of workflows – which may be manual or automated, or a mix of both – to verify service availability, establish accounts and payment methods, assign network facilities, and schedule installation and activation of service.

After creation of your service order, the exact path to service delivery will depend on a number of factors, such as whether or not your specific location has had service previously at the level requested and whether facilities connecting your specific location to the ISP's core network were placed at the time of construction or if the plan called for installation of such facilities to connect you following an order. If facilities need to be added, such as "drops," this could take up to 10 days to complete. In all cases, facilities and equipment will need to be assigned and tracked. While this can be done manually on a very small scale, the larger the network, the more involved this can become with purpose-built systems becoming more desirable.

Once you are connected, the ISP's work shifts primarily to billing, customer care, technical support teams and service technicians as may be needed. Each company is unique in how they approach each of these topics. Depending on the size of the ISP and the scope of its operations in your area, some of these functions may be performed "in-house" while others are outsourced, and some may be automated while others will turn upon interaction with an ISP's customer service representatives.

The timing for upgrades of networks is also something every ISP must consider remaining responsive to consumer and community needs. Many technologies need to be updated every several years to make sure that broadband access will keep pace with consumer demand. This is certainly the case for many wireless and older wireline technologies – but even a new fiber network that is capable of serving a community for decades will still require electronic upgrades, continual adds, moves, and many kinds of customer support.

Keeping existing networks running is also no small feat – especially in rural areas where locations may be miles apart and "truck rolls" for service calls might be measured in hours in each direction. The maintenance stage involves monitoring the network for performance issues to ensure it is operating effectively and efficiently. Transmission interruptions due to equipment failures need to be repaired rapidly to ensure that the network is operational and that there is limited or no downtime disruptions. Ongoing training of personnel and upgrades of systems and tools are a continual part of the budget and all planning and needs forecasting for every ISP.

Personnel, tools, trucks, spare inventory, software, office, and warehouse space are also required, as well as cybersecurity protection and response plans. The real value of this work is hard to quantify until it is truly needed, even as it represents a significant and increasing aspect of every ISP's operations.

CONCLUSION

The deployment of broadband technology and delivery of broadband services from beginning to "end" represents a pivotal advancement in our collective digital journey. While bridging the digital divide, expanding broadband infrastructure can revolutionize connectivity and enhance economic opportunities. But it takes hard work and timeintensive effort to build a network from the planning and permitting stages through actual construction – and the job is just beginning when the network is "done."

> ***"There is no "end" to the business of broadband, because the work never ceases to meet the needs of customers over time."***

Consumers today have a healthy appetite for information and entertainment. As we approach the end of this decade and enter the next, multi-gigabit speed delivery to subscribers will be the norm, rather than the exception. To accommodate advanced technologies like virtual reality, augmented reality, artificial intelligence, and 4K and 8K streaming, networks need to be scalable. This means more than just faster internet speeds for you as a customer. It demonstrates increased access to telehealth services, educational resources, remote work possibilities, and innovative technology regardless of where you are located.

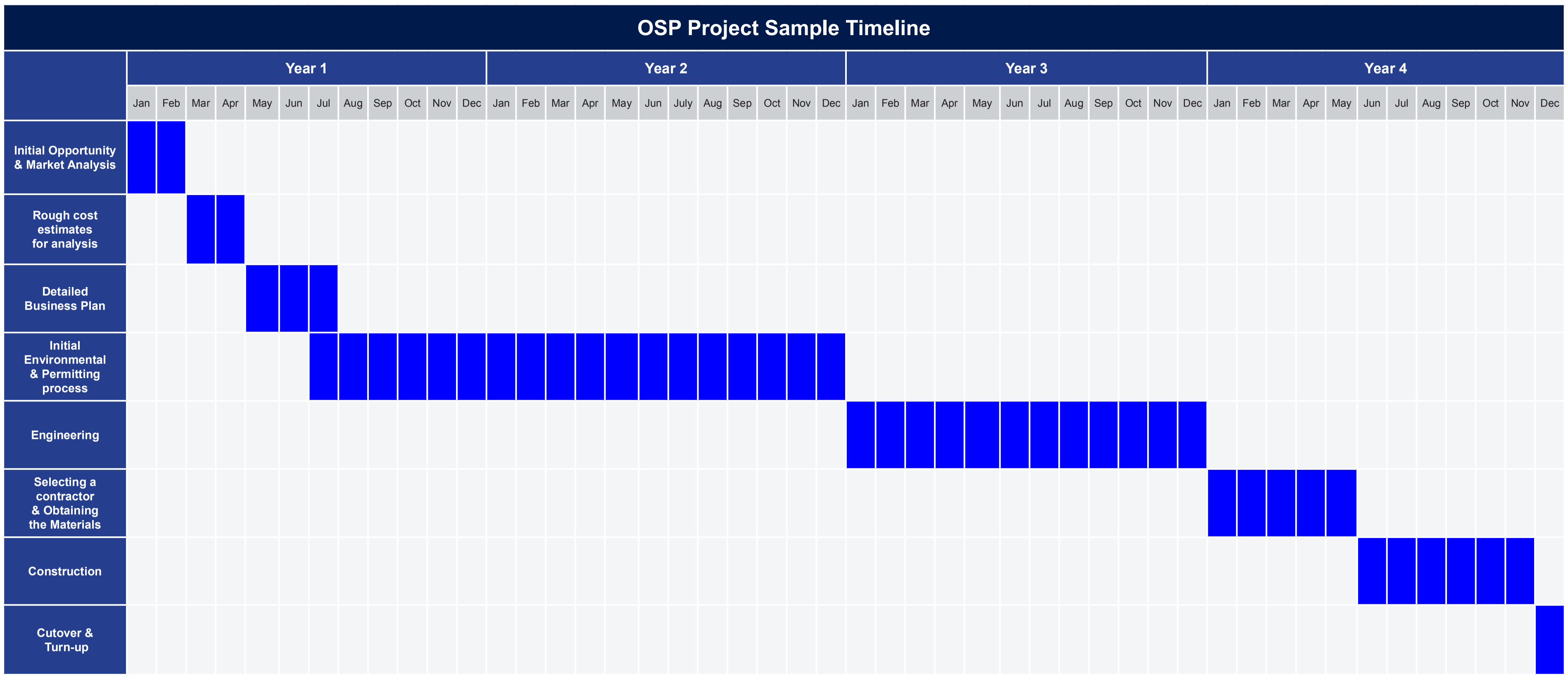
The deployment of broadband networks is undoubtedly a monumental task, requiring immense coordination, technical expertise, and financial investment. However, challenges still present themselves after the network is built. Operating a broadband network is not a passive endeavor. It is a dynamic business that demands continuous oversight, adaptability, and customer-focused strategies.

While many understandably focus on the excitement associated with broadband deployment and the initial thrill of announcing that customers are connected, we cannot overlook the many steps that go into making that happen in the first place – and the many additional ongoing steps that go into making sure that this has a lasting impact for those that get connected.

TYPICAL TIMELINE FOR NEW BROADBAND NETWORK DEPLOYMENT

A typical timeframe for a new broadband network deployment may take anywhere from two years to four years.

The longest anticipated timeline may include:



This project was developed in conjunction with JSI, an industry-leading broadband solutions partner with expertise in Engineering, Strategic Planning, Financial, Regulatory, Cyber Security, and Network Management. Established in 1962, JSI's complete suite of services allows them to partner with communications providers across North America. They help their clients leverage innovative technology, enabling providers to create a positive impact on the communities they serve and bridge the digital divide.

The Foundation for Rural Service (FRS) was established in 1994 as a non-profit 501(c)(3) by NTCA–The Rural Broadband Association. The organization plays a unique role within the telecommunications industry by supporting rural telecom companies, consumers and policymakers with educational information, products, and programming. The FRS mission is to sustain and enhance the quality of life in America by advancing an understanding of rural issues. The vision of FRS is to harness the power of the rural communications industry to enrich lives in America. Through scholarships, grants, and a variety of educational programs, FRS focuses on educating rural youth, encouraging community development, and introducing policymakers and the public to challenges unique to rural communities.

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