Digital Access Infrastructure Plan

May 2022

The Development of the following Plan was made possible through partnership and cooperation with –

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Key Findings & Vision

Summary of Key Findings

Orangeburg's primary objectives are to –

1. **Make digital access affordable and available for all residents in the Orangeburg DPU service area.**
2. **Create a long term (50+ year) solution rather than incrementally improving the problem over time.**
3. **Recognize the value of Orangeburg's institutions of higher learning by assuring that any digital access investment leverages the local value they offer.**

There are four primary tools to achieve these objectives

1. **Use public funds to invest in open public infrastructure.**
2. **Establish a fiber optic utility within Orangeburg's existing Department of Public Utilities.**
3. **Leverage established municipal utility operational models for funding, construction, operation, fee collection, and leverage established municipal utility powers, tax exemptions, and liability protections to drive costs down and service levels up.**
4. **Enable true competition and choice for private services with an open access fiber optic infrastructure utility.**

What will this cost?

To make sense of the cost, we need to understand what residents in the Orangeburg service area are paying today –

Internet Spend in Orangeburg Today

Average monthly cost of home internet connectivity in US today $68.38

Number of Premises (Home | Businesses)	**20,800**[1]
Average Monthly Internet	**$68.38**
Annual Internet Spend	**$17,067,648**
20 Year Internet Spend	**$341,352,960**

[1] Households = 26,000 minus 20% Households without internet service.

https://www.newamerica.org/oti/reports/cost-connectivity-2020/

If 80% of the population currently accesses the internet across a coaxial or DSL wire in the DPU service territory, residents are currently paying roughly $17 million per year to incumbent operators. It is important to understand the existing revenue stream in comparison to proposed models which focus on the opportunities for improving what is available today.

Achieving Affordability

This document focuses on the following:

1) A recommended first project primarily focused within the City of Orangeburg boundaries. (See Page 48)
2) A financial model that spans the entire DPU footprint to 26,000 premises (See Page 16)

The financial modeling in both cases does not include the benefit of ARPA funds, state or federal grants, philanthropic contributions, or the $30 subsidy under the Affordable Connectivity Program. It is anticipated that Orangeburg and its residents will qualify for governmental grants and other subsidies. These funds further strengthen the feasibility of the modeled project, but the project can be successful on its own – without these grants and subsidies.

In addition to the possibility of lowering the monthly cost to subscribers via federal and state grants and subsidies, other tools can be leveraged to improve affordability and accessibility. These tools include:

- Operate the infrastructure as utility infrastructure (like water & sewer facilities).
- Access public financing rates and terms.
- Enable competition with an Open Access system.
- Eliminate the traditional ISP in those homes that cannot afford market rates for connectivity without requiring any outside subsidy by using Open Access innovations to provide essential connectivity where:

    1. Schools stretch their campus networks into the home at no cost.
    2. Libraries stretch their internet connectivity into the home at no cost.
    3. The Fiber Utility provides a Lifeline plan.
    4. ISPs offer a Lifeline Plan (Orangeburg Fiber Utility could require some free offerings as part of market participation).

    Note: Extending the school network to the home would provide direct fiber access between the school and the home for a student. This model will not only result in a completely different cost model, but a different user experience as a local school operated network could be used for remote campus or virtual classroom applications. The same could be true for extending a library network.

Cost Comparison

Below is the per Mbps cost of service using the standard packages and advertised cost published on each providers website in comparison to modeling for a Orangeburg Fiber Utility.

Network Provider >>>	Spectrum	AT&T	Fiber Utility
Cost Per Mbps – Plan 30	**$1.00** 30/3 Mbps Plan	**$2.80** 25/5 Mbps Plan	**$.05** 1000/1000 Mbps Plan
Cost Per Mbps – Plan 50	**$1.10** 50/5 Mbps Plan	**$1.40** 50/5 Mbps Plan	**$.05** 1000/1000 Mbps Plan
Cost Per Mbps – Plan 100	**No Offering**	**$1.40** 100/10 Mbps Plan	**$.05** 1000/1000 Mbps Plan
Cost Per Mbps – Plan 200	**$.38** 300/10 Mbps Plan	**No Offering**	**$.05** 1000/1000 Mbps Plan
Cost Per Mbps – Plan 400	**$.24** 400/20 Mbps Plan	**No Offering**	**$.05** 1000/1000 Mbps Plan
Cost Per Mbps – Plan 940	**$.14** 900/35 Mbps Plan	**No Offering**	**$.05** 1000/1000 Mbps Plan

Commercial and Other Institutions

All modeling in this report is focused on lowering the costs for all participants and solving digital inequities for residential subscribers. However, this infrastructure will provide a significant positive benefit for residential, commercial, and other institutions, all of which will have access to this infrastructure.

The Initial Project will help solidify a cost model for commercial and anchor institutions. An open marketplace will have a meaningful and positive impact on the cost of access for Orangeburg's businesses and anchor institutions. Additionally, participation from businesses and other institutions will have a positive impact on lowering the cost of network operations for all subscribers.

Collaboration with Local Universities

Orangeburg can provide a unique value proposition by partnering with the local institutions of higher education; Claflin University and South Carolina State University. The opportunity for these institutions and the broader community is to use this digital infrastructure to create the 'living labs' necessary for modern research, development, and education processes. Orangeburg's Universities are currently at a disadvantage when compared other institutions that have the digital access to create these public-private-people partnerships.

Overview

A lack of broadband competition and investment in Orangeburg has resulted in an affordability gap. Digital redlining privileges some neighborhoods and leaves others unserved or underserved. Industry has failed to address these shortcomings. Potential new market entrants that would bring competitive pressure to incumbents must invest in a new infrastructure to enter a market because the model persists where services are tightly bundled to infrastructure. These common practices have resulted in just one or two legacy wireline options for most Orangeburg DPU properties. Because legacy cable infrastructure offers greater bandwidth than DSL solutions, there is either only one or no adequate provider for many residents in the Orangeburg service area. Further, solutions which seek to deliver the least service for maximum price are vulnerable to true utility models which focus on delivering the maximum service for the least cost. To optimize outcomes, an Orangeburg Fiber Utility must apply a utility model.

The lack of competition negatively impacts availability and affordability in two important ways. First, the infrastructure costs are higher as redundant infrastructures must be constructed and maintained for service competition because the services are bundled with the infrastructure. This market situation would never have arisen naturally, except that the two competing infrastructures were originally built for analog voice and cable. Today they compete for digital access, something that was not imagined when they were originally constructed. Second, the service costs are driven higher by creating artificial market scarcity for services - effectively driving up demand and costs. As a result, many Orangeburg properties are left without a viable digital access option.

Understanding these market conditions and their origins is essential to the development of an effective solution, as they demonstrate that any infrastructure investment that continues to bundle infrastructure and services will have a negative impact on affordability and availability.

The mechanisms are in place for an Orangeburg Fiber Utility to put in place long term solutions to connect all Orangeburg DPU customers. The key enabler to connect everyone is for an Orangeburg Fiber Utility to control its digital infrastructure destiny by owning this essential infrastructure. Once an Orangeburg Fiber Utility is the infrastructure owner, the Fiber Utility will be able to use other tools to drive desired outcomes.

Those seeking to preserve the status quo may use fear, uncertainty, and doubt to dissuade Orangeburg leadership from controlling its own digital infrastructure destiny. However, based on the findings in this report, the existing utility is very well positioned to successfully build and operate this network.

NETWORK FUNDING

The current juxtaposition in technology, infrastructure funding, and public demand creates a singular opportunity for Orangeburg to provide affordable access to every property. Technology has provided the ability to separate or 'unbundle' services from the core infrastructure. This means that software can be used to create a virtual space for the network operator and an infinite number of other independent virtual spaces for services providers interested in providing services on this network. This will allow the Fiber Utility to build one publicly owned fiber optic infrastructure capable of enabling true competition leveraging the capacity of fiber

optic networks and software defined networking tools to meet the needs of multiple concurrent service providers without requiring any redundant investment in infrastructure.

Historic levels of federal funding for digital infrastructure are being made available through competitive processes that favor need, public ownership, and open access. Public opinion supports treating digital access just like roads, bridges, water, sewer, and power. Combining these key aspects will provide a Orangeburg Fiber Utility with a fiber optic access utility with a focus on providing maximum service for least cost in comparison with the industry model that provides least service for maximum cost.

More importantly, an Orangeburg Fiber Utility must recognize that this investment will be made by a private operator if it is not developed by a public owner. DPU is perfectly positioned to make this investment in a project that can both lower costs and significantly improve network speed and reliability. The important question that an Orangeburg Fiber Utility can help to answer is will this be a closed infrastructure, operated by a single provider applying a bundled services model, or an open infrastructure which is positioned to reduce costs by supporting desired competition.

Additionally, allowing this to remain closed infrastructure negates the opportunity of leveraging the unique opportunity to work collaboratively with the Universities in Orangeburg. Progressive institutions across the country are creating 'living labs' to support research and development to better inform their work, improve the education they provide to students, and create collaborative relationships with the industries their alumni serve.

UTILITY MODEL

Public utility models are properly applied to the construction, operation, and delivery of essential infrastructure and services. These utilities exist to support essential functions critical for societal success. Applying these same frameworks to digital access will result in maximum service delivery at the lowest possible cost. Current digital access solutions in Orangeburg lack adequate competition and utility-based infrastructure to achieve the affordability, ubiquity, and service levels required to connect everyone. With historic funding available to solve specific problems, the City of Orangeburg and the Orangeburg DPU are launching a Initial Project to evaluate whether applying these existing institutional authorities to the construction, maintenance, and operation of a municipal automated open access fiber optic infrastructure can enable private service competition to every address in the Orangeburg DPU service area as the cornerstone of a broader digital equity strategy.

A utility model aligns with separating core monopoly infrastructure from the services available over the core infrastructure. Power distribution and transmission infrastructure is often separate from generation. Wastewater treatment plant operations can be separated from the core collection system(s) to serve more than one collection system as a service outside of the core monopoly infrastructure, improving affordability. Water pumping or treatment systems can be separate from the core water distribution systems.

It is also important to note that these separations are not only possible, but fundamental for the electric grid. The national gird is interconnected. The electricity received by the end customer could be coming from any generation point, as demonstrated by outages at one generation point can affect service in a separate distribution system. These same types of outcomes are experienced in digital transport and access systems where the services are now supported outside of the core monopoly infrastructure. (They used to be bundled,

but Ethernet/IP has effectively unbundled these systems technically. The problem is that the industry has not followed suit with a supporting business model.

Scale often determines the value of separating these systems. Digital access is now global, so the scale would indicate that there is clear economic value in creating and maintaining separation between infrastructure and services in digital infrastructure. Fiber optic infrastructure is a natural monopoly (i.e., no new value is gained by having multiple infrastructures because fiber offers nearly infinite speed and capacity). However, great value for subscribers will come by exposing services to competition.

Therefore, it is logical to use utility frameworks to support one robust locally owned digital infrastructure and foster commercial competition across that infrastructure. This will not only improve affordability, but also lead to choice, innovation, and competition.

The differences in economics between private industry and public utility operations will also improve affordability and availability.

CATEGORY	INDUSTRY	UTILITY
Capital Costs (CAPEX)	Equal	Equal
CAPEX Financing	5 – 8 YR return with market interest	20–30 YR return with low interest
Operational Costs	Equal	Equal with automation
Services (Closed or Open)	Negative impact	Positive impact
Profits (Paid to investors)	Negative impact	Positive impact

Value Proposition

The key digital access objective for a potential Orangeburg Fiber Utility is that it must be available to everyone at affordable rates. For this reason, public utility models are recommended for the construction and operation of an automated open access fiber optic system. The application of these frameworks will result in models completely different from industry models. Industry experts may say that the modeling used by an Orangeburg Fiber Utility is incorrect or inaccurate because it differs from the industry standard. Pursuit of universal availability and affordability will lead to completely different outcomes for the businesses and residents of an Orangeburg Fiber Utility.

Orangeburg leaders should expect the industry to view this infrastructure as competitive to their interests because incumbent control and profit models depend on their ownership of the infrastructure. Any industry assertions that an Orangeburg Fiber Utility directly competes with private networks is not accurate because incumbents will be invited to deliver their services across this infrastructure at virtually no upfront capital costs. In an open access network, incumbent providers will face competition from other private providers.

Collaboration with Local Universities

The proposed business model and technology innovations offered by Automated Open Access will enable users to access local private networks at no additional cost. This represents tremendous value for the Universities in Orangeburg as direct connections from the campuses could be created instantaneously with individual, commercial, or anchor institutions for the benefit of both the student, university, and industry to

collaborate on research in real time. Similar connectivity from the campus could be published to the residents in Orangeburg, allowing them to participate in distance learning or research as part of a 'living lab.'

Other Technology Opportunities

Currently the value of this functionality is not well understood by the public, but it has the capacity to enable any number of local digital providers, like telehealth, energy management, and local security monitoring for the benefit of the local community. There will also be opportunities for national service providers like Netflix, Amazon, or Disney to create local connections and direct relationships with Orangeburg Fiber Utility customers without the additional expense of a third-party internet service provider. These local connections would also come with much better speed/reliability performance due to the direct point to point fiber optic access.

Vision Statement

By 2027, City and Community leaders in Orangeburg will work together to make a meaningful improvement in digital access affordability and eliminate the digital divide in underserved neighborhoods by developing policies and infrastructure which will serve as a innovation catalyst to unleash the economic potential of all stakeholders – students, residents, businesses, local government, and application service providers.

Education Partners

Orangeburg digital infrastructure would be designed and operated in partnership with Orangeburg's higher education partners and seeks to serve as a catalyst for innovation, education for students and the community, to unleash economic potential across stakeholders – students, residents, employers, local government, and application service providers.

Research done by the Federal Reserve of Richmond underscores the importance of infrastructure as the share of households with children who have access to computers and the share of households that have a broadband internet subscription at home are predictors of the homework gap. The conclusion of this research is that "without a computer at home and access to the internet, online learning becomes a significant challenge for students."

https://www.richmondfed.org/research/regional_economy/regional_matters/2020/rm_08_28_2020_homework_gap

Key findings from South Carolina's Q3 2020 data analysis include:

- Nearly seven out of ten South Carolina students in grades 3 through 8 are projected not to meet grade level proficiency standards in mathematics and English Language Arts in spring 2021.
- Comparing fall 2019 to fall 2020 in *mathematics* achievement, the COVID slide was most dramatic in grades 2 through 5, with between 10% and 16% fewer South Carolina students expected to meet grade level proficiency. In grades 6 through 8, approximately 5% fewer students are projected to be proficient on grade level standards in *mathematics*: only 1 out of 4 South Carolina students is projected to be proficient in *mathematics* in grades 7 and 8.

Matthew Ferguson, EOC's Executive Director, suggested "the pandemic has presented an unprecedented upheaval to the education of students in every corner of the state. While the disruption has provided many challenges and, in some instances, opportunities for innovation and creativity, we cannot ignore that many students have and will continue to experience learning loss. Student success – from cradle to career – must remain our collective goal."

https://eoc.sc.gov/news/2021-01/study-shows-sc-student-achievement-impacted-covid-19-0

These educational gaps in access, opportunities, achievement, and outcomes existed before the pandemic, but COVID has deepened these divides across classrooms and campuses. Negative impacts are falling disproportionately on students who went into the pandemic with the greatest needs and fewest opportunities. Improving digital access by assuring that it is affordable and available to all will serve as a necessary first step. The Richmond Fed research indicates that fast, affordable access is the base that is needed to then layer on access to devices, digital literacy, and education.

A vibrant and robust educational system that includes both brick and mortar, and online or virtual opportunities for students of all ages is essential not just for student outcomes, but also for a community's economic vitality as the average bachelor's degree holder contributes $278,000 more to local economies than

the average high school graduate through direct spending over the course of his or her lifetime; an associate degree holder contributes $81,000 more than a high school graduate.

https://www.brookings.edu/research/what-colleges-do-for-local-economies-a-direct-measure-based-on-consumption/

Importance of Infrastructure

The City of Orangeburg and Orangeburg DPU recognize the significance of this moment as an opportunity to take necessary steps towards solving the digital divide by owning the process of developing and implementing digital infrastructure.

The coronavirus pandemic has effectively moved everyday life online, much of it to stay. In June 2021, Consumer Reports conducted a nationally representative multi-mode survey of 2,565 adults administered by NORC at the University of Chicago. The survey found that three out of four Americans feel that municipal/community broadband should be allowed because it would ensure that broadband access is treated like other vital infrastructure such as highways, bridges, water systems, and electrical grids, allowing all Americans to have equal access to it.

This plan follows evolving public opinion by treating digital infrastructure the same as other vital public infrastructures. Public utility frameworks will be used to fund, construct, and operate a state-of-the-art open access fiber optic infrastructure. This public digital infrastructure will enable new levels of innovation and competition without the crushing capital costs normally associated with such improvements. Just as virtually all the traffic on our roads and bridges is not government or utility traffic, the services, or information flowing through this digital infrastructure will be from private providers as they serve their clients and communities.

Orangeburg will provide the infrastructure necessary to drive positive organic change in digital access for residents across the Orangeburg DPU service area.

To effect real and meaningful digital access changes the underlying infrastructure must:

- Be considered a necessity not a luxury - Treat broadband like roads, bridges, and other utilities
- Be accessible and affordable - Unbundle services to promote transparency
- Be economically sustainable - Local government will procure, retain, and maintain ownership of fiber infrastructure
- Be service provider friendly - Incentivize innovation and competition by remaining provider agnostic
- Be HBCU friendly - Recognize the historic role of HBCUs as economic hub(s) within the community

Orangeburg's plan adheres to these core principles assuring that the resulting public utility digital infrastructure serves Orangeburg's students, residents, employers, local government, and application providers.

Orangeburg recognizes the requirement for systemic changes and the crucial importance of partnering with community anchor institutions like our public schools and institutions of higher learning to effectively eliminate the digital divide. While nothing in this plan will interfere with the operation, extension, or upgrade of existing

communications infrastructures, current providers are encouraged to take advantage of this opportunity to access the utility fiber system which will improve their service delivery and cost model. It is true that incumbent providers will be exposed to competition at the service layer, subscribers will benefit from this competition and will realize faster speeds, greater network reliability, and more affordable prices.

Orangeburg Resolution

With the adoption of this plan -

Orangeburg recognizes that removing digital access barriers to establish universal availability and affordability to fiber optic infrastructure are public domain concerns that industry cannot address alone. Effective and lasting solutions to these problems will require public investment coupled with good policy. Therefore, in consideration of public support and unprecedented funding opportunities to effect meaningful change, the City of Orangeburg will pursue the following policies and procedures.

Policies and Procedures

01 Focus on universal availability and affordability for all residents in the Orangeburg service area.

a. Use public funds to invest in open public infrastructure to enable true competition and choice for private services.

b. Codify an automated open access fiber optic infrastructure utility in the municipal code to hold and manage the infrastructure in a proprietary or enterprise fund for public benefit.

c. Leverage established municipal utility operational models for funding, construction, operation, and fees.

d. Leverage established municipal utility powers, tax exemptions, and liability benefits to drive costs down and service levels up.

e. Implement an automated system to improve affordability and scalability in support of innovative use cases and overall user satisfaction.

02 **Focus on solving the digital divide.** Favor the use of public funding for sustainable capital investments, such as publicly owned digital access infrastructure, rather than short term unsustainable solutions, such as public subsidies made to private service providers.

a. Separate public infrastructure investment and operation from private service investment and operation in law, ordinance, and practice.

b. Recognize fiber optic media as the preferred infrastructure investment for fixed installations.

c. Establish Ethernet as the infrastructure communications standard.

03 Create local value for Orangeburg.

a. Improve property values through the installation of affordable fiber optic access to every address.

b. The infrastructure itself will be directly available to Residents, Businesses, and University Students for their use without requiring a commercial service or internet provider.

04 Leverage existing investments and institutions for support.

a. Establish native system support to extend community anchor institution services, such as those offered by Orangeburg's HBCUs, to effectively enable direct digital campus and classroom access from any address.

b. Implement joint powers and cost sharing agreements with any publicly funded entity either inside or outside the city whenever possible.

c. Seamlessly fold this new municipal utility operation into all existing city operations for the benefit of all by requiring in policy that all intracity connectivity be performed by the fiber optic utility.

d. Use already established public assistance infrastructures, such as academic outreach and educational programs to provide municipal fiber optic utility training, support, and devices to improve adoption and digital literacy.

05 **Establish fiber optic utility fees that provide for sustainability** based on capital and operational cost recovery, not excessive reserve funding or profit.

a. Fees shall be based on infrastructure costs which are agnostic to services consumed or provided.
b. Fees shall be established, published, charged, and collected using already established municipal utility infrastructure, assets, and systems.

06 **Use the infrastructure as a platform for equity and innovation.**

a. Establish models and funding to provide a basic level of connectivity for all at no cost.
b. Establish financial assistance models using the Emergency Broadband Benefit program, the Orangeburg, Allendale, Bamberg, Calhoun County Community Action Agency, or similar models to provide support.
c. Encourage innovation through fee structures that focus on infrastructure costs agnostic to bandwidth.
d. Seek to create and improve the digital opportunities available to all Residents.

Closing the digital divide will require Orangeburg to develop strategy and policy around more than digital access. Therefore, these Digital Access Policies and the resulting Strategic Infrastructure Plan represents only a crucial first step in the development of a broader plan focused on eliminating the digital divide in Orangeburg. The Orangeburg plan is not a 'replication', but an 'evolution' that will transform costs and services. While the first step in any paradigm shift is often hardest, this is the right first step because only by owning the infrastructure can Orangeburg provide the necessary underpinnings to assure access and equity outcomes. It is also the right public investment because it avoids favoring any single private provider by eliminating monopoly infrastructure capital costs for both incumbent and new providers, while at the same time allowing any provider to build, upgrade, extend, and use their own infrastructure as they desire.

This plan is designed to create opportunity, achieve equity, drive success, and deliver digital prosperity for all residents in the Orangeburg DPU service area. The subsequent financial sections provide the background data and details to inform this Plan.

SECTION 2

DPU Territory Wide Deployment

DPU Territory Wide Deployment

Costs and Phasing

The financial modeling presented below was developed using industry standard proforma models for a fiber optic utility installation that would pass some 26,000 properties. The model is not strictly based on any Orangeburg specific inputs, rather it was calculated using some accepted national standards for fiber construction in similar environments. For this reason, this modeling is only presented here for high level cost modeling and baseline financial performance analysis. For financial modeling specific to Orangeburg please see the heading Recommended Initial Project later in this report.

It is anticipated that Orangeburg will qualify for and receive governmental grants and other funds that would offset a portion of the infrastructure costs outlined in this report.

This section provides cost modeling for a potential DPU-wide deployment. The main cost categories for deploying and operating broadband networks are:

- Infrastructure Capital Costs *(Financed over 20-30 years)*
- Network Maintenance & Operations (Monthly Utility Fee)
- Services (Paid directly to Service Providers)

To optimize the subscriber cost for each category, it is recommended that the costs are separated and transparent to each stakeholder (Subscriber, Network Operator, and Service Provider).

Monthly Infrastructure Cost Model

The cost modeling for the infrastructure construction is based on South Carolina wage rates. A take-rate of 60% (This means that 60% of homes and businesses subscribe) was used in the model. The variables in the cost model can be adjusted on a neighborhood-by-neighborhood basis as needed. A 60% take-rate may seem aggressive given the strong market position of the incumbent cable operator. However, the current pricing of incumbents versus the proposed price modeling for a DPU fiber utility could lead to lower pricing and exponentially faster speeds.

The data in the line items in this model comes from actual bids for materials and network buildout experience. It should be noted that supply chain pressures have made the network materials market volatile for conduit, electronics, and some other network components.

The first illustration of Infrastructure Capital Costs per premise assumes a project that is 100% aerial.

The second illustration of Infrastructure Capital Costs per premise assumes a project that is 80% aerial and 20% buried.

Costs at 60 % Take Rate			
100% Aerial			
Description	Common	Drop	Total
Labor	$605	$297	$902
Equipment & Materials	$1,132	$491	$1,623
Professional Services	$117	$25	$142
Short Term Interest	$69	$0	$69
Total	$1,923	$813	$2,736

Monthly Infrastructure Per Premise Cost	**$15.89**

Costs at 60 % Take Rate			
20% Buried | 80% Aerial			
Description	Common	Drop	Total
Labor	$726	$356	$1,082
Equipment & Materials	$1,213	$517	$1,730
Professional Services	$117	$25	$142
Short Term Interest	$76	$0	$76
Total	$2,132	$899	$3,031

Monthly Infrastructure Per Premise Cost	**$17.54**

Take-Rate is the percentage of premises that sign up for services out of the total number of homes that have the infrastructure available to them.

The Infrastructure Cost is the cost to build the network to the premise and includes the connection cost. In this model, this line item goes away once the infrastructure is paid off.

The Maintenance and Operations cost is an ongoing cost which is structured as a fiber optic utility.

ISP Services – Customers will shop for an ISP in much the same way they shop for other goods and services online. Five to Ten ISP's will be available in a portal.

Total Infrastructure Costs

The total projected construction costs for a city-wide deployment are summarized in the table below. The projections assume that 80% of the network will be aerial and 20% will be buried with a 60% take rate and an interest rate of 3% for 20 years. Take rate is the percentage of premises that sign up or subscribe in a specific geographic area. The interest rate and term of the loan can be adjusted in the model to match reality as the financing plan is finalized.

Project Pro-Forma

Financial Pro-Forma of Full Project Costs - 4 Year Build - Ethernet Architecture	
Projected Cost Per Premise (Common and Drop)	$3,131
Estimated Subscribers	15,600
Total Projected Project Costs	**$48,840,954**

Why Take-Rate is Important to Total Infrastructure Cost

Take-rate is a variable that is critical to project success because the operational sustainability of a project depends on crossing a certain take-rate threshold and take-rate has a meaningful impact on the cost per premise.

The following table illustrates the impact of take-rate on total cost per premise under a 80% aerial and 20% buried network with a take-rate of 60% as neutral on impact.

Take-Rate Modeling

Take-Rate	Cost/Sub	Subscribers	Difference	vs. 60% Take-Rate
5.00%	$26,311	1,300	-	($23,180)
10.00%	$13,667	2,600	$12,643	($10,536)
15.00%	$9,453	3,900	$4,214	($6,322)
20.00%	$7,345	5,200	$2,107	($4,214)
25.00%	$6,081	6,500	$1,264	($2,950)
30.00%	$5,238	7,800	$843	($2,107)
35.00%	$4,636	9,100	$602	($1,505)
40.00%	$4,184	10,400	$452	($1,054)
45.00%	$3,833	11,700	$351	($702)
50.00%	$3,552	13,000	$281	($421)
55.00%	$3,322	14,300	$230	($192)
60.00%	$3,131	15,600	$192	$0
65.00%	$2,969	16,900	$162	$162
70.00%	$2,830	18,200	$139	$301
75.00%	$2,709	19,500	$120	$421
80.00%	$2,604	20,800	$105	$527
85.00%	$2,511	22,100	$93	$620
90.00%	$2,428	23,400	$83	$702
95.00%	$2,354	24,700	$74	$776
100.00%	$2,288	26,000	$67	$843

Full Fiber Utility-Wide Network Operations

The following Table summarizes the anticipated cost structure for Network Maintenance & Operations (M&O) on a city-wide basis. This schedule produces a projected monthly M&O fee for the Broadband Utility at $20.00 per month. This could be staffed with Fiber Utility employees or a contracted 3rd party operator.

Depending on the speed of the buildout, the City may need to subsidize network operations until enough scale is established to achieve sustainability. An accelerated deployment schedule will minimize a subsidy needed by the city. The model illustrates that any subsidy required from the city would be paid back over time.

Residential M&O	Subscriber	Monthly	Annual	Percentage
Labor	$5.00	$78,000	$936,000	24.99%
Office Expense	$6.14	$95,784	$1,149,408	30.69%
Equipment & Supplies	$2.90	$45,306	$543,676	14.52%
Operations Expense	$2.41	$37,596	$451,152	12.05%
Reserves	$3.55	$55,380	$664,560	17.75%
Total	**$20.00**	**$312,066**	**$3,744,796**	**100.00%**

Network Management & Operations Cost Structure

The numbers and categories in the above model are derived from many years of experience with actual costs for Broadband projects. Labor costs are modeled to reflect wages from the Orangeburg region.

Staffing Modeling for Internal Network Operations

The Table below models the cost structure for the positions needed for Orangeburg to operate the network as a fiber utility. The model is conservative in projecting the staffing estimates needed to operate the network in a sustainable manner. The model is for operations only and does not include resources for construction. The analysis assumes that the Orangeburg fiber utility will build the network over a 36-month period. **This timeline would mean that the network will need to be subsidized for less than 15 months. After that, the investment will be paid back by operational surpluses as the number of subscribers grows beyond the target of 15,600 premises.**

The work that will be done by a Fiber Utility includes network monitoring, network management, outside plant repairs, and new customer installations.

As stated earlier, the Fiber Utility has the option of operating the network with internal staffing resources or a 3rd Party network operations partner. EntryPoint expects M&O costs will be 25% - 30% more expensive with a 3rd party operator due to changed incentives from service to profit and reductions in efficiencies.

The following staffing model provides anticipated fully burdened salary information, years to profitability, and the revenues and expenses from the operation.

Staffing Projections

Position	Fully Compensated Hourly Rate	Fully Compensated Monthly Cost	Fully Compensated Annual Cost
Manager	$53	$9,187	$110,240
Network Admin	$42	$7,280	$87,360
I.T. Technician	$33	$5,720	$68,640
Outside Manager	$31	$5,373	$64,480
Outside Plant Tech	$24	$4,160	$49,920

Subscriptions & Staffing Projections

Subscribers	Year 1	Year 2	Year 3	Year 4	Year 5 +
New Subscribers	3,000	4,200	4,200	4,200	-
# of Subscriber at Year End	3,000	7,200	11,400	15,600	15,600
Labor Allocation (From M&O Fees)	$5.00	$5.00	$5.00	$5.00	$5.00
Cash Flow from Labor	$90,000	$306,000	$558,000	$810,000	$936,000

Staffing Projections	Year 1	Year 2	Year 3	Year 4	Year 5
Manager	0.0	0.0	0.0	0.0	0.5
Network Admin	0.0	0.5	0.5	1.0	1.0
IT Technician	1.0	1.0	2.0	3.0	4.0
Outside Plant Manager	0.0	0.5	1.0	1.0	1.0
Outside Plant Laborer	2.0	3.0	6.0	9.0	9.0

Position	Year 1	Year 2	Year 3	Year 4	Year 5
Manager	$0	$0	$0	$0	$55,120
Network Admin	$0	$43,680	$43,680	$87,360	$87,360
IT Technician	$68,640	$68,640	$137,280	$205,920	$274,560
Outside Plant Manager	$0	$32,240	$64,480	$64,480	$64,480
Outside Plant Laborer	$99,840	$149,760	$299,520	$449,280	$449,280
Total	**$168,480**	**$294,320**	**$544,960**	**$807,040**	**$930,800**
Net	**-$78,480**	**$11,680**	**$13,040**	**$2,960**	**$5,200**

Subscriber Costs

The table below summarizes the projected costs for two scenarios: 1) A deployment that is 25% Buried / 75% Aerial, and 2) a deployment that is 100% Aerial. The summary breaks this down into the three main cost categories.

Projected Subscription Cost

Projected Residential Services Monthly Costs	100% Aerial
Infrastructure	$15.89
Maintenance and Operations	$20.00
ISP Services (Dedicated 1 GB Symmetrical)	$9.99
Monthly Total	**$45.88**

Projected Residential Services Monthly Costs	80% Aerial / 20% Buried
Infrastructure	$17.54
Maintenance and Operations	$20.00
ISP Services (Dedicated 1 GB Symmetrical)	$9.99
Monthly Total	**$47.53**

Note: The Residential $9.99 monthly ISP fee listed above is based upon current pricing from a list of ISPs interested in providing services.

Financial Modeling Assumptions

EntryPoint based its analysis on the following demographic information for the Fiber Utility of Orangeburg:

Potential Subscribers: 26,000
(Households and Businesses)

Subscribers @ 60%: 15,600

Income Statement and Balance Sheet

The following two tables represent a projected Income Statement and Balance Sheet covering the first 5 years, during the initial network deployment stage. These tables assume the full $48.8 million build cost is funded with debt at a 3% interest rate over 20-years.

Projected Income Statement

Timeline	Year 1	Year 2	Year 3	Year 4	Year 5 +
Subscribers					
New Subscribers	3,000	4,200	4,200	4,200	-
# of Subscriber at year end	3,000	7,200	11,400	15,600	15,600
Income Statement (Revenue)					
Infrastructure Fees	$315,661	$1,073,249	$1,957,101	$2,840,953	$3,282,879
Maintenance and Operations	$360,077	$1,224,260	$2,232,474	$3,240,688	$3,744,796
Gross Income	$675,738	$2,297,509	$4,189,575	$6,081,642	$7,027,675
Maintenance & Operating Costs (Expenses)					
Labor	-$168,480	-$294,320	-$544,960	-$807,040	-$930,800
Office Expense	-$110,520	-$375,768	-$685,224	-$994,680	-$1,149,408
Equipment & Supplies	-$52,277	-$177,740	-$324,114	-$470,489	-$543,676
Operating Expenses	-$43,380	-$147,492	-$268,956	-$390,420	-$451,152
Premise Equipment Refresh/Replacement	$0	-$2,173	-$7,924	-$17,253	-$26,582
Total M & O Expenses	-$374,657	-$997,493	-$1,831,178	-$2,679,882	-$3,101,618
Interest Expense	-$229,085	-$597,734	-$974,967	-$1,337,057	-$1,362,824
Depreciation Expense	-$183,268	-$623,112	-$1,200,406	-$1,841,845	-$2,162,564
Total Expenses	-$787,010	-$2,218,338	-$4,006,552	-$5,858,783	-$6,627,005
Net (Revenue vs Expenses)	-$111,272	$79,171	$183,024	$222,858	$400,669
	-16.47%	3.45%	4.37%	3.66%	5.70%

Projected Balance Sheet

Timeline	Year 1	Year 2	Year 3	Year 4	Year 5 +
ASSETS					
Cash	$301,081	$976,012	$1,834,202	$2,860,634	$3,536,242
Reserve Account	$379,561	$1,034,402	$1,856,661	$2,839,181	$3,450,576
Year 1 Fiber Build	$9,163,406	$9,163,406	$9,163,406	$9,163,406	$9,163,406
Year 2 Fiber Build		$12,828,768	$12,828,768	$12,828,768	$12,828,768
Year 3 Fiber Build			$12,828,768	$12,828,768	$12,828,768
Year 4 Fiber Build				$12,828,768	$12,828,768
Total Fiber Build Assets	$9,163,406	$21,992,174	$34,820,943	$47,649,711	$47,649,711
Accumulated Depreciation (Year 1 Build)	-$183,268	-$549,804	-$916,341	-$1,282,877	-$1,649,413
Accumulated Depreciation (Year 2 Build)		-$256,575	-$769,726	-$1,282,877	-$1,796,028
Accumulated Depreciation (Year 3 Build)			-$320,719	-$962,158	-$1,603,596
Accumulated Depreciation (Year 4 Build)				-$320,719	-$962,158
Total Accumulated Depreciation	-$183,268	-$806,380	-$2,006,786	-$3,848,631	-$6,011,194
Net Fiber Build Assets	$8,980,138	$21,185,795	$32,814,157	$43,801,081	$41,638,517
TOTAL ASSETS	**$9,660,781**	**$23,196,209**	**$36,505,020**	**$49,500,896**	**$48,625,335**
LIABILITIES & CAPITAL					
Year 1 Debt	$9,392,491	$9,044,419	$8,685,761	$8,316,193	$7,935,385
Year 2 Debt		$13,149,488	$12,662,187	$12,160,065	$11,642,670
Year 3 Debt			$13,149,488	$12,662,187	$12,160,065
Year 4 Debt				$13,149,488	$12,662,187
Total Debt	$9,392,491	$22,193,907	$34,497,436	$46,287,933	$44,400,308
Reserves Payable	$379,561	$1,034,402	$1,856,661	$2,839,181	$3,450,576
Retained Earnings	$0	-$111,272	-$32,101	$150,923	$373,781
Net Income	-$111,272	$79,171	$183,024	$222,858	$400,669
TOTAL LIABILITIES & CAPITAL	**$9,660,781**	**$23,196,208**	**$36,505,020**	**$49,500,896**	**$48,625,335**

Potential Sources of Capital

Grant, Loan & Philanthropic Opportunities

The Fiber Utility and its partners will pursue all available Federal and State broadband grant opportunities that may be a fit for Orangeburg's proposed project. The Fiber Utility will rely on legal advisors and industry experts as it seeks and utilizes state and federal funding assistance.

Potential Capital Sources may include:

- Philanthropic Contributions
- Coronavirus State & Local Fiscal Recovery Funds (ARPA)
- Infrastructure Investment and Jobs Act
- NTIA - Connecting Minority Communities Initial Program
- Affordable Connectivity Program
- State Grants
- Other

ARPA

The Final Rule for the Coronavirus State & Local Fiscal Recovery Funds will take effect on April 1, 2022. The US Treasury Department guidance states:

The final rule significantly broadens eligible broadband infrastructure investments to address challenges with broadband access, affordability, and reliability.

The Coronavirus State and Local Fiscal Recovery Funds may be used to make necessary investments in broadband infrastructure, which has been shown to be critical for work, education, healthcare, and civic participation during the public health emergency. The final rule broadens the set of eligible broadband infrastructure investments that recipients may undertake.

Sources – https://home.treasury.gov/system/files/136/SLFRF-Final-Rule-Overview.pdf

Infrastructure Investment and Jobs Act

President Biden's Infrastructure Investment and Jobs Act seeks to ensure every American has access to reliable high-speed internet. Broadband internet is necessary for Americans to do their jobs, to participate equally in school learning, health care, and to stay connected. Yet, by one definition, more than 30 million Americans live in areas where there is no broadband infrastructure that provides minimally acceptable speeds – a particular problem in rural communities throughout the country. And, according to the latest OECD data, among 35 countries studied, the United States has the second highest broadband costs. The Bipartisan Infrastructure Law will deliver $65 billion to help ensure that every American has access to reliable high-speed internet through a historic investment in broadband infrastructure deployment. The legislation will also help lower prices for internet service and help close the digital divide, so that more Americans can afford internet access.

Source: https://www.whitehouse.gov/bipartisan-infrastructure-law/

The Connecting Minority Communities Initial Program

The Connecting Minority Communities Initial Program, which will direct $268 million for expanding broadband access and connectivity to eligible Historically Black Colleges or Universities (HBCUs), Tribal Colleges or Universities (TCUs), minority-serving institutions (MSIs), and consortia led by an HBCU, TCU, or MSI that also include a minority business enterprise or tax-exempt 501(c)(3) organization.

"Communities of color have faced systemic barriers to affordable broadband access since the beginning of the digital age," said U.S. Secretary of Commerce Gina M. Raimondo. "The investments we make as part of the Connecting Minority Communities Initial Program will help communities that are struggling with access, adoption and connectivity, and will inform our path forward as we seek to finally close the digital divide across the country."

Source: https://www.ntia.doc.gov/press-release/2021/department-commerce-s-ntia-begin-accepting-applications-268-million-connecting

Affordable Connectivity Program

Congress created the Affordable Connectivity Program, a new long-term, $14 billion program, to replace the Emergency Broadband Benefit Program. This investment in broadband affordability will help ensure we can afford the connections we need for work, school, health care and more for a long time. The maximum monthly benefit will change from $50 per month to $30 per month for households not located on qualifying Tribal lands.

Source: https://www.fcc.gov/broadbandbenefit

Individual State Broadband Grants

Broadband Equity, Access, and Deployment (BEAD) Program Funding includes $42.45 billion for new BEAD programs focused on connecting underserved areas by funneling money through state grants. The legislation gives the National Telecommunications and Information Administration (NTIA) 180 days to establish the program and develop funding guidelines. It is unclear how long after those states will begin awarding broadband grants.

Each of the 50 states will receive an initial allocation of $100 million from the $42.45 billion pot, with additional funding to be distributed based on coverage maps that have yet to be put out by the Federal Communications Commission (FCC). To receive funding, each state must submit a five-year action plan that identifies locations that should be prioritized for support; outlines how to serve unconnected locations; and assesses how long it would take to build out universal broadband.

SECTION 3

Market Assessment

Market Analysis

Incumbent Offers and Pricing

In Orangeburg, most residents and businesses subscribe to wireline internet services from the cable operator (Spectrum) and telephone incumbent (AT&T).

Spectrum

Spectrum advertises the following residential ISP services in Orangeburg:

Speed (Mbps) [Down / Up]	12 Month Rate [Contract Required]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
30/3	$18.00	$30.00	TBD
50/5	$30.00	$55.00	TBD
200 / 10	$50.00	$75.00	TBD
400 / 20	$70.00	$95.00	TBD
940 / 35	$110.00	$135.00	TBD

[Advertised Speeds and Pricing from Spectrum's Website]

Taxes and Fees often represent an additional (20%-30%) of Standard Pricing
Shared Network – Speeds are "Up To" and are not guaranteed
Speeds are not Symmetrical
Availability depends upon location – not available in all areas

AT&T

AT&T advertises the following residential services in Orangeburg:

Speed [Down / Up]	12 Month Rate [+ Taxes and Fees]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
5 Mbps / .5 Mbps	$55.00	$70.00	Self-Install
25 Mbps / 5 Mbps	$55.00	$70.00	$99.00
50 Mbps / 5 Mbps	$55.00	$70.00	$99.00
100 Mbps / 10 Mbps	$55.00	$70.00	$99.00

[Advertised Speeds and Pricing from AT&T's Website]

Taxes and Fees often represent an additional (10%-15%) of Standard Pricing
Speeds are "Up To" and are not guaranteed
Speeds are not Symmetrical
Availability depends upon location – not available in all areas

Spectrum Business

Spectrum advertises the following business ISP services in Orangeburg:

Speed (Mbps) [Down / Up]	Promo Pricing [12 months rate]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
200 / 10	$65.00	Not Disclosed	TBD
600 / 35	$115.00	Not Disclosed	TBD
940 / 35	$149.00	Not Disclosed	TBD

[Advertised Speeds and Pricing from Spectrum's Website]

Taxes and Fees often represent an additional (20%-30%) of Standard Pricing
Shared Network – Speeds are "Up To" and are not guaranteed
Speeds are not Symmetrical
Availability depends upon location – not available in all areas

AT&T Business

AT&T advertises the following DSL business ISP services in Orangeburg:

Speed [Down / Up]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
1.5 Mbps / .3 Mbps	$40.00	$99.00
6 Mbps / .5 Mbps	$40.00	$99.00
100 Mbps / 10 Mbps	$70.00	Included
300 Mbps / 20 Mbps	$90.00	Included
1,000 Mbps / 35 Mbps	$150.00	Included

[Advertised Speeds and Pricing from AT&T's Website]

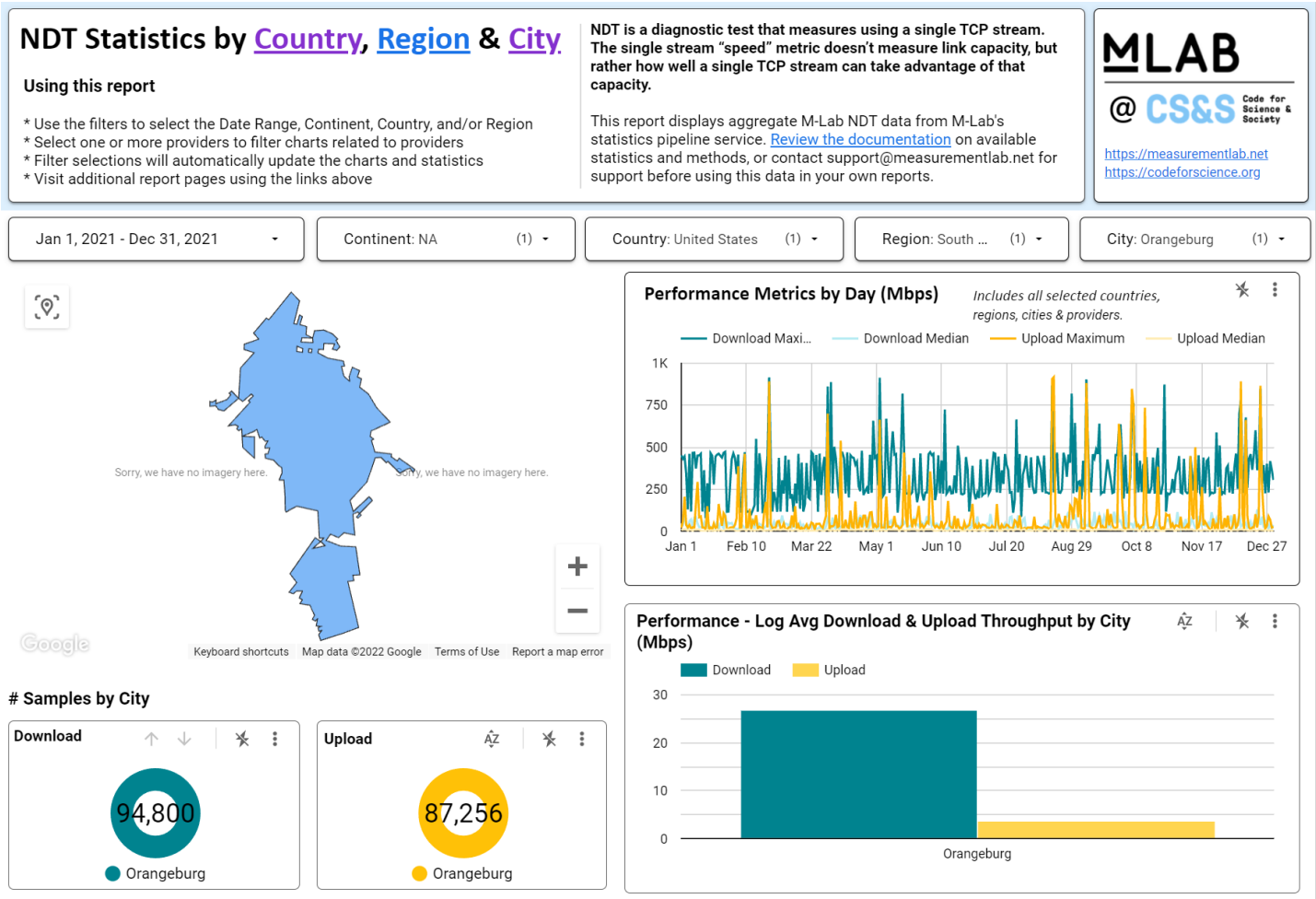
Taxes and Fees often represent an additional (10%-15%) of Standard Pricing
Speeds are not Symmetrical
Availability depends upon location – not available in all areas

[Market Research Conducted in January 2022]

Speed Test Data

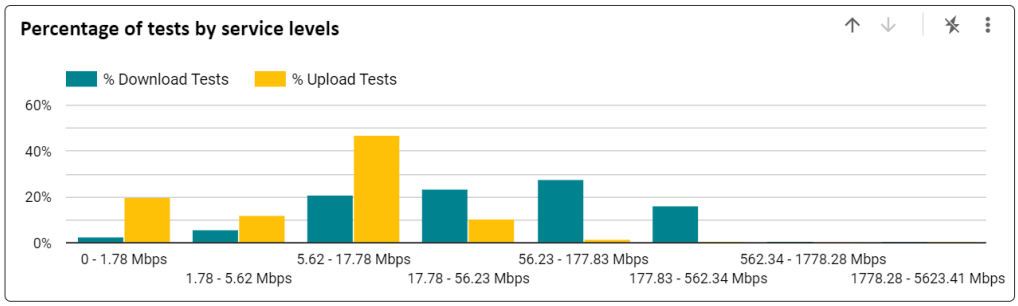
mLABS is an academic group that provides authoritative data from speed tests on a city-by-city basis across the United States. Academic and scientific research organizations rely on mLAB data. Every time an individual runs a speed test through an affiliate of mLABS, the data is saved in Cloud Storage hosted by Google and made available to the public. The data below is the speed test results in the City of Orangeburg from January 1, 2021 to December 31, 2021. The sample size for this 12-month period includes 94,800 speed tests.

The average speed delivered by Spectrum (Charter) in Orangeburg is 63.86 Mbps download / 7.55 Mbps upload. AT&T's average speed in Orangeburg is 9.47 Mbps download / 1.11 Mbps upload.



NDT statistics used in this report are provided as daily histograms, consisting of the percentage of measurements within a range of "service levels" or speed ranges.

The chart on the right presents the histogram of tests that measured at these levels over the selected date range and locations, across all providers.

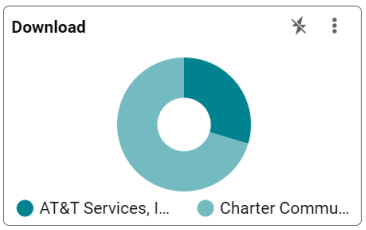


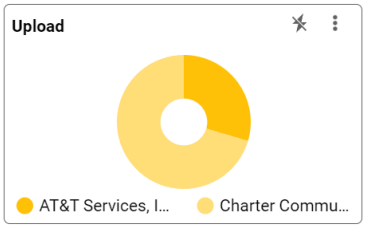
Provider Statistics

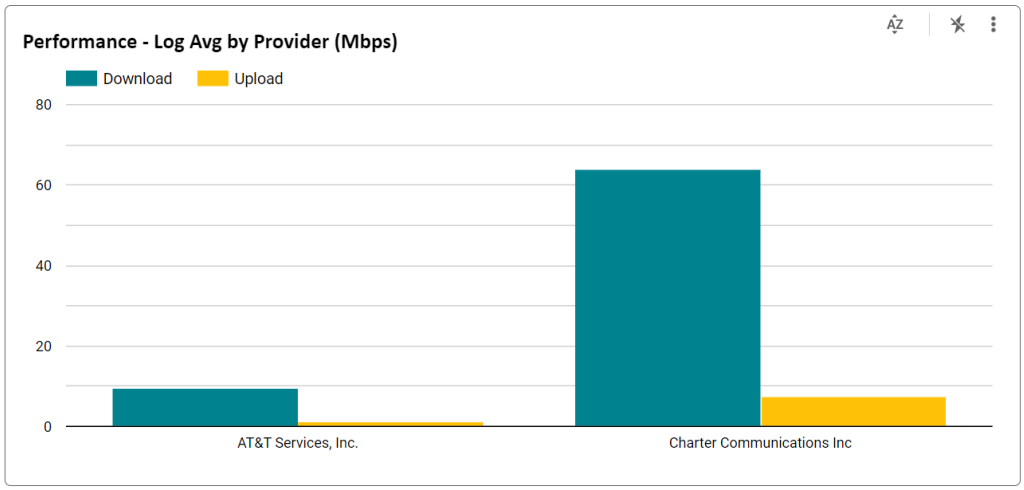
Provider: AT&T Services, Inc., Cha... (2)

In the NDT dataset, each test is associated with the Autonomous System operating the IP address from which each test was conducted. This may be different than the ISP that offers service.

 # Samples by Provider







Market Analysis Conclusion

Spectrum appears to hold the equivalent of an ISP Monopoly in the Orangeburg area.

As of the release of this report, the DPU is just beginning the process of community engagement, which will include a community survey to better understand the consumer's view of the broadband market in Orangeburg. Therefore, the data points used to estimate take rate in this plan are taken from national data in similar markets.

Understanding that the incumbent operators in Orangeburg are Spectrum and AT&T, and that most existing customers are currently paying $70 a month or more for average speeds of approximately 27 megabits per second download and 4 megabits per second upload (See mLAB data above). This demonstrates that achieving an initial take rate of 33% for an exponential service improvement of 20x while reducing the monthly rate by $20 would not pose a challenge. Rather, the challenge lies in communicating the value proposition presented by DPU's broadband offering.

SECTION 4

Technical Details

Comparison of Available Media

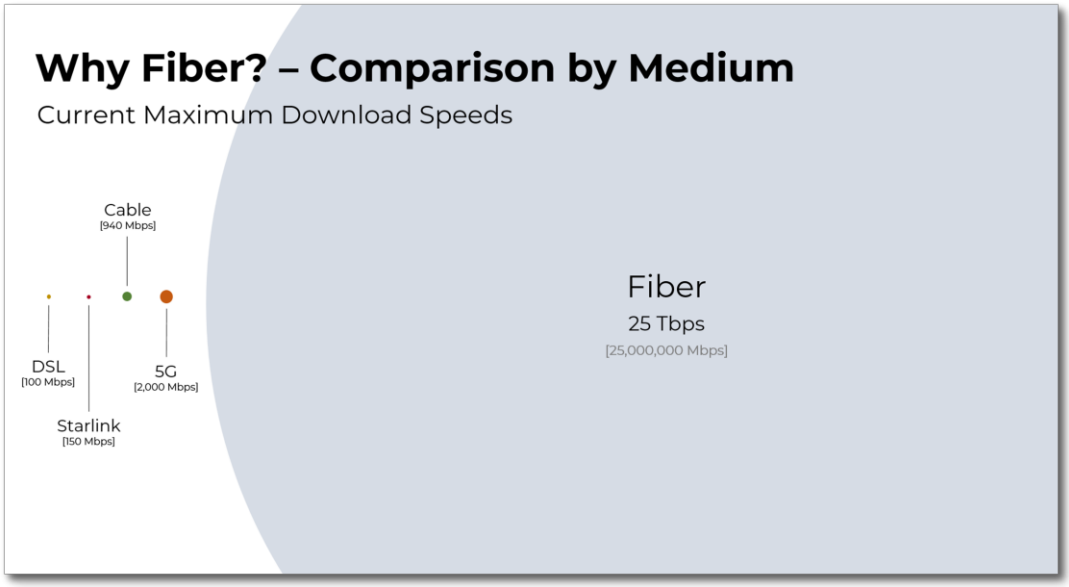
The primary media used for internet access today in the United States includes DSL, Coaxial Cable, Wireless, and Fiber Optic cable.

DSL stands for Digital Subscriber Line, and it is one of the technologies used to provide Internet connectivity to homes and businesses. DSL uses existing telephone lines and a transceiver, or modem to bring a connection into a home or business and allows the household to use the Internet and make telephone calls at the same time. AT&T is the incumbent telephone company in Orangeburg and uses DSL technology. DSL is asymmetrical (the download speed is much faster than the upload speed), is a dedicated connection capable of download speeds up to 100 Mbps depending on the DSL standard, copper line age, and distance. Most consumers accessing the internet via DSL experience speeds between 5 – 25 Mbps. According to mLAB data for Orangeburg County, AT&T's average speed is 9.7 Mbps download and 1.0 Mbps upload.

Coaxial Cable uses copper cable designed with one physical channel that carries the signal surrounded by a layer of insulation and then another physical channel, both running along the same axis – hence the coaxial name. Coaxial cable is primarily used by cable TV companies to connect transmission facilities to customer homes and businesses to deliver cable TV and internet access. Spectrum is the incumbent cable company in the Orangeburg area. Coaxial Cable is asymmetrical and shared between up to 200 customers or more. The most recent cable standard of DOCSIS 4.0 can provide up to 10 Gbps in shared bandwidth depending on supported standards and other environmental factors. The standard currently implemented in Orangeburg is 3.1 and the maximum speed available is 940 Mbps. In addition to the limitation of sharing among a large number of customers, another limitation of coaxial infrastructure is that the signal begins to degrade after 300-400 feet.

Fiber Optic Cable sends information down strands of glass known as optical fibers which are less than the size of a human hair. These fiber optic strands can transmit 25 Tbps today and researchers have successfully demonstrated a transmission experiment over 1045 km with a data-rate of 156 Tbps *(https://phys.org/news/2018-04-fiber transmission.html)*. Fiber-optic cables carry information between two places using optical (light-based) technologies which convert electrical information from the computer into a series of light pulses. Fiber Optic Cable is capable of symmetrical speeds up to 25 Tbps and the signal can travel as far as 60 kilometers without degrading. Fiber optic infrastructure is also less expensive to deploy than any other existing wireline infrastructure.

Because the difference in capacity between fiber optics and alternative media is so significant, fiber optics should be the foundational media for any new broadband infrastructure project when financially feasible.



Wireless Internet access is made possible via radio waves communicated to a person's home computer, laptop, smartphone, or similar mobile device. Wireless Internet can be accessed directly through providers like AT&T Wireless, Verizon Wireless, T-Mobile, or by a Wireless Internet Service provider (WISP).

5G is the 5th generation of technology used in cellular networks and refers to a standard for speed and connection. Because of the extensive marketing around the emergence of 5G, many people wonder whether 5G will replace fiber optic cables. In fact, 5G depends on fiber optic infrastructure. All wireless technologies work better the faster they get back to fiber optics. 5G is not broadcast on a single frequency. There are several frequencies used by 5G networks and these different frequencies have different advantages and disadvantages – depending on the application.

- Low-band 5G operates between 600-850 MHz. This is only moderately faster than 4G with speeds between 50-250 Mbps and offers similar coverage areas for each cell tower.

- Mid-band 5G operates in the 2.5-3.7 GHz range and delivers speeds between 100-900 Mbps. While offering less range per cell tower, this type of 5G is going to be the most common implementation of 5G networks for many years to come. It is a compromise between network speed and range in both medium-density urban areas and less dense rural regions.

- High-band 5G is the band that is most commonly associated with 5G. Operating at 25-39 GHz, this is known as "millimeter wave" spectrum and delivers gigabit speeds (currently tested as high as 3 Gbps). The millimeter wave transmitters have very limited range and requires the deployment of many small transmitters. Each transmitter connects to fiber optics.

  https://www.businessinsider.com/what-frequency-is-5g

Satellite Internet is a wireless internet connection that is available nearly everywhere in the U.S. While it is relatively slow in comparison to cable or fiber optic connections, satellite internet access is faster than some DSL options. This makes it a good option for some rural premises.

Satellite internet speeds range from 1 Mbps – 100 Mbps for download speeds and it is common to have latency and packet loss issues because the signal must travel to space and back. Satellite internet providers include HughesNet, Viasat, and Starlink. These providers DO NOT promote themselves as a solution for suburban or metro areas.

Satellite internet does require special equipment, including a satellite dish that connects to a communication satellite in space.

Wi-Fi is common in homes and commercial buildings and is a way to deliver a network connection from a network hub over a wired connection to wireless devices via a wireless access point. Most people access the internet over a wireless connection, but it is important to remember that wireless connectivity ultimately depends on a wired connection and wireless access works best the faster it gets back to a wire.

Impact of Bandwidth on Applications

Length & Type of Media	Approx Size	10 Mbps	20 Mbps	100 Mbps	1,000 Mbps
4-Minute Song	4 MB	3 sec	1.5 sec	0.3 sec	0.03 sec
5-Minute Song	30 MB	26 sec	13 sec	2.5 sec	0.2 sec
9-Hour Audio Book	110 MB	1.5 min	46 sec	9.2 sec	0.9 sec
45-Minute TV Show	200 MB	3 min	1.5 min	16 sec	1.7 sec
45-Minute HDTV Show	600 MB	8.5 min	4 min	50 sec	5 sec
2-Hour Movie	1.0-1.5 GB	21.5 min	10.5 min	1.5 min	8 sec
2-Hour HD Movie	3.0-4.5 GB	60 min	32 min	4.5 min	25 sec
Large Archive File	10 GB	Too Long	Slow	Better	80 sec

Upload vs Download Speeds

In addition to the fact that fiber optic cable will offer exponentially greater bandwidth than DSL and coaxial cable, fiber optic cable also offers the ability to deliver symmetrical speeds. In an asymmetrical connection, the download speeds are much faster than upload speeds.

Upload speed is the amount of data a person can ***send*** in one second and download speed is the amount of data a person can ***receive*** in one second. Upload speeds can be especially important for businesses, including home-based businesses or people who work from home. Applications that depend on good upload speeds include sending large files, cloud applications like Google Docs, Dropbox, VoIP, FaceTime, Skype, Zoom, WebEx, hard drive backups and In-house web hosting.

Network Architecture

The two main network designs are Switched (Active) Ethernet and Passive Optical Networks (PON). The key difference between these two models is that PON is a shared infrastructure (32, 64, or 128 neighbors share a connection) and Ethernet gives subscribers their own connection.

Switched Ethernet Network

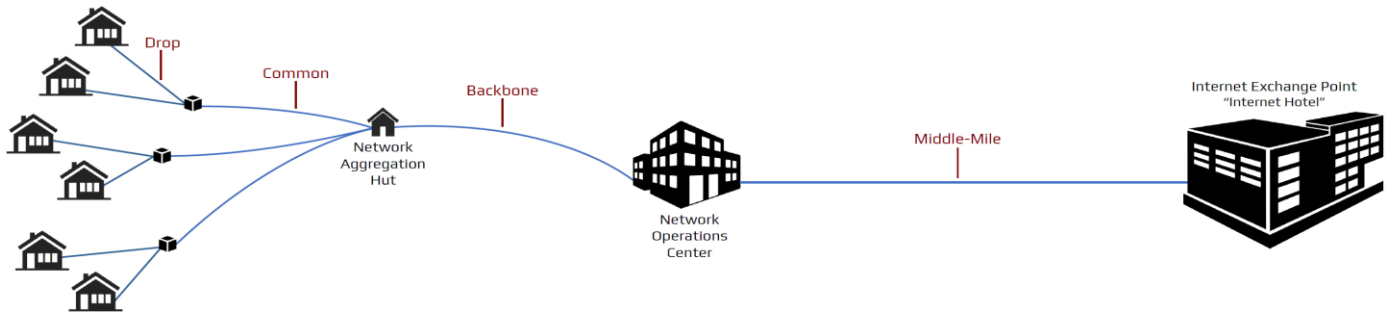
The Switched Ethernet architecture provides a dedicated connection for each customer rather than a shared connection and the customer experience is significantly better than in a shared architecture during periods of network congestion because the throughput of a switch-based architecture is superior to a shared architecture during times of network congestion.

Passive Optical Network (PON)

Passive Optical Networks (PON) make use of Time Division Multiplexing (TDM) technologies to create a Bus or shared architecture with performance very similar to coaxial cable installations. In a PON network, splitters are placed in the field and a single fiber connection is shared between 32, 64, or 128 premises. This shared architecture may result in packet loss during periods of peak usage. Additionally, upgrading individual connections relies on complicated vendor specific solutions if possible. It can also be more difficult to isolate and troubleshoot faults in a PON network because of the topology. PON equipment suppliers also use proprietary management platforms to establish long term vendor lock-in.

Proponents of PON Architecture will argue that PON is less expensive than an ethernet design. That was true historically. The illustration below shows that the variable costs of a switched ethernet deployment is now equal to PON. This change in pricing differences was driven by the fact that all Data Center deployments use Switched Ethernet architectures and the enormous growth of Data Centers over the past 20 years has driven down the cost of Ethernet electronics.

Network Segments – Definitions & Costs Allocations



Drop = The Drop is the fiber that runs from the street to the premise (home or business).

Common = The Common is the shared fiber infrastructure in a neighborhood that runs from a Drop to the closest Aggregation Hut.

Backbone = The Backbone fiber runs from an Aggregation Hut back to the Network Operations Center.

Middle-Mile = The Middle Mile is usually 3rd-Party fiber that runs from the Network Operations Center to the closest Internet Exchange Point. The cost of the Middle-Mile is included in the Monthly Maintenance and Operations (M&O) Utility Fee and is borne by all network subscribers.

Municipal Network Models

Municipal Broadband Models Comparison

To compare the various models that exist in the United States today, the following model variables are important to understand:

Broadband Network Models

- Privately Owned & Privately Operated
- Publicly Owned & Privately Operated
- Publicly Owned & Publicly Operated

Access

- Closed Networks (Single ISP)
- Open Access Networks (Multiple ISPs)
  - Dark
  - Lit Manual
  - Lit Automated

A mix of prominent municipal fiber optic projects were selected to illustrate the types of models that have been deployed. The following comparison summarizes different approaches to funding and operating municipal broadband infrastructure and services followed by a description of the advantages and disadvantages of each:

Municipality	Population	Model Type	Open vs. Closed	Dark vs. Lit	Manual vs. Automated	Take-Rate	Cost of 1 Gig
Chattanooga, TN	179,139	Electrical Utility ISP	Closed	Lit	N/A	60%	$68.00
Lafayette, LA	126,000	Electrical Utility ISP	Closed	Lit	N/A	40%	$99.95
Westminster, MD	19,000	City Fiber, Private ISP	Closed	Lit	N/A	20%	$89.99
Huntsville, AL	194,585	Dark Fiber Open Access	Closed	Dark	N/A	Not Published	$70.00
Sandy, OR	10,000	Municipal ISP	Closed	Lit	N/A	60%	$59.95
Longmont, CO	86,000	Electrical Utility ISP	Closed	Lit	N/A	55%	$69.95
Ammon, ID	17,000	Automated Open Access	Open	Lit	Automated	65%	$47.50
Monmouth, OR	15,083	Municipal ISP	Closed	Lit	N/A	80%	$129.65
Lexington, KY	321,959	Private Partner Owned	Closed	Lit	N/A	Not Published	$59.95
Santa Monica, CA	110,000	Dark Fiber Business Only	Closed	Lit	N/A	N/A	N/A
Fort Collins, CO	165,000	Electrical Utility ISP	Closed	Lit	N/A	Early Stage	$59.95
UTOPIA	150,000+	Manual Open Access	Open	Lit	Manual	15%	$70.00

Ownership Considerations

Privately Owned & Privately Operated

A private owner designs, builds and operates a network. The private builder and operator assumes all the risk and does the work of overseeing design, project management, construction, customer acquisition and operations.

This model leaves the community vulnerable to the private owner operating as a monopoly or selling the network to a monopoly operator. A national or regional private operator reduces the ability of the subscriber to influence the policies, practices, and pricing of the operator. Historically, private owners have not demonstrated a willingness or ability to solve the digital divide.

Publicly Owned & Privately Operated

A City, Town, or County owns the network and utilizes a 3rd party operator to maintain and operate the network. The primary value of publicly owned infrastructure is that the network will not be under the control of an unregulated monopoly that is not accountable or vulnerable to an election cycle where subscribers are empowered to influence outcomes. A private operator may be more expensive for subscribers due to the additional cost for profit. However, this depends on variables like efficiency, the cost of employee benefits, and the percentage the operator takes for profits. Public owners have greater incentives to solve the digital divide.

With fiber optics, only one infrastructure is necessary. Redundant sets of fiber optic infrastructure will increase the cost for subscribers.

Publicly Owned & Publicly Operated

A City, Town, or County owns and operates the network. This model protects the community from a private owner operating as an unregulated monopoly or selling the network to a monopoly operator. It also makes the network operator accountable to subscribers via an election cycle where subscribers are empowered to influence outcomes. Public owners have greater incentives to solve the digital divide.

Access Model Considerations (Single ISP vs Open Access)

Single ISP - Closed Access

This model mainly provides advantages for the ISP. A single ISP does not expand choice or competition and is likely to be more expensive for subscribers than an open access model.

Dark Fiber - Open Access

Dark Fiber Open Access is a model where infrastructure is built to the curb and the subscriber then selects an ISP as its provider. The ISP finishes the connection to the home with its own infrastructure and electronics. Operating a dark fiber network is less complicated than operating a lit network and the Dark Fiber model also enables public ownership of infrastructure. While the Dark Fiber model increases choice for consumers, the downside is that the subscriber and operator give up control over last mile infrastructure via giving up control over the drop from the curb to the premise. The Dark Fiber model therefore limits the usability of each strand of fiber. With an isolated dark fiber connection, it is impossible to connect to other services that may be available through other service providers other than services running across the internet. The Dark Fiber

Model also does not scale efficiently due to difficulty in anticipating the required fiber count to meet the demand. This can create significant complications for the network operator.

Lit Fiber - Manual Open Access

Lit Fiber - Manual Open Access is a model where the network is lit end to end. This means the network operator places and controls the electronics at both ends of the network. Switching service providers can be requested from a web portal and may appear to be automated but the network provisioning is done manually. A manual Open Access network increases choice for consumers. However, it does not necessarily produce the desired effects of competition if the business model presents barriers to competition. Operating a Manual Open Access network is more complex than operating other models because of the requirement for human management of network tasks and any increase in the number of service providers operating on the network adds to network complexity.

Lit Fiber - Automated Open Access

Automated Open Access is a model where the network operator places electronics at both ends of the network and subscribers can dynamically select service providers in real-time. Software Defined Networking is used to automate various network management tasks. In this model, multiple service providers can deliver services simultaneously and independently across a single wire. When a subscriber selects a new service provider, the provisioning is done using automation and therefore happens on-demand. The automated provisioning creates a marketplace for services which includes ISP's and private networks for other services. The ability to switch service providers on demand increases choice and competition. This network model also includes the ability to provide local network resilience via local communications if connections over the middle mile are down.

Disclosure: EntryPoint Networks owns and operates a SaaS model Automated Open Access solution and is the technology solution provider in these networks.

Risk Assessment

Strategy Statement

The Fiber Utility seeks to understand the primary risks of building and operating a municipal fiber optic network and to actively manage those risks during construction and then on an ongoing basis during network operations.

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Risk Factors >

Likelihood
Impact
Mitigation

The following is an analysis of the main risk factors facing the Fiber Utility of Orangeburg as it pursues its fiber-to-the-premise deployment. Ten Risk Factors are analyzed:

1. Subscriber Churn Risk
2. Take-Rate Risk
3. Project Execution Risk
4. Equipment and Technology Risk
5. Community Engagement Risk
6. Cost Modeling Risk
7. Timeline Risk
8. Regulatory Risk
9. Middle Mile Risk
10. Pole Attachment & Make-Ready Risk

Subscriber Churn

Subscriber Churn is the risk that customers sign up and then do not remain subscribers to the network.

Likelihood: Today customers are primarily driven by cost, speed, and customer service. Churn is possible and is a consequence of the customers pursuing an option to get better value from an alternative solution. The likelihood of churn is high if a new market solution simply replicates the incumbent model. The likelihood of churn goes down under a Business Model where 1) the customer is financially responsible for the drop to their property and 2) where the value proposition is strong enough to make the customer voluntarily committed to the network.

Impact: The impact of churn on the network is potentially catastrophic if it reaches a level where the capital and operational cost of the abandoned infrastructure cannot reasonably be shared by remaining subscribers.

Mitigation: Churn can be mitigated by implementing a business model that makes customers voluntarily committed to the network and by assigning financial responsibility to customers for their lateral connection.

Take-Rate Risk

Take-rate risk (Demand Risk) is the risk that the Fiber Utility builds out the network and ends up with a take-rate that is lower than expected.

Likelihood: Take-rate risk is possible and is a function of the value proposition of the network and how well that value proposition gets communicated and managed before construction starts. High take-rates lead to lower network costs for subscribers. This creates a virtuous cycle where lower costs lead to higher take rates. The reverse is also true.

Impact: The worst-case scenario is one where lower take rates lead to higher costs and churn which create a death spiral that negatively compounds until the network is not sustainable.

Mitigation: Manage demand aggregation before construction begins and give consumers a value proposition that makes them voluntarily committed to the network infrastructure.

Project Execution Risk

Project Execution includes strategy, planning, project management and fulfillment of the project plan and operational execution.

Likelihood: Project execution failure is possible and is a function of the effectiveness of project planning, management, controls, and execution.

Impact: The severity of impact is in proportion to the effectiveness of project management and execution. A worst-case scenario is one where project execution affects the value proposition, which in turn affects take-rate and churn.

Mitigation: Hire or partner with skilled project managers and key strategic partners. Create alignment among key team members on the project plan and operational plan. Develop project controls that are monitored and reported to senior leadership monthly.

Equipment & Technology Risk

Equipment & Technology Risk includes both software and hardware solutions and is the risk that equipment failure rates are higher than expected, major software bugs are unresolved, operational reliability is lower than expected, and/or that the technology lifecycle leads to faster obsolescence than is expected. For a network, the size of Orangeburg, an additional risk is scalability risk.

Likelihood: Solutions with short deployment histories, unreliable references, unclear quality control and test procedures, weak professional teams, and poorly architected scalability abstractions present increased equipment and technology risk.

Impact: The impact of this risk category is moderate because it is possible to vet both software and hardware systems to assess this risk. The base technology of the network will be fiber optic cable and that has sufficient history to present a minor risk to the project. Remaining risks include electronics and software systems.

Mitigation: Implement thorough due diligence processes with trained professionals to scrutinize references, architecture, software abstractions, quality control systems and the professional histories of vendors being considered.

Community Engagement

Community Engagement is the marketing, education and communication processes and strategies used to inform residents and businesses about the value proposition offered by the network.

Likelihood: Community Engagement risk is possible but nonetheless a risk that can be managed and monitored. Poor planning, management and execution increases the level of risk. Community engagement can be handled by internal Fiber Utility staff. However, risk increases if staff member resources are inadequate for a project of this size. There is an abundant supply of marketing professionals available to assist with community engagement processes.

Impact: Community engagement is a key driver of project success due to the relationship between community engagement and take-rate.

Mitigation: Leverage the skills of competent marketing professionals and provide sufficient resources to make it easy for every resident to learn the basic value proposition for the network in comparison to alternatives through a variety of marketing, education, and communication strategies.

Cost Modeling Risk

Cost Modeling Risk is the risk that cost modeling significantly underestimates actual design, construction, and/or operational costs.

Likelihood: There is enough industry data to reasonably validate cost estimates. However, there is significant market volatility currently due to supply chain disruptions.

Impact: Cost overruns can have a moderate to disastrous impact on network sustainability.

Mitigation: Validate financial assumptions against industry assumptions, market conditions, and account for local economic variables.

Timeline Risk

The benefits of building the network in an accelerated pace include the following:

1) Each phase requires legal, financing and accounting transaction costs. Building the network with fewer phases will lower the overall transaction costs for the project.

2) Building at a faster pace will result in an accelerated period to break-even.
3) Interest Rates are at an unprecedented low currently and building over an extended period may expose later project years to some interest rate risk.

Likelihood: Costs are certain to be higher for an extended buildout period. However, there may be execution risk exposure for accelerating the buildout, depending on the experience and capacity of the construction partner. These trade-offs need to be weighed by City leaders.

Impact: Costs will be incrementally higher for an extended build-out schedule and M&O will have a longer ramp to sustainability.

Mitigation: The Fiber Utility can control the buildout schedule following a cost / benefit analysis of the options. An important consideration is alignment with construction partners. If the Fiber Utility is going to outsource construction, it should consult with potential construction partners about the alternative construction schedules to make sure that the Fiber Utility's strategy is amenable to key construction partners.

Regulatory Risk

Regulatory Risk is the risk that State or Federal regulations become an impediment or barrier to the Fiber Utility successfully building or operating a municipal network. The Orangeburg Fiber Utility Attorney should prepare a separate analysis describing the Fiber Utility's legal authority to build, own, and operate broadband infrastructure as well as information on the legal structures that are available in the State of South Carolina to house the operation. EntryPoint has not sought a legal opinion on this, nor do we have an attorney on staff.

Likelihood: Historically, incumbent operators have taken legal action to stop several municipalities from building a competing network whenever they have a legal basis for doing so. Other cities and utilities have built this infrastructure in South Carolina, but legal guidance is needed to understand any legal constraints.

Impact: If a claim were to be brought against Orangeburg, it could take an extensive amount of time and cost to contest or appeal the claim – but this is unlikely.

Mitigation: It is necessary for Fiber Utility Attorney's to summarize their findings under South Carolina law in a legal memo to be included with this Plan.

Middle Mile Risks

Middle Mile risks include the following:

1) Lack of redundant options on divergent paths
2) Pricing risk
3) The risk of being stranded or isolated without a viable path to an internet exchange point

Likelihood: Orangeburg will likely have multiple middle mile paths back to an Internet Exchange point in Atlanta or Charlotte.

Impact: Each of the Middle Mile Risks listed above could have a significant impact on network success but all of them have a low likelihood of occurring because of Orangeburg's location.

Mitigation: The way the Fiber Utility can mitigate and possibly eliminate Middle Mile Risk is by building in redundancy to the network by having multiple backhaul providers along independent paths back to an internet exchange point.

Pole Attachment & Make Ready Risk

This is the risk that pole owners cause unexpected and significant impact on costs or timeline due to delays in make ready and pole attachment work.

Likelihood: Because Orangeburg owns the utility poles in its service area, this risk is non-existent. There may be some poles that need replacement or repair, but a partnership with an Orangeburg Fiber Utility is an ideal scenario because this risk is eliminated.

Impact: Make Ready work for Pole Attachment can have a meaningful impact on costs and timeline if the pole owners are non-responsive or want the Fiber Utility to replace old poles.

Mitigation: The Fiber Utility is in an ideal position for pole attachment. However, a buried network has many long-term maintenance advantages and should be considered.

Community Engagement

The following is a summary of a variety of Community Engagement tools available to an Orangeburg Fiber Utility. Community Engagement is the most important component of any fiber construction project because feasibility is a function of take rate and take rate is a function of creating value and communicating that value to the members of the community.

Evaluation & Education

Document the current state of broadband and determine the level of interest among residential users and business owners.

Community Survey

A survey for residents and business owners was conducted to determine the level of interest in a municipal fiber network. Education and promotion programs should be influenced by ongoing survey engagement and response.

Publish Educational Information

Leverage website content specific to the municipal fiber program to outline the core message of broadband as a utility lower cost, increase choice and subscriber control, and foster digital inclusion. Use customized videos to educate online visitors on the following:

a. Functionality of the community fiber network
b. Options for services
c. Frequently Asked Questions (FAQ's)

Mapping Community Interest

Distribute an "I am interested" sign-up form with associated heat map where residential and business property owners can register as someone interested in municipal fiber.

Marketing & Promotion

Utilize Press Releases and utility bill inserts to promote the municipal fiber program, driving traffic to the fiber website with the goal of educating community members and generating interest and encouraging community participation.

Use all available social media platforms (Facebook, Instagram, Twitter, etc.) to promote the fiber network.

Neighborhood Entrance and Yard Signs

As construction (fiber build) begins in a neighborhood, Orangeburg can post signs at neighborhood entrances announcing the construction and letting residents know they can still sign-up to get connected while crews are in the neighborhood.

As homes are connected in the neighborhood, yard signs are placed in the yards of subscribers indicating that the home now enjoys a fiber broadband connection.

Grassroots Engagement

Webinars & Open House Events

Orangeburg can use Webinars and Open House events to educate residents and business owners about the fiber project, ask questions, become educated about the business model, infrastructure, and costs.

Webinars and Open Houses are promoted using utility bill inserts, press releases, public service announcements, local news reports, Fiber Utility websites, social media platforms, etc.

Webinars and Open House events are intended to educate residents, promote the network, and identify Fiber Champions in the various neighborhoods (fiber zones).

Fiber Champions

Fiber Champions are individuals that demonstrate a voluntary commitment to promoting the network within their neighborhood. Fiber Champions may be incentivized by a practice of building to those neighborhoods that have the highest level of engagement or demand first (initial fiber zones are connected in order of take-rates – highest to lowest). Fiber Champions assist sign-up efforts within their designated neighborhood (fiber zone). They organize and lead neighborhood meetings where neighbors can learn about the Orangeburg fiber program. Orangeburg leaders and employees provide support to the Fiber Champions in their efforts. Fiber Champions drive conversations and contractual commitments of neighbors via the Door-to-Door Sales and Education campaign.

Door-to-Door Campaign

Individuals (possibly college students from CSU, Orangeburg) representing the network contact residents and business operators within the planned footprint to answer questions and ascertain the potential subscribers' interest for participating. [Yes (Opt-in) or No (Opt-out)].

This direct person-to-person contact gives everyone in the community an opportunity to ask questions, clarify understanding, and express a level of interest in participating.

To maximize the effectiveness of this process, door hangers are distributed to every home and business prior to canvassing a neighborhood. These inform property owners that a representative will be stopping by to explain the value proposition, answer questions, and determine the level of interest from potential subscribers.

Door-to-Door Campaigns are very effective in giving people an opportunity to learn and ask questions in a one-on-one interaction.

It is important to support this effort with public notifications, press releases, mass emails, websites, social media sites, mobile applications, and other community outreach venues. This may include outside professional marketing and/or PR firms.

Commissions for a Door-to-Door campaign can be funded by a sign-up fee or wrapped into the infrastructure installation cost.

Community Resources

A citywide broadband project creates an opportunity to collaborate with business students and faculty at university students and college. University students can be effective representatives for an Orangeburg Network and gain real world marketing and business experience.

Case Study – Newberry, SC Fiber

The City of Newberry has completed construction on a fiber network to its 4,200 residential and commercial customers currently connected to its municipal electric utility. The project took 14 months to complete and is primarily an aerial deployment – leveraging the utility's power poles.

Newberry Open Access

The Newberry fiber network is a Dark Fiber Open Access system, meaning multiple ISPs are allowed to deliver their services across the network but it is unlikely that another ISP will ever join the network because of the onerous list of requirements to join the network, including an upfront $50,000 fee to initiate the process. Additionally, ISPs are required to offer telephone, internet, and television, must be licensed to provide telephone in South Carolina, be headquartered in the state, and have not filed bankruptcy in the last 10 years. The reason for these steep requirements is that they didn't want "two guys in their mom's garage to start providing Internet service to our customers and then be gone after six months. We did that mostly to protect our customer base."

Newberry partnered with WC Fiber, an ILEC ISP in South Carolina. Newberry contributed approximately $5.6 million to the network to build out the network backbone – passing every customer. The city utility maintains that backbone and receives $10 per customer per month in return. WC Fiber then provides the drop to each subscribing customer and provides the premise equipment and core network equipment. Currently, the network has close to a 25% take rate or around 1,500 subscribers connected at this point.

Comparison to Proposed Orangeburg Network

Orangeburg DPU has a much larger footprint than Newberry, with close to 26,000 residential and commercial customers. Orangeburg plans to build and own its entire network all the way to the customer premise equipment.

Orangeburg Open Access

The Open Access system proposed for Orangeburg will actively encourage ISPs to join. There will be a very nominal fee (around $50 per month) to offer services across the network and the system seeks to lower the barriers to entry rather than making it difficult to join. The reasoning for this is that Orangeburg actively encourages competition to drive the cost of ISP services down to make access affordable. Additionally, if an ISP provides poor or unreliable service, users will be able to switch their ISP in less than 60 seconds via a web portal, without making a phone call or having a repair person come to the home.

Orangeburg seeks to own the network because the city now views this infrastructure as essential infrastructure, similar in importance to the electrical grid offered by the city.

Key differences and similarities between these two networks include the following:

Quick View Comparison

Category	City of Newberry	City of Orangeburg
Cost for Gig Service	$80 per month	$50 per month (Projected)
Shared vs Not Shared	Shared Connection	Not Shared (Dedicated to each home)
Number of Customers	5,000	26,000
Electric Utility	Yes	Yes
Network Ownership	Partial	Yes
Control	WC Fiber owns the drop	Orangeburg – total ownership
Investment	$1,000 per home	$2,000 - $3,000 per home
Take Rate	25%	TBD
Connected Customers	1,500	TBD
Open Access	In Name Only	Yes

SECTION 5

Recommended Initial Project

Recommended Initial Project

Background

The economics associated with a successful initial implementation are complicated. Numerous factors such as scale, take rate, capital recovery, operational costs, and service costs will all influence success. In recommending an initial project or investment, scale and take rate will prove to be the two most important factors for success.

Scale is critical because while the initial risk can be reduced by minimizing the scale of the project, there are inherent scale benefits associated with fiber to the home infrastructures. This is true for the capital costs because there are capital costs that can be shared among all connected addresses. Many of these costs are somewhat fixed and do not increase with the addition of more subscribers thereby providing individual cost improvements as the scale increases. These same conditions apply to the maintenance and operational costs. While increasing the number of subscribers will increase overall or total costs, there is not a fixed rate of increase for each additional subscriber. Rather, there is a reduction in individual costs as more subscribers are added. For this reason, while a smaller scale is desirable to manage initial investment risk, the proper scale of the initial investment should be identified and selected based on the best economy of scale achievable within the acceptable risk, or available funding.

Take rate refers to the percentage of properties that connect to the fiber system and pay a monthly fee in comparison to the total number that the infrastructure passes and have the option of connecting. This factor has the greatest impact on the monthly capital recovery fee charged to subscribers. To understand the impact of take rate on costs consider that the feasibility modeling for Orangeburg identified approximately 4,900 demand points, or properties, that would potentially require a fiber drop or connection. The estimate to construct a fiber optic infrastructure to every address in the design, which would be a take rate of 100%, is $9,642,766. Dividing this total project cost by the number of subscribers leads to a cost per subscriber of $1,964. Reducing the take rate to 50% or connecting only half of the properties passed with fiber, will also reduce the overall project cost to $7,483,443. While the total project cost is reduced, the individual costs, or cost per subscriber increase as the common or shared costs are now distributed among 2,450 subscribers compared to the 4,900 that have been passed. This leads to a cost per subscriber of $3,047 at a 50% take rate. Costs will continue to rise for subscribers as the take rate declines. A 30% take rate is commonly used as the industry baseline for a new infrastructure entrant into the market. A take rate of 30% in Orangeburg will result in a subscriber cost of $4,392 for the installation.

Because these individual costs change based on take rate, estimating an accurate estimated take rate using market research is critical for success. Since these two key aspects of scale and take rate are directly connected, this process of determining how to best balance these aspects as a part of establishing a recommended initial project is a circular or iterative process as changing the take rate raises or lowers the monthly cost which in turn raise or lower the take rate, which in turn raises or lowers the monthly cost again, and so forth. Using market research combined with this iterative process a balance must be struck between these economic factors that will most effectively achieve the desired outcome. For this reason, the purpose of this section is to recommend an initial project rather than present a comprehensive consideration of all the

granular details that would drive the strategy. Instead, this section of the plan will focus on the specific details for a recommended initial project that would be expected to provide the best outcome for both the Orangeburg DPU and those they serve.

Initial Investment and Scale

A recommended initial capital investment based on the feasibility design performed for the DPU and area market research is $7 million. This amount represents the recommended amount of funding to achieve the strongest outcomes. Specific financial details for an initial DPU project based on such an investment are set forth in the table below:

DESCRIPTION	DETAIL
Initial Capital Investment	$7,000,000
Number of Properties Passed	4,909
Estimated Construction Cost	$6,749,507
Estimated Monthly Residential Utility Rate	$40
Minimum Take Rate for Sustainability	33%
Anticipated 33% Take Rate Achieved at	Year 3
Annual Bond Payment based on 20 YRS @ 3%	$470,510
Annual Capital Recovery Amount at Year 3	$485,100
Capital Recovery Surplus for Year 3	+$14,590

Seven million dollars is recommended for an initial investment to fund the $6.75 million dollar capital investment to construct the fiber optic infrastructure which is projected to connect 33% of the properties passed based on the $40 per month residential utility fee. A smaller investment could be made, but proforma modeling indicates that any scale smaller than $7 million will result in monthly residential utility rates of $42 which could potentially have a negative impact on the projected take rate, which would raise the rate even more. A breakdown for the targeted monthly residential rate of $40 is set forth in the table below:

AMOUNT	DESCRIPTION
$20.00	Capital Recovery
$5.00	Reserve Fund (starts Year 6 after 33% take rate is achieved)
$5.00	Operations (Open Access Software Platform and TIER 2 Customer Support)
$10.00	Infrastructure Maintenance (Fiber Cable and Plant Equipment)
$10.00	Internet Service Provider (ISP) for 1,000 x 1,000 Mbps
$50.00	**GRAND TOTAL**

Projected Balance Sheets

Fiber fund balance for the first 10 years of operation is modeled in the table below based on bond rates of 3% over 20 years. The model assumes construction will be complete at some point in year 3 and that only the bond or loan amount will be drawn incrementally as needed to accommodate the construction schedule, rather than drawing the full bond amount initially and necessitating a full bond payment of over $470,000. Key inputs that inform this balance sheet include:

- Immediate 33% take rate for constructed areas
- Construction complete in year 3
- Take rate growth to 50% by year 5
- No reserve funding until year 6 ($5 reserve funding used for Capital Recovery until year 6)
- Costs to add subscribers in years 4 and 5 are accounted for in the balance

These projected inputs would result in the following proforma ten-year balance sheet for the capital recovery portion of the fund:

PROFORMA BALANCE SHEET						
YEAR	PAYMENT	SUBSCRIBERS	TAKE RATE	REVENUE	DIFFERENCE	BALANCE
1	$155,268	540	11%	$161,997	$6,729	$257,221
2	$310,537	1,080	22%	$323,994	$13,457	$270,679
3	$470,510	1,620	33%	$485,991	$15,481	$286,160
4	$470,510	1,964	40%	$589,080	$118,570	$102,238
5	$470,510	2,209	45%	$662,715	$192,205	$78,378
6	$470,510	2,455	50%	$589,080	$118,570	$196,948
7	$470,510	2,455	50%	$589,080	$118,570	$315,518
8	$470,510	2,455	50%	$589,080	$118,570	$434,088
9	$470,510	2,455	50%	$589,080	$118,570	$552,658
10	$470,510	2,455	50%	$589,080	$118,570	$671,228

The reserve fund would start to build in year 6 with a total expected annual revenue of $147,270 based on the projected $5 per month fee and a 50% take rate, which would result in an ending balance of $736,350 in year 10 if no draws were required from the reserve fund. However, it is expected that some minimal equipment replacement will be required starting in year 6. Additionally, replacement demands should be expected to increase to a range of 10 to 15% annually as a part of operational support. The following reserve fund proforma balance sheet includes these factors in the modeling.

YEAR	REVENUE	EXPENSES	BALANCE
6	$147,270	$36,825	$110,445
7	$147,270	$73,650	$184,065
8	$147,270	$110,475	$220,860
9	$147,270	$110,475	$257,655
10	$147,270	$110,475	$294,450

The $10 monthly fee to maintain the infrastructure would result in the following annual revenue amounts and balances if regular maintenance will require no more than two Full Time Employees (FTEs) on average. The modeling includes two vehicles, a splice trailer, locating equipment, and some expenses for facilities, supplies and consumables, based on a 5-year replacement plan for the equipment.

YEAR	REVENUE	EXPENSES	BALANCE
1	$64,799	$0	$64,799
2	$129,598	$60,000	$134,396
3	$194,396	$130,000	$198,793
4	$235,632	$200,000	$234,425
5	$265,086	$230,000	$269,511
6	$294,540	$260,000	$304,051
7	$294,540	$288,500	$310,091
8	$294,540	$288,500	$316,131
9	$294,540	$288,500	$322,171
10	$294,540	$288,500	$328,211

Combining all these projections into a balance sheet that represents the fund total results in a projected balance of $1,293,889 at the end of year 10. Years 4 and 5 show some decrease in fund balance based on projected take rate increases which will require the utility to fund a projected 344 drop connections in year 4 and 245 additional connections in years 5 and 6.

TOTAL FUND BALANCE				
YEAR	CAPITAL	RESERVE	STAFF	TOTAL
1	$257,221	$0	$64,799	$322,020
2	$270,679	$0	$134,396	$405,075
3	$286,160	$0	$198,793	$484,953
4	$102,238	$0	$234,425	$336,663
5	$78,378	$0	$269,511	$347,889
6	$196,948	$110,445	$304,051	$611,444
7	$315,518	$184,065	$310,091	$809,674
8	$434,088	$220,860	$316,131	$971,079
9	$552,658	$257,655	$322,171	$1,132,484
10	$671,228	$294,450	$328,211	$1,293,889

Key aspects to achieving these target balances include:

- Being able to incrementally borrow only what is necessary for construction the first three years.
- Establishing a community engagement effort that includes the ability for property owners to 'sign up' for an installation to support construction in areas with 30% or higher take rates.
- Establishing the that the projected bond rates or better are obtainable.

Project Details

The project itself would pass some 4,909 properties with fiber optic infrastructure. The table below shows projected passings and take rates by year through year 6.

YEAR	PASSINGS	SUBSCRIBERS	TAKE RATE
1	1,620	540	11%
2	3,240	1,080	22%
3	4,909	1,620	33%
4	4,909	1,964	40%
5	4,909	2,209	45%
6	4,909	2,455	50%

The feasibility level design for this project requires the installation of three fiber aggregation huts, 201 fiber optic splice enclosures, 1,514 six port Multi Service Terminals, 342,666 feet of aerial cable, 103,323 feet if underground cable, and 848 underground vaults of various sizes. The total cost for this installation is estimated at $6,749,507 with an expected construction schedule of three (3) years.

The architecture used in the design is Ethernet. Ethernet was selected over other architectures such as Passive Optical Network (PON) technologies because of Ethernet's native ability to support unique subscriber connections compared to having multiple subscribers share a single port. This architecture provides better performance, allows for individual subscriber upgrades, and can support multi-tenant environments as an 'automated open access' system. Open Access operation 'unbundles' or separates the underlying infrastructure from the services by allowing multiple service providers to offer services across the same infrastructure. This model allows DPU to own the infrastructure separate from the services which are owned and operated by the service providers. This results in true competition for services and improved subscriber costs.

The feasibility level design performed by Biarri Networks made use of Geospatial Information Systems (GIS) data and software algorithms to achieve maximum design efficiency. Design estimates are expected to be accurate within plus or minus 10%. A concerted data correction effort to refine and confirm the data inputs of the design would be the next step in the design process. This would move the design from feasibility to high level. The resulting high-level design will then need to be aligned with field conditions to verify the constructability of the high-level design. Any necessary adjustments will be added to the data inputs resulting in a constructable low level design with maximum efficiency. From this low-level design, any required construction drawings and splicing artifacts will be created. Cost to perform these design operations are included in the project budget.

Recommended Next Steps for an Initial Project

- Fund a small demonstration project in partnership with the local higher education facilities? (150K)
- Continue the community engagement process, including local surveys and initial sign-up options
- Coordinate a middle mile solution with State Broadband Office and C-Light
- Release an RFI using the feasibility design data to better inform the cost model
- Fund high level design to better inform the cost model

SECTION 6

Next Steps

Summary of Next Steps

Legal

Have the Orangeburg Fiber Utility legal counsel draft a legal memo summarizing the authority granted to a fiber utility under South Carolina statute to finance, own and operate broadband infrastructure.

Explore and understand the legal structures available to fund the infrastructure under state statute?

> Utility
> Municipal corporation
> Municipal utility district
> Public utility district
> Other

Financing

Refine strategy for financing for Initial and subsequent phases of the project.
Identify funding source for Initial Project.
Pursue state and federal grant opportunities.

Business Model

Conduct public process (Request for Proposal (RFP), Request for Information (RFI), or Request for Qualifications to select Open Access Partner. This partner will also assist with project oversight, including design, quality control on construction, and oversee provisioning and turn-up of electronics.

Design / Engineering

Conduct public process Request for Proposal (RFP), Request for Information (RFI), or Request for Qualifications to select Design / Engineering for a City-wide Design. Follow a public selection process to obtain construction ready design documents and refine cost modeling based on network design.

Launch make-ready process for utility pole attachments.

Initial Project

Work with Advisors and the Broadband Committee to refine the Scope of Work for the Initial Project. Some of the objectives of the Initial Project will include:

1) Create a Fiber Utility owned fiber network to specific properties for the purposes of reducing costs, taking ownership, and supporting improved internal operations, including public health and safety.

Establish locations to serve as fiber access points for fiber to the home and fiber to the business. From one or more of these locations construct to a Initial area to demonstrate ability to close affordability gap.

2) Demonstrate the strategies advanced by the Broadband Committee with a real-world implementation.

3) Validate the cost structure that is modeled in the Broadband Master Plan.

4) Provide key team members at the Fiber Utility with firsthand experience to design/engineering, construction, and operations for a fiber optic system as needed.

5) Validate the ability of an Open Access system to positively address gaps in competition, choice, and to lower the cost of services.

6) Demonstrate the strategy, model, and planning to support grant applications.

Community Engagement

Collaboratively Refine Community Engagement Plan. Community Engagement is the most important sub-project to successfully deploy publicly owned fiber optic infrastructure.

> Determine whether the Fiber Utility will use an outside professional marketing firm.

> Develop Project Plan for participation from all external marketing resources.

> Grassroots initiatives.

- Implement a Community Engagement and demand aggregation process.
- Deploy a competitive process to establish initial take-rate.

Construction

A downstream decision will be made about whether the Fiber Utility will develop any internal construction resources to supplement 3rd party construction. We anticipate the Fiber Utility will at least have an individual who is a liaison with the Construction teams.

Identify Construction Manager. Key skills and knowledge include, but are not limited to:

> Ability to manage the fiber optics project and budget, direct construction in accordance with the approved design, and coordinate work with other staff and design team members.

> Be a key point of contact with clients, contractors, and local government officials.

> Review project design aspects as needed and coordinate adjustments to support constructability and budget outcomes.

> Review work products, quality control, and budgeting.

> Mentor, develop, and supervise staff.

Evaluate Construction Project Management software options.

Conduct RFP/RFQ for materials and labor for construction.

> Create RFP/RFQ Documents.

City Leadership Approval

Prepare to advance full initiative to City Council for approval.

Deploy Initial project when approved by the City Council.

SECTION 7

Frequently Asked Questions

Frequently Asked Questions

Is this action necessary?

YES. While the gaps in internet affordability, availability, and reliability don't feel like a crisis for the well served, these barriers create a crisis for the underserved and unserved. Today's technology-based interactions link and mediate our culture, the economy, and society. Connectivity expands opportunities and enlarges possibilities when it is affordable and available to all. People are diminished and condemned to negative outcomes beyond their control by the existing barriers to digital access. The incentives for private industry point away from treating digital infrastructure as essential utility infrastructure, in the same sense that roads, electricity, water, and sewer are essential systems. The action of establishing a municipal utility to provide this vital infrastructure is a logical and necessary first step towards closing the divide in Orangeburg.

Is the Orangeburg plan legal under South Carolina law?

Yes. Orangeburg has the authority under law to enact ordinances considered necessary for the security, general welfare, and convenience of the municipality, or for preserving health, peace, order, and good government. Digital access is necessary, especially as more essential functions move online, like education, health care, employment, and economics. South Carolina state law does prohibit public entities from becoming 'government-owned communications service providers.' This plan complies with this legal requirement because the city will only provide open access to fiber optic facilities that are not, in and of themselves, capable of providing a communications service, any more than a road is the same as a delivery service, like the U.S. Postal Service, UPS or FedEx. Instead, the road is the infrastructure necessary to provide affordable services.

Why fiber optic?

Fiber's durability, lower maintenance costs, and less hardware than other connections result in a better up-front investment with long-term payoffs. Any public capital investment in infrastructure must also factor in its usefulness and capacity to handle the projected growth of consumption. For years without fail, data consumption has continued to rise as more applications and services require greater amounts of capacity. The only real choice for long term investment is fiber because only fiber will still be useful 50 years from now.

Won't fiber cost too much?

A myth often pushed by incumbents who want to forestall universal fiber is that there is a high "cost" of fiber and cheaper alternatives. Fiber is affordable public infrastructure. Consider the costs associated with other public infrastructure projects. Using a $15 million dollar investment a city could build ¼ mile of light rail, or make 3 miles of bridge repairs, or mill and resurface 12 miles of a 4-lane road, or replace 15 miles of water pipes and meters, OR build 87 miles of an underground, urban, fiber network.

Why open access?

Open Access is an arrangement in which the network infrastructure is open for independent service providers to offer services. Open access addresses a key digital access problem by ensuring residents and local businesses have high quality services. Open access ensures high quality at the best possible price via competition – if people can switch away from their Internet Service Provider, the ISP has an incentive to provide better services at lower costs. However, the high cost of building networks is a barrier for new ISPs to enter the market – limiting the number of options for communities. Open access provides an effective and scalable solution: multiple providers sharing the same physical infrastructure.

Publicly owned, open access infrastructures create a vibrant and innovative market for digital services. Municipalities build the physical infrastructure (fiber-optic lines) and independent Internet Service Providers (ISPs) operate in a competitive market using the same physical infrastructure. In this competitive marketplace, ISPs compete for customers and have incentives to innovate rather than simply locking out competitors with a de facto monopoly.

Public open access will also enable Orangeburg to move beyond the current internet paradigm by providing direct fiber access between local educational facilities to every address. This has the potential to improve the online educational experience for every student while also reducing costs.

What about dark fiber models?

Dark fiber leasing models do not provide the same cost savings or scalability as automated open access systems. In open access dark fiber systems, only the fiber cable is owned by the open access operator, each service provider must provide electronics throughout the system, including the device installed in the home. This effectively splits the capital investment between the open access operator and the service provider. As a result, there are significant additional capital costs incurred by each new provider entering the market and these costs get passed on to subscribers. Additionally, the system is only capable of supporting a finite number of providers based on the actual physical fiber count that is available. Other limitations include the fact that switching providers would require a new piece of equipment to be installed and it is not possible to receive services from multiple providers at the same time. Automated open access systems overcome all these deficiencies in software by providing 'virtual' fiber connections or 'virtual' networks using the same electronics and equipment for all providers. This eliminates the scale limitations associated with the physical fiber count, provides residents with the ability to switch or add providers in real time, and allows for the delivery of multiple services and providers on the same device and at the same time without any change in equipment.

What about 5G or other technologies?

Wireless cannot serve as a foundational long-term investment like fiber optic can. The fastest 5G 'to the home' technologies operate in higher frequencies using millimeter wave (microwave) spectrum to achieve speeds like the slowest fiber technologies. This type of installation requires fixed antennas placed on every home with a line of sight to access point antennas installed about every 600 feet throughout the neighborhood. Each radio antenna installation would still require a fiber optic connection and power. The typical life cycle for wireless technologies is 10 years, with an expected device life span of 5 years. Satellite technologies provide shared connections that will never have the capacity to meet the needs of Orangeburg. These factors make installing fiber to every address the right public investment.

Can Orangeburg afford this investment?

A factor related to affordability is financing. Private investment typically requires a 5-to-8-year return that includes profits and interest. Public investment typically requires a 20-to-30-year payoff with guaranteed low interest rates and no profits paid. Orangeburg will apply these existing utility frameworks to the construction and operation of this automated open access infrastructure. As a point of reference, if all the direct COVID relief payments received by Residents since the start of the pandemic were directed to the plan outlined here, it would be enough to fund a fiber to every address in Orangeburg. The challenge, therefore, is not one of affordability, but priority.

To help put things into perspective, consider that the Orangeburg DPU serves approximately 26,000 electric customers. Current data would indicate that 65 percent of these customers are paying for a wireline internet connection at their home with an average monthly cost of $70 or more. This equates to some $15 million dollars annually. High level feasibility estimates show that constructing fiber to every Orangeburg DPU electric customer would cost approximately $90 million, an amount already being paid every 6 years. Using public utility frameworks to fund this capital investment would cost less than $20 dollars per month.

Where will Orangeburg get the funding?

DPU can pursue traditional public finance options. Also, unprecedented levels of Federal and State funding are being made available to cities for broadband infrastructure. This plan will put Orangeburg at the front of the line for these funds by providing a citywide fiber optic design with cost estimates to install fiber optic lines to every address in DPU's service area. Orangeburg DPU will oversee the buildout of a Initial Project that will be used to inform Orangeburg's funding applications and prove the benefits that would come from State and Federal infrastructure investment. While grant opportunities alone will not provide enough funding to reach every home and business, these funds could provide a key mobilizing force to address the affordability gap in the Orangeburg region.

What will this cost me?

There will be no cost to anyone who does not request an installation or service using city fiber. This plan separates the costs for the final service into three (3) separate and distinct categories:

1. The cost of installation (capital costs)
2. The cost of operation (maintenance and operation of the fiber system)
3. The cost of service (provided via a private marketplace of services)

This plan will make the best use of available grant and low interest public bonds to drive the installation costs as low as possible with the stated goal of $10 per month for this cost. The city will create a new utility department within the Orangeburg Department of Public Utilities to manage operations with the stated goal of $15 per month for this cost. It is expected that robust, reliable internet access will be available from multiple Internet Service Providers (ISPs) within the online marketplace with packages from $5 to $25 per month depending on the specific service offered. **The goal of this plan is to make world class fiber optic connectivity available to every address in Orangeburg for less than $50 a month.** Additionally, the city will develop and implement customer assistance programs for those unable to afford connectivity at that price point.

How will Orangeburg determine rates and charge fees?

Utilities are fundamentally different from other businesses because they are NOT allowed to charge whatever they want, or whatever the market will bear. Because a public utility model will be applied to the fiber optic system, rates will be determined based on the actual costs to maintain and operate the system, not on market rates. This public process requires utility rate changes to undergo a regular 'rate case' or evaluation of actual expenses compared to the rates being charged, resulting in adjustments as necessary with an emphasis on providing an essential service at the least possible cost. True public utilities also benefit from specific legal and liability protections, as well as access to low interest, long term funding for capital projects that result in lower operating costs when compared to other businesses.

What will this do to my property's value?

High-speed fiber Internet can add an average of 3.1% to home value, according to a study conducted by researchers at the University of Colorado at Boulder and Carnegie Mellon University in 2015. The study used data from nearly half a million home sales between 2011 and 2013, U.S. Census data and data from the National Broadband Map to determine the effect of high-speed fiber-optic Internet on home prices. The median home value in the study was $175,000. When high-speed fiber is added, this home sees an increase in value of $5,437. The increase is approximately equivalent to the value of a fireplace or a little under half the value of a bathroom. Since the pandemic has only increased the need for reliable, robust, digital access, subscribers can be confident that any investment in fiber to a property will increase its value.

How will this plan benefit students?

Currently online learning requires both the educational facility and the student to maintain an adequate Internet subscription through a 3rd party private provider. This plan's automated open access system will provide direct fiber optic access between the campus or classroom and the students residence, eliminating the commercial internet subscription requirement. This will vastly improve the online educational experience, enable true virtual classroom opportunities, while at the same time reducing costs.

Are Initial Project properties receiving a benefit that will not be available to other Orangeburg properties?

While the economic frameworks employed by a utility benefit from averaging the costs across many customers, they are prevented by law from discrimination, including free or preferential rates for some customers in comparison with others. In simple terms, this means that the economic benefits to the Initial project will be extended to future customers as the scale increases through cost-averaging across all customers over time. This cost-averaging over time is fundamentally different from typical business operations, and assures that economic benefits, like grants or philanthropic contributions, are extended to all rather than a few.

When will the 'Initial project' start?

Requests For Proposals (RFPs) for Initial project procurement are being released in conjunction with the release and adoption of this Plan, with construction of the Initial project scheduled to start in May of 2022 with the first Initial participants being connected in August 2022.

When can my property get a fiber optic connection?

This will vary by property. Orangeburg will prioritize the citywide buildout based on need and demand. There will be regular updates made available through the outlets maintained by Orangeburg. All properties will have access by 2030.

What can I expect during the installation process?

A walkthrough of each property will be conducted as part of passing by or through each property only if the property owner requested the installation of a fiber line to the home or business. Mainline fiber is always installed in a city owned Right of Way (ROW) or public utility easement. The extension that crosses private property requires property owner permission, and the placement of all fiber and electronics inside the home or business will require property owner approval. The initial meeting will be scheduled in advance of the mainline cables being placed. The purpose of this meeting is to agree on the placement of fiber through the property and the placement of the electronics inside the building. If there is work desired within the home that

cannot be performed by construction personnel due to cost constraints or complexity, a property owner may arrange the installation inside the building. Sometime after the mainline and extension or 'drop' to the property is installed, an installation will be scheduled where a technician will complete the fiber installation inside the building, set the equipment and make sure that connectivity is complete. Orangeburg will provide online contact information and management systems to help property owners coordinate their installation, and any necessary property restorations that result from the construction process.

How can I make sure I get a fiber installation?

Regular communications related to plan progress will be distributed through Orangeburg's regular communication channels. Orangeburg will also maintain a robust and exhaustive online site dedicated to this effort. This site will include plan information, regular updates, maps, and forms to assure that all Residents benefit from this important process. Property owners will also be notified when construction is starting near their property via mail and door hangers that will include information on how to make sure a property is signed up to receive an installation.

How does an 'automated open access' system work?

Open access provides multiple options in broadband services, and internet for Residents to choose from. To obtain service, property owners will first need to complete a city fiber installation form which will be available online. Once the installation is complete, a party responsible for payment of a monthly utility bill will need to sign up for utility fiber service, just like sewer and water. After signing up for service, a username and password are provided that will allow the recipient to log into Orangeburg's utility fiber system. This portal login information will be specific to that property and will include access to a marketplace of available services. Services can be selected and automatically provisioned in a matter of minutes via the online portal. Provisioning is automated and designed to make subscribing and unsubscribing an easy process for subscribers. Changes in packages or subscriptions are just as easily accomplished automatically at any time of the day or night. There are also tools available within the portal to assist with testing and troubleshooting the property's connectivity, as well as contact information for assistance. The portal login can be accessed by plugging into any city fiber connection or through a web browser with an internet connection.

What does this mean for Orangeburg's incumbent providers?

Orangeburg recognizes and appreciates the historical investment already made by incumbent providers. Nothing in Orangeburg's plan will force these operators to abandon their current infrastructure or create any barriers to upgrading or extending their infrastructure if they desire to do so. This plan is neutral to those options while presenting opportunities for incumbent operators to upgrade their infrastructure at no capital cost by utilizing the new city fiber optic infrastructure. This opportunity is important to the incumbent phone operators as the twisted pair infrastructure they operate is decades old and often incapable of meeting the minimum requirement for broadband. It is equally important for the incumbent cable operators as they are private commercial operators that rely on franchise agreements to obtain access to Orangeburg's Rights of Ways (ROW) in which they install coaxial cable to deliver their service. These cable franchise agreements require that the operator is offering cable service, defined as channelized video content, for which access, the city is adequately compensated. As system bandwidth is shifted from delivering channelized video to internet and data services, these operators will have no legal claim to continue accessing Orangeburg's ROW. This plan effectively solves this problem by providing cable operators with the ability to move their internet or data only customers over to the municipal fiber optic utility infrastructure with no capital costs incurred.

What relationships are important to plan success?

There are numerous internal relationships that will be cultivated between this new fiber optic utility and other city departments and operations. This infrastructure will be installed to meet the digital communication needs of all other city departments, operations, and functions over time. This will be a requirement in both ordinance and policy.

There will also be numerous external relationships established and cultivated for the combined success of Orangeburg and any other public or tax supported entity. State law allows for and encourages tax supported entities to enter interlocal or joint powers agreements, and to utilize cost sharing to reduce costs and improve services for the taxpayers they serve. These relationships will be encouraged and cultivated in both ordinance and policy.

Has this been done anywhere before?

Ammon, Idaho was the first municipality in the country to take a municipally owned automated open access fiber optic utility approach in 2017. Ammon has received numerous awards and accolades for their revolutionary approach. Residential properties with an Ammon fiber installation have the option of receiving 1 Gbps fiber optic internet service for less than $30 per month with no data caps or contract. Today there are 40 other cities across the country actively planning for or in the process of implementing the 'Ammon Model'.

What if a costly upgrade to the system becomes necessary in the future?

This is not a new challenge for municipal utilities. For example, Orangeburg DPU has budgeted to spend some $45 million dollars on necessary capital improvements. These improvement costs are averaged across all the system's customers and paid for over a period of time. It is these unique utility funding and rate mechanisms that help to maintain affordability even in the face of large capital improvements. These same frameworks will be used to maintain affordability if a costly system upgrade becomes necessary in the future.

What can I do to support the plan?

Order a fiber installation at your property as soon as possible. Utility costs benefit from scale. As more property owners participate in the plan, costs will move lower for everyone because shared infrastructure will have a larger set of customers to spread the cost across.

How will the infrastructure support equity?

For the first time ever, Orangeburg will have the ability to focus a digital access investment to facilitate inclusive prosperity, redress existing gaps, and advance local goals and priorities. Service subsidies do not effectively solve these problems but are instead designed to only manage the problem. Orangeburg can include necessary structural reforms as part of plan execution, and will start by connecting those most disadvantaged first, something industry cannot do.

How will the infrastructure support innovation?

The new infrastructure will expand educational instruction and remote learning opportunities by building the digital and instructional capacity of Orangeburg's educational institutions to deliver web-based entrepreneurship training programs that create opportunities for employment and entrepreneurship for students. This program will allow the city to fully leverage and maximize new investments in our broadband and technology.

New and innovative use cases and services will have access to a robust digital infrastructure without incurring the high capital costs associated with building a new infrastructure. This will greatly accelerate the speed of innovation in Orangeburg while also exponentially reducing the cost of innovation.

What are some examples of future services Orangeburg wants to be prepared for?

Digital access is already needed for distance learning and telehealth. New services on the horizon include virtual campus and classroom, connected vehicles, and transactive energy. These industries are seeing enormous investment and services are evolving rapidly. An automated digital open access platform is well prepared for these innovations because secure dedicated networks can be created on demand for these new and innovative uses.

SECTION 8

Glossary

Glossary

Industry Terms and Abbreviations

Term	Description	Definition / Narrative
Aerial	Fiber-optic network cables installed on existing utility poles	Aerial fiber deployments are one of the most cost-effective methods of installing fiber cables. Rather trenching and/or boring for underground installations, operators can simply use existing pole infrastructure to deploy the cables.
Asymmetrical	Broadband Download and Upload Speeds are nor the same	An asymmetrical connection does not have equal download/upload speeds. For example, 60/3 means 60 Mbps download and 3 Mbps upload speed.
Bit	Binary Digit	The most basic unit of data in telecommunications and computing. Each bit is represented by either a 1 or a 0 in binary code.
Buried	Fiber-optic network cables installed underground in conduit	Buried fiber deployments, unlike aerial, are protected from weather damage by being buried below the freezing point in the ground.
Digital Divide	Digitally unserved and/or underserved neighborhoods and/or demographic - typically low-income and rural communities	The gulf between those who have ready access to computers and the internet, and those who do not.
DOCSIS	Data Over Cable Service Interface Specification	An international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable television (CATV) system.
DSL	Digital Subscriber Line	A technology for the high-speed transmission of digital information over standard phone lines.
Fiber	Fiber-optic	Thin flexible fibers with a glass core through which light signals can be sent with very little loss of strength.
GB or Gig	Gigabit = 1,000,000,000 Bits or 1,000 Megabits	A unit of information equal to one billion (10^9) or, strictly, 2^{30} bits.
Gbps	Gigabits per Second	Billions of bits per second.
GHz	Gigahertz	One billion hertz, especially as a measure of the frequency of radio transmissions or the clock speed of a computer.
Internet Exchange Point	IXPs or IXes or Internet Exchange Hotel	Internet exchange points (IXes or IXPs) are common grounds of IP networking, allowing participant Internet service providers (ISPs) to exchange data destined for their respective networks.
ISP	Internet Service Provider	A company that provides subscribers with access to the internet.
K or KB	Kilobit(s)	A unit of computer memory or data equal to 1,024 (2^{10}) bits.

MB or Meg	Megabit = 1,048,576 Bits	A unit of data size or network speed, equal to one million or 1,048,576 bits.
Mbps	Megabits per Second	Millions of bits per second.
MHz	Megahertz	One million hertz, especially as a measure of the frequency of radio transmissions or the clock speed of a computer.
Middle Mile	Middle Mile Communications Provider	In the broadband Internet industry, the "middle mile" is the segment of a telecommunications network linking a network operator's core network (central office) to the nearest internet aggregation point.
mLAB	Measurement Lab	M-Lab provides the largest collection of open Internet performance data on the planet.
NTIA	National Telecommunications and Information Administration	NTIA is the Executive Branch agency that is principally responsible for advising the President on telecommunications and information policy issues.
PON	Passive Optical Network	A passive optical network, or PON, is designed to allow a single fiber from a service provider the ability to maintain an efficient broadband connection for multiple end users.
Symmetrical	Broadband Download and Upload Speeds are the same	A connection with equal download and upload speeds. For example, with a 500/500 Mbps fiber internet connection you get 500 Mbps of download AND 500 Mbps of upload speeds.
Take-Rate	The Percentage of Subscribers in a given network	A tabulation of broadband penetration rates. The calculation is determined by dividing the number of subscribers by the total number of potential subscribers in a given network footprint.
Tbps	Terabits per Second	Trillions of bits per second.
8K Video	Ultra-High-Definition Video	Television resolutions of 7,680 pixels horizontal x 4,320 pixels vertical.

Open Access Network Terms

Term	Description	Definition / Narrative
Backbone	Shared Fiber Infrastructure from Aggregation Point to Network Operations Center	The Backbone fiber runs from an Aggregation Hut back to the Network Operations Center.
Common	Shared Fiber Infrastructure from Drop to the Closest Aggregation Point	The Common is the shared fiber infrastructure in a neighborhood that runs from a Drop to the closest Aggregation Hut.
Drop	Segment of the Fiber Network from Street into Home or Business	Drop is the fiber that runs from the street to the premise (home or business).
Middle Mile	Shared Fiber Infrastructure from Network Operations Center to Internet Exchange Point	The Middle Mile is usually 3rd-Party fiber that runs from the Network Operations Center to the closest Internet Exchange Point. The cost of the Middle-Mile is included in the Monthly M&O Utility Fee and is borne by all network subscribers.

Network Operator	Department or Company that Manages the Network Physical Infrastructure	The organization that manages the Network Physical Infrastructure on a day-to-day basis. The Network Operator may or may not be the owner of the physical network infrastructure.
Service Provider	A Company that offers Services to Consumers on the Network	A company or organization that offers services (ISP and other) over the Open Access physical network infrastructure.
Subscriber	A Customer/Consumer on the Network	Household or Business that participates as a subscriber on the network.

THANK YOU

For Your Consideration

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