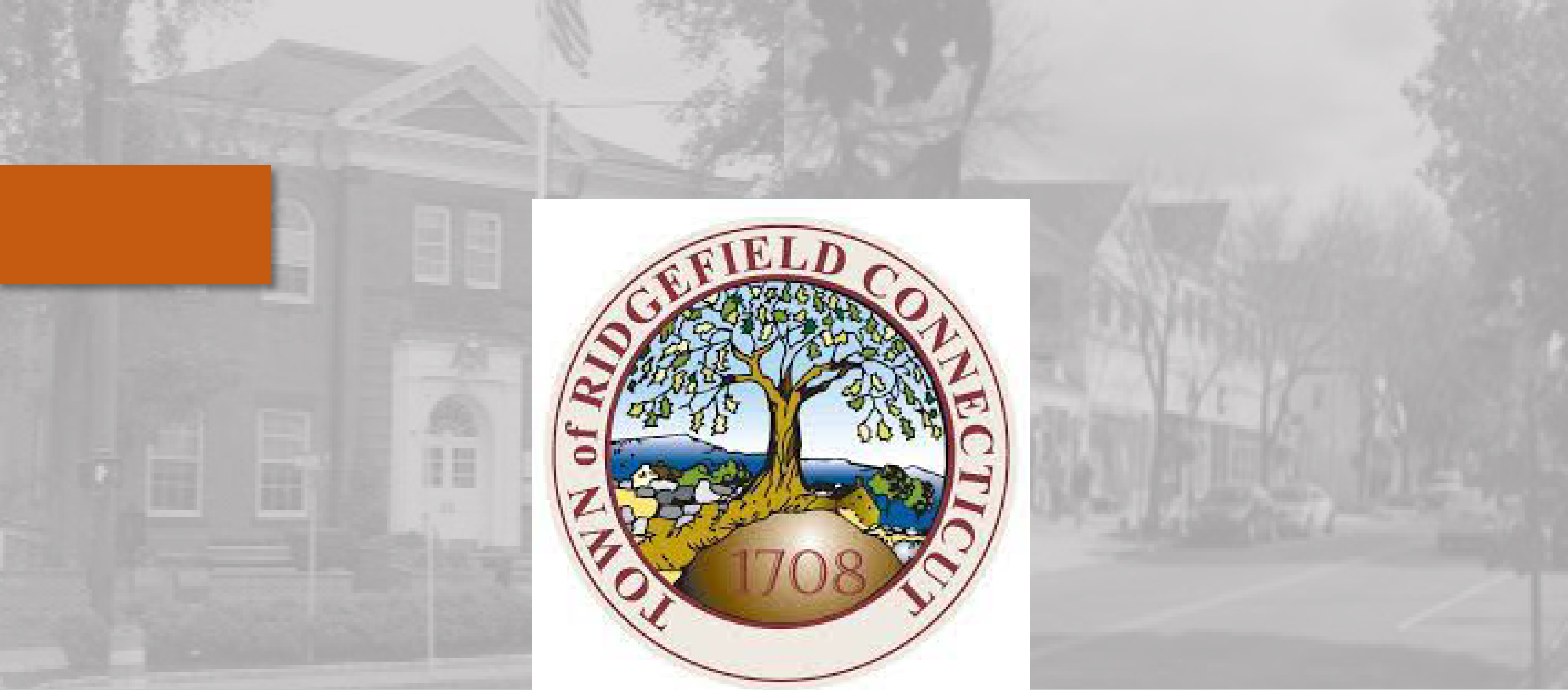


Broadband Feasibility Study

May 2023

Broadband Feasibility Study

Table of Contents

SECTION 1

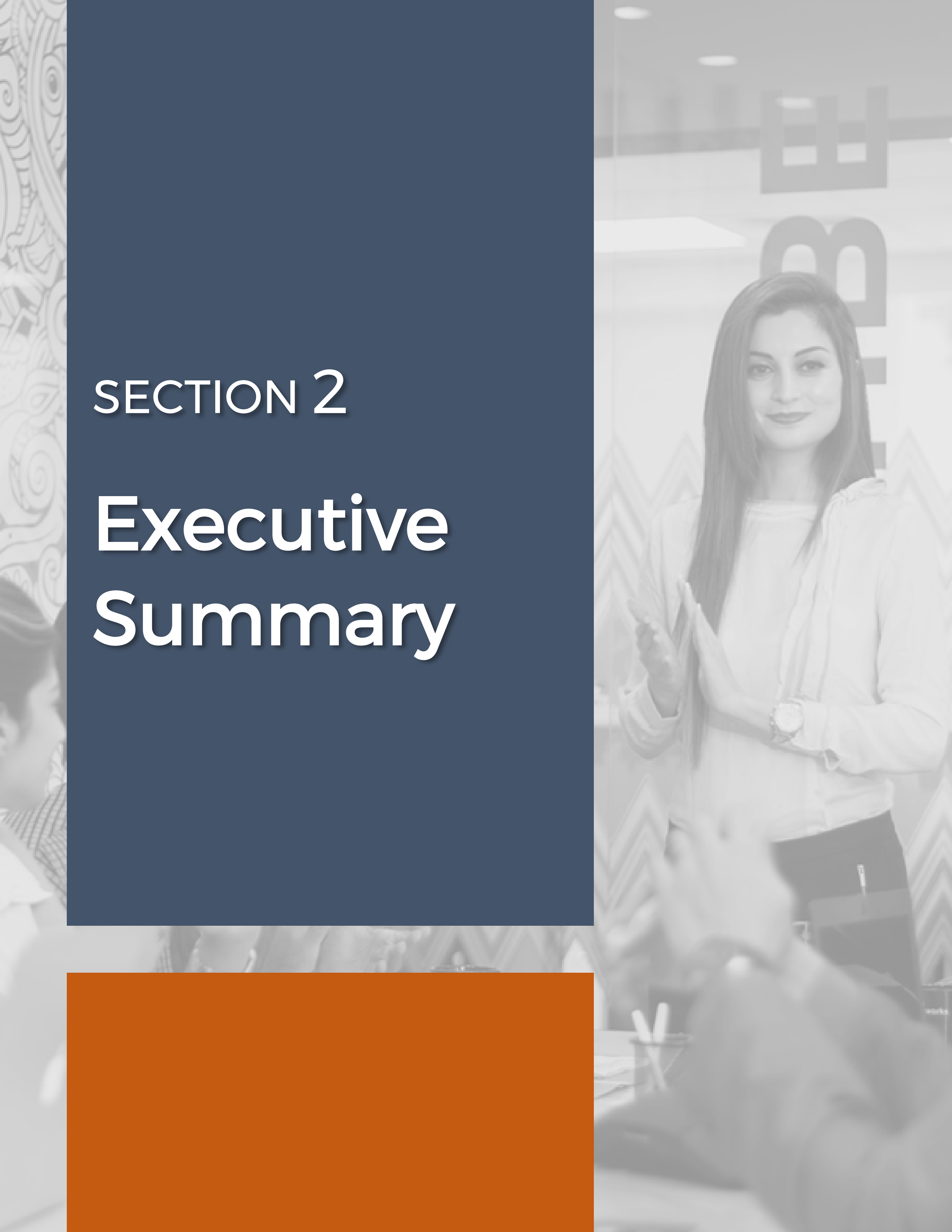
Vision Statement

Vision Statement

Ridgefield Fiber, a high-speed fiber network project, will be designed to bring high-speed internet services to every Ridgefield home and business. Everyone will have an opportunity to have a fast, reliable, affordable internet connection that will support future applications, increase bandwidth demands, high-speed business transactions, consistent home connectivity, fast and stable Wi-Fi connectivity, and better communications for all. Ridgefield will be prepared for greater economic opportunity and an even better quality of life.

SECTION 2

Executive Summary



Broadband Feasibility Study

Executive Summary

The Town of Ridgefield seeks to eliminate reliability and affordability barriers to internet access for its residents and businesses. Many communities struggle with the quality and reliability of their connections while working from home, which was exasperated during the pandemic. Students also experience the challenges of remote learning, weak security, and connectivity issues. Ridgefield must rely on more than market forces to remedy these issues. The Town is seeking alternative solutions to this problem, which is the primary impetus for this study.

The Bipartisan Infrastructure Law was signed into law in 2021 to rebuild America's essential services like roads, bridges, and rails, expand access to clean drinking water, ensure every American has access to high-speed internet, and invest in communities that have too often been left behind. The 2021 bipartisan congressional infrastructure bill (H.R. 3684, Infrastructure Investment and Jobs Act (IIJA)) defines digital equity as "the condition in which individuals and communities have the information technology capacity that is needed for full participation in the society and economy of the United States." The Federal Communications Commission (FCC) defines digital access speeds as 100/20mbps or greater.

This plan emphasizes three actions to drive real change in affordability and availability for the residents and businesses of Ridgefield:

1. Begin treating the infrastructure as a public utility built on the assumption that the infrastructure and related services are now essential.
2. Unbundle the infrastructure and network maintenance and operations costs from services (internet access). This will allow the Town to control the availability and affordability of the infrastructure without becoming a retail internet service provider.
3. Implement an open access model for service providers to foster competition and choice. The open access model will also play an important role in making the monthly cost affordable for subscribers. The feasibility of this plan can be compared as an alternative to the current business model offered by the incumbent operators (Xfinity/Comcast and Frontier).

The Town of Ridgefield has worked with EntryPoint Networks to develop this analysis to help Town leaders determine whether it is feasible and advisable to deploy and operate a municipally owned fiber network for the residents, businesses, and anchor institutions in the Town of Ridgefield. This report seeks to assist Town leaders in understanding the operational implications, important risk factors, and a realistic cost framework for developing and operating a Town-owned fiber optic infrastructure.

As state and federal grant opportunities unfold, municipalities should position themselves as favorably as possible to attract funding for their jurisdictions to enable meaningful change.

Broadband Feasibility Study

A reliable digital infrastructure is vital to enable participation in the modern world. Optimizing an open access municipal fiber network depends on unbundling or separating the infrastructure and services and having a neutral host own and control the infrastructure. This allows competition to flow freely. It can also enable long-term benefits in education, healthcare, public safety, efficient delivery of government services, and the general economy.

Ridgefield is perfectly positioned to be a neutral host of fiber optic infrastructure. This will enable competition and lower costs to create a more robust digital future for the Town than private internet service providers (ISPs) who optimize profit rather than affordability, equity, and accessibility for all.

The financial projections provided in this report point to several viable options to approach the next phase of connectivity in Ridgefield, from procurement and public funding to the billing models for the Town and internet service providers. However, key decisions are to be made that will decide the path forward.

Key Decisions

- **Ownership / Control:** Decide the degree to which the Town wants to control or influence the outcomes it desires for digital access.
- **Governance:** Determine the governance structure that is appropriate to advance the Town's objectives (Town owned – Town operated vs. Town owned – Third-party operated).
- **Business / Operational Model:** Decide whether a vertically integrated (single ISP) or an open access model aligns with the Town's objectives.

Projected Costs

The total projected infrastructure costs for a Townwide open access deployment have been forecasted:

- Capital costs for a 20% buried/80% aerial network are estimated to be $24,821,970.
- Capital costs for an 80% buried/20% aerial network are estimated to be $38,629,035.

These scenarios are calculated assuming passing all 10,388 premises with fiber and a projected 40% take-rate (4,155 subscribers) with a bond/interest rate of 4.5% for 20 years.

Projected capital costs include all network materials and labor, electronics, including the edge device that goes inside the premise of each household or business, project management, engineering, architecture, and design.

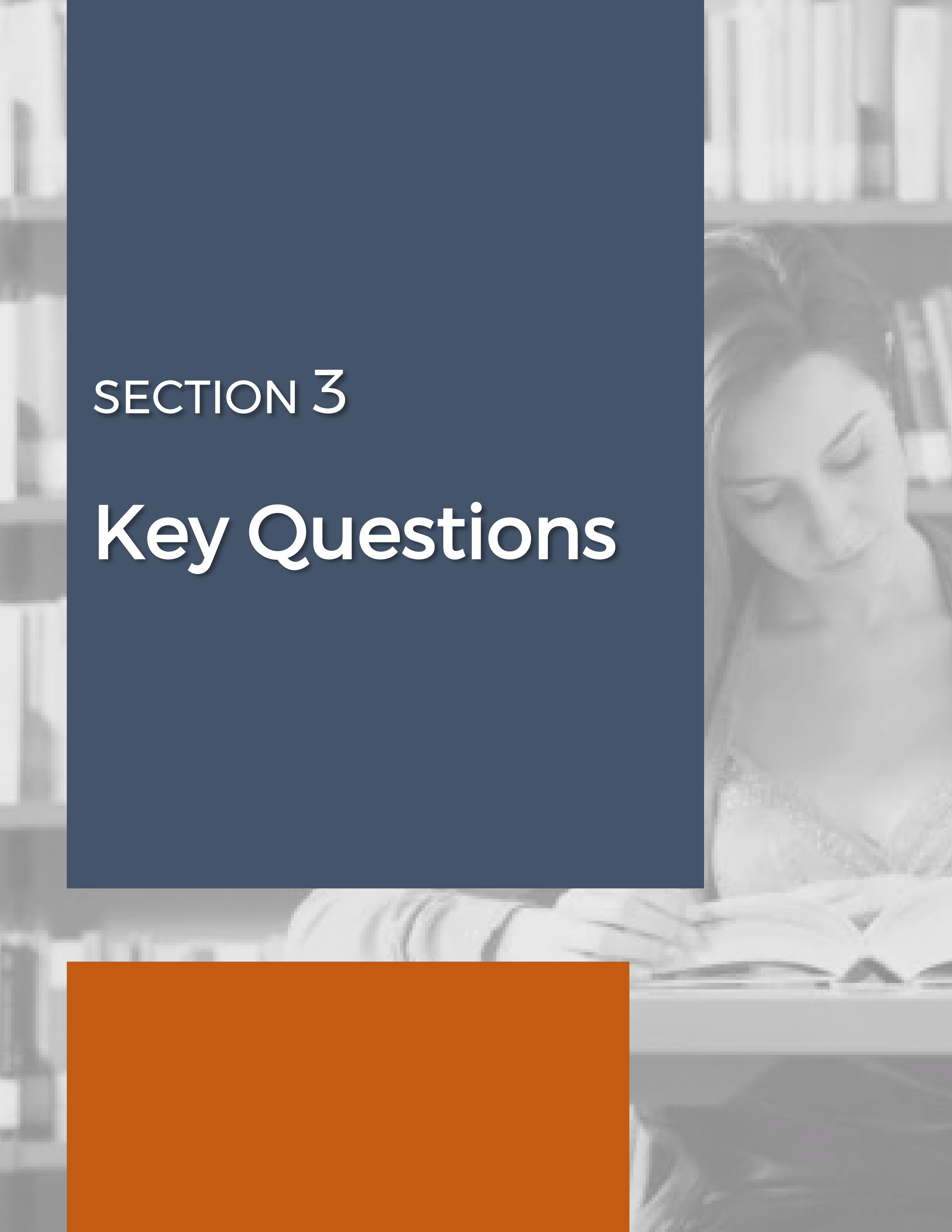
Based on these assumptions, the forecasted monthly subscription costs are estimated to be:

Projected Residential Services Monthly Costs	20% Buried / 80% Aerial	80% Buried / 20% Aerial
Infrastructure	$38.27	$59.56
Maintenance and Operations	$20.50	$20.50
ISP Services (Dedicated 1 GB Symmetrical)	$9.99	$9.99
Total Monthly Subscriber Costs	**$68.76**	**$90.05**

This is a living document. If Town leaders determine the project has sufficient merit, the planning process will continue to the next phase of a Townwide fiber network implementation.

SECTION 3

Key Questions



Key Questions

This plan is organized around three key questions:

1. Why should Ridgefield consider building a municipal fiber optic network?
2. What would a sustainable financial model look like for building a municipal fiber network?
3. What are the next steps to advance the process?

1 Why Should Ridgefield Consider Building a Municipal Fiber Network?

Reliable digital infrastructure is vital to enable participation in today's economy. Broadband networks provide the road system in a digital economy and are critical to nearly every function of a Town's services and operations, from finance to transportation to emergency services. The importance of this infrastructure will only increase over time.

Similarly, businesses require reliable and fast digital infrastructure to connect with customers, ensure their supply chain, and operate efficiently. The education and healthcare systems require digital infrastructure to connect with students or patients, communicate between facilities, and ensure timely and appropriate services.

The incumbent model is intended to optimize profit for private companies rather than optimizing affordability, equity, and accessibility for all. As additional fiber deployment takes place in Ridgefield, there is little incentive for multiple private operators to install fiber in the same locations in the Town, leading to more limited choices. Due to the critical nature of digital infrastructure, ensuring a reliable and equitable network is a clear public policy concern. This places communities in a unique position to deploy an infrastructure asset that can have a far-reaching positive impact on all systems important in a Town.

Limitations of the Current System:
Incumbent infrastructure is treated as an amenity rather than essential.
The infrastructure and services are bundled together.
Today's digital roads are susceptible to monopoly control.
The interests of the incumbents are misaligned with the interests of subscribers.
There is no local influence over pricing, governance, or quality.
Current incentives have created the digital divide.

A municipal fiber network can overcome these limitations. For example, the Town roads provide the infrastructure for competitors to deliver their goods and services, rather than asking these same competitors to build and maintain their own road infrastructure. Deploying a fiber network at the municipal level accomplishes the same objective of providing equitable, reliable access to all residents and businesses while continuing to encourage competition. As the road system supports competition among various delivery services, a digital network would support competition among internet service providers.

2 What are the benefits of a municipal fiber network?

The opportunities to improve digital resources are unique to a municipal entity. They can enable long-term benefits in education, health care, public safety, efficient delivery of government services, and spur the economy. Because these opportunities are contrary to profit motives and existing incentives, commercial internet service providers (ISPs) are unlikely to pursue them.

1) Improve Affordability

The dominant national ISPs have developed a "rent-seeking" business model sustained by controlling the infrastructure. Network control allows incumbents to impose premium pricing on network rents (ISP fees). The actions listed below can effectively overcome these "rent-seeking" practices and drive down the cost of access in a meaningful way. These include:

1. Applying established municipal utility operational models for funding, construction, operation, and fees. Leverage established municipal utility structures, tax exemptions, access to public grant funding, lower borrowing rates, and better liability treatment to drive costs down.
2. Putting downward pressure on price by enabling dynamic competition between service providers via an open access network model.

3. Separating and optimizing the key cost components of digital access into the three main network categories: (1) Capital Infrastructure Investment, (2) Monthly Maintenance & Operations Expenses, and (3) Monthly Internet Access Fee from the ISP.
4. Allowing households in multi-tenant buildings to share the infrastructure, maintenance, and operations costs.
5. Allowing subscribers to pay off the infrastructure cost and eliminate that line item once the infrastructure debt has been retired.
6. Leveraging automation to lower operational expenditures.
7. Targeting state and federal grants to offset the cost of deploying a new fiber optic infrastructure.

2) Create Sustainable Solutions for the Digital Divide

The internet has moved from a luxury item to a necessary feature of modern life—like other utility infrastructure. Persistent barriers to universal internet access, availability, affordability, and adoption are now public domain concerns. The incentives for private industry are not aligned toward resolving persistent gaps. The solutions advanced by them have not addressed these critical public needs or provided effective, sustainable solutions. Informed public policies and targeted public investments are needed to provide lasting solutions. These public policies must be informed that reliable internet is necessary to access educational systems, economic activities, healthcare, public safety systems, and many other cultural and societal interactions.

3) Foster New Economic Development Opportunities

We live in a digital economy. Communication infrastructure is now fundamental to commerce and economic development because it provides the foundation for the economy. Historically, economic development has followed investment in infrastructure for all major systems, including transportation, water, sewer, and communications. Until now, municipalities have mostly remained independent, leaving the governance role over digital infrastructure to private companies. This allows private entities to decide where and what they will build, the cost of services, and the kind of innovation that will happen to these systems. However, the network is now so fundamental to modern life and commerce that municipalities are increasingly taking a more active role in governance and enabling new opportunities that depend on this infrastructure.

4) Treat Fiber Optic Infrastructure as a Public Utility

Implementing fiber optic networks managed as a public utility is consistent with the notion that this is an essential infrastructure in the modern economy. Utility frameworks, such as roads, water, sewer, storm drains, and electricity, exist to support essential functions critical for societal success. Providing digital access as a public utility offers maximum service for residents, businesses, and anchor institutions at the lowest possible cost. The lack of adequate competition and the practice of treating this as an amenity rather than a utility affects affordability, ubiquity, equity, and quality of service.

5) Increase Competition Through an Open Access Model

Open access is a model that divides the infrastructure and services into two separate systems and then shares the infrastructure between multiple service providers, like road systems and airports. A key goal of an open access system is to lower costs and improve service by increasing choice and competition. For an open access system to realize its potential, it is critical for the infrastructure owner to be a neutral host of the infrastructure. The role of a neutral host is to control and manage the infrastructure without privileging one service provider over another. A true open access network depends on enabling robust shared infrastructure operated on a non-discriminatory basis. This model is analogous to the structure of deregulated electricity markets where the utility provides the distribution. The supply can come from a wide range of options.

6) Unbundle Infrastructure and Services

The dominant national ISPs bundle the infrastructure and services together to insulate the infrastructure owner from outside service providers. An open access model depends on unbundling or separating the primary functions and network costs into three buckets: (1) Infrastructure Capital Deployment, (2) Ongoing Network Operations, and (3) Services. To optimize each function and to enable the Town to become a neutral host, it is important to unbundle the key network functions and costs.

7) Alignment with Users

Residents, business owners, and visitors of Ridgefield should receive maximum value for minimum cost. The Town has established goals of enhancing livability, increasing economic development, ensuring equity, enabling important anchor institutions like healthcare and education, and caring for natural and human resources. As digital infrastructure becomes increasingly important to each of these things, the significance of alignment with the network owner and operator also increases. The Town of Ridgefield is aligned with the interests of residents and business owners to support a network that delivers maximum value for the minimum cost.

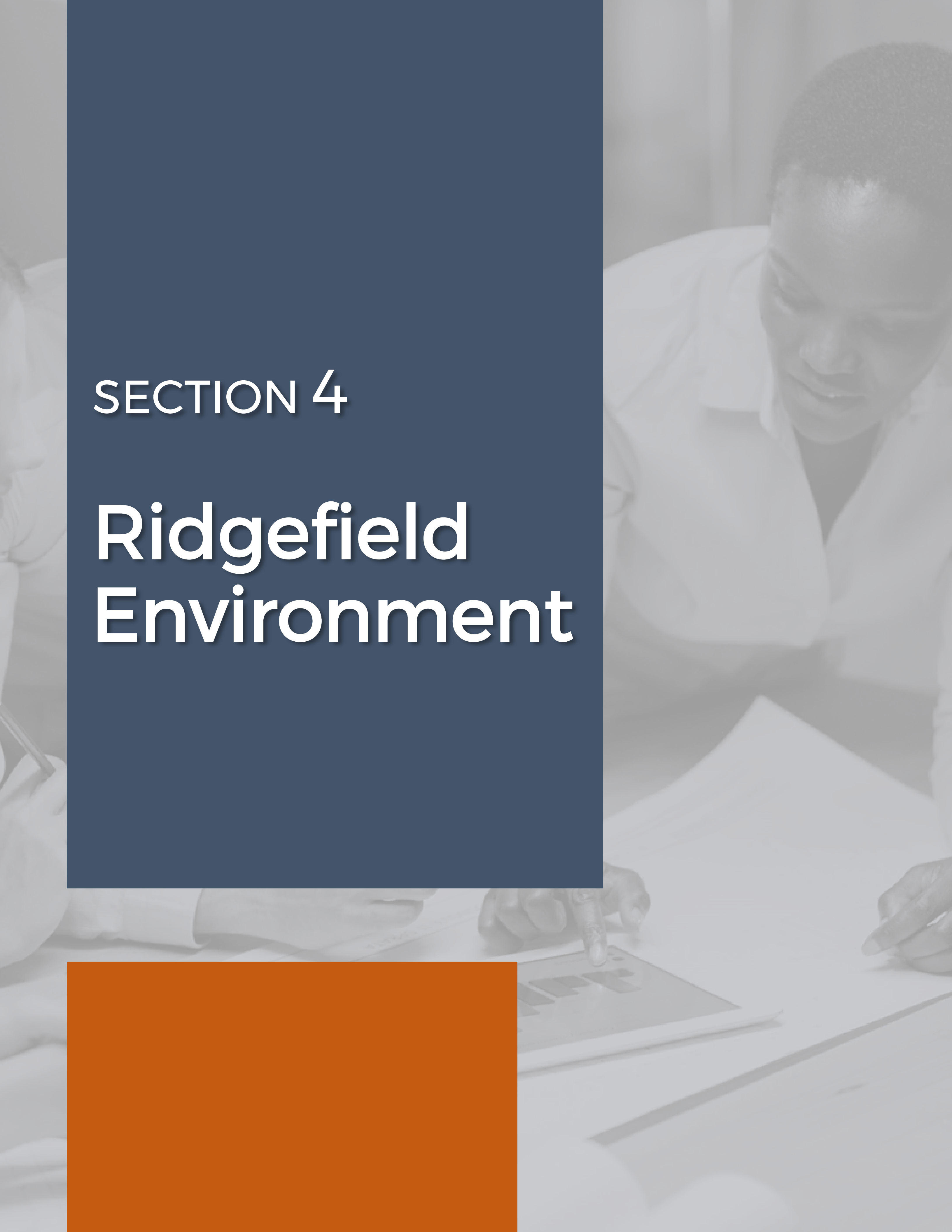
8) Establish Local Control Over Pricing and Reliability

Local control over critical infrastructure allows the needs of residents and business owners in Ridgefield to drive policy and regulations. Today’s dominant ISPs are nationwide companies that are not organized to align the network with local needs and interests. Digital infrastructure will be positioned to increase local value when it is owned and controlled by a local neutral host. The digital divide, education, economic development, public safety, and healthcare are all local variables that can best be understood and addressed locally. Control over network infrastructure will allow Ridgefield to leverage the power of the network in advancing communication solutions for these issues.

3 What Are the Next Steps to Advance the Process?

The objective of this section is to provide a roadmap to Town leaders for actions to take once the Broadband Feasibility Study is complete. Town leaders must align with the vision for the overall project to be successful.

A series of recommended actions and considerations are outlined in detail beginning on page 25.



SECTION 4

Ridgefield Environment

Ridgefield Environment

Census, Demographics, and Income

The following are key demographics and income statistics for the Town of Ridgefield:

- Total population – 25,011
- Total households – 9,125
- Race and ethnicity – 86.8% White, 5.1% Hispanic, 1.5% Black, 3.3% Asian, 0.1% Native American, Two or More 3.8%
- Gender – 49% male, 51% female
- Less than high school graduate or equivalency – 1.9%
- Bachelor's degree – 73%
- Square miles covered – 34.5
- People per square mile – 725.6
- Properties that are owner occupied – 85.7%
- Average household size – 2.73
- Persons below the poverty line – 3.4%
- Median household income – $160,258
- Median state household income – $83,572
- Median national household income – $69,021
- Households that have a computer – 96.5%
- Households with a broadband connection – 94.2%

Source: https://www.census.gov/quickfacts/fact/table/ridgefieldtownfairfieldcountyconnecticut/AGE295221

https://www.census.gov/quickfacts/fact/table/CT,US/PST045221

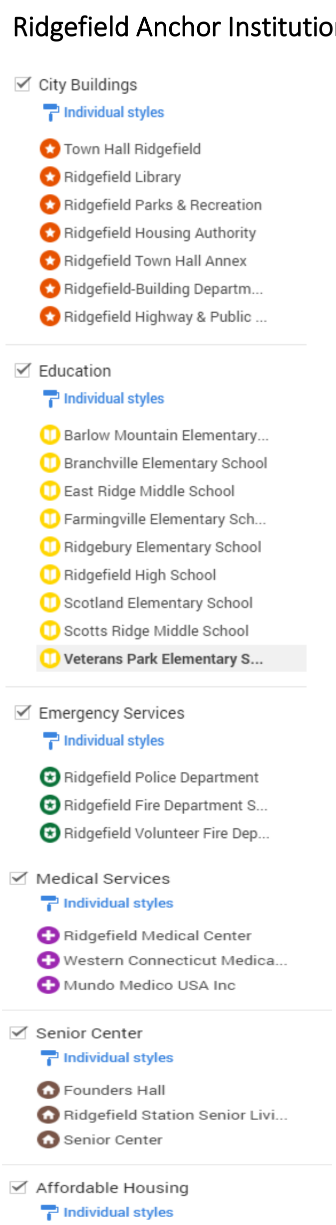
- Total Biarri premises – 10,388

Broadband Feasibility Study

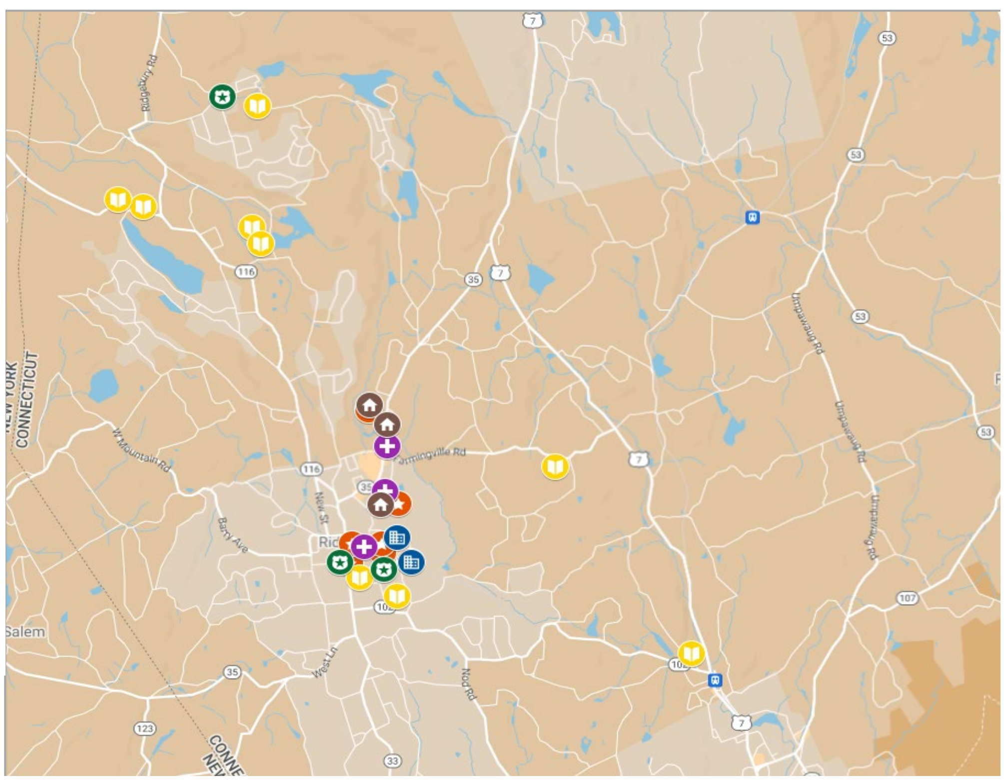
Anchor Institutions

EntryPoint has identified the Town of Ridgefield's primary anchor institution sites. Section I.C.f. of the BEAD Notice of Funding Opportunity (NOFO) defines a community anchor institution (CAI) *as an entity such as a school, library, health clinic, health center, hospital or other medical provider, public safety entity, institution of higher education, public housing organization, or community support organization that facilitates greater use of broadband service by vulnerable populations, including, but not limited to, low-income individuals, unemployed individuals, children, the incarcerated, and aged individuals. An Eligible Entity* (the State Broadband Office) *may propose to NTIA that additional types of institutions should qualify as CAIs within the entity's territory*.

Source: *Page 11: https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf*



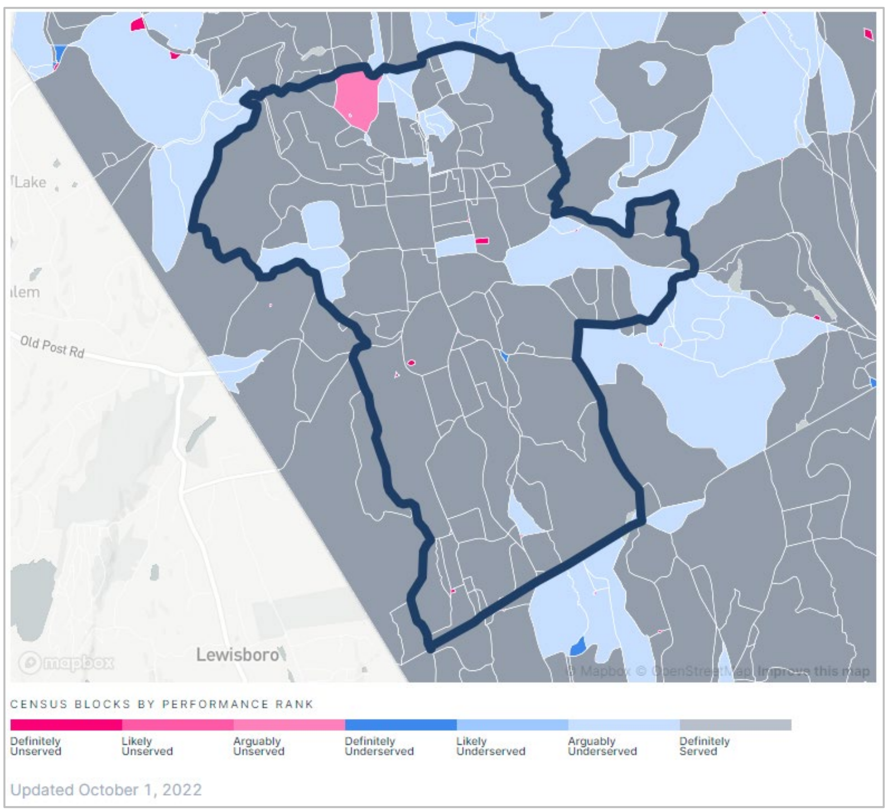
The Town will seek these anchor institutions as customers, service providers, and locations to provide digital literacy education. A selection of these institutions is illustrated on the map below. Click here to access this interactive Google Map.



Current Broadband Options

Ridgefield is currently subject to a near-monopoly for internet coverage. Xfinity controls nearly the entire residential market. There is some fiber deployment in the Town, but it is limited to fiber to the node in the Comcast system. Frontier currently has a presence in Ridgefield but has a nominal market share. Frontier, a Connecticut-based company, is marketing to the cities and towns that it plans to deploy fiber over the next two (2) to three (3) years.

Readily found data on unserved and underserved citizens in cities, towns, townships, and municipalities is under dispute due to discussions about the latest information released by the Federal Communications Commission (FCC) in their broadband maps. According to FCC maps, the fastest typical speeds are 25/3 Mbps. Many communities are finding errors, and the information we include in this report is from official sources. Each municipality must validate it as it goes forward with official network development plans.



Broadband.Money audits tell a different story. This map shows the total demand points and quality of broadband coverage in Ridgefield. This map clearly outlines places most in need of improvement and can serve as a resource when considering improvement or expansion of broadband services. Visit Ridgefield, Connecticut Broadband Audit to learn more.

SECTION 5

Feasibility Analysis

Sustainable Financial Model & Feasibility Analysis

The feasibility of deploying municipal infrastructure is a function of comparing current market factors (pricing, customer satisfaction, services, speeds) to realistic projections for a Town controlled infrastructure.

Financial Feasibility

A key objective of Ridgefield is that the infrastructure must be available to everyone at affordable rates. Ridgefield's pursuit of universal availability and affordability will lead to completely different outcomes than the current state for the businesses and residents of Ridgefield. This analysis is built on the following:

- Estimated Current Internet Spend in Ridgefield
- Projected Total Cost of a Townwide Deployment
- Projected Cost per Household at a 40% Take-Rate

Aggregate Internet Connectivity Cost in Ridgefield Today

The following table provides a reasonable estimate of how much money the residents of Ridgefield are paying for internet access today. This is based on a national median average of $74.99 from the Consumer Reports white paper on broadband pricing (Consumer Reports – November 17, 2022). There is an opportunity to keep some of those dollars locally. This average does not include businesses and is meant to illustrate the current cash flow available to support a locally-owned network and underscore that $9.3 million is leaving the community today.

Internet Spend in Ridgefield Today

Average monthly cost of home internet connectivity in U.S. today is $74.99

Number of Households w/ broadband	10,388
Average Monthly Internet	$74.99
Annual Internet Spend	$9,347,953
20 Year Internet Spend	$186,959,069

Projected Monthly Cost to Subscribers

A target outcome for this planning effort is to put the Town in a position to leverage grant and appropriation opportunities to lower the cost of new infrastructure and then finance the remaining infrastructure cost over 20 years.

The main cost categories for deploying and operating broadband networks are:

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

It is recommended that the costs are separated and transparent to each stakeholder (e.g., subscriber, network operator, service provider) to optimize the subscriber cost for each category. In this model, the billing for infrastructure and network maintenance and operations comes as two separate line items in a bill from the Town. The preferred billing mechanism for services would be done directly from the ISPs by credit card. If an automated payment to the service provider is a barrier for some residents, we can evaluate having the services be an additional line item on the Town billing notice. In the recommended open access model, the ISPs will be in a marketplace, and subscribers will be able to switch ISPs on demand. A key objective will be to have ISPs in the marketplace that qualify for the FCC Affordable Connectivity Program (ACP) subsidy to improve affordability further.

Per Household Projected Subscription Cost – Using Biarri Numbers

The following cost projections are based on Biarri's network design which focused on the cost of building fiber optic infrastructure to 10,388 physical premises in Ridgefield with a projected take-rate of 40% (4,155 subscribers). This design generates a bill of materials (BOM), which details the materials (e.g., fiber, conduit, splice boxes) needed to build infrastructure to each subscribed premise. The residential $9.99 monthly ISP fee is based upon current pricing from ISPs interested in providing services. The first table below does not account for the total number of households (40% take-rate). Under this modeling, specific to Ridgefield, the monthly cost for subscribers is projected as follows:

Projected Monthly Subscription Cost

Projected Residential Services Monthly Costs	100% Aerial	20% Buried / 80% Aerial	80% Buried / 20% Aerial	100% Buried
Infrastructure	$31.18	$38.27	$59.56	$66.66
Maintenance and Operations	$20.50	$20.50	$20.50	$20.50
ISP Services (Dedicated 1 GB Symmetrical)	$9.99	$9.99	$9.99	$9.99
Monthly Total	**$61.67**	**$68.76**	**$90.05**	**$97.15**

Projected Townwide Infrastructure Capital Costs

The total projected construction costs for a Townwide deployment are summarized in the table below. These numbers assume that construction techniques and routes will largely avoid other utility infrastructure, rock, and other impediments. These numbers can change significantly if contractors face unknown or known variables impacting construction timelines. Capital costs for three scenarios are provided: (1) a 100% aerial network deployment, (2) a 20% buried/80% aerial network, (3) an 80% buried/20% aerial, and (4) a 100% buried network. These scenarios are calculated at a 40% take-rate and a bond/interest rate of 4.5% for 20 years. These capital costs include all network materials and electronics, including the edge device that goes inside the premises of each household. This modeling does not include a Wi-Fi router for each premise. The projections below do not account for the possibility that federal and state grants or other appropriations will reduce infrastructure costs.

Per Premise Projected Infrastructure Cost – Using Biarri Data

The projections in the first table reflect the year-one capital cost. They are based on the Biarri network design, which includes 10,388 physical premises in Ridgefield. These numbers do not account for the average number of households per premise. This is an important data point because the monthly cost for subscribers will be driven by the number of households rather than the number of premises. The modeled aerial costs do not include the possibility of pole replacement fees or other unexpected make-ready charges. Under this modeling, the total cost per premise is projected to be as follows:

Projected Total Infrastructure Costs

Financial Pro-Forma of Full Project Costs - 3 Year Build - Ethernet Architecture

	100% Aerial	20% Buried / 80% Aerial	80% Buried / 20% Aerial	100% Buried
Projected Cost Per Premise (Common and Drop)	$4,866	$5,974	$9,297	$10,405
Estimated Subscribers	4155	4155	4155	4155
Total Projected Project Costs	**$20,218,230**	**$24,821,970**	**$38,629,035**	**$43,232,775**

Common: *The shared fiber infrastructure in a neighborhood that runs from a drop to the closest aggregation hut.*
Drop: *The fiber that runs from the street to the side of the premise (home or business).*

Why Take-Rate is Important to Total Infrastructure Cost

Take-rate is a variable critical to project success because the operational sustainability of a project depends on crossing a certain take-rate across a broad number of subscribers, translating into an attractive and affordable cost-per-premise.

Projected Monthly Subscription Cost (80% Buried/20% Aerial)

Projected Residential Services Monthly Costs	40% Take Rate	50% Take Rate	60% Take Rate
Infrastructure	$59.56	$48.81	$41.65
Maintenance and Operations	$20.50	$20.50	$20.50
ISP Services (Dedicated 1 GB Symmetrical)	$9.99	$9.99	$9.99
Monthly Total	**$90.05**	**$79.30**	**$72.14**

Projected Monthly Subscription Cost (20% Buried/80% Aerial)

Projected Residential Services Monthly Costs	40% Take Rate	50% Take Rate	60% Take Rate
Infrastructure	$38.27	$31.64	$27.22
Maintenance and Operations	$20.50	$20.50	$20.50
ISP Services (Dedicated 1 GB Symmetrical)	$9.99	$9.99	$9.99
Monthly Total	**$68.76**	**$62.13**	**$57.71**

Take-Rate

Take-rate is a key consideration with financial feasibility. Take-rate is the percentage of potential subscribers who are offered the service who subscribe. Feasibility is a function of take-rate. Take-rate is a function of creating value and effectively communicating that value to subscribers. Higher take-rates lead to lower shared infrastructure costs.

Ridgefield is a town in Fairfield County, Connecticut, United States, and is a 300-year-old community. It is situated in the foothills of the Berkshire Mountains. Projected costs are provided for both an aerial and buried implementation. The aerial projections do not include an analysis or cost projection for pole-make-ready work.

If Ridgefield can achieve the projected take-rate of 40% (the number used for financial modeling), the projected monthly aerial/buried combination rate of $68.76 or $90.05 per month for 1G - 1,000/1,000 Mbps would represent a savings of $21.95-$43.24 per month over the premium cable offering from Xfinity of 1000/20 Mbps.

Ultimately, feasibility will depend on the quality and effectiveness of community engagement to educate residents on the value proposition of a locally controlled and municipally sponsored network.

Network Management and Operations

The work required for network operations includes network monitoring, network management, outside plant repairs, and new customer installations. EntryPoint recommends that the Town own the network and outsource operations to a third-party. It also makes sense for the open access partner to provide customer support, network operations center (NOC) support, monitoring, and troubleshooting. EntryPoint suggests utilizing a public process to select a local group to manage an outside plant—which includes physical repairs, splicing, new customer connections, maintenance of the physical asset, and emergency response for the physical plant. We have budgeted $20.50 per subscriber per month to cover the cost of maintenance and operations. This number includes fees for suppliers, including the open access partner, the third-party partner handling the physical or outside plant, and the middle mile operator.

Financial Modeling Assumptions

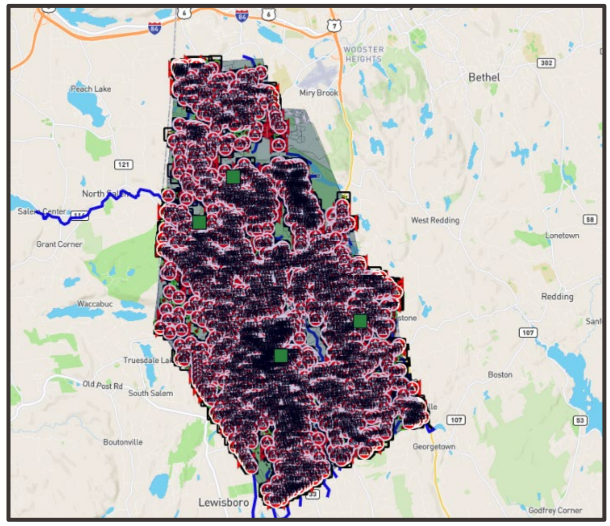
Financial modeling analysis is based on the following demographic information for the Town of Ridgefield:

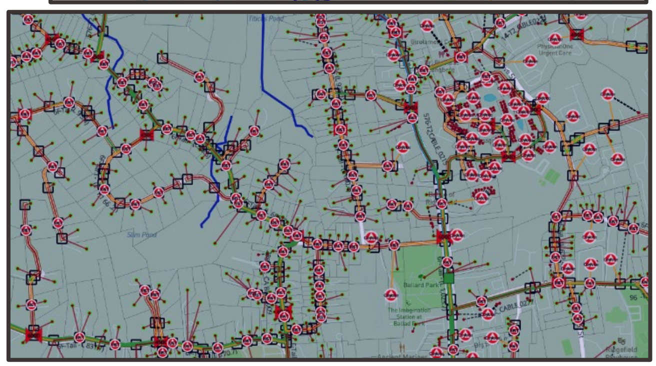
Tables Based on Biarri Data

Total Potential Premises: 10,388
(Households and Businesses)

Subscribers @ 40%: 4,155

Biarri Networks develops end-to-end technical solutions that accelerate the design and deployment of fiber, broadband, and 5G networks. They blend 21st-century best practices in software engineering with civil engineering and infrastructure development. They simplify and accelerate the work of upgrading and building telecommunications networks across the globe. Biarri Networks performed the feasibility level design for the Ridgefield study which informed the financial modeling assumptions.





Sample Town of Ridgefield design schematics.

SECTION 6

Market Analysis

Market Analysis

Incumbent Offers and Pricing

In Ridgefield, most residents and businesses currently subscribe to a cable or telephone internet provider. The content below is listed on the websites of these incumbent providers.

Residential

Xfinity

Xfinity advertises the following residential services in Ridgefield on their website:

Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]	Internet [Billings]
800/20	$50.00	$107.00	TBD	$114.99
1000/20	$70.00	$112.00	TBD	$117.95
1200/35	$80.00	$117.00	TBD	$123.23

Taxes and fees often represent an additional (10% - 15%) of standard pricing.
Shared Network – Speeds are "up to" and are not guaranteed.
Speeds are not symmetrical.
Modem with Wi-Fi – Additional $14.00/$20.00 per month.
Cancellation charges may apply.
Contract may be required.
Availability depends upon location – not available in all areas.

Frontier

EntryPoint conducted an exhaustive online search throughout the Town to identify Frontier's pricing and the packages they offer to the community. It is clear from their website that they no longer allow new DSL customers and have not yet laid any fiber. For this reason, Frontier has not published its advertised pricing.

Business

Comcast Business

Comcast Business advertises the following business services in Ridgefield on their website:

Speed (Mbps) [Down / Up]	Contract Period	Standard Pricing [+ Taxes and Fees]	Equipment [Required]	Install [Fee]
50	1-Year	$69.00	N/A	N/A
100	2-Year	$109.94	$19.95	Included
100	3-Year	$119.94	$19.95	Included
250	2-Year	$139.94	$19.95	Included
250	3-Year	$129.94	$19.95	Included
500	2-Year	$179.94	$19.95	Included
500	3-Year	$169.94	$19.95	Included
750	2-Year	$219.94	$19.95	Included
750	3-Year	$209.94	$19.95	Included
1250	2-Year	$239.94	$19.95	Included
1250	3-Year	$229.94	$19.95	Included

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.

Note: *Market research conducted in January 2023.*

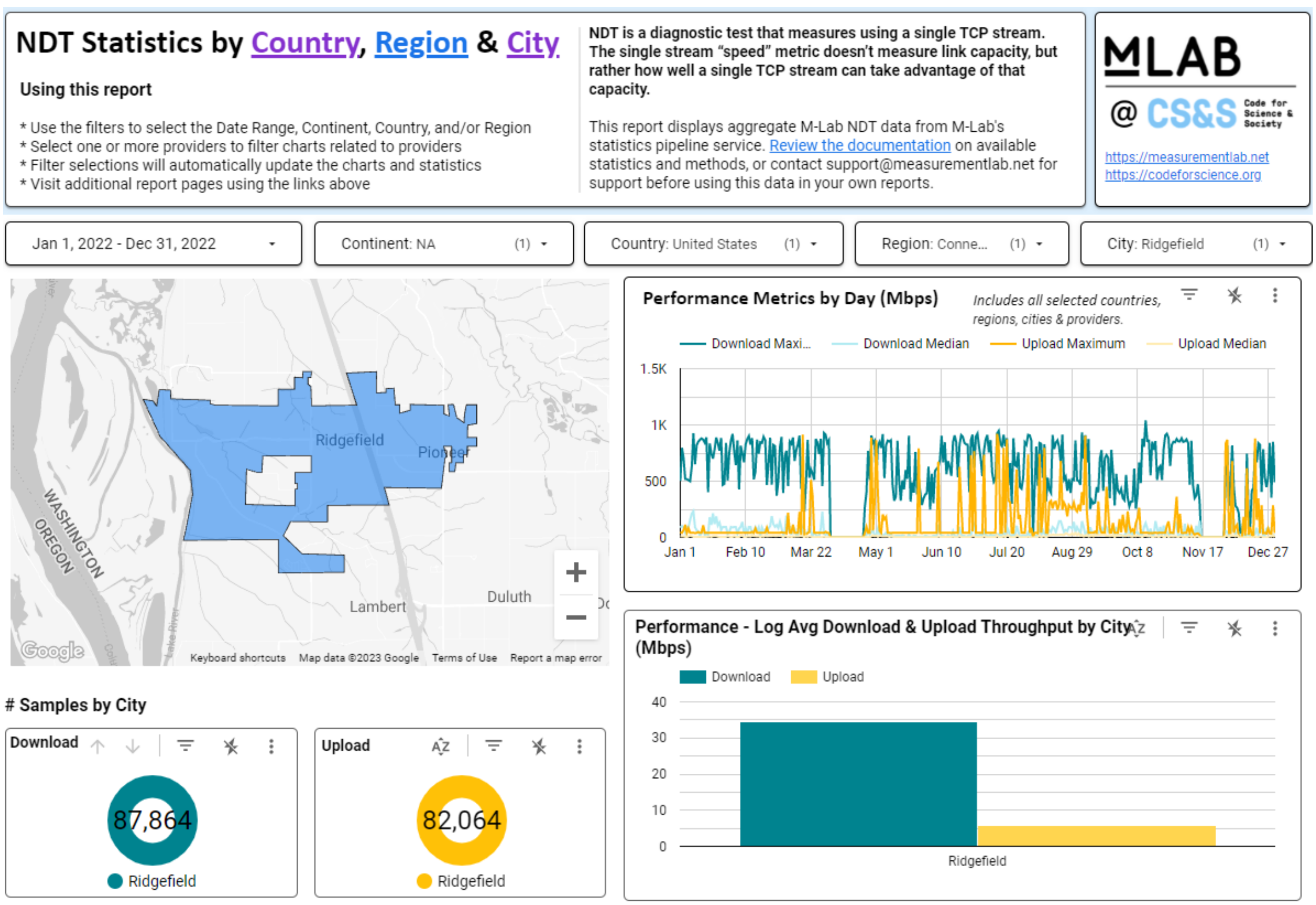
Broadband Feasibility Study

Speed Test Data

M-Lab is a research consortium that provides open data from speed tests across the United States. Academic, scientific, and public interest research organizations rely on M-Lab's open data. Every time an individual runs a speed test through an open-source integration of M-Lab's tools, the data is saved in Cloud Storage hosted by Google and made available to the public via BigQuery. The data below is the speed test results for Ridgefield from January 1, 2022, to December 31, 2022.

The average speeds delivered by the ISPs in Ridgefield are:

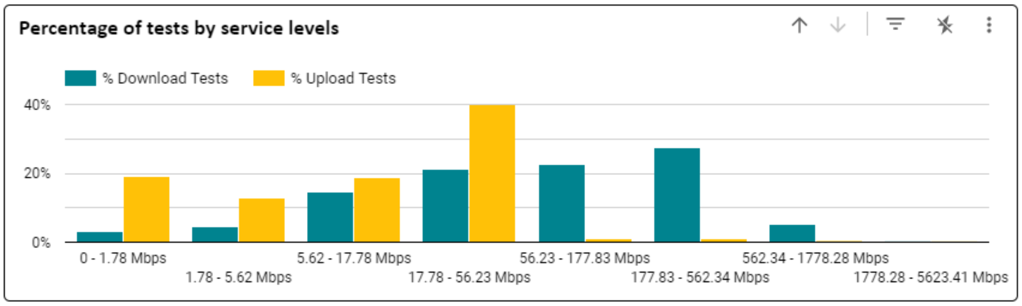
- Xfinity/Comcast = **125.04 download/14.31 upload**
- Frontier = **13.21 download/1.09 upload**



Broadband Feasibility Study

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.

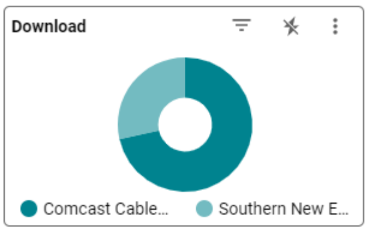


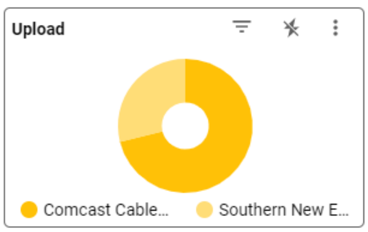
In the NDT dataset, each test is associated with the [Autonomous System]() operating the IP address from which each test was conducted. This may be different than the ISP that offers service.

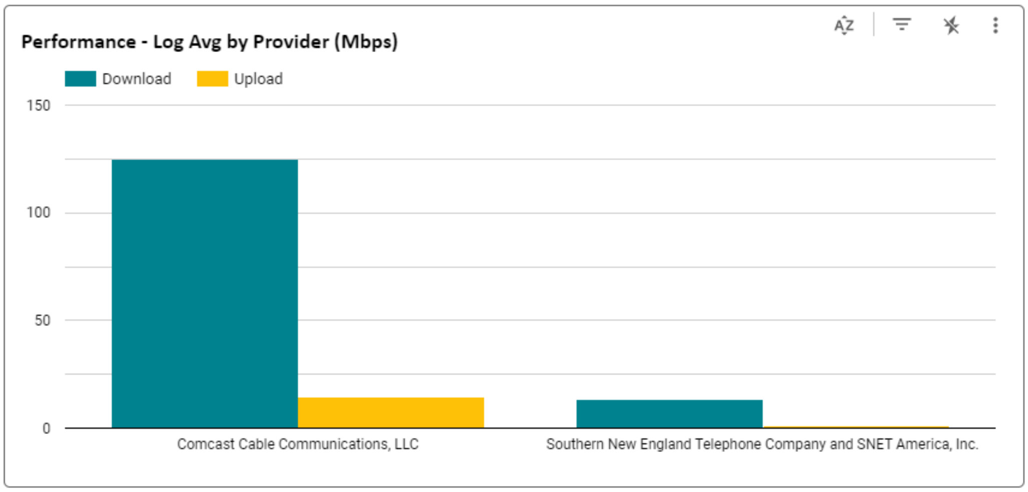
Provider Statistics

Provider: Comcast Cable Commu... (2)

 # Samples by Provider







Ridgefield Broadband Survey Results

From December 5, 2022 - January 27, 2023, Ridgefield surveyed residents and business operators to assess the sentiment regarding existing internet services and the level of support for a municipal fiber network. Professional survey administrators did not develop the survey. Key findings from the survey include the following:

Total Responses	**1,143**		
Respondent Category			
	1,110	Residential	97.11%
	33	Commercial	2.89%
Primary Use of Internet			
	944	Work	85.59%
	511	School	44.71%
	1,057	Entertainment	92.48%
	1,119	Email	97.75%
	1,083	Shopping	94.75%
	900	Social Media	78.74%
	428	Gaming	37.45%
	413	Business	36.13%
	107	Other	9.36%
Current Internet Access			
	1,100	Fixed Wire Connection	96.24%
	41	Cellular Connection Only	3.59%
	2	Do Not Have Internet	17.00%
Type of Internet Connection			
	957	Cable	87.40%
	74	DSL	6.76%
	22	Fiber	2.01%
	1	Satellite	0.09%
	5	Other	0.46%
	36	Don't Know	3.29%
Why do you not have internet connectivity?			
	0	I do not have good internet options	
	2	I cannot afford internet option available to me	
Current Internet Reliability			
	71	Poor	7.55%
	225	Fair	23.94%
	303	Good	32.23%

255	Very Good	27.13%
84	Excellent	8.94%
2	No Internet	0.21%

Current Internet Speed

86	Poor	9.15%
226	Fair	24.04%
329	Good	35.00%
212	Very Good	22.55%
86	Excellent	9.15%
1	No Internet	0.11%

Current Internet Affordability

378	Poor	40.21%
364	Fair	38.72%
167	Good	17.77%
22	Very Good	2.34%
8	Excellent	0.85%
1	No Internet	0.11%
742	**Poor/Fair**	**78.93%**

Affordable Residential Internet

19	$0 - $20	2.02%
151	$21 - $40	16.06%
292	**$41 - $60**	**31.06%**
189	$61 - $80	20.11%
161	$81 - $100	17.13%
77	$101 - $120	8.19%
27	$121 - $140	2.87%
24	$141+	2.55%

Should the Town of Ridgefield Consider Building a Fiber Optic Broadband Network Throughout the Town?

700	Yes	74.47%
221	Possibly	23.51%
19	No	2.02%
921	**Yes/Possibly**	**97.98%**

SECTION 7

Next Steps

Next Steps

The growing number of municipally owned networks is a response to the misalignment between private incentives and the essential nature of internet access in modern society. Incumbent operators have been free to establish most of the rules governing their infrastructure and services, including service levels, maintenance standards, network reinvestment, and service territories. Alternatively, public entities are perfectly positioned to be a neutral host of fiber optic infrastructure enabling competition and lower costs.

THE IMPORTANCE OF STRATEGY

As state and federal grant opportunities evolve, municipalities are positioning themselves as favorably as possible to attract funding into their jurisdictions to enable meaningful change.

Three key questions will provide direction to subsequent phases of the decision-making process. These require careful consideration before endorsing a specific implementation model for expanding broadband access.

KEY DECISIONS

1) **Ownership / Control:** Decide the degree to which the Town wants to control or influence the outcomes it desires for digital access.
2) **Governance:** Determine the appropriate governance structure to advance the Town's objectives.
3) **Business / Operational Model:** Decide whether a vertically integrated (single ISP) or an open access model aligns with the Town's objectives.

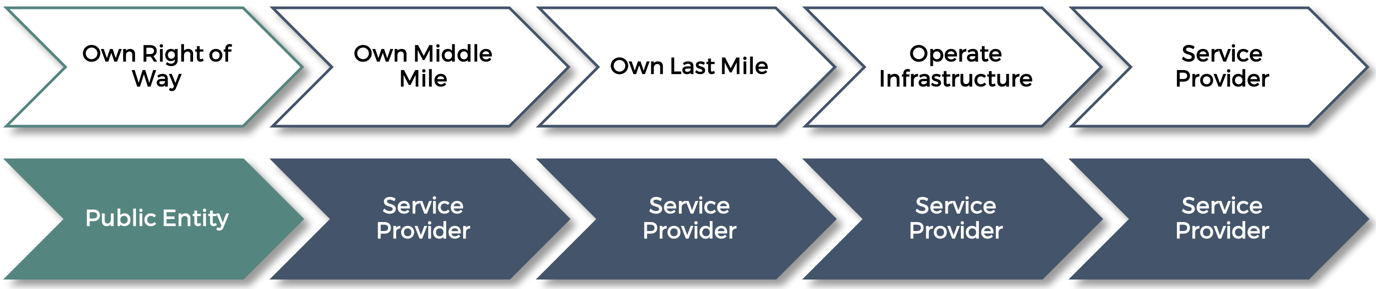
KEY DECISION #1: INFRASTRUCTURE OWNERSHIP

Ridgefield's proposed digital infrastructure will be owned by either a private company, a public entity (the Town) or a hybrid private-public partnership (PPP). Each of these is explained below.

Private Network Ownership

The easiest course for a Town is to do nothing and allow private companies to continue to own and operate internet infrastructure. Private companies who own the infrastructure dictate which business model is used. Typically, they select a model to maximize the company's return on investment rather than emphasizing public benefit. The dominant model used by most providers in the industry is a vertically integrated model. It is a single-service provider operational model where consumers can access privately owned infrastructure supporting one provider's services.

Figure 1: The Existing Deployment and Operation Model

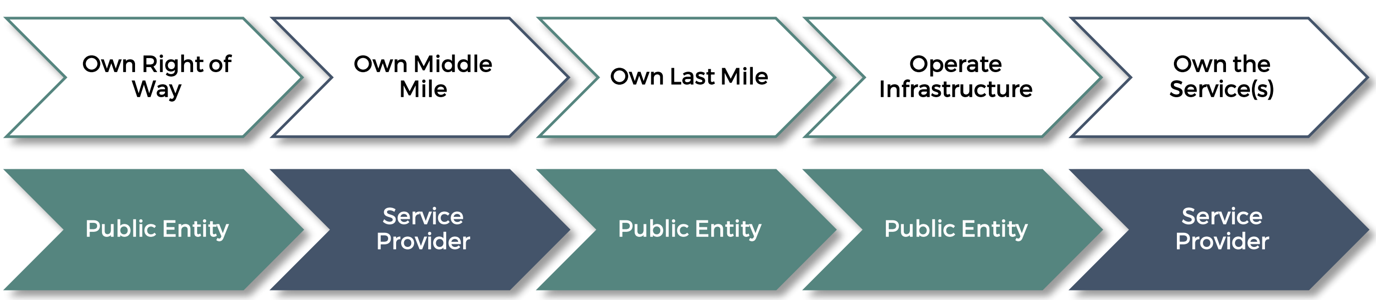


A single internet service provider often dominates rural areas because costs are higher. Cost is a factor of distance to build per subscriber. Lower population density means a greater distance between customers, significantly increasing the network operator's cost to build. As a result, people in denser urban areas typically have access to multiple internet service providers. In contrast, people in less dense rural areas may have one or two choices. This results from a facilities-based competition—building siloed infrastructure that a private entity uses exclusively.

Public Network Ownership

Public ownership of network infrastructure can produce many tangible benefits for individuals and communities. Costs can be lower if the network is operated as a non-profit enterprise and the public entity increases competition through an open access system. Public owners have greater incentives to solve the digital divide. It is more likely that the Town is aligned with residents on what they want from the network (e.g., low cost, high reliability, abundant bandwidth) than a third-party owner. Third-party owners will always be motivated first by the survival of their organization (e.g., profits, financial reserves, investors), while the Town's focus is on making the system self-sustaining and adding value. The Town also has much broader and different interests related to broadband infrastructure. These include economic development, livability, public safety, education, healthcare, emergency communications, smart grid, efficient government services, environmental stewardship, universal access, and smart city applications. All these things are now network-dependent, and the value from the network to the Town aligns perfectly with the interests of constituents who subscribe to the network.

Figure 2: Municipal Infrastructure Ownership and Operation Model

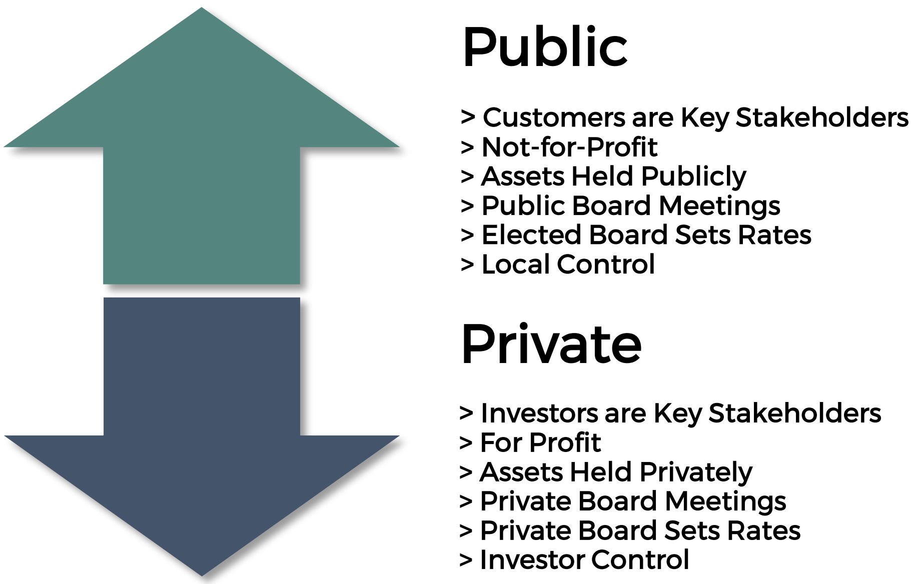


Additionally, the public entity will not have to get permission or incur new expenses whenever it wants to connect the network to a new service or application. Furthermore, public ownership of the network will allow the Town to optimize the network for local needs rather than organizing the operation to serve a national market.

Locally owned public infrastructure 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. Finally, the network will have significant value once it is built. The local community can share that value.

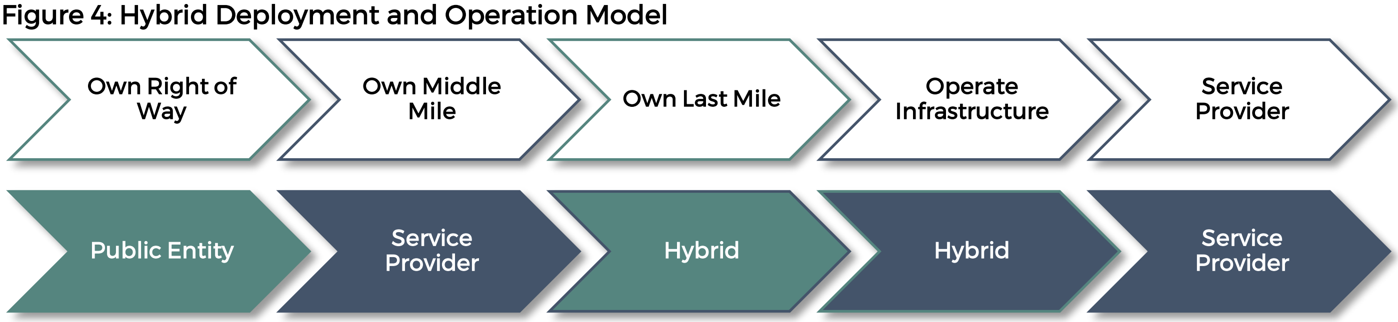
The figure below summarizes some differences between privately owned and publicly owned infrastructure.

Figure 3: Public vs. Private Broadband Models Summary



Hybrid Ownership and Operations

Figure 4: Hybrid Deployment and Operation Model



Hybrid ownership and operational models are emerging but are now in their infancy. An example of this model is a special purpose entity or special purpose vehicle (SPV). An SPV is a legal entity established to separate an asset, subsidiary, or financial transaction from a larger corporation or government agency. These are typically created to help isolate risk in a transaction or manage the risks associated with the development of an asset. A special purpose entity can also be established for collaborations between a government agency and a privately owned company via a public-private partnership (PPP).

An SPV may be a politically acceptable vehicle for managing risk for infrastructure projects. It can help local governments complete projects sooner since the private company may have the resources needed to complete an infrastructure project and may be less encumbered by public sector operational processes. SVPs can vary based on their founding legal and financial agreements. The specific role can be unique to the partnership between the government agency and the private entity.

Ownership Decision-Making

The following guidelines may be helpful to the municipality as its leaders determine whether private, public, or hybrid ownership is right for them.

- If the Town's key priorities are to limit ownership and operational responsibilities and are willing to forgo any level of control or ownership, then pure private models should be given favorable consideration.
- If the Town's broadband goals include universal access for all residents and reliable digital access to providers and services, models that provide for public or hybrid ownership of the local infrastructure should be given favorable consideration.
- If long-term municipal funding is available for constructing broadband facilities through a revenue bond or property assessment vehicle, then models that provide for public ownership of the local infrastructure should be given favorable consideration.
- If the Town desires to limit ownership and operational responsibilities but would like to maintain some control and the possibility of future public ownership, then hybrid models should be given favorable consideration.
- If the Town desires to facilitate a shift away from facilities competition to competition among service providers, then public or hybrid ownership should be given favorable consideration.

KEY DECISION #2: GOVERNANCE MODEL

Governance includes the statutory frameworks that define what is possible and not possible for a Town that seeks to own and operate this infrastructure and the policies and operational processes that a Town imposes on itself, third-party partners, and subscribers.

The State of Connecticut does not impose barriers to municipally owned infrastructure, but Ridgefield will need its legal advisors to provide guidance on the Connecticut state code if they choose to move forward with the next steps.

If the Town pursues a hybrid ownership model, governance will be specified in the agreement between the parties.

OTHER CONSIDERATIONS

The following considerations may be relevant to the Town's governance decision-making.

Maximize Funding Opportunities

Successful models can draw from multiple funding sources that maximize opportunities. These can include the ability to apply for state and federal grants, such as bonds, which should be given critical consideration.

Long-Term Stability

The long-term stability of the selected model is essential. Sustainable and predictable long-term outcomes are critical when selecting the preferred model(s).

Required Authorities

The legal authorities of the selected model are critical. The ability to carry out the required actions must be explicitly provided in statute to avoid legal challenges and the financial losses they incur.

Risk Mitigation

Each model has a level of risk associated with a combination of unique participants. Risks related to the various models include subscriber churn (i.e., when customers stop using a reoccurring service), take-rate (i.e., percent of the available market that subscribes to a service), technology, community engagement, cost models, timeline, and design risks depending on the model.

Flexibility

Models with flexible statutory requirements have implementation advantages over more rigid models. Short-term flexibility can provide the ability to change and adapt as needed or desired to result in better outcomes than less flexible models.

Required Initial Investment

Some models can achieve sustainable outcomes with minimal investment(s). This will have the effect of minimizing risks while at the same time creating a safety net for future investments.

Implementation Simplicity

Models that reduce implementation complexity related to design, installation, maintenance, and operations will improve efficiencies and result in more successful outcomes.

Cross-Jurisdictional Collaboration

In many cases, a model allowing regional collaboration is beneficial. The ability to encourage and develop regional consensus should be considered in determining effective governance models. Regional project paths require that projects can span across unincorporated and incorporated territories. Some models natively have this ability, while others will require a combination of two structures to provide regional project paths. Regional projects will require stakeholder consensus, influencing the Town Council's ability to affect regional outcomes.

POLICY & OPERATIONAL CONSIDERATIONS

Opt-In (Voluntary Participation)

Will residents be able to participate voluntarily, or will the infrastructure be treated like other utilities where connection to the infrastructure is mandatory? Voluntary participation is more politically tenable.

Billing

Does the Town have other utility billing processes, and can broadband be added to those mechanisms? If not, how will billing be handled for the capital cost, the maintenance and operations cost, and the ISP services? Also, how will billing be handled for residents that may not have a banking relationship or are not connected to modern digital financial transaction systems?

Treating the Infrastructure as an Improvement to Property

When a resident connects to municipal water, sewer, or other utility infrastructure, the connection is treated as an improvement to the property. The resident is obligated to pay off the infrastructure upfront or overtime. However, the incumbent facilities-based competition model does not impose a commitment to the infrastructure.

Customer Premises Equipment

It is common for the cost of the equipment that goes into the customer's home to be included in the initial capital cost. Will the replacement cost of that equipment be the customer's responsibility, or will it be financed through the maintenance and operations budget?

Customer Support

If the Town pursues an open access model, how will support be handled to minimize frustration for the subscriber?

KEY DECISION #3: OPERATIONAL MODEL

Choosing the right operational model depends on the roles of the market participants in the broadband value chain. For this report, three possible roles are in focus:

1. The Physical Infrastructure Provider
2. The Network Operator
3. The Service Provider(s)

Different business models arise depending on which roles the market participants take within the operational model. The following summarizes key considerations for important network attributes for the main operational models.

Model Attributes	Vertically Integrated	Dark Fiber Leasing	Manual Lit Fiber	Automated Lit Fiber
Ownership	Same entity owns the infrastructure, operations, and services	A neutral host owns and operates the infrastructure to the curb; the ISP owns the drop	A neutral host owns and operates the infrastructure but does not own services	A neutral host owns and operates infrastructure but does not own services
Closed vs. Open	Infrastructure is closed to outside service providers	Mixed—the backbone is open; the drop is closed	Infrastructure is open to outside service providers	Infrastructure is open to outside service providers
Retail vs. Wholesale Services	A single ISP is offered on a retail basis	Multiple ISPs are offered wholesale	Multiple ISPs are offered wholesale	Multiple ISPs are offered wholesale
Bundling of Roles – Are the three primary roles separated?	All three roles are bundled together—vertically integrated	Mixed	Ownership and operation of the infrastructure is unbundled from the services	All three roles are unbundled
Neutral Host	No	Mixed—the backbone is owned by a neutral host; the drop is owned and operated by the service provider	Yes	Yes
Facilities-Based Competition vs. Services-Based Competition	Facilities-based competition	Mixed—backbone network is open to multiple services; the drop is not open	Services-based competition	Services-based competition
Provisioning	The owner /operator manually provisions services	The service provider manually provisions services	The operator manually provisions services	The subscriber provisions services via automation
Virtualization	Each service requires a physical fiber	Each service requires a physical fiber	Each service requires a physical fiber	Many services can be delivered across a single fiber strand
Multiple Services Simultaneously	One service at a time	One service at a time	One service at a time	Multiple services at a time
Hardware-Defined vs. Software-Defined	Hardware	Hardware	Hardware	Software
Examples	Comcast, Charter, AT&T, Frontier, Verizon	Huntington, AL, Westminster, MD	Utopia SiFi Networks	Ammon, ID, Chico, CA Eagle, ID Mountain Home, ID

Definitions

Ownership: Digital infrastructure will be owned by a private company, a public entity (the Town), or a hybrid private-public partnership (PPP).

Closed vs. Open: **Open access** combines a business model and architecture that creates a single shared infrastructure operated by a neutral host, which gives service providers open, wholesale access at fair, reasonable, and equal terms. A Town is perfectly positioned to function as a neutral host. **Closed infrastructure** does not allow outside service providers onto the infrastructure. This results in a single ISP offering with facilities-based competition.

Open infrastructure allows for third-party service providers, which typically leads to services-based competition.

Facilities-Based Competition: Industry incumbents always follow a facilities-based model. This means that every service provider is required to construct their exclusive infrastructure to compete in a market. This increases the barriers to entry, puts more infrastructure in crowded infrastructure channels, and results in higher consumer costs. Incumbent industry models almost follow a vertically integrated model with single ownership for the infrastructure and services offered to end users.

The alternative to facilities-based competition is services-based competition. This occurs when service providers compete on a single shared infrastructure, preferably owned and operated by a neutral host that treats all service providers equally. An important goal of a neutral host should be to lower the barriers to entry to accelerate competition.

Provisioning: The provisioning of new services can either be done by the network owner/operator, the service provider, or the subscriber. The concerns for the subscriber include whether alternative services are available, how long a new service takes to be provisioned, and whether an appointment with a technician is required.

Virtualization: A technical term that describes using software to separate traffic to enable more than one service to be delivered across a single fiber strand. Virtualization is commonly used in data centers but is less common in fiber-to-the-home networks.

Multiple Services Simultaneously: A virtualized network can deliver multiple services simultaneously. A network that is not virtualized will not be able to deliver more than one service at a time. This capability will grow in importance as smart Town applications gain traction.

Retail vs. Wholesale Services: The infrastructure is available to all market participants under equal conditions in an open access network. This requires a neutral party rather than a service provider to own and operate the infrastructure.

Bundling of Roles: If one market participant takes or bundles all three roles, it functions in a vertically integrated model. Unbundling or separating the three primary roles (infrastructure, operations, and services) is an enabling requirement for a true open access network. It is necessary to optimize the functionality and cost of each role. Unbundling allows the infrastructure to be operated by a neutral party (neutral host). The unbundling of roles does not necessarily result in unbundling subscriber costs. Establishing a clear separation of roles and responsibilities within the operational model requires successfully unbundling subscriber costs.

Hardware vs. Software-Defined Management: The distinction between hardware-defined and software-defined is an emphasis on how resources are pooled and managed. For the subscriber, this translates into key concerns like how long it takes to make needed network changes, the cost for these changes, and whether the subscriber captive to a single hardware vendor. In general, it is faster and less expensive to make changes in software than in hardware and a software-defined network can be liberated from vendor lock-in.

Operational Model Summary

In January 1999, the Town of Portland, and Multnomah County, Oregon, filed a lawsuit to block AT&T's acquisition of a local cable network. Oregon public officials said they would approve the transfer if AT&T agreed to open its broadband assets to competition. The 9th U.S. Circuit Court of Appeals ruled that providing high-speed internet access is very different from the cable television business and should not be subject to the same set of regulations, and AT&T and other large incumbents were not required to open their existing infrastructure to competing service providers.

One result of this ruling has been a gradual decrease in regulations over telecommunication services over time. Another result has been that the vertically integrated model became entrenched as the de facto internet access model because legacy cable and telephone companies had the enormous advantage of existing infrastructure that could deliver the internet to the public.

The inherent limitation of the single-provider model is that it gives customers few choices and naturally trends toward monopoly control for the provider that can offer the greatest bandwidth. Alternatively, open access networks are growing in popularity for public infrastructure owners because the model improves choice, competition, and affordability and works in rural and urban settings.

The introduction of network automation enables self-service provisioning for stakeholders. It creates a more open environment, improving adoption and reducing costs. The most advanced open access networks support multiple service providers delivering services simultaneously over the network. End users can freely view the services and their associated costs and subscribe at any time. Service providers can create new categories of services, and subscribers can easily subscribe to them via an online marketplace without assistance. Additionally, the implementation is in software and can support rapid change and integration.

Source: *https://www.lightreading.com/gigabit/fttx/debunking-the-open-access-myths/a/d-id/720514*

Identifying Service Providers

Identifying the best fit for service providers will depend on the ownership and operational models selected. Finding service providers will not be difficult regardless of the model selected, but the chosen partners should align with operational objectives.

Federal Policy and Opportunities

Numerous federal programs have demonstrated a clear preference for open access fiber.

The Reconnect Loan and Grant Program will not fund legacy copper or wireless systems, only fiber by listing a requirement for 100 Megabits symmetrical service. The program awards extra points for applications meeting public ownership and open access requirements.

Source: *https://www.usda.gov/reconnect*

The recent NTIA Middle Mile Grant Program was open to public entities, requiring fiber and favoring open access in scoring.

Source: *https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/MIDDLE%20MILE%20NOFO.pdf*

NTIA's Broadband Equity, Access, and Deployment (BEAD) Program will open to applications from public entities, prioritizing the deployment of fiber and encouraging scoring that favors open access on the part of the state offices overseeing the application and award processes. As part of their goal of broadband deployment to all unserved and underserved locations, Eligible Entities may fund the deployment of Wi-Fi infrastructure to multi-family buildings that either entirely or partially lack high-speed broadband access (100/20). For example, funds can be used to extend broadband service to multi-tenant buildings lacking high-speed broadband, including those in low-income urban areas. Eligible Entities must give priority to a residential building that (1) have a substantial share of unserved households or (2) are in locations in which the percentage of individuals with a household income at or below 150% of the poverty line applicable to a family of the size involved is higher than the national percentage of such individuals.

Source: page 41 – https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf

Formalize the Selection of an Operational Model

There are downstream architecture and business plan decisions that require model selection. This makes selecting the operational model an important next step for Ridgefield. This will require stepping through the formal process of presenting the options outlined in this report to the broader committee and Town leaders, providing technical support to inform the decision-making process. The final selection should be memorialized in the meeting minutes and properly documented to inform the procurement process that will follow.

BEYOND THE THREE KEY DECISIONS

Business Model RFP

Once Town leaders have decided on a preferred direction for (1) ownership, (2) governance, and (3) business model), EntryPoint recommends conducting a public process (request for proposal (RFP), request for information (RFI), or request for qualifications (RFQ)) to select a solution partner for the selected business model. Whether the Town is pursuing a single ISP model or an open access model, this is an appropriate next step because the partner needs to advise the Town on network design, network architecture, equipment selection, quality control on construction, provisioning, and turn-up of network electronics, selection of other key partners, and general project oversight. It will be appropriate to organize the RFP to identify a solution partner for the implementation of the business model as the owner's representative for the overall project.

Selecting a partner with the demonstrated technical expertise necessary to guide and manage downstream procurement processes with the Town's oversight and approval is important.

Additional Procurement

Once selected, the business model partner can assist with organizing the specifications and solicitations for a public process (request for proposal (RFP), request for information (RFI), or request for qualifications (RFQ)) for the following:

- Assume or Procure the Network Operator Role

  If Ridgefield selects an operational model where it will assume the network operator role, clear responsibilities will need to be assigned, and resources will need to be allocated within Ridgefield to establish the workforce and expertise necessary to perform network architecture, oversee design, select materials and equipment for cost modeling, and so forth. If network operations are outsourced to a third-party, selecting a partner with the demonstrated ability to support the desired operational model and business plan at this stage is critical to achieving desired outcomes. The technical and economic ability to deliver desired functionalities will be directly related to the network provider's capabilities. Procuring this partner will be required to complete state, federal, or private funding applications.

- Design/Engineering RFP

  Select a design/engineering firm. The design process includes developing construction-ready plan documents, refining cost modeling based on network design, and initiating the make-ready process for utility pole attachments for aerial portions of the network.

- Materials RFP

  Provide technical assistance in organizing a solicitation for network materials.

- Construction RFP

  Select a design/engineering firm and help prepare the technical specifications for the construction work.

- Project Management
  The business model partner will need to provide high-level project management but will not be onsite daily to manage timelines, project milestones, and work schedules. If the Town is going to handle project management internally, the business model partner can be an advisor to assist internal project leadership. If the Town outsources project management, the business model partner can assist in organizing the specifications for a public process (request for proposal (RFP), request for information (RFI), or request for qualifications (RFQ)) to select a project management partner and then collaborate with that partner throughout the construction process.

  Key project management skills and knowledge may include, but are not limited to:

  - Managing fiber optics projects and budgets, directing construction per the approved design, and coordinating work with other staff and design team members.
  - Interfacing with Town staff, participants, and local government officials.
  - Reviewing project design as needed and coordinating adjustments to support constructability and budget outcomes.
  - Reviewing work products, quality control, and budgeting.
  - Mentoring, developing, and supervising staff.
  - Providing core project management functionality.

Project Budget

Developing a budget that can be trusted requires a process of moving from projected costs to hardened costs. This process includes a collaboration between Town staff, the business model partner, and the engineering/design partner to develop a construction-ready design. This construction-ready design will be the basis for the construction RFP. The design will be refined once a construction partner is selected. Still, the construction-ready design should be 98% accurate.

Phasing

The business model partner can assist with refining the phasing options being considered and provide financial analysis on these options. The primary phasing decision will be whether to build as quickly as possible or pursue an extended process which may be necessary due to internal constraints. Potential internal considerations specific to Ridgefield may include:

- Leveraging planned road construction of Town water system and installing conduit.
- Leveraging planned sidewalk construction of Town water system and installing conduit.
- Build in conjunction with other large construction or public works projects in Ridgefield.
- Strategically selecting neighborhoods most impacted by affordability constraints.

Work with State Agencies to Streamline Processes

Multiple touchpoints with various state offices and authorities represent opportunities for improving outcomes for potential network subscribers. These include procurement, regulatory, and financing processes. The Connecticut Broadband office could become a helpful partner in advancing these initiatives. The following are examples in which state agencies could assist Connecticut Towns in improving processes and related functions:

- Create a procurement vehicle that municipalities could use to qualify bidders.
- Provide structural advocacy and technical assistance in procurement so municipalities aren't duplicating efforts and competing for limited resources.
- Pursue legislation to expand the statutory tools available to cities to build municipal networks.
- Review and guide RFP documents.

SECTION 8

Addendum

Addendum

The content in the Addendum provides additional detail related to:

- Infrastructure Grants
- Network Architecture
- Media Comparison
- Business Model Options
- Risk Assessment
- Community Engagement

Infrastructure Grants

The Town and its partners should pursue all available federal and state broadband grant opportunities that may be a fit for Ridgefield's proposed project.

Potential supplementary capital sources may include:

- American Rescue Plan Act (ARPA)
- Infrastructure Investment and Jobs Act (IIJA)
- State Grants
- Other

American Rescue Plan Act (ARPA)

The final rule for the Coronavirus State & Local Fiscal Recovery Funds (SLFRF), which is part of ARPA, took effect on April 1, 2022. The United States 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.

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

Infrastructure Investment and Jobs Act (IIJA)

President Biden's Infrastructure Investment and Jobs Act (IIJA) 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, healthcare, 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/

Individual State Broadband Grants

Broadband Equity, Access, and Deployment (BEAD) Program funding includes $42.45 billion for a new program focused on connecting underserved areas by distributing 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 universal broadband.

FCC's Affordable Connectivity Program (ACP)

The $14 billion Affordable Connectivity Program (ACP) is a targeted subsidy that provides up to $30 per month for qualifying households. Analysis provided by the City of Baltimore in 2021 found that only 40.7% of residents have access to a broadband subscription. This means nearly 96,000 individuals in Baltimore do not have access to a broadband subscription. Additionally, 33.3% of residents—75,000—do not have access to a computer. The federal subsidy program was designed to address both challenges. However, according to the FCC's data, only 34,734 households in the Baltimore area had registered for the federal subsidy at the time of the analysis. Three barriers identified by a Baltimore task force were that the subsidy seemed "too good to be true," providers promoted the subsidy through marketing materials, and sales representatives attempted to upsell customers. A key takeaway provided by the Baltimore task force is relevant for Ridgefield and other cities with a known digital divide gap: "a trusted point of contact for community members to call made it easier to help wary residents enroll in the program." Additionally, having resources available to help overcome language barriers also made It easier to get residents enrolled. Ridgefield may be able to access funds from a Digital Equity Grant to function as a digital navigator to help resident's sign-up for the ACP subsidy.

Source: https://www.benton.org/headlines/baltimore-and-emergency-broadband-benefit-program

Overview of Network Financing Considerations

Historic levels of funding for digital infrastructure seek to close existing gaps, support public ownership, and encourage open access. Public opinion supports treating digital access like roads, bridges, water, sewer, and power. Combining these key aspects will provide Ridgefield with a fiber optic access utility capable of providing maximum service, including reliability and accessibility, for the least cost to subscribers.

Network Architecture

Network architecture has a meaningful impact on network reliability. The description below covers variables that should be considered for network reliability.

The two main network designs are switched ethernet (also known as "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). In contrast, switched ethernet gives subscribers their dedicated connection.

Switched Ethernet Network

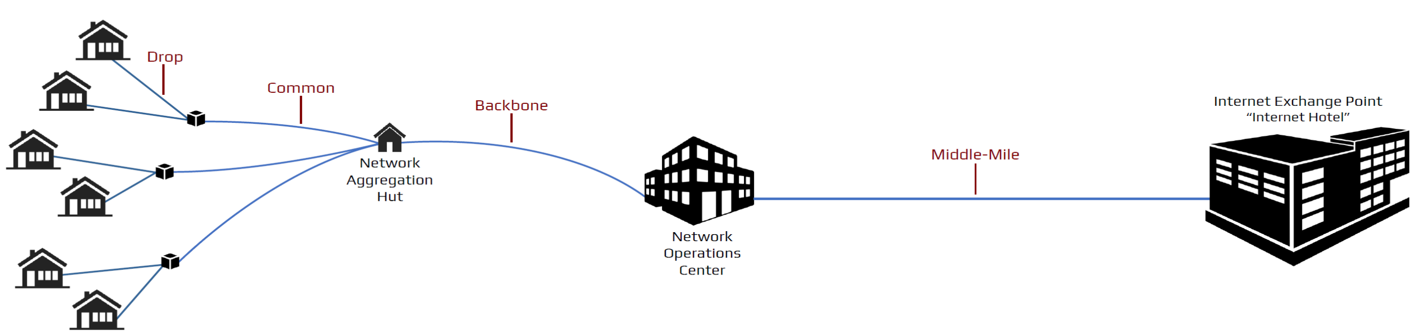
The switched ethernet architecture provides a dedicated connection for each customer rather than a shared connection. The customer experience is significantly better than in a shared architecture during periods of network congestion because the throughput of a switch-based architecture is superior to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

Passive Optical Network (PON)

Passive optical networks (PON) use 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. This change in pricing differences was driven by the fact that all data center deployments use switched ethernet architectures. 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 third-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.

Internet Exchange Point = An internet exchange point is the central point where all internet traffic flows for routing. This is analogous to the role of a central post office for the U.S. postal system.

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. DSL is asymmetrical (the download speed is much faster than the upload speed) and 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.

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. Cable TV companies primarily use coaxial cable to connect transmission facilities to customer homes and businesses to deliver cable TV and internet access. Coaxial cable is asymmetrical and shared between up to 200 customers or more. The most recent cable standard 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 Ridgefield is 3.1, and the maximum speed available is 940 Mbps. In addition to the limitation of sharing among many 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. Researchers have successfully demonstrated a transmission experiment over 1045 km with a data rate of 159 Tbps.

Source: 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, or approximately 37 miles, 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 device. Wireless internet can be accessed directly through cellular providers like AT&T Wireless, Verizon Wireless, and T-Mobile or by a wireless internet service provider (WISP). Wireless reliability can be affected by poor weather conditions and may require line of sight.

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. 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. Instead, there are several frequencies used by 5G networks, and these different frequencies have different advantages and disadvantages – depending on the application.

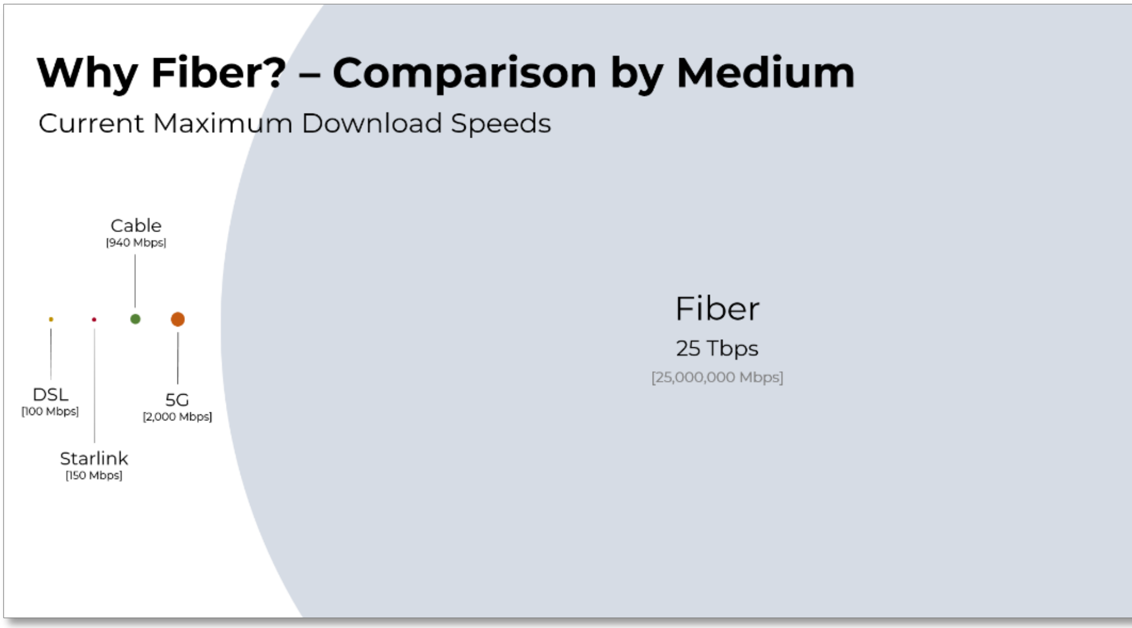
- **Low-band 5G** operates between 600-850 MHz. This is only moderately faster than 4G with speeds between 50-250 Mbps and offers similar coverage areas for each cell tower.
- **Mid-band 5G** operates in the 2.5-3.7 GHz range and delivers speeds between 100-900 Mbps. While offering less range per cell 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 associated with 5G. Operating at 25-39 GHz, this is known as the “millimeter wave” spectrum and delivers gigabit speeds (currently tested as high as 3 Gbps). The millimeter wave transmitters have a very limited range and require the deployment of many small transmitters. Each transmitter connects to fiber optics.

Source: 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.

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 the 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. It is also important for telemedicine and online schooling to ensure good picture quality with video calls. Applications that depend on good upload speeds include sending large files, cloud applications like Microsoft 365/One Drive, Google Docs, Dropbox, VoIP, FaceTime, Skype, Zoom, WebEx, Microsoft Teams video calls, hard drive backups, and in-house web hosting.

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

- Vertically Integrated – Privately Owned & Operated
- Publicly Owned & Privately Operated
- Publicly Owned & Operated

Access

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

Ownership Considerations

Vertically Integrated – Privately Owned & Operated

A private owner designs, builds, and operates a network. The private builder and operator controls pricing, the business model and architecture, assumes all the risk, oversees the design, project management, construction, customer acquisition, and operations.

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

Publicly Owned & Privately Operated

A community (e.g., city, town, or county) owns the network and utilizes a third-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 or semi-regulated private company, which 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 employment, and the percentage the operator takes for profits. Public owners have greater incentives to solve the digital divide. The private operator has limited risk because it does not need to recover a capital investment.

The current model suggests that each ISP builds its infrastructure. That is not necessary with fiber optics. One good fiber network will provide up to a 100-year infrastructure. Multiple fiber networks will only drive up the costs for consumers and will provide no new or added value to the community.

Publicly Owned & Operated

A neutral host, such as a 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 is primarily the most common infrastructure built out today and mainly provides advantages only to the ISP. A single ISP does not expand choice or competition and may 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 infrastructure and electronics. Operating a dark fiber network is less complicated than operating a lit network. 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. For example, giving up control over the drop from the curb to the premise. The dark fiber model, therefore, limits each fiber strands' usability. With an isolated dark fiber connection, the range of possible services and service attributes is limited to services offered by the ISP controlling the drop to the premise. 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 internet service providers can be requested from a web portal and may appear 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

Lit Fiber – 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. Automated provisioning creates a marketplace for services including ISPs 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 a technology solution provider in these networks.

Risk Assessment

The Town seeks to understand the primary risks of building and operating a municipal fiber-optic network and to actively manage those risks during construction and ongoing network operations.

The following is an analysis of the main risk factors facing the Town of Ridgefield if it pursues its fiber-to-the-premise deployment.

Take-Rate Risk	Timeline Risk
Subscriber Churn Risk	Regulatory Risk
Project Execution Risk	Middle Mile Risk
Equipment and Technology Risk	Pole Attachment & Make-Ready Risk
Community Engagement Risk	Network Aggregation Huts Risk
Cost Modeling Risk	

Take-Rate Risk

Take-Rate Risk (demand risk) is the risk that the Town builds out the network and ends up with fewer subscribers than expected.

Likelihood: Take-rate risk is an important risk factor and is a function of the network's value proposition and how well that value proposition gets communicated and managed before, during, and after construction. 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: Positive take-rates and performance will compound to the benefit of all stakeholders. Negative take-rates lead to higher costs and churn, which creates a negative spiral that compounds until the network is not sustainable.

Mitigation: To mitigate take-rate risk, demand aggregation must be managed before, during, and after construction and give consumers a value proposition that makes them voluntarily committed to the network infrastructure.

Subscriber Churn Risk

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

Likelihood: Today, customers are primarily motivated 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 higher if a new market solution replicates the incumbent model.

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

Mitigation: The risk of churn goes down under a business model where 1) the customer connection is treated as an improvement to the property, and 2) the value proposition is strong enough to make the customer committed to the network.

Project Execution Risk

Project Execution Risk includes the risks related to fulfilling expectations for 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 where project execution affects the value proposition, affecting take-rate and churn.

Mitigation: This risk is reduced by hiring or partnering with skilled project managers and key strategic partners and creating alignment among key team members on the project and operational plans. Further, it is important to develop project controls that are monitored and reported to senior leadership monthly. State agencies could also provide technical assistance, execution standards, and monitoring to mitigate project execution risk.

Equipment & Technology Risk

Equipment & Technology Risk includes 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.

Likelihood: Solutions with short deployment histories, unreliable references, unclear quality assurance 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, which has sufficient history to present a minor risk to the project. The 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 Risk

Community engagement includes 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 can be managed and monitored through proactive engagement. Poor planning, management, and execution increase the level of risk. Community engagement can be handled by internal Town staff. However, the risk increases if staff member resources are inadequate for a project of this size. There are external marketing professionals available to assist with the 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 marketing professionals and provide sufficient resources to make it easy for residents to learn the basic value proposition through a variety of education and communication strategies.

Cost Modeling Risk

Cost Modeling Risk is the risk that the financial modeling performed significantly misstates actual design, construction, and/or operational costs.

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

Impact: Cost overruns significantly can impact network construction and sustainability.

Mitigation: Risk is reduced by validating financial assumptions against industry assumptions, market conditions, and accounting for local economic variables. As inflation and demand for materials drive market demand pressure in the short-term, state procurement of electronics and materials may help mitigate the impact through economies of scale.

Timeline Risk

The benefits of building the network at 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 time to break even.
3. An accelerated timeline reduces the potential for unexpected movement in interest rates.

Likelihood: Costs are likely 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.

Impact: Costs will be incrementally higher for an extended buildout schedule, and maintenance and operations will have a longer ramp to sustainability.

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

Regulatory Risk

Regulatory Risk is the risk when state or federal regulations become an impediment or barrier to the Town successfully building or operating a municipal network. The Ridgefield Town Attorney should prepare a separate analysis describing the Town's legal authority to build, own, and operate broadband infrastructure as well as information on Connecticut statutes and regulatory rulings applicable to municipal broadband.

EntryPoint has not sought a legal opinion on this, nor do we have an attorney on staff, but our understanding is that the State of Connecticut does not have explicit barriers to municipal Town broadband.

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.

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

Mitigation: It is important for the Town Attorney to summarize any relevant Connecticut state code findings for Town leaders.

Middle Mile Risk

Middle mile risks include the following:

1. Lack of redundant options on divergent paths
2. Pricing risk—the cost of connecting to middle mile carriers
3. The risk of being stranded or isolated without a viable path to an internet exchange point

Likelihood: Ridgefield will likely have a middle mile path back to an internet exchange point in the Metro Hartford Region. However, this analysis needs to be done if the Town moves forward to the next phase of the project.

Impact: The middle mile risks listed above could significantly impact network success, but all of them have a low likelihood of occurring because Ridgefield is likely to have a path back to Hartford, at least on the Nutmeg network.

Mitigation: The Town can mitigate and possibly eliminate middle mile risk by building redundancy to the network by having multiple backhaul providers or multiple independent paths back to an internet exchange point.

Pole Attachment & Make-Ready Risk

Pole owners can cause unexpected and significant impact on costs or timeline due to delays in make-ready and pole attachment work.

Likelihood: Because Ridgefield does not own the utility poles in its service area, this risk is important. There may be poles which need replacement or repair which will add to project's total cost.

Impact: Make-ready work for pole attachments can have a meaningful impact on costs and timeline if the pole owners are non-responsive or want the Town to replace old poles.

Mitigation: The Town can manage the pole attachment process or pursue a buried network—which is more expensive up front but has many long-term maintenance advantages and should be considered.

Real Estate Risk for Network Aggregation Huts

The Town of Ridgefield may need to identify a location or two which is suitable for aggregation huts in Town neighborhoods.

Likelihood: The likelihood of this risk can be identified during low-level and construction-ready design phases. The Town will need to potentially collaborate with schools or other community organizations to solve this problem.

Impact: The worst-case scenario would be that any fiber runs that cannot be aggregated into a neighborhood hut will need to either go into smaller cabinets out in the field or be designed for a homerun to the network's central office. This may increase the cost of fiber materials.

Mitigation: The Town will need to work with community partners (like schools), utilize cabinets out in the field, or follow a design that runs all fiber strands back to the home office. The optimal solution can be identified in the construction-ready design work.

Community Engagement – Evaluation & Education

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

Community Survey

Residents and business owners were surveyed 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 local utility that offers lower costs, an increase in choice, subscriber control, and fosters digital inclusion. Use customized videos to educate online visitors on topics such as the functionality of the community fiber network, options for services, frequently asked questions (FAQs), and more.

Mapping Community Interest

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

Marketing & Promotion

Utilize press releases to promote the municipal fiber network, driving traffic to the fiber website to educate community members, generate interest, and encourage community participation. Use all available social media platforms (e.g., Facebook, Instagram, Twitter) to promote the fiber network.

Neighborhood Entrance and Yard Signs

As construction (fiber build) begins in a neighborhood, Ridgefield 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 can be placed in the yards of subscribers, indicating that the home now enjoys a fiber broadband connection.

Grassroots Engagement

Webinars & Open House Events

Ridgefield can use webinars and open house events to educate residents and business owners about the fiber project, ask questions and 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, Town 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 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 (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 Ridgefield fiber program. Ridgefield leaders and employees support the fiber champions in their efforts. Fiber champions drive conversations and contractual commitments of neighbors via the door-to-door sales and education campaign.

A Ridgefield Community Broadband Committee could provide an advisory governance role and be composed of a champion from each neighborhood to represent diverse views and lived experiences.

Door-to-Door Campaign

Individuals representing the local network contact residents and business operators within the planned footprint to answer questions and ascertain the potential subscribers' interest in 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.

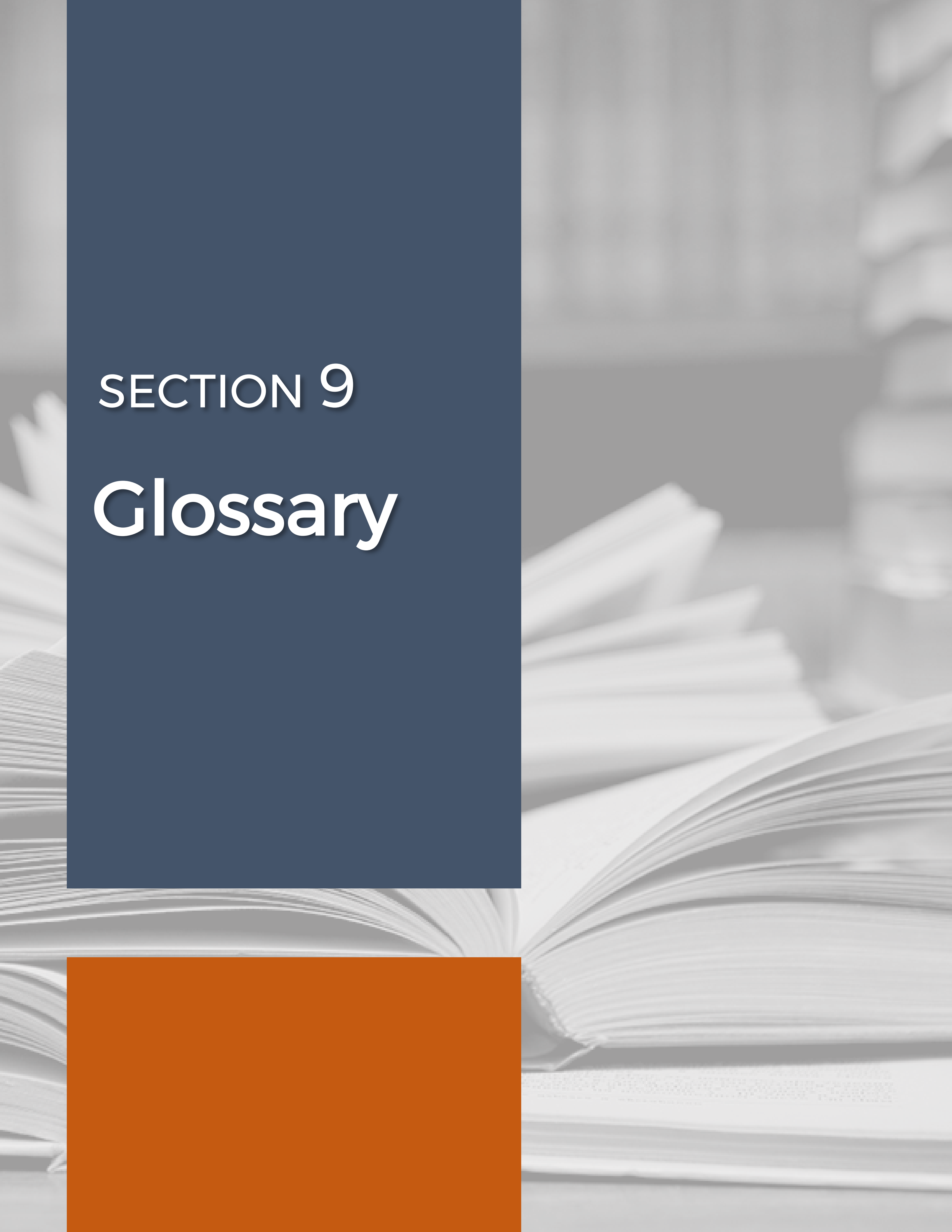
To maximize the effectiveness of this process, door hangers are distributed to every home and business before canvassing a neighborhood. These inform property owners that a representative will be stopping by to explain the value proposition, answer questions, and determine the level of interest from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

Door-to-door campaigns are very effective in allowing people 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 public relations firms.

Another path to explore is nonprofit organizations that provide digital literacy programs. These programs typically target the underserved and senior populations with education, communication, and subscribership. They often host local programs that residents can participate in as well as contribute to community engagement and door-to-door efforts.

Commissions for a door-to-door campaign and digital literacy programs can be funded by a sign-up fee or wrapped into the infrastructure installation cost.



SECTION 9

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 not 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.
Microtrenching	Fiber strands in conduit are placed in a 2”-3” wide trench that is usually cut in asphalt roadways or sidewalks.	Microtrenching is a fiber network construction technique that lays the protective conduit that houses the fiber strands below and at the side of a roadway. It requires much less digging and much less disruption than other network building methods.
Digital Divide	Digitally unserved and/or underserved neighborhoods and/or demographic—typically lower-income and rural communities	The gulf between those who have ready access and affordability to 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.

Industry Terms and Abbreviations (Continued)

Term	Description	Definition / Narrative
Internet Exchange Point	IXPs or IXes or internet exchange hotel	An internet exchange point is the central point where all internet traffic flows for routing. This is analogous to the role of a central post office for the U.S. postal system.
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.
M-LAB	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 of the United States of America 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 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 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 the street into the home or business	Drop is the fiber that runs from the street to the premise (home or business).
Middle Mile	Shared fiber infrastructure from the network operations center to the internet exchange point	The middle mile is usually third-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.

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