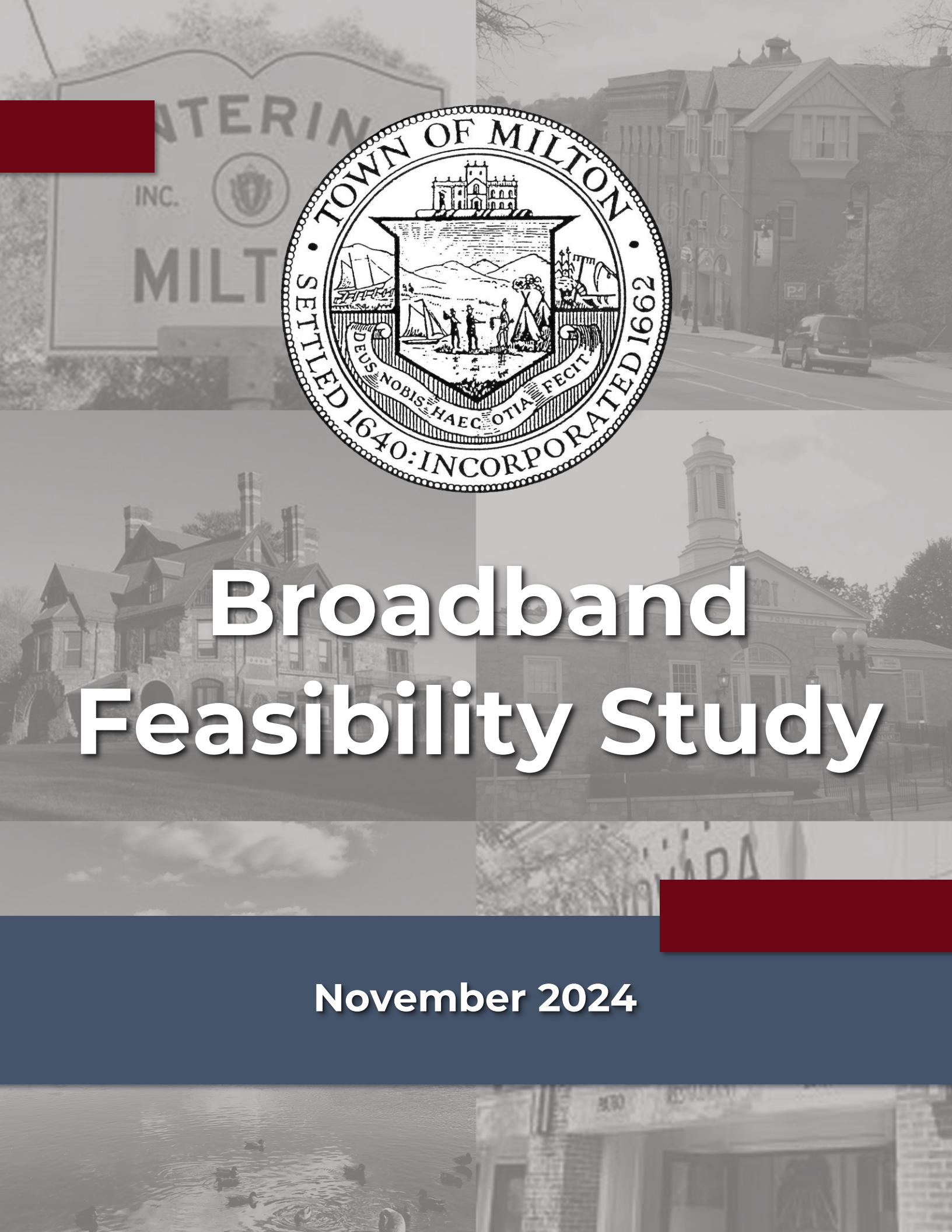

Broadband Feasibility Study

November 2024

Broadband Feasibility Study

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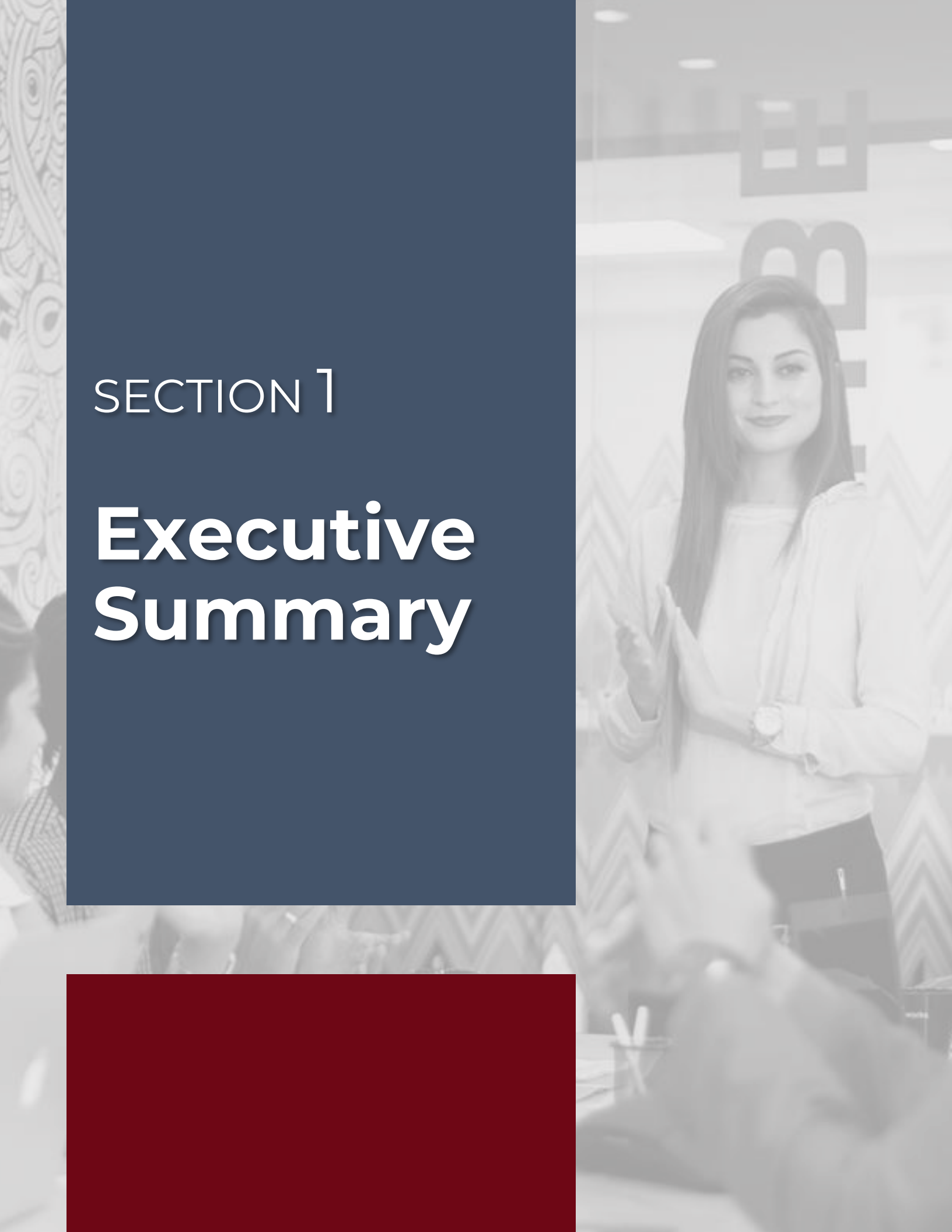
SECTION 1

Executive Summary



Broadband Feasibility Study

Executive Summary

The Town of Milton is a little over 13 square miles and borders Boston, Quincy, Randolph, and Canton. According to the Milton Department of Public works, Milton has a population of approximately 28,450 with 8,500 to 9,000 residential and business premises. Quincy is currently launching an effort to deploy city-owned digital infrastructure.

Milton's Broadband Committee has been tasked with evaluating the feasibility and advisability of building a "Fiber to the Premise" municipal network that would connect households and businesses to the internet. This work is an acknowledgement that reliable internet has now risen to the level of essential infrastructure, and it is in the Town's interest to evaluate whether the Town should play an active policy and ownership role related to digital infrastructure.

In 2018, the Select Board of the Town of Milton appointed a Municipal Broadband Committee to explore the feasibility of deploying Town-owned fiber optic infrastructure throughout the town. The first tangible result from the committee's work is that the town will soon begin updating the existing Town institutional network (I-Net) that will connect Town buildings and schools. The new I-Net is primarily funded by Federal ARPA grants and will replace the existing Town network that has been declared obsolete by the former provider.

The I-Net's purpose is to connect Town offices for municipal business via a private network. The spare fiber optic strands can also serve as the backbone for a larger Fiber-to-the-Premise network if Town leaders elect to move forward with a larger network. Town Meeting members have already voted to establish a Municipal Light Plant (MLP) to advance the process of evaluating owning and operating such a network.

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

All three key decisions will be influenced by Project Costs. The total projected infrastructure costs for a Town owned municipal open access deployment have been forecasted using two models, Ethernet and Pon (definitions in the addendum section):

- Capital costs for an XGS-PON 10% buried/90% aerial network are estimated to be $22,221,000.
- Capital costs for an Ethernet 10% buried/90% aerial network are estimated to be $24,907,500.

These scenarios are calculated, assuming 9,000 premises passed with a projected 50% take-rate (4,500 subscribers) and a long-term bond rate of 4% over 30 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. At this time, there has been no analysis on the potential cost for pole replacement or make-ready for a potential project in Milton. However, we know Verizon and Eversource own the poles. This could create a situation where Verizon/Eversource make it difficult and expensive to be on the poles. It is important to consider this when looking at whether to go down the path of an aerial or buried network. A buried network also has the advantages of greater resiliency to weather related disasters.

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

Projected Residential Services Monthly Costs	Ethernet 10% Buried / 90% Aerial	XGS-PON 10% Buried / 90% Aerial
Infrastructure	$26.68	$23.80
Maintenance and Operations	$27.07	$27.07
ISP Services (Dedicated 1 GB Symmetrical)	$14.99	$14.99
Total Monthly Subscriber Costs	**$68.74**	**$65.86**

A significant cost advantage of a municipal network is that rates for municipal debt are in the 4%-6% range while Private Debt and Equity rates are between 10% - 25%. The current national median cost for broadband service is $74.99 (Consumer Reports - broadband pricing market research). Market research in this analysis reveals that the three broadband options currently available in the Town of Milton include the following Gigabit (GB) pricing: Xfinity/Comcast ($115), Astound/RCN ($71.93) which offers traditional cable and limited fiber services, and Verizon, offering 5G wireless, DSL, and Fios Fiber (99.99). In addition to the projected lower cost for a GB service from a municipal network, a significant advantage of a municipal network is that once the infrastructure portion of the total cost is paid down, the total cost of the network can be reduced by 30%-40%. As a matter of policy, this can be on an individual or group basis. The table above shows that a constructed fiber network would provide lower pricing compared to national averages for 1 GB service from fiber and cable networks. Once the infrastructure is paid off, the costs of a Milton fiber network would be 40% - 50% lower than national averages for comparable speeds. Municipal networks tend to treat this infrastructure like water or sewer systems and the only charges in perpetuity are the costs for maintenance, operations, and services.

For example:

Projected Residential Services Monthly Costs	Ethernet 10% Buried / 90% Aerial	XGS-PON 10% Buried / 90% Aerial
Infrastructure (Goes away when paid off)	~~$26.68~~	~~$23.80~~
Maintenance and Operations	$27.07	$27.07
ISP Services (Dedicated 1 GB Symmetrical)	$14.99	$14.99
Total Monthly Subscriber Costs	**$42.06**	**$42.06**

The current standard for building fiber networks has begun to trend towards PON hardware. The early advantages that ethernet had over PON have greatly been reduced with the introduction of XGS-PON. The historical disadvantage of PON networks is an architecture which is shared between 32 – 64 homes. Historically, this has resulted in slower speeds during times of network congestion. XGS-PON has largely solved this issue by increasing the shared pipe from 2.5 GB to 10 GB and by making the network symmetrical rather

than asymmetrical. PON systems continue improving their speeds, effectively erasing the perceivable advantages of ethernet. PON is solidifying its position as the industry standard because it is a more cost-effective solution – particularly in urban areas.

The committee chose not to conduct a high-level feasibility engineering design at this time due to cost considerations. However, financial modeling was developed based on other geographically similar studies and other benchmarking. The committee elected to project costs based on 9,000 total premises.

The research that was conducted includes data gathered in committee meetings, access to national data, and geographically similar engineering analysis. Financial projections include a combination of aerial and underground infrastructure, business model illustrations, and estimated customer cost scenarios. This analysis illustrates ways to deploy and maintain a fiber-optic network in Milton, including installation, equipment and network maintenance.

If this initiative goes forward, the project would be developed with the following principles and objectives:

1. Nobody will be forced to participate. Participation would be on a voluntary, opt-in basis.
2. Taxes would not be increased to fund the network.
3. The ongoing operation of the network would be self-sustaining and not dependent on any kind of subsidy from the Town.

Primary goals for this infrastructure initiative include the following:

1. Lower the cost of internet access for both residents and businesses.
2. Increase competition giving residents and businesses multiple choices of new Internet Service Providers (ideally, 4-5 new options).
3. Build a state-of-the-art network that will improve economic development and foster innovation.
4. Leverage the network to improve the services provided in the Town including public safety, transportation, healthcare, education, emergency communications, transactive energy (smart grid) and new services that will become possible with advanced network infrastructure.

Broadband Feasibility Study

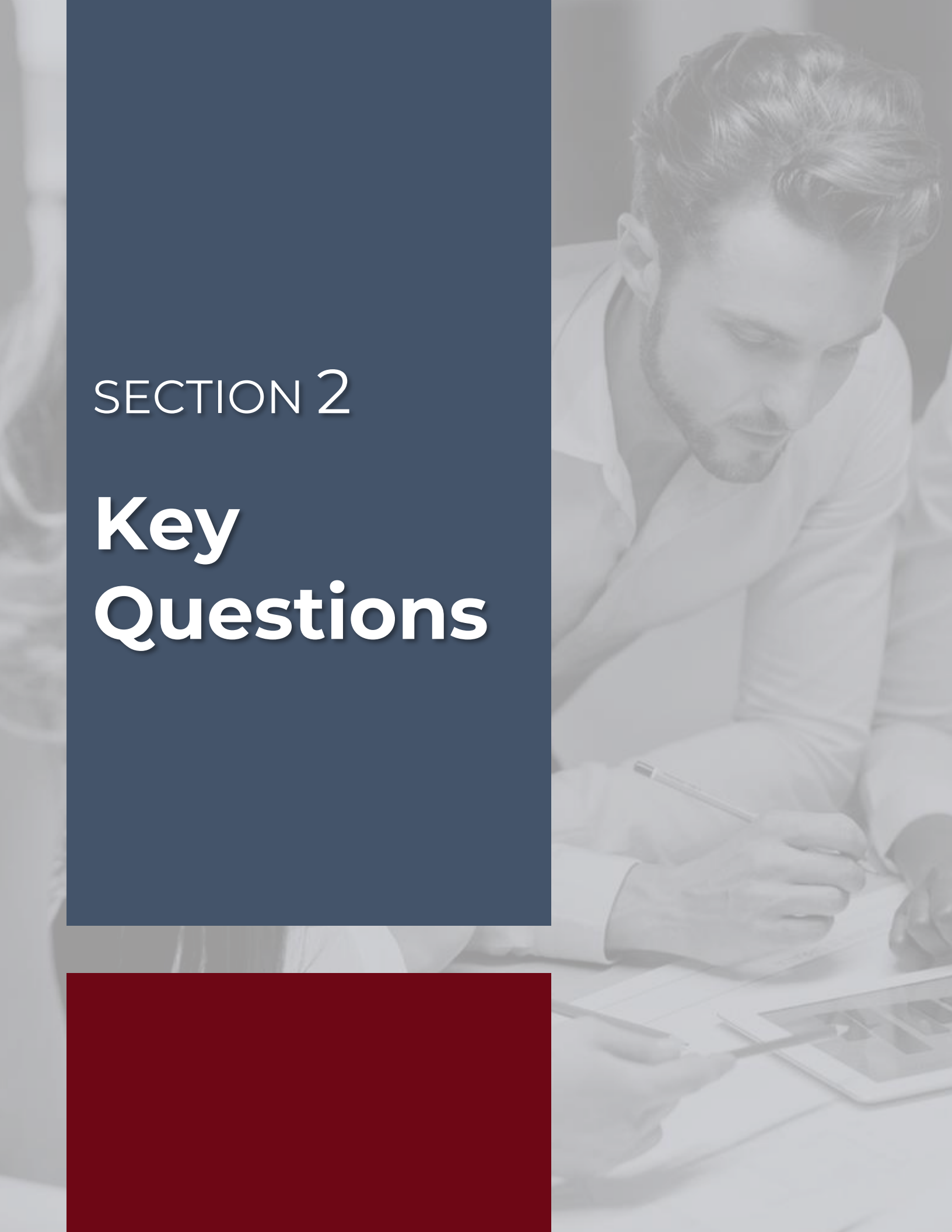
Key takeaways to drive real change in affordability and availability for the residents and businesses of Milton include the following:

1. Ownership and control of the infrastructure should be a neutral host 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 neutral host 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.
4. Observe the process and results in neighboring Quincy, which is preparing to launch an Open Access network.
5. If Milton chooses to move forward with a municipally sponsored network, a meaningful benefit can likely be derived from leveraging the Town's INET which is currently moving forward.

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.

The Municipal Broadband Advisory Committee contracted with EntryPoint Networks, Inc. to manage the feasibility analysis. Community interest and feedback has been collected through a survey which was open for residents for approximately 10-weeks. This report reflects those survey results as well as additional findings material to a potential municipally owned fiber optic broadband network.

Disclosure: EntryPoint Networks owns and operates a SaaS model automated open access® solution for both public and privately owned infrastructure.



SECTION 2

Key Questions

Broadband Feasibility Study

Key Questions

This plan is organized around three key questions

1. **Why should Milton consider building a municipal fiber optic network?**
2. **What are the benefits of a municipal fiber network?**
3. **What are the next steps to advance the process?**

1 Why Should Milton Consider Building a Municipal Fiber Network?

Reliable digital infrastructure is vital to 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. Due to the critical nature of digital infrastructure, ensuring the presence of a reliable and ubiquitous 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 that are important in a Town. A local open access municipal fiber network can overcome each of the following limitations.

Broadband Feasibility Study

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 several of these opportunities are contrary to profit motives and existing incentives, commercial internet service providers (ISPs) are unlikely to pursue those initiatives.

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 subscribers to pay off the infrastructure cost and eliminate that line item once the infrastructure debt has been retired.
5. Leveraging automation to lower operational expenditures.
6. 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 being 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 in availability, affordability, and accessibility. 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 with these systems. However, the network is now so fundamental to modern life and commerce that municipalities are increasingly taking a more active role to ensure the outcomes needed from 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 creates incentives that are aligned with offering 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. Further, the Town has existing utility systems including billing and other administrative functions already in place to support a municipal fiber utility.

5) Increase Competition Through an Open Access Model

A key strategic objective of the committee is to increase competition and choice for subscribers. 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 distribution partner is not necessarily the generation or transmission provider of the electricity.

A single ISP model can be used but that model will have a limited effect on the objective of increasing competition and choice. A comparison of the Single ISP (Vertically Integrated) model and the various Open Access models is provided on page 35 of this document.

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, local business owners, and visitors of Milton 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 Milton is aligned with the interests of residents and business owners to support a network that delivers maximum value for a competitive cost.

8) Establish Local Control Over Pricing and Reliability

Local control over critical infrastructure allows the needs of residents and business owners in Milton 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 Milton to leverage the power of the network in advancing communication solutions for these issues.

Broadband Feasibility Study

What Are the Next Steps to Advance the Process?

3

If Town leaders determine the plan has sufficient merit, the following steps are recommended to advance this initiative.

The seven core elements listed in the graphic below are critical to success of a municipal broadband network. The objective of this section is to provide an outline for actions to be taken once the Broadband Feasibility Study becomes an actionable plan. This outline suggests an order to the steps; however, some will be continuous and run concurrently. For example, community education and engagement will be ongoing throughout the process. Town leaders and the community must align the vision for the overall project to be successful.

Advance the process, document the strategy, and formalize the following 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 governance structure that is appropriate to advance the Town's objectives (Town-owned – Town-operated vs. Town-owned – third-party operated).
3) Business/Operational Model: Decide whether a vertically integrated (single ISP) or an open access model aligns with the Town's objectives.

Once key decisions (i.e., ownership, governance, and the operational model) have been determined, selecting an open access partner is a critical next step in advancing the process. No two open access systems are alike. Not only do they operate under different business models, but they are also unique regarding financing, architecture, design, capability, and technology requirements. Depending on the partner you choose some or all the following steps may apply:

- Work with the community throughout the process to raise awareness, educate, and engage.
- Conduct an open access business model request for proposal (RFP) – this should include but may not be limited to project management, billing, customer support, installation, hardware, software, and the network operations center (NOC).
- Prepare to apply for state and federal grants.
- Assume or procure the network operator role – insource or outsource.
- Conduct the engineering request for proposal (RFP) - in partnership with the open access business partner.
- Conduct the materials request for proposal (RFP) - in partnership with the open access business partner.
- Conduct the construction request for proposal (RFP) - in partnership with the open-access business partner.
- Finalize the project budget.
- Finalize the implementation phasing plan.

Observe Results in Neighboring Quincy

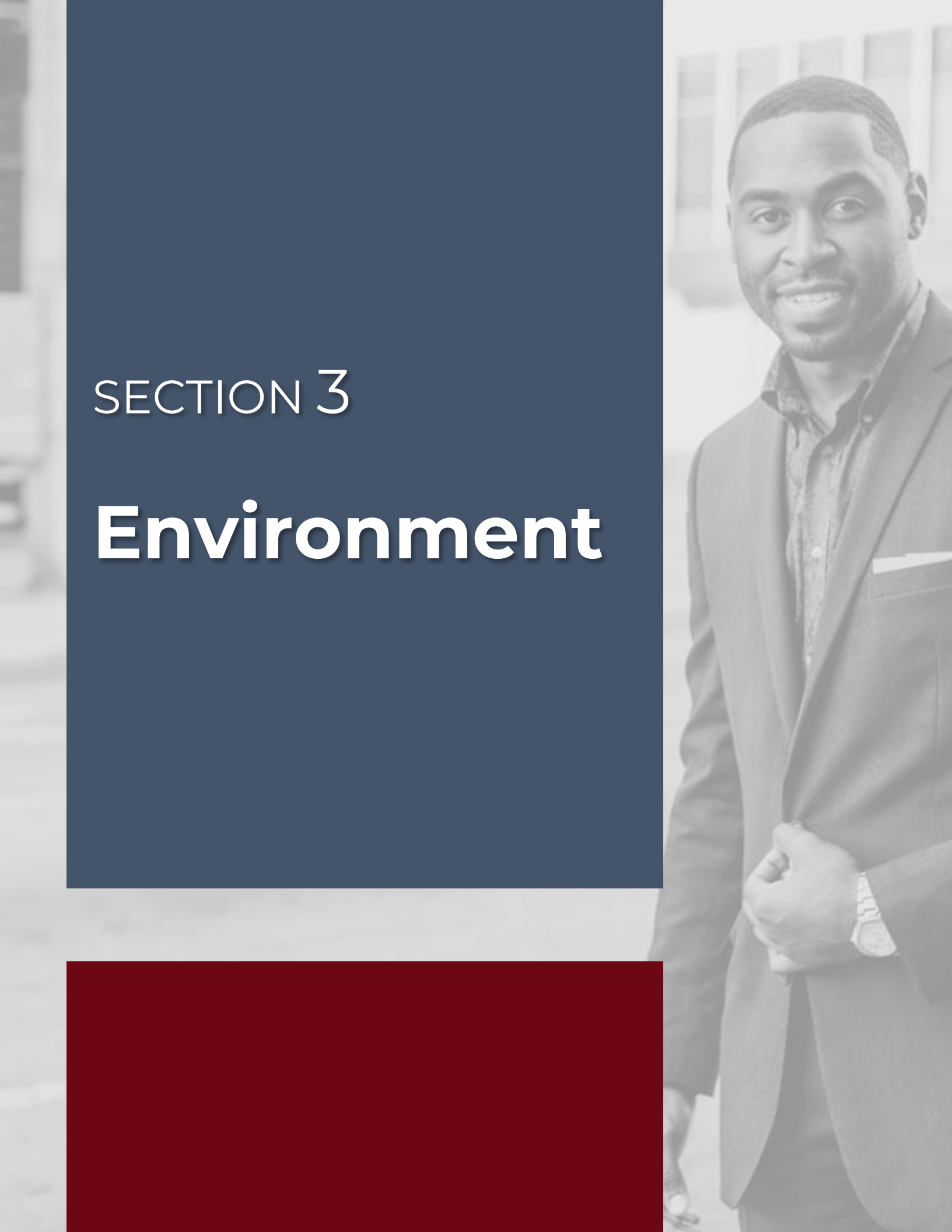
The City of Quincy is mobilizing to deploy open access infrastructure beginning in 2025. Observing outcomes from this neighboring city will provide key insights for decision makers at the Town of Milton.

A series of recommended actions and considerations are outlined in detail beginning in the Next Steps section.

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.

SECTION 3

Environment



Environment

Demographics

The following are key demographics and income statistics for the Town of Milton in 2022:

- Total population – 28,450
- Total households – 9,139
- Race and ethnicity – 69% White, 4% Hispanic, 16% Black, 6% Asian, 0% Native American, 5% Two or More
- Gender – 47% male, 53% female
- High school graduate or equivalency – 95.8%
- Bachelor's degree – 67.7%
- Square miles covered – 13
- People per square mile – 2,186.6
- Properties that are owner occupied – 84%
- Average household size – 2.9
- Persons below the poverty line – 5.5%
- Median household income – $170,531
- Median state household income – $94,488
- Median national household income – $69,021
- Households that have a computer – 97.4%
- Households with a broadband connection – 95.6%

Source: *https://censusreporter.org/profiles/16000US2541725-milton-ma/*

Broadband Feasibility Study

Anchor Institutions

The Milton Broadband Committee and EntryPoint have identified the Town of Milton'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: *https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf*

Milton Anchor Institutions

Education

- Curry College
- Delphi Academy
- Milton High School
- Milton School District
- Glover Elementary School
- Cunningham Elementary School
- Milton Academy
- St Mary of the Hills School
- The Goddard School of Milton
- Village School
- Collicot School
- St Agatha School
- Tucker Elementary School
- Wilson-Kindelan School
- Pierce Middle School
- Labouré College of Healthcare

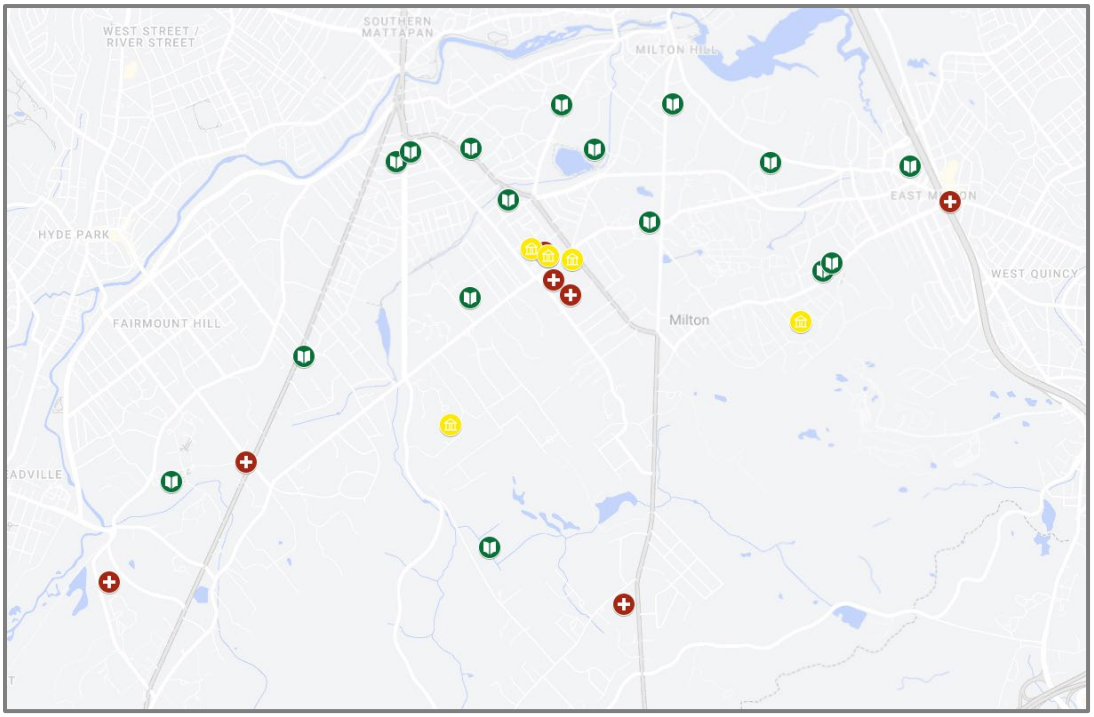
Healthcare/Emergency Services

- Milton Health Care
- Beth Israel Deaconess Hospital–Milton
- Milton Fire Department
- Milton Fire Department
- Milton Fire Department
- Milton Police Department
- Fallon Ambulance

Government/Community

- Milton Town Hall
- Milton Public Library
- MILTON SENIOR CENTER
- Milton Housing Authority
- Milton Animal League

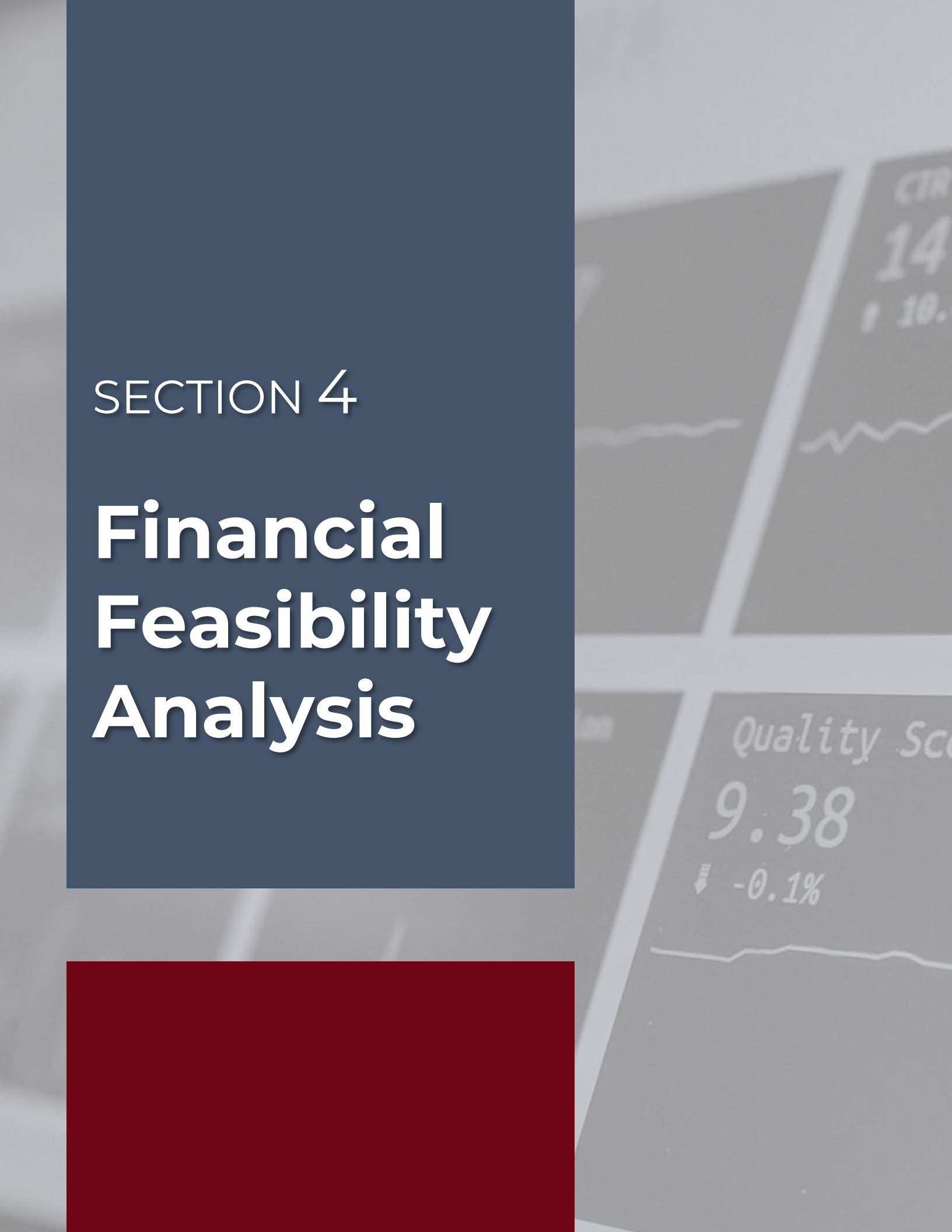
The Town will seek these anchor institutions as customers, service providers, and locations to provide digital literacy and education. A selection of these institutions is illustrated on the map below. Click here to access this interactive Google Map or follow the source link below.



Source: *https://www.google.com/maps/d/edit?mid=1qcDbZsSmq7iChNKYT1mLnmi1-Jbg4kU&usp=sharing*

SECTION 4

Financial 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 projections for a Town owned and operated broadband infrastructure. This report considers two technology options, XGS-PON and Ethernet. Financial illustrations have been projected for both network deployments.

Financial Feasibility

A key objective of the Milton broadband committee is that the infrastructure must be available to everyone at affordable rates. Milton's pursuit of universal availability and affordability will lead to different outcomes than those available via the current options available to the businesses and residents of Milton. This analysis is built on the following:

- Estimated Current Internet Expenses in Milton
- Projected Total Cost of a Townwide Deployment
- Projected Cost per Household at a 50% Take-Rate

Aggregate Internet Connectivity Cost in Milton Today

The following table provides a reasonable estimate of how much money the residents of Milton 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 also an opportunity to keep some of those dollars in the local economy. 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 $8.1 million is leaving the community today on an annual basis.

Internet Spend in Milton Today

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

Number of Households w/ broadband	9,000
Average Monthly Internet	$74.99
Annual Internet Spend	$8,098,920
20 Year Internet Spend	$161,978,400

Broadband Feasibility Study

Projected Monthly Cost to Subscribers

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

- Infrastructure Capital Costs (Financed over 30 years)
- Network Maintenance & Operations (Monthly Utility Fee)
- Services (Paid 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. 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. Another key objective will be to have ISPs in the marketplace that qualify for any available state and/or federal subsidies to improve affordability further.

Per Household Projected Subscription Cost

Financial modeling analysis is based on total premises, subscriber take-rate target, similar geographic benchmarks, as well as the public works department input and committee comment. The analysis uses 9,000 physical premises in Milton with a projected take-rate of 50% (4,500 subscribers) and does not consider pole make-ready costs for an aerial deployment. The residential $14.99 monthly ISP fee is based upon current pricing from ISPs interested in providing services. Under this modeling, specific to Milton, the monthly cost for subscribers is projected as follows:

Ethernet Projected Monthly Subscription Cost (50% take rate)

Projected Residential Services Monthly Costs	100% Aerial	10% Buried / 90% Aerial	100% Buried
Infrastructure	$25.54	$26.68	$36.88
Maintenance and Operations	$27.07	$27.07	$27.07
ISP Services (Dedicated 1 GB Symmetrical)	$14.99	$14.99	$14.99
Monthly Total	**$67.60**	**$68.74**	**$78.94**

Note: The Residential $14.99 monthly ISP fee listed above is based upon current pricing from ISPs interested in providing services.

XGS-PON Projected Monthly Subscription Cost (50% take rate)

Projected Residential Services Monthly Costs	100% Aerial	10% Buried / 90% Aerial	100% Buried
Infrastructure	$22.85	$23.80	$32.30
Maintenance and Operations	$27.07	$27.07	$27.07
ISP Services (Dedicated 1 GB Symmetrical)	$14.99	$14.99	$14.99
Monthly Total	**$64.91**	**$65.86**	**$74.36**

Note: The Residential $14.99 monthly ISP fee listed above is based upon current pricing from ISPs interested in providing services.

Broadband Feasibility Study

Projected Design Scenario Infrastructure Capital Costs

The total projected construction costs for the Town design scenario 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 10% buried/90% aerial network, and (3) a 100% buried network. These scenarios are calculated at a 50% take-rate and a long-term bond rate of 4% over 30 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 pole attachment fees can significantly change these numbers.

Per Premise Projected Infrastructure Cost

The projections in the first two tables reflect the year-one capital cost. They are based on the Biarri network design, which includes 5,791 physical premises in Milton. 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 (i.e., multi-dwelling units). 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:

Ethernet Projected Total Infrastructure Costs

Financial Pro-Forma of Full Project Costs - 2 Year Build - Ethernet Architecture

	100% Aerial	10% Buried / 90% Aerial	100% Buried
Projected Cost Per Premise (Common and Drop)	$5,300	$5,535	$7,653
Estimated Subscribers	4,500	4,500	4,500
Total Projected Project Costs	**$23,850,000**	**$24,907,500**	**$34,438,500**

Note: Assumes 50% take rate & short-term interest rate of 8% and long-term bond rate of 4% for 30 Years

XGS-PON Projected Total Infrastructure Costs

Financial Pro-Forma of Full Project Costs - 2 Year Build - Ethernet Architecture

	100% Aerial	10% Buried / 90% Aerial	100% Buried
Projected Cost Per Premise (Common and Drop)	$4,742	$4,938	$6,702
Estimated Subscribers	4,500	4,500	4,500
Total Projected Project Costs	**$21,339,000**	**$22,221,000**	**$30,159,000**

Note: Assumes 50% take rate & short-term interest rate of 8% and long-term bond rate of 4% for 30 Years

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 threshold across a broad number of subscribers, translating into an attractive and affordable cost-per-premise.

Ethernet Projected Monthly Subscription Cost (90% aerial/10% buried)

Projected Residential Services Monthly Costs	40% Take Rate	50% Take Rate	60% Take Rate
Infrastructure	$32.13	$26.68	$23.04
Maintenance and Operations	$27.07	$27.07	$27.07
ISP Services (Dedicated 1 GB Symmetrical)	$14.99	$14.99	$14.99
Monthly Total	**$74.19**	**$68.74**	**$65.10**

Note: The Residential $14.99 monthly ISP fee listed above is based upon current pricing from ISPs interested in providing services.

XGS-PON Projected Monthly Subscription Cost (90% aerial/10% buried)

Projected Residential Services Monthly Costs	40% Take Rate	50% Take Rate	60% Take Rate
Infrastructure	$28.74	$23.80	$20.50
Maintenance and Operations	$27.07	$27.07	$27.07
ISP Services (Dedicated 1 GB Symmetrical)	$14.99	$14.99	$14.99
Monthly Total	**$70.80**	**$65.86**	**$62.56**

Note: The Residential $14.99 monthly ISP fee listed above is based upon current pricing from ISPs interested in providing services.

Take-Rate

Take-rate is a key consideration for 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.

Based on the financial feasibility projections, if Milton can achieve the projected take-rate of 50% (the number used for financial modeling), the projected monthly aerial/buried combination rate of $65.86 per month for XGS-PON and $68.74 per month for ethernet at 1G - 1,000/1,000 Mbps would represent a customer household savings of $49.14 (XGS-PON) or $46.26 (ethernet) per month over the premium cable offering from Xfinity of 1142/23 Mbps.

Ultimately, financial projections 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.

Broadband Feasibility Study

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 recommends utilizing a public process to select a local company 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 $27.07 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 managing the physical or outside plant, and the middle-mile operator. If Milton were to insource the operations of the network and stand-up a broadband operations department, it is likely that the cost per subscriber would decrease.

Financial Modeling Assumptions

Financial modeling analysis is based on total premises, targeted subscriber take-rate, similar geographic benchmarks, as well as the public works department input and committee comments:

Financial tables are based on the following points:

- Total Premise Scenario: 9,000

  (Households and Businesses)
- Subscriber estimated take-rate @ 50%: 4,500
- Pole ownership: Verizon has co-ownership with Eversource of the poles in Milton, This creates a situation that could allow Verizon/Eversource to make it difficult and expensive to have pole access. This may lead to a buried network being a more feasible path to follow. The cost of aerial and buried construction should be evaluated if Milton moves forward and builds a fiber to the home network.
- Pole Make-Ready: There will be a cost for make-ready and those potential costs have not been considered here.
- Municipal gain: It is unclear if there is any type of formal municipal gain to access the poles for town network purposes or if the Town may have to enter into a lease agreement with Verizon and/or Eversource.
- Approximately 99% of the current utility infrastructure is aerial.
- For the purposes of the financial analysis, the committee chose to model a 90% aerial and 10% underground network.
- Geological make-up consists of some rock and ledge, boring and horizontal drilling possible in some areas.
- Currently the town leases some dark fiber from Comcast which connects the town buildings.

- Milton has invested in building out their own Town Institutional Network (I-Net). The new I-Net is primarily funded by Federal ARPA grants, and it will replace the existing Town network that has been declared obsolete by the incumbent provider. The I-Net's purpose is to interconnect Town offices for municipal business.
- The I-Net would also be able to serve as the backbone for a larger municipal Fiber-to-the-Premise network.
- Milton has already voted to establish a Municipal Light Plant (MLP), the legal entity that could own and/or operate such a network.

Milton did not choose to do a high level engineering design at this time. Financial modeling was created by using similar geographical relevant data and Town input.

SECTION 5

Market Analysis

Market Analysis

Incumbent Offers and Pricing

In Milton, 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 Milton on their website:

Plan	Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
Connect More	351/23	$30.00	$90.00	$100.00
Gigabit	1142/23	$50.00	$115.00	$100.00
Gigabit Extra	1302/41	$75.00	$120.00	$100.00
Gigabit x2	2088/206	$90.00	$120.00	$100.00

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.
Cancellation charges may apply.
Contract may be required.
Unlimited Data
Modem with Wi-Fi/Xfi – Additional $15.00/$25.00 per month.
Late Fee – 5% of outstanding balance
-$10/month Auto pay and online billing discount available
Availability depends upon location – not available in all areas.

Broadband Feasibility Study

Astound Broadband / RCN

Astound Broadband advertises the following residential services in Milton on their website:

Plan	Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]	Contract
300 Mbps	327/24	$20.00	$56.93	$94.94	2 Year
600 Mbps	655/36	$20.00	$66.93	$94.94	2 Year
1000 Mbps	941/52	$35.00	$71.93	$94.94	2 Year
1500 Mbps	1683/53	$45.00	$81.93	$94.94	2 Year

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
Cancellation charges may apply
Unlimited Data
Auto pay and online billing discount may be available
Router is included for 24 months. After is $5-$12.95/mo depending on router
Availability depends upon location – not available in all areas.

Verizon

Verizon advertises the following residential services in Milton on their website:

Plan	Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Price Guarantee
Fios 300 Mbps	307/324	$49.99	$59.99	2 Year
Fios 500 Mbps	517/552	$74.99	$84.99	3 Year
Fios 1 Gig	940/911	$89.99	$99.99	4 Year

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.
Cancellation charges may apply.
Contract may be required
Router is included
Unlimited Data
Deposit - $0-$250 depending on a credit check
Late Fee – 1.5% or $9 of outstanding balance (whichever is higher)
-$10/month Auto pay and online billing discount available
Availability depends upon location – not available in all areas.

Broadband Feasibility Study

Business

Comcast Business

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

Plan	Speed (Mbps) [Down / Up]	Contract Period	Advertised Pricing	Standard Pricing [+ Taxes and Fees]	Equipment [Required]	Install [Fee]
150 Mbps	178/115	2-Year	$59.99	$132.90	$22.95	$99.95
300 Mbps	357/115	2-Year	$79.99	$182.90	$22.95	$99.95
500 Mbps	582/210	2-Year	$109.99	$232.90	$22.95	$99.95
800 Mbps	952/210	1-Year*	$149.99	$272.90	$22.95	$99.95
1250 Mbps	1415/306	1-Year*	$199.99	$432.90	$22.95	$99.95
2000 Mbps	2214/306	1-Year*	$199.99	$532.90	$22.95	$99.95

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.
Unlimited Data
Paperless billing - -$10.00/Mo
Connection Pro w/4G LTE Backup – Additional $10.00/Mo
*Have a 1-Year contract and 5-year price lock before moving to standard pricing
Availability depends upon location – not available in all areas.

Astound Broadband/RCN Business

Astound Broadband advertises the following business services in Milton on their website:

Plan	Speed (Mbps) [Down / Up]	Price Lock	Advertised Pricing	Standard Pricing [+ Taxes and Fees]	Install [Fee]
110 Mbps	122/22	3-Year	$59.95	$103.83	$79.95
250 Mbps	276/22	3-Year	$69.95	$123.83	$79.95
500 Mbps	592/24	3-Year	$79.95	$163.83	$79.95
1000 Mbps	911/24	3-Year	$189.95	$253.83	$79.95
1500 Mbps	1921/12	3-Year	$209.95	$273.83	$79.95

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.
Cancellation charges may apply.
Auto pay and online billing discount may be available
Upgraded Wi-fi Available at $19.95/Mo or $29.90/Mo
Availability depends upon location – not available in all areas.

Verizon Business

Verizon Business advertises the following residential services in Milton on their website:

Plan	Speed (Mbps) [Down]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Contract / Price Lock	Install [Fee]
10 Mbps*	9/6	$69.00	$79.00	N/a / 2-Year	N/a
25 Mbps*	23/6	$69.00	$109.00	N/a / 2- Year	N/a
50 Mbps*	25/6	$99.00	$209.00	N/a / 2-Year	N/a
Fios 200 Mbps	307/324	$59.00	$79.00	2-Year / 3-Year	$49.00
Fios 500 Mbps	517/552	$79.00	$139.00	2-Year / 3-Year	$49.00
Fios 1000 Mbps	940/911	$99.00	$259.00	2-Year / 3-Year	$49.00

Taxes and fees often represent an additional (10% - 15%) of standard pricing.
Shared Network – Speeds are "up to" and are not guaranteed.
Speeds may not be symmetrical.
Cancellation charges may apply.
Auto pay and online billing discount may be available
Verizon Business Gateway - $399.99 or $18.00/Mo for Fios and $399.99 or $11.11/Mo for Standard
Verizon Security - $20/Mo
Backup - $14.99/Mo
Static IP - $20.00/Mo
Unlimited data for Fios
*Data Caps at 300 GB/mo. Additional data is $10 per 5G of data.
Availability depends upon location – not available in all areas.

Note: *Market research conducted in September 2024.*

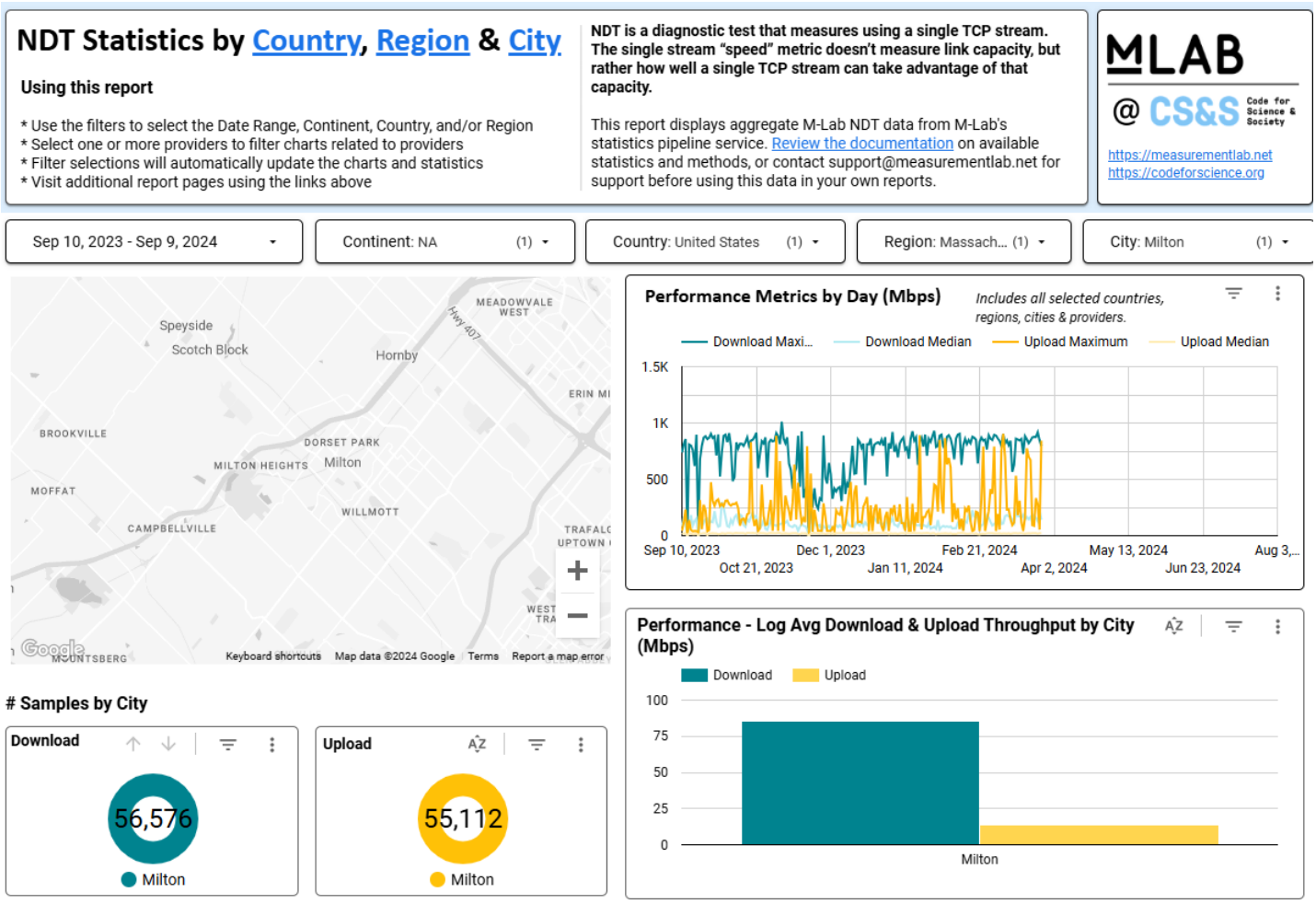
Broadband Feasibility Study

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 North Milton and South Milton from September 10th, 2023, to September 9th, 2024.

The average speeds delivered by the ISPs in Milton are:

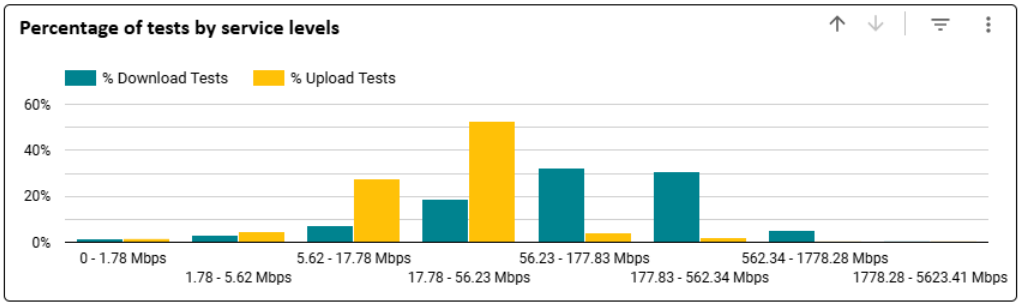
- Xfinity/Comcast = **92.82 download/12.44 upload**
- Verizon = **26.9 download/3.03 upload**
- Astound/RCN = **72.63 download/13.32 upload**
- Town Average = **85.28 download/13.6 upload**



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.

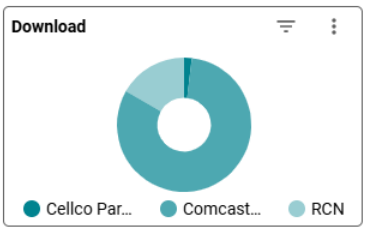


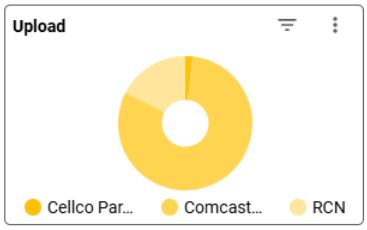
Provider Statistics

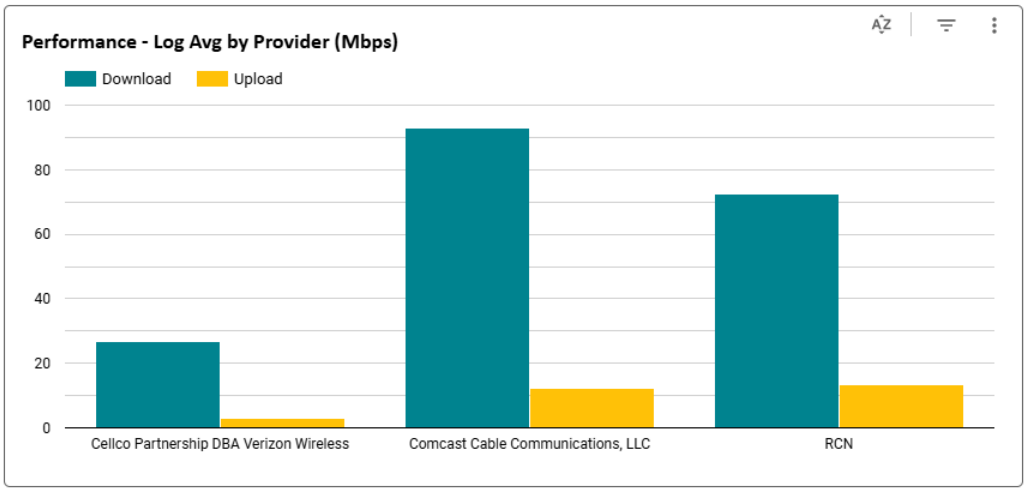
Provider: Cellco Partnership DBA Ve... (3)

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

Samples by Provider







Note: Verizon speeds are reflective of their DSL/wireless offerings. As Verizon continues to build out their fiber network, it is expected for speeds to increase.

Broadband Feasibility Study

Milton Broadband Survey Results

For approximately 10-weeks from June 2024 - August 2024, Milton surveyed residents and business operators to assess the sentiment regarding existing internet services and the level of support for a municipal fiber network. EntryPoint Networks developed the survey and it was administered through a professional survey tool, SurveyMonkey.

Based on an estimated population size of 28,450, to gain a 95% confidence level representative of the target population, with a 5% margin of error, the survey would require 380 survey responses. The Town of Milton captured 412 responses (verified through the Qualtrics sample size calculator - https://www.qualtrics.com/blog/calculating-sample-size/). Key findings from the survey include the following:

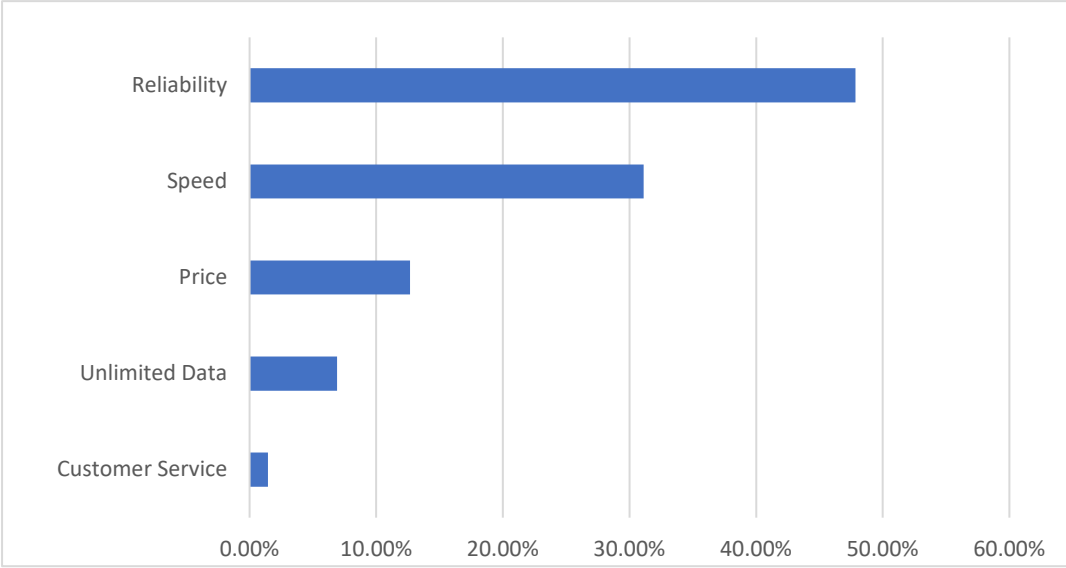
Total Responses	**412**		
Respondent Category			
	407	Residential	98.79%
	5	Commercial	1.21%
Precinct			
	37	Precinct 1	9.07%
	53	Precinct 2	12.99%
	48	Precinct 3	11.76%
	33	Precinct 4	8.09%
	15	Precinct 4a	3.68%
	28	Precinct 5	6.86%
	21	Precinct 6	5.15%
	41	Precinct 7	10.05%
	23	Precinct 8	5.64%
	29	Precinct 9	7.11%
	28	Precinct 10	6.86%
	52	Other	12.75%
Primary Use of Internet			
	328	Work	79.61%
	170	School	41.26%
	360	Streaming TV/Video	87.38%
	400	Email	97.09%
	373	Shopping	90.53%
	331	Social Media	80.34%
	145	Gaming	35.19%
	115	eCommerce	27.91%
	40	Other	9.71%

Broadband Feasibility Study

Current internet access at my home or business		
395	I have Wired Internet Connection, i.e. Xfinity/Comcast, Verizon Fios, RCN/Astound, Satellite, etc.	95.87%
15	I only have internet through my cellular carrier i.e. AT&T, Verizon, T-Mobile, Xfinity Mobile, etc.	3.64%
2	I do not have Internet Service	0.49%
Wired Service		
237	Cable (Xfinity)	60.31%
59	Fios (Verizon)	15.01%
87	Cable (Astound/RCN)	22.14%
1	Satellite	0.25%
0	Other Fiber	0.00%
8	Other	2.04%
1	I Don't Know	0.25%
Cellular Service		
42	5G	63.64%
12	LTE/4G	18.18%
4	Other	6.06%
8	I don't know	12.12%
Why don't you have Internet Service?		
0	I do not have internet service options available to me.	0.00%
2	Internet service options available to me are not affordable.	100.00%
0	Other (please specify)	0.00%
On a scale of 1-4, how would you rate your current internet service provider for: Overall Reliability		
15	Poor	4.24%
64	Fair	18.08%
162	Good	45.76%
113	Excellent	31.92%
Overall Speed		
13	Poor	3.67%
78	Fair	22.03%
160	Good	45.20%
103	Excellent	29.10%
Overall Cost		
125	Poor	35.31%
138	Fair	38.98%
73	Good	20.62%
18	Excellent	5.08%

Broadband Feasibility Study

Their Customer Service		
80	Poor	22.60%
133	Fair	37.57%
113	Good	31.92%
28	Excellent	7.91%
At what price point would you consider a fast and reliable internetconnection to be affordable?		
12	$0 - $20	3.46%
45	$21 - $40	12.97%
122	$41 - $60	35.16%
81	$61 - $80	23.34%
54	$81 - $100	15.56%
24	$101 - $120	6.92%
9	$121+	2.59%
Should the Town of Milton Consider Building a community owned fiber optic broadband network throughout the Town?		
255	Yes	73.49%
83	Possibly	23.92%
9	No	2.59%
347	**Yes/Possibly**	**97.41%**
What is most important to you when choosing an internet service provider?		
166	Reliability	47.84%
108	Speed	31.12%
44	Price	12.68%
24	Unlimited Data	6.92%
5	Customer Service	1.44%



SECTION 6

Next Steps

Next Steps

Municipally owned networks are a response to the misalignment between private interests and 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 naturally incentivized to be accountable to residents and are perfectly positioned to be a neutral host of fiber optic infrastructure which enables 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

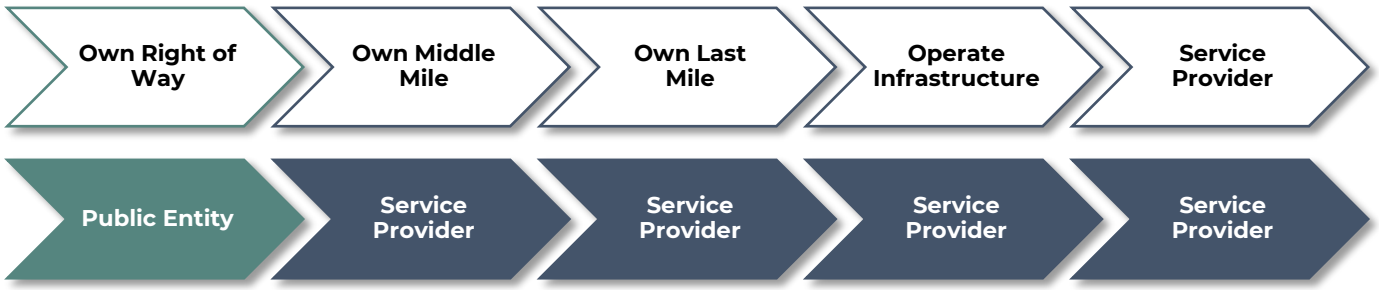
Milton's proposed digital infrastructure will be owned by either a private company, a public entity (the Town) or a hybrid private-public partnership (PPP). Each of these is explained below.

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 decide 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. Private ownership works best when more than one provider has competitive infrastructure and pricing.

Broadband Feasibility Study

Figure 1: The Existing Deployment and Operation Model



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.

Privately Funded Open Access Network

Private financing through private equity or an infrastructure fund is an option when building a municipal fiber network. However, density is a significant consideration when trying to achieve equitable and competitive pricing. Private capital also considers whether there are existing fiber optic assets, favorable building and construction conditions, reasonable cost to build, reasonable pole attachment agreements, backhaul and middle mile access.

Figure 2: Privately funded Open Access Network Deployment and Operation Model

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 3: 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 4: Public vs. Private Broadband Models Summary

Public

> Customers are Key Stakeholders
> Not-for-Profit
> Assets Held Publicly
> Public Board Meetings
> Elected Board Sets Rates
> Local Control

Private

> Investors are Key Stakeholders
> For Profit
> Assets Held Privately
> Private Board Meetings
> Private Board Sets Rates
> Investor Control

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 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 facilitate a shift away from facilities competition to competition among service providers, then public 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 Massachusetts allows for municipally owned infrastructure, but Milton will need its legal advisors to provide guidance on whether a Municipal Light Plant (MLP) or Enterprise Fund is most favorable for publicly owned infrastructure for Milton.

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. However, the Town would need to determine whether the replacement cost of that equipment will be the customer's responsibility, or will it be financed through an alternative mechanism – like the maintenance and operations budget?

Customer Support

In open access models, it is common for the ISP to provide Tier 1 support and the open access partner to provide Tiers 2-5 Support.

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.

Broadband Feasibility Study

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, Sherburne, NY Eagle, ID Mountain Home, ID

Definitions

Ownership: Digital infrastructure will be owned by a private company or a public entity (the Town).

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 is open to applications from public entities, prioritizing the deployment of fiber and encourages 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) has 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 Milton. 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. A Design/Build approach may be conducive to procuring a solution that keeps costs down so that the network can offer competitive pricing. 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 partners 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/project manager 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 Milton 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 Milton 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. As suggested earlier, a Design/Build approach may be conducive to procuring a solution that keeps costs down so that the network can offer competitive pricing.
- 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 and will 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 Milton may include:

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

Observe Results in Quincy, MA

The City of Quincy is mobilizing to deploy open access infrastructure beginning in 2025. Observing outcomes from this neighboring city will provide key insights for decision makers at the Town of Milton.

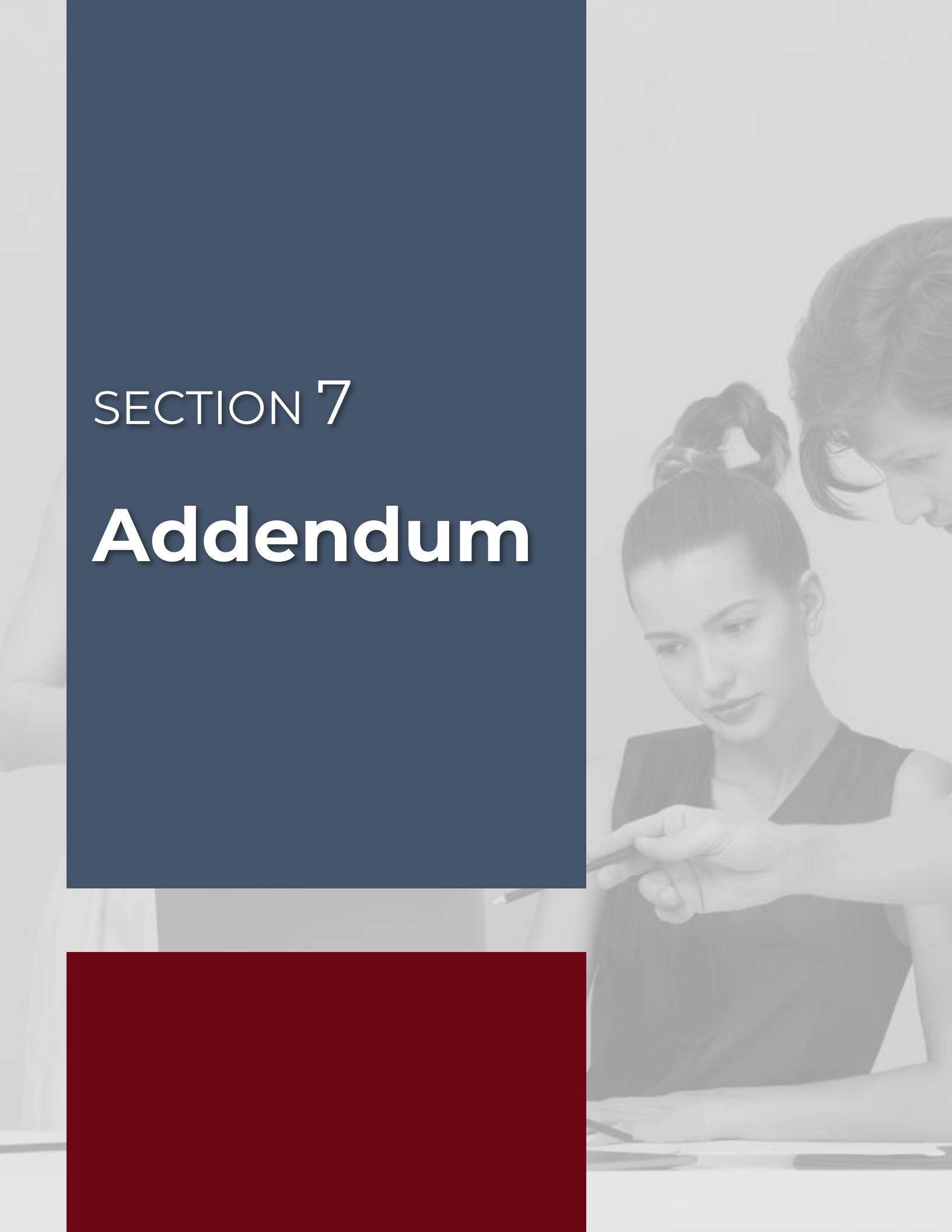
Work with State Agencies to Streamline Processes

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 Massachusetts Broadband office could become a helpful partner in advancing these initiatives. The following are examples in which state agencies could assist Massachusetts 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 7

Addendum



Broadband Feasibility Study

Addendum

The content in the Addendum provides additional detail related to:

- **Network Architecture**
- **Media Comparison**
- **Business Model Options**
- **Risk Assessment**
- **Community Engagement**
- **Strategic Decision-Making Framework**

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

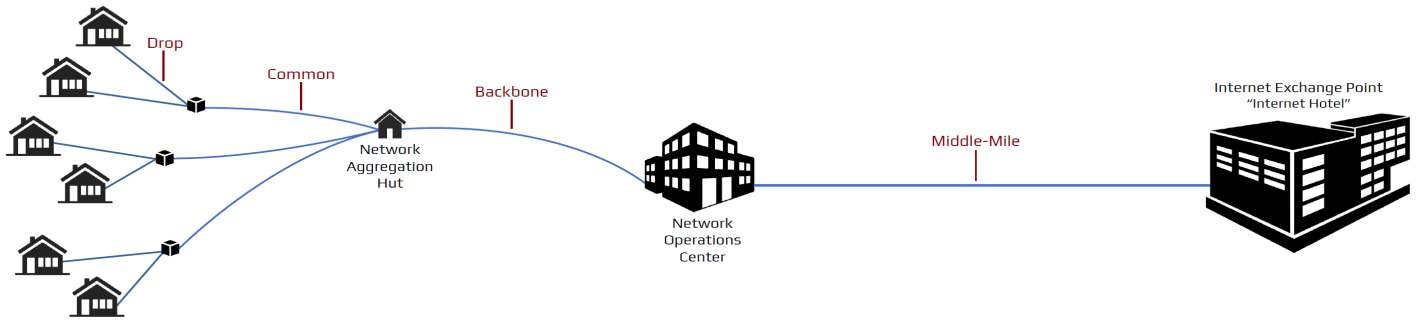
The switched ethernet architecture provides a dedicated connection for each customer rather than a shared connection. The customer experience is significantly better than in a shared architecture during periods of network congestion because the throughput of a switch-based architecture is superior to 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 legacy system performance that is very similar to coaxial cable. In a PON network, splitters are placed in the field, and a single fiber connection is shared between 32, 64, or 128 premises. GPON provides a 2 Gbps connection to be shared by neighbors within a particular node. XGSPON improves the reliability of the shared network by providing a 10Gbps shared node. 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. However, with time these capabilities are improving.

Broadband Feasibility Study

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.

Media Comparison

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 Milton 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.

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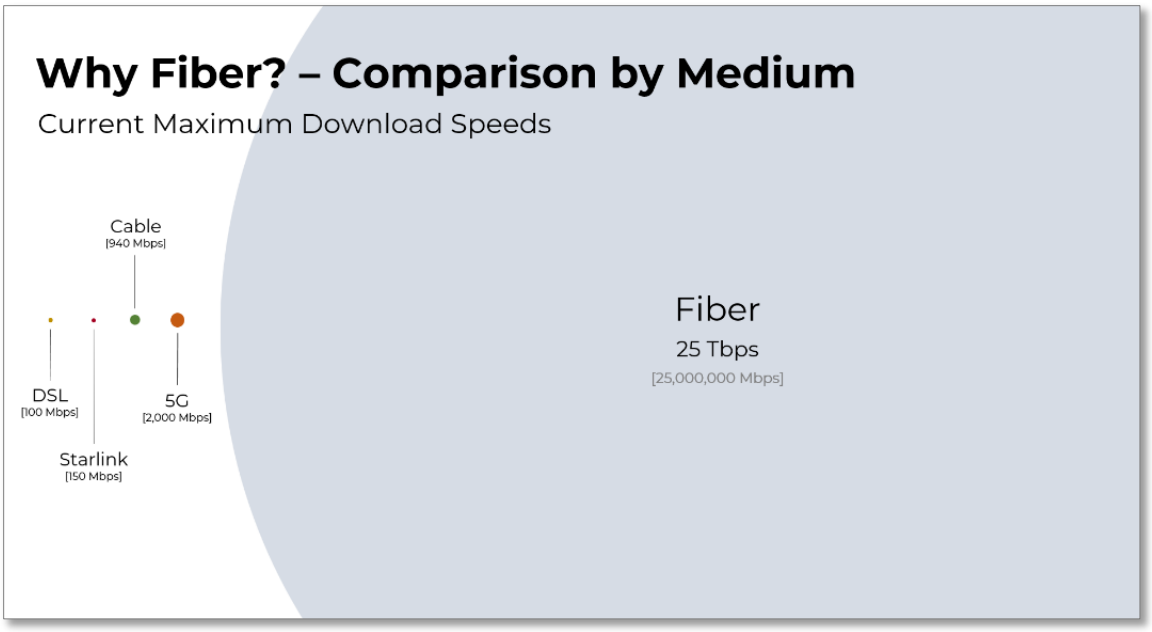

Business Model Options

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

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.

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 Milton 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: The two factors which can potentially impact Cost Modeling Risk are: 1) Lack of density 2) Unknown Pole Attachment Fees. These will not be known until a Contractor is retained to build the network. 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 can significantly 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 Milton legal representation would need to prepare a separate analysis describing the Town's legal authority to build, own, and operate broadband infrastructure as well as information on Massachusetts 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 and experience is that the State of Massachusetts allows for this infrastructure to be built either as an Enterprise Fund or as a Municipal Light Plant.

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 Milton, 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 legal representative to summarize any relevant Massachusetts 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: Milton will likely have a middle mile path back to an internet exchange point in Boston or Providence. 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 Milton is likely to have a path back to Boston or Providence and can likely access the Open Cape 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 Milton 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 Milton 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.

Broadband Feasibility Study

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 "on-line 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, Milton 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

Milton 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 Milton fiber program. Milton 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 Milton 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.

Broadband Feasibility Study

Strategic Decision-Making Framework

This addendum is a strategy development framework created by the Broadband Committee and EntryPoint. It is advised to use for guidance and decision making as Town leaders moves forward with the project.

– Strategic Consideration Pillars

Objectives	Current Environment	Barriers	Strategy Points	Success
• Bring Choice & Competition to ISP market in Milton	• Will be left with 2 primary incumbents (Comcast & Verizon)	• Political | Regulatory	• Open Access may be one piece of a strategy to achieve target outcomes	• Provide quality service for an affordable price. Open Access is a means to an end
• Enable local ownership and control of network infrastructure	• Fiber land grab | Consolidation next 3-4 years • Town working on I-net	• Municipal financing will need to be thoroughly explained to Town leaders and residents	• Local control can be achieved via infrastructure ownership	• Local ownership & accountability, self-sustaining MLP or Enterprise Fund,
• Ensure network is self-sustaining via reserves	• Town support is unclear currently	• Incumbent race to build	• Institutional services and fiber leasing • Open Access for additional services	• Identify appropriate level of reserve • Identify a revenue stream that is not a veiled tax
• Validate community support	• Town support is unclear currently	• Incumbent market control, • Procurement structure • Affordability	• Follow a process to select the optimal 3rd party operator	• Achieve target take rates
• Make a fully vetted choice about aerial vs. underground	• Verizon and Eversource own the poles	• Verizon has pole ownership	• A buried network would likely be more expensive but would give the Town full control	• Select pathway that accommodates timeline and budget requirements
• Outsource Maintenance and Operations | Insource control and decision making	• Multiple options for 3rd party network operators	• Town would need to utilize a procurement process to select 3rd party and then decide on governance process.	• All key roles can be outsourced – except ownership	• Select project partners that stay on budget, within timeline, and help achieve target take rates
• Avoid technology obsolescence	• Rapid rate of change for software and electronics. Fiber has long lifespan	• Town will need to develop expertise or rely on advisors	• Virtualized networking capabilities (smart city, private networks, etc.)	• Deploy fiber network with validated partners for electronics and network management software

SECTION 8

Glossary

Glossary

Industry Terms and Abbreviations

Term	Description	Definition / Narrative
Aerial	Fiber-optic network cables installed on existing utility poles	Aerial fiber deployments are one of the most cost-effective methods of installing fiber cables. Rather trenching and/or boring for underground installations, operators can simply use existing pole infrastructure to deploy the cables.
Asymmetrical	Broadband download and upload speeds are 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 **f**iber 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. Gigabits refers to file transfer rates and Gigabytes refers to file storage size.
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. Kilobits refers to file transfer rates and Kilobytes refers to file storage size.
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. Megabits refers to file transfer rates and Megabytes refers to file storage size.
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. Terabits refers to file transfer rates and Terabytes refers to file storage size.
8K Video	Ultra-high-definition video	Television resolutions of 7,680 pixels horizontal x 4,320 pixels vertical.

Broadband Feasibility Study

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.

THANK YOU

For Your Consideration

ENTRY POINT NETWORKS

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