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Broadband Master Plan

Prepared for the Superior City Council

July 2021

– Prepared By –

ENTRY POINT NETWORKS

www.entpnt.com

Broadband Master Plan

July 2021

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Executive Summary

In addition to lowering costs and delivering significant improvements in network speeds, additional objectives for the network include positively impacting economic development, livability, public safety, education, healthcare, emergency communications, smart grid, efficient government services, universal access, environmental stewardship, and smart City initiatives.

The Superior CIT Committee has worked with EntryPoint Networks to develop this Broadband Master Plan to assist with a planning and decision-making process as the Superior Mayor and City Council determine whether it is feasible to deploy and operate broadband infrastructure for the residents, businesses, and anchor institutions in the City of Superior. The information in this report will be used to assist in the planning and evaluation of feasibility for implementation of a network that can lower broadband costs and increase network value for all stakeholders in Superior. Additionally, this report is designed to assist City leaders in understanding the operational implications, important risk factors, and a realistic cost framework for developing and operating City owned fiber optic infrastructure.

The Broadband Master Plan is a living document that will first be used to analyze feasibility. If the Mayor and City Council determine that the project has sufficient merit, the planning process will continue toward a formal process for selecting Engineering, Construction, and Network Management Tools. The specific steps to this process are covered at the end of this document in the Next Steps section.

The primary drivers for this analysis include an interest by the Mayor and City Council in lowering costs and improving network speed and reliability. In addition to lowering costs and delivering significant improvements in network speeds, additional objectives for the network include positively impacting economic development, livability, public safety, education, healthcare, emergency communications, smart grid, efficient government services, universal access, environmental stewardship, and smart city initiatives.

This report seeks to provide the data needed for City leaders to thoughtfully plan and implement a communications infrastructure strategy that will benefit residents, businesses, and anchor institutions for years to come. City leaders will be able to use this document to lay the groundwork to address the challenges of a project of this size and scope. The key focus of the report is on the following primary activities:

1) Network Design & Architecture
2) Current Market Analysis
3) Business Model and Financing
4) Cost Analysis for Construction
5) Cost Analysis for Network Operations
6) Customer Acquisition
7) Risk Management

Strategy

Deploying a large-scale fiber optic network is a significant public works and information technology project.

Key Strategic Ideas guiding this Plan were established by the Superior CIT Committee and include the following:

Strategic Priorities for a Municipal Fiber Network

1. **Improve Affordability** – The City of Superior seeks to promote policies and initiatives that will reduce the cost of internet access by 20%-25%.

2. **Improve Network Speed & Reliability** – City leaders seek to promote network attributes that will increase reliability for residents, businesses, and anchor institutions within City limits.

3. **Foster Innovation & Economic Development:** The city seeks to ensure that city residents and businesses have access to infrastructure that will foster innovation, economic development, and growth.

4. **Promote Abundant Bandwidth** – City leaders seek solutions that move from the current practice of treating bandwidth as a scarce commodity toward policies and programs which treat bandwidth as an abundant resource.

5. **Foster Competition & Choice** – The City seeks to promote initiatives that will increase the number of service providers and types of services that are available to Superior residents.

6. **Solve the Digital Divide** – The City of Superior seeks to promote policies and initiatives that will make internet access universally available and affordable.

7. **Establish Local Control over Essential Infrastructure** - The economy is now an information economy and the importance of digital infrastructure continues to grow. The City of Superior has an interest in ensuring that City residents and businesses have robust digital infrastructure and promoting initiatives that will give the City greater influence over this important infrastructure. In building these systems, the city seeks to provide resilience in the event there is a natural disaster or other public safety event.

Strategy - Funding Considerations

The following are the guiding principles for the business model being proposed by the Superior CIT Committee:

1. Nobody will be forced to participate. Subscription will be on a voluntary, opt-in basis.

2. Taxes will not be increased to finance the network.

3. The ongoing operation of the network must be self-sustaining and not dependent on any kind of subsidy from the City.

4. The City may contribute to get the network started – but any contributions from municipal finances will be paid back over time.

SWOT Analysis

The SWOT Analysis included here is not an analysis of current offerings within Superior. Rather, the analysis considers the Strengths, Weaknesses, Opportunities and Threats related to advancing a municipally sponsored fiber optic network within the City of Superior.

STRENGTHS	» Early indication of support from subscribers (Demand) » Frustration with current options » Awareness of importance of infrastructure (Pandemic) » Good Middle-Mile Options » Low Interest Rate Environment
WEAKNESSES	» Short construction season » Access to poles – aerial » Some constraints in Wisconsin law
OPPORTUNITIES	» Reduce costs » Better service » Faster speeds » Introduce competition » Economic development » Improved property values
THREATS	» Incumbent opposition » Potential for interest rates to rise » Fear of the unknown » Inertia » Risk Factors (Summarized at end of report)

Infrastructure

Comparison of Available Media

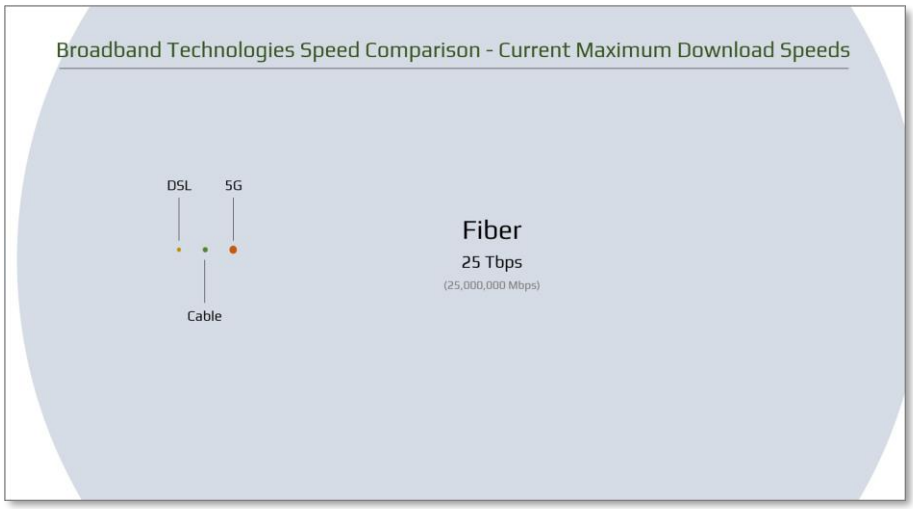
The primary media used for internet access today in the United States includes DSL, Coaxial Cable, Wireless and Fiber Optic cable.

DSL stands for Digital Subscriber Line and it is one of the technologies used to provide Internet connectivity to homes and businesses. DSL uses existing telephone lines and a transceiver 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. CenturyLink is the incumbent telephone company in Superior and uses DSL technology. DSL is asymmetrical (the download speed is much faster than the upload speed), is typically shared between 32 or 64 homes, and is capable of download speeds up to 100 Mbps. However, 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. Coaxial cable is primarily used by cable TV companies to connect transmission facilities to customer homes and businesses to deliver cable T.V. and internet access. Spectrum is the incumbent cable company in the Superior area. Coaxial Cable is asymmetrical, is typically shared between 32 or 64 homes, and is capable of download speeds up to 940 Mbps. A limitation of coaxial cable is that the signal begins to degrade after 360 feet.

Fiber Optic Cable sends information down strands of glass known as optical fibers which are about the size of a human hair. These fiber optic strands can transmit 25 Tbps today and researchers have successfully demonstrated a transmission experiment over 1045 km with a data-rate of 159 Tbps *(https://phys.org/news/2018-04-fiber transmission.html)*. Fiber-optic cables carry information between two places using optical (light-based) technologies which convert electrical information from the computer into a series of light pulses. Fiber Optic Cable is capable of symmetrical speeds up to 25 Tbps and the signal can travel as far as 60 kilometers without degrading.

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



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

5G is the 5th generation of technology used in cellular networks and refers to a standard for speed and connection. Because of the extensive marketing around the emergence of 5G, many people wonder whether 5G will replace fiber optic cables. In fact, 5G depends on fiber optic infrastructure. All wireless technologies work better the faster they get back to fiber optics. The graphic above is not to scale (fiber has much greater capacity than the illustration represents) but this illustrates the magnitude of the difference between the different media types. The emergence of 5G is very early but there is a potential revenue opportunity for 5G carriers to operate on City infrastructure and contribute to the ongoing cost of network operations. Cellular networks can be symmetrical or asymmetrical and are sometimes capable of download speeds up to 2,000 Mbps

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

Impact of Bandwidth on Applications

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

Upload vs Download Speeds

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

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

Transmission Distance

As described above, an additional benefit of fiber optic infrastructure is that a communication signal sent over fiber does not start to degrade for 45 miles while a signal sent over coaxial cable starts to degrade after 340 feet.

Assessment of Existing Broadband Infrastructure

Deloitte.

"The United States requires between $130 and $150 billion over the next 5–7 years to adequately support broadband competition, rural coverage and wireless densification."

"The primary finding of the Deloitte report is that legacy infrastructure needs to be replaced with Fiber Optic cable in the near-term to meet bandwidth demands."

A 2017 Deloitte Consulting analysis summarizes the current needs and realities for legacy broadband infrastructure in the United States this way:

"The United States requires between $130 and $150 billion over the next 5–7 years to adequately support broadband competition, rural coverage and wireless densification.

Despite the demand and potential economic benefits of fiber deployment, the United States lacks the fiber density in access networks to make the bandwidth advancements necessary to improve the pace of innovation and economic growth.

Some wireline carriers are reluctant or unable to invest in fiber for the consumer segment despite the potential benefits. Expected wireline capital expenditures range between 14–18 percent of revenue. Wireline operating expenditures can be 80 percent of revenue. Fiber deployment in access networks is only justified today if a short payback period can be guaranteed, a new footprint is being built, repairs from rebuilding after a storm or other event justifies replacement, or in subsidized geographies where Universal Service funds can be used. The largest US wireline carriers spend, on average, five to six times more on operating expenses than capital expenditures. Excessive operating expenditures caused, in part, by legacy network technology restrict carriers' ability to leverage digital technology advancements. Worse, as legacy networks continue to descale, the percentage of fixed costs overwhelms the cost structure leading to even greater margin pressure."

Citation: https://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-5GReady-the-need-for-deep-fiber-pov.pdf

The Deloitte report is not specific to infrastructure in Superior, Wisconsin, but the conclusions from the Deloitte report are generally applicable. Telco and Cable operators in U.S. cities often have fiber to an aggregation point and then legacy infrastructure from the aggregation point to the premise.

The primary finding of the Deloitte report is that legacy infrastructure needs to be replaced with Fiber Optic cable in the near-term to meet bandwidth demands. There is no indication that incumbents intend to replace legacy infrastructure with Fiber Optic infrastructure in the near term and even if they did, this upgrade would solve the base infrastructure problem, but it would not solve for the lack of competition or premium pricing for Gig speeds.

Legacy copper and coaxial infrastructure will need to be replaced with state-of-the-art infrastructure to meet the ever-growing demands for greater bandwidth and faster speeds. An important question is whether unique value can be derived by having the City and its residents own and control this infrastructure or whether private companies should continue to own and operate all communications infrastructure.

Ideal infrastructure includes more than just the fiber optic cables running throughout the City. Important infrastructure considerations include the electronics at both ends of the fiber as well as systems that manage and control the network. As the City deploys its infrastructure, the following are important considerations that should guide decision making:

- **Capacity & Speed:** The demand for bandwidth and speed will continue to grow.
- **Emerging Services and Applications:** 5G, connected vehicles, edge computing, and virtual reality are all examples of emerging applications that have infrastructure dependencies. An

important consideration is how flexible the business model and technology systems are to enable whatever may come.

- **Local Control:** An advantage of a network that is locally controlled is that the network can be much more responsive to local needs and may enable innovation and adaptation for emerging opportunities.
- **Local Resilience:** Many communities are not locally resilient against attacks on internet infrastructure. It is possible to design networks in a way that provides residents and businesses with a network that is locally resilient if, for some reason, middle mile connections are severed.
- **Privacy & Security**: Subscribers are becoming increasingly sensitive to security, privacy, and confidentiality controls.
- **Risk Analysis**: Consideration of the risks for all potential network stakeholders is an essential part of the planning process.

Market Analysis

In Superior, most residents and businesses subscribe to wireline internet services from the cable operator (Spectrum) and telephone incumbent (CenturyLink).

Spectrum

Spectrum advertises the following residential ISP services in Superior:

Speed (Mbps) [Down / Up]	12 Month Rate [Contract Required]	Standard Pricing [+ Taxes and Fees]	Install [Fee]	Internet [Billings]	Triple Play [Billings]
50 / 5	$55.00	$75.00	$50.00	$61.01	$208.89
100 / 10	$55.00	$75.00	$50.00	$86.53	$247.69
400 / 20	$70.00	$95.00	$50.00	No Data	No Data
940 / 50	$110.00	$130.00	$200.00	No Data	No Data

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
Data Caps Apply
Modem - $14.00 per month
Availability depends upon location – not available in all areas.

CenturyLink

CenturyLink advertises the following residential services in Superior:

Speed [Down / Up]	Standard Pricing [+ Taxes and Fees]	Install [Fee]	Internet [Billings]	Double Play [Billings]
1.5 Mbps / 50 Kbps	$45.00	Not Disclosed	$46.24	No Data
6 Mbps / 500 Kbps	$64.00	Not Disclosed	No Data	No Data
10 Mbps / 750 Kbps	$64.00	Not Disclosed	$75.00	$85.00
15 Mbps / 750 Kbps	$64.00	Not Disclosed	$59.55	No Data
60 Mbps / 750 Kbps	$69.00	Not Disclosed	$74.22	No Data

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
Soft Data Caps apply to all service plans
Availability depends upon location – not available in all areas.

Spectrum Business

Spectrum advertises the following business ISP services in Superior:

Speed (Mbps) [Down / Up]	Promo Pricing [contract required]	Standard Pricing [+ Taxes and Fees]	Install [Fee]	Internet [Billings]	Triple Play [Billings]
100 / 10	$60.00	$90.00	No Data	$119.00	$220.87
200 / 10	$80.00	$110.00	No Data	$145.42	$377.30
400 / 20	$110.00	$150.00	No Data	No Data	No Data

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
Data Caps Apply
Availability depends upon location – not available in all areas.

CenturyLink Business

CenturyLink advertises the following DSL business ISP services in Superior:

Speed [Down / Up]	Standard Pricing [+ Taxes and Fees]	Install [Fee]	Internet [Billings]	Double Play [Billings]
20 Mbps / 1.5 Mbps	$64.00	Not Disclosed	No Data	No Data
80 Mbps / 10 Mbps	$64.00	Not Disclosed	No Data	No Data
100 Mbps / 10 Mbps	$64.00	Not Disclosed	$147.31	$291.26

CenturyLink quotes the following fiber-optics business ISP services in Superior

Speed [Down / Up]	Standard Pricing [+ Taxes and Fees]	Contract [Required]	Install [Fee]	5 Yr. Spend [+ Taxes and Fees]
500 Mbps	$925.90	60 Months	Waived	$55,554.00

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
Data Caps Apply
Availability depends upon location – not available in all areas.

Market Analysis Conclusion

Spectrum holds the equivalent of an ISP Monopoly in Superior. Because of this, residents and businesses in Superior are significantly overpaying for internet connectivity.

Superior residents and businesses are paying for a luxury automobile but getting a subcompact.

Community Engagement Plan

The sample Community Engagement Plan that follows is built on an assumption that Superior will take the next step toward a City Sponsored project by aggregating demand through a Community Engagement process. It is our recommendation that Superior consider hiring a professional Marketing / PR firm to help drive the Community Engagement efforts.

Goals & Objectives

The objective of a *Superior Community Engagement Plan* is to achieve a minimum 40% take-rate for homes and businesses within Superior City limits. Additionally, a scale of 2,500 subscribers is an important target for the project to be operationally sustainable. In the financial section later in this report, the financial models are built to a target of a 60% take-rate. The modeling can easily be adjusted to match actual take-rates.

Evaluation & Education

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

Community Survey

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

Publish Educational Information

Leverage the website specific to the municipal fiber program to outline the core message of broadband as a utility that will support an environment of choice and subscriber control. Additionally, use customized videos to educate online visitors on the following:

a. Functionality of the community fiber network
b. Options for services
c. Frequently Asked Questions (FAQ's)
d. Inquiry Form where community members can submit questions to the municipality

Mapping Community Interest

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

Evaluation & Education Budget = $3,000 - $10,000

Marketing & Promotion

Superior can issue Press Releases and use inserts in monthly utility bills to promote the municipal fiber program, driving traffic to the fiber website with the goal of educating community members and generating interest and encouraging community participation.

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

Neighborhood Entrance and Yard Signs

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

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

Marketing & Promotion Budget = $10,000 - $15,000

Grassroots Engagement

Webinars & Open House Events

Superior can use Webinars and Open House events to educate residents and business owners can hear an educational presentation about the fiber project, ask questions about the fiber project, become educated about the Superior fiber plan, business model, etc.

Webinars and Open Houses are promoted using utility bill inserts, press releases, public service announcements, local news reports, city 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 are individuals that are committed to promoting the network within their neighborhood. Fiber Champions are also incentivized to be the first neighborhood to get connected (initial fiber zones are connected in order of take-rates – highest to lowest).

Fiber Champions

Fiber Champions assist sales efforts within their designated neighborhood (fiber zone). They organize and lead Cottage Meetings where neighbors come together to discuss the Superior fiber program. Superior leaders and employees provide support to the Fiber Champions in their efforts. Fiber Champions drive conversations and contractual commitments of neighbors via the Door-to-Door Sales and Education campaign.

Grassroots Engagement Budget = $2,000 - $5,000

Door-to-Door Campaign

Network sales agents (typically an independent group representing the network) contact residents and business operators within the planned network footprint to answer questions about the network and ascertain the potential subscribers' intentions regarding their participation in the network. [Yes (Opt-in) or No (Opt-out)].

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

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

Door-to-Door Campaigns are very effective in giving people an opportunity to learn and ask questions in a personal interaction. The COVID pandemic impacts the timing of utilizing this tool.

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

Door-to-Door Sales Effort Budget = $100 per Premise that Subscribes
[Sign-up Fee or Wrapped into the Infrastructure Installation Costs]

Total Superior Community Engagement Plan Budget = $15,000 to $30,000 + Door to Door Sales Commissions.

Please Note – The work outlined in the various Steps of this Community Engagement Plan, in whole or part, can be managed by internal Superior personnel or can be outsourced to a professional marketing and promotions organization.

Superior Community Listening Tour

In the months of April, May and June 2021 Connect Superior conducted two public Webinars, two Open House events, and other meetings with community organizations, and private institutions in the City of Superior.

Connect Superior Webinars
Two separate webinar sessions were held in April and May 2021. Community member attendance at these webinars ranged between 31-47 people. Each webinar lasted an hour and 20 minutes with active participation from attendees. The questions and comments from attendees during these webinars were overwhelmingly supportive of a citywide fiber infrastructure deployment. Video recordings of both webinars are available for review at: https://www.connectsuperior.com/education

Superior Rotary Club - Barker's Island Inn & Resort
EntryPoint provided a 45-minute presentation (With Q&A) to the Superior Rotary Club regarding the work that has been done with the CIT Committee and the recommendations from the CIT Committee to the Mayor and City Council. The lunch was attended by approximately 38 Rotary members. The questions and conversations during the event were all supportive of the city proceeding with a municipally sponsored fiber optic network.

Essentia Health St. Mary's Hospital
We met with Kim Pearson, Administrator at the Superior Essentia Health Hospital and provided an overview of the project and the plan that will be proposed to the City Council. Ms. Pearson was particularly interested in Telemedicine opportunities that would be enhanced by this project and potential synergies with surrounding communities if they were to follow the same course.

Duluthian Networks
We met with Pat Malley, owner of Duluthian Networks, a regional ISP located in Duluth. Our interest in meeting with Mr. Malley was to determine whether a local ISP would be interested in participating in an Open Access Network. After explaining the model to Mr. Malley, he said that is company would definitely participate as an ISP if Superior goes forward. After the meeting, Mr. Malley told a City Council member from Duluth that Superior was following the best municipal model he had heard about. Mr. Malley is currently providing consulting services to several cities and Townships in the region.

Wisconsin Indianhead Technical College
We met with John Will, President of the Wisconsin Indianhead Technical College. We provided an overview of the project and the plan that will be proposed to the City Council. Mr. Will asked if other communities in the region were also considering municipal fiber optic infrastructure. Much of the meeting was spent talking about coursework and training the Technical College currently provides its students for outside fiber optic plant, electronics, and network management. Mr. Will indicated that the network could be particularly valuable in accelerating training and career opportunities for its students both regionally and nationally.

Superior Business Improvement District
In our meeting with Lindsey Jacobson at the Superior Business Improvement District, Ms. Jacobson said that a fiber optic network in the city would be a positive for the business community in Superior. Ms. Jacobson asked about the timing for building the network.

University of Wisconsin – Superior
We met with David Wagner, Chief Technology Officer at the UW – Superior campus. Mr. Wagner moved to the region and started in his current role during the Covid-19 Pandemic. Mr. Wagner said that his wife works from home for a large health care company and her work requires that she live in an area with a particular upload and download speed. They ended up buying a home outside of Superior, partly for this reason but he also said that they do not have access to fiber optics at their home and he sees that as a key enabler for the city and he wishes that he had access to this kind of network. Mr. Wagner said he would do whatever he could to support the city in this effort.

Superior School District
We met with Amy Starzecki, Superintendent of the Superior School District. Ms. Starzecki came from a community that had a fiber optic network and she was surprised and concerned about the number of students who are poorly connected in the district. Ms. Starzecki said she was a strong proponent of this project. The digital divide is the core concern for the school district, with too many students in the district both in the city and outside the city limits who have either poor connectivity or no connectivity. This was a pronounced problem for the school district during the pandemic.

Development Association
We met with two members of the Development Association and provided an overview of the project and the plan that will be proposed to the City Council. The memorable note from that meeting was that the projected total cost of the fiber network is significantly lower than the proposed Convention Center – which sounds like a great project.

Open Houses - Superior Public Library
Two Open Houses for the public were held on June 17th at the library auditorium. The first Open House meeting was held at noon. There was a 30-minute presentation and 30 minutes of Q&A. Most of the crowd was there to support the fiber network initiative. However, there was one participant who was vocally opposed. His basic claim was that “the city was solving a problem that doesn’t exist and this should be left to the private sector.” Two women sitting in front of this man responded and said, “this may not be an issue for this man, but it is very much a problem in our neighborhood. Both women claimed that connectivity was so poor in their neighborhood that they could do very little online. Some of the audience was there to learn in both the mid-day session and in the evening session, but a clear majority was there to support the initiative. The evening session did not have any vocal opponents.

Superior Broadband Survey Results

And the Survey Says…

In December 2019, the City deployed a website to begin the process of educating the public regarding its evaluation of the feasibility of a City sponsored fiber optic network. The City distributed an initial survey to Superior residents assessing current sentiment regarding existing services and the level of interest in a municipal network. The survey was not developed by professional survey administrators. To date key findings from the survey, include the following:

Total Responses	538		
Support Network			
	21	No	3.90%
	123	Possibly	22.86%
	394	Yes	73.24%
	517	Yes/Possibly	96.10%
Internet Speed Importance			
	4	Not Important	0.74%
	85	Somewhat Important	15.80%
	449	Very Important	83.46%
	534	Important/Very Important	98.60%
Average Connection Speeds			
	415	Download	76.32 Mbps
	415	Upload	10.82 Mbps
Choice in ISP & Plans - Importance			
	28	Not Important	5.20%
	122	Somewhat Important	22.68%
	388	Very Important	72.12%
	510	Important/Very Important	94.80%
Rate Current ISP			
	87	Poor	16.17%
	186	Fair	34.57%
	171	Good	31.78%
	70	Very Good	13.01%
	24	Excellent	4.46%
	273	Poor/Fair	50.74%

Municipal Broadband Models Comparison

The Institute for Local Self Reliance has mapped municipal networks throughout the United States using an interactive map that can be found at the following link:

https://muninetworks.org/communitymap

To compare the various models that exist in the United States today, a mix of prominent municipal fiber optic projects were selected to illustrate the types of models that have been

deployed. The following comparison summarizes different approaches to funding and operating municipal broadband infrastructure and services followed by a description of the advantages and disadvantages of each:

Municipality	Population	Model Type	Electric Utility	Take-Rate	Cost of 1 Gig
Chattanooga, TN	179,139	Electrical Utility ISP	Yes	60%	$68.00
Lafayette, LA	126,000	Electrical Utility ISP	Yes	40%	$99.95
Westminster, MD	19,000	City Fiber, Private ISP	No	20%	$89.99
Huntsville, AL	194,585	Dark Fiber Open Access	Yes	Not Published	$70.00
Sandy, OR	10,000	Municipal ISP	No	60%	$59.95
Longmont, CO	86,000	Electrical Utility ISP	Yes	55%	$69.95
Ammon, ID	17,000	Automated Open Access	No	60%	$47.50
Monmouth, OR	15,083	Municipal ISP	No	80%	$129.65
Lexington, KY	321,959	Private Partner Owned	No	Not Published	$59.95
Santa Monica, CA	110,000	Dark Fiber Business Only	No	N/A	N/A
Fort Collins, CO	165,000	Electrical Utility ISP	Yes	Early Stage	$59.95
UTOPIA	150,000+	Manual Open Access	No	15%-20%	$70.00

Municipal Broadband Models Defined – Summary | Pros | Cons

City Owned & Operated, Single ISP

Summary: The City owns and operates the network and is also the sole service provider on the network.

Pros: This model can be successful when incumbent operators have some combination of the following: monopoly or near monopoly status, high prices, poor infrastructure, slow speeds, a poor reputation, and widespread customer resentment.

Cons: A single ISP does not significantly expand choice or competition. There have been very few *City Owned & Operated, Single ISP* deployments that have been successful. The City is essentially replicating the incumbent model and competing against the incumbent head-to-head. This model leaves the City vulnerable to the incumbent dropping their price to influence the municipal take-rate and destabilize the municipal network.

Examples of this model include Sandy, OR and Monmouth, OR.

Municipal Electrical Utility Owned & Operated, Single ISP

Summary: The Municipal Electrical Utility owns and operates the network and is also the sole service provider on the network.

Pros: The most common municipal model that has been successful using a Single ISP approach has been the Electrical Utility model. A measure of this success can be attributed to the fact that the Electrical Utility has the advantage of having an established reputation in the community. Also, electrical Utilities often have financial, customer service, and engineering expertise that

may be beneficial to the network and the skill set for Outside Plant personnel for a municipal network is similar in kind to the existing range of skills in an Electrical Utility. The likelihood of success increases in instances where the incumbent operator has monopoly or near monopoly status, higher than average prices, poor infrastructure, slow speeds, a poor reputation and/or widespread customer resentment.

Cons: A single ISP does not significantly expand choice. Expertise in network operations will need to be enhanced or developed. This model is essentially replicating the incumbent model and involves competing against the incumbent head-to-head. This model leaves the City / Electrical Utility vulnerable to the incumbent dropping their price to impact the take-rate and destabilize the network.

Examples of this model include Chattanooga, TN and Longmont, CO. Fort Collins, CO. is in the early stages of deployment and is replicating this model.

Dark Fiber, Open Access

Summary: Dark Fiber Open Access is a model where the city builds infrastructure to the curb and the subscriber then selects an ISP as its provider and the ISP finishes the connection to the home with its own infrastructure and electronics.

Pros: Open Access increases choice for consumers. Operating a dark fiber network is less complicated than operating a lit network. The Dark Fiber model enables Public ownership of infrastructure.

Cons: The Dark Fiber model gives up control over last mile infrastructure, i.e., the drop from the curb to the premise. The Dark Fiber model therefore limits the usability of each strand of fiber. With an isolated dark fiber connection, it is impossible to connect to other services that may not be available through the ISP that controls the drop to the customer premise. The Dark Fiber Model may not scale easily due to difficulty in anticipating the required fiber count to meet the demand. This can create significant complications for the network operator.

An example of this model is Huntsville, AL.

Manual Open Access

Summary: Manual Open Access is a model where the network is lit end to end. This means that the network operator places and controls the electronics at both ends of the network. In this model, switching service providers can be requested from a web portal and may appear to be automated but the network provisioning is not automated.

Pros: A manual Open Access network increases choice for consumers.

Cons: Operating a Manual Open Access network is more complex than operating a Single ISP network because of the requirement for human management of network tasks. Any increase in the number of service providers operating on the network adds to network complexity.

An example of this model is the UTOPIA Network. UTOPIA is the largest manual open access network in the United States with just over 20,000 premises connected. UTOPIA struggled under heavy debt obligations for 15 years but is now operating on a sustainable trajectory. In addition to UTOPIA, there are several Manual Open Access networks throughout Europe.

Automated Open Access

Summary: 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.

Pros: Multiple service providers can deliver services simultaneously and independently across a single wire. When a subscriber selects a new service provider, the provisioning is done using automation and therefore happens on-demand. The automated provisioning creates a marketplace for services which includes ISP's and private networks for other services. The ability to switch service providers on demand increases choice and competition. This network model also includes the ability to provide local network resilience via local communications if connections over the middle mile are down.

Cons: The model was first implemented in late 2016. Ammon, ID is the only city that has a full implementation operating today.

Examples of this model include Ammon, ID and early-stage deployments in McCall, Idaho, Mountain Home, Idaho, and Elkhart County in Indiana.

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

Private Sector Owner & Operator, Single ISP

Summary: A private builder designs, builds and operates a network. The private entity is also the sole ISP on the network – replicating the incumbent model.

Pros: A private builder and operator assumes all the risk and does the work of overseeing design, project management, construction, customer acquisition and operations. This model increases the choices available to consumers with minimal obligation or burden for the city.

Cons: The new operator is replicating the incumbent model. There is no local control over infrastructure and ISP choices increase by just one new provider. There is no guarantee that the operator will address the digital divide. The network can be sold to another operator.

There are many examples of over-builders but Lexington, Kentucky is a recent example.

Private Sector Owner & Operator, Open Access

Summary: A private builder designs, builds and operates a network. The private entity uses an Open Access model rather than the incumbent model for service delivery.

Pros: A private builder and operator assumes all the risk and does the work of overseeing design, project management, construction, customer acquisition and operations. This model provides an increase in the choices available to consumers at almost no cost to the city. Risk exposure to the city is very low. The private builder/operator builds and stabilizes the network and may give the city the option to acquire the network after an agreed upon number of years for a premium price above the actual cost to develop.

Cons: There is no local control over infrastructure. There is no guarantee that the operator will address digital divide issues. A private owner will be free to sell the network to a new operator that may or may not be aligned with community objectives for the network.

An example of this model is Fullerton, CA (SiFi).

Cooperative Owned & Operated, Open Access ISP

Summary: A fiber-optic infrastructure cooperative owns and operates the network using an Open Access model.

Pros: The subscribers to the network are the owners of the infrastructure. This creates local control over infrastructure. The speed to market can be much faster than municipal ownership because the model is established up front. The model gives subscribers choice and competition among service providers which will likely lead to lower pricing in comparison to incumbent operators. Probability of success increases when incumbent operators have some combination of the following: monopoly or near monopoly status, high prices, poor infrastructure, slow speeds, a poor reputation, and widespread customer resentment.

Cons: It is more difficult to obtain financing because the cooperative has no assets for collateral at the beginning of the project. If financing can be obtained, the cost of money will be more expensive than a city or town sponsored project.

Network Design

Switched Ethernet Network

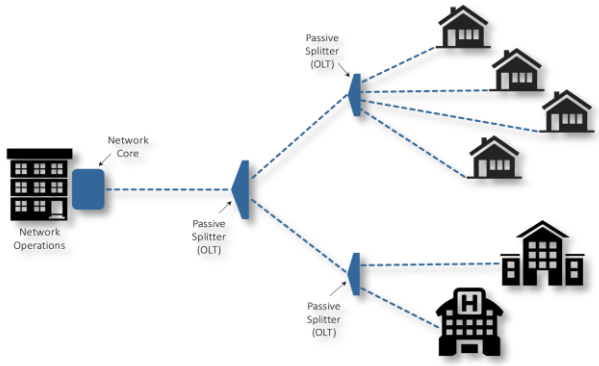
The Switched Ethernet architecture provides a dedicated connection for each customer rather than a shared connection and the customer experience is significantly better than in a shared architecture during periods of network congestion. This is due to the fact that the throughput of switch-based architecture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

Passive Optical Network (PON)

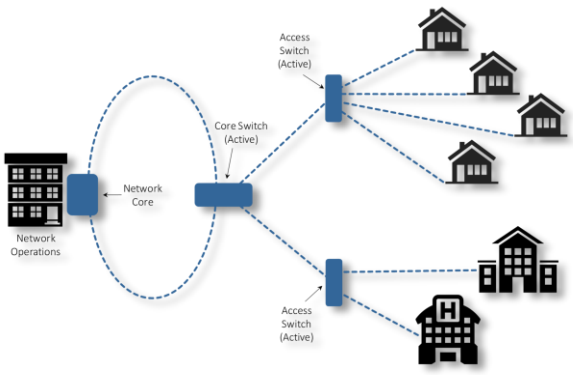
Passive Optical Networks (PON) and Coaxial (Cable) networks follow a Bus architecture.

A Bus architecture is a shared architecture. A splitter is placed in the field and a connection is often shared between 32 or 64 premises. The Bus Architecture leads to more packet collisions on the network which can result in high amounts of packet loss during congestion. Additionally, it is more difficult to isolate and troubleshoot faults in the network with a bus topology.

Passive Optical Network (PON) Design



Switched Ethernet Network Design



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

PON - Network Access Equipment

Description	Unit Cost	Qty	Extended Cost
Install Package	$696.50	1	$696.50
Splitter Shelf	$84.00	8	$672.00
OLT	$4,196.50	2	$8,393.00
10GE SFP+	$837.90	2	$1,675.80
2x 1GE BIDI CSFP	$157.50	24	$3,780.00
Access Line-up			$15,217.30
Number of Subscribers Served			96
Average Cost per subscriber			$158.51

Ethernet - Network Access Equipment

Description	Unit Cost	Qty	Extended Cost
Switch	$1,300.00	2	$2,600.00
SFP	$12.00	96	$1,152.00
Access Line-up			$3,752.00
Number of Subscribers Served			96
Average Cost per subscriber			$39.08

PON - Premise Equipment

Description	Unit Cost	Qty	Extended Cost
Indoor ONT	$225.15	1	$225.15
Power supply for 700GE ONT	$12.00	1	$12.00
Premise Line-up			$237.15
Number of Subscribers Served			1
Average Cost per subscriber			$237.15

Ethernet - Premise Equipment

Description	Unit Cost	Qty	Extended Cost
White Box VBG	$330.00	1	$330.00
1000Base 1310nm-Tx/1550nm RX 10km	$9.00	1	$9.00
Premise Line-up			$339.00
Number of Subscribers Served			1
Average Cost per subscriber			$339.00

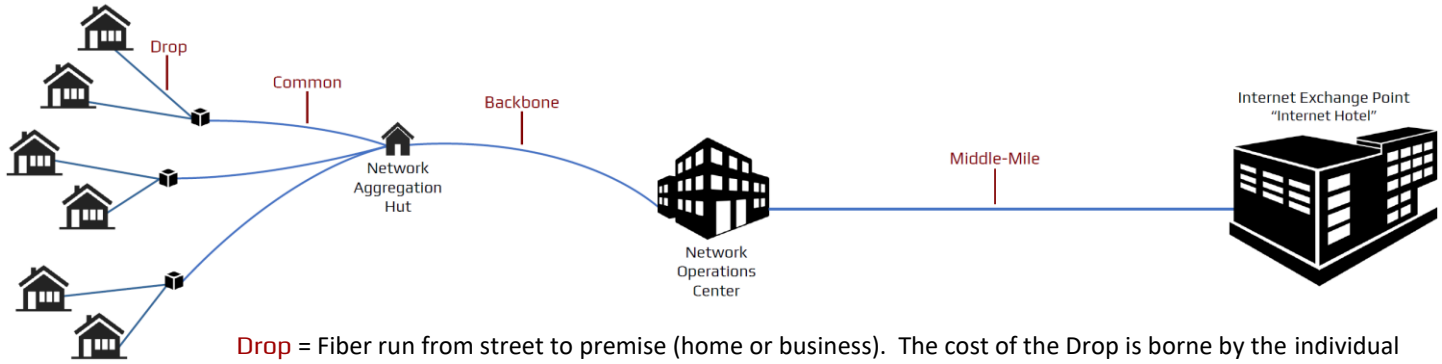
Per Premise PON Equipment Costs

Total cost per Subscriber	**$395.66**

Per Premise Ethernet Equipment Costs

Total cost per Subscriber	**$378.08**

Network Segments – Definitions & Costs Allocations



Drop = Fiber run from street to premise (home or business). The cost of the Drop is borne by the individual subscriber.

Common = Fiber runs from street in front of premise to closest Aggregation Hut. The cost of the Common is borne by all subscribers on the network.

Backbone = Fiber runs from Aggregation Hut back to the Network Operations Center. The cost of the Backbone is borne by all network subscribers, with potential municipal contribution.

Middle-Mile = Third-Party fiber run 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.

Project Partners

Middle Mile

"Middle-mile" is an industry term that describes the network infrastructure that connects local networks to an Internet Exchange Point – usually in a large city. The "last mile" is the local part of a communication network which connects a service provider at the Network Operations Center to a residential or business customer.

EntryPoint sought and received a proposal from a middle-mile carrier from the University of Wisconsin at Superior (Swenson Hall Data Center) to the Citon Data Center at 209 West 1st Street in Duluth, MN (Internet Exchange Point). The proposal is very competitively priced and scalable.

Superior can secure a long term, duo strand, dark-fiber lease for $1,025 per month. This dark-fiber configuration would provide Superior the arrangement it would need to scale a network. The cost of the middle-mile connection should be allocated on a per subscriber basis, included in the monthly M&O utility fee.

Internet Service Providers (ISP) Partners

An Internet Service Provider gives subscribers access to the internet. The City will need to determine what model it will follow or support before it engages one or more Internet Service providers. If the City selects an Open Access Model, there are several ISP's that have expressed a verbal interest in being service providers to Superior subscribers. The participation of these ISP's could be formalized through an MOU process.

Cost Analysis & Phasing

High Level Network Design

A high-level network design was done for a residential neighborhood to build a cost model for that project. The Biarri Networks Fiber Optic Network Design Tool was used to create the design and calculate materials costs for these designs. The main cost categories for deploying and operating broadband networks are separated to optimize the costs in each of the following categories:

- Infrastructure Capital Costs *(Financed over 20 years)*
- Network Maintenance & Operations
- Services

Monthly Infrastructure Cost Modeled from 700 Premises

The first illustration of Infrastructure Capital Costs per premise assumes a 60% take-rate and a project that is 100% aerial. The data in the line items in this model comes from a combination of the Biarri Network Design tool, actual bids for materials, and network buildout experience.

The second illustration of Infrastructure Capital Costs per premise assumes a 60% take-rate and a project that is 20% aerial and 80% underground. We can adjust these variables on a neighborhood-by-neighborhood basis as needed.

The third illustration of Infrastructure Capital Costs per premise assumes a 60% take-rate and a project that is 100% underground.

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

Costs at 60% Take Rate			
100% Aerial			
Description	Common	Drop	Total
Labor - Hours	10.42	2.50	12.92
Labor - Dollars	677.08	162.50	$839.58
Equipment	185.36	28.63	$213.98
Materials	241.81	79.36	$321.16
Supplies	$93.27	$5.63	$98.90
Restoration	$48.10	$1.76	$49.86
Hut/Cabinet	$108.07	$5.90	$113.97
Feeder Fiber	$36.02	$0.99	$37.01
Engineering	$37.10	$1.03	$38.13
Professional Services	$148.42	$15.16	$163.58
Electronics	$166.67	$350.00	$516.67
Subscriber Acquisition	$0.00	$0.00	$0.00
Total	**$1,741.88**	**$650.95**	**$2,392.83**
Backbone Cost per Premise			$197.54
Total w/ Backbone			**$2,590.37**
Short Term Interest			$191.43
Total Capitalized			**$2,781.80**

Monthly Infrastructure Per Premise Cost	$15.58

Costs at 60% Take Rate			
80% Buried | 20% Aerial			
Description	Common	Drop	Total
Labor - Hours	18.75	4.50	23.25
Labor - Dollars	1,218.75	292.50	$1,511.25
Equipment	333.65	51.53	$385.17
Materials	435.26	142.84	$578.09
Supplies	93.27	5.63	$98.90
Restoration	48.10	1.76	$49.86
Hut/Cabinet	108.07	5.90	$113.97
Feeder Fiber	36.02	0.99	$37.01
Engineering	37.10	1.03	$38.13
Professional Services	148.42	15.16	$163.58
Electronics	166.67	350.00	$516.67
Subscriber Acquisition	0.00	0.00	$0.00
Total	**$2,625.28**	**$867.33**	**$3,492.62**
Backbone Cost per Premise			$197.54
Total w/ Backbone			**$3,690.15**
Short Term Interest			$295.21
Total Capitalized			**$3,985.37**

Monthly Infrastructure Per Premise Cost	$22.32

Costs at 60% Take Rate			
100% Buried			
Description	Common	Drop	Total
Labor - Hours	20.83	5.00	25.83
Labor - Dollars	$1,354.17	$325.00	$1,679.17
Equipment	$370.72	$57.25	$427.97
Materials	$483.62	$158.71	$642.33
Supplies	$93.27	$5.63	$98.90
Restoration	$48.10	$1.76	$49.86
Hut/Cabinet	$108.07	$5.90	$113.97
Feeder Fiber	$36.02	$0.99	$37.01
Engineering	$37.10	$1.03	$38.13
Professional Services	$148.42	$15.16	$163.58
Electronics	$166.67	$350.00	$516.67
Subscriber Acquisition	$0.00	$0.00	$0.00
Total	**$2,846.13**	**$921.43**	**$3,767.56**
Backbone Cost per Premise			$197.54
Total w/ Backbone			**$3,965.10**
Short Term Interest			$301.41
Total Capitalized			**$4,266.51**

Monthly Infrastructure Per Premise Cost	$23.90

Why Take-Rate is Important

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

Take-Rate	Cost/Sub	Subscribers	Difference	vs. 60% Take-Rate
5.00%	$32,370.73	650	-	($28,878.12)
10.00%	$16,619.03	1,300	$15,751.70	($13,126.42)
15.00%	$11,368.47	1,950	$5,250.57	($7,875.85)
20.00%	$8,743.18	2,600	$2,625.28	($5,250.57)
25.00%	$7,168.01	3,250	$1,575.17	($3,675.40)
30.00%	$6,117.90	3,900	$1,050.11	($2,625.28)
35.00%	$5,367.82	4,550	$750.08	($1,875.20)
40.00%	$4,805.26	5,200	$562.56	($1,312.64)
45.00%	$4,367.71	5,850	$437.55	($875.09)
50.00%	$4,017.67	6,500	$350.04	($525.06)
55.00%	$3,731.28	7,150	$286.39	($238.66)
60.00%	$3,492.62	7,800	$238.66	$0.00
65.00%	$3,290.67	8,450	$201.94	$201.94
70.00%	$3,117.58	9,100	$173.10	$375.04
75.00%	$2,967.56	9,750	$150.02	$525.06
80.00%	$2,836.30	10,400	$131.26	$656.32
85.00%	$2,720.48	11,050	$115.82	$772.14
90.00%	$2,617.52	11,700	$102.95	$875.09
95.00%	$2,525.41	12,350	$92.12	$967.21
100.00%	$2,442.50	13,000	$82.90	$1,050.11

Please Note

The proforma infrastructure costs outline in this report assume a 100% subscriber funded model. It is likely that a significant portion of these costs will be offset with ARPA funds and other Federal and State grant opportunities, substantially lowering the infrastructure costs to residents and businesses in Superior.

Full City-Wide Network Operations

The following Table summarizes the anticipated cost structure for Network Maintenance & Operations. This schedule produces a monthly M&O fee for the Broadband Utility at $21.16 per month. The City would need to subsidize network operations until enough scale is established to achieve sustainability.

Residential M&O	Subscriber	Monthly	Annual	Percentage
Costs/Accruals/Reserves	**$21.16**	**$165,037**	**$1,980,445**	**100.00%**
Power	$1.41	$10,971	$131,648	6.65%
Co-Lo Fees	$0.35	$2,743	$32,912	1.66%
Labor	$6.00	$46,800	$561,600	28.36%
Office	$0.58	$4,540	$54,475	2.75%
Vehicles	$0.73	$5,675	$68,094	3.44%
Tools	$0.21	$1,646	$19,747	1.00%
Equipment	$1.18	$9,174	$110,085	5.56%
Supplies	$0.12	$946	$11,349	0.57%
Dig-line	$0.19	$1,513	$18,158	0.92%
Maintenance	$1.18	$9,174	$110,085	5.56%
Call Center	$0.36	$2,837	$34,047	1.72%
Network Operations Monitoring	$0.36	$2,837	$34,047	1.72%
Equipment Refresh (Reserves)	$4.00	$31,200	$374,400	18.90%
Licenses Fees (SaaS, Etc.)	$2.00	$15,600	$187,200	9.45%
Rentals	$0.50	$3,900	$46,800	2.36%
Bad Debt	$0.46	$3,594	$43,126	2.18%
Equipment Replacement	$0.02	$189	$2,270	0.11%
Taxes and Fees (Property)	$0.00	$0	$0	0.00%
Middle Mile	$0.50	$3,900	$46,800	2.36%
Reserves	$1.00	$7,800	$93,600	4.73%
Total	**$21.16**	**$165,037**	**$1,980,445**	**100.00%**

Network Management & Operations Cost Structure

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

Staffing Modeling for Internal Network Operations

The following Table models the cost structure for the positions needed for the City of Superior to operate the network as a Department within the City structure. The model is conservative in the staffing estimates needed to operate the network in a sustainable manner. The model does not include resources for construction. Assuming the City builds the entire network over a 36-month period, the City will need to subsidize this department for less than 36 months. After that, the investment will be paid back by operational surpluses as subscribers grow beyond the target of 7,800 subscribers. The work that will be done by a Fiber Network Department includes network monitoring, network management, outside plant repairs, & new customer installations.

The City has the option of operating the network with internal staffing resources or an outsource network operations partner. The following staffing model provides anticipated fully burdened salary information, years to profitability, and the revenues and expenses from the operation.

Staffing Projections

Position	Fully Compensated Hourly Rate	Fully Compensated Monthly Cost	Fully Compensated Annual Cost
Manager	$48	$8,320	$99,840
Network Admin	$38	$6,587	$79,040
I.T. Technician	$30	$5,200	$62,400
Outside Manager	$28	$4,853	$58,240
Outside Plant Tech	$22	$3,813	$45,760

Subscriptions & Staffing Projections

Subscribers	Year 1	Year 2	Year 3	Year 4
New Subscribers	1,560	3,120	3,120	-
# of Subscriber at Year End	1,560	4,680	7,800	7,800
Labor Allocation	$6.00	$6.00	$6.00	$6.00
Cash Flow from Labor	$56,160	$224,640	$449,280	$561,600

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

Position	Year 1	Year 2	Year 3	Year 4
Manager	$0	$49,920	$49,920	$49,920
Network Admin	$39,520	$39,520	$39,520	$39,520
IT Technician	$31,200	$62,400	$124,800	$124,800
Outside Plant Manager	$0	$58,240	$58,240	$58,240
Outside Plant Laborer	$45,760	$91,520	$183,040	$274,560
Total	**$116,480**	**$301,600**	**$455,520**	**$547,040**
Net	**-$60,320**	**-$76,960**	**-$6,240**	**$14,560**

Project Pro-Forma

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

Projected Backbone	Included
Projected Cost Per Premise (Common and Drop) [1]	$3,985.37
Estimated Subscribers	7,800
Total Cost (Common & Drop)	$31,085,859.97
Professional Services	Included
Total Projected Project Costs	$31,085,859.97

[1] *Assumes 80% Buried / 20% Aerial, 60% take rate & short-term interest rate of 8% and long-term bond rate of 3% for 20 Years.*

Projected Subscription Cost

Projected Residential Services Monthly Costs	100% Aerial
Infrastructure	$15.58
Maintenance and Operations	$21.16
ISP Services (Dedicated 1 GB Symmetrical)	$9.99
Monthly Total	**$46.73**

Projected Residential Services Monthly Costs	80/20 Split
Infrastructure	$22.32
Maintenance and Operations	$21.16
ISP Services (Dedicated 1 GB Symmetrical)	$9.99
Monthly Total	**$53.47**

Projected Residential Services Monthly Costs	100% Buried
Infrastructure	$23.90
Maintenance and Operations	$21.16
ISP Services (Dedicated 1 GB Symmetrical)	$9.99
Monthly Total	**$55.05**

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

Projected Income & Cash Flow

Timeline	Year 1	Year 2	Year 3	Year 4 +
Subscribers				
New Subscribers	1,560	3,120	3,120	0
# of Subscriber at year end	1,560	4,680	7,800	7,800
Income Statement (Revenue)				
Infrastructure Fees	$208,945.81	$835,783.23	$1,671,566.46	$2,089,458.07
Maintenance and Operations	$198,044.50	$792,177.98	$1,584,355.97	$1,980,444.96
Total Revenue	$406,990.30	$1,627,961.21	$3,255,922.43	$4,069,903.03
Operating Costs (Expenses)				
Maintenance and Operations	-$151,244.50	-$604,977.98	-$1,209,955.97	-$1,512,444.96
M&O Labor Difference	-$60,320.00	-$76,960.00	-$6,240.00	$14,560.00
Equipment Refresh/Replacement	$0.00	-$4,680.00	-$18,252.00	-$71,229.60
Interest Reserve	-$248,755.09	-$475,878.64	-$435,878.64	$0.00
Debt Service Reserve	-$208,945.81	-$417,891.61	-$417,891.61	$0.00
M&O Reserve	-$46,800.00	-$182,520.00	-$356,148.00	-$396,770.40
Total Expenses	-$716,065.39	-$1,762,908.24	-$2,444,366.23	-$1,965,884.96
Net (Revenue vs Expenses)	-$309,075.09	-$134,947.03	$811,556.20	$2,104,018.07
Loan Payment				
Backbone	$0.00	$53,853.90	$53,853.90	$53,853.90
Build Out	$0.00	$380,872.59	$1,142,617.77	$1,904,362.94
Total Loan Payments	$0.00	$434,726.49	$1,196,471.66	$1,958,216.84
Net	-$309,075.09	-$569,673.51	-$384,915.46	$145,801.23
Cash Flow				
Capital Expenditures	-$6,218,877.28	-$11,896,966.08	-$10,896,966.08	$0.00
Net Money Borrowed	$6,218,877.28	$11,114,905.40	$11,332,844.72	$435,878.64
Net	$0.00	-$782,060.68	$435,878.64	$435,878.64
Revenue	$406,990.30	$1,627,961.21	$3,255,922.43	$4,069,903.03
Cash Expenses	-$211,564.50	-$681,937.98	-$1,216,195.97	-$1,497,884.96
Loan Payments	$0.00	-$434,726.49	-$1,196,471.66	-$1,958,216.84
Net Cash	$195,425.81	$511,296.74	$843,254.80	$613,801.23
Accrued Interest	-$248,755.09	-$475,878.64	-$435,878.64	$0.00
Unrestricted Cash	-$309,075.09	-$1,347,054.19	$69,215.18	$652,909.48
Reserves				
Interest Reserve	$248,755.09	$475,878.64	$435,878.64	$0.00
Debt Service	$208,945.81	$417,891.61	$417,891.61	$0.00
Maintenance and Operations	$46,800.00	$182,520.00	$356,148.00	$396,770.40
Total Reserve	$504,500.90	$1,076,290.26	$1,209,918.26	$396,770.40
Total Cash	**$195,425.81**	**-$270,763.93**	**$1,279,133.44**	**$1,049,679.88**

Projected Capital Expenditures & Funding

Timeline	Year 1	Year 2	Year 3	Year 4 +	Total
Capital Costs					
Backbone	$770,394.24	$1,000,000.00	$0.00	$0.00	$1,770,394.24
Subscriber Drops	$1,353,041.04	$2,706,082.08	$2,706,082.08	$0.00	$6,765,205.20
Subscriber Common	$4,095,442.00	$8,190,884.00	$8,190,884.00	$0.00	$20,477,210.00
Interest Reserve (Drops)	$217,939.32	$435,878.64	$435,878.64	$0.00	$1,089,696.61
Interest Reserve (Backbone)	$30,815.77	$40,000.00	$0.00	$0.00	$70,815.77
Total	$6,467,632.37	$12,372,844.72	$11,332,844.72	$0.00	$30,173,321.82
Short Term Financing (Build Out)					
New Backbone	$770,394.24	$1,000,000.00	$0.00	$0.00	**$1,770,394.24**
Retired		-$770,394.24	-$1,000,000.00	$0.00	**-$1,770,394.24**
Total	$770,394.24	$229,605.76	$0.00	$0.00	**$1,000,000.00**
New Build	$5,448,483.04	$10,896,966.08	$10,896,966.08		**$27,242,415.20**
Retired	$0.00	-$5,448,483.04	-$10,896,966.08	-$10,896,966.08	**-$27,242,415.20**
Total	$5,448,483.04	$5,448,483.04	$0.00	-$10,896,966.08	**$0.00**
Long Term Funding					
New Backbone		$801,210.01	$1,040,000.00	$0.00	**$1,841,210.01**
New Build		$5,666,422.36	$11,332,844.72	$11,332,844.72	**$28,332,111.81**

Financial Modeling Validation

EntryPoint based its analysis on the following demographic information for the City of Superior:

Population:	27,244 people,
Households:	11,670
Families:	6,548
Population Density	737.1 inhabitants per square mile (284.6/km2).
Housing Units:	12,328
Average density	333.5 per square mile (128.8/km2).

Legal Structure & Financing Considerations

The legal structure for financing is organized around the following objectives:

1. Nobody will be forced to participate as a subscriber to the network. Rather, subscription will be on a voluntary, opt-in basis.
2. Taxes will not be increased to finance the network.
3. The ongoing operation of the network must be self-sustaining and not dependent on any kind of subsidy from the city.
4. The City may contribute to get the network started but will be paid back over time.

Voluntary Participation – The alternative to taxing all residents is to deploy a business model that allocates network costs to voluntary participants. Allowing subscribers to voluntarily opt-in to network participation honors individual preferences for residents and businesses, eliminates Political Risk and can increase public support for the network. Allowing subscribers to voluntarily opt-in or opt-out of network participation is less efficient and more expensive than a model that mandates universal participation.

Ongoing Operations - The City views its roles as enabling the development and implementation of a potential network and then may choose at the appropriate time whether to operate the network on behalf of Superior residents. However, the network must become self-sustaining during the first 3-5 years of operations.

Use of ARPA Funds for Municipal Broadband Infrastructure Projects

On June 17, 2021, the US Treasury Department clarified the rules for using federal ARPA money that is being given to states, counties, and cities. The new FAQs provide important clarity for cities considering using ARPA funds for broadband projects.

Building to Homes that are not Underserved
FAQ 6.8: "*Unserved or underserved households or businesses do not need to be the only ones in the service area funded by the project*." While the goal of a broadband project must be to provide service to unserved or underserved areas, the Treasury recognizes in its FAQ's that it may be necessary to serve a larger area for a project to be economical and sustainable. This is a significant clarification - that unserved and underserved locations need not be the only places funded by the ARPA funding.

Rationale for Broadband Projects
FAQ 6.11 The Treasury FAQ's also make it clear that advertised speeds do not define broadband speeds, but rather the actual broadband performance experienced by customers is the standard that can be the basis of decision making.

Further, our interpretation of the decision on whether an area is deserving of an infrastructure upgrade is up to the local authority contemplating using ARPA funding to address specific needs in their city or county. There is no specific standard or process described or defined. Therefore, the local entity determines whether current infrastructure is sufficient. The municipality needs to document how it rationalizes the decision (which could simply be in the minutes of a city council meeting) is to provide some reference to the process and rationale applied if challenged to show that they did consider the need and what was available in reaching their decision.

Reliability
The use of "reliably" in the IFR provides recipients with significant discretion to assess whether the households and business in the area to be served have access to wireline broadband service that can actually and consistently meet the specified threshold of at least 25/3 Mbps – i.e., to consider the actual experience of current broadband customers that subscribe to a service at or above the 25/3 Mbps threshold. Whether there is a provider serving the area that advertises or otherwise claims to offer speeds that meet the 25 Mbps download and 3 Mbps upload speed threshold is not dispositive.

FAQ 6.11 Governments can consider a wide range of information to use as proof that broadband is not reliably meeting the 25/3 threshold including federal or state broadband data (State broadband maps or the newly released NTIA broadband map), speed tests, interviews with residents, surveys, analysis on whether speeds are adequate at all times of the day, analysis on whether both the download and the upload is satisfactory, etc.

Significantly, the FAQ's also allows municipalities to overbuild neighborhoods still being served by DSL only networks. There are thousands of Census blocks where telcos claim rural DSL speeds of 25/3 Mbps and these claims are no longer sufficient to designate an area as adequately served.

FAQ 6.10 also says that the ARPA funding can be used to fund middle-mile fiber as long as it is done with a goal of supporting last-mile fiber.

From our listening sessions, we learned that at least the Kilner Bay area still only has access to DSL. That is the area where the city has also had the most inquiries and complaints because of their abysmal internet. It appears that the City has express permission to overbuild that area using ARPA funds and any surrounding area that it deems necessary to make a project viable and sustainable. The FAQ's also give the city clarity on the fact that backbone infrastructure can be funded as long as it is built to support these neighborhoods. Lastly, the community engagement work that has been done – specifically the survey data and listening tour supports a rationale to move forward with a project that is supported with the use of ARPA funds.

The above is EntryPoint's understanding of the ARPA FAQ's specifically addressing using funds for broadband deployment. EntryPoint has not consulted with a Broadband Attorney in coming to the above conclusions. City leaders and the City Attorney should review the following sources and focus on FAQ#'s 6.8, 6.9, 6.10 and 6.11 to corroborate our findings.

Sources – *https://home.treasury.gov/system/files/136/SLFRPFAQ.pdf*
https://potsandpansbyccg.com/2021/06/21/treasury-makes-it-easier-to-fund-broadband/

Federal Infrastructure Funding Bill – Grant Opportunities

The Federal Infrastructure Bill is still being negotiated in Congress. Currently, this legislation includes $65 Billion for broadband projects. Historically, the projects that have successfully received Federal grant funding are projects that are advanced in their planning and progress and are credible or believable in demonstrating that the project can be successful. Superior should continue to advance its network planning and implementation and should respond to this and future grant funding opportunities.

As state previously, the use of ARPA funds as well as Federal Infrastructure Grant opportunities will significantly subsidize infrastructure deployment costs, significantly lowering subscriber costs.

Financing Dependencies

Because project feasibility is ultimately a function of getting people to sign up and remain loyal to the network, there needs to be a value proposition that mobilizes customers to subscribe. For that to happen, subscribers need a compelling solution, and the network needs to create cash flow predictability and bankable contracts to attract financing for the project. NetEquity in San Francisco visualizes these dependencies in this way:

NetEquity Stack

People	are hungry for	Services
Services	are hungry for	Infrastructure
Infrastructure	is hungry for	Capital
Capital	is hungry for	Cash Flow Predictability
Cash Flow Predictability	is hungry for	Bankable Contracts
Bankable Contacts	result from	Aligned Incentives
Aligned Incentives	requires	Trust
Trust	comes from	Having the Same Vision

*Isfandiyar (Asfi) Shaheen developed the **NetEquity Stack** above. Mr. Shaheen is a Global Broadband Infrastructure Thought Leader based in San Francisco.*

Legal Authority

The Superior City Attorney has prepared a legal summary describing the City's right to build, own, and operate broadband infrastructure under Wisconsin State law. Those findings are included in an addendum to this Plan. The City has decided not to engage Bond Counsel until the Community Engagement Plan has been launched and there is clear evidence that there is sufficient demand in the community to make the network independently sustainable.

[Note: The City Attorney's legal memo is attached at the end of this report.]

10

Risk Factors >

Likelihood
Impact
Mitigation

Risk Analysis

The following is an analysis of the main risk factors facing the City of Superior as it pursues its fiber-to-the-premise deployment. Nine Risk Factors are analyzed:

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

Subscriber Churn

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

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

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

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

Take-Rate Risk

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

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

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

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

Project Execution Risk

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

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

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

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

Equipment & Technology Risk

Equipment & Technology Risk includes both software and hardware solutions and is the risk that equipment failure rates are higher than expected, major software bugs are unresolved, operational reliability is lower than expected, and/or that the technology lifecycle leads to faster

obsolescence than is expected. For a network, the size of Superior, an additional risk is scalability risk.

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

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

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

Community Engagement

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

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

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

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

Cost Modeling Risk

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

Likelihood: There is enough industry data to reasonably validate cost estimates.

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

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

Timeline Risk

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

1) Each phase requires legal, financing and accounting transaction costs. Building the network with fewer phases will lower the overall transaction costs for the project.
2) Building at a faster pace will result in an accelerated period to break-even.
3) Interest Rates are at an unprecedented low currently and building over an extended period may expose later project years to some interest rate risk.

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

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

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

Regulatory Risk

Regulatory Risk is the risk that State or Federal regulations become an impediment or barrier to the City successfully building or operating a municipal network. The Superior Assistant City Solicitor has prepared a separate analysis describing the City's legal authority to build, own, and operate broadband infrastructure as well as information on the legal structures that are available to cities in the State of Wisconsin to house the operation. The memo also includes some information on legal and risk-related considerations for organizing a broadband utility.

Likelihood: Historically, incumbent operators have taken legal action to stop a municipality from building a competing network whenever they have a legal basis for doing so. According to the Assistant City Solicitor, the City does have the authority from the State to own and operate a fiber optic network.

Impact: If a claim were to be brought against Superior, the likely process is that it could take an extensive amount of time and cost to contest or appeal the claim.

Mitigation: The Superior City Attorney has conducted a thorough review of Wisconsin law related to municipal ownership and control over telecommunications and is confident the City has the authority to proceed.

Middle Mile Risks

Middle Mile risks include the following:

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

Likelihood: The closest internet exchange point is in Duluth. Because of Superior's proximity to Duluth, there are several divergent middle mile paths back to the Internet Exchange point.

For this report, we have solicited and received one middle mile proposal and it is competitively priced.

The risk of getting isolated or cut off from internet access is possible but has a low likelihood of occurring.

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

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

Pole Attachment & Make Ready Risk

This is the risk that pole owners cause unexpected and significant impact on costs or timeline due to delays in make ready and pole attachment work.
Likelihood: Because Superior does not own the utility poles within city limits, this risk is a potential problem and will have to be actively managed if the city decides to have some portion of the network be aerial.

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

Mitigation: The city can mitigate this risk by installing a buried network or by assigning a project manager to apply continuous pressure to the pole owners to not unnecessarily delay make ready work.

Next Steps

1. Refine strategy for use of ARPA funds.
2. Create high level design and refine cost modeling based on the strategy the finalize for the use of Recovery Act funds.
3. Create a legal checklist and timeline to work through legal requirements (Ex. Hold Public Hearings as required by Wisconsin law and as noted by the city attorney.) to get to construction.
4. Select Open Access Partner. This partner will also provide project oversight, including design, quality control, construction, provisioning, and turn-up.
5. Explore legal pathways available to fund the infrastructure under the different ownership models?
    - Tax supported mechanisms. (Taxing districts)
    - Property backed mechanisms. (Improvement districts)
    - Revenue backed mechanisms. (Revenue bonds)
    - A public utility model - if broadband is recognized as a utility.
    - Engage Bond Counsel for guidance on best path for financing the project.
6. Collaboratively Refine Community Engagement Plan.
    - Determine whether the city will use an outside digital marketing firm.
        - Professional firm?
        - Can the University help?
    - Implement Community Engagement and demand aggregation process.
    - Deploy competitive process to establish initial take-rate.
7. Identify Construction Manager. Key skills and knowledge include, but are not limited to:
    - Manage the fiber optics project and budget, direct construction in accordance with the approved design, and coordinate work with other staff and design team members.
    - Be a key point of contact with clients, contractors, and local government officials.
    - Review project design aspects as needed and coordinate adjustments to support constructability and budget outcomes.
    - Review work products, quality control, and budgeting.
    - Mentor, develop, and supervise staff.
8. Conduct RFP/RFQ for materials and labor for construction.
    - Create RFP/RFQ Documents.
9. Evaluate Construction Project Management software options.
10. Prepare construction ready design documents.
11. Launch make-ready process for utility pole attachments if some portion of the network is aerial.
12. Prepare to advance initiative to City Council for approval.
13. Deploy network.

AMENDED MEMORANDUM

TO: Members of the CIT Committee
CC: Members of the Common Council and Mayor Jim Paine
FROM: Frog Prell, City Attorney
RE: City-owned Broadband Infrastructure
DATE: December 28, 2020

Background

On December 9, 2020, I submitted an opinion to the common council regarding the legality of the city owning and operating fiber optic infrastructure that would ultimately be utilized, through ISP providers, to bring internet and other services to end users. While writing the December 9 memo, I was under the mistaken belief that broadband services were not yet being provided in the City of Superior. Broadband does currently exist within the city and is utilized by more than one company to provide internet and other services. The purpose of this memo is to correct the process that I previously identified if / when the city should pursue the construction and ownership of a broadband service.

Question

Is it legal for the City of Superior to own and operate broadband infrastructure, likely through the construction and use of fiber optic cable, that will be available to ISPs and other service providers in an open-access market, to provide internet access and other services to end-users for a yet-to-be-determined fee? The City would not be an ISP, but would collect a fee from the ISPs or structure some other mechanism through which it would seek to recover the cost of acquiring, installing, maintaining and operating the broadband infrastructure. Broadband service currently exists within the City and is provided by more than one company.

Analysis

As previously stated in the December 9 memo, the authority granting Wisconsin local governments (cities, villages or towns) the ability to construct, own and operate a facility for providing broadband service, is found in Wis. Stat. sec. 66.0422.

A Wisconsin city may enact legislation to authorize itself to construct, own and operate a facility for providing broadband service as long as certain processes are followed. The City must hold a public hearing on the proposed ordinance or resolution and provide notice of that

hearing through publication of a class 3 notice.[1] No less than thirty days before the public hearing, the City must prepare and make available for public inspection a report:

> "estimating the total costs of, and revenues derived from, constructing, owning or operating the facility and including a cost-benefit analysis of the facility for a period of at least 3 years. The costs that are subject to this paragraph include personnel costs and costs of acquiring, installing, maintaining, repairing, or operating any plant or equipment, and include an appropriate allocated portion of costs of personnel, plant, or equipment that are used to provide jointly both telecommunications services and other services." See Wis. Stats. Sec. 66.0422(2)(a-c).

Conclusion

The City may construct, own and operate broadband infrastructure through the installation of fiber optic cable or other material, as long as it follows the notice and hearing requirements described herein while making available for public inspection a report that contains estimated costs, revenues and other information identified within the statute.

With no funds yet budgeted for what may be a very costly endeavor, the City should give thought to the timing of the public hearing and the production of the required report. If the City chooses to go forward with the production of a report and a public hearing in the very near future, but does not act on the construction of a broadband facility for some years due to budgetary or other concerns, the data contained in the report may very well be stale as the costs of labor and materials change over time.

Filed with the office of the city clerk in accord with Wis. Stat. Sec. 62.09(12)(c)

[1] All notices designated as class 3 notices require 3 insertions.