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Lyndon, Vermont

Broadband Feasibility Report

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Executive Summary

Vantage Point Solutions (VPS) was awarded a competitively bid contract to conduct a Broadband Assessment and Feasibility Study for Lyndon, Vermont. The main purpose of this Study was to determine and identify what the broadband problems and challenges are in Lyndon and the surrounding communities, and how they impact residents, businesses, local government and others.

To conduct the feasibility assessment, VPS gathered data and information by:

- Engaging with city officials and volunteer committee members
- Holding stakeholder outreach meetings with citizens and groups
- Talking with providers to discuss partnership opportunities
- Conducting a residential survey
- Analyzing information provided by the Town
- Researching information obtained through publicly available sources

This comprehensive report details the information that was collected and analyzed and discusses the following aspects of the Study:

1. Competitive Landscape
2. Survey and Stakeholder Outreach
3. Network Types and Operating Models
4. Funding and Financing Options
5. Potential Network Designs
6. Recommendations

When discussing broadband, it is important to understand the definition. The Federal Communications Commission (FCC) currently defines broadband as speeds that reach a minimum of 25 Mbps downstream and 3 Mbps upstream (25/3). However, most of the federal grant programs define unserved areas as those where service levels fall below a lower threshold of 10 Mbps downstream and 1 Mbps upstream (10/1). Although even the current FCC definition of broadband is far behind what most customers perceive to be adequate for residential use, for purposes of this report – high-speed broadband is internet speeds that meet or exceed the federal definition of broadband.

Key Findings

The biggest question a municipal feasibility study needs to answer is “what is the problem we need to solve?” As such, the most critical task of a feasibility study is to conduct outreach in the community in order talk to as many stakeholders as possible. Stakeholders represent key groups of potential end-users of a municipal network such as citizens, businesses and government agencies. The purpose is to obtain feedback regarding current levels of service, future needs and concerns. The information gathered from these tasks directly assists in the development of the models and the final recommendations.

Below is a summary overview of the comments provided through the Stakeholder Outreach.

Group	Comments
Health Care	Poor connectivity presents issues with Doctor-to-Doctor and Doctor-Patient communications, recruiting talent, ability to provide home health care.
Business Community	The economy and workforce are impacted by poor broadband availability including attracting new employees and providing service for tourists.
Local Realty Professionals	Number 1 question asked by prospective buyers is "What are the high-speed internet options?" People won't even look at a property (to rent or buy) if they don't have a good broadband option.
Public Safety	Fire departments have issues with connecting critical devices while in the field and struggle with communication between units and between units and the station.
Schools and Libraries	Schools have conducted their own survey and report that only 20-35% of students have internet at home. Schools are looking to implement distance learning and e-learning but are unable to implement programs due to lack of student connectivity. Many individuals utilize the Public Library Wi-Fi as only means of connection.
Citizens – Town Hall Meeting	Satellite is the only option for some rural residents. Residents also state issues with connectivity and reliability of home telephone service as well as electricity in rural areas. All factors which contribute to overall connectivity issues.

Additionally, there are multiple key findings to highlight and these include:

- Current providers are not meeting the needs and/or expectations of many residents, especially those residing outside of the developed portions of Lyndon. Information obtained through the Survey and Stakeholder Outreach (as detailed in Section 3), anecdotally contradicts the availability of speeds and service offerings as reported by the Providers in Section 2.3.

- Approximately 24% of respondents are either very satisfied or satisfied with the overall service and value they receive from their current provider. This is an extremely low percentage.

- Internet plans for residents and businesses are expensive and copper lines, mobile internet, fixed wireless and satellite technologies present speed, reliability and latency issues for end-users.

- Some homes and businesses have multiple choices for internet or bundled service providers that offer a variety of pricing options. However, many others are limited to only Fixed Wireless, Mobile, or Satellite providers. Due to topography and terrain challenges, many residents have problems connecting to mobile internet, fixed wireless or satellite connections. Depending on a variety of issues these providers may present latency issues which limit the speed and capability of the end user's connection.

- Remote areas need better cellular coverage and better internet connections. Not having access is negatively impacting local business, employee attraction and economic growth. \

- Many respondents to the Survey feel that the continued growth and success of Lyndon and the surrounding communities will be directly impacted by the ability to improve broadband service for current and future residents. The ability to work from home is a central issue with respondents of this survey.

- Residents are looking to local government for support and involvement in improving broadband speeds in the area. Residents are far more favorable towards direct government involvement than what is seen in many communities currently across the US.

Recommendations

Based on all the information and data obtained through the data collection efforts, the network models developed and analyzed, VPS makes two main recommendations. While a middle-mile network costs significantly less to deploy, **the primary problem facing the region is the lack of robust and reliable internet service to residents and businesses that meets or exceeds the federal definition of broadband.**

Therefore, in order of priority - it is the recommendation of VPS that Lyndon and the surrounding communities:

1. **Further explore the viability of deploying a last-mile network**. Action items include:
    - Consider establishing a Communications Union District and creating a model like ECFiber.
    - Engaging in direct dialogue with potential last-mile partners.
    - Investigating funding sources including determining eligibility for federal grants.
    - Completing a business plan once the operating model and partner or partners have been identified and are committed to the project.

2. **Further explore the viability of deploying a middle-mile network either in conjunction with, or in place of, a last-mile network if the last-mile option is not an immediately viable solution.** Action items include:
    - Considering establishing a Communications Union District and creating a model like EC Fiber. This could allow a more phased-in approach for a last-mile network.
    - Engaging in direct dialogue with potential network operators.
    - Investigating funding sources outside of grants which would not be available for middle-mile only projects.
    - Completing a business plan once the operating model and partner or partners have been identified and are committed to the project.

Additional details on these Recommendations are provided throughout the Report as well as in Section 9.4.2

1. Glossary

Below are key terms found in this Report. An expanded discussion the various technology types is found in **Appendix A**.

Broadband: The Federal Communications Commission (FCC) currently defines broadband as speeds that reach a minimum of 25 Mbps downstream and 3 Mbps upstream (25/3).

Backbone: A high-fiber count fiber optic mainline that provides connectivity to the internet. Connections to buildings from the backbone are called lateral connections.

Backhaul: In a telecommunications network, the backhaul portion of the network comprises the intermediate links between the core network, or backbone network, and the small subnetworks at the edge of the network.

Conduit: A means by which something is transmitted. The conduit houses the fiber.

Dark Fiber: Refers to fiber optic cable that has been installed and is available to use but is not connected to any electronic devices and not transmitting any data. *Also referred to as excess capacity.*

Demand Aggregation: Strategy employed by network owners to determine the neighborhoods in the community that are most likely to purchase service in order to build there first.

Fiber-to-the-Premise (FTTP) or Fiber-to-the-Home (FTTH): A last-mile network that connects all buildings (residential, business and government) in a community.

GPON Architecture: Defined as Gigabit Passive Optical Network. This is technology used to provide fiber connections to the end consumer.

Indefeasible Right of Use (IRU): Commonly used in the industry to provide long-term access to assets. Conduit and fiber deployed is leased through an agreement called an IRU.

Last-Mile Network: Network that provides services directly to homes and businesses in the community.

Latency: Term used to indicate the delay that happens in data communication over a network.

Middle-Mile Network: Typically defined as a network that serves community anchor institutions (i.e. schools, libraries, government buildings, public safety agencies, hospitals, etc.) but does not directly serve homes and businesses.

Open-Access Network: A network where the infrastructure assets (conduit and fiber) are made available through leases to multiple non-network owners that meet the terms and conditions set.

Outside Plant (OSP): Commonly used to refer to the engineering and construction of fiber infrastructure assets.

Over the Top (OTT): Television provided over a data stream but utilizing the existing wiring to the household

Public-Private Partnerships (PPPs): A legal partnership created by two or more public and private partners that balances and apportions risk, benefit and control of a last-mile network.

2. Competitive Landscape

One of the first tasks in conducting a broadband feasibility study is to undertake an evaluation of the current competitive landscape in the municipality. This includes looking at what existing infrastructure is present as well as researching what current providers are offering residents and businesses in terms of services and pricing. This section explores what existing infrastructure assets can be found in Lyndon and the surrounding communities.

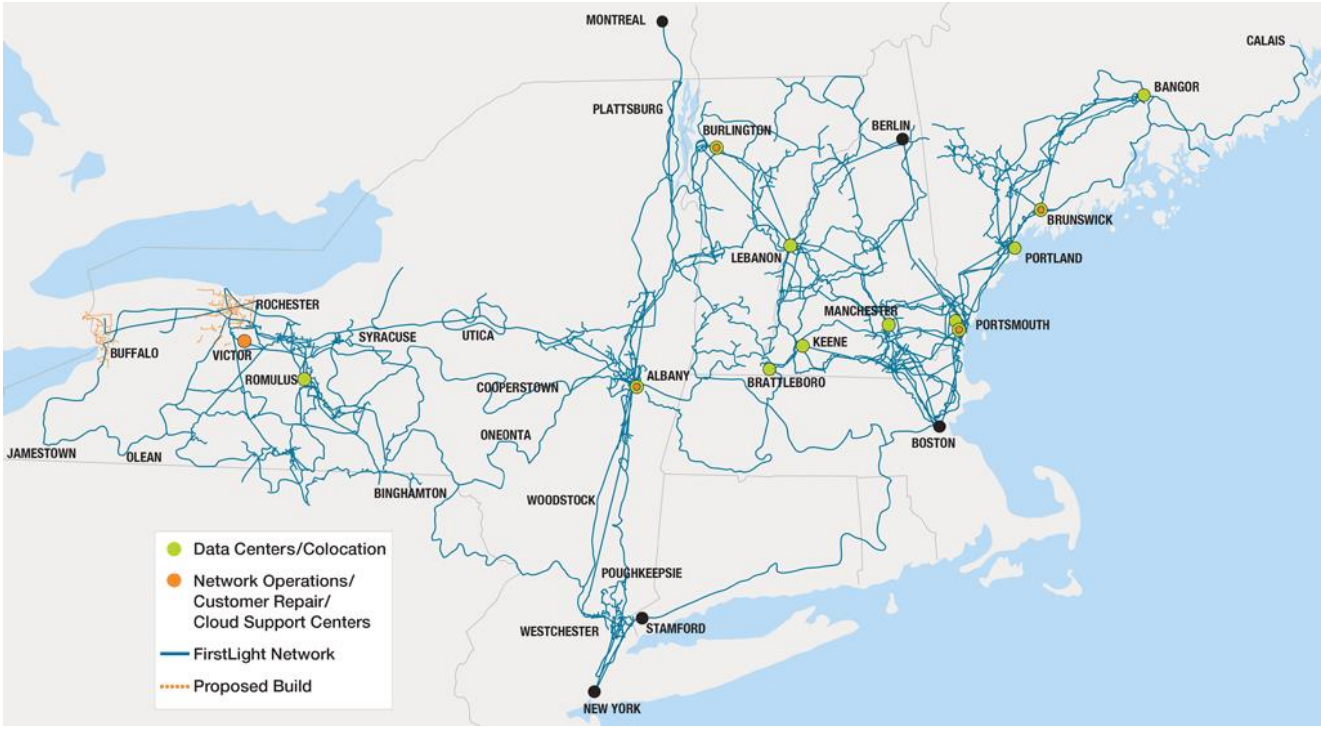
2.1 Existing Network Infrastructure

We know from discussions with various providers and groups, that there is some existing infrastructure in and around Lyndon and the surrounding communities. Providers generally do not make their network maps public on the grounds that the information is confidential and proprietary. However, there is one carrier in the area that has published a network map.

FirstLight is a telecommunications carrier and public utility that provides fiber-optic data, Internet, data center cloud and voice services to enterprise and carrier customers throughout the Northeast. They are headquartered in Albany, New York. FirstLight connects nearly 8,000 locations with service, with an additional 25,000 locations serviceable by its more than 14,000 route mile fiber network. Locally in Lyndon, FirstLight provides service to the Cobleigh Public Library.

FirstLight also serves national cellular providers, local providers and others including spanning high-tech manufacturing and research facilities, hospitals, banking and financial industries, law firms, secondary education sites, colleges and universities, and local and state governments.

Below is the existing fiber route map published on FirstLight's website. Based on all the information, it appears that FirstLight has infrastructure in and around Lyndon and the surrounding communities that could be leveraged (leased) in a new build.



2.2 Current Provider Offerings

This section details the packages and service offerings that are available in the region broken down by zip code and **according to the providers**. The main purpose for this exercise is to understand what the providers are saying in terms of their own services and availability.

For this portion of the Study, VPS collected data directly from each provider's website, as well as from a number of publicly available sources including BroadbandNow.com. **All of the data detailed in this section is information that is self-reported by the providers to third-party sites including the FCC.** For example, each provider is required to file a 477 Form with the FCC that details their coverage. Most third-party sites utilize the 477 data in addition to other publicly available data to generate coverage maps. None of the data and information provided is the opinion of, nor validated by VPS.

As such it is important to understand that the following:

- Providers report data based on entire census blocks and not by individual address level, so data does not accurately show where there might be gaps. Many third-party sites aggregate this data by zip code, which may further skew data.
- The speed data only shows the highest speeds of **what may be offered** by providers in an area. The speed data does not reflect what residents or businesses are actually receiving.
- It is unclear whether the FCC validates portions of the 477 data that is filed by the providers.

It is also important to note that unfortunately, most federal grant programs utilize the 477 data as a tool to determine whether an area is unserved or underserved. In other words, if the 477 data shows a provider is offering 10/1 speeds in an area – that area could be disqualified from pursuing federal funding opportunities. In addition, it would be the responsibility of the applicant to prove the negative - that an area is not actually being served if the 477 data says otherwise.

The data for the charts included for each zip code and area in this report includes:

- Provider
- Type of provider (wireline or wireless)
- Coverage % (within the zip code)
- Fastest advertised available speed (not actual speed)
- Customer rating (as reported by BroadbandNow.com)
- Pricing of stand-alone internet service offerings
- Pricing of available bundled package offerings

VPS looked at the variety of service offerings, as well as packages that are currently available through existing providers. The data will be presented through tables showing:

- Competitive data
- Residential and business price lists by carrier
- Residential and business bundled services price lists by carrier

The following caveats apply to this data:

- Only competitors who have greater than 2% coverage of an examined zip code have been included in this analysis.

- Providers often offer promotional pricing and alter pricing structures based on contract length and duration. The data included in this report attempts when possible, to be representative of having at least a 12-month contract with the provider. When possible, pricing included in this report excludes any promotional pricing offers in order to accurately represent total cost to potential customers.
- Pricing for bundled services has been included. There are many different options for bundled services. In an effort to provide clear and concise data, only standard bundled pricing options have been included.
- Enterprise or "build-to-fit" custom business offerings have not been included. All business pricing included is standardized offerings available to small to medium size businesses.
- Business coverage may not be representative of current service, rather willingness of providers to serve businesses in a given area.

2.2.1 Competitive Data Summary

The following tables serve as a summary overview of the number of providers in Lyndon and the surrounding communities, type of technology, coverage area, and customer rating.

Burke (05832)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating[1]**
Residential				
King Street Wireless	Fixed Wireless	100%	Up to 1 Mbps	-
Kingdom Connection[2]	Fixed Wireless	99%+	Up to 2 Mbps	-
Consolidated Communications[3]	DSL	93%+	Up to 25 Mbps	53%
Charter Spectrum	Cable	62%+	Up to 300 Mbps	50%
Business				
Spectrum Business	Cable and Fiber	39%+	Up to 300 Mbps	50%

Lyndon Center (05850)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
Residential				
Charter Spectrum	Cable	100%	Up to 300 Mbps	50%

[1] The Customer Rating comes from www.broadbandnow.com and is based on whether or not current and verified customers would recommend the service to others. Example: 25% of customers asked would recommend the service to others. Those companies without ratings are marked with a dash.

[2] King Street Wireless advertises to business customers as well, however, they do not have any indication that service or pricing varies from their residential options.

[3] Consolidated Communications was formerly known as FairPoint Communications. Consolidated Communications offers business services in addition to their residential services listed above. Their website claims "Consolidated has Internet service coverage in the entire state of Vermont." Actual location to location business specific coverage is difficult to determine without inquiring about specific business addresses.

Kingdom Connection	Fixed Wireless	100%	Up to 2 Mbps	-
King Street Wireless	Fixed Wireless	100%	Up to 1 Mbps	-
Consolidated Communications	DSL	63%+	Up to 25 Mbps	53%
Business				
Spectrum Business	Cable	100%	Up to 300 Mbps	50%

Lyndonville / Wheelock (05851)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
Residential				
Kingdom Connection	Fixed Wireless	98%+	Up to 2 Mbps	-
King Street Wireless	Fixed Wireless	97%+	Up to 1 Mbps	-
Consolidated Communications	DSL	96%+	Up to 25 Mbps	53%
Charter Spectrum	Cable	85%+	Up to 300 Mbps	50%
Business				
Spectrum Business	Cable	44%+	Up to 300 Mbps	50%

North Concord / Kirby (05858)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
Residential				
King Street Wireless	Fixed Wireless	95%+	Up to 1 Mbps	-
Consolidated Communications	DSL	84%+	Up to 25 Mbps	53%
Kingdom Connection	Fixed Wireless	72%+	Up to 2 Mbps	-
Charter Spectrum	Cable	46%+	Up to 300 Mbps	50%
Wireless LINC	Fixed Wireless	15%+	Up to 6 Mbps	-
Business				
Spectrum Business	Cable	19%+	Up to 300 Mbps	50%
Wireless LINC	Fixed Wireless	16%+	Up to 10 Mbps	-

Sheffield (05866)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
Residential				
Consolidated Communications	DSL	97%+	Up to 25 Mbps	53%
Kingdom Connection	Fixed Wireless	94%+	Up to 2 Mbps	-
King Street Wireless	Fixed Wireless	58%+	Up to 1 Mbps	-
Charter Spectrum	Cable	45%+	Up to 300 Mbps	50%
Cloud Alliance	Fixed Wireless	10%+	Up to 6 Mbps	-
Business				
Spectrum Business	Cable	13%+	Up to 300 Mbps	50%

Sutton (05867)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
Residential				
Consolidated Communications	DSL	98%+	Up to 25 Mbps	53%

Kingdom Connection	Fixed Wireless	98%+	Up to 2 Mbps	-
King Street Wireless	Fixed Wireless	91%+	Up to 1 Mbps	-
Charter Spectrum	Cable	48%+	Up to 300 Mbps	50%
Business				
Spectrum Business	Cable	37%+	Up to 300 Mbps	50%

West Burke / Newark (05871)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
Residential				
Kingdom Connection	Fixed Wireless	99%+	Up to 2 Mbps	-
Consolidated Communications	DSL	96%+	Up to 25 Mbps	53%
King Street Wireless	Fixed Wireless	89%+	Up to 1 Mbps	-
Charter Spectrum	Cable	59%+	Up to 300 Mbps	50%
Business				
Spectrum Business	Cable	25%+	Up to 300 Mbps	50%

Satellite (Constant)				
Provider	**Type**	**Coverage %**	**Fastest Available Speed**	**Customer Rating**
HughesNet	Satellite	100%	Up to 25 Mbps	25%
Viasat - Exede	Satellite	100%	Up to 12 Mbps	35%

VTel Wireless: VTel Wireless also serves customers within the study area. However, because VTel Wireless utilizes mobile, cellular based technology neither the FCC 477 Map or the BroadbandNow map shows their coverage area. As a result, VPS was not able to obtain their corresponding data. However, it is important to note that VTel Wireless was able to secure substantial federal funding to serve underserved and unserved residents in Vermont including in Lyndon and the surrounding communities and this will be an issue in pursuing grant funding. Many residents have raised issues with the reported coverage and completion of this project.

2.2.2 Residential and Business Price Lists by Carrier

The next two tables detail the residential and business pricing for the services offered by each carrier.

2.2.2.1 Residential Pricing

Provider	Speed (Mbps)	Monthly Price
Consolidated Communications	Up to 20 Mbps	$36.99
	Up to 60 Mbps	$56.99
Kingdom Connection	Up to 2 Mbps	$59.95
King Street Wireless	Up to 1 Mbps	No Data Publicly Available
Charter Spectrum	Up to 100 Mbps	$44.99
	Up to 300 Mbps	No Data Publicly Available

Wireless LINC	Up to 2.5 Mbps	$54.95
	Up to 4 Mbps	$64.95
	Up to 6 Mbps	$74.95

2.2.2.2 Business Pricing

Provider	Speed (Mbps)	Monthly Price
Consolidated Communications	Up to 7 Mbps	$30.59
	Up to 25 Mbps	$48.59
	Up to 100 Mbps	$71.99
Spectrum Business	Up to 100 Mbps	$59.99
	Up to 300 Mbps	$109.99
Wireless LINC	Up to 10 Mbps	$84.95

2.2.2.3 Satellite Providers

Provider	Speed (Mbps)	Monthly Price
Residential		
HughesNet	Up to 25 Mbps – 10 GB Data	$59.99
	Up to 25 Mbps – 20 GB Data	$69.99
Viasat - Exede	Up to 12 Mbps – 12 GB Data	$50.00
	Up to 12 Mbps – 25 GB Data	$75.00
	Up to 12 Mbps – 50 GB Data	$100.00
Business		
HughesNet	Up to 25 Mbps – 35 GB Data – Rules Apply	$69.99
	Up to 25 Mbps – 50 GB Data – Rules Apply	$99.99
	Up to 25 Mbps – 75 GB Data – Rules Apply	$149.99
	Up to 25 Mbps – 100 GB Data – Rules Apply	$199.99
Viasat - Exede	Up to 35 Mbps – 1 GB Data	$50.00
	Up to 35 Mbps – 10 GB Data	$80.00
	Up to 35 Mbps – 20 GB Data	$100.00
	Up to 35 Mbps – 50 GB Data	$150.00
	Up to 35 Mbps – 200 GB Data	$400.00

2.2.3 Bundled Services Pricing Lists by Carrier

2.2.3.1 Consolidated Communications Bundled Services

Voice Calling Plan & DIRECTV

Broadband Speed	Channel Offering	Monthly Price	Add-Ons
-	185+	$54.99	Unlimited Local & Long Distance
High-Speed Internet & Voice Calling Plan			
Broadband Speed	**Channel Offering**	**Monthly Price**	**Add-Ons**
Up to 7 Mbps	-	$38.98	Unlimited Local & Long Distance
High-Speed Internet & DIRECTV			
Broadband Speed	**Channel Offering**	**Monthly Price**	**Add-Ons**
Up to 7 Mbps	185+	$68.99	-
High-Speed Internet & Voice Calling Plan & DIRECTV			
Broadband Speed	**Channel Offering**	**Monthly Price**	**Add-Ons**
Up to 7 Mbps	185+	$73.98	Unlimited Local & Long Distance

2.2.3.2 Charter - Spectrum Bundled Services

Internet - Phone			
Broadband Speed	**Channel Offering**	**Monthly Price**	**Add-Ons**
Up to 100 Mbps	-	$54.98	Free Internet Modem
Internet - TV			
Broadband Speed	**Channel Offering**	**Monthly Price**	**Add-Ons**
Up to 100 Mbps	125+	$89.98	Free HD, On Demand, Optional DVRs
Up to 100 Mbps	175+	$109.98	Free HD, Unlimited Local & Long Distance
Internet - TV – Phone			
Broadband Speed	**Channel Offering**	**Monthly Price**	**Add-Ons**
Up to 100 Mbps	125+	$99.97	Free HD, Unlimited Local & Long Distance
Up to 100 Mbps	175+	$119.97	Free HD, Unlimited Local & Long Distance
Up to 100 Mbps	200+	$139.97	Free HD, Unlimited Local & Long Distance

2.2.3.3 HughesNet

HughesNet offers lowered pricing for both residential and business customers who bundle internet and phone together. Currently, HughesNet offers $10 off per month for bundling for the first twelve months.

2.2.3.4 Viasat

Similar to HughesNet, Viasat offers lowered pricing for residential and business customers who bundle internet and phone together. Viasat also offers discounted pricing for bundling their services with DirectTV. Currently, customers can save $10 a month for the first six months when bundling phone and internet, and an additional $10 a month for the first twelve months when bundling internet and DirectTV.

2.3 Provider Discussions

VPS had discussions with a number of existing and potential new providers. Below is a summary of those conversations.

2.3.1 Kingdom Fiber

VPS spoke with CEO Michael Birnbaum. Kingdom Fiber states that they plan to reach Lyndon in 2 years. They are currently in the process of building out their network. Kingdom Fiber states that they currently serve Hardwick, Greensboro, Craftsbury, and the Albany area. They state they plan to build out a number of communities in the following counties: Lamoille, Caledonia, Essex, and Orleans. A full list of communities can be found at: https://kingdomfiber.net/next/

2.3.2 ECFiber

VPS spoke with Carolyn Monroe at ECFiber. The East Central Vermont Telecommunications District (ECFiber) is a municipal body with 24-member towns in east-central Vermont. The group was formed to build a community-owned fiber-optic network. ECFiber contracted with ValleyNet to design, build, and operate the network. The goal of ECFiber is delivering fast, reliable, and affordable Internet to every home, business, and civic institution in their territory. ECFiber serves Barnard, Bethel, Braintree, Brookfield, Chelsea, Granville, Hancock, Hartford, Montpelier, Norwich, Pittsfield, Pomfret, Randolph, Reading, Rochester, Royalton, Sharon, Stockbridge, Strafford, Thetford, Tunbridge, Vershire, West Windsor and Woodstock, Vermont. ECFiber is discussed in more detail in Section 6.8.

2.3.3 Kingdom Connection

Kingdom Connection is a wireless broadband provider. VPS spoke with Wil Merrill. Kingdom Connection has towers on Burke Mountain, Crow Hill and Danville. Kingdom Connection utilizes unlicensed frequencies. Customers must have line of sight to the towers. Kingdom Connection noted that the 900 Frequency has too much interference. They also stressed the concern that Cable, and DSL are currently much cheaper for customers, so the company was struggling to compete. The speeds offered are 2 Mbps up to 10 Mbps. Current customer counts are on a downward trend. Kingdom Connection had 530 customers, they are now down to 180 despite the fact that people often call to see if they can get service. Due to current technology, they are unable to serve many potential customers.

2.4 Key Findings

Based on the information gathered, VPS provides the following key findings:

- The Study area has a fair amount of middle-mile infrastructure (i.e. FirstLight).
- Overall, there are a number of providers. However, many residents still do not have access to reliable high-speed broadband.
- There is not an effective and comprehensive residential fiber deployment in Lyndon and the surrounding communities.
- Some homes and businesses have multiple choices for internet or bundled service providers that offer a variety of pricing options. However, many others are limited to only Fixed Wireless, Mobile, or Satellite providers. Depending on a variety of issues these providers may present latency issues which limit the speed and capability of the end user's connection.

- Multiple providers only offer “Up to 2 Mbps” to residents. This is far below the FCC definition of broadband.
- Differences in advertisements and actual coverage areas from multiple providers in the area make it difficult for current residents to determine true connectivity capabilities of their current of future residence or place of business.
- Information obtained through the Survey and Stakeholder Outreach (as detailed in Section 3), anecdotally contradicts the availability of speeds and service offerings.

3. Survey and Stakeholder Outreach Results

The biggest question a municipal feasibility study needs to answer is "what is the problem we need to solve?" As such, the most critical task of a feasibility study is to conduct outreach in the community in order talk to as many stakeholders as possible. Stakeholders represent key groups of potential end-users of a municipal network such as citizens, businesses and government agencies. The purpose is to obtain feedback regarding current levels of service, future needs and concerns.

In order for the stakeholder outreach to be as comprehensive as possible, VPS utilized a variety of methods to collect the data and information including holding town hall meetings with citizens, one-on-one meetings with key groups, and conducting a residential survey.

3.1 Stakeholder Meetings

VPS conducted stakeholder meetings over the course of two days with a variety of groups. A chart detailing those comments is provided below.

Group	Comments
Health Care	● Poor connectivity presents issues with employees communicating with the local hospital. ● Poor broadband impacts healthcare providers ability to recruit talent to the area. ● Poor broadband impacts home healthcare providers ability to chart, communicate, and coordinate with clinic-based providers. ● Many local healthcare facilities lack necessary network redundancy and are vulnerable to network failure.
Business Community	● The economy and workforce are impacted by poor broadband availability. ● Attracting new young employees is hard without proper broadband speeds ● Tourism is large factor of Lyndon's economy. Tourists expect better service when visiting. ● Poor broadband during local festivals can negatively impact vendors and attendants alike.
Local Realty Professionals	● Number 1 question asked by prospective buyers is "What are the high-speed internet options?" ● People won't even look at a property if they don't have a good broadband option. ● Many residents work from home and have "really bad" internet. Individuals are considering moving because of it. ● Rental properties in areas such as Newark constantly lose potential renters because there is not a viable broadband option to the property.
Public Safety	● Fire departments have issues with connecting critical devices while in the field. ● Departments also struggle with communication between units and between units and the station.
Schools and Libraries	● Schools have conducted their own survey and report that only 20-35% of students have internet at home. ● Schools are looking to implement distance learning and e-learning but are unable to implement programs due to lack of student connectivity. ● Many individuals utilize the Public Library Wi-Fi as only means of connection.
Citizens – Town Hall Meeting	● Satellite is the only option for some rural residents. They state cost is too high for spotty service. ● Residents state the inability to stream services due to speed and latency issues. ● Residents also state issues with connectivity and reliability of home telephone service as well as electricity in rural areas. All factors which contribute to overall connectivity issues.

In summary, there are five key points that stand out from the Stakeholder Outreach. They are:

- Remote areas need better cellular coverage and better internet connections. Not having access is negatively impacting local business, employee attraction and economic growth.
- Lack of coverage is creating significant issues for public safety and first responders.
- Internet plans for residents and businesses are expensive and mobile broadband, fixed wireless and satellite technologies present speed and latency issues for many customers. One resident even mentioned that he subscribes to 3 different services at a cost of over $300 a month in the hopes that one connection works at any given time.
- Government facilities, hospital and other locations need a redundant connection to safeguard against primary system going down.
- There is a clear need for more infrastructure – towers and fiber throughout the area.

3.2 Residential Survey Results

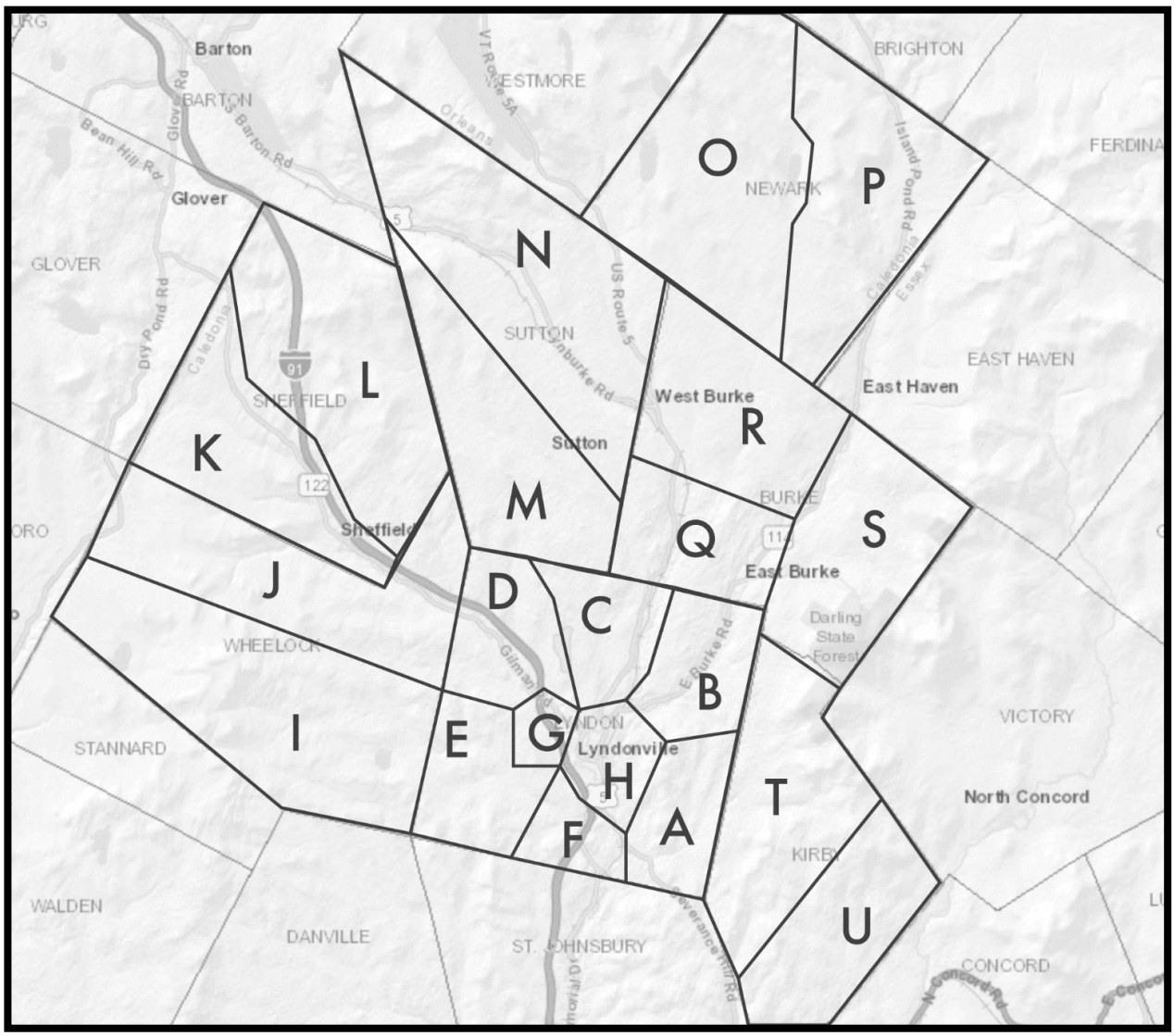
VPS conducted an informal survey to obtain key data points regarding current level of service, satisfaction with current providers, resident's willingness to switch providers, and what price do residents consider to be reasonable for high-speed broadband. The survey was promoted by the Town of Lyndon, and others through social media and email. This survey is considered to be directional research and informal only because the budget did not allow for an extensive mail program to randomly selected households. Respondents self-selected to complete the survey.

The survey itself contained a total of 25 questions (4 of which were demographic related) and was hosted on the online platform Survey Monkey. Overall, VPS received 437 survey responses which is a strong and robust sample. The official survey data and analysis is presented below broken down by topic. Actual results are rounded to the closest whole percent for presentation purposes.

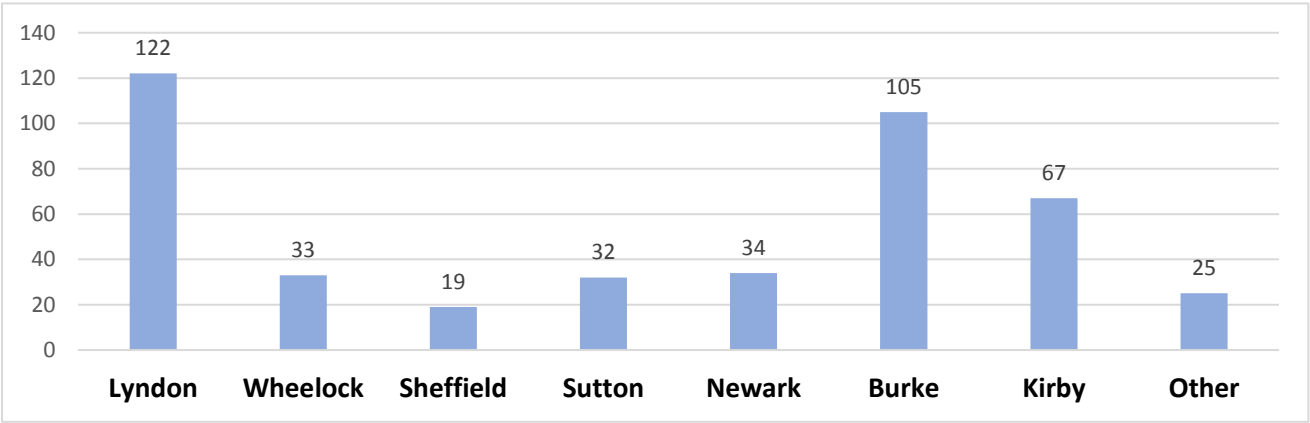
3.2.1 Demographics

Respondents identified themselves as being from 21 different areas within Lyndon and the surrounding communities. The areas examined are outlined in the chart and map below:

Lyndon	Wheelock	Sheffield	Sutton	Newark	Burke	Kirby
A. East Lyndon	I. South Wheelock	K. 122 North-Sheffield Sq. Rd	M. South-Calendar Brook Rd-Wheelock Rd	O. Newark West	Q. West Burke-Burke Hollow-Route 5 North	T. North Kirby-Ridge Rd
B. 114 North-Darling Hill-Burrington Bridge Rd	J. 122 North-Vertical Mile Rd	L. 91 North-Berry Hill Rd	N. North-Route 5	P. Newark East	R. Village Darling Hill-Route 5 South	U. South Kirby
C. Route 5 North-Pudding Hill-Little Egypt					S. East Burk-Burke Mtn	
D. 122 North						
E. South Wheelock Rd						
F. Lyndon Corner-Route 5 South						
G. Lyndon Center						
H. Village-Downtown						



The number of responses for the above areas were broken down as follows:



3.2.2 Household Services Purchased and Ranking by Importance

Respondents purchase a variety of communications services for their household, but they are not purchased equally. For example:

- 87% purchase internet
- 88% purchase cellular/mobile service
- 55% purchase cable or satellite television
- 36% purchase land-line telephone service
- 6% purchase phone service such as VOIP directly from a cable provider

When asked to rank the services from most to least important, internet and cellular/mobile telephone service were overwhelmingly the most important. On a ranking scale with 4 being most important, the following scores illustrate what community members find most important:

- 3.62 for High-speed internet connection
- 3.02 for Cellular/mobile telephone
- 1.93 for Television
- 1.51 for Fixed (land-line) telephone

Based on this data, approximately 88% of respondents purchase internet services in some form. Approximately 42% of those who do not purchase internet services indicated that internet was not available at their location. Other reasons for not purchasing internet included that an internet connection was too expensive (21%), or the family had no need for internet (2%). Around 10% indicated that internet was simply too slow to purchase. The remaining respondents stated a number of other reasons for not purchasing internet services.

It's important to note that this is a relatively high percentage of people that do not purchase internet services. In many communities, it is not uncommon for the percentage of those who do not purchase internet to be less than 2%. This indicates that service availability is lacking.

3.2.3 Current Internet Service

For those that do purchase internet services, the survey asked about cost. Around 8% of respondents answered that they purchase internet through a bundled package with phone and/or television so it’s difficult to determine how much they are paying just for internet. However, of the remainder that do purchase internet as a stand-alone service:

- 28% are paying $41-$60 a month
- 28% are paying $61-$80 a month
- 13% are paying $81-$100 a month
- 12% are paying $40 or less a month
- 11% are paying over $100 a month

It is important to note that 34% of respondents receive their service from Charter Spectrum. Approximately 28% purchase service from FairPoint/Consolidated with slightly less than 16% purchasing internet services from VTel. The remaining 22% is made up of various providers with Hughes Net (12%) as the next most used provider and The Kingdom Connection and Viasat/Exede (both at approximately 5%). The remaining respondents, approximately 1%, subscribed to Dish Network

(which partners with third-party satellite internet providers to offer service). Due to coverage, many respondents commented that they felt they did not feel they had enough options in their respective areas. Many respondents felt this lack of providers hampered the economy. Specifically, respondents pointed out issues with their ability for residents to work from home.

3.2.4 Satisfaction of Current Providers

The next set of questions explore how satisfied internet subscribers are with their current broadband providers and service.

Approximately 24% of respondents are either very satisfied or satisfied with the overall service and value they receive from their current provider. This is an extremely low percentage. In most communities this percentage ranges between 40-60% or higher.

Approximately 48% of respondents answered that they were dissatisfied or very dissatisfied with their current overall service and value they receive from their internet provider. This leaves 28% who are neither satisfied or dissatisfied. Looking further into what aspects of service respondents were most concerned with, the following statistics stated:

- **Price:** 22% were either very satisfied or satisfied with price of service, while 53% were unsatisfied or very unsatisfied with the price of service. The remaining amount were neutral. This level of satisfaction is well below what is typically seen.

- **Speed:** Approximately 33% were very satisfied or satisfied with the speed of their connection. 51% of respondents were unsatisfied or very unsatisfied with the speed of their connection. The remaining amount were neutral.

- **Reliability:** Respondents were overall more likely to believe that their connections were reliable as 38% felt very satisfied or satisfied with their current connection. This was opposed to 42% who were unsatisfied, or very unsatisfied with their connection's reliability. The remaining amount were neutral.

Delving a bit deeper into the various aspects of their internet service, respondents indicated how important certain aspects of home internet service were to them. The weighted averages of the following aspects indicate that no specific feature of home internet access stood out above the rest:

- Price (2.96)
- Speed (2.76)
- Reliability (2.69)
- Technical support (2.69)
- Overall customer service (2.67)

3.2.5 Willingness to Switch from Current Providers

Keeping in mind what respondents are currently paying for internet service, the survey asked respondents what is the most they would pay if a new provider offered gigabit service. The respondents answered the following:

Answer Choices	Responses
$21 to $40	14%
$41 to $60	33%
$61 to $80	25%
$81 to $100	16%
$100 to $125	6%
Over $125	6%

86% of respondents indicated that they would switch providers at the price selected above. This data suggests that individuals may be willing to pay slightly more money to receive a higher quality service. However, according to a previous question in which only 22% of respondents were satisfied with price, raising prices past current market may be more than current residents are able to bear. The data and survey indicate most importantly that residents would switch to a provider who offered them value. Many households indicate they are already paying a premium for services, yet not receiving adequate speeds or reliability. These households are not likely to pay more, yet they would be willing to switch to a provider who offered them more for what they are already paying.

Overall, the data indicates that the biggest problem is with value. Respondents are paying too much for internet service that is lacking in reliability and speed.

3.2.6 Willingness to Pay One-time Hookup Fees

The survey asked respondents what is the most you would pay for a one-time hookup/connection fee if it were required by a new provider that offered a reliable, robust, high-speed internet connection (up to 1 gig) The purpose of this question is to explore partial funding mechanisms for deploying a network. Any hook-up fees can help offset some or a significant portion of the deployment fees depending on the amount. Residents do not mind paying hook-up fees if they are reasonably priced, but they would need to be under $100. Unfortunately, at this price point, the fee would do little to offset any costs. Hookup fees, especially in rural areas, can be much higher. Below is the data on how much respondents would be willing to pay:

- 35% would pay $50 dollars or less
- 31% would be willing to pay up to $100 dollars for a hook-up fee
- 12% would be willing to pay up to $250 dollars
- 13% of respondents would pay or consider a fee over $250 dollars
- 8% were averse to the idea of a hookup fee and indicated that they would not pay an upfront hook-up fee regardless of cost.

3.2.7 Television

Television is an important staple in many households across America. As technology changes, there have become more options for watching popular shows, movies, and live events. Many individuals have begun to move away from traditional sources of television (cable or satellite) and started purchasing programming options over the internet. With respect to television programming respondents reported that:

- 40% purchase satellite television such as Direct TV
- 28% stream content over the internet (including Netflix, Hulu, Vudu, etc...)

- 19% don't purchase any television service
- 15% purchase cable television
- 9% obtain television content free - over the air with an antenna
- 6% only stream shows using the internet and do not subscribe to any other television service

The data tells us that 55% of respondents purchase satellite and cable services and 28% are currently purchasing Internet programing (such as Netflix, Hulu, Vudu). Respondents were able to select more than one option, so someone could indicate they purchase cable service and buy programming through the internet. Interestingly, only 6% of respondents who are using Internet streaming services are not also paying for some other type of programming via satellite or cable. This indicates that, for those purchasing programming, most respondents who purchase programming have not made the switch to solely streaming their video and television programming and become "cord cutters."

Cord cutting is the term given to households that stop purchasing traditional television services and instead solely utilize their internet connection to stream television content. The national average is approximately 13-15% of viewers are cord cutters. As you can see by the percentages above, cord cutting is well below the national areas. This is common in rural areas that lack adequate broadband speeds to sustain a streaming service.

3.2.8 Cellular Telephone

Since the feasibility study also looked at cellular broadband, the survey asked a few questions about resident's cell phone experiences. Overall 88% purchase cellular telephone service. Approximately 54% of respondents purchase cellular service through Verizon. Percentages of identified carriers are as follows:

- 54% Verizon
- 30% AT&T
- 1% T-Mobile
- 1% Sprint
- 14% Other

Approximately 19% of those that purchase cellular telephone service indicated that "The cell signal is weak at my house and it's very difficult to use my cell phone at home." Another 20% indicated that they need to move around the house in order to make or receive a call. Just under 5% of respondents had no cellular telephone service at their residence. 56% of respondents answered that their cell signal was strong most of the time or better.

Overall, based on the data, the cellular coverage is relatively good and reliable in many areas, but struggles in other areas. Due to the lack of, or limited number of available broadband providers in certain areas, some residents have chosen to use cellular hotspots which provide internet for devices through cellular data. This option is often far more costly than traditional services, and is data capped. This means there may be limited use. Many respondents specifically pointed out the need for better cell service in certain areas in the "additional comments" section of the survey. A few respondents noted that there are large areas that are not only underserved but are completely unserved by current cell providers.

3.2.9 Local Government Action

The survey asked one question regarding respondents' opinion of the role of local government in improving broadband. The responses were very mixed. However, approximately 30% agree with the statement that local government has a role in improving broadband services, but they aren't sure what government should do. Just about 23% believe that local government should use public funds to finance and build a town-owned network. In stark contrast, around 5% of respondents believe that current providers are meeting the needs and local government shouldn't do anything. Another

42% of respondents felt the local government needed to at least consider using public funds to finance a network of some kind if current providers were not able to improve broadband services. These numbers are higher than average in support of government involvement. This indicates constituent trust in local government action, as well as the need for action.

Out of 147 respondents who added additional general comments, only 3 respondents added that they were wary or had adverse opinions to local government becoming involved in broadband improvement. This is notably well below the average rate of direct and negative responses directed at local government's involvement in broadband improvement.

3.2.10 Respondent Comments

Below is a summary of the open-ended comments submitted by survey respondents that express a wide-range of opinions regarding their current concerns and need for better broadband.

Note: The opinions stated below are directly from respondents of this survey and do not represent the views, opinions or positions of VPS in any way.

- **Respondents have very strong opinions about the current state of broadband in the communities they reside in.**
  - *"Please hurry! We've been living with bad or no internet for YEARS!"*
  - *"Having fast, reliable internet in our home is critical for our employment (educators) as well as our children's education. It is also crucial for staying actively involved in our community as it provides us with the information, we rely on to do so."*
  - *"It is almost non-existent in this area, and way overpriced. A bad value. And an unattractive attribute to outsiders wanting to move to the area, and locals wanting to stay."*
- **Many respondents believe that their broadband options and deployments are behind the times.**
  - *"Highspeed broadband is significantly way overdue… it is a necessity not a luxury."*
  - *"It is pathetic in this day and age that our schools do not have the broadband necessary for students to even take online tests."*
  - *"Thank you for your interest in expanding internet service in the area. In order to keep up with the rest of the world, the NEK needs to have access to high quality, economic broadband."*
- **Many respondents feel that they do not have as many options for broadband as they would like and that certain areas of Lyndon and the surrounding areas are monopolized by current providers.**
  - *"Charter without any real competitors has a practical monopoly."*
  - *"Whenever services are improved, its only downtown, on main highways. It would be nice to have reasonably priced options when you live just off the main road. Broadband to all should mean all."*
  - *"I work from home and depend on high-speed internet service to do so. We have one option; I would welcome another."*
- **Many expressed concerns about the personal and public ramifications that not improving broadband access may have. Respondents were notably concerned about educational and public safety issues.**
  - *"It would be great for our rural area to have fast and reasonably priced internet. As a teacher, I can empathize with the difficulties my lower income students face with internet!"*
  - *"There is huge educational inequity in this area. Many of the towns Lyndon Institute draws students from (Lunenburg, Kirby, Sutton, Newark) have the least access to good broadband in Vermont. School-work is all online, and some students and parents can easily work from home and others cannot."*
  - *"At this point, I think that excellent broadband is important as electricity and running water. When my service is down, I feel isolated and worried that I won't have access to fire and police and ambulance services should that need arise."*

- **The current state of broadband severely hampers work-from-home opportunities, which may deter individuals from moving to the area.**
  - *"Both my wife and I work from home. We are considering moving to a place where we have better access to high speed internet!"*
  - *"I work from home and reliable high-speed Internet is crucial for my livelihood."*
  - *"Lack of good broadband limits my ability to access my work from home, which is a real drawback at times."*
- **Broadband experiences currently vary majorly from resident to resident. Two locations and residences may have completely different experiences with speed and reliability.**
  - *"I am only 2 miles from center of town and my only option is dsl with fair point. I pay for high speed it's expensive not reliable and not very fast my neighbor has cable if I wanted it, they told me at least $6000 and that was years ago shouldn't be that much there's only three poles between us and they are already there for power and phone."*
  - *"It is frustrating that within a mile there is fast internet."*
  - *"I have Cable at my house and a mile away, friends do not have access to cable."*
- **Some residents share concerns about the economic impact of current broadband service and speeds in the area.**
  - *"I think our community as a whole desperately needs a major push in broadband infrastructure and there is a strong correlation between economic growth and access to affordable and reliable high-speed internet service."*
  - *"If development and jobs are wanted, broadband is essential."*
  - *"As a local business owner, extending this service to East Haven would have a very positive impact for us."*
- **Much of the areas lack speeds which meet the FCC's high-speed broadband standards and lack basic cellular coverage.**
  - *"We have no cellular service or dsl internet available at our location."*
  - *"We live in west Burke and we do not have access to internet. We also have poor cell phone reception. We can barely make a call sometimes, especially if it is cloudy or raining. Th area needs access to internet!"*
  - *"Broadband is needed badly in our area. Service is limited, costly, and for a lot of us we can't even make a call at our house on our cell phones. In order to need to drive to West Burke village."*

3.2.11 Key Take-Aways From the Survey

A summary of the top key findings of the survey is provided below.

- Current providers are not meeting the needs and/or expectations of many residents, especially those residing outside of the developed portions of Lyndon.

- Residents of Lyndon and the surrounding communities are looking to local government for support and involvement in improving broadband speeds in the area. Residents are far more favorable towards direct government involvement than what is seen in many communities currently across the US.

- The ability to work from home is a central issue with respondents of this survey. Of the 147 respondents who left comments in the "additional comment" section, 27 respondents specifically noted the impact poor broadband had on the ability to work from home. Many other respondents commented generally on the economic impact that improving broadband would have on local business.

- Many respondents feel that the continued growth and success of the area will be directly impacted by the ability to improve broadband service for current and future residents.

It should be noted that the survey did not ask respondents to test their speed due to the fact that speed tests are dependent on the time of day they are tested, and it can create confusion for the respondents in the middle of a survey

because individuals need to open a new web browser to conduct the test. Also, the respondent may not be completing the survey from home. Due to this fact, it should be noted that no steps were taken to verify speeds claimed specifically by respondents. However, according to the speeds offered by providers in Section 2, It is of note that speeds offered in portions of Lyndon and the surrounding communities are extremely low, and almost all fall well below the federal definition of “broadband”.

4. Municipal Network Model Overview

Now that the existing infrastructure, provider offerings and stakeholder outreach results have been presented and analyzed, the next step in the process is to understand what the various network models are and to explore the pros and cons of each.

There are two main types of municipal networks that serve end-users (other than networks built exclusively for internal government use) and they are most commonly referred to as last-mile and middle–mile. For purposes of this discussion, the term network is inclusive of all technologies including fiber and/or wireless.

4.1 Last-Mile Network Models

A last-mile network (also known as Fiber-to-the-Premise or FTTP) is one that is designed to provide service directly to homes and businesses in the community. Last-mile networks can also serve government buildings and other community anchor institutions.

Last-mile networks are the most expensive to deploy but can provide the biggest benefit to the community. However, municipal FTTP networks are also more-rare due to the cost it takes to deploy the infrastructure and the need to have an operator/provider who can run and manage the network. For this reason, most of the municipal last-mile networks in existence are in communities that also have a municipal electric utility. This is because the local government (through its municipal utility) already owns utility pole infrastructure that can be leveraged to offset deployment costs. Municipal electric utilities also have operating and billing systems already in place to serve customers. Therefore, they have experience in serving customers and can more easily shift gears to offer a broadband service as a new offering rather than having to create an operational system greenfield.

The other key factor is that last-mile networks usually require a take-rate that is between 40-60%. This means that the network operator needs to obtain 40-60% of the residential subscriptions available in the community in order to recoup the capital investment, make a profit and be sustainable. Examples of FTTP networks – both those that have a municipal electric utility and those that do not - are provided below. The municipal electric networks are all very similar and so only one example is provided.

Muni Electric FTTP Network Examples	
Longmont, CO	Longmont's "NextLight" is a gigabit fiber network owned and operated by the city and its power utility, Longmont Power & Communications (LPC). In 2013 Longmont supported the network build at a 70% level, approving a $40.3 million bond issuance to cover the startup costs of the Internet service. Even the $40 million price tag would have been significantly higher if not for the existing asset of an 18-mile fiber loop within the City's limits. Longmont has 38,000 premises and 92,000 residents within its approximately 30 square miles. NextLight offers symmetrical gigabit service at $50/month for those who signed up early. This $50 rate is for both the lifetime of the home as well as the owner should he/she move within city limits. Late in 2016 the City voted to increase LPC's budget by $7 million, sourced from the Electric and Broadband Utility Fund balance to hire staff needed to support take rates significantly higher as initially predicted. Current take rates average 53%.

Non-Muni Electric FTTP Network Examples	
Rio Blanco County, CO	Rio Blanco County utilized county funds and Colorado DOLA grant funds to construct an FTTP network serving its rural community. The technologies deployed are a mix of fiber and wireless. Rio Blanco is building a fiber to the premises network in its main two population centers (Meeker and Rangley) and a shared fixed wireless solution designed to reach all other addresses. Additionally, Rio Blanco is building middle-mile fiber available for carriers to lease in the county.
Ammon, ID	The City of Ammon Idaho has a very unique model. Ammon has built an open access network that lets multiple private ISPs offer service to customers over city-owned fiber. The City self-funded a portion of the network. However, Ammon is using a model similar to Google Fiber's "Fiberhoods," in which construction happens first in neighborhoods where a majority of residents commit to buying service. Those who opt-in have the option to pay either an upfront fee of $3000 or pay the amount gradually over a 20-year period, excluding an additional utility fee of $16.50 a month. Should a home-owner sell their house prior to the $3000 fee being paid off – it would be the responsibility of the new home-owner to continues those payments. Conversely, should a homeowner move after paying the upfront free – the new homeowner would have the benefit of the network connection without needing to pay the connection fee. This model has been touted as the "model of the future" but it is far from being complete. Success is yet to be determined the fee structure may not be appropriate for many communities.
Fairlawn, OH	The City of Fairlawn established FairlawnGig as a forward-thinking, economic development strategy founded on the belief that business growth, innovation, and community transformation will follow with every connection. The build cost approximately $10 million dollars (paid for by bond) and the City will connect every home and business. The City is not looking to the network to become a profit-making revenue stream. The City felt that FairlawnGig was a necessity for the community at large. The network has a take rate of just over 50% and is looking at expanding to neighboring towns.

4.2 Middle-Mile Networks

A municipal middle-mile network is typically defined as a network that serves community anchor institutions (i.e. schools, libraries, government buildings, public safety agencies, hospitals, etc.) but does not directly serve homes and businesses. A middle-mile network could either be operated directly by the municipality or outsourced to a network operator.

The purpose of middle-mile networks is generally to build a high fiber count (fiber cables with strand counts of 144 and above) backbone[4] that provides direct lateral connections to key institutions and enables infrastructure assets to be leveraged and leased by others including businesses and private providers. Although, there are middle-mile networks that are built to support internal government needs only (closed network).

Middle-mile networks are much more commonly constructed by municipalities than last-mile networks due to the significantly lower cost of deployment and operations and reduced risk. Middle-mile networks can be a tremendous asset to a community in that it can generate revenue, and provide critical infrastructure needed to support government operations.

Examples of middle-mile networks are provided below.

[4] A backbone is literally the spine of the network. Backbone's are usually built along main corridors and provide transport to and from the hub site where the electronics are located to the connected entity.

Middle-Mile Municipal Network Examples	
Kent County, MD	Kent County, Maryland is a rural county on the Eastern shore of the state. Kent County determined a few years ago that they wanted to invest in middle-mile infrastructure that they could own as an asset. The County decided not to finance the network build through a bond, but rather paid for it entirely out of general funds. The County now has a 110- mile network completed and have made the assets available to be leased and leveraged by others.
City of Centennial, CO	The City of Centennial (107,000 residents) is in the process of building a fiber backbone. The City is self-funding the middle-mile portion of the network build and will own the assets. Centennial has selected Ting to be the FTTP service provider, who is currently taking signups for residential service for $89/month range for symmetrical gigabit speeds. While the network is the property of the City and eventually an "open network," Ting partnerships typically feature an "exclusive right to operate network" term of multiple years. While the build is the responsibility of the respective cities, Ting will lease and light the fiber and provide all equipment and Internet access. Funding the build is a $5.7 million allocation from the general fund. The city council led by the fiber subcommittee looked at this funding as an infrastructure investment removing the expectation that this funding would be directly paid back.
Northwest Colorado Broadband (NWCB); Steamboat Springs, CO	The City of Steamboat Springs teamed with Routt County, Yampa Valley Electric Association, Yampa Valley Hospital, Chamber of Commerce and the Steamboat Springs School System to legally form a nonprofit. The partners supplied some of the capital along with DOLA grant funds to build a middle-mile network through Steamboat Springs. NWCB selected Mammoth Networks as its network operator who will manage, operate the network and lease fiber to interested and qualified applicants. NWCB is also talking with the City of Craig and Moffat County about being the Network Operator for a regional network.

4.3 Open Access Middle-Mile Networks

An open access network is one where the infrastructure assets (conduit and/or fiber) are made available under certain policies and procedures to multiple non-network owners. Most middle-mile networks are usually open networks and most last-mile networks are usually closed particularly those built by providers.[5] Publicly funded grant programs offered by the federal and state government sometimes require networks to be open access.

Middle-mile networks that lease dark fiber and conduit are designed to be open access. With middle-mile networks – the more users, the bigger the benefit to the network and the more revenue it generates. A private provider that is considering building in a community may have an interest in leasing middle-mile assets because it helps with reducing their costs of deployment. A provider, then, would only need to invest in the lateral connections to homes and businesses and would not have to build the backbone. Larger businesses and those with multiple office locations may also be interested in leasing fiber assets to help connect an internal network or obtain better broadband.

In most cases, excess[6] conduit and fiber deployed can be leased through an agreement called an Indefeasible Right of Use (IRU). IRUs are commonly used in the industry to provide long-term access to assets. The term of an IRU typically runs between 10-20 years.

[5] Open access is a hotly debated topic particularly as it relates to last-mile networks because the greater the number of providers, the harder it is for a new-entrant provider to meet its take-rate goals and make a profit. This will be of particular concern for providers that are also making a financial investment. Will a provider be able to meet take rates of 40-60% while other providers are invited to compete for the same customers? Ultimately, the open access question will be determined by all the investors and stakeholders.

[6] Conduit and fiber strands that will not be used by the municipality.

4.4 Conduit Leasing

Conduit is something that is generally (except in extreme circumstances) part of every underground network fiber build. The most expensive part of a deploying a broadband network is the construction. The cost of the actual assets (fiber and conduit) are a tiny portion of the overall budget. Therefore, if engaging in a network build, it is cost-effective to install larger or extra conduit banks and install high-count fiber during the initial construction phase to cover all current and future needs. It is not cost-effective to have to dig more than once.

There are a variety of conduit sizes that can accommodate one or more fiber cables. Often, the network owner will install a larger size conduit than what is needed in order to lease excess space to other providers that want to install fiber. Sometimes a network owner will install multiple conduits side-by-side instead of having one larger conduit bank because some providers prefer to have exclusive rights to a single conduit for security reasons.

Conduit pricing is usually based on a per-foot basis. Pricing varies based on demand in the region and amount of conduit available. Below is a chart that provides examples of three different pricing structures for conduit:

Location	Price	IRU Term	Total Cost
Boulder, Co	$5.50 per foot	20 years	$722,271 in a one-time payment
Lincoln, NE	$65,000 per year	20 years	$1.3 million paid monthly over 20 years with an escalation clause not exceed CPI.
Baltimore, MD	$3.00 per foot (appx)	Negotiable	Depends on how much leased. City requires any new conduit built by provider to be owned by City

Investing in conduit without building a fiber network is actually a strategy that several localities have successfully implemented.

In 2012, the City of Lincoln invested $700,000 into building an extensive conduit system. Restrictions on municipal broadband prevented them from building a fiber network, so they limited the infrastructure to conduit. The conduit was leased for several years to multiple providers including Level 3 and NebraskaLink. In 2014 the city launched a free Wi-Fi initiative with backhaul provided by NebraskaLink. In 2015, the city announced that the conduit project had attracted Allo Communications, who planned to lease the conduit and undertake a massive FTTP buildout with the goal to serve every home and business in Lincoln. As of September 2018, the project is nearly complete. Allo plans to have the project completed no later than early 2019. Allo charges competitive pricing with 1 gigabit service costing approximately $90 per month, and 300 Mbps costing approximately $65 per month.

Atlanta BeltLine is a nonprofit organization that was established to help ignite economic development in an urban area of central Atlanta. The BeltLine owns an old railroad Right-of-Way (ROW) that is a natural loop around the City. The Beltline has been building a conduit system to run under the land around the entire ROW. The BeltLine is moving forward with plans to lease the conduit to interested broadband providers and they have recently hired a company to assist them with the marketing and management of the system.

4.5 Dark Fiber Leasing

Dark fiber refers to fiber optic cable that has been installed and is available to use but is not connected to any electronic devices and not transmitting any data. Dark fiber is also referred to as excess capacity. Fiber optic cable comes in strand counts ranging from 12 strands to 1400+ strands. Any strands not in use by the owner (or other entity) are considered dark fiber strands that can leased.

Similar to conduit, dark fiber pricing is subjective and includes but is not limited to the following criteria:

- Availability of dark fiber in the area
- Market rate of other dark fiber in the area (sometimes very difficult to ascertain)
- Number of strands to be leased (minimum of two)
- Amount of footage to be leased (per mile)
- Term of years requested
- Payment up-front versus over time
- Number of strands remaining that may not be marketable (i.e. if an entity only leases a portion of a route, the corresponding strands on the remainder of the route may not be usable. Often providers require the entire route to be leased for this reason.)

Unlike conduit, dark fiber is not based on price per foot but rather based on a per-strand, per mile, per month basis. Prices can range from $5-$750 per pair of strands with a typical IRU term of 10-20 years. Similar to conduit, payments can be made on monthly, annually or on a one-time payment. One-time payments require less administrative work and book keeping. It also provides a large infusion of cash. However, smaller entities may not be able to provide one-time payment and it is difficult to estimate market value over the course of twenty years. Ultimately, all of these considerations are discussed in the negotiating process.

Maintenance can be included in the cost of the IRU or added as an additional fee. Maintenance fees range from about $200-700 per mile, per year. The below chart shows what a rate schedule would look like for a price per pair of strands ranging from $10 - $100 exclusive of any up-front or maintenance fees.

Rate Schedule Based on Flat Fee Per Pair of Strands										
Per Pair	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**	**Per Mile**	**Per month**	**Per Year**	**10 Yrs**	**20 Yrs**
$10	1	$10	$120	$1,200	$2,400	10	$100	$1,200	$12,000	$24,000
$20	1	$20	$240	$2,400	$4,800	10	$200	$2,400	$24,000	$48,000
$30	1	$30	$360	$3,600	$7,200	10	$300	$3,600	$36,000	$72,000
$40	1	$40	$480	$4,800	$9,600	10	$400	$4,800	$48,000	$96,000
$50	1	$50	$600	$6,000	$12,000	10	$500	$6,000	$60,000	$120,000
$60	1	$60	$720	$7,200	$14,400	10	$600	$7,200	$72,000	$144,000
$70	1	$70	$840	$8,400	$16,800	10	$700	$8,400	$84,000	$168,000
$80	1	$80	$960	$9,600	$19,200	10	$800	$9,600	$96,000	$192,000
$90	1	$90	$1,080	$10,800	$21,600	10	$900	$10,800	$108,000	$216,000
$100	1	$100	$1,200	$12,000	$24,000	10	$1,000	$12,000	$120,000	$240,000

4.6 Other Conduit and Dark Fiber Leasing Considerations

When leasing conduit and dark fiber, the owner of the infrastructure must take into account the following considerations:

- A map (GIS ideally) and inventory of all assets leased and available to be leased must be kept current and active. There are several companies that offer cloud-based cutting-edge fiber management software solutions.
- Maintenance of the conduit and the fiber generally falls to the network owner and so the owner must have policies and procedures in place to meet any service level agreements (SLAs) that the lessees have in place. In other words – the network owner must be able to repair fiber cut within an emergency window to prevent downtime outages to the network customers.
- The network owner must have a plan in place for third-party network access.
- The network owner must have a process in place for interested third-party applications as well as templates for legal agreements and other documents.

5. Network Ownership Models

There are multiple kinds of ownership and operating models for municipal networks.

5.1 Publicly-Owned and Operated Network

This is a municipal network that is almost 100% self-provisioned. In other words, the municipality solely owns, and internally manages and operates the network and may only need to hire a few contractors for things like locates, and installations. Networks that are self-provisioned are most likely to be municipal electric utility broadband networks such as Longmont NextLight because they already have the back-office systems, trucks, and experience to add on a broadband service. However, FairlawnGig previously discussed in Section 6 is a rare example of a greenfield municipal network that is 100% self-provisioned without having an electric utility.

5.2 Publicly-Owned and Privately-Operated Network

In this model, the municipality owns the assets, and provides oversight, but outsources the management and operations to a third-party entity who also provides the services. This is a more common model for municipal networks and is appealing for localities that do not wish to directly become a service provider. An example of this type of operating structure is Hudson Oaks, Texas previously discussed in Section 4. Hudson Oaks owns the infrastructure and is leasing access to a local ISP who is serving as the service provider.

5.3 Hybrid

Another option is to create a hybrid model that combines one or more of the above options. This includes:

- Public-Private Partnership (PPP)
- Creation of a non-profit or regional entity

5.4 Public Private Partnerships (PPPs)

Public-private partnerships (PPPs) are a relatively young phenomenon in broadband. A PPP is a legal partnership wherein the partners balance and apportion risk, benefit and control. Recently, more and more municipalities are exploring establishing a PPP for deploying and operating last-mile networks. There are many different types of PPPs and these are more fully explored in Section 6.7.

5.5 Joint Authority or Non-Profit Entity or Communications Union District

For networks that may involve more than one municipality or financial contributions that are coming from more than one entity, a good option to consider is to create some kind of joint-authority entity or nonprofit. In Vermont, this would take the form of a Communications Union District (See Section 6.8 for more detail). For example, Northwest Colorado Broadband that was more fully discussed in Section 4 created a nonprofit entity with six founding members that included the City, County, school system, electric association, Chamber of Commerce, and hospital. Several of the partners contributed funding and/or own assets that were part of the project to build a middle-mile network through Steamboat Springs. The founding members serve on the Board of the nonprofit and the nonprofit is responsible for overseeing the network build, and operations. Since the nonprofit does not have any staff, the nonprofit hired a network operator to manage the network and manage the dark fiber leasing and marketing.

The entity may also pursue grants and expand services in the region. By establishing a Communications Union District, it increases the ability to share resources, share costs and create economies of scale for smaller networks that may better entice network partners. A regional entity could also more easily deploy and manage options for programs including Wi-Fi deployment, smart city applications and dark fiber leasing.

6. Funding and Financing

A key component in developing the business plan for the selected model is to identify all potential funding sources. This last section briefly discusses possible funding options for municipalities separate from any private-sector partner contributions that could be possible. Depending on the amount of funding needed to support the selected model, one more of the below options could be utilized.

One thing to keep in mind is that a local government usually has a different need for building a network than a private sector provider. For example, a private provider is largely profit driven and must generate revenue for the network to be sustainable. Municipal networks – particularly those that are middle-mile usually serve a different purpose. The municipality is building the network for internal connectivity to anchor institutions, to generate cost savings, or to use for economic development purposes. Therefore, in many cases, municipal networks cannot rely on network-generated revenue as a mechanism to support a bond payment or loan.

6.1 Public Self-Funding

The first funding option to consider is through general fund set-aside. Depending on the amount of funding needed, the municipality may be able to entirely fund a network build by either shifting funds or budgeting for them. Kent County, Maryland funded their entire 100-mile network build by paying for it directly out of their general funds. A municipality may also set-aside general funds to pay back a revenue bond if partially or fully funding a network out of general funds is not feasible.

6.2 Revenue Bonds

Aside from allocating capital project funds as part of the budget process, bond funding is something municipalities can utilize to assist with funding network construction, and to support startup and maintenance costs. This is traditionally what many municipalities have used to finance their broadband network. Bonds can be repaid either by revenue generated from the network or through other funds. Bonding agencies have supported this movement because a fiber network is a valuable asset to a community.

If revenue from the network is expected to be relied upon as funds to pay back the bond, the business plan must support that expectation. In addition, the municipality should have a contingency in place in the event the identified funds for paying back the bond do not materialize. For example, the State of Kentucky ended up with an $11 million-dollar shortfall for bond repayment because a source of funding to pay back the bond fell through.

6.3 Taxation

Taxation is another source of funding that local governments can consider. Some municipalities have either obtained approval to utilize other taxation revenues already in place or have opted to place a referendum on the ballot for residential approval to establish a special taxation district. These strategies are typically utilized in high-dollar builds when millions of dollars of funding is needed.

6.4 Inter-governmental Loans

The City of Fairlawn, Ohio financed their greenfield FTTP network through the Development Finance Authority of Summit County, OH which offers fixed rate/bond fund, conduit/non-bond fund, PACE program and tax credit financing arrangements for businesses located in Summit County, OH. This type of funding is like an intergovernmental loan.

6.5 Connection Fees/Liens

Another mechanism for partially funding a last-mile network is to charge a large connection fee to every home that wishes to connect to the network. The City of Ammon, Idaho has funded a significant part of their network by charging a $3000 connection fee payable either in lump sum or over a twenty-year period to every home that wishes to purchase service. The connection fee operates like a lien. If a resident moves, the payment stays with the house and applies to the next home-owner. If money is still-owed, the new resident will be expected to pay the remaining funds due. Based on the survey results, this does not appear to be an option for residents.

6.6 Federal Grant, Loan, and Funding Programs

Below are some identified programs that may be options to pursue with the right partners. Additional information on each of these programs is provided in **Appendix B.**

- **USDA: Community Connect Grant:** This program helps fund broadband deployment into rural communities where it is not yet economically viable for private sector providers to deliver service. The application window for this program will be open from February 12th, 2019 through April 15th, 2019.

- **Distance Learning & Telemedicine Grants:** These programs help rural communities use the unique capabilities of telecommunications to connect to each other and to the world. The grant helps awardees to acquire the technology and training necessary to connect educational and medical professionals with the teachers and medical providers who serve rural residents at the local level. Two funding opportunities have been published for 2019. Applications to the Traditional DLT Program must be submitted by May 15th, 2019. Applications for the Opioid DLT program must be submitted by April 15th, 2019.

- **The Rural Broadband Access Loan & Loan Guarantee Program:** This program furnishes loans and loan guarantees to provide funds for the costs of construction improvements or acquisition of facilities and equipment needed to provide service at the broadband lending speed in eligible rural areas. RUS is currently accepting applications on a rolling basis throughout 2019. Applications will be processed on a first come, first served basis.

- **Healthcare Connect Fund (HCF):** The purpose of the Healthcare Connect Fund is to expand HCP access to broadband services, particularly in rural areas, and to encourage the formation of state and regional broadband networks linking health care providers. Applications for this program are being accepted from February 1st, 2019 through May 31st, 2019.

- **ReConnect Loan and Grant Program:** With the passage of the 2018 Farm Bill, the Rural Utilities Service established a pilot broadband program named the Reconnect Loan and Grant Program on March 23, 2018. The program looks to bring reliable broadband to Americans who are not currently receiving 10/1 Mbps speeds. Application windows for the various programs can be found in Appendix B.

- **IRS Opportunity Zone.** The 2017 Tax Cuts and Jobs Act created a program designed to spur investment in distressed communities throughout the country through tax benefits. Under a nomination process completed in June of last year, 8,761 communities in all 50 states, the District of Columbia and five U.S. territories were designated as qualified Opportunity Zones. Opportunity Zones retain their designation for 10 years. Investors may defer tax on almost any capital gain up to Dec. 31, 2026 by making an appropriate investment in a zone, making an election after December 21, 2017, and meeting other requirements. While this is not a broadband-specific program, broadband may qualify as an eligible project.

With any grant funding opportunities, it is important to keep in mind the following:

- There is no guarantee that the grant will be awarded, and it is an intense in-depth process to develop the application with a lot of data and information that must be supplied by the municipality.
- A municipality should have a Plan B for funding in the event the grant is either not fully or only partially awarded.
- There will most likely be a substantial cash match requirement. Most grants do not accept in-kind (i.e. waving of pole attachment fees to qualify as a part of the match).
- If another entity has received prior federal funding for broadband within the territory, the municipality may be disqualified from applying for federal funding.
- Areas that have internet speeds of 10/1 Mbps or greater will most likely not qualify for grant funding.
- A consortium or partnership usually does not qualify as an applicant. The lead applicant needs to be the ISP provider.

6.7 Third-Party Funding – Public Private Partnerships

Municipalities looking to build a FTTP network often seek a PPP in order to off-set the costs and share the financial risk with a private sector partner. As previously stated, while this development is a recent trend, PPPs are actually difficult to establish. There are also many different types of PPPs. For example, PPPs include but are not limited to the following:

- An investment entity that steps forward to provide funding for the network in exchange for a long-term payback on their investment. This is a traditional PPP. The investment entity usually requires an ownership stake in the assets and sets other conditions such as requiring the municipality to provide a credit backstop to guarantee investments. The municipality generally may or may not need to provide cash contributions. An investment entity is only likely to be drawn to projects that cost a minimum of $15 million dollars. An investment entity also generally works with another partner that is the service provider.

- A partnership wherein both the municipality and provider contribute funding and resources to the project. Both may share in ownership of the assets. For example, the municipality invests in and owns the middle-mile infrastructure, but the provider invests in and owns the drops from the middle-mile network to the customer premise.

The type of PPP depends on a number of factors, including:

- Whether the provider can make a profit with take rates that justify an investment;
- The sum total amount of financial resources the municipality can provide;
- Whether the municipality is willing to be flexible on asset ownership;
- Whether there is a private-entity that is interested and viable;
- Whether the municipality and private partner can come to agreement on terms and requirements.

Some ISPs would prefer to own their own infrastructure - including the middle-mile backbone in order to control the infrastructure. On the other hand, other ISPs need the municipality to build the middle-mile to offset deployment costs.

Despite the fact that PPPs are widely pursued as options for last-mile municipal broadband networks, a PPP is difficult to establish. This is particularly true in rural areas where the cost of the build is high, and the number of potential customers makes it difficult to justify the investment. This is also true in suburban areas where there are existing incumbent providers with a broad footprint that have a market share of subscribers.

A recent trend by communities interested in exploring PPPs, is for the municipality to issue a Request for Information (RFI) to invite potential interested partners to submit proposals. To date, this has not yet proven to be an effective strategy in the establishment of a PPP.

This is due to a few key reasons. First, there are instances where the RFI itself has created confusion and significant delay in network planning – particularly where the RFI is issued prematurely, is open ended, vague, or includes too many difficult to meet requirements. In some cases, this has resulted in situations where a community has had to re-issue the RFI with new requirements and/or hold multiple rounds of interviews. Vendors are wary of the RFIs that lead to nowhere. A much more effective strategy is to hold meetings with providers and explore this option before issuing out any RFIs or RFPs.

6.8 Communications Union Districts

Creating a Communications Union District is both a potential funding and financing model as well as an operating and business model. In accordance with Section 3051 of Title 30, Chapter 82 of the Vermont Statues:

> *"(a) Two or more towns and cities may elect to form a communications union district for the delivery of communications services and the operation of a communications plant, which district shall be a body politic and corporate."*

While Chapter 82 provides the details for the creation of such a district, it is beneficial to discuss the model as developed by ECFiber.

Initially, ECFiber was able to secure $1M in insider startup financing in 2011. With that financing, they built a 20-mile pilot project and connected their first customers. ECFiber then began to raise funds in $2,500 increments on a neighborhood by neighborhood basis. ECFiber eventually raised a total of $7M from nearly 500 investors by 2015. The state of Vermont also provided over 100 miles of dark fiber and several grants totaling approximately $600,000. In 2016 ECFiber became the state's first Communications Union District, The East Central VT Telecommunications District.

As a Communications Union District, ECFiber has been able to access the broader capital markets in recent years. ECFiber raised $32M in long-term revenue bonds. Overall, they were able to put up 1400 miles of fiber in unserved areas. ECFiber shared that the network costs were approximately $30K per mile; 6 drops per mile. They were able to build 250 miles of fiber per year. ECFiber shared that it is best to buildout entire towns and to overbuild when necessary.

Lyndon and the surrounding communities should absolutely consider creating a Communications Union District to help facilitate the buildout of one or both of the presented network models.

7. Potential Town of Lyndon, Vermont Broadband Network Model

This section explores a cost estimate for Town of Lyndon, Vermont (Lyndon) to build a middle-mile broadband network. For this estimate, VPS developed a middle-mile network design and provided outside plant (OSP) and electronics costs for consideration and comparison. It should be noted that the estimates provide a high-level capital cost only for the design, construction and implementation of a fiber-optic network. In addition, these cost estimates do not include costs associated with the operational structure that would be needed to support each network option. Operational structures will be discussed in Section 8.

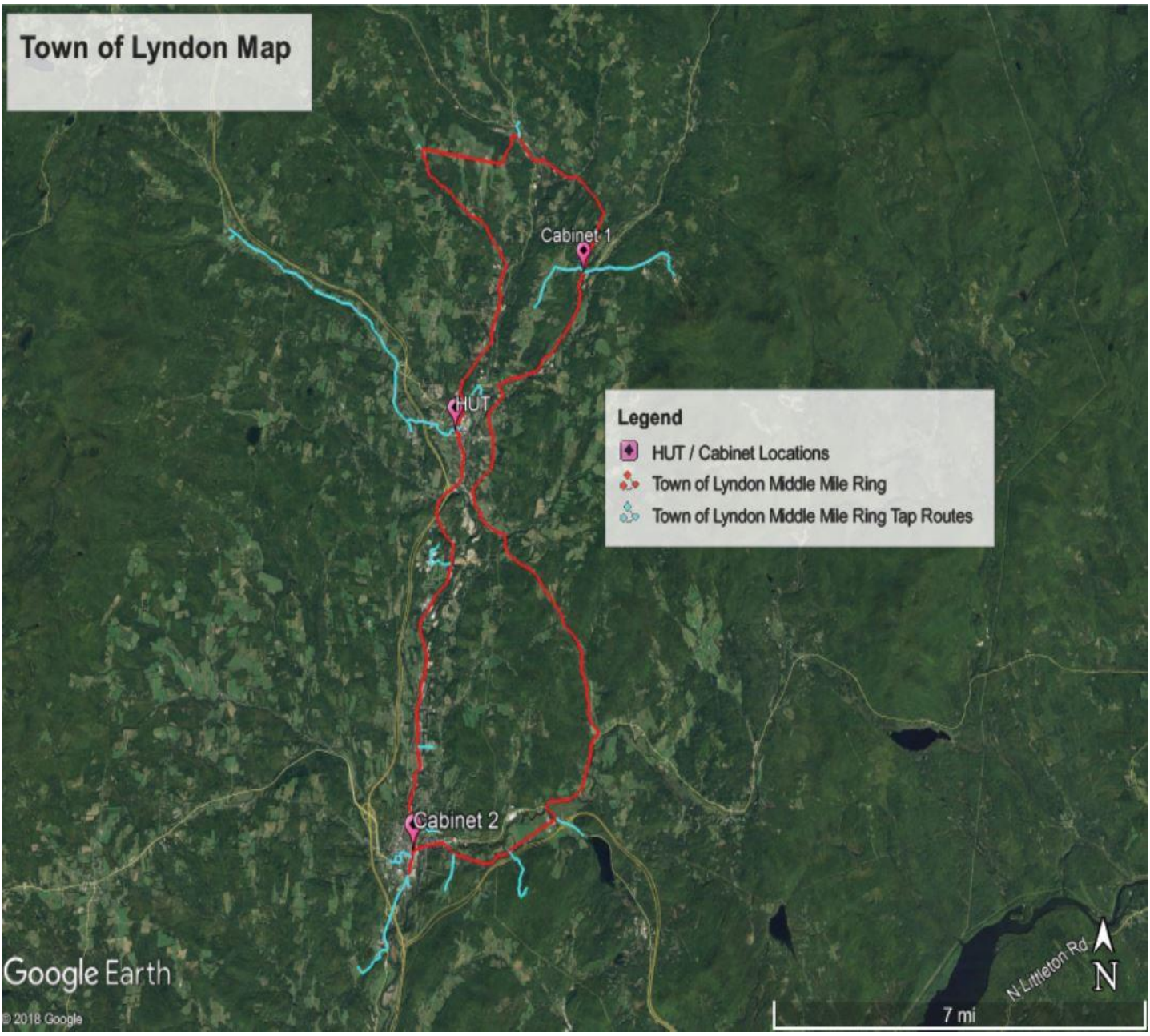
The middle-model developed includes the following:

- A middle-mile network design that connects anchor institutions and can be utilized as a transport network for a Fiber to the Home (FTTH) deployment.
- A buried cost estimate on the for the middle-mile network, including OSP and electronics.
- A 100% aerial and 100% buried OSP middle-mile network cost comparison.

7.1 Middle-Mile Design

VPS explored various middle-mile options. In the event of fiber or electronic failures, the ring topology will allow the network to self-heal via a redundant path. The red and the light blue lines indicate the proposed fiber and the pink placemarks identify the locations of the electronics.

VPS has also provided an electronic KMZ (Google Earth) file for greater detail review of the maps depicted.



7.1.1 Middle-Mile Cost Estimate

VPS utilized the network model described previously to estimate the costs to deploy a state-of-the-art broadband network to provide high speed service to the anchor institutions on the ring. VPS utilized construction costs from projects of similar size, scope, and geography as well as electronics costs to encompass the total capital expense in the estimate provided. If desired, the same proposed fiber ring can also be utilized as a possible transport network for a FTTH network deployment in the future.

Various assumptions were made in the design and estimate phase and have been documented in the following assumptions section.

Below is the outside plant (OSP) and electronics cost estimate for a 100% buried fiber ring.

Town of Lyndon 100% Buried Middle-Mile Estimate				
OSP		**Miles**		**Cost**
	Buried Rural Mainline	53.6	$	2,777,000
	Buried Town Mainline	18.6	$	2,824,000
	Buried Drops	2.3	$	51,000
	Fiber Management (52 drops)		$	4,000
	Total		**$**	**5,656,000**
Electronics		**Units**		
	Hut	1	$	230,000
	Data Router	1	$	173,000
	Cabinets	2	$	69,000
	Access Electronics		$	90,000
	Electronics Install		$	49,000
	ONTs and Install	52	$	27,000
	Total		**$**	**638,000**
Total Cost				
	OSP Construction		$	5,656,000
	Electronics		$	638,000
	Grand Total		**$**	**6,294,000**

In summary, to serve the 52 anchor institutions, the proposed design includes 72.2 miles of mainline fiber and 2.3 miles of drop fiber. The total OSP cost is $5,656,000 and the electronics cost is $638,000 for a total of $6,294,000.

Consequently, VPS ran the same study to estimate the OSP costs of 100% aerial fiber optic cable as opposed to the 100% buried fiber optic cable for the middle-mile network, the electronics costs would remain the same. See table below:

Town of Lyndon 100% Buried vs 100% Aerial Comparison	
OSP	**Total**
Buried OSP Total	$ 5,656,000
Aerial OSP Total	$ 2,663,000

7.1.2 Middle-Mile Assumptions

VPS designed the high-level middle-mile network using only satellite imagery. A site visit and further in-depth engineering would be needed to confirm the feasibility of the network and costs estimated. The basic assumptions made in the design phase of the Town of Lyndon middle-mile model are listed below:

- Assumes serving locations from a single hut and 2 remote cabinets.
- Location counts assume 52 community anchor institutions provided by Lyndon.
- The estimated buried cost does not include variable costs for rocky soil conditions.
    - With limited field knowledge and large variations in possible rock type and percentage of rock, VPS does not include these costs in estimates.
    - If rocky soil is present along the middle-mile route, an additional cost of $75 per foot of rocky soil should be added to the cost estimate.
- The estimated aerial cost does not include any make ready engineering or make ready construction costs.
    - With limited field knowledge and large variations in possible make-ready concerns, VPS does not include these costs in estimates.
    - In the event a pole replacement is needed, the cost per pole ranges from $5,000 to $7,500. Cost can vary greatly for size and class of pole, distribution vs transmission pole, etc.
    - In the event a riser needs extended, or neutral needs adjusted for clearance on the poles, the additional cost can be estimated at $500 per pole.
- Aerial cost estimates assume the same route as the buried path because pole line data was not provided at the time of design.
    - The mileage could increase if utility pole lines are not close to routes assumed.
- Electronics and fiber management costs assume GPON architecture.
- Estimates do not include costs for any right-of-way acquisition or pole attachment agreements.
- Internet provider meet point was not determined, if meet point is not along proposed fiber path, assume additional costs.
- Estimates include both engineering and overhead costs.
- Estimates do not include RF or IP video expenses, switching costs, or transport to exchange.

Furthermore, VPS makes every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the

actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please also keep this in mind when budgeting for this project.

7.2 Last-Mile Design

A last-mile network (also known as an access network or Fiber to the Home (FTTH) network) is one that is designed to provide service directly to homes and businesses in the defined serving area. Last-mile networks can also serve government buildings and other community anchor institutions.

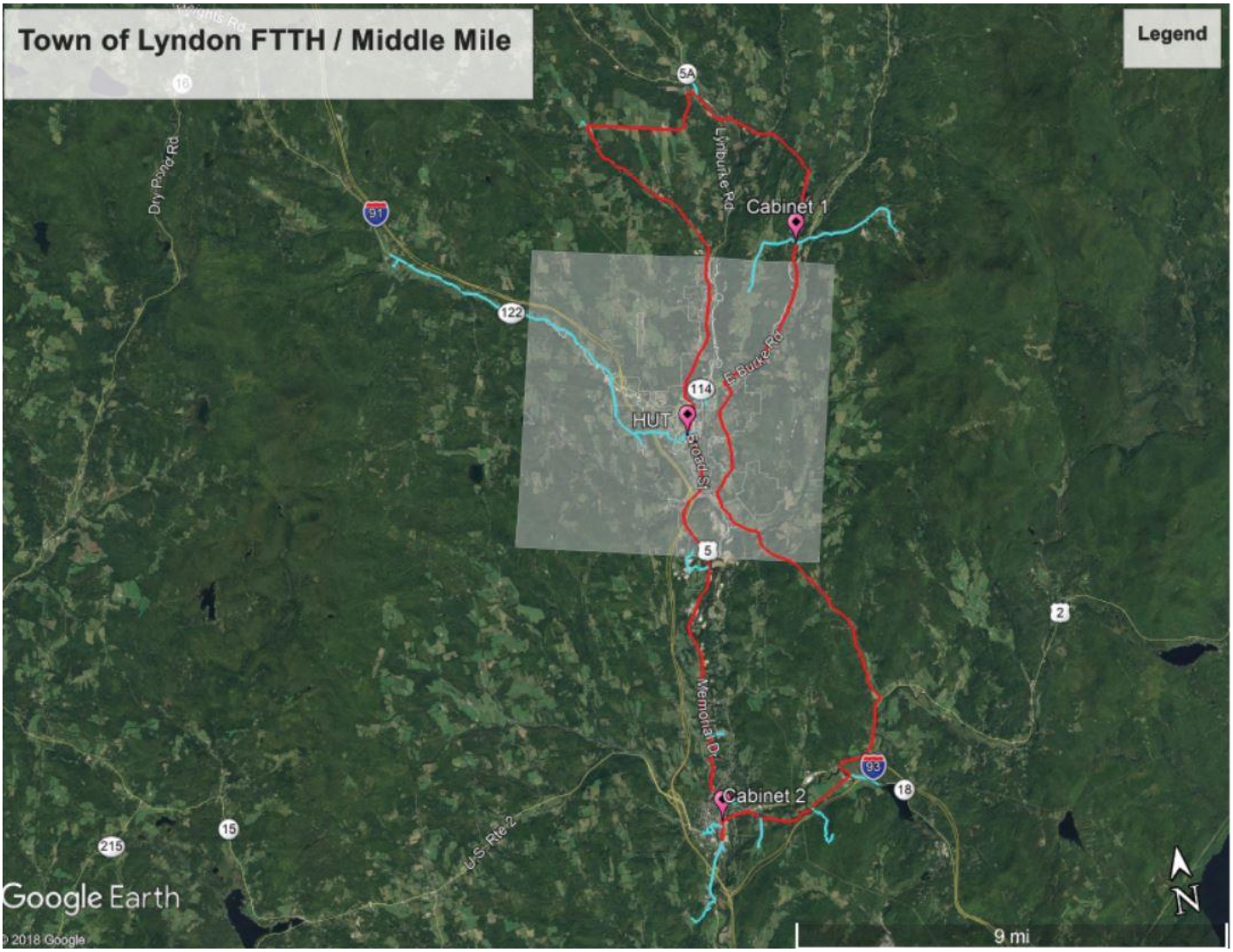
It should be noted that the estimates provide a high-level capital cost only for the design, construction and implementation of a fiber-optic network. In addition, these cost estimates do not include costs associated with the operational structure that would be needed to support each network option. Operational structures will be discussed in Section 8.

The last-mile model developed for the Town of Lyndon includes the following:

- A last-mile FTTH network deployed to 100% the premises within the Town of Lyndon, as defined in Last-mile Design section.
- An aerial cost estimate for the last-mile network, including OSP and electronics.

The maps below provide a high-level look at the entirety of the proposed middle-mile ring and FTTH service area together, including the locations of the electronics to be installed. For the middle-mile model, the red and the light blue lines indicate the proposed fiber and the pink placemarks identify the locations of the electronics. The grey boundary indicates the proposed service area for the FTTH network. The second map more closely shows the FTTH model. With this model, VPS served all locations within this boundary that were within 250’ of provided pole data.

VPS has also provided an electronic KMZ (Google Earth) file for greater detail review of the maps depicted.


Town of Lyndon FTTH / Middle Mile
Legend
Cabinet 1
HUT
Cabinet 2
Lyndonville Rd
E. Burke Rd
Broad St
Memorial Dr
U.S. Rte 2
Dry Pond Rd
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91
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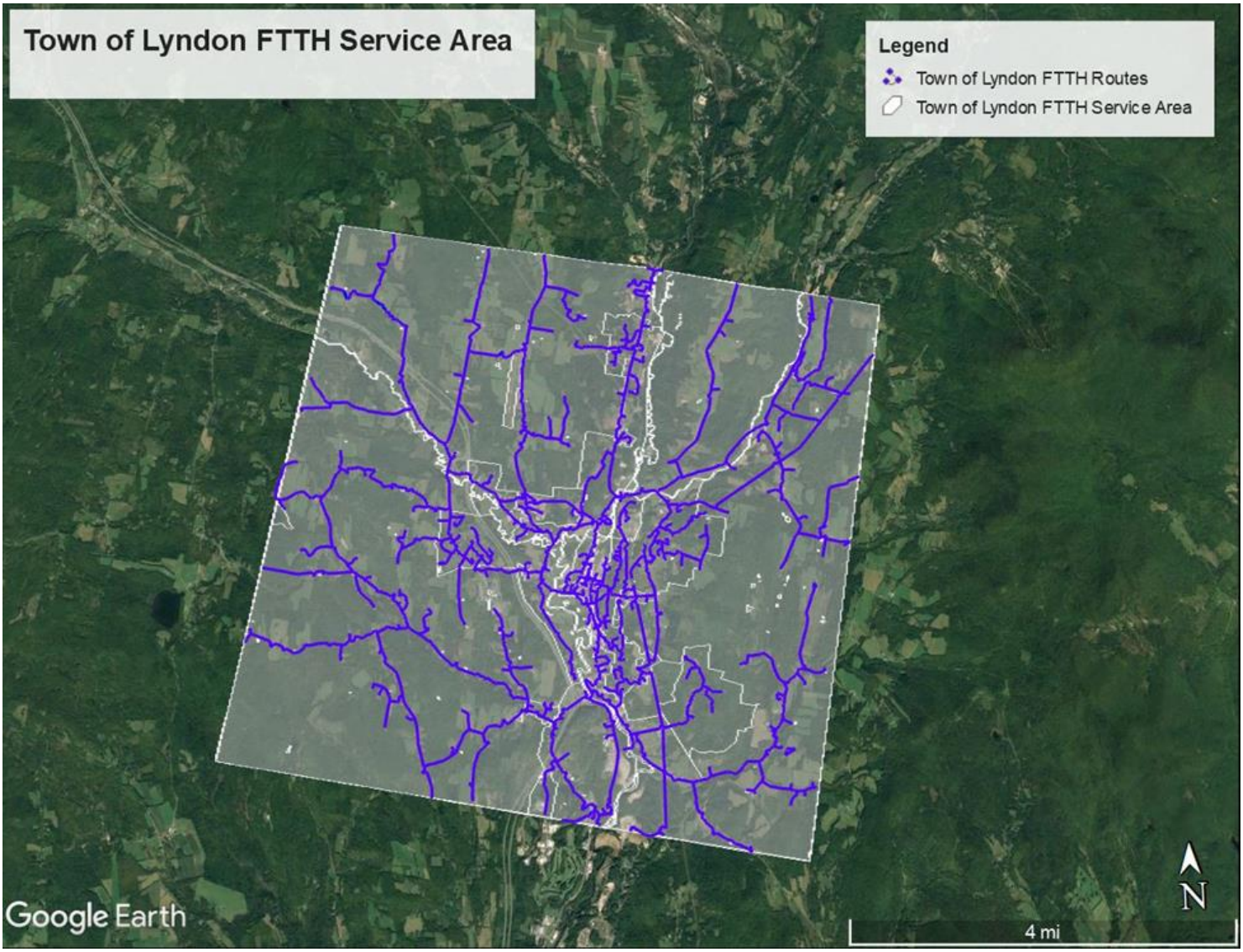
Town of Lyndon FTTH Service Area
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Town of Lyndon FTTH Routes
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7.2.1 Last-mile Cost Estimate

VPS utilized the FTTH network model above to estimate the costs to deploy a state-of-the-art FTTH broadband network to provide high speed service to all the locations within the service area. VPS utilized construction costs from projects of similar size, scope, and geography as well as electronics costs to encompass the total capital expense in the estimate provided. The FTTH costs do not include the costs to deploy the middle-mile network. If both the middle-mile network and the FTTH network are constructed at the same time, reduced costs would be probable.

Various assumptions were made in the design and estimate phase and have been documented in the following assumptions section.

Below is the outside plant and electronics cost estimate for a 100% penetration and 100% take-rate, aerial FTTH network.

Town of Lyndon 100% Aerial FTTP Estimate			
OSP		**Miles**	**Cost**
	Aerial Rural Mainline	131.8	$ 3,789,000
	Aerial Town Mainline	11.5	$ 664,000
	Aerial Drops	108.0	$ 1,968,000
	Fiber Management		$ 132,000
	Total		**$ 6,553,000**
Electronics		**Units**	
	FTTP Electronics		$ 302,000
	Electronics Install		$ 27,000
	ONTs and Install	2074	$ 1,131,000
	Total		**$ 1,460,000**
Total Cost			
	OSP Construction		$ 6,553,000
	Electronics		$ 1,460,000
	Grand Total		**$ 8,013,000**

In summary, to serve the 2,074 locations, the proposed design includes 143.3 miles of mainline fiber and 108.0 miles of drop fiber. The total OSP costs is $6,553,000 and the electronics costs is $1,460,000 for a total of $8,013,000.

7.2.2 Last-mile Assumptions

VPS designed the high-level last-mile network using satellite imagery and the pole line data provided by Lyndonville Electric Department. A site visit and further in-depth engineering would be needed to confirm the feasibility of the network and costs estimated. The basic assumptions made in the design phase of the Town of Lyndon last-mile model are listed below:

- Location counts assumes serving all locations within 250' of pole lines within Lyndonville township boundary.
- Last-mile costs do not assume costs to serve middle-mile network.
- Last-mile costs assume serving all locations from an existing hut and existing router in Lyndonville, as included in the Middle-mile design.
- Assumes 100% aerial construction on pole lines provided by Village of Lyndonville Electric Department.
- The estimated aerial cost does not include any make ready engineering or make ready construction costs.
    - With limited field knowledge and large variations in possible make ready concerns, VPS does not include costs in estimates.
    - In the event a pole replacement is needed, the cost per pole ranges from $5,000 to $7,500. Cost can vary greatly for size and class of pole, distribution vs transmission pole, etc.
    - In the event a riser needs extended, or neutral needs adjusted for clearance on the poles, the additional cost can be estimated at $500 per pole.
- Electronics and fiber management costs assume GPON architecture.
- Estimates do not include costs for any right-of-way acquisition or pole attachment agreements.
- Internet provider meet point was not determined, if meet point is not along proposed fiber path, assume additional costs.
- Estimates include both engineering and overhead costs.
- Estimates do not include RF or IP video expenses, switching costs, or transport to exchange.

Furthermore, VPS makes every attempt to have our estimates be within +/- 10% of the actual project cost, which is normally the case. However, it is still an estimate, there are many factors outside of our control that could result in the actual cost differing by more than 10%, such as material or labor charges, design changes since estimate, inflation, construction delays, etc. Please also keep this in mind when budgeting for this project.

8. Overview of Operating Costs

The data presented in Section 7 provided high-level capital costs for the deployment of different network options that included design, engineering, electronics, materials and construction for each model. However, when considering network options, understanding the operating costs and developing the right ownership and operating model are critical for success. This Section provides a high-level overview of operating costs.

8.1 Operating Costs

If and when a network model is selected, the next phase would be to develop a full business and financial plan that would include operating costs. Since a model has not been selected yet, we wanted to provide a rough overview of what operating costs would look like for the various options.

8.1.1 Last-Mile Operating Costs

For any of the last-mile FTTP network options, operating costs to build into a business plan would include but would not be limited to the following items:

- Personnel
- Customer service for residential customers (call center, technicians, etc...)
- Back office billing and administrative systems
- Operational vehicles
- Electronics and equipment warranty and support
- Insurance
- Electricity/utilities
- Transport/bandwidth cost
- Marketing
- Professional services - legal/consulting/accounting;
- Depreciation
- Maintenance and repair

The full business plan will also determine the pricing for offerings such as video, phone, and broadband services. Pricing of services should not be developed without a business plan.

Based on VPS experience in developing business plans for providers across the country, operating costs can range between $90 and $160 dollars per location/per month.

8.1.2 Middle-Mile Operating Costs

The operating costs for a middle-mile network would be significantly less than what is discussed above. When comparing the operating costs of an FTTP with a middle-mile network, it is clear that for a middle-mile network:

- Personnel will be significantly less and could be as few as one or two individuals
- Customer service (call center, technicians, etc..) would not be needed
- Back office billing and administrative systems could be rolled into existing City systems
- Operational vehicles would probably not need to be purchased

- Electronics and equipment warranty and support will be significantly less
- Network insurance will be significantly less and might be covered by current City Insurance policy
- Electricity/utilities will be significantly less
- Transport/bandwidth cost will be significantly less
- Marketing will only be needed if the City wants to lease its conduct or dark fiber
- Professional services - legal/consulting/accounting would be significantly less
- Maintenance and repair including locates will be significantly less (less fiber miles to manage)

If Lyndon and the surrounding communities decided to build a backbone network that did not connect to any anchor institutions, the capital costs and the costs to operate the network would be less. This option is not recommended unless the Town decides to make the backbone an open-access network which would provide some benefit to the City through leasing revenue.

If Lyndon and the surrounding communities were to consider extending the middle-mile network beyond what is proposed, to include a few additional facilities (i.e. schools, hospital), the capital costs to build the network extensions would increase while the operating costs would relatively stay the same.

If Lyndon and the surrounding communities were to build an open-access middle-mile network there could be a few additional costs for the set-up to manage the conduit and dark fiber leasing program. However, there have been models where the locality outsources these tasks to a vendor who then pays commission on fees generated from leased assets. This kind of model can help to offset some of the operating costs of a dark fiber leasing program.

9. Analysis and Recommendations

Based on all the information detailed in this Report, this Section analyzes the network models presented in Section 6 and provides recommendations.

9.1 Key Findings

As a reminder, the biggest question a municipal feasibility study needs to answer is "what is the problem we need to solve?" In summary, the biggest issue facing Lyndon and the surrounding communities is inconsistent and poor residential and business internet service that falls well short of the federal definition of broadband.

In addition, as previously detailed in this study, a summary of a few key findings include the following:

- Current providers are not meeting the needs and/or expectations of many residents, especially those residing outside of the developed portions of Lyndon.
- Multiple providers only offer "Up to 2 Mbps" to residents.
- Internet plans for residents and businesses are expensive and copper lines, mobile internet, fixed wireless and satellite technologies present speed, reliability and latency issues for end-users.
- Due to topography and terrain challenges, many residents have problems connecting to mobile internet, fixed wireless or satellite connections.
- Remote areas need better cellular coverage and better internet connections. Not having access is negatively impacting local business, employee attraction and economic growth.
- While there appears to be a fair amount of middle-mile fiber infrastructure in the region (i.e. FirstLight), last-mile infrastructure is severely lacking.

There are multiple ways to approach solving this problem. Below we analyze the two network options and provide final recommendations.

9.2 Middle-Mile Model Assessment

Middle-mile networks cost less to deploy because they are only designed to create a ring through the community and connect to a selected number of anchor institutions.

The benefits of a middle-mile network are substantial and would enable Lyndon and the surrounding communities to:

- Deploy critical infrastructure that will serve regional needs for the next 30+ years.
- Own a network with an investment cost that is much smaller with a risk much less significant than a last-mile network.
- Potentially phase-in a last-mile solution.
- Potentially build fiber to towers to better encourage wireless technology deployment.
- Reduce costs for last-mile providers in reaching the underserved areas.

- Lease excess fiber and conduit to generate revenue and encourage private provider investments.

Another benefit of a middle-mile network is the Town could coordinate with neighboring communities which would increase the benefits and allow for economies of scale. For example:

- A larger inter-governmental regional middle-mile network provides more fiber that could be leased to third-parties with longer routes.

- A Communications Union District or joint entity could be formed to oversee and manage the regional networks together which would save operating costs and maximize resources.

- A Communications Union District or joint entity could more easily deploy smart city applications, launch pilot projects, and generate economic development on a regional level.

With the presence of FirstLight, there is some fiber-optic middle-mile infrastructure in the area. To offset the costs of even deploying a middle-mile area, the Town could work with FirstLight and explore leveraging their network in overlapping areas. FirstLight may also be a potential network operator for a middle-mile network.

9.3 Last-Mile Network Assessment

As discussed above in Section 9.1, the **biggest issue facing Lyndon and the surrounding communities is inconsistent and poor residential and business internet service that falls well short of the federal definition of broadband.** There are significant gaps in accessibility to robust internet service. This lack of service can be devastating to a community but could be resolved with a comprehensive FTTH Network that serves every home and business.

Today broadband is not a luxury, but rather a necessity. Residents, businesses, tourists and others need broadband in order to (among other things):

- Apply for jobs.
- Access web-based government services.
- Work from home or a secondary location.
- Access educational services and conduct research.
- Conduct business and support business services directly tied to revenue.
- Stay connected to family.
- Access the internet and watch web-based programming.

For a local government – and over time, the cost of funding a broadband solution can be significantly less than the cost of not having robust broadband. Similar to the benefits of a middle-mile network, the benefits of a FTTH network are substantial and would enable Lyndon to:

- Deploy critical infrastructure that will serve regional needs for the next 30+ years.
- Significantly increase economic development opportunities including job attraction and retention.
- Increase real estate value (particularly for those areas that are currently unserved by fiber. The City of Fairlawn Ohio saw an 8% increase in property values after their FTTH network was deployed).
- Enable Lyndon to compete with other VT towns that are moving forward with improving broadband connectivity.

Of course, there are additional considerations with deploying a FTTH network that include:

- This option carries the most financial risk and is the most expensive.
- The operational costs are high.
- It may not be possible to find a provider-partner who is willing to invest its own funds into the network.

9.4 Challenges and Recommendations

This section outlines some of the biggest challenges to network deployment and provides recommendations for how the Town of Lyndon and surrounding communities can solve the problems identified in this Report.

9.4.1 Network Deployment Challenges

With each of the above network models, there are a significant number of challenges including finding the right partners and implementing strategies to maximize subscription rates. However, the biggest challenge is determining how to fund the network build and operations. The most common method for funding municipal networks is through revenue bond funding or through some sort of taxation system. However, funding may also come from the private providers and/or grant funding.

When seeking third party investment, challenges include the following:

- Many providers interested in working with a community need the community to contribute financially to the build in order for them to make a return on their investment.
- Providers may or may not want to own middle-mile infrastructure. (i.e. providers may want/need the municaplity to own the middle-mile infrastructure).
- There may not be a provider who is willing and able to serve the entire community but is able to serve a smaller portion.

When seeking grant funding, challenges include the following:

- Areas where providers report offering internet speeds of 10/1 Mbps or greater will most likely not qualify for grant funding unless the applicant can prove that actual speeds are less than what is being reported by the provider.
- Lyndon and the surrounding communities may have issues pursuing grant funding due to the fact that there are entities within the region that have received prior federal funding for broadband. This would need to be evaluated.
- If grant funding is a viable pursuit, there will be a cash match requirement. Most grants do not accept in-kind (i.e. waving of pole attachment fees to qualify as a part of the match).
- If grant funding is a viable pursuit, Lyndon and the surrounding communities will need to quickly find a provider partner that would be willing to serve as the lead applicant. Federal grants usually do not allow a consortium or partnership to qualify as an applicant. The lead applicant should be the ISP provider.
- Grant funding programs usually only award for last-mile network models.

9.4.2 Recommendations

While a middle-mile network costs significantly less to deploy, **the primary problem facing the region is the lack of robust and reliable internet service to residents and businesses that meets or exceeds the federal definition of broadband.**

Therefore, based on all of the information detailed in this Report, in order of priority - it is the recommendation of VPS that Lyndon and the surrounding communities:

1. **Further explore the viability of deploying a last-mile network**.

   Action items include:
   - Consider establishing a Communications Union District and creating a model like ECFiber.
   - Engaging in direct dialogue with potential last-mile partners including but not limited to Kingdom Fiber and FirstLight to determine if either vendor, or both could:
     - Potentially serve as a network operator/and or last-mile partner and what their requirements would be (i.e. Town financial or resource support) and scope of project (territory).
     - Be the lead applicant (only one provider can be lead applicant) for federal grants (if the region is eligible).
     - Contribute financial resources to resolving the problems identified through this feasibility study (form a PPP).
     - Serve as a partner in pursuing financing through the IRS Opportunity Zone Program.
     - Allow their existing infrastructure to be leveraged in order to save build-out costs.
   - Investigating funding sources including determining eligibility for federal grants.
   - Completing a business plan once the operating model and partner or partners have been identified and are committed to the project.

2. **Further explore the viability of deploying a middle-mile network either in conjunction with or in place of a last-mile network if the last-mile option is not an immediately viable solution.**

   Action items include:
   - Consider establishing a Communications Union District and creating a model like ECFiber. This could allow a more phased-in approach for a last-mile network.
   - Engaging in direct dialogue with potential network operators including but not limited to Kingdom Fiber and FirstLight to determine if either vendor, or both could:
     - Potentially serve as a network operator and what their requirements would be (i.e. Town financial or resource support) and scope of project.
     - Serve as a liaison and assist with working with other last-mile providers (in the role of network operator) if they were not interested in serving in that role.
     - Allow their existing infrastructure to be leveraged in order to save build-out costs.
   - Investigating funding sources outside of grants which would not be available for middle-mile only projects.
   - Completing a business plan once the operating model and partner or partners have been identified and are committed to the project.

Appendix A – Technology Background

For background and as a Broadband 101 primer, it's important to understand the definition of broadband as well as the different types of technologies referenced in this Report. Broadband technologies can be broken down into two main categories – wireline and wireless. This Appendix provides an overview of each and helps define some the terms that will be utilized in this report.

Wireline Technologies

Wireline technologies rely on a physical cable for transmission of the communication signal. These cables usually transport an electrical signal on a copper cable or an optical signal on a fiber optic cable. There are three common wireline technologies used by wireline companies today. These are:

- Digital Subscriber Line (DSL) – This wireline technology overlays a broadband signal on existing twisted pair copper cables. Broadband speeds on DSL networks are dependent on the customer's distance from electronics in remote terminals or central offices. Modern DSL technologies can typically provide 1 Mbps to 2 Mbps download speeds, depending upon the quality and size of the copper cable. However, for customers served by copper cable that exceeds 18,000 feet in length, the distortion caused by the capacitance of the cable renders the cable unsuitable for quality voice. Telephone companies have historically provided voice service over twisted pairs of copper cable. Consequently, millions of miles of twisted pair copper cables have been deployed throughout the country. However, most service providers have concluded that DSL is near the end of its useful life and will not be a long-term solution for broadband delivery. Therefore, they have been looking to fiber technology to meet the increasing customer demand.

- Coaxial Cable (DOCSIS) – Coaxial cable can also be used to provide wireline broadband services with typical speeds of 160 Mbps downstream and 120 Mbps upstream that can be shared by a large number of subscribers. Most Cable Television (CATV) providers like Comcast rely on COAX cables. The CATV industry has implemented standards called Data Over Cable Service Interface Specifications (DOCSIS), which defines how the COAX network can be used to deliver broadband services to their customers. It is important to note that the CATV coax networks are shared – meaning a single cable leaving the CATV headend is split many times to serve many customers. Often, a single cable will provide broadband and/or video to hundreds of customers. This architecture worked well for broadcast video services, since it was a "one-to-many" service, but has limitations when delivering services such as broadband, where each customer requires their own unique connection.

- Fiber to the Premises (FTTP) – This wireline technology serves all customers by a fiber optic cable. Most FTTP equipment allows between 70 Mbps and 1 Gbps of broadband to each customer and is capable of serving customers that are more than twelve miles from the central office or electronic field terminal locations.

Wireless Technologies

Wireless technologies transmit the communication signal "over the air" on a radio frequency (RF) carrier. There are four common wireless technologies used by providers today. These are:

- Fifth Generation (5G) – The Third Generation Partnership Program (3GPP) organization is in process of defining the 5G standards, expected circa 2019. Per the GSM Association, 5G will be targeting user throughputs of 10 Gbps peak, a hundred times that of 4G networks. Although inherently a mobile technology, the first wave of 5G will be utilized for the fixed delivery of wireless broadband services. 5G is anticipated to incorporate higher-

order spatial diversity (MIMO schemes, beam forming, cell splitting, etc.), self-organizing networks to minimize self-interference and new user interfaces to support the Internet of Things (IoT).

- Fourth Generation (4G) – Utilizes Long Term Evolution (LTE) licensed spectra to provide wireless broadband services, as defined by the 3GPP organization, with duplexing methodology of both time (TD-LTE) and frequency Divisions. Although inherently a mobile technology, today, nearly all terrestrial wireless providers have standardized on Long Term Evolution (LTE) with fixed Customer Premises Equipment (CPE), as the Wireless Metropolitan Area Network (WMAN) broadband technology of choice. All major cellular providers in the U.S. have deployed LTE and continue to expand their LTE footprints.

- Unlicensed Operations – Unlicensed operations on unlicensed spectra can also be used to provide wireless broadband services. Systems operating on unlicensed spectra typically utilize vendor proprietary air interfaces, Institute of Electrical and Electronics Engineers (IEEE) 802.11, or another variant of the IEEE standards. Operations in the unlicensed spectra inherently are utilized for the fixed delivery of wireless broadband services, as the utilization of fixed devices allow for additional deployment efforts to overcome interference inherent within the unlicensed bands.

- Satellite - Satellite-based broadband is not considered a viable broadband alternative due to the high latency which makes it unsuitable for many applications and unable to provide reliable, high-quality voice connectivity.

Some believe that wireless can be a substitute for terrestrial wireline connections that may be too costly to construct. While wireless can be part of the solution and should be considered for deployment in very rural areas – there are considerations that should be taken into consideration.

- Wireless technologies must be replaced every 5-7 years and they can be very costly to maintain.
- Wireless is not suited for growth. For example – since bandwidth is shared among subscribers, available bandwidth per subscriber decreases as density of subscribers or devices increases.
- Available bandwidth decreases as distance of subscriber from access point increases.
- Broadband speeds are more limited. 4G technologies might allow customers to burst up to 10 or 20 Mbps for short periods of time.
- Not well suited for large bandwidth needs and often discouraged by carriers by only allowing a limited amount of data per month.
- Geography and atmospheric conditions can and will impact service delivery for technologies that need to be in sight of each other in order to transmit a signal. Mountains, hills, valleys, buildings, and trees interfere with the propagation of the wireless signal. Some technologies such as LTE can provide non-line-of-site service (NLOS) to some extent, but at significantly reduced throughput compared to direct LOS. These terrain issues and obstacles can mean that some customers cannot receive the broadband signal or that additional towers (and investment) are required.

Wireline vs. Wireless Technology

Both wireless and wireline broadband service providers have benefited from technology advances, but *wireline* technologies have historically been capable of speeds many times faster than the best *wireless* technologies. Fiber optic cable has been used by service providers for more than forty years to build high-speed broadband networks, primarily for long haul transport routes. Over the last ten to fifteen years, fiber has also been used to increase broadband speeds to the customer because no other technology can deliver as much broadband speed. With FTTP,[7] the broadband speed provided is not dependent upon cable length, but electronics, and each new generation of FTTP electronics allows service providers the ability to offer significantly higher broadband speeds over greater distances without having to make

[7] Fiber-to-the-Premises is sometimes referred to as Fiber-to-the-Home (FTTH).

significant changes to their outside plant architecture. There is no foreseeable end to the amount of bandwidth that can be provided over fiber cables.

There are many reasons why fiber is the best technology to construct modern network or upgrade existing networks. Fiber is immune to electromagnetic interference, provides the most reliable services, and minimizes operational expenses. Therefore, it delivers the best voice and broadband services available for today and the foreseeable future. Over the last several years, increases in copper prices, advances in technology, and growth in broadband demand have all worked together to make FTTP a more economical wireline technology for providing broadband. Not only is a fiber network less expensive to deploy, maintain, and upgrade than other wireline technologies, but it has superior broadband capabilities, such as being able to offer telecommuting, telemedicine services, and telepresence. All of these factors make it clear that copper is a dying technology in the telecommunications industry. It would be unwise for companies to utilize copper in their network deployments going forward, except in certain very limited situations.

Once fiber infrastructure is in place, service providers are able to increase the broadband by simply upgrading the electronics on the fiber cable, which represents a relatively small portion of the overall fiber network investment. Fiber technology will allow higher speeds to be delivered to customers over time with minimal incremental investment, making it the best technology for meeting future broadband service needs.

The amount of bandwidth per customer is significantly greater for a FTTP network when compared to a wireless network. Using the technologies available today, the bandwidth delivered to a customer can be more than 100 times greater than what is possible over a wireless network under similar conditions. The bandwidth advantage for FTTP will increase significantly in the coming years due to technology advances with the electronics.

Fiber optic cable is the most-costly to construct. However, it is also an enabling technology that allows for growth. A lion's share of the FTTP investment is the placement of the cable facilities, which typically has a 30-year life, compared to the wireless infrastructure, which has a greater portion of the investment associated with faster-depreciating infrastructure. When placement costs are included over a 30-year life, the cost savings for a wireless network are significantly reduced or eliminated.

Appendix B – Grant & Loan Programs

USDA: Community Connect Grant

1) **Deadline:**
   a. The application window will be from February 12th, 2019 through April 15th, 2019.
2) **Purpose:**
   a. This program helps fund broadband deployment into rural communities where it is not yet economically viable for private sector providers to deliver service.
3) **Eligible Applicants:**
   a. Most State and local governments
   b. Federally-recognized Tribes
   c. Non-profits
   d. For-profit corporations
4) **Approved Use of Funds:**
   a. Construction, acquisition or leasing of facilities, spectrum, land or buildings used to deploy broadband service.
   b. The cost of providing broadband service free of charge to critical community facilities for 2 years.
   c. **Please Note:** Less than 10% of the grant amount, or up to $150,000 may be used for the improvement, expansion, construction or acquisition of a community center that provides online access to the public.
5) **Requirements & Rules:**
   a. The impacted area must be classified as Rural and lack any existing broadband speed of at least 10 Mbps down and 1 Mbps up.
   b. Applicant must provide matching funds of at least 15% from non-federal sources. These funds can be used for operating costs.
   c. Buildings constructed with grant funds must be located on property owned by the awardee.
   d. Leasing expenses will only be covered through the advance of funds period included in the award documents.
   e. Grantees must have legal authority to provide, construct, operate and maintain the proposed facilities or services.
   f. Partnerships with other federal, state, local, private and non-profit entities are encouraged.
   g. For additional detail see Code of Federal Regulations 7 CFR, Part 1739.
6) **Type of Funding Available:**
   a. Grant Funding

USDA: Distance Learning & Telemedicine Grants

1) **Deadline**
   a. Applications under the Traditional DLT program must be submitted by May 15th, 2019. Applications under the Opioid DLT program must be submitted by April 15th, 2019.
2) **Purpose**
   a. Traditional DLT: Helps rural communities use the unique capabilities of telecommunications to connect to each other and to the world. Helps to acquire the technology and training necessary to connect educational and medical professionals with the teachers and medical providers who serve rural residents at the local level.
   b. Opioid DLT: The programs aims to help address the opioid epidemic in rural America by providing assistance to areas such as prevention, treatment, and recovery.
3) **Eligible Applicants:**
   a. Most State and local governments
   b. Federally-recognized Tribes
   c. Non-profits
   d. For-profit Corporations
4) **Approved Use of Funds:**
   a. Acquisition of eligible capital assets, such as:
      i. Broadband transmission facilities
      ii. Audio, video and interactive video equipment
      iii. Terminal and data terminal equipment
      iv. Computer hardware, network components and software
      v. Inside wiring and similar infrastructure that further DLT services
   b. Acquisition of instructional programming that is a capital asset.
   c. Acquisition of technical assistance and instruction for using eligible equipment.
5) **Requirements & Rules:**
   a. A minimum 15% match is required for grant-only awards (cannot be from another federal source).
   b. DLT 100% grant applications are accepted through a competitive process. The application window is announced annually (typically after the first of the year) through a Notice of Funds Availability (NOFA) or a Notice of Solicitation of Applications (NOSA) in the Federal Register. Applicants are required to provide a minimum 15 percent match. Awards can range from $50,000 to $500,000.
6) **Type of Funding Available:**
   a. Grant Funding

USDA: The Rural Broadband Access Loan & Loan Guarantee Program

1) **Deadline:**
   a. Applications are now accepted for 2019
2) **Purpose**
   a. Furnishes loans and loan guarantees to provide funds for the costs of construction improvements or acquisition of facilities and equipment needed to provide service at the broadband lending speed in eligible rural areas.
3) **Eligible Applicants:**
   a. Corporation
   b. LLC
   c. Cooperative or mutual organization
   d. Tribes or Tribal organization
   e. State or local government
4) **Approved Use of Funds:**
   a. The construction, improvement, and acquisition of facilities required to provide service at the broadband lending speed including facilities required for providing other services through the same facilities.
   b. The cost of leasing facilities required to provide service at the broadband Lending speed if such lease qualifies as a capital lease under Generally Accepted Accounting Principles (GAAP).
   c. An acquisition, under certain circumstances and with restrictions.
   d. For additional detail see 7 CFR 1738
5) **Requirements & Rules:**
   a. Proposed funded service areas must be completely contained within a rural area or composed of multiple rural areas, as defined in 7 CFR 1738.
   b. At least 15 percent of the households in the proposed funded service area are unserved,
   c. No part of the proposed funded service area has three or more "incumbent service providers."
   d. No part of the proposed funded service area overlaps with the service area of current RUS borrowers or the service areas of grantees that were funded by RUS.
   e. Communities where USDA Rural Utilities Service has previously provided funding for construction of broadband infrastructure may not be eligible.
   f. **Please Note:** In order to be counted as a provider for eligibility purposes, a provider must file a response to a Public Notice Filing for an area they operate in. Please see the Broadband Mapping Tool for more information and to sign up for a subscription to be notified when Public Notice Filings are published.
6) **Type of Funding Available:**
   a. Direct Cost of Money Loan Funding

USAC - Healthcare Connect Fund (HCF)

1) **Deadline:**
   a. The initial filing window is February 1 – May 31, 2019.
2) **Purpose:**
   a. The purpose of the Healthcare Connect Fund is to expand HCP access to broadband services, particularly in rural areas, and to encourage the formation of state and regional broadband networks linking health care providers.
3) **Eligible Applicants:**
   a. A post-secondary educational institution offering health care instruction, such as teaching hospitals or medical schools,
   b. A community health center or health center providing health care to migrants,
   c. A local health department or agency,
   d. A community mental health center,
   e. A not-for-profit hospital,
   f. A rural health clinic, including mobile clinics,
   g. A dedicated emergency room of a rural for-profit hospital, or
   h. Skilled Nursing Facilities (SNFs)
4) **Approved Use of Funds:**
   a. Under the program, eligible rural HCPs, and those non-rural HCPs that are members of a consortium that has a majority rural HCP sites, can receive a 65 percent discount from the fund on all eligible expenses.
5) **Requirements & Rules:**
   a. HCPs are required to contribute the remaining 35 percent to participate in the program.
   b. HCPs can use the Healthcare Connect Fund to purchase services and equipment, as well as construct their own broadband infrastructure where it is shown to be the most cost-effective option.
   c. Non-rural HCPs may participate and receive support as part of consortia that include a majority rural HCP site.
6) **Type of Funding Available:**
   a. Support Funding
7) **Further Information:**
   a. On June 25, 2018, the Federal Communications Commission (FCC) issued an Order that adopts rules to: (1) increase the annual RHC Program funding cap to $571 million and apply it to FY2017; (2) annually adjust the RHC Program funding cap for inflation, beginning with FY2018; and (3) establish a process to carry-forward unused funds from past funding years for use in future funding years. As noted in the FCC's RHC 2018 Funding Cap Order, the RHC Program funding cap for FY2018 will be $581 million, adjusted for inflation

ReConnect Loan and Grant Program

1) **Deadline:**
   a. 100% Grant Funding Application – Applications Due: April 29,2019 – Awards subject to competitive scoring
   b. 50% Grant / 50% Loan Funding Application – Applications Due: May 29, 2019 – Awards subject to competitive scoring
   c. 100% Loan Funding Application – Applications Due: June 28, 2019 – Awarded on first come / first serve basis
   Applicants are only allowed to apply in one of the funding categories
2) **Purpose:**
   a. Provide up to $600 million in loan and grant funding to assist with building broadband infrastructure in rural areas. Provide broadband to unserved or severely underserved areas which lack 10/1 Mbps broadband speeds.
3) **Eligible Applicants:**
   a. Non-Profit Entities
   b. For-Profit Corporations
   c. Limited liability Companies
   d. Cooperative or Mutual Organizations
   e. State and Local Government Entities
   f. Territory or Possession of the U.S.
   g. Indian Tribe Budget Control Mechanism Calculation and Per-Line Limit on Universal Service
   **CAF II Auction recipients limited to 100% loan category.*
4) **Eligible Areas:**
   a. 100% Grant Funding Application – Service area is only eligible if 100% of the area lacks 10/1 Mbps
   b. 50% Grant / 50% Loan Funding Application – Service area is only eligible if 90% of the area lacks 10/1 Mbps
   c. 100% Loan Funding Application – Service area is only eligible if 90% of the area lacks 10/1 Mbps
5) **Requirements & Rules:**
   a. Recipients must provide 25/3 Mbps to every location within the proposed funded service area.
   b. Applicants must prepare a 5-year financial forecast to support financial feasibility and sustainability of the project. Key elements of these financials include:
      i) Positive ending cash each year of forecast
      ii) Positive cash flow from operations
      iii) Must meet two of the following criteria:
         (1) Current Ratio of 1.20
         (2) Tier Ratio of 1.20 minimum (100% loan or 50% loan / 50% grant)
         (3) DSCR Ratio of 1.20 minimum (100% loan or 50% loan / 50% grant)
         (4) If no existing debt, not proposing new debt and only applying for grant only, the Current Ratio of 1.20 is required
6) **Type of Funding Available:**
   a. Total of $200 million for projects seeking 100% grant funding - Max request limit is $25 million
   b. Total of $200 million for projects seeking 50% grant and 50% loan funding - Max request limit is $25 million for loan, and $25 million for grant funding
   c. $200 million for projects seeking 100% loan funds - Max request is $50 million