Fiber Broadband Feasibility Study

Created by ValleyNet and Rural Innovation Strategies, Inc. for the Vermont Department of Public Service on behalf of the Rutland Regional Planning Commission and the Otter Creek Communications Union District

December 1, 2020

Broadband Innovation Grant Process

The Rutland Regional Planning Commission (RRPC) and its partners, Otter Creek Communications Union District (OCCUD), ValleyNet, and Rural Innovation Strategies Inc. (RISI), were awarded a Broadband Innovation Grant (BIG) in April 2020.

The Broadband Innovation Grant process has two components. First, it includes funding for a feasibility study to determine whether it is financially and technically possible to provide fiber broadband service to every premise in the region by forming a Communication Union District (CUD). Then, upon the feasibility study's review and approval by a third party and by the state of Vermont, the Broadband Innovation Grant supports the creation of a business plan and detailed financial modeling to allow the Communication Union District to adopt an operating and governance model that fits the needs of the region.

Executive Summary

To be considered viable, a fiber network must be 1) technically feasible in the region 2) able to reach a critical mass of customers 3) sufficiently profitable to operate long-term and 4) able to grow while remaining financially stable.

This study finds that a Communication Union District created to provide universal Fiber-to-the-Premise (FTTP) service comprised only of the Rutland Region is feasible with current construction and materials costs; however, the CUD is strongly encouraged to further mitigate risk by merging or coordinating with an adjacent district.

This study first finds that the Rutland Region presents no major technical challenges to building a fiber network. This study also finds that a network in the region could eventually comprise 5,000 customers, achieving a scale that would make it attractive to an operator in the long term. However, the Internal Rate of Return (IRR) of the network is 5.05%, which is only slightly greater than the expected cost of capital (~5%).

With such a slight margin, the CUD would be vulnerable to factors such as changes in interest rates, a competitive response by incumbent providers, or increasing construction costs. Additionally, the outcome of the upcoming FCC Rural Digital Opportunity Fund auction could impact the viability of a stand-alone CUD in the Rutland Region.

The challenges facing the region are the result of two factors. First is the amount of existing coaxial cable and fiber internet available in the region. In an ideal situation, the network would be built to reach as many people who are currently unserved by cable or fiber as possible, because this provides the least expensive construction scenario (it is less expensive to build in places with fewer attachments on utility poles) and the highest and most predictable subscription numbers. However, in the Rutland Region, the vast majority of roads already have cable service, which both increases the construction cost and decreases the anticipated number of customers per passing. Relatedly, it is harder to predict how the existing cable internet providers will react to competition. They may not change their operations after being overbuilt, or they may lower prices drastically in an attempt to stave off competition. The latter scenario would further damage the viability of the project, and could make it hard for the Otter Creek CUD to gain enough customers to reach the 5,000 customer threshold.

Second, construction and materials costs have increased appreciably even in the past few months, driven largely by increased demand for skilled broadband construction labor, the pandemic's reduction of factory capacity, and tariffs on Chinese goods. With these increased costs, the study finds that the increased overall construction costs reduce the ability of the project to maintain a healthy cash flow throughout the years of construction.

Ultimately, this report strongly recommends that the Otter Creek CUD consider forming an "operational partnership" or merge with a neighboring CUD — most likely Maple Broadband, the Addison CUD, or perhaps with the Southern Vermont CUD, depending on the Rural Digital Opportunity Fund auction results and potential new fiber deployment plans from the incumbent. An operational partnership would entail coordinating with a neighboring CUD to pick the same network operator and designing and constructing the networks with the intent that they be operated by the same entity. Either an operational partnership or a merger would provide benefits to both CUDs by allowing for cost savings due to greater scale, and would make the region a more attractive opportunity for a range of potential operators who could feel more confident they could reach a viable number of customers to be healthy and profitable.

Of course, the CUD's outlook for operating alone could improve if construction costs went down (for example, if tariffs on key materials were removed), or if lower cost capital became available; for example, if the VEDA broadband loan program provided larger loans, or other sources of lower-interest capital was secured. However, this report makes no judgement on whether those scenarios are likely, and models the network based on current information available.

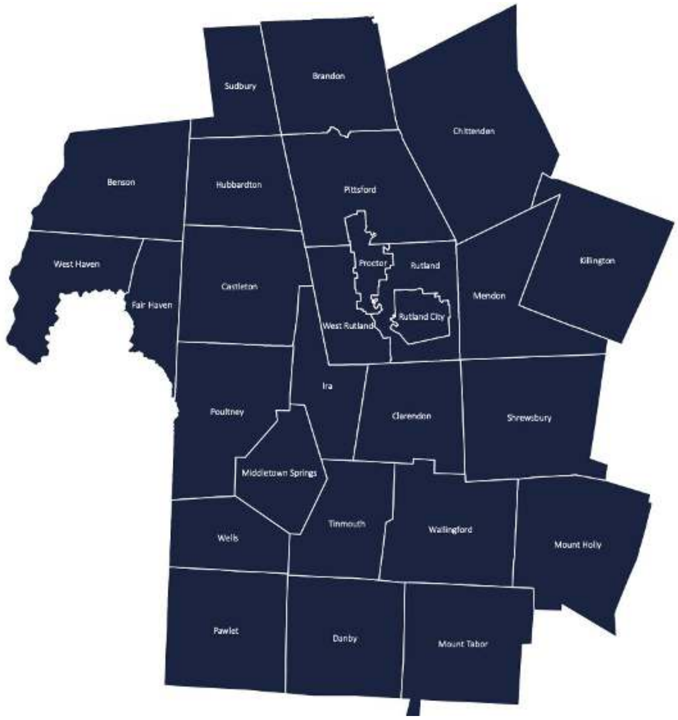
This study models the scenario of Otter Creek CUD operating alone, proving that it may be possible but is risky under current conditions, and shows that a network comprised of the towns in the Rutland Region with a neighboring CUD would be a safer route.

Background Information

The Rutland Region

The Rutland Region studied for this project includes 27 towns, all of which are located in Rutland County, Vermont.[1] Goshen, which is located in Addison County, is also included because it has joined the Otter Creek CUD.

[1] The Rutland Region includes Benson, Brandon, Castleton, Chittenden, Clarendon, Danby, Fair Haven, Hubbardton, Ira, Killington, Mendon, Middletown Springs, Mount Holly, Mount Tabor, Pawlet, Pittsford, Poultney, Proctor, Rutland City, Rutland Town, Shrewsbury, Sudbury, Tinmouth, Wallingford, Wells, West Haven, and West Rutland. Pittsfield is in Rutland County but is not part of the Rutland RPC region; it is located in the northwest corner of Rutland County. Goshen is in Addison County, but has joined the Otter Creek CUD.



Rutland Region

The Rutland Region is situated in the southwestern portion of central Vermont. Killington Peak and Pico Mountain run through the northeastern corner of the region. US-4 runs east-west and connects Killinton peak and Fair Haven to Rutland City, the region's most populous town. Lake Champlain lines the northwestern edge of the region that borders upstate New York. US-7 runs north-south through the center of the region and provides access to Bennington County directly south of the region and north to Addison County.

Towns in the Rutland Region range in population size, from less than 500 to over 15,000 residents. There are around 34,300 housing units (including second homes) and around 60,000 year-round residents in the region.There are also a sizable number of part-time residences in the region.

The economy is diverse and comprises a mix of industries including tourism and recreation, education, healthcare, professional services, and manufacturing. The region is home to a variety of natural resources, primarily slate, marble, limestone, and lumber. Major employers include Killington/Pico Mountain Resorts, General Electric, and Rutland Regional Medical Center.

Much of the region is covered by challenging mountainous terrain and has few major roads that cross east-west and north-south, especially in the eastern portion of the region. Existing infrastructure often dead ends on rural roads and traverses cross country off the roadway, making it difficult to create a network with redundant distribution. The terrain would also make it difficult for a wireless network to provide universal service.

Using Fiber to Achieve Universal Broadband

The FCC defines "Broadband" as having access to speeds of 25 Megabits per second (Mbps) download and 3 Megabits per second (Mbps) upload (known as 25/3Mbps). According to this definition, areas considered served have 25/3Mbps or better, and areas considered unserved have less than 25/3Mbps. This standard was set by the FCC in 2015, but much higher speeds will be required in the near future. The authors of this study feel strongly that any areas not served by coaxial cable or fiber infrastructure will again be underserved in the very near term (or are already underserved).

This belief is widely supported throughout the state. In 30 V.S.A. § 202c, the Vermont Legislature directs the state to "support measures designed to ensure that by the end of the year 2024 every E-911 business and residential location in Vermont has infrastructure capable of delivering Internet access with service that has a minimum download speed of 100 Mbps and is symmetrical." This desire by the state can only be met by wired infrastructure (coaxial cable or fiber), and only fiber allows for continually greater speeds as demand increases.

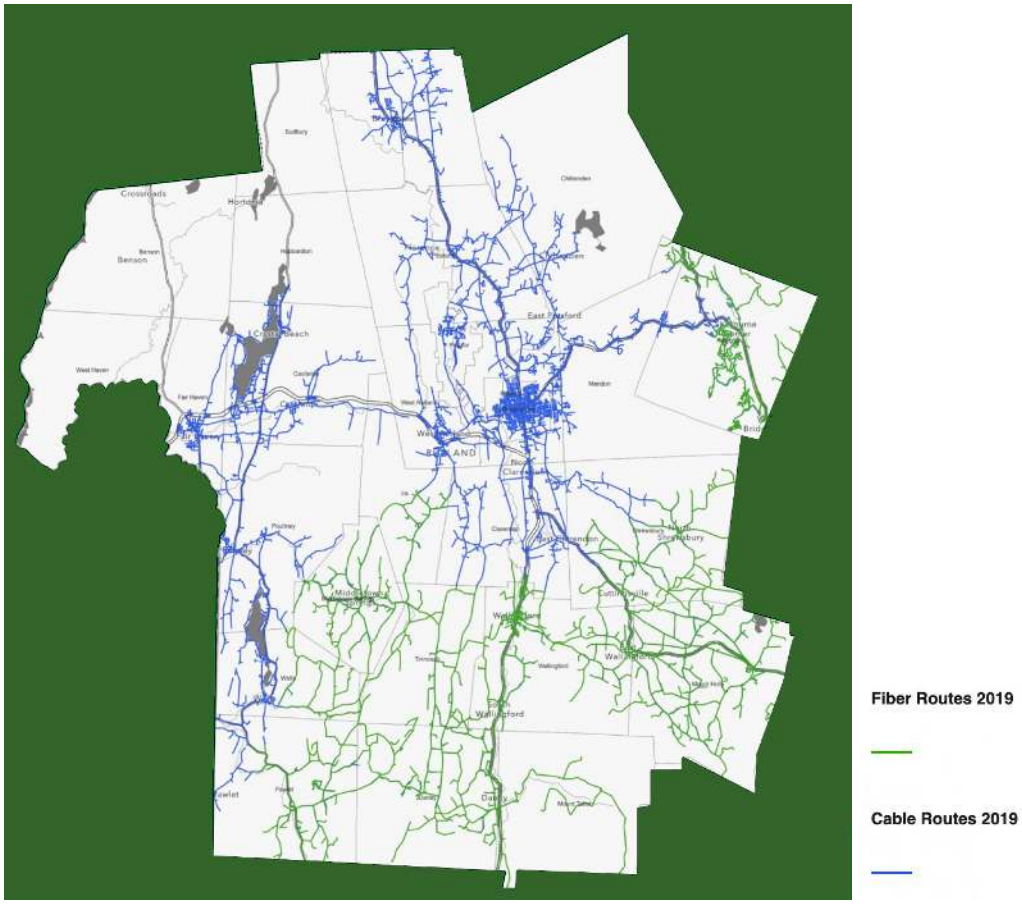
Fiber broadband uses glass strands and lasers to carry light, which is used to transmit data at the speed of light, and this infrastructure solves the broadband access problem more completely than any other existing technologies today. Though setting up a network is cost intensive, ongoing upkeep is relatively inexpensive compared to a coaxial cable or wireless network, and the infrastructure will not degrade nor will the technology become outdated for decades.

Current technologies allow 1Gbps symmetrical connections over fiber networks. However, this capacity can be scaled up even further as demand dictates. With commercially available technology today, it is possible to replace electronics at each central distribution site (hub site, roughly one per town) and in the home of each customer for a cost of $500-700 per customer to allow 10Gbps symmetrical connections. 100G technology is being tested, and 1 Terabyte speeds will be possible when demand exists.

Existing Broadband

There are many towns served by coaxial cable in the region that provide broadband (25/3Mbps) speeds or better; these services often do ***not*** cover the most rural parts of these towns. Comcast is the primary cable internet provider in the Rutland Region; Consolidated Communications is the primary DSL provider in the region. VTel offers fiber connections in the northeastern corner near Killington as well as much of the southern portion of the region. Towns served by VTel fiber include Danby, Killington, Middletown Springs, Mount Holly, Mount Tabor, Pawlet, and Wallingford. Historically, VTel has shown no interest in expanding their fiber network.

Below is a map of existing cable (blue) and fiber (green) coverage in the Rutland Region. (An interactive version of this map can be found at the Vermont Department of Public Service website.[2])



Map of existing cable and fiber in the Rutland Region

Beyond cable and fiber internet, DSL, satellite, and mobile data are currently the primary means of accessing the internet for the rest of the region. For those without access to cable, fiber, or DSL, satellite internet or mobile cellular data (4G) may be the best current option. None of these options provide reliable or consistent broadband speeds. All are affected to some extent by the weather and struggle especially with providing upload speeds capable of video-conferencing and other upload-intensive activities.

Additional broadband technology being developed, deployed, or expanded

In addition to the longtime service models listed above, there are a few broadband technologies that are either currently being developed and therefore may be relevant to the region in the near future (5G and Low Earth Orbit satellites) or are currently being expanded in the region (VTel 4G LTE Wireless). These technologies are important to understand and be

[2] https://publicservice.vermont.gov/content/interactive-broadband-map

aware of; however, they do not provide a viable alternative route to providing universal coverage for the region.

5G is the 5th generation mobile network. 5G wireless technology is meant to deliver higher multi-Gbps peak data speeds, ultra low latency, more reliability, massive network capacity, increased availability, and a uniform user experience to more users. It should be noted that 5G providers promote the fastest potential speeds their network may provide, which may not reflect the internet speeds ultimately achieved. For example, 5G signals are commonly hindered by physical barriers such as hills and trees.[3] Overall, actual speeds experienced by wireless users are often only 15 percent of the peak data connection rate, even though the peak data connection rate is the speed advertised.[4] Additionally, wireless internet solutions are generally less stable than wired internet, like FTTP.

Perhaps more importantly, 5G networks utilize short range airwaves, which exist within 800 feet from 5G enabled towers. Each tower is usually connected/backhauled to the Internet with fiber. To reap the full benefits in rural areas, all premises would need to be within 800 feet of a tower. This would require a significant fiber network to connect each tower, as well as investments in new towers and base stations. As cell carriers decide where to begin deploying 5G networks, they will likely focus on high density cities first, and may never bring 5G to rural areas.

Low Earth Orbit (LEO) satellite internet is another emerging technology that has received significant attention. In particular, Elon Musk's company, SpaceX, is in the process of building Starlink, which aims to use LEO satellites to provide internet; Starlink recently deployed 60 additional satellites,[5] for a total of 800, and is preparing for beta testing. LEO satellite companies aim to create a constellation of satellites to provide better internet coverage than traditional GEO satellites. In particular, because LEO satellites are closer to earth, they provide connections with lower latency than traditional satellite internet.

The ultimate extent and quality of Starlink's service is not known at this time. While the impact could be significant if Starlink is able to provide quality internet for a reasonable price, LEO satellite internet must clear several hurdles in order to reach this point:

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[3] pcmag.com/news/testing-verizon-5g-in-chicago-speedy-but-watch-out-for-that-tree
[4] https://www.bbcmag.com/rural-broadband/5g-is-not-the-answer-for-rural-broadband
[5] https://www.space.com/spacex-starlink-satellites-launch-rocket-landing-oct-18-2020

- Traditional satellite internet providers have data caps. It is unclear what the pricing tiers and data caps will be with LEO satellite services, but capped service may not meet many consumers' needs.

- While fiber internet will remain relevant for decades to come, and will be able to handle faster speeds as bandwidth needs increase, the same cannot be said for LEO satellite internet. LEO internet speeds will decrease when more users attempt to get online. While recent beta testing demonstrated decent speeds — 30-60 Mbps download and 5-18 Mbps upload[6] — only a small number of users were connecting during beta tests. Speeds will almost certainly go down as the service is used by more people.

- LEO satellites, and StarLink in particular, have made progress towards clearing one major hurdle: latency (lag time). Initially, it was not known if LEO satellite internet would be able to meet the latency needs of consumers who use technologies such as video conferencing. Starlink then claimed they reached latency of 50 ms or less, and showed latency of 31-94 ms in recent beta tests.[7] While the FCC initially communicated "serious doubts" that LEO satellite technology can provide adequate connectivity at scale to compete as a "low-latency provider" (100 ms or less) in the Rural Digital Opportunity Fund (RDOF) auction,[8] the FCC recently approved StarLink as a qualified bidder in the low-latency category.[9] StarLink still needs to prove they can deliver low-latency service at-scale though.

LEO satellites are important to continue to monitor, but at this point the project team has not seen proof that LEO satellites can provide cost effective and robust internet coverage to compete with fiber in the long run.

VTel Wireless is a 4G LTE (Fourth Generation - Long Term Evolution) technology. The network consists of wireless sites throughout Vermont on towers, silos, steeples and other high spots. 4th generation of mobile communications allows for large amounts of data to be sent and received. However, as with most wireless technologies, it is not universal, and not every served location has access to the same speed or capacity. It is very dependent upon where the access site is located in relationship to a customer. 4G LTE generally delivers speeds in the range of 5-12 Mbps download and 2-5 Mbps upload. Occasionally under ideal conditions it may deliver

[6] https://arstechnica.com/information-technology/2020/08/spacex-starlink-beta-tests-show-speeds-up-to-60mbps-latency-as-low-as-31ms/

[7] https://arstechnica.com/information-technology/2020/08/spacex-starlink-beta-tests-show-speeds-up-to-60mbps-latency-as-low-as-31ms/

[8] https://www.cnet.com/news/fcc-has-serious-doubts-about-spacexs-broadband-service/

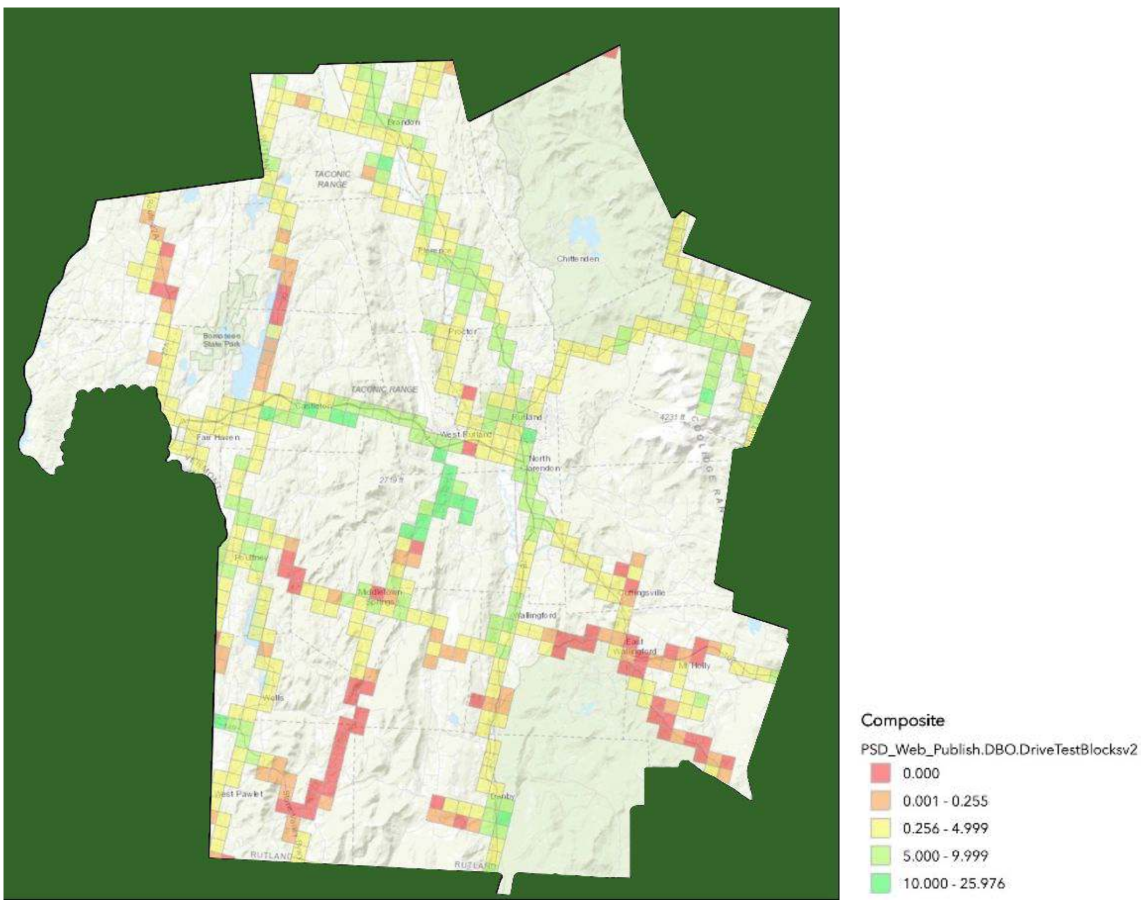
[9] https://arstechnica.com/tech-policy/2020/10/spacex-gets-fcc-approval-to-bid-in-16-billion-rural-broadband-auction/

speeds approaching 50 Mbps download, though this is nothing remotely close to the capacity and consistency that fiber can provide. Although the VTel 4G LTE network has delivered internet access to many in rural Vermont, it is not ubiquitous and even if VTel continues to expand, 4G wireless service will never provide the really fast, consistent, and reliable symmetrical speeds of fiber.

Utilities and additional telecommunications access

The landscape of non-internet utilities and telecommunications access in the Rutland Region is typical for mountainous and forested terrain. Data collected by the Department of Public Service in 2018 show serious gaps in cellular coverage, especially in the southern portion of the region near East Wallingford, Mount Holly, and Pawlet.

PSD 2018 Mobile Wireless Drive Test[10]



[10] An interactive version of this map is available at https://publicservice.vermont.gov/content/mobile-wireless-drive-test

Some recent efforts have begun to expand wireless service in the region as part of a statewide expansion.[11] In February 2020, The Vermont Public Utility Commission approved a Certificate of Public Good for an AT&T/FirstNet Cell Tower to be installed in Mount Holly, and construction was scheduled to begin during summer 2020.[12] In addition to Mount Holly, similar tower expansions were planned for Benson, Castleton, Pittsford, and Killington.

Green Mountain Power provides electricity to the entirety of the Rutland Region.[13]

Economic Development

High speed broadband is a critical foundation to a thriving, diverse economy and has been shown to increase job productivity in rural areas.[14] Downtown and commercial areas need to be connected to conduct business, and residential internet service is crucial for home businesses and those who work from home. Furthermore, even before the COVID pandemic and physical distancing guidelines, the American Community Survey estimated that 7% of workers in Rutland County worked from home — i.e., they worked remotely, or they ran a business out of their home.[15]

The CUD and/or operator may choose to offer contracts that allow second-homeowners to shut off service for half a year, further encouraging seasonal Vermonters to subscribe to fiber broadband. Further, access to fiber broadband raises property values by 3-5%,[16] and apartment buildings with fiber fill vacancies faster than ones without it.[17] Lack of sufficient broadband impacts the ability of homeowners to sell their homes at any price.

Further, the education system relies on broadband to connect students with teachers, to provide adult online education resources, and to simply give Vermonters better access to education. Broadband is also critical to healthcare, connecting patients with medical providers for appointments and information, monitoring chronic diseases, and for remote therapy sessions. In workplace, healthcare, and education contexts alike, the ability to video conference with high definition, consistent streaming quality, and low latency allows participants to read facial expressions and empathize, creating a communication environment that leads to better outcomes for all.

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[11] https://about.att.com/story/2020/fn_vermont.html

[12] http://www.mounthollyvt.org/wp-content/uploads/2020/03/PUC-Order-CPG.pdf

[13] https://puc.vermont.gov/sites/psbnew/files/doc_library/electric-service-territory-map.pdf

[14] https://dailyyonder.com/research-report-broadband-and-job-productivity-what-matters/2020/08/05/

[15]https://data.census.gov/cedsci/table?g=0400000US50_0500000US50021&d=ACS%205-Year%20Estimates%20Data%20Profiles&tid=ACSDP5Y2018.DP03

[16] https://www.fiberbroadband.org/blog/study-shows-home-values-up-3.1-with-access-to-fiber

[17] Knutson, Ryan, "How Fast Internet Affects Home Prices," *Wall Street Journal,* June 30, 2015, https://www.wsj.com/articles/SB11064341213388534269604581077972897822358

Importantly, fiber broadband is also future-proof, meaning it will remain relevant, competitive, and scalable as the technology enmeshed in our lives continues to advance and evolve. A fiber network will serve the region's bandwidth needs today and for decades to come.

Determining Need

The most important aspect of determining a region's need for broadband is understanding where there is and isn't existing 25/3Mbps broadband or, for all intents and purposes, where there is existing coaxial cable or fiber and where there is not.

In understanding where broadband is available in the region, this study utilized 2019 Vermont Public Service Department (PSD) data on the current location of cable and fiber. The following chart outlines a town by town summary of served and unserved areas according to the Public Service Department.

Knowing where coaxial cable and fiber exist is important for two reasons. First, existing cable and fiber will be the strongest competition to a new fiber network, and as such, any areas with existing cable or fiber that get "overbuilt" by the CUD will see lower subscription rates (it should be noted that while the CUD will likely overbuild areas served by cable, it is not recommended to overbuild areas already served by fiber). Second, it is more expensive to build in areas with existing cable or fiber, as there are more wires on the utility poles. Areas with cable or fiber will be referred to as "cabled."

	Population	**PSD premises**	**% Served with Cable or Fiber (PSD data)**
Benson	907	610	0.00%
Brandon	3796	1849	88.80%
Castleton	4570	2294	93.03%
Chittendon	1342	717	87.87%
Clarendon	2497	1191	96.89%
Danby	1300	793	99.75%
Fair Haven	2611	1151	93.05%
Goshen	134	141	0.00%
Hubbardton	568	651	10.45%
Ira	378	225	94.22%

Killington	726	1387	99.28%
Mendon	971	649	88.75%
Middletown Springs	784	450	99.33%
Mount Holly	1168	1123	98.58%
Mount Tabor	240	125	100.00%
Pawlet	1287	839	88.20%
Pittsford	2846	1435	90.10%
Poultney	3333	1703	86.79%
Proctor	1696	767	98.57%
Rutland City	15577	6121	98.86%
Rutland Town	4066	1842	100.00%
Shrewsbury	1177	609	96.88%
Sudbury	639	426	0.00%
Tinmouth	637	358	100.00%
Wallingford	2094	1042	100.00%
Wells	978	964	98.03%
West Haven	320	144	0.00%
West Rutland	2398	978	97.65%
Total	**58906**	**30443**	**90.11%**

Benson, Goshen, Sudbury, and West Haven are completely unserved by cable or fiber; Hubbardton is mostly unserved. Several towns are well served by cable or fiber; towns served by VTel fiber are particularly well-covered.

This data, along with population data and housing units per mile data, allows us to determine which towns have the most unserved areas, and which have the most densely located households and businesses without service.

Decision not to conduct a take-rate survey

Feasibility studies sometimes include a survey of residents in order to determine existing broadband coverage and demand for better connectivity.

In this case, the project team decided to forgo a survey for several reasons. First and foremost, the project team is able to utilize historical data from ECFiber, the network in East Central Vermont that ValleyNet operates. More information on ECFiber can be found below in the section on Communication Union Districts. Historical ECFiber data provides better information than surveys, which by their nature have to ask hypothetical questions. For example, surveys often ask residents whether they would switch to "competitively priced fiber." This question is difficult to answer in the abstract, without knowing how inconvenient it may or may not be to switch and without knowledge of actual pricing and service options (which will not be decided upon until an operator partner is chosen).

Second, the Department of Public Service provides highly accurate information on what locations are already served and unserved. This information — along with data on road miles per town and basic ACS data on populations and households — provides the primary inputs needed to conduct a feasibility study.

Finally, time is of the essence when building broadband, and conducting a robust survey would take at least 6 weeks. Ultimately, we concluded that we could accurately determine the feasibility of a fiber project in Rutland without conducting a survey.

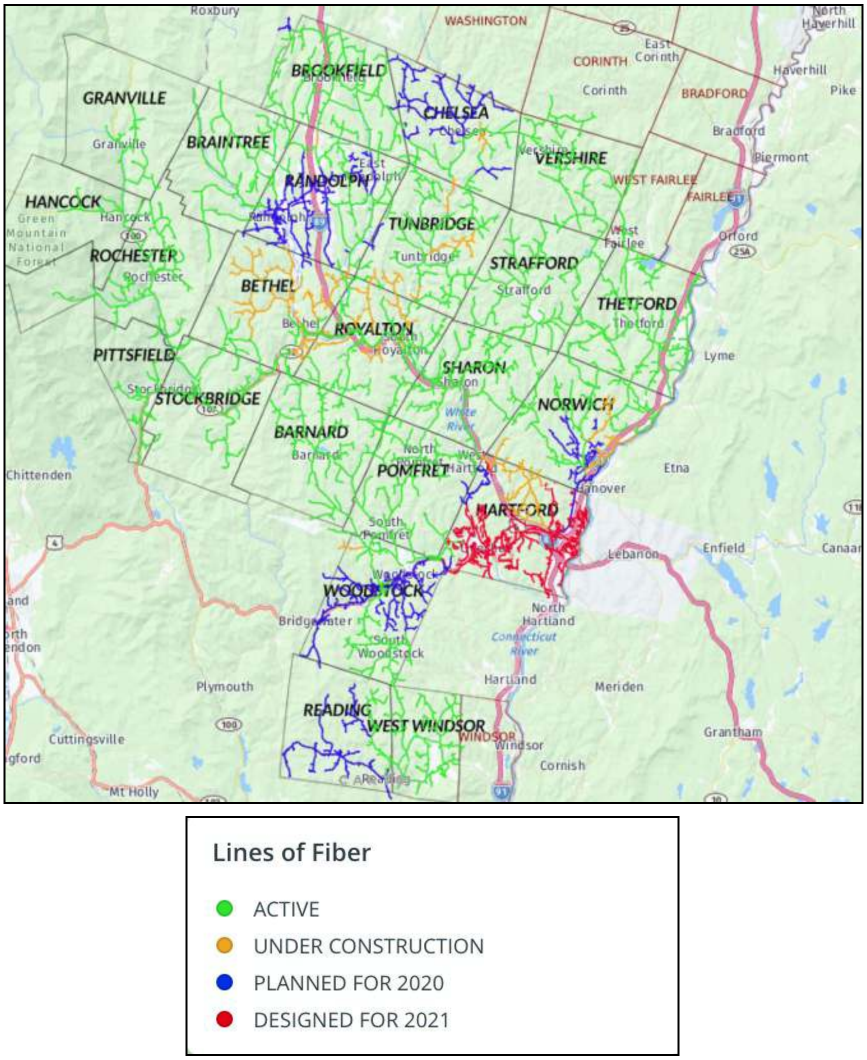
Communication Union Districts

In 2015, the Vermont Legislature authorized the formation of Communication Union Districts,[18] enabling multiple towns to join together to provide communication infrastructure to residents. Much like a water and sewer or solid waste district, this allowed towns to aggregate demand for a service and find efficiency by sharing operation of the district. Critically, in Vermont, this legislation also ensures that taxpayers in individual towns are not liable or responsible for mismanagement or failure of the CUD to repay debt incurred in building the network.

The East Central Vermont Telecommunications District (ECFiber) has been operational as a CUD since 2016, and serves as a model for this project. Prior to the 2015 legislation, ECFiber towns were organized through an Interlocal Contract; after the establishment of the ECFiber District, all towns became a part of the first CUD in Vermont. The initial CUD included 23 towns, and the CUD has expanded to include 31 towns. ECFiber focuses on serving areas that previously did not have access to coaxial cable or fiber, though has done some overbuilding of areas covered by coaxial cable areas both to reach other unserved areas, and in denser downtown areas (e.g., Hartford) to compete for customers.

ECFiber's Network

[18] 30 V.S.A § 3051



Because the region covered by the ECFiber CUD resembles the Rutland Region in terms of population, socioeconomics, existing infrastructure assets, and geography, data from the ECFiber district is used to guide this feasibility study.

Determining the optimal size of the Otter Creek CUD

The Otter Creek CUD is looking to the guidance of this feasibility study to understand whether their current make-up is sufficient to allow for a feasible network, or if they would be better served expanding or merging with another CUD. As of November 12, 2020, ten towns have joined the Otter Creek CUD: Brandon, Benson, Castleton, Chittenden, Hubbardton, Pittsford, Sudbury, West Haven, West Rutland, and Goshen (Addison County).

The minimum number of towns in a CUD by law is 2, however from a feasibility standpoint, enough customer demand needs to be aggregated in a CUD to make the business case for a fiber deployment viable, financeable, and large enough to create scale economies and attract an operator. In the project team's experience, CUDs should target 5,000 subscribers to achieve a viable size, if the intention is that the network is run by a private operator. Networks much smaller than this will not be big enough to generate comfortable margins once built and would therefore be unattractive to operators or financiers in the long term.

The size of a network needed to serve 5,000 customers is determined by how many *potential* customers are passed in unserved areas (without fiber or cable) and how many customers are passed in areas served by coaxial cable; customers currently served by fiber are unlikely to switch providers. In the case of the OCCUD, the project team recommends that the CUD aim to incorporate all towns in the Rutland Region, excluding those areas already served by VTel fiber.[19] VTel offers high speed fiber connections in these towns at a low price, so it is not recommended that the CUD attempt to compete with their product. In towns partially covered by fiber (e.g., Ira, Shrewsbury), the CUD is not recommended to overbuild existing fiber, but can build to the unserved areas, as the fiber provider in that case, VTel, is unlikely to want to expand beyond their ILEC territory.

While there are about 100 locations unserved by cable or fiber in the southwest corner of Pawlet, these households would be most efficiently served by the new Southern Vermont CUD, as the locations are adjacent to unserved locations in Rupert. The Rutland CUD could also potentially serve these locations, although this would likely happen later in the build sequence and is not currently incorporated into the feasibility model.

Excluding towns covered by VTel's fiber, about 88% of locations are currently served by coaxial cable, which increases the risk of the project because construction costs are higher in cabled areas and take-rates tend to be lower. Our team's recommendation, born out by the numbers presented in the models below, is to continue adding towns in the Rutland Region, and to consider either merging with another CUD or coordinating to choose an operator that is shared with a neighboring district in an "operational partnership."

Using an Operational Partnership to Expand Network Size

Forming an operational partnership to expand the size of the network while maintaining the CUD's independence (and ability to secure a VEDA loan) would require the Otter Creek CUD and their partner CUD:

- Coordinate RFPs for construction, maintenance, and operation
    - Respondents should bid on operation of both CUDs as one
    - May require a separate contract between each CUD and RFP respondent
- Construct their networks with the understanding that they will be operated by the same entity

[19] Towns served by VTel fiber are Danby, Killington, Middletown Springs, Mount Holly, Mount Tabor, Pawlet, Tinmouth, and Wallingford. Ira, Shrewsbury, and Wells are partially covered by fiber.

    - Coordinate on hub locations
    - Use uniform standards and mechanism for construction
    - Use the same brand(s) of equipment and electronics
    - Contract with the same entities for internet backhaul sharing a central hub location for purposes of redundancy and economies of scale. Internet backhaul per GB prices decrease with larger purchases.
        - *Note: the project team recommends all CUDs coordinate through the Vermont CUD Association (VCUDA) and attempt to aggregate purchasing power*
- Share resources and coordinate to gain efficiency moving forward
    - Purchasing / negotiations
    - Website and brand name
    - Equipment, contractors, consultants,plans for network maintenance as needed

Once build-out is complete and VEDA loans repaid, there may be little reason to remain separate CUDs and a merger may make ongoing operation easiest.

Benefits of an Operational Partnership or Merged District

There are several benefits to forming an operational partnership or outright merging with another CUD. First, larger districts are more attractive to operators, and the CUD may receive more favorable responses to their RFPs. Second, a larger network is more attractive to private investors, which may allow the CUD to secure subordinated debt at more favorable rates. Finally, a shared network allows the sharing of fixed costs over a larger number of customers, increasing margins of the network and mitigating risk.

In order to ensure timely customer service, the driving distance from the central office to the edges of the network should not significantly exceed an hour. A network covering Addison and Rutland counties can meet this criteria; for example, Orwell is within an hour drive of Pawlet (to the south) and Starksboro (to the north).

Operational Partnership vs. Merged District

Both an operational partnership or a merged network are viable paths towards building a FTTP network in the region; in both the merged district and operational partnership scenarios, the CUD will benefit from increased scale. The primary advantage of an operational partnership is that each CUD will likely be able to receive a $4 million VEDA loan. Additionally, each CUD board may be able to be more attentive to the needs of its constituents under an operational partnership. The primary drawback of an operational partnership compared to a merged district is increased complexity. The CUDs must coordinate closely to put out RFPs at the same time, select the same network operator, and design and construct the networks with interoperability in mind (e.g., use the same brand of equipment).

Potential Drawbacks of a Larger Network

While larger fiber networks benefit from economies of scale, there are some potential downsides to a larger network. While a network consisting of Addison and Rutland counties would not be too large geographically, a larger network (whether in the form of an operational partnership or a merged district) will be more complicated. Additionally, some CUD members may feel being in a larger network dilutes local decision making and control. CUD board members can mitigate this concern by remaining attentive to the needs of their constituents, being clear to the public about the benefits of a larger district, and being transparent about projected build timelines and the build sequence so constituents understand when they will likely receive service, and why the timeline is such.

Effect of an Operational Partnership on Build Speed

Truth be told, it is hard to fully predict the effect of a partnership on the build speed of both networks. Clearly, serving towns as fast as possible is a priority for all CUDs. This study's calculations estimate that under an operational partnership, each CUD will be able to complete 200 miles of make-ready each year, compared to 250 miles a year if both are operating independently. That being said, GMP owns the majority of the poles in the region, and both CUDs will likely request make-ready work at similar times, even if they are operating independently. As such, any bottlenecks in completing make ready work due to an operational partnership requesting a lot of make-ready all at once might also occur if the CUDs operated independently.

The project team advocates that the CUD maintain open lines of dialog with legislators and DPS to advocate for policies that decrease potential make-ready bottlenecks, and keep officials informed of those bottlenecks if they occur.

Network Operator

Finding and selecting an experienced network operator and negotiating a mutually satisfactory relationship will be the District's most important decision. Most importantly, this relationship will dramatically affect the ability of the District to attract financing. Though all operators will want to see the results of the feasibility study and business plan, as well as see the successful full formation of the CUD before submitting formal operating proposals, discussions are ongoing with a range of entities that could eventually become the operator. As the CUD indicated, they are open to learning about all operating models and structures at this point, with a preference towards models that allow them to retain some control over the quality of service provided to member towns.

To achieve a successful project within the parameters of the financing options available and with the interests of Otter Creek CUD member towns in mind, the operator should:

- Exist currently as a business entity, and have proven experience delivering a utility or telecom service to customers
- Be able to leverage a range of current assets, systems and experience, from system construction, customer service/phone/billing systems, to experienced executive leadership

- Have a business structure, accounting experience, and compliance acumen, and motivation to secure flexible, disparate, and sometimes challenging funding opportunities, including bonds, loans, grants, and other sources
- Be willing to work for lower profits than those attainable in less rural (denser) areas (i.e., possibly a non-profit, B Corporation, or similar)
- If the OCCUD decides to enter a operational partnership with another CUD, the operator must be prepared to serve both CUDs

From a potential operator's perspective, a CUD must make itself attractive by by having the following characteristics:

- Have the scale to present a sufficiently profitable opportunity
- Be adequately financed
- Be willing to commit to a multi-year (likely 5 year) exclusive operating contract, subject to termination if objective operating standards are not met
- Have robust pre-subscriptions for service (i.e., evidence of sufficient demand) and be willing to help with local marketing efforts
- Be realistic about the amount of control it will exert on day to day operations.

Entering into an operational partnership with another CUD will make the Otter Creek CUD an attractive opportunity for potential operators by:

- Increasing the number of potential customers and therefore ultimate revenue opportunities
- Introducing new efficiencies, e.g., more customers can be served per central office, technicians, and hub locations
- Mitigating risk, as the project will not rely on overbuilding as many cabled areas in order to reach viable scale

The primary portion of the operating protocols for a successful partnership between a District and an operator is summarized below:

I. General Principles

1. The Project network (the "Network") shall be universal and financially self-sustaining.
2. The Network shall offer, within operational limits, 'net-neutral' Internet access (i.e. not linked to any specific browser, not filtered or blocked).
3. The Network's day-to-day operations shall be delegated, according to the terms of the Operation Agreement to the Operator, including, but not restricted to Rollout, Connection, Pricing, Marketing, Personnel Issues and Customer Service.

4. The Network's connection fees shall be standardized for all new subscribers, with the following exceptions:

· Sales Promotions;
· Subscriber connections exceeding Standard 400 ft aerial drops.

· Such other circumstances as exigencies may require – but only with the consent of the District Governing Board.

II. General Roles regarding the Project

A. District
a. Formulate and articulate general governance policies
b. Oversee District accounts
c. Monitor Operator performance
d. Due diligence and approval regarding budgets, major contracts and agreements
e. Interface with investors
f. Sign contracts above a stipulated amount; delegates to the Operator the right to sign contracts below a stipulated amount.

B. Operator
a. Execute and complete the Network project including designing, building all associated Network assets and operating them as an ongoing business.
b. Acknowledge and comply with District policies
c. Manage Network operations, monitoring availability, ensuring security, and coordinating with contracted backhaul internet providers
d. Report regularly on Network project progress and operations
e. Promptly inform District of changes or difficulties

Ultimately it is up to the CUD to decide which provider best fits their desired governance and operational model. As needed, RISI and ValleyNet will continue to provide assistance to the Otter Creek CUD to help them vet potential providers until they select a partner.

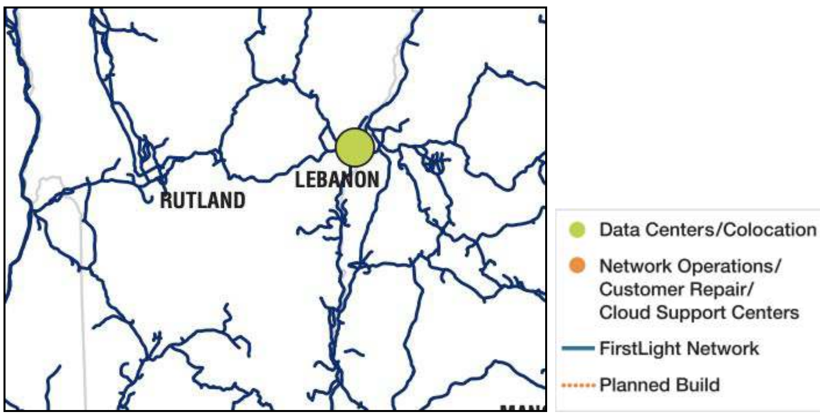
Technical Feasibility

There is nothing about the region that would hinder the technical feasibility of a multi-town FTTP system. The existing infrastructure in the region will not present any barriers to creating a viable and detailed engineering plan for the region at a later stage in the process.

Backhaul Availability

The first technical hurdle the network needs to clear is determining where access to fiber backhaul is relative to the network. Backhaul refers to the fiber infrastructure needed to carry information between the core and the edge, between a regional network's router location to the "carrier hotel" where it connects to the greater global Internet network. Fortunately, the Otter Creek CUD will have a choice in the matter, with Firstlight, Consolidated Communications, and VELCO (Vermont Electric Power Company) all indicating interest in being the backhaul provider for the network. CenturyLink also has fiber availability from Albany, NY to Burlington, VT through western Vermont. This will allow the OCCUD to compare proposals and pick the backhaul provider that best suits their needs, or multiple providers to establish redundancy in the network.

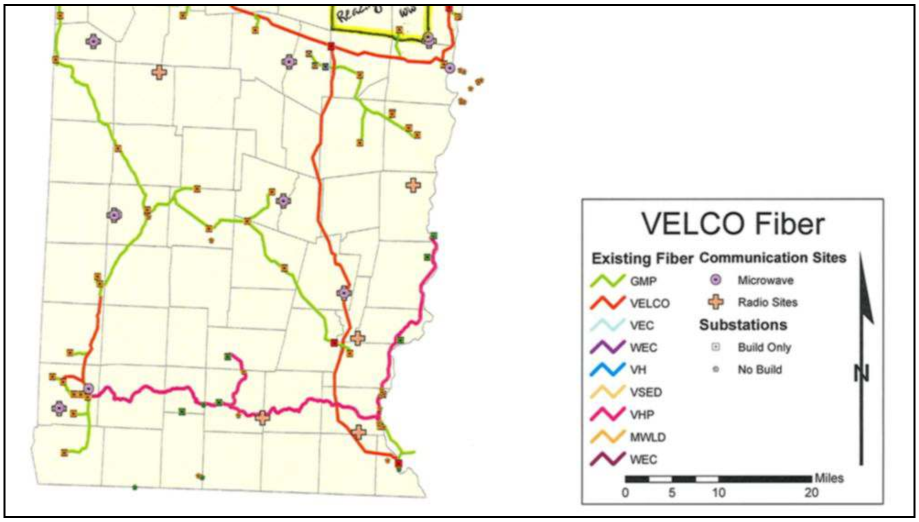
As a result of the FirstLight acquisition of Sovernet, FirstLight has available fiber assets in southern Vermont connecting educational institutions and commercial properties. Their network reaches into 14 of the 27 towns in the Rutland Region studied here. In addition, FirstLight has interconnections to the Internet at major carrier hotel facilities in Boston, Springfield, Albany, NYC, Portland, and Montreal which would allow for multiple paths of egress (note: these interconnections are not shown on the map).



Firstlight Fiber Network (2020)

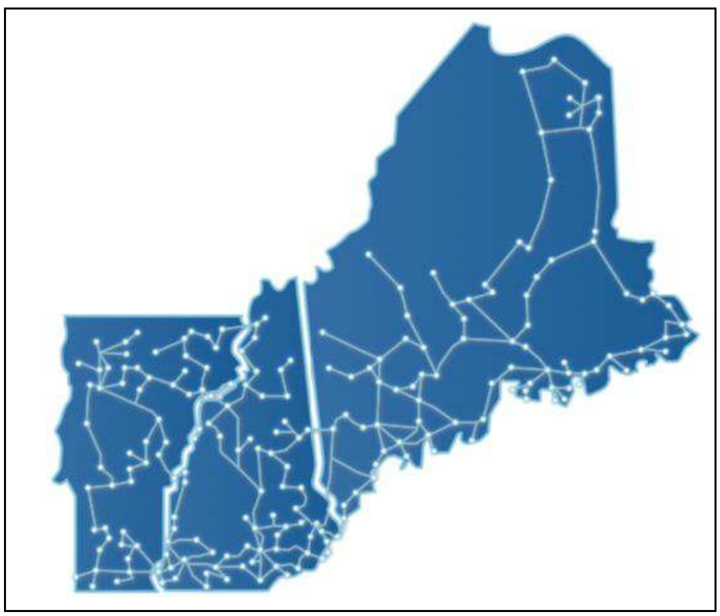
Another option for middle mile fiber and backhaul is the Vermont Electric Power Company (VELCO), which owns, with the other electric companies, a network of fiber along transmission lines through Vermont. This network has many strands of unused fiber and has been eager to be a partner to fiber projects in the state. VELCO's reach is also quite extensive in the Rutland County Region, and could accommodate a variety of build plans. Although this appears to be contrary to the recent Magellan Report[20] on the feasibility of electric utility involvement in broadband, recent meetings with VELCO have indicated a real desire to be a part of the VT broadband solution.

[20] "Feasibility Study of Electric Companies Offering Broadband in Vermont," https://publicservice.vermont.gov/announcements/psd-releases-feasibility-study-electric-companies-offering-broadband-vermont



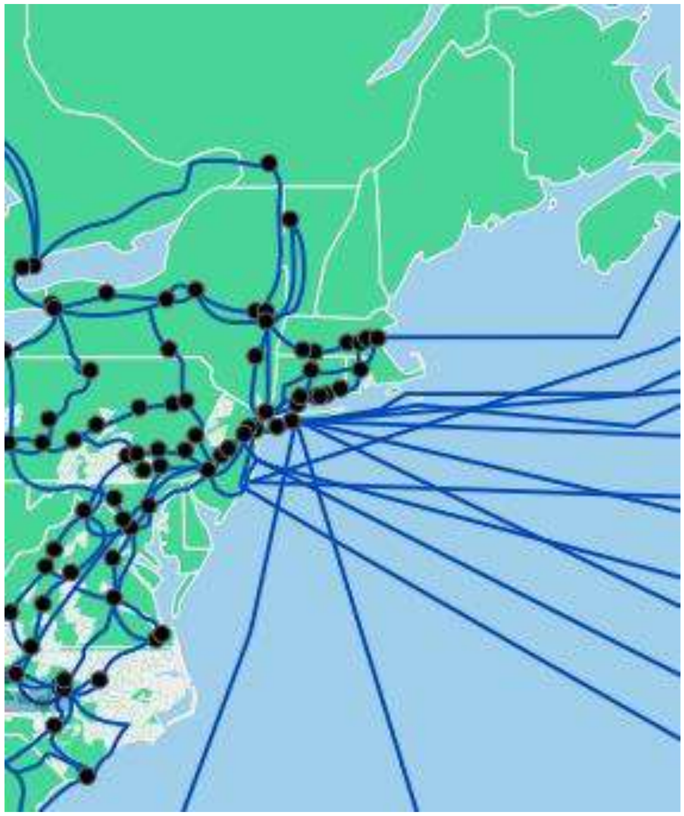
VELCO Fiber Network

In addition, Consolidated Communications has fiber assets within the region that could be used for backhaul to the Internet or hub connections.



Consolidated Communications Fiber Network

CenturyLink has available fiber connecting co-location facilities in New York City to Albany and Montreal, with fiber from Albany to Bennington and then Burlington. This fiber could provide some redundancy to the internet backhaul.



CenturyLink Fiber Network

The fiber availability in all of these networks could eventually be utilized to connect the various communication union districts together to create redundancy in the networks, to connect hub locations, and to aggregate services for further cost savings.

All of these options would provide appropriate and sufficient backhaul to the network, and existing fiber lines are located in enough towns in the region to allow for construction of the underserved areas of the region first, with multiple deployment routes to choose from.

Additional existing fiber assets

FirstLight, VELCO, and Consolidated Communications have available fiber along the main thoroughfares in the Rutland Region. VELCO (Vermont Electric Power Company) was established in order to create and maintain an interconnected electric transmission grid. In order to do so, VELCO needed to connect all facilities with optical fiber to manage and monitor the electrical facilities. As a result, they have excess fiber on many parts of their fiber network.

Although it is unlikely this fiber could be used for distribution (connection directly to premises), it could be used to connect geographically separated towns in the early phases of construction and connect hubs and build resiliency and redundancy in the fully built broadband network. It also could be used to connect Communication Union Districts or other broadband networks together for redundancy and possible cost savings. Consolidated Communications has a fiber network that connects all DSL equipment hubs back to their central offices. In addition, CCI often delivers fiber network access to large commercial entities.

Lastly, many of the Town offices and emergency services are located in buildings with backup generator power. These locations make excellent hub sites for the network.

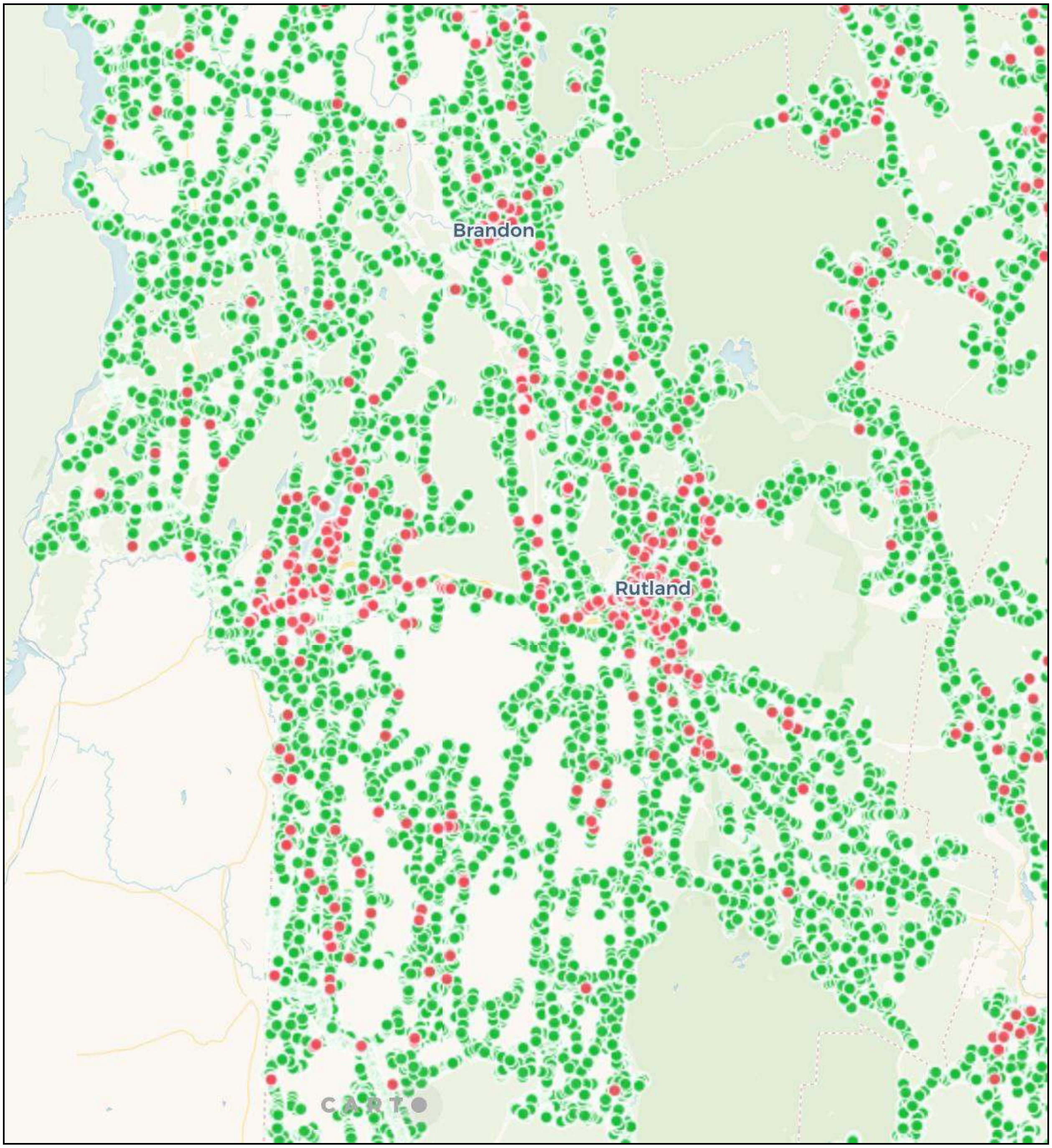
Utility poles in the region

Because our study is focused on the deployment of Fiber-to-the-Premise and not wireless solutions or other mechanisms for providing broadband, the only important vertical infrastructure are utility poles.

Green Mountain Power (GMP) provides data on their utility poles through the Vermont Geodata Portal; as such, this data identifies locations and characteristics of poles, including pole height and pole class. Extremely old poles, which tend to be under 30 feet, and poles that have 2 or more attachees in the communications space will more often need to be fully replaced to be used for fiber attachment, increasing the cost of deployment.

The average cost to make space on the pole for a new fiber attachment in a Vermont rural area where there are few attachments on the pole is $100-$200 per pole. This translates to an average cost of $5,000 per mile (assuming roughly 30 poles per mile). That amount potentially triples in cabled and densely populated areas where there are multiple attachees on a pole and pole replacements (costing upwards of $1000 per pole) are more likely. Vermont instituted new pole attachment rules last year, including one-touch make-ready in the communication space. This new option should help to reduce make-ready costs and delays overall.

What follows is a map of GMP pole locations in the Rutland Region. Green poles are 30' and higher, and red poles are less than 30' in height.



Green Mountain Power pole locations in the Rutland Region

Around 1.5% of poles in the Rutland Region are likely in need of replacement due to being too short. Even then, fiber will not be attached to every pole, and determining exactly how many poles need to be replaced will occur when an exact deployment route is being created and make-ready conditions for each pole are negotiated with utilities on a joint “rideout.”

In addition, the coaxial cable and fiber route data published by the Vermont DPS allows the model to estimate the percentage of poles that are likely to be more crowded, which increases the cost of deployment. These numbers are all factored into the construction cost projections below.

In order to gain access to the utility poles in the right-of-way, the Otter Creek CUD will also need to obtain a Certificate of Public Good. This Certificate of Public Good authorizes an entity to provide telecommunications services and can be obtained from the Vermont Public Utility Commision.

Underground Construction

A few miles of utility cable and copper infrastructure in each town will likely be underground. The fiber network will follow the same route and underground conduit will need to be installed, often in the Town's road right-of-way. Underground construction is several times more costly than aerial construction and can be very difficult in Vermont's rocky terrain. Without a detailed design it is impossible to predict exactly what percentage of the network construction is underground, but ECFiber's experience is that it averages less than 5% of total mileage and has not significantly impacted build costs in the state of Vermont. Each Town has its own permitting process for use of the Town right-of-way; these processes are often different from each other. Documenting that process in advance will be very useful when the CUD is ready to install underground utilities.

Bandwidth needs

Based on the bandwidth needs of the ECFiber network, bandwidth needs for the fully operational Otter Creek CUD are estimated to be 20 Gbps, split between 2 network router hubs with egress to the Internet (10 Gb at each location). However, this is all scalable. The network would be built initially with 3-5 Gb backhaul and increase capacity as needed as more users come on-line.

Basic Network Design

An optical fiber Gigabit Passive Optical Network (GPON) with distributed splitting in the field is recommended. GPON networks have become the standard for municipal broadband and for Fiber-to-the-Premise projects in the US. The infrastructure is scalable and is limited only by the equipment on both ends of the fiber. The fiber network is future-proof; as increased bandwidth and capacity are necessary, the electronic equipment can be upgraded without needing to rebuild the base fiber architecture. The initial network will consist of a hub location in each town connected to each other with 10 Gb fiber transport, eventually creating interconnecting, redundant rings. The initial design will include two central hub locations that will also house the routing equipment to access the Internet. These two locations will provide redundancy, in the case of a failure, for each other. Home equipment (e.g, Internet routers) will also be gigabit compatible. If the OCCUD creates an operational partnership with a neighboring CUD, the second major hub location may be unnecessary as redundancy will be provided by the other CUD (or, perhaps, the two CUDs could share 3 major hubs).

An alternative fiber network option is an Active Ethernet Optical Network (AON). This network would dedicate a strand of fiber from the hub location to each premises. This type of network is not recommended because more fiber would need to be deployed throughout the network, increasing construction and operation costs for very little additional customer benefit.

Build Sequence

As a rule, the CUD should focus on reaching unserved areas first and then selectively and incrementally overbuilding cabled areas based on factors such as demonstrated demand (via a pre-subscription tool) and density.

The build sequence used in the feasibility study is not intended to be a definitive recommendation for the exact path the CUD should take, and the exact build sequence may also be refined during the design and engineering phase. In addition, the build sequence will likely not follow town boundaries exactly; for example, an area of unserved premises on one edge of Town X might be built while an adjoining Town Y is built, but unserved premises on the other side of Town X might be built in a later year.

The following is an approximation of the build sequence based on building unserved towns first (Phase I), followed by building unserved areas in the partially cabled towns (Phase II) by overbuilding as little cable as possible to reach the unserved areas, and then lastly selectively overbuilding the higher-density, already cabled areas of the CUD that remain (Phase III), which could include fully cabled towns or the cabled areas of partly cabled towns that were partially built in a previous year.

In Phase II, it is estimated that 20% of the cabled miles in a given partially cabled town will need to be overbuilt to reach unserved areas; the CUD will likely lure some customers away from cable during this phase and gain better insight into expected take-rates for phase III. The project team does not recommend overbuilding areas served by VTel fiber.

Town	Phase	Year Built	Miles built	Cumulative Miles Built by Year
Benson	Phase I	2	58	58
Sudbury	Phase I	2	32	90
West Haven	Phase I	2	38	128
Goshen	Phase I	2	17	145
Hubbardton	Phase II	2	34	179
Brandon	Phase II	2	33	212
Chittenden	Phase II	2	18	229

Mendon	Phase II	2	14	243
Poutlney	Phase II	3	34	34
Castleton	Phase II	3	37	71
Clarendon	Phase II	3	21	92
Fair Haven	Phase II	3	19	111
Ira	Phase II	3	5	116
Pittsford	Phase II	3	23	139
Shrewsbury	Phase II	3	18	157
West Rutland	Phase II	3	19	176
Hubbarton	Phase III	3	1	177
Brandon	Phase III	4	38	38
Chittenden	Phase III	4	12	50
Mendon	Phase III	5	13	13
Poutlney	Phase III	5	38	51
Castleton	Phase III	5	40	91
Clarendon	Phase III	5	43	134
Fair Haven	Phase III	6	17	17
Pittsford	Phase III	6	41	57
West Rutland	Phase III	6	18	75
Proctor	Phase III	6	15	97
Rutland City	Phase III	7	59	59
Rutland Town	Phase III	7	43	102
Wells	Phase III	7	38	140

The feasibility model demonstrates a network that overbuilds cabled areas in towns with higher density — Benson, Sudbury, West Haven, Hubbardton, Brandon, Chittenden, Mendon, Poultney, Castleton, Clarendon, Fair Haven, Pittsford, West Rutland, Proctor, Rutland City, Rutland Town, and Wells,[21] should be undertaken to some degree, however, this overbuilding need not be total across the town and should be done selectively as demand and density indicate.

The build speed will also be constrained by financial and physical considerations.

ValleyNet's experience in Vermont is that building more than 250 miles in a given year is logistically difficult due to the speed at which pole owners can perform make-ready work. This limit could perhaps increase in the future if make-ready regulations increase the speed and reliability of make-ready work by the utilities. However for the purposes of this study it is assumed that 250 miles per year is the limit to what can be built.

[21] While the CUD could overbuild cable in Wells, the CUD would only overbuild areas covered in cable, not fiber. The network is also viable without overbuilding in Wells at all, which has a lower density and so therefore may not be profitable.

If the OCCUD pursues an operational partnership with another CUD, we estimate that the utilities could complete about 400 miles per year across both regions. As more CUDs are created and require make-ready work, there is a risk of delays; this is addressed more thoroughly in the risk management portion of the feasibility study.

Further, the CUD may need to slow down or speed up the build speed due to financial constraints. For example, in our model, we project the CUD may need to slow down the build speed in year 4 for one year, until revenue bonds are secured, to maintain a healthy balance sheet. Judgements like these will need to be made each year.

Inputs Used in Financial Feasibility Calculation

The preliminary financial feasibility analysis for universal coverage has been developed with a range of inputs informed by historical data.

Again, the purpose of this work is to produce a high-level determination of the project's feasibility. Due to the similarities in demographics, density, geography, and scale between the Rutland Region and the service area of ECFiber, the project team has relied largely on historical data from the ECFiber network to determine if a similar approach could work in the Rutland Region. Construction cost assumptions are based on data from both the most recent ECFiber expansions and the ongoing build of LymeFiber in Lyme, NH. Due to COVID-related factory closures and tariffs on Chinese goods, materials costs have recently increased. Construction labor prices have also gone up, due to increased demand for skilled labor. The feasibility study incorporates these increased costs.

Revenues and expenses are based on a historically consistent take rate, ARPU, EBITDA margin (varying by size of system) and capital expenditure (varying by type of build and customer). Determining a baseline of feasibility will allow us to refine the exact business model in the subsequent grant phase.

Importantly, ECFiber's operator agreement with ValleyNet is fairly unique and is perhaps not representative of what other operators may charge. We have adjusted this expense to represent 3% of gross revenues, or $75,000, whichever is more.

The EBITDA margins are generally representative of ECFiber's margins at similar stages of development. One primary difference is the cost of backhaul — because consumer bandwidth needs have increased since ECFiber built its network, the feasibility model assumes the Otter Creek CUD will offer service tiers at 50/200/800 Mbps, which is higher than the service ECFiber currently offers of 25/100/300/800. If the selected operator requires a different structure or higher/lower percentage of revenues than 3%, the financials may need to be further adjusted.

The model uses the following key assumptions:

Penetration rates

The project team has elected to use historical data from ECFiber CUD's network to calculate penetration rates (also called take-rates) by year in our model. We have adjusted the penetration rates to reflect increased subscription due to COVID-19. COVID-19 has created a significant increase in subscriptions and service tier upgrades. While it is uncertain whether customers who requested higher service tiers will keep that service once the pandemic is over, it is safe to assume that most new customers will stay with fiber rather than reverting to their previous internet provider moving forward. Penetration rate assumptions are as follows:

	Penetration by Year	
year	cabled	uncabled
1	11.0%	22.0%
2	17.9%	35.8%
3	22.0%	44.0%
4	24.8%	49.5%

In the first year, it is assumed that construction occurs an average of mid-way through the year, leaving fewer months for people to sign up and receive service. After year 4, customers increase at 3% each year, a rate which eventually then declines as the network reaches saturation of market demand. These numbers can be enhanced by factoring in other demographic data, like median income levels by town, but are sufficient for the feasibility analysis.

For context, these assumptions would result in an overall penetration rate for the Otter Creek CUD of 30% of PSD premises in year 10 (vs. ECFiber's current penetration rate is at 30%, 9 years after starting operations). Because of the surge in subscriptions since March, ECFiber has enough demand (assuming 85% of pre-subscribers become customers) to reach 42% penetration in areas without cable or fiber competition in the next 12-18 months.

The ECFiber footprint has slightly higher income than the Rutland Region. According to 2018 American Community Survey data, the median household income of ECFiber member towns was $66,500 while households in the Rutland Region had a median income of $55,000. However, findings from a statistical analysis conducted by ValleyNet suggest that years in service has a stronger association with penetration rates than that of median household incomes. Penetration rates in ECFiber towns also varied significantly based on other factors — most particularly in whether the town ran a pre-subscription campaign and whether there were one or more local/neighborhood champions supporting the project.

Average Revenue Per User (ARPU)

It may seem that a survey is a good tool to determine what users would be willing to pay for a service. This type of survey — called a "willingness to pay" survey, is notoriously hard to execute and hard to obtain significant results. Typically, when surveys ask in the abstract about what customers would pay for service or what they deem is fair, customers respond with a lower than what they might truly pay. It is much easier to volunteer a number in theory than open your wallet and pay in reality. In the broader field of economic and market research, economists and researchers hesitate to use willingness to pay survey answers in analyses.

As such, in order to estimate the Average Revenue per User, we took historical ECFiber data and incorporated a cushion. ECFiber's service tiers start at $72/month for the Basic tier and increase at higher speeds. 46% of customers choose a plan faster than Basic's 25/25 Mbps speeds, which means that actual average revenue per customer, including people who subscribe to phone service (>60% take phone service for $25 per month), business service, and higher tiers of residential service, is $110/month. The feasibility study conservatively uses a starting ARPU of $105 per month — approximately 5% less than ECFiber's actual ARPU. APRU declines slightly over time as the proportion of customers subscribing to a phone service decreases.

Revenue, Expense, Capital Expenditure, and Financing Assumptions:

A. **REVENUE**
   a. Penetration
      i. Based on years of service and status of mileage (served or unserved)
   b. ARPU/Pricing — "Double Play" Product Offering — Internet and Phone (No video packages) — resulting in a starting Average Revenue per User of $105/month with:
      i. Internet speed — 3+ tiers
      ii. Phone service — includes all features and unlimited long distance
      iii. Mix of Residential/business Customers (90%+ residential)
      iv. Business customer rates (higher to account for higher service expectations)
      v. Installation fees — assumed $99 for aerial installation (or underground with usable conduit) less than 400 ft;, increased in model to $200 for Independent CUD scenario

ECFiber Service Tiers and Rates

	***** 2019 AND PRIOR ******				****** SINCE 2/1/20 *****			
	RESIDENTIAL		*BUSINESS*		*RESIDENTIAL*		*BUSINESS*	
	Mbps	Price	Mbps	Price	Mbps	Price	Mbps	Price
Basic Internet	25	$74	25	$80	25	$72	30	$90
Standard	50	$99	50	$109	100	$104	100	$124
Ultra	200	$124	200	$134	300	$134	300	$159

Wicked	700	$149	700	$207	800	$164	800	$250
Phone		$20		$30		$25		$35
incl. unlimited Long Distance Calling and all features								
Voicemail		$3		$3	Included with Phone Service			
Static IP Address		N/A		$7		N/A		$7

These rates resulted in an average revenue per customer per month of $110 for ECFiber in Q1/2020 – excluding installation revenue.

B. **EXPENSE*** — Average operating expenses based on ECFiber experience, including:
   a. Phone service — $7-9 per customer per mo
   b. Internet backhaul — based on traffic volume
   c. Pole Rental — ~$10 per pole per year - recently reduced from $15
   d. Personnel/Benefits
      i. Outside Plant — partially capitalized
      ii. Installation — partially capitalized
      iii. Customer service
      iv. Administration and Finance
      v. Technical
   e. Other Expenses
      i. Rent
      ii. Insurance
      iii. Regulatory
      iv. Legal
      v. Network maintenance — contracted
      vi. Other — utilities, supplies, vehicle maintenance, bad debt
      vii. Operator “profit” assumed at 3% of gross revenues or $75,000 a year, whichever is less

*Actual expenses in early years could vary greatly depending on the extent of an operator’s existing operations and the terms of the contract between the CUD and the operator — these assumptions will need to be solidified in a more formal business plan.

C. Capital Expenditures — Assumptions based on the ECFiber experience, including:
   a. Pole Data Collection/FTTP Design and Engineering Costs
      i. $1,300 per mile
   b. Pole Make-Ready (unserved and cabled areas)
      i. $5,000 per mile in unserved areas, $15,000 in cabled areas
   c. Electronics/Hubs
      i. “Calix” brand equipment assumed
      ii. Hub sites — one per town
      iii. Main Routers (2 to start)

iv. Laser transceivers/networking electronics at hubs
v. Customer Premise Equipment — $300 per customer included in the Drop and Installation Costs.

d. Capital Construction/Splicing Costs — including capitalized labor and replacement costs

Capital Expenditures a+b+c+d average $28,000 per mile in unserved areas and $38,000 in cabled areas

e. Drop and Installation Costs — including capitalized labor
   i. Approx. $1400 per customer
   ii. Drop — connecting/splicing from road to premise
   iii. Installation Costs — CPE, In-home wiring and customer education

D. Financing Terms for VEDA loans, subordinated debt and (non-recourse) revenue bonds

	Interest Rate	Term	Seniority
VEDA Loans	4%	5 yrs	Senior
Subordinated Debt	8-9%	N/A	Junior
Revenue Bonds	5-6%	23-28 yrs	Senior*

*assumes VEDA loans paid down by first Revenue Bond offering

Sources of Financing

For the purpose of this feasibility study, three primary sources of financing were considered:

1) Vermont Economic Development Authority (VEDA) loans to CUDs as recently authorized by the Vermont legislature.
   a) $4M per CUD with 10% match requirement
   b) 5 year term, interest rate assumed to be 4%, assumed balloon repayment
   c) Interest payments can be deferred for up to two years
2) Subordinated Debt raised from private investors
   a) High interest rate — accrued, not cash pay (8% assumed), junior to both VEDA loan and revenue bonds (below)
   b) Replaced by lower interest revenue bonds when possible
3) Municipal Revenue Bonds — ECFiber has issued $42M of these bonds from 2016-2019
   a) Non-recourse to the CUD/towns, investors have recourse ONLY to revenues of the system in case of default
   b) 6% interest rate, declining to 5% — lower rate for later tranches (lower risk)
   c) 3 years interest only
   d) 23-28 year maturity

Other financing sources that could be available in the near future, and can be evaluated in the Business Plan phase should that occur:

1) State Grants
    a) Connectivity Initiative
    b) New COVID-19 recovery plans
2) Unused, Available (Dark) Fiber
    a) If Vermont could provide dark fiber along major routes with local distribution access points (similar to that built by the Vermont Telecommunications Authority) that would be helpful for both middle mile and local distribution — unfortunately, Vermont does not own fiber with local distribution access points in Rutland county.[22]

Financing sources not currently viable for this project:

3) USDA Rural Utility Service (RUS) Loans
    a) 20 year with 2-3% interest — requires a lot of compliance work to meet federal standards for expenditures/etc.
    b) Currently not allowed because the USDA considers VT "covered" by previous loans/grants for VTel Wireless "canopy."
4) FCC Rural Digital Opportunity Fund (RDOF) Reverse Auction
    a) This program provides support to broadband carriers to build unserved areas in a reverse auction format, where winning bidders promise to deliver broadband and voice services at the lowest cost
    b) CUDs aligned with qualified partners may benefit from this auction;

Financial Feasibility Findings

There are three critical thresholds in the trajectory of the network's finances important to consider when determining the project's feasibility.

First, the network must become EBITDA (Earnings Before Interest Taxes Depreciation and Amortization) positive. It is the Public Service Department's strong desire that this occur within 3 years after the start of deployment for the network to be considered feasible. For reference, in ECFiber's experience, this occured as the network reached approximately 1,000 customers (5 years in service).

[22] https://publicservice.vermont.gov/content/map-fiber-owned-department-public-service

Second, it is important to calculate when the network can maintain revenue bond debt service covenants of 1.25X EBITDA. This threshold is the point at which revenue bonds can be raised to pay back startup loans/subordinated debt and fund the full expansion of the network.

Third, the overall health of the project can be assessed by comparing the entire project's Internal Rate of Return (IRR) to the cost of capital. The IRR must clearly exceed the cost of capital for the project to be viable.

To understand when the network would reach the thresholds listed above, the project team calculated the trajectory of the network under two scenarios:

- Scenario 1: OCCUD operates independently
- Scenario 2: OCCUD creates an operational partnership with the Maple Broadband CUD (Addison) or Catamount Fiber (Southern Vermont)

In both scenarios, the project team needed to rely on the use of subordinated debt to enable the network to expand faster than the VEDA loan alone would allow. **10 year comparison projections for both scenarios can be found in Appendix A.**

Scenario 1: Otter Creek CUD operates independently

In this scenario, the project team found that:

- CUD reaches 1,000 customers in year 3 and 5,000 customers in year 7.
- Viability is contingent upon CUD being able to achieve a take-rate of 22% in cabled areas (after 4 years of service in that area) with starting ARPU of $105.
- **$17.1M** of subordinated debt is required in years 1-4 to accelerate the build to quickly reach enough customers to cover operating margins.
- EBITDA positive result occurs in year 3.
- OCCUD reaches the necessary 1.25x EBITDA margin in year 5, allowing the CUD to access out revenue bonds.
- **The CUD will have an Internal Rate of Return of about 5.05%. This is higher than the cost of capital, which is about 5%, meaning the CUD could be financially sustainable.**

Scenario 2: Otter Creek CUD creates an operational partnership

The project team modeled one scenario in which Otter Creek CUD partnered with Maple Broadband CUD (Addison Region CUD), and another with Catamount Fiber CUD (Southern VT/Bennington Region CUD).

The Addison partnership would include all towns in the Addison Region, as well as most towns in the Rutland Region (excluding towns covered by VTel's FTTP network). The Addison CUD would be well suited to partner with Otter Creek CUD considering Otter Creek's first towns and the Rutland Region's most unserved towns are adjacent to the Addison Region. Furthermore, the driving distance across the two regions is not so great as to hinder timely customer service.

In this scenario, the network can reach sufficient scale without overbuilding all cabled areas. The CUD is advised to make overbuilding decisions on a case-by-case basis, evaluating factors such as density and demonstrated demand. In addition to overbuilding the cabled areas in the Rutland Region listed in the Build Sequence, several cabled towns in the Addison region will be overbuilt.

Modeling an operational partnership with the Addison CUD, the project team found that:

- Operator reaches 1,000 customers in year 3 and 5,000 customers in year 5.
- A take rate of 22% in cabled areas (after 4 years of service in that area) is assumed with a starting APRU of $105; viability is significantly less dependent on overbuilding cabled areas.
- EBITDA positive result occurs in year 3.
- The operator will reach 1.25X EBITDA coverage by year 5, allowing them to access revenue bonds to continue construction.
- $30 M of subordinated debt is required in years 1-4 to achieve sufficient early construction.
- **The operator would have an IRR of 5.6% This is higher than the cost of capital, and thus is financially sustainable.**

The scenario in which Otter Creek partners with the Catamount Fiber CUD (Southern Vermont CUD) could also work, under the following conditions:

1) The RDOF winner in the Bennington Region is either a lesser technology (e.g., a wireless solution), or the RDOF winner elects to build cable and would be willing to be a partner to both Otter Creek and Catamount Fiber.
2) The CUD is highly strategic with where they build, prioritizing underserved areas first and then the densest cabled areas second.

Though relying on overbuilding cabled areas does introduce risk in that the cable provider may drop prices, this risk is true of the scenario in which Otter Creek operates alone, and overall, it is likely that Otter Creek and Catamount Fiber together would provide a safer route than Otter Creek alone.

Further, investments in fiber by the incumbent in the region should also be closely monitored. Should the incumbent begin building fiber in the densest cabled areas of the region, this would greatly impact the viability of the network.

Modeling an operational partnership with the Catamount Fiber CUD under the optimal conditions described above, the project team found that;

- Operator reaches 1,000 customers in year 3 and 5,000 customers in year 5.
- A take rate of 22% in cabled areas (after 4 years of service in that area) is assumed with a starting APRU of $105;
- EBITDA positive result occurs in year 3.
- The operator is projected to achieve 1.25X EBITDA coverage by year 5, allowing them to access revenue bonds to continue construction.
- $35 M of subordinated debt is required in years 1-4 to achieve sufficient early construction.
- **The operator would have an IRR of 6.8% This is higher than the cost of capital, and thus is financially sustainable.**
- Note: This scenario is heavily dependent on overbuilding cabled areas, and as such, should be considered risky while incumbent plans and RDOF results are unknown

Appendix A demonstrates a comparison of the independent scenario vs operational partnership scenarios with Maple Broadband CUD in Addison, and the Catamount Fiber CUD in Bennington, for the next 10 years.

This model assumes an operational partnership, where both CUDs receive a VEDA loan. The network would also be viable as a merged CUD with one VEDA loan; the CUD would need to take out more subordinated debt. Because the operator is shared, we will refer in some cases below to thresholds the operator will achieve, not just that the CUD will achieve.

To be clear, these hypothetical partnerships have not been agreed upon by any parties, although all CUDs mentioned have indicated they are open to discussing potential partnerships.

Factors the could improve the viability determination

The broadband landscape is rapidly changing. While many potential developments represent risks to the project (and are discussed thoroughly in the “Project Risk” section), there are developments that could improve the financial outlook of the Otter Creek CUD.

- The VEDA loan program may expand to provide bigger loans, or more favorable loans, to each CUD.
- The state may make additional grants available, perhaps using COVID-related stimulus funds if a new stimulus is approved or states are given an extension to use previous funds
- Build costs may decrease as factories closed due to COVID-19 start to re-open and fiber supply increases, or tariffs on relevant materials are removed
- The RDOF winner may be willing to partner with the OCCUD and share RDOF funds.

- RUS loans, which are not currently available in much of Vermont, may become available for unserved areas at a 3% interest rate. (That being said, RUS loans and revenue bonds each must be senior, meaning RUS loans still may not be a viable option.)

Project Risks

Any project of this scale involves risks that need to be evaluated and prepared for constantly. The biggest risks are as follows.

RDOF Auction

A major source of uncertainty in this project is the upcoming Rural Opportunity Digital Fund reverse auction. In this auction, the FCC will disburse up to $20.4 billion to telecommunications carriers to subsidize broadband deployment in underserved areas, including a range of areas in the Rutland Region. Census blocks where no locations are served are eligible for RDOF funding; about 18% of unserved locations in the Rutland Region are eligible for RDOF funding.

Unfortunately, CUDs or even the state of Vermont have no control over who receives this federal money, so the RDOF auction may result in the expansion of a provider into the area that goes counter to the CUD's intentions for providing universal fiber coverage. Depending on the winning provider and the census blocks included in the subsidy, this could necessitate a drastic change in the CUD's build sequence, strategy, business plan, and could even change the feasibility outlook entirely. Alternatively, the recipient of the money could make a willing and advantageous partner to the CUD; such an outcome could be welcome and make the project more feasible.

Potential outcomes include:

- An incumbent telephone provider wins the bid with a VDSL product on their existing copper assets. Although this will increase competition in the region, it is unlikely to change the Otter Creek CUD's approach or feasibility outlook, as VDSL does not offer the same level quality and capacity as fiber.
- The RDOF winner (e.g. incumbent telephone provider, private network company) serves RDOF locations with a FTTP network and *partners* with the CUD to build remaining areas. This public-private partnership would be able to access state resources such as the VEDA loan. Such a partnership may change the build sequence slightly in order to prioritize serving RDOF locations, but could be a favorable outcome nonetheless.
- The RDOF winner serves RDOF premises with a FTTP network and is not interested in partnering with the CUD. RDOF locations would now be "served," changing the CUD business plan to build them later in the process or not at all. This scenario represents the greatest risk to an independently operating CUD. In this scenario, the IRR drops to about 4.8% and the CUD would likely need to form an operational partnership with another CUD. However, the project team believes this scenario is unlikely because any RDOF winner could more easily meet their coverage requirements by partnering with

the CUDs, so the project team maintains hope that this RDOF outcome is one of the least likely.

In the "worst case scenario," where RDOF premises are served by coaxial cable or fiber, we found that **a network consisting of towns in both Rutland and Addison is likely feasible.** The CUDs would have less room for error in this scenario though, as the internal rate of return is lower at 5.0%. A combined network will be more resilient to risks such as an adverse RDOF outcome or robust competition by cable companies in cabled areas.

Competitive Response

Significant portions — about 90%— of the Rutland Region already have access to cable or fiber internet. While the CUD is not recommended to overbuild towns covered by VTel fiber, the CUD will need to overbuild some areas with cable internet in order to serve everyone and to reach a critical mass of customers. Incumbent cable providers may respond by dropping prices, which would affect the CUDs take-rate. In some areas in smaller Vermont towns, cable providers have not changed their prices in response to a new wired service provider, but in other areas, such as Burlington, cable companies have dropped prices significantly to try to compete for customers. Such uncertainty may also make it more difficult to secure subordinated debt, as lenders are more inclined to support networks in mostly uncabled areas. Merging or partnering with a CUD that has more uncabled areas, such as the Addison CUD, can mitigate this risk.

Also in this category of risk include potential competitive fiber build-outs by the incumbent telephone provider. The incumbent can often deploy fiber with lower construction costs due to their existing infrastructure and/or pole attachments. Though they are unlikely to build to the most remote areas without significant subsidy, there is a real chance that they could target some of the densest areas, which could seriously impact the CUD's viability and plans.

Construction Cost Inflation

Construction costs have already increased significantly due to factory closures and tariffs — a fact which is incorporated into this study. It is possible that construction costs increase more in the coming months. If the limited number of fiber broadband construction firms are suddenly in demand all around the country the construction and deployment costs could grow exorbitantly due to the increased demand for these services. (This was the case in 2012 with the American Recovery and Reinvestment Act broadband projects. Lead time for the delivery of optical fiber went from 4-6 weeks to 4-6 months in a very short period of time and the price also escalated reflecting that demand).

At this point, the CUD should continue to project that the price of construction and materials will stay at its current levels (rather than assuming costs will come down as factories return to normal production). There is no way to know if and when costs will decrease.

To account for higher construction costs, the CUD should stay alert for different sources of capital that could give the CUD more of a cushion. With infrastructure — and in particular broadband infrastructure — being discussed as a priority for COVID-19 recovery, there is a chance that greater resources might be available to fiber broadband projects across the country in the fall or beyond. There is also a chance that CUDs will be able to access low interest USDA RUS loans in the future, which would partially mitigate the effects of increased construction costs.

Make-Ready or Construction Delays

Any delay in deploying fiber in any portion of a planned build (either due to pole make-ready delays or construction capacity constraints — see above) can sometimes delay service on many other miles of completed network. With CUDs forming all at once across the state and needing the same work and services performed, including pole data collection, make-ready work, construction, and more, this could cause a shortage of qualified labor and/or delay in completion of work.

In 2019, the governor of Vermont signed HB 513 into law, which in addition to creating the BIG Grant and the VEDA broadband loans, also included a provision to facilitate the make-ready process. The new regulation states that if make-ready work is not completed on-schedule, after 30 days the pole owner must refund payment for uncompleted work, and the network constructor can hire a qualified contractor to complete the remaining make-ready work. Hopefully this new regulation will reduce delays.

Even if everything proceeds according to schedule, there is a limit to the amount of make-ready work that can be completed in a given year. GMP owns most poles in the region, and with several CUDs begining broadband deployment at the same time, GMP may be unable to keep up with make-ready requests. ValleyNet has had discussions with both GMP and the Department of Public Service, who are aware of the situation; GMP believes it has sufficient crews to handle multiple new Districts.

The only surefire solution to this involves state policymakers providing funding or incentives to support make-ready work. This involves both support to increase GMP's capacity and potentially support to increase the local capacity of private construction and technician groups like Eustis Cable via Vermont Training Grants or other programs. The Otter Creek CUD should take every opportunity to inform legislators of this risk and keep the Department of Public Service appraised of make-ready progress.

Failed Execution

The operating company selected to run the network could fail to adequately control the construction and operation of the network. Failure could be due to any number of reasons — mismanagement, overextension, continuing broader economic shock or recession, or other — but the results would be damaging. Though the contract between the CUD should be written in a way to protect the CUD and the deployed fiber asset and give the CUD the option of finding a new operating partner, such an event would delay and disrupt service and erode trust between the towns and the CUD, and between the customers and the CUD.

Take Rate Variability

Due to the current unemployment and economic slowdown, which may or may not last until fiber starts to be deployed, historical penetration data is not as robust. The penetration data used in this study is based on mid-pandemic numbers, which could continue to increase even into the recovery phase, or could subside to previous levels. A pre-subscription campaign will be a clearer indicator of projected take-rates and encourage financial investment in the network.

Additionally, determining the take-rate for cabled areas is even harder because the cable provider may respond by dropping their prices, or they may not. Unfortunately, it is difficult to predict exactly how competitors will behave. The best way to mitigate this risk is to operate jointly with another, less cabled CUD.

Conclusion of Financial Feasibility Analysis

Ultimately, we find that an independent OCCUD is feasible under current conditions. This study strongly recommends that the CUD consider an operational partnership or merger with another CUD, which will strengthen the financial position of the network and mitigate potential risks.

These risks are not insignificant; however, the RDOF auction will be complete in the early stages of the business planning phase, which is ideal timing for the business plan to incorporate the results into the CUD's strategy.

Pre-Subscription Campaign

In addition to prioritizing unserved areas first, and to choosing a compatible operator, a third key tactic to increase the network's viability is to use a pre-subscription campaign. A pre-subscription campaign collects subscription information from people who desire service (including choosing Internet speeds and phone service and acknowledging pricing), and does not require a deposit or any guarantee beyond a digital signature.

Pre-subscription campaigns allow a provider to understand where there is the most interest, which can inform where to build first (within technical feasibility). More importantly, it also allows the fiber build crews to hook up houses as they pass them rather than needing to make a second trip to a location, thereby saving time and money. And finally, all sources of financing will appreciate seeing significant pre-subscription numbers (as opposed to theoretical survey results); strong numbers will make it easier to secure loans and grants.

In ECFiber's experience, 85% of pre-subscriptions become paying customers, with the remainder realizing that their long driveway requires additional connection fees for conduit installation, or moving, or signing a long term contract with another operator. ECFiber was able to achieve higher rates of penetration in areas that ran an intensive pre-subscription campaign

— although these results were also influenced by town demographics and dedicated town leadership.

Based on ECFiber's experience, both the pre-subscription campaign and the issuance of subordinated debt (primarily with local investors because VT residents can take full advantage of the double tax free nature of the interest) would serve to make the issuance of revenue bonds more achievable. This is because outside investors view both robust pre-subscription totals and local debt issuance as demonstration of community commitment.

To achieve the maximum impact of the pre-subscription campaign, it should be enacted after the Business Plan (phase 2 of the BIG grant process) is complete.

Third Party Opinion

Municipal Capital Markets, a nationwide financier of a variety of infrastructure, community, and municipal projects including broadband, has reviewed this work, believes our assumptions are credible, and has issued a letter to that effect, which includes a desire to work with the CUD when they are ready to issue revenue bonds. The letter can be found in Appendix C.

Conclusion

The project team believes this document is accurate and credible and represents our best judgement as to the feasibility of a Fiber-to-the-Premise network in the Rutland Region. While a network in the Rutland Region is feasible, we advise the OCCUD to either consider either merging or form an operating partnership with a neighboring CUD in order to decrease the risk of the project. Merging or partnering with another CUD would mean the project can better overcome challenges such as a competitive response from an incumbent cable provider or an unfavorable RDOF outcome.

RISI and ValleyNet want to stress that even when pursued in coordination with a neighboring CUD, this project will continue to require great effort on the part of CUD leadership, a responsiveness to continued changes in our country's economic, political, and public health landscape, successful fundraising, finding the right operator partner, and ongoing attention to minimizing costs.

At this juncture, the project team recommends that the OCCUD focuses on adding towns in the Rutland Region and exploring a partnership or merger with a neighboring CUD. This is not an easy time to be building a new fiber network from the ground up. The volatility of the economic and political landscape, as well as the ongoing pandemic, do not make this an easy task. The project team is committed to helping OCCUD keep their head on a swivel and adjust mid-course as new information becomes available. The OCCUD has built a capable and responsive team, and we look forward to continuing with the CUD as they plan and eventually govern a fiber network in the region.

Appendix A: Comparison INDEPENDENT v PARTNERSHIPS

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Miles	INDEPENDENT		243	421	471	605	702	878	878	878	878
	PARTNER W/ ADDISON		354	654	922	1,177	1,424	1,756	1,756	1,756	1,756
	PARTNER W/ SoVT		336	609	931	1231	1532	1532	1532	1532	1532
Passings	INDEPENDENT		2,854	5,385	7,203	11,476	14,898	23,825	23,825	23,825	23,825
	PARTNER W/ ADDISON		3,646	7,925	11,667	16,635	24,355	39,816	39,816	39,816	39,816
	PARTNER W/ SoVT		4172	8214	16596	28147	41567	41567	41567	41567	41567
New Miles	INDEPENDENT		243	177	50	134	97	176	0	0	0
	PARTNER W/ ADDISON		354	300	268	255	247	332	0	0	0
	PARTNER W/ SoVT		336	273	322	300	301	0	0	0	0
Customers	INDEPENDENT		564	1,271	1,905	2,774	3,647	5,159	6,113	6,690	7,078
	PARTNER W/ ADDISON		784	2,137	3,581	5,112	6,853	9,592	11,292	12,349	13,043
	PARTNER W/ SoVT		830	1970	3629	5940	8788	10530	11571	12199	12565
New Customers	INDEPENDENT		564	707	634	869	873	1,512	954	577	388
	PARTNER W/ ADDISON		784	1,353	1,444	1,531	1,741	2,739	1,700	1,057	694
	PARTNER W/ SoVT		830	1,140	1,659	2,311	2,848	1,742	1,041	628	366
Customers Per Mile	INDEPENDENT		2.3	3.0	4.0	4.6	5.2	5.9	7.0	7.6	8.1
	PARTNER W/ ADDISON		2.2	3.3	3.9	4.3	4.8	5.5	6.4	7.0	7.4
	PARTNER W/ SoVT		2.5	3.2	3.9	4.8	5.7	6.9	7.6	8.0	8.2
Penetration	INDEPENDENT		20%	24%	26%	24%	24%	22%	26%	28%	30%
	PARTNER W/ ADDISON		22%	27%	31%	31%	28%	24%	28%	31%	33%
	PARTNER W/ SoVT		20%	24%	22%	21%	21%	25%	28%	29%	30%
EXPENSES	INDEPENDENT	(250)	(628)	(1,153)	(1,666)	(2,115)	(2,495)	(3,052)	(3,515)	(3,833)	(4,005)
	PARTNER W/ ADDISON	(250)	(697)	(1,835)	(3,047)	(3,919)	(4,663)	(5,690)	(6,506)	(7,077)	(7,385)
	PARTNER W/ SoVT	(270.00)	(843.59)	(1,876.82)	(2,697.06)	(3,818.86)	(5,162.27)	(6,909.30)	(7,627.73)	(6,957.09)	(7,018.62)
EBITDA	INDEPENDENT	(250)	(450)	-	450	980	1,676	2,716	3,650	4,180	4,540
	PARTNER W/ ADDISON	(250)	(450)	-	823	1,815	3,133	5,064	6,756	7,718	8,371
	PARTNER W/ SoVT	(270.00)	(500.00)	-	994.80	2,438.83	4,398.21	5,433.18	6,398.59	8,080.18	8,619.28
Debt	INDEPENDENT	2,496	12,096	18,683	24,394	32,823	40,268	47,486	48,814	49,296	48,486
	PARTNER W/ ADDISON	2,940	16,143	29,215	42,792	58,318	73,871	86,800	88,964	87,647	86,119
	PARTNER W/ SoVT	4,540	16,186	31,536	51,502	71,915	87,484	93,910	93,992	92,948	91,151
Sub Debt incl accrued	INDEPENDENT	1,296	8,096	14,683	20,394	19,823	19,268	12,486	4,045		
	PARTNER W/ ADDISON	540	8,143	21,215	34,792	33,818	32,871	21,300	6,901		
	PARTNER W/ SoVT	540	8,186	23,536	43,502	43,415	40,984	25,410			
Debt Service Coverage	INDEPENDENT	-	-	-	-	1.37	1.50	1.50	1.59	1.46	1.49
	PARTNER W/ ADDISON	-	-	-	-	1.35	1.44	1.49	1.6	1.51	1.52
	PARTNER W/ SoVT	-	-	-	-	1.43	1.63	1.43	1.26	1.41	1.4

Appendix B:
Independent CUD Scenario

			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
Miles				243	421	471	605	702	878	878	878	878	878	878	878	878	878	
Passings				2,854	5,385	7,203	11,476	14,898	23,825	23,825	23,825	23,825	23,825	23,825	23,825	23,825	23,825	
Customers			**-**	**564**	**1,271**	**1,905**	**2,774**	**3,647**	**5,159**	**6,113**	**6,690**	**7,078**	**7,291**	**7,510**	**7,735**	**7,967**	**8,206**	
average				282	918	1,588	2,340	3,211	4,403	5,636	6,402	6,884	7,185	7,401	7,623	7,851	8,087	
per mile				2.3	3.0	4.0	4.6	5.2	5.9	7.0	7.6	8.1	8.3	8.5	8.8	9.1	9.3	
penetration				20%	24%	26%	24%	24%	22%	26%	28%	30%	31%	32%	32%	33%	34%	
ARPU		$ 105		$105.00	$104.69	$104.37	$104.06	$103.75	$103.43	$103.12	$102.81	$102.51	$102.20	$101.89	$101.59	$101.28	$100.98	
($000s)						$ 104												
Revenue				**290**	**1,294**	**2,116**	**3,095**	**4,172**	**5,767**	**7,165**	**8,013**	**8,545**	**8,854**	**9,092**	**9,337**	**9,588**	**9,846**	
Service revenue				178	1,153	1,989	2,921	3,997	5,465	6,974	7,898	8,468	8,811	9,049	9,292	9,542	9,799	
Installation revenue		$ 200		113	141	127	174	175	302	191	115	78	43	44	45	46	48	
Expenses			(250)	(628)	(1,153)	(1,666)	(2,115)	(2,495)	(3,052)	(3,515)	(3,833)	(4,005)	(4,120)	(4,220)	(4,329)	(4,439)	(4,568)	
EBITDA			**(250)**	**(450)**	**-**	**450**	**980**	**1,676**	**2,716**	**3,650**	**4,180**	**4,540**	**4,733**	**4,873**	**5,008**	**5,150**	**5,279**	
EBITDA Margin					*0%*	*21%*	*32%*	*40%*	*47%*	*51%*	*52%*	*53%*	*53%*	*54%*	*54%*	*54%*	*54%*	
Interest VEDA			(48)	(160)	(160)	(160)	-	-	-	-	-	-	-	-	-	-	-	
Interest Rev Bonds			-	-	-	-	(715)	(1,115)	(1,815)	(2,302)	(2,527)	(2,485)	(2,426)	(2,355)	(2,278)	(2,195)	(2,107)	
Principal VEDA			1,200	2,800			(4,000)	-	-	-	-	-						
Principal Rev Bonds			-	-	-	-	12,220	7,520	13,160	9,168	4,227	(809)	(1,136)	(1,378)	(1,506)	(1,611)	(1,713)	
Principal Sub Debt - less 3% issuance			1,164	6,014	5,335	4,074	(2,039)	(1,982)	(7,707)	(8,740)	(4,045)	-	-	-	-	-	-	
Capex			(1,822)	(8,063)	(5,942)	(4,403)	(5,973)	(6,404)	(6,343)	(1,725)	(1,237)	(1,015)	(817)	(877)	(943)	(1,015)	(1,094)	
FCF/IRR		*5.05%*	*(2,072)*	*(8,513)*	*(5,942)*	*(3,953)*	*(4,994)*	*(4,728)*	*(3,627)*	*1,925*	*2,944*	*3,525*	*3,916*	*3,996*	*4,065*	*4,134*	*4,184*	*26,392.66*
Cash Flow			244	141	(767)	(39)	472	(305)	11	51	599	232	355	264	282	329	366	
Cash Balance			**244**	**385**	**(382)**	**(422)**	**51**	**(254)**	**(244)**	**(192)**	**407**	**639**	**993**	**1,257**	**1,539**	**1,868**	**2,234**	
rev bond issuance							13,000	8,000	14,000	10,000	5,000							
FINANCINGS																		
VEDA Total	principal		1,200	2,800			(4,000)	-	-	-	-	-						
balloon at end of yr 4	interest		(48)	(160)	(160)	(160)	-	-	-	-	-	-						
	balance		1,200	4,000	4,000	4,000												
Rev Bond Total																		
3 yrs interest only	principal		-	-	-		13,000	8,000	14,000	9,768	4,527	(809)	(1,136)	(1,378)	(1,506)	(1,611)	(1,713)	
less Debt Svc Reserve Fund (3%) and issuance (3%)					-	-	(780)	(480)	(840)	(600)	(300)	-	-	-	-	-	-	
	interest		-	-	-	-	(715)	(1,115)	(1,815)	(2,302)	(2,527)	(2,485)	(2,426)	(2,355)	(2,278)	(2,195)	(2,107)	
	balance		-	-	-	-	13,000	21,000	35,000	44,768	49,296	48,486	47,350	45,972	44,466	42,855	41,142	
Subordinated Debt																		
	principal		1,200	6,200	5,500	4,200	(2,039)	(1,982)	(7,707)	(8,740)	(4,045)							
	balance		1,296	8,096	14,683	20,394	19,823	19,268	12,486	4,045								
Total Debt			**2,496**	**12,096**	**18,683**	**24,394**	**32,823**	**40,268**	**47,486**	**48,814**	**49,296**	**48,486**	**47,350**	**45,972**	**44,466**	**42,855**	**41,142**	
Debt Service Rev Bonds					**-**	**-**	**(715)**	**(1,115)**	**(1,815)**	**(2,302)**	**(2,857)**	**(3,044)**	**(3,384)**	**(3,643)**	**(3,784)**	**(3,806)**	**(3,819)**	
EBITDA Coverage	**must be > 1.25X**						**1.37**	**1.50**	**1.50**	**1.59**	**1.46**	**1.49**	**1.40**	**1.34**	**1.32**	**1.35**	**1.38**	

Appendix B:
Partnership with Addison CUD

		2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	
Miles			354	654	922	1,177	1,424	1,756	1,756	1,756	1,756	1,756	1,756	1,756	1,756	1,756	
Passings			3,646	7,925	11,667	16,635	24,355	39,816	39,816	39,816	39,816	39,816	39,816	39,816	39,816	39,816	
Customers		**-**	**784**	**2,137**	**3,581**	**5,112**	**6,853**	**9,592**	**11,292**	**12,349**	**13,043**	**13,435**	**13,838**	**14,253**	**14,680**	**15,121**	
average			392	1,461	2,859	4,347	5,983	8,223	10,442	11,821	12,696	13,239	13,637	14,046	14,467	14,901	
per mile			2.2	3.3	3.9	4.3	4.8	5.5	6.4	7	7.4	7.6	7.9	8.1	8.4	8.6	
penetration			22%	27%	31%	31%	28%	24%	28%	31%	33%	34%	35%	36%	37%	38%	
ARPU	$105		$105.00	$104.69	$104.37	$104.06	$103.75	$103.43	$103.12	$102.81	$102.51	$102.20	$101.89	$101.59	$101.28	$100.98	
($000s)					$104												
Revenue			**404**	**2,105**	**3,870**	**5,734**	**7,796**	**10,754**	**13,262**	**14,795**	**15,756**	**16,315**	**16,754**	**17,205**	**17,668**	**18,144**	
Service revenue			247	1,835	3,581	5,427	7,448	10,206	12,922	14,584	15,617	16,236	16,673	17,122	17,582	18,055	
Installation revenue	$200		157	271	289	306	348	548	340	211	139	78	81	83	85	88	
Expenses		(250)	(697)	(1,835)	(3,047)	(3,919)	(4,663)	(5,690)	(6,506)	(7,077)	(7,385)	(7,592)	(7,775)	(7,978)	(8,179)	(8,417)	
EBITDA		**(250)**	**(450)**	**-**	**823**	**1,815**	**3,133**	**5,064**	**6,756**	**7,718**	**8,371**	**8,722**	**8,979**	**9,227**	**9,489**	**9,726**	
EBITDA Margin				*0%*	*21%*	*32%*	*40%*	*47%*	*51%*	*52%*	*53%*	*53%*	*54%*	*54%*	*54%*	*54%*	
Interest VEDA		(96)	(320)	(320)	(320)	-	-	-	-	-	-	-	-	-	-	-	
Interest Rev Bonds		-	-	-	-	(1,348)	(2,173)	(3,398)	(4,223)	(4,500)	(4,420)	(4,311)	(4,183)	(4,044)	(3,895)	(3,737)	
Principal VEDA		2,400	5,600			(8,000)	-	-	-	-	-						
Principal Rev Bonds		-	-	-	-	23,030	15,510	23,030	15,543	5,194	(1,528)	(2,100)	(2,487)	(2,704)	(2,889)	(3,070)	
Principal Sub Debt - less 3% issuance		485	6,790	11,155	10,670	(3,479)	(3,382)	(13,148)	(14,910)	(6,901)	-	-	-	-	-	-	
Capex		(2,395)	(11,303)	(11,004)	(11,150)	(12,007)	(13,377)	(11,500)	(2,770)	(1,909)	(1,443)	(1,068)	(1,135)	(1,209)	(1,288)	(1,377)	
FCF/IRR	*5.60%*	*(2,645)*	*(11,753)*	*(11,004)*	*(10,327)*	*(10,192)*	*(10,244)*	*(6,437)*	*3,986*	*5,810*	*6,928*	*7,655*	*7,844*	*8,019*	*8,201*	*8,350*	*48,632.48*
Cash Flow		144	317	(169)	23	11	(288)	48	396	(397)	981	1,244	1,174	1,272	1,417	1,544	
Cash Balance		**144**	**461**	**292**	**315**	**326**	**38**	**86**	**482**	**85**	**1,066**	**2,310**	**3,484**	**4,756**	**6,173**	**7,717**	
rev bond issuance						24,500	16,500	24,500	17,000	6,500							
FINANCINGS																	
VEDA Total	principal	2,400	5,600			(8,000)	-	-	-	-	-						
balloon at end of yr 4	interest	(96)	(320)	(320)	(320)	-	-	-	-	-	-						
	balance	2,400	8,000	8,000	8,000												
Rev Bond Total																	
3 yrs interest only	principal	-	-	-		24,500	16,500	24,500	16,563	5,584	(1,528)	(2,100)	(2,487)	(2,704)	(2,889)	(3,070)	
s Debt Svc Reserve Fund (3%) and issuance (3%)				-	-	(1,470)	(990)	(1,470)	(1,020)	(390)	-	-	-	-	-	-	
	interest	-	-	-	-	(1,348)	(2,173)	(3,398)	(4,223)	(4,500)	(4,420)	(4,311)	(4,183)	(4,044)	(3,895)	(3,737)	
	balance	-	-	-	-	24,500	41,000	65,500	82,063	87,647	86,119	84,019	81,532	78,828	75,939	72,869	
Subordinated Debt																	
	principal	500	7,000	11,500	11,000	(3,479)	(3,382)	(13,148)	(14,910)	(6,901)							
	balance	540	8,143	21,215	34,792	33,818	32,871	21,300	6,901								
Total Debt		**2,940**	**16,143**	**29,215**	**42,792**	**58,318**	**73,871**	**86,800**	**88,964**	**87,647**	**86,119**	**84,019**	**81,532**	**78,828**	**75,939**	**72,869**	
Debt Service Rev Bonds				**-**	**-**	**(1,348)**	**(2,173)**	**(3,398)**	**(4,223)**	**(5,121)**	**(5,511)**	**(6,108)**	**(6,554)**	**(6,747)**	**(6,784)**	**(6,807)**	
EBITDA Coverage	**must be > 1.25X**					**1.35**	**1.44**	**1.49**	**1.6**	**1.51**	**1.52**	**1.43**	**1.37**	**1.37**	**1.4**	**1.43**	

Appendix B:
Partnership with Bennington CUD

			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Miles				**336**	**609**	**931**	**1,231**	**1,532**	**1,532**	**1,532**	**1,532**	**1,532**	**1,532**	**1,532**	**1,532**	**1,532**	**1,532**
Passings				**4,172**	**8,214**	**16,596**	**28,147**	**41,567**	**41,567**	**41,567**	**41,567**	**41,567**	**41,567**	**41,567**	**41,567**	**41,567**	**41,567**
Customers				**830**	**1,970**	**3,629**	**5,940**	**8,788**	**10,530**	**11,571**	**12,199**	**12,565**	**12,942**	**13,330**	**13,730**	**14,142**	**14,567**
per mile				2.5	3.2	3.9	4.8	5.7	6.9	7.6	8.0	8.2	8.4	8.7	9.0	9.2	9.5
penetration				19.9%	24.0%	21.9%	21.1%	21.1%	25.3%	27.8%	29.3%	30.2%	31.1%	32.1%	33.0%	34.0%	35.0%
ARPU		$ 105		$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105	$ 105
($000s)																	
Revenue				**344**	**1,877**	**3,692**	**6,258**	**9,560**	**12,342**	**14,026**	**15,037**	**15,638**	**16,107**	**16,590**	**17,088**	**17,601**	**18,129**
	Service revenue			261	1,764	3,528	6,029	9,279	12,170	13,923	14,975	15,602	16,070	16,552	17,048	17,560	18,087
	Installation revenue	$ 99		82	113	164	229	282	172	103	62	36	37	38	40	41	42
Expenses			(270)	(844)	(1,877)	(2,697)	(3,819)	(5,162)	(6,909)	(7,628)	(6,957)	(7,019)	(7,190)	(7,368)	(7,571)	(7,792)	(8,006)
EBITDA			**(270)**	**(500)**	-	**995**	**2,439**	**4,398**	**5,433**	**6,399**	**8,080**	**8,619**	**8,917**	**9,222**	**9,517**	**9,809**	**10,123**
EBITDA Margin - est					*0%*	*27%*	*39%*	*46%*	*44%*	*46%*	*54%*	*55%*	*55%*	*56%*	*56%*	*56%*	*56%*
Interest VEDA			(200)	(400)	(400)	(400)	-	-	-	-	-	-	-	-	-	-	-
Interest Rev Bonds			-	-	-	-	(1,710)	(2,700)	(3,800)	(5,070)	(5,008)	(4,909)	(4,765)	(4,616)	(4,457)	(4,289)	(4,111)
Principal VEDA			4,000	4,000	-	-	(8,000)	-	-	-	-	-	-	-	-	-	-
Principal Rev Bonds			-	-	-	-	28,500	18,000	22,000	25,492	(1,044)	(1,797)	(2,651)	(2,737)	(2,935)	(3,100)	(3,286)
Principal Sub Debt - less 3% issuance			485	6,790	12,610	14,550	(6,525)	(8,683)	(20,492)	(25,410)	-	-	-	-	-	-	-
Capex			(2,514)	(11,315)	(12,280)	(14,531)	(14,881)	(11,028)	(2,882)	(1,944)	(1,416)	(1,102)	(1,176)	(1,257)	(1,344)	(1,440)	(1,543)
FCF/IRR		*6.8%*	*(2,784)*	*(11,815)*	*(12,280)*	*(13,536)*	*(12,442)*	*(6,630)*	*2,551*	*4,454*	*6,664*	*7,517*	*7,741*	*7,965*	*8,173*	*8,369*	*8,579*
Cash Flow			1,501	(1,425)	(70)	614	(178)	(13)	259	(533)	611	812	324	611	780	980	1,182
Cash Balance			**1,501**	**76**	**5**	**619**	**441**	**429**	**688**	**155**	**766**	**1,578**	**1,902**	**2,514**	**3,294**	**4,274**	**5,456**
rev bond issuance							28,500	18,000	22,000	26,000							
FINANCINGS																	
VEDA Total	principal		4,000	4,000		-	(8,000)										
balloon at end of 3 yrs	interest		(200)	(400)	(400)												
	balance		4,000	8,000	8,000	8,000											
Rev Bond Total																	
3 yrs interest only	principal					-	28,500	18,000	22,000	25,492	(1,044)	(1,797)	(2,651)	(2,737)	(2,935)	(3,100)	(3,286)
less Debt Svc Reserve Fund (3%) and issuance (3%)						-	-	-	-	-	-						
	interest					-	(1,710)	(2,700)	(3,800)	(5,070)	(5,008)	(4,909)	(4,765)	(4,616)	(4,457)	(4,289)	(4,111)
	balance					-	28,500	46,500	68,500	93,992	92,948	91,151	88,499	85,762	82,827	79,727	76,440
Subordinated Debt																	
	principal		500	7,000	13,000	15,000	(6,525)	(8,683)	(20,492)								
	balance		540	8,186	23,536	43,502	43,415	40,984	25,410								
Total Debt			**4,540**	**16,186**	**31,536**	**51,502**	**71,915**	**87,484**	**93,910**	**93,992**	**92,948**	**91,151**	**88,499**	**85,762**	**82,827**	**79,727**	**76,440**
Debt Service Rev Bonds					**-**	**-**	**(1,710)**	**(2,700)**	**(3,800)**	**(5,070)**	**(5,732)**	**(6,147)**	**(6,703)**	**(6,640)**	**(6,626)**	**(6,585)**	**(6,547)**
EBITDA Coverage	**must be > 1.25X**						**1.43**	**1.63**	**1.43**	**1.26**	**1.41**	**1.40**	**1.33**	**1.39**	**1.44**	**1.49**	**1.55**

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May 12th, 2020

Stan Williams
Chief Financial Officer
Valley Net
415 Waterman Rd.
Royalton, VT 05068

RE: Letter of Interest to finance the Addison & Rutland Broadband Communication Union Districts Projects.

Dear Stan:

Municipal Capital Markets Group (MCM) has been funding the East Central Vermont Telecommunications District (ECFiber) since 2015 and look forward to continuing our financial support of building fiber infrastructure in rural Vermont. After review of the Addison and Rutland Project's Feasibility Study, MCM is interested in financing the infrastructure much like the ECFiber's network, provided that the new district can achieve what is anticipated in the Feasibility Study.

MCM believes the assumptions made in the Feasibility Study including network construction costs, penetration (adoption), average rate per user, etc. is viable and realistic to serve the rural markets in Vermont. To that end, the project satisfies MCM's main investment objectives and allows us to leverage our unique position with experience in Broadband, USDA-Rural Development, and underwriting / selling non-rated revenue bonds.

Sincerely Yours,

Christopher R. Perlitz
Managing Director
Municipal Capital Markets Group, Inc.
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Member: FINRA & SIPC

Cc: James Anderson, Mgr. Director, MCM

Appendix D: Glossary of Broadband, Telecom, and Finance Terms

1G/10G/100G	Short for 1/10/100 Gigabits per second connection speed
Accrued Interest	Interest that is not paid in cash, but ‘accrued’ and added to principal balance
Active E/EPON	Provides a direct link to each premise without splitters – more expensive to build than GPON
ADSL	a.k.a. DSL – an asymmetric Internet connection over copper with download speeds much higher than upload
ADSS fiber	All Di-electric Self Supporting fiber – does not require strand – often used in the electrical space since it is non-conductive
Aerial Drop	Drop that is all above ground on poles
ARPU	Average Revenue per Unit – a standard telecom metric measuring the average revenue derived each month from a customer
Attenuation	Measure of the loss in signal strength due to distance, splicing, bends, etc
Backhaul	Refers to an ISP’s connection from their network to the broader Internet - (In wireless networks, how data is transmitted to/from a cell site – wireless backhaul is typically insufficient to offer 1Gbps speeds – fiber backhaul is the standard for most cell sites
Balloon Repayment	The repayment of a loan or bond in one lump sum at the end of its maturity – i.e., principal not amortized over time
Bandwidth Overbooking	A practice whereby an ISP calculates the average peak usage for backhaul and buys that amount (rather than the max speed offered to each customer) – if overdone to reduce expenses, this can degrade a customer’s experience of the full speeds for which they are paying (at peak hour)
Coaxial Cabled	A road that has cable service delivering (asymmetric) Internet over coaxial cable
Capex per Customer	Varies by build cost, density and penetration rate

Capex per Passing	Capital cost required to pass – varies by build cost and density
Carrier hotel	Also called a colocation center, a carrier hotel is a physical site where networks from multiple communications providers converge and are interconnected
Conduit	Pipe or tubing through which cables can be pulled or housed – usable conduit for pulling fiber is typically 2+” in diameter and must have rounded sweeps – i.e., fiber cannot be bent at a sharp angle without a large attenuation in signal strength
Cost of Goods Sold	Variable cost of providing service – for ISPs, this includes wholesale cost of phone service, Internet backhaul, video (if offered) and sometimes pole rental
Customer	A residence or business that is receiving service
Customers per Mile	Ann alternative to Penetration Rate which takes into account the density of the network
Dark Fiber	Fiber that is in place on the poles but not “lit” by electronics at either end – allows companies to buy/lease fiber infrastructure rather than an actual connection
Debt Service Covenant	An agreement with provider of debt to maintain debt service at a certain level – ex., EBITDA must be > 1.25X Debt Service – if a covenant is breached the owner of the debt can take certain pre-negotiated steps to bring the debt into compliance or, under extreme conditions, may be able to take control of the debtor
Debt Service Coverage	A standard financial ratio measuring the ability to service interest and principal payments on debt = EBITDA / Debt Service (Interest and Principal) for a given time period (usually annually)
Density	Linear Density of an area = homes per mile of network
Dig Safe	A service provided at no charge by utilities to mark where underground plant is before a homeowner/contractor can dig (dial 811)
Distributed Splitting	32 way splitter located in the field (not the hub) – reduces fiber count
Distribution Fiber	Typically 12-24 strands used from a DSP to a FAP for local distribution
Double Play	Internet and Phone

Drop	The connection from the road to a premise
DSP/FSA	Digital Split Point (Fiber Service Area = area served by the DSP) – the point in the network where the signal is split 32 ways for final distribution
EBITDA Margin	EBITDA divided by revenue as a percentage
EBITDA	Earnings Before Interest Taxes Depreciation and Amortization – a standard financial metric for telecom systems that measures the ability to service debt and ongoing maintenance of the network
FAP	Fiber Access Point – the point at which a connection is spliced from the road (mainline network) to a premise
Fiber Count	The number of fiber strands in a given fiber cable – typically highest close to hubs and between hubs and lowest on dead end roads – a multiple of 12 (see Fiber Tube)
Fiber Strand	A single strand of fiber thinner than a human hair coated with a colored material to make it identifiable when splicing
Fiber Tube	Fiber is divided into tubes of 12 fiber strands
Fiber/Tube Colors	Each fiber strand and tube has a distinct color – strand colors are blue, orange, green, brown, slate, white, red, black, yellow, violet, rose, and aqua.
FTTH/P	Fiber to the Home or Premise – fiber goes all the way to each customer
GO Debt	General Obligation Debt – is issued by towns and supported by taxpayers – a “general obligation” of the town – VT law does not allow GO debt to be used by towns to finance telecom systems (other than for services used by the town internally)
GPON	Gigabit Passive Optical Network – requires no electronics between central hub site and premise – uses 32 way splitters – used by Verizon Fios and most FTTH providers in the US
Gross Margin	A measure of network profitability = Revenues less Cost of Goods Sold – can also be expressed as a percentage of revenue
Home Run	Network using one strand of fiber to each premise, with 32 way splitter in the hub – requires high fiber count, but allows for higher bandwidth to select locations

Hub Site	Houses transceivers to distribute and receive laser light signals for the “last mile” – typically 10-15 miles – in VT this means roughly one hub site in the center of each town
Installation	Installing the home transceiver (ONT) for the fiber network (and attaching phone where necessary)
ISP	Internet Service Provider - the entity providing Internet service
Last Mile Fiber	Fiber designed for local distribution with FAPs (a local road with access to each driveway along it)
Latency	The delay between sending a bit and receiving a response – can be very high for geo-stationary satellite connections making certain Internet capabilities (such as VPN) impossible
Light Level	the strength of a light signal at various points in the network – a certain minimum light level is needed at each customer to provide service – light levels are reduced (“attenuated”) by distance, # of splices, splice quality, bending, crimping, etc.
Lit	A network is lit once light levels have been tested and electronics are activated in the hub
Long Haul Fiber	Like Middle Mile but longer – typically used for Internet backhaul (to Boston or Albany or Portland)
Mainline Build	Fiber installed on public roads (i.e., not the drop)
Make-Ready	The process and cost of making utility poles ready to accept an ISP’s gear – this is done by utilities – the timing and cost of this can be a major factor in a new ISP’s success (or failure)
Middle Mile fiber	Fiber typically going from town to town, with no FAPs for local distribution (similar to an Interstate highway with limited exits)
Non-recourse Debt	Debt that is NOT supported by a general obligation of the town – can be secured by assets or revenues or be unsecured
ONT/CPE	Optical Network Transceiver/Consumer Premise Equipment – typically comes with a WiFi router built in
OTMR	One Touch Make-Ready – regulations whereby one (or at most two) trucks/crews are sent out to make a pole ready (rather than each attachee – phone/cable/other ISP sending their own) – does not generally apply to make-ready by electric utilities because of the

	special training and equipment needed to operate in the electrical "space"
OTT Video	Over the top video a.k.a. streaming – it is "over the top" using a basic Internet connection and not controlled by the ISP
Passing	A residence/business/E911 location that is passed by the lit network
Peak Hour	The hour of the day where Internet usage peaks – typically 9-11 PM (streaming) but changing now due to pandemic
Penetration Rate	Customers divided by Passings, a.k.a Take Rate
Pole Attachee	Any utility having equipment on a pole – typically power and phone in underserved areas, plus cable in denser areas and sometimes other fiber providers (often middle mile, not last mile)
Revenue Bonds	Bonds that are supported by the revenues from a given asset financed by the bonds – a form of non-recourse debt
Sag	The amount a cable attached to a pole sags between poles – the lowest attachee on a pole cannot "sag" closer than 16' to the ground – otherwise pole needs to be replaced with a larger pole to allow a new attachee (which is very expensive)
Slack	Extra fiber left in loops to make maintenance easier – typically ~10%
Strand	the "other" strand - The metal carrier cable to which fiber is attached between poles
Streaming	Usually refers to watching video over an Internet connection (but can also be music/audio) – Streaming requirements vary by user hardware and streaming video providers – standard SD video (480p) requires 3Mbps, HD video (720 or 1080 p) requires 5Mbps per stream, and 4K/8K video can require 25+Mbps
Subordinated Debt	Debt that has a lower rank in terms of repayment than other ("senior") debt – typically has a higher interest rate to compensate for increased risk
Subscriber	A residence or business that has signed up for service
Symmetrical	A connection supporting the same speeds in both directions
Transport Fiber	Fiber used for communications from hub-to-DSP or hub-to-hub

Triple Play	Internet Phone and Video
Underground Drop	Drop that is underground – typically in conduit, which can be re-used if large enough – fiber can share conduit with phone or cable plant but not electricity – some homes with underground drops have only one conduit (for electricity) – the phone lines are “direct buried” without conduit – in these cases the customer must install new conduit
Universal Coverage	Covering EVERY premise in a town/region (with the possible exception of premises that are off grid or served by a pole line from a town outside the service area)
VOIP	Voice Over Internet Protocol (i.e., voice service over Internet)
VPN	Virtual Private Network – used by companies to secure their employee’s connection to company servers when working away from the office - can also be used to disguise an Internet user’s actual location by sending and receiving traffic through an intermediate server