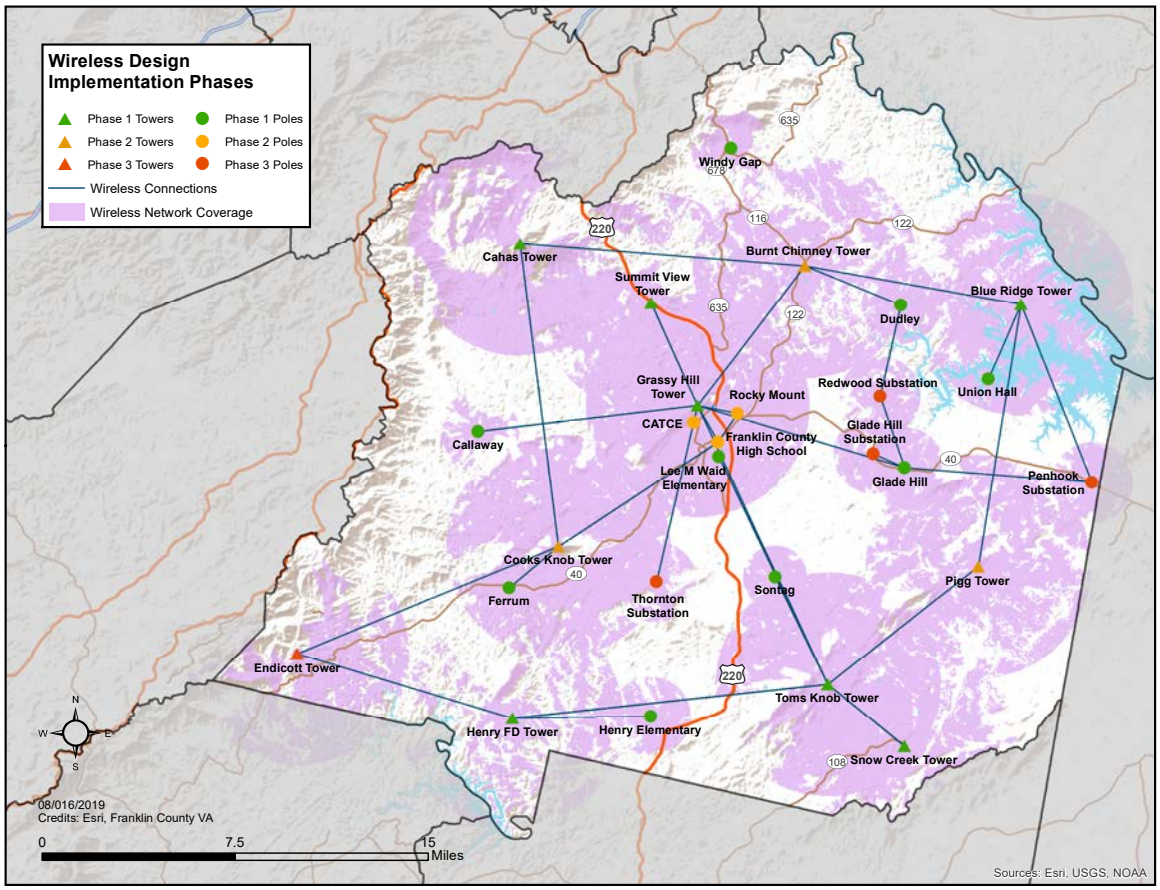
BROADBAND FOR FRANKLIN COUNTY

Broadband Assessment and Plan

August 2019



DESIGN NINE
broadband planners

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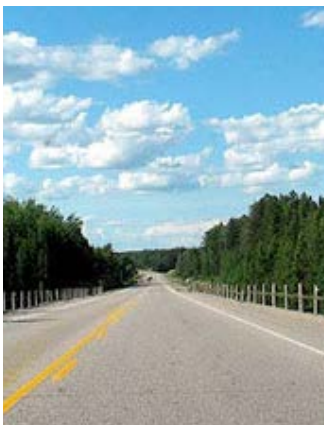
1 BROADBAND INFRASTRUCTURE AS A UTILITY

Governments build and manage roads, but don't own or manage the businesses that use those roads to deliver goods and services.



The tremendous versatility of the Internet and the underlying technology bases now allows services that used to require their own, separate (analog) road system (voice telephony and TV services) to be delivered alongside other services like Internet access on a single, integrated digital road system.

If we managed overnight package delivery the way we manage telecom, UPS and Fedex would only deliver packages to residences and businesses where each delivery firm had built a private road for their exclusive use. We recognize immediately the limitations of such a business model–few of us would have overnight package delivery to our homes because the small number of packages delivered would not justify the expense of building a private paved road.

Before the rise of the automobile, most roads were built largely by the private sector. After cars became important to commerce and economic development, communities began building and maintaining roads because it became an economic development imperative to have a modern transportation system in communities.

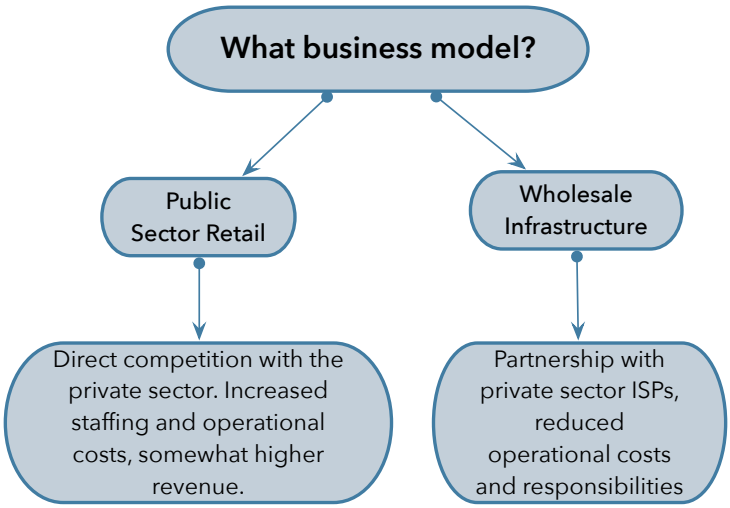
Before the rise of the Internet, digital networks were built largely by the private sector. As broadband has become critical to commerce and economic development, communities with digital roads are more competitive globally.

The time has come to recognize that it is inefficient and wasteful to build full duplicated digital road systems, which only raise the cost of telecom services to all public and private users. Networks that share capacity among a wide variety of public and private users have a lower cost of construction and a lower cost of operation–benefiting all users.

A UTILITY COMPARISON		
SHARED ROADS	SHARED AIRPORTS	SHARED TELECOM
Historically, roads have been built and maintained by the community for the use of all, especially private firms that want to use them to deliver goods and services.	Airports are built and maintained by a community or region as an economic and community development asset. Both public and private users benefit from the shared use of a single, well-designed airport	Towers, duct and fiber may be installed and maintained by the community and/or a neutral owner/operator for the use of all, including private firms that want to use them to deliver goods and services.
Access to the community road system is provided by parking lots and driveways, built by property owners, developers and builders.	Airport assets like departure gates, ticket areas, and runways provide access to the airline services.	In the digital road system, access across private property to the community–wide network in the public right of way is provided by towers, duct and fiber built by property owners and/or developers and builders.
The local government uses roads only to deliver government services. Local government does not offer services like overnight package delivery.	While the local government or a consortium of local governments typically own the airport facility, the local governments do not offer flight services.	Local government uses the digital transport system only to deliver government services. Government does not offer services like Internet access or Voice over IP.
Private sector businesses use roads so that their own cars and trucks can deliver goods and services to customers. Because businesses do not have to build and maintain roads, all businesses benefit directly by being able to reach more customers at less	Private sector airlines are able to offer competitively priced airfares because of the shared cost of the airport terminal facilities. Each airline does not build its own airport (which would sharply increase the cost of airfare).	Private sector businesses use the digital transport system to deliver goods and services to customers. Because businesses do not have to build and maintain a digital road system, all service providers benefit directly by being able to reach more customers at less
There are no road connection fees, and anyone may connect to the road system for free. Governments pay for the cost of maintaining roads largely from those that use the roads . Fees are proportional to use, from taxes on tires and gasoline.	Businesses and citizens do not pay a fee to access the airport facility. The cost of maintaining the airport facility is paid by the airlines, which bundle that cost into the price of airfare. Fees are proportional to actual use by flying customers. Airlines benefit because they do not have to build, own, and operate the airport directly. Those costs are shared across all users.	Any qualified service provider may connect to the digital road system for a nominal fee and begin to offer services, without any significant capital expense. Network capital and operating costs are recovered by charging service providers a small fee that is based on a percentage of their income from services offered over the system.

1.1 THE SHARED INFRASTRUCTURE BUSINESS MODEL

Traditionally, the telecom services market has been vertically integrated, with telephone and cable companies owning the cable infrastructure (i.e. twisted pair copper cable for telephone, and coaxial copper cable for TV). These companies bundled analog services with their own infrastructure, which made sense when only one service could be delivered over the cable.



American residents and businesses needed two networks: one for voice telephone service, and one for television. The rise of the Internet and associated changes in technology led to digital services (voice, video, Internet) that could be delivered simultaneously over a single cable or wireless connection.

By the early 2000s, it was becoming apparent that it was inefficient and costly to have two competing "retail" cable systems (e.g. telephone, cable) delivering the same content and services—it was only creating higher costs for residents and businesses.

A new business model became possible: wholesale leasing of the cable/wireless infrastructure to private sector service providers, which unbundles the infrastructure from the services. A side effect of this unbundling is that it becomes much easier to determine what a customer is actually paying for a given service: in the vertically integrated 20th century model, with the cost of infrastructure maintenance bundled together with the services, it is much more difficult to determine what a service actually costs.

While a few communities have pursued the retail business model (typically building fiber to the home and business and selling retail Internet and other services directly to customers), most of these retail efforts have been by local governments that are also providing electric service—owning the utility poles is a significant cost advantage not available in most communities.

In the wholesale infrastructure business model, local government investments are limited to passive infrastructure like conduit, dark fiber, and wireless tower space. Services for businesses and residents are offered by private sector providers offering Internet, TV, telephone and other data services. The components of the transport network include conduit, handholes, cabinets and shelters, splice closures, and network equipment.

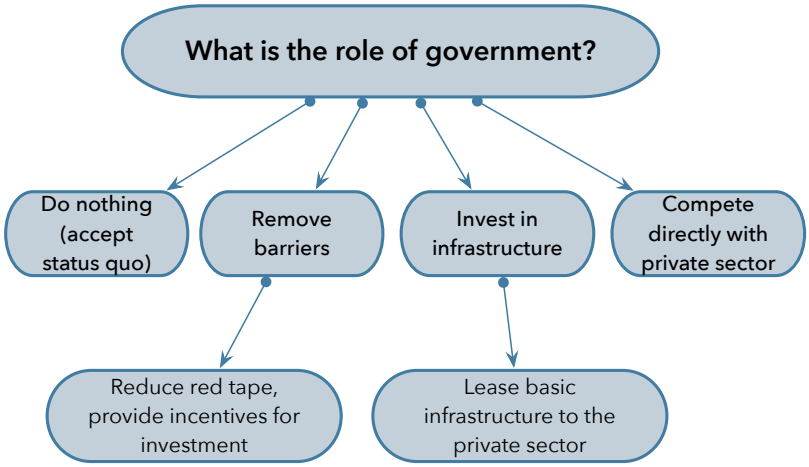
Recommendation

In the county, improved wireless broadband is going to be an important part of improving broadband service availability and affordability, and WISP access to existing and/or new towers should continue.

Features	Municipal Retail	Wholesale Infrastructure
Basic Concept	Generally more difficult to because of possible legal challenges from incumbent providers.	One or more private sector ISPs would use the infrastructure to sell their own services directly to residents and businesses. Use of County-owned conduit, fiber, and wireless towers makes it less expensive for ISPs to expand service.
Government Involvement	Local government competes directly with the private sector for Internet service.	County involvement is limited to providing basic infrastructure to ISPs.
Management	Local government is responsible for management and operations. Most functions could be outsourced to a qualified third party entity.	ISPs responsible for virtually all day to day customer services and support. The Broadband Authority is only responsible for network and tower maintenance and repairs.
Competition	The incumbent telephone and cable providers would compete vigorously against local government service offerings.	Private sector ISPs would provide competition to the telephone and cable companies.
Service Options	Local government would sell only Internet. Businesses and residents could get TV and voice using their Internet connections.	ISPs would focus on high speed Internet, with some other service offerings like voice and business services.
Risks	The primary risk would be lawsuits from incumbent providers.	Leasing tower space, conduit, or dark fiber is relatively simple to manage, with limited day to day responsibilities. A tower-based radio backhaul network requires some additional management, but most tasks can be outsourced to a qualified private sector firm. It is important to identify prospective service providers early in the process.

2 WHAT IS GOVERNMENT'S ROLE?

Successful improvements in broadband access, affordability, and reliability for the county involves several decision points, as outlined in the illustration below. Government has several "first choice" options.



Do nothing is to accept that businesses and residents in the county will have to continue to use whatever is available, despite the cost and bandwidth limitations that limit what many are able to do online.

Government can ***remove barriers*** to private sector investment. This can be an effective and low cost strategy. Possibilities include reducing permit fees for fiber construction and tower installation, incentives to developers to install conduit and meet-me boxes in new residential and commercial construction, simplified permit requirements for rural utility pole installation on private property, and identifying areas of residential and business demand and sharing that information with providers.

The county could choose to make ***investments in basic infrastructure*** and make that infrastructure available to the private sector via revenue-generating lease agreements.

When communities have chosen the option to ***compete directly with the private sector*** by offering retail Internet, phone, and TV services lawsuits from incumbents often create difficulty moving forward as well as expensive legal fees.

Recommendation

The County and the Broadband Authority can both **remove barriers** and **make targeted investments** in infrastructure. These two activities can be executed in parallel, with investments taking place as funding sources are identified. There are a variety of low cost and no cost efforts, mostly at the policy level, that the County can do to encourage more private investment–with a primary focus on keeping the cost of permitting and constructing new wireless towers as low as possible.

As one example, investments in improvements to existing county-owned towers and/or adding new county-owned towers could help the county's existing wireless providers bring more services to underserved areas of the county (e.g. the Snow Creek project) and/or attract much competitive broadband wireless providers into the county.

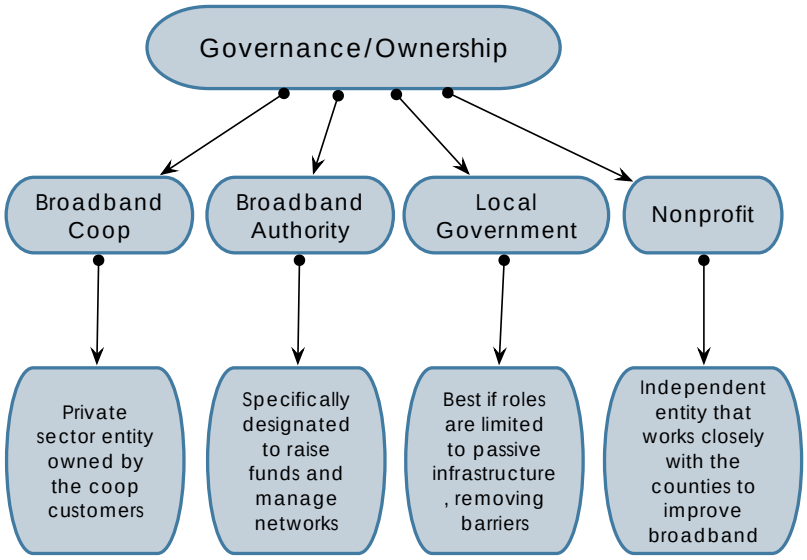
3 GOVERNANCE AND OWNERSHIP OPTIONS

For whatever infrastructure improvements may be made in the county, there will be a limited number of essential roles.

Community and county government investments in telecom improvements can be a mix of passive infrastructure like dark fiber, conduit, and wireless towers and well as some network electronics. These assets can be leased out to the private sector.

Franklin County has already formed a Broadband Authority , and there is no reason to change this structure. County departments can provide assistance as needed. In other areas of the country, where it is often more difficult to form an authority specifically for broadband, other approaches are being adopted.

In Virginia, a **Broadband Authority** has been both popular and effective in improving broadband access, especially in rural Virginia counties. Broadband Authorities are a political subdivision, have bonding privileges, and are able to operate across multiple jurisdictions. The Wired Road Broadband Authority, as one of several Virginia multi-jurisdictional authorities include Carroll County, Grayson County, and the City of Galax.



In some instances, broadband infrastructure projects are owned directly by a **local government** entity. The nDanville fiber network is part of the City of Danville's Utility Department. The City of Palm Coast, Florida also directly owns its fiber network. However, most direct local government ownership efforts are managed as an enterprise fund to provide full transparency on revenue and expenses related to the network.

Another option is to form a **nonprofit**, which would not be subject to the state level restrictions on local government. A number of communities have formed a nonprofit (typically a 501(c)(4) to provide the governance and ownership roles for a community broadband effort.

A **broadband coop** is becoming evaluated more frequently. Coops are typically formed as a 501(c)(12) and are owned by the members (who are also the customers of the coop). Coops can receive membership fees in advance of providing the service, which can help raise the funds needed for infrastructure. There can also be more than one type of membership (e.g. residential, small business, large business, government, institutional, etc.), and each membership type can have a different membership fee associated with it.

3.1 ABOUT BROADBAND AUTHORITIES

The primary advantages of an Authority as opposed to other ownership options include:

- A single entity manages and coordinates a wide variety of activities effectively with less duplication of effort and overlap.
- Coordination and management of grant funding opportunities, preparation of grant applications, and management of grant funds.
- Coordination of expenditures of County CIP funds when available.
- Work directly with existing incumbent and competitive service providers to assist them in making service improvements, coordinating CAF2 expenditures (Connect America Fund round 2), and coordinating any joint funding opportunities (e.g. DHCD funds).
- Work closely with local government departments (e.g. planning, IT, GIS, etc.) to remove barriers, simplify permitting, and track assets like towers and fiber/conduit.
- Collaborate with public safety initiatives, including shared space on existing towers and shared use of any new towers.

Franklin County has a Broadband Authority in place that is working closely with County staff and public safety officials. The existing Authority should continue to be the lead on broadband in Franklin County.

3.2 ABOUT NONPROFITS

There are various kinds of nonprofit businesses. The most common is the 501(c)(3), which is limited to strictly charitable efforts. A 501(c)(3), according to IRS rules, must have a well-defined charitable purpose targeted toward a specific need and/or a specific target population. In other words, a 501(c)(3) cannot, according to IRS rules, operate as a nonprofit business that provides services to the general public.

Many of the first community networking projects in the early and mid-nineties were formed as 501(c)(3) organizations; it was common for these entities to offer dial-up Internet access to the general public at a time when Internet service providers were still relatively uncommon. But by 2000, most of these organizations had closed their doors and/or discontinued their Internet access services because of IRS challenges.

Today (2019), we have seen new 501(c)(3) and 501(c)(4) organizations being formed, and the Federal government's 2015 endorsement of both community-owned networks and the open access business model has removed the uncertainty of using a nonprofit for this kind of effort. The IRS defines one role for 501(c)(4) entities as "*Social welfare organizations: Civic leagues or organizations not organized for profit but operated exclusively for the promotion of social welfare.*"

A 501(c)(3) can accept tax deductible donations, but contributions to a 501(c)(4) are not tax deductible. The advantage of a nonprofit is that they are relatively easy to create and legal fees are usually nominal. Nonprofits are often eligible for certain kinds of grants not available to for profit enterprises, and the nonprofit can provide the needed oversight to manage broadband infrastructure investments.

3.3 ABOUT COOPS

Cooperative business enterprises as formal entities date from the mid-1800s. The first cooperative was set up in England to serve customers unhappy with local merchants. In the United States, the Grange movement began setting up cooperatives in rural areas to sell needed items to members and to help sell produce and other agricultural products that were produced by members. Today, credit unions are the most common form of coop business in the United States, with more than 65 million people obtaining services from over 12,000 credit unions.

Telephone and electric coops continue to be very common in rural parts of the U.S., and in fact, the majority of telephone companies in the United States are coops, but most have very small numbers of customers--often less than a thousand subscribers. Telephone coops serve more than a million subscribes in thirty-one states. The True Value and Ace Hardware chains are actually buying coops that help keep independent hardware stores competitive with the large chain stores.

The U.S. Department of Agriculture (USDA) provides extensive support for existing coops, and also helps communities start coops. One of their publications lists the principles of the coop:

- User-Benefits Principle -- Some purposes of a coop are to help members get services that might otherwise not be available, to get access to markets, or for other "mutually beneficial" reasons.
- User-Owner Principle -- The users of the cooperative own it.
- User-Control Principle -- The owners of the coop (i.e. members) control the coop through voting (annual meetings, etc), and indirectly by electing a board of directors to manage the enterprise. Large users who make high volume purchases of goods or services may receive additional votes.

Because cooperatives are user-managed, control of the enterprise is vested in the community or region where the users reside. Cooperatives also return excess earnings to its members; these refunds are called patronage refunds, and are typically computed at the end of the fiscal year. The expenses and income of the coop are calculated for the year, and any excess is returned to members, based on the percentage paid in by each member (e.g. a member that paid in 1% of total earnings would get a refund of 1% of any excess earnings).

Most cooperatives do not pay dividends on capital. This helps keep outsiders from taking control of the company, which would result in the community losing control over the quality of services and direction of the enterprise.

Coops are organized in part based on the territory they serve, and there are several classifications that may be relevant for community broadband efforts. A local coop serves a relatively small area that may be a single town or county and/or a radius of ten to thirty miles. A super local coop serves two or more counties. A regional coop may have a service area of several counties up to an entire state (or multiple states). For projects that involve several local government entities that are already trading services like local public safety dispatch, a super local coop may be the most appropriate designation.

Most local and super local coops use the centralized governance structure, which means that individuals and businesses represent the bulk of members.

Cooperatives offer one or more of three kinds of services:

- Marketing coops help sell products or services produced by members.
- Purchasing coops buy products and services on behalf of members.
- Service cooperatives provide services to members, and service coops include the credit unions, the electric coops, and the telephone coops.

Equity is typically raised for coops by direct investment from members. In return for an investment, members receive a membership certificate. The member may also receive shares of stock if the cooperative issues stock (some do, and some do not). Once a member has invested, they gain the right to vote in elections. As an example, if a local government made a large initial investment in the cooperative, they could gain substantial influence in the affairs of the organization by gaining multiple shares and increased voting rights. Property owners (residential property owners and business property owners) who paid an initial connection or pass-by fee would also gain shares in the business, so every property owner that pays the connection fee gains ownership in the enterprise--an important selling point when encouraging property owners to, quite literally, invest in the project.

Although cooperatives are typically constrained by both Federal and state laws to do a majority of business with members, in most cases, cooperatives are able to do business with nonmembers up to some percentage of business income that can be as high as 49 percent. Note that this may be affected by the underlying legal incorporation of the cooperative--if incorporated as a 501(c)(12), the IRS requires that 85% of income must come from members for the purpose of meeting ordinary expenses.

In summary:

- Coops are member (subscriber) owned, meaning they are strongly vested in the community. Any effort by the coop board to dispose of assets or to sell the coop would have to be approved by a majority vote of the members.
- Members play an active long term role in governance by nominating and electing board members. So members have a straightforward way of influencing decision-making by the board.
- Coops generally operate on a cost-plus basis. Income that exceeds some preset level is returned to members periodically as a distribution of funds.
- Broadband coop bylaws must be carefully written, especially if there is an interest in several classes of membership. Each class of membership can be charged a different membership fee, and this can be a valuable source of start up funds, but membership categories are difficult to change later.
- Coops are largely immune to challenges by incumbent telecom providers due to the long history of existing coops and because of special legislation passed by Congress.
- Coops can tap USDA funds, but the application process would be time-consuming and expensive for a start up coop.

Advantages of a Coop

The primary advantages of an Coop as opposed to a local government pursuing projects independently include:

- Avoids the strict limitations on local government participation. A coop, as a private sector entity, would have a wider range of infrastructure options, including offering retail wireless and fiber services.
- Coops can raise funds prior to delivering services to its shareholder customers. A broadband coop could solicit memberships from throughout the county (as long as the coop can clearly articulate its mission). Alternately, it could start with smaller "first phase" service areas and only solicit memberships from the initial target areas.
- A coop, with local members as the shareholders and owners, is firmly vested in the community. By comparison, a nonprofit, while easier to set up, does not have the same vesting in the community–the volunteer board of a nonprofit can sell the assets and/or disband it without any input from the community.

A broadband coop would need a carefully selected board of directors with significant business and management experience.

3.4 GOVERNANCE QUANTITATIVE EVALUATION

Six factors can be evaluated to provide a assessment of the governance options. These factors are:

- Transparency - Does the governance structure provide adequate transparency about decision making? Do stakeholders and interested parties have adequate ways to obtain documents, financial reports, and related governance materials?
- Timeliness - How quickly can the governance entity be legally formed? Time may be of the essence.
- Community Oversight - Does the entity have adequate community control and oversight? Does the community at large and the County have adequate representation in the governance structure to ensure that assets are managed properly?
- Legislative Authority to Build/Operate - Does the governance entity have clear legislative approval to build and operate a telecommunications network?
- Financing Options - Are there adequate financing options available to provide the appropriate level of funding over time to meet the long term vision of the county?
- Tax Liability - Does the governance entity incur tax obligations?

3.5 RECOMMENDATION

There is a role for investments by the County, especially if public safety tower needs can be combined with improved broadband wireless tower needs in underserved areas of the county.

In Virginia, the Broadband Authority is an ideal vehicle for obtaining grants and for managing broadband infrastructure. The County should continue to fund and support the existing Broadband Authority.

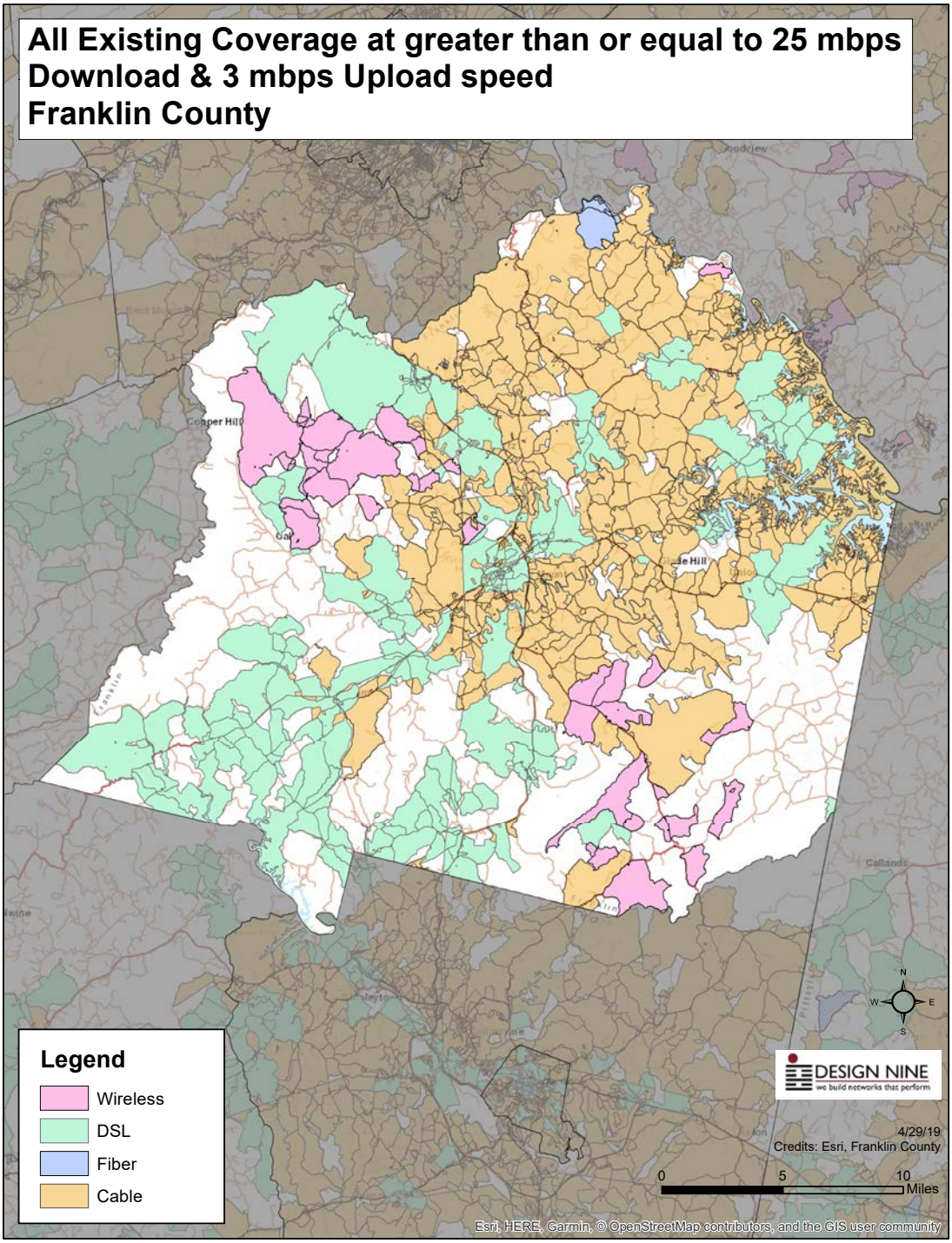
5 EXISTING ASSETS AND DEMOGRAPHY

The maps on the following pages include information on where Internet and cellular phone service is available. Due to the way that the FCC allows the incumbent telephone, cable and Internet providers to report data by census block, if a single location in a census block is able to receive a given service level, every home in the census block is listed as "served." This leads to coverage maps that are optimistic about where coverage is actually available.

- Existing coverage areas at 25/3 speeds. The FCC defines an area as "served" if provider can deliver 25 Meg down and 3 Meg up to customers.
- DSL coverage at the 25/3 rate.
- Fixed point wireless broadband service in the county at 25/3 speeds.
- Cellular service is widely available in the County, but the cellular providers tend to be very optimistic about where service is available. There are many areas of the County, particularly in the western and southwestern portions of Franklin County, where service is spotty or not available.
- Broadband wireless, cable and DSL at 25/3 or greater, with17% of locations remain underserved, the actual number of underserved is likely higher.
- At least 4,913 addresses are underserved (less than 25/3 Internet service), mostly in the rural parts of the county.
- Points of interest, including household density (an important factor when evaluating new service areas).
- LMI Areas of the county (Low and Moderate Income). Very important for certain kinds of grants.
- Towers in various parts of the county. These are taken from the FCC tower registry and other sources. The FCC registry which includes both cell towers and other kinds of towers (e.g. radio/TV broadcast towers, public safety towers).
- Long haul fiber routes through the county, which are important data routes to the rest of the Internet.

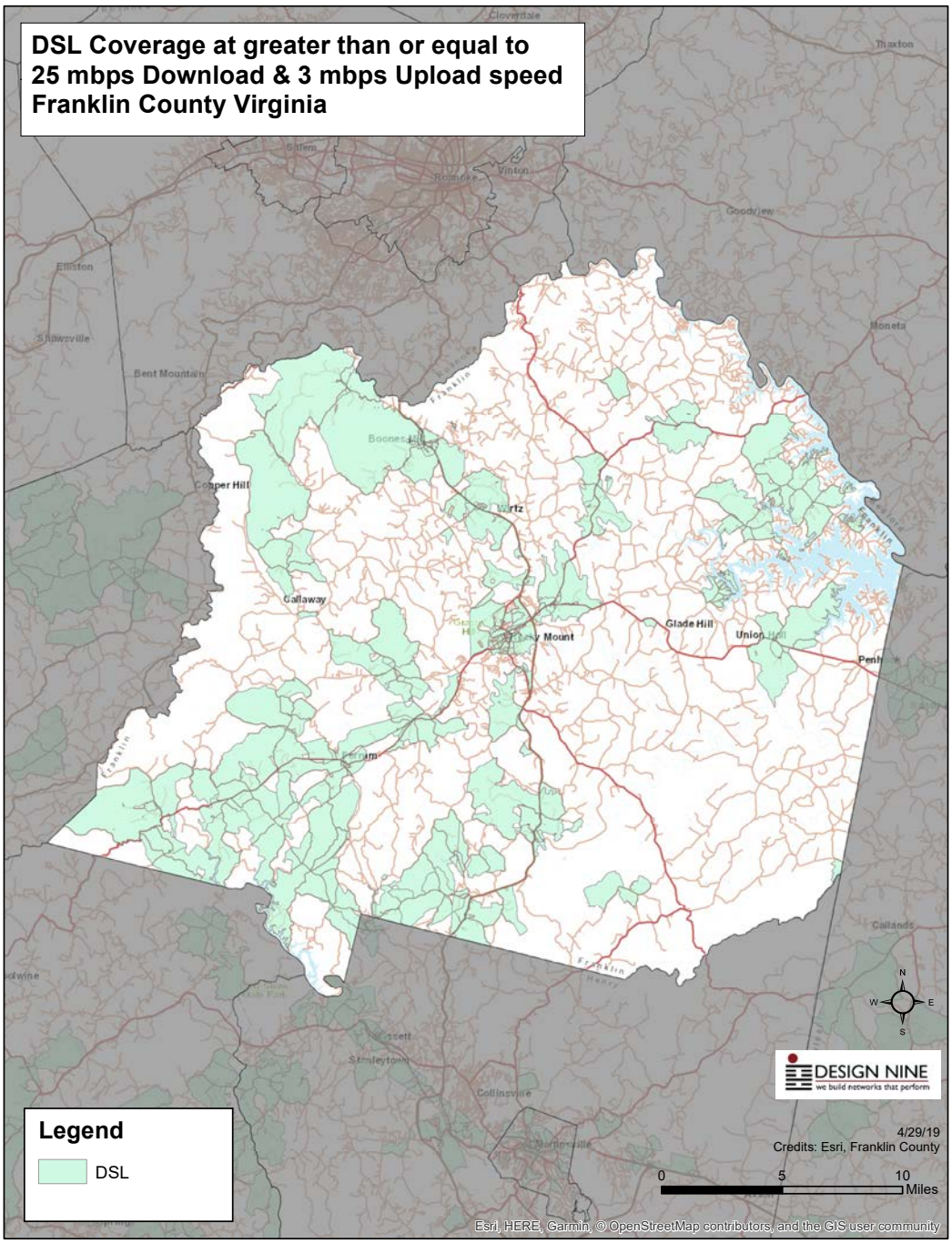
5.1 EXISTING BROADBAND COVERAGE AT 25/3 SPEEDS

Many areas of the County are not able to get service at 25/3 speeds.



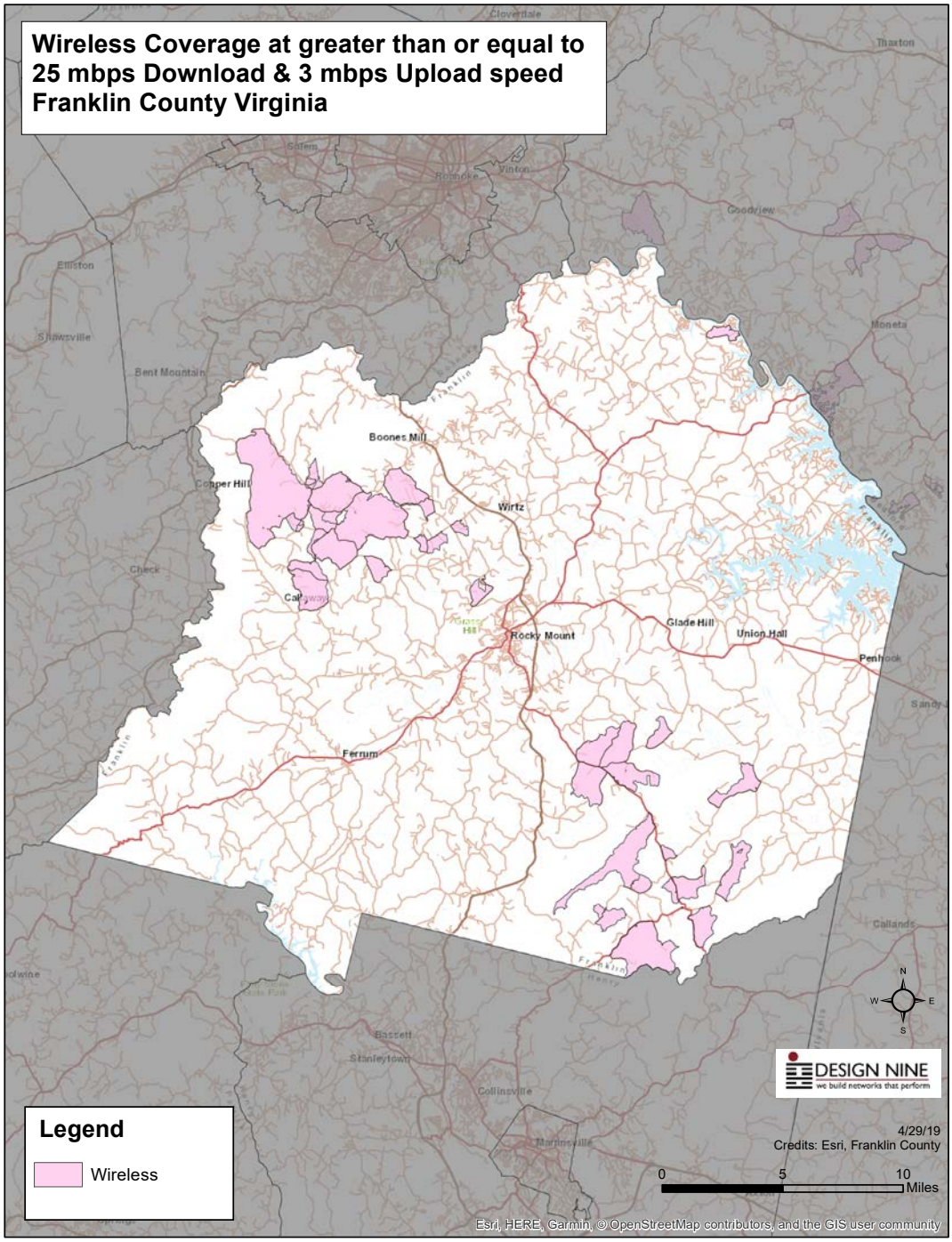
5.2 EXISTING DSL COVERAGE AT 25/3 SPEEDS

Most homes and businesses in the county have access to DSL service, but not all locations can receive DSL service at 25/3 speeds.

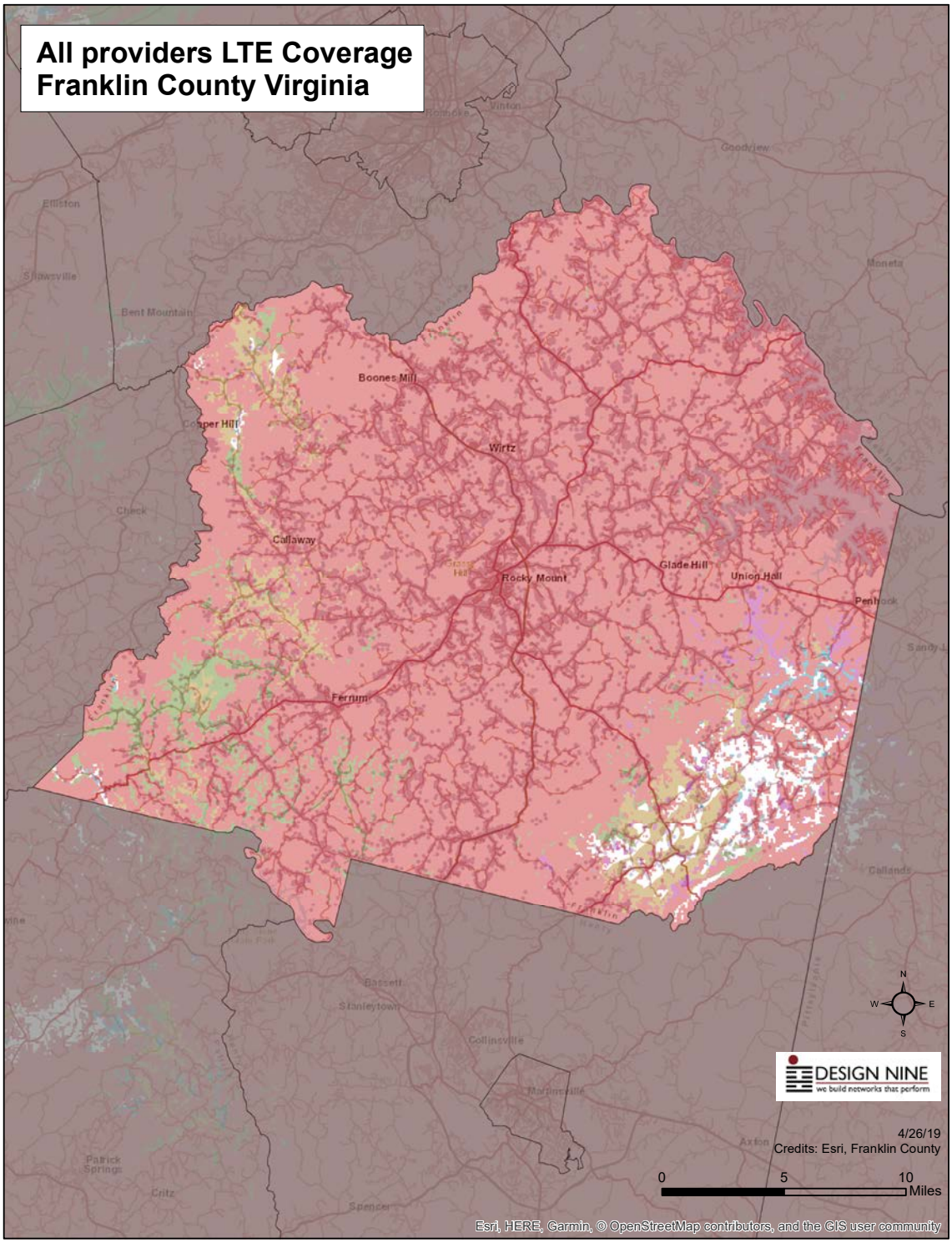


5.3 FIXED POINT WIRELESS AT 25/3 SPEEDS

Fixed point wireless broadband is more widely available in the County than this map indicates, but not all wireless tower sites are able to deliver 25/3 speeds.

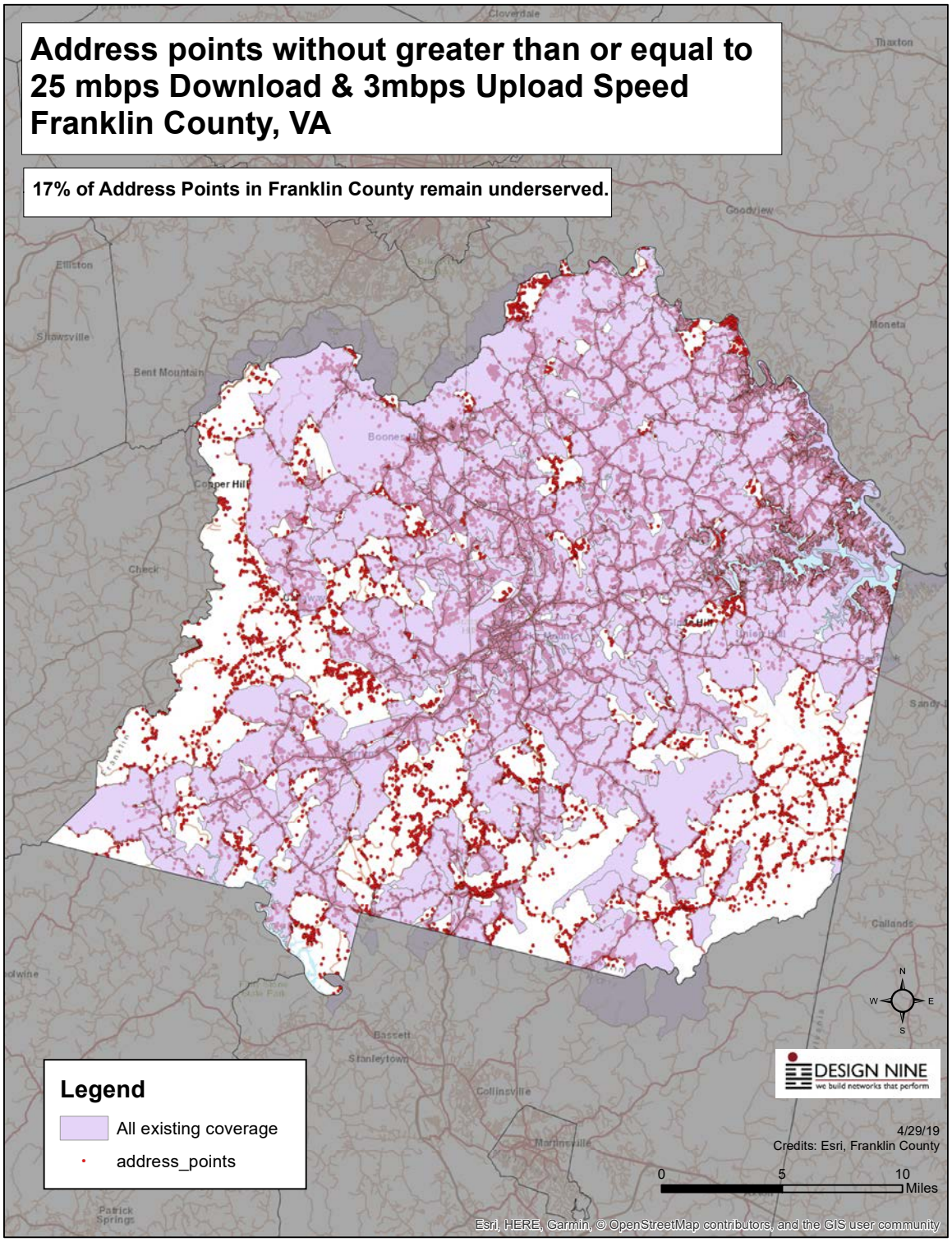


5.4 CELLULAR COVERAGE BY ALL PROVIDERS



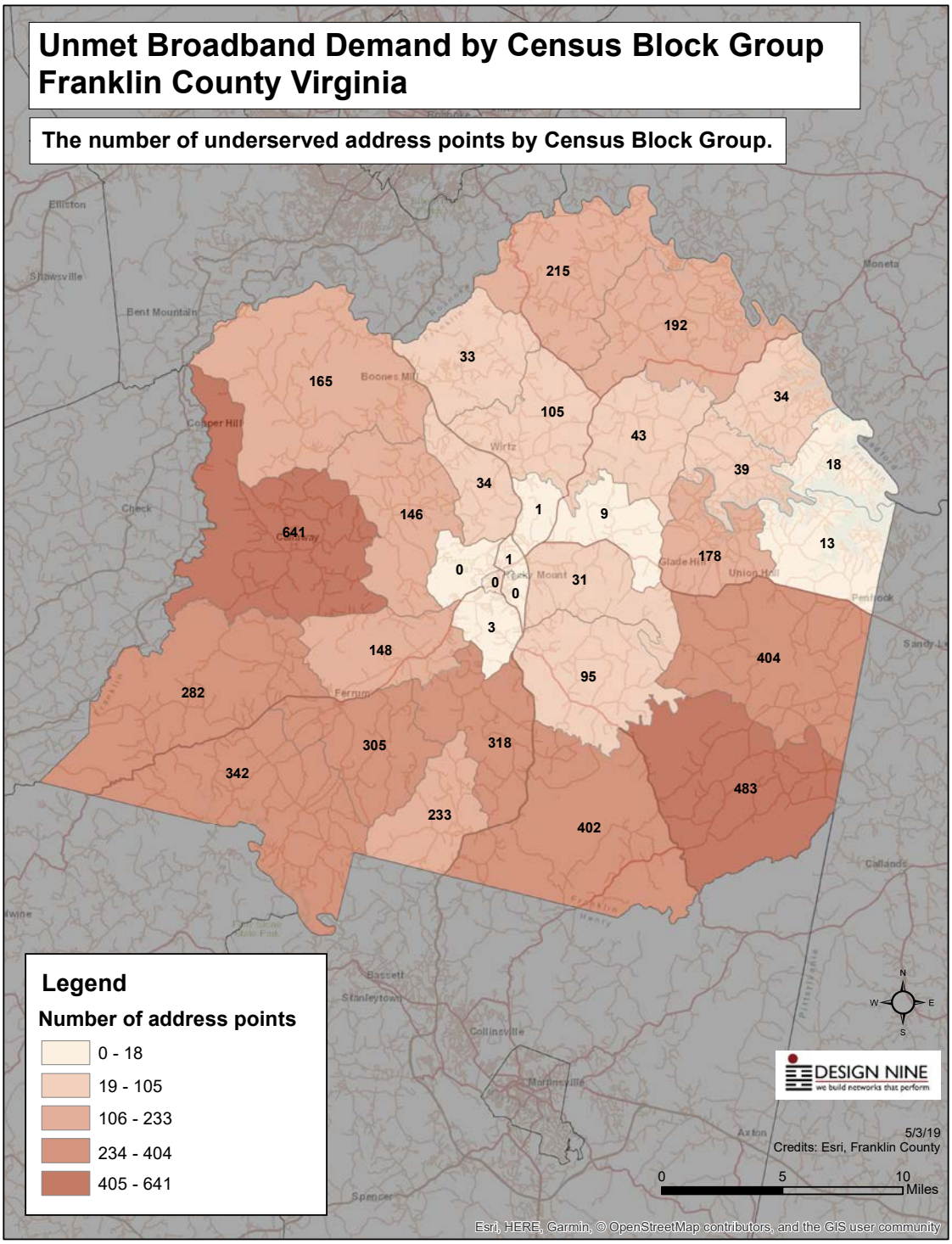
5.5 25/3 COVERAGE WITH ADDRESS POINTS

Broadband wireless, cable and DSL at 25/3 or greater, with17% of locations remain underserved, the actual number of underserved is likely higher.

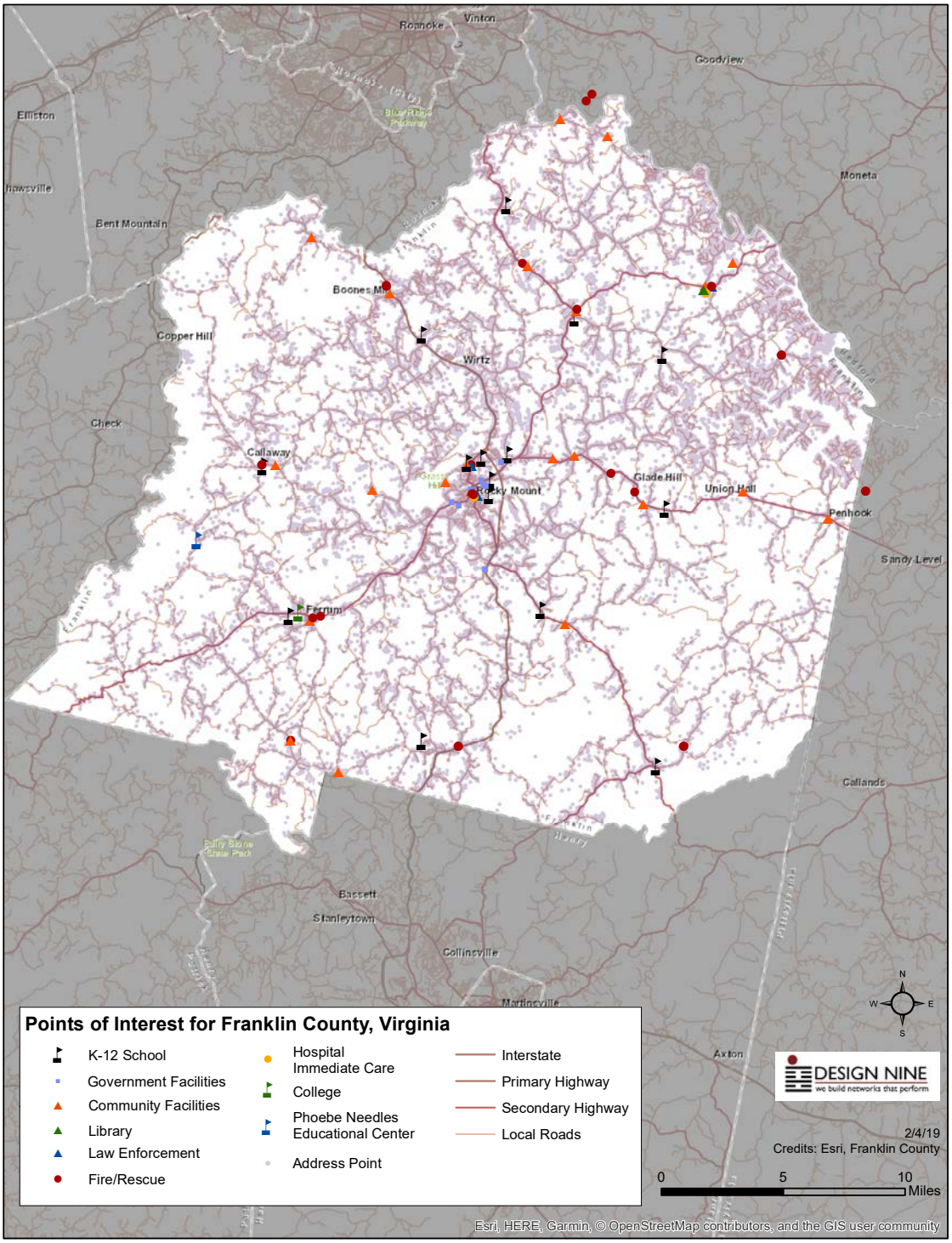


5.6 UNDERSERVED BY CENSUS BLOCK GROUP

At least 4,913 addresses are underserved (less than 25/3 Internet service), mostly in the rural parts of the county.

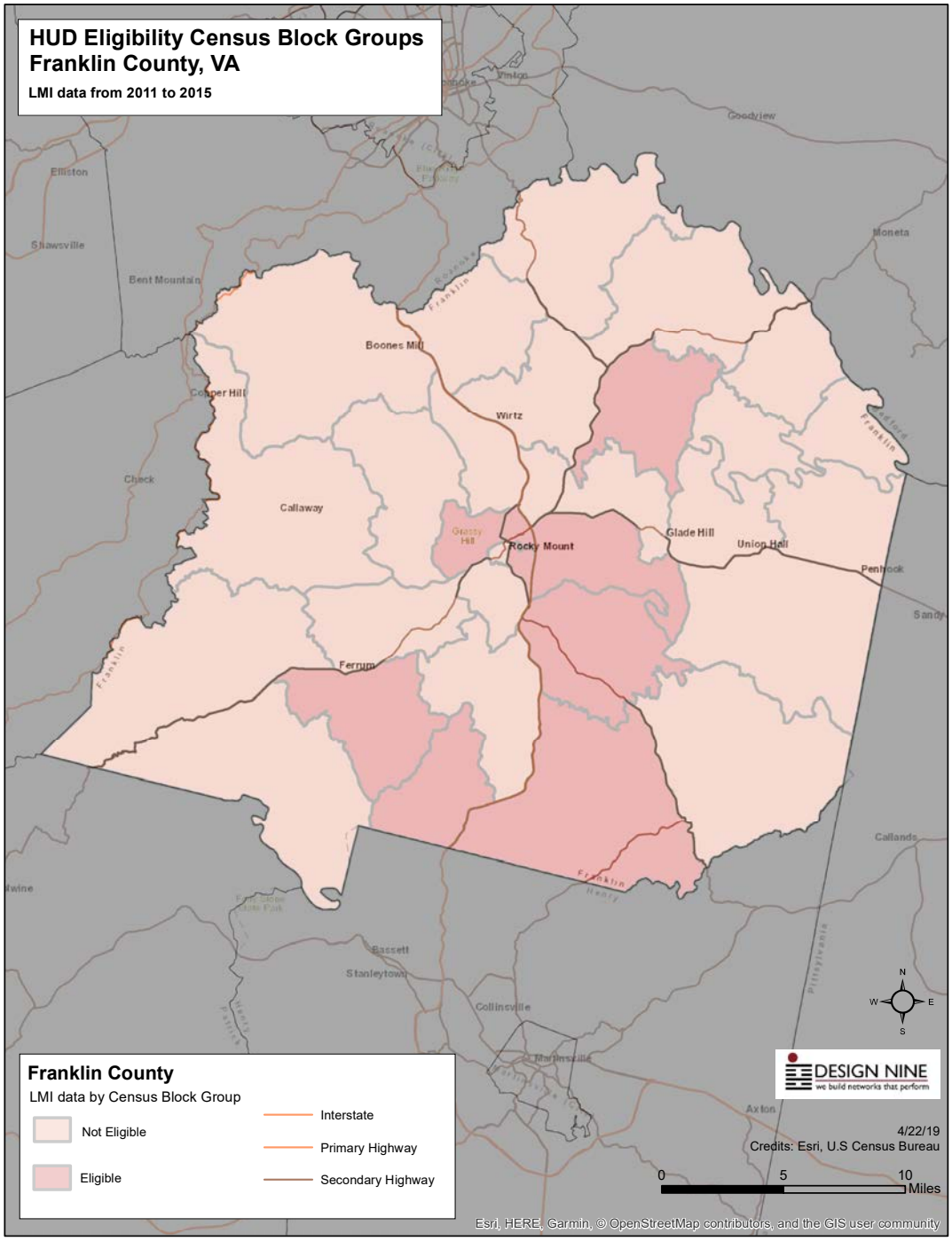


5.7 POINTS OF INTEREST



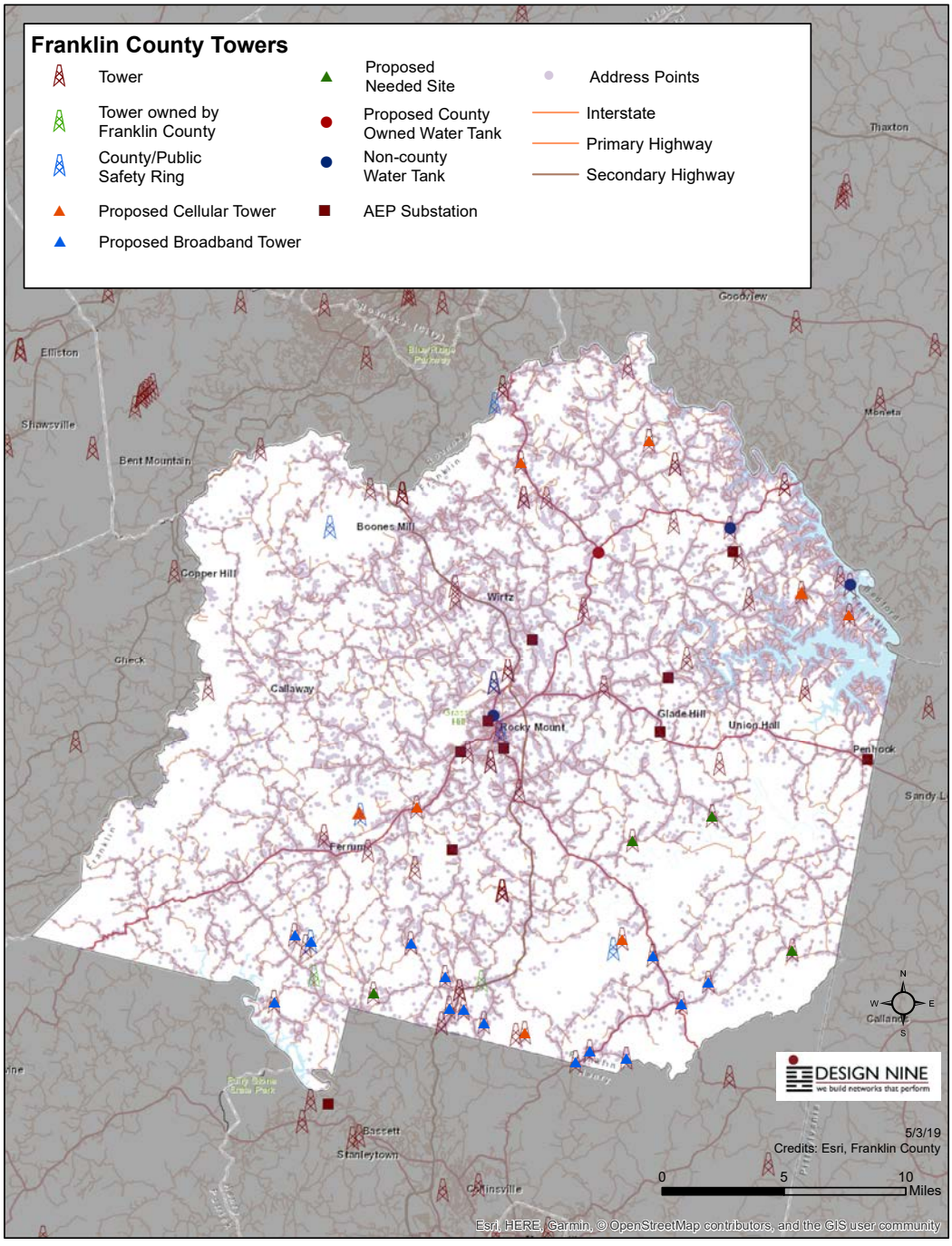
5.8 LMI AREAS OF THE COUNTY

Certain kinds of grants (e.g. CDBG funding) favor LMI (Low and Moderate Income) areas. Large parts of the county would qualify for grants that have a preference for LMI areas.



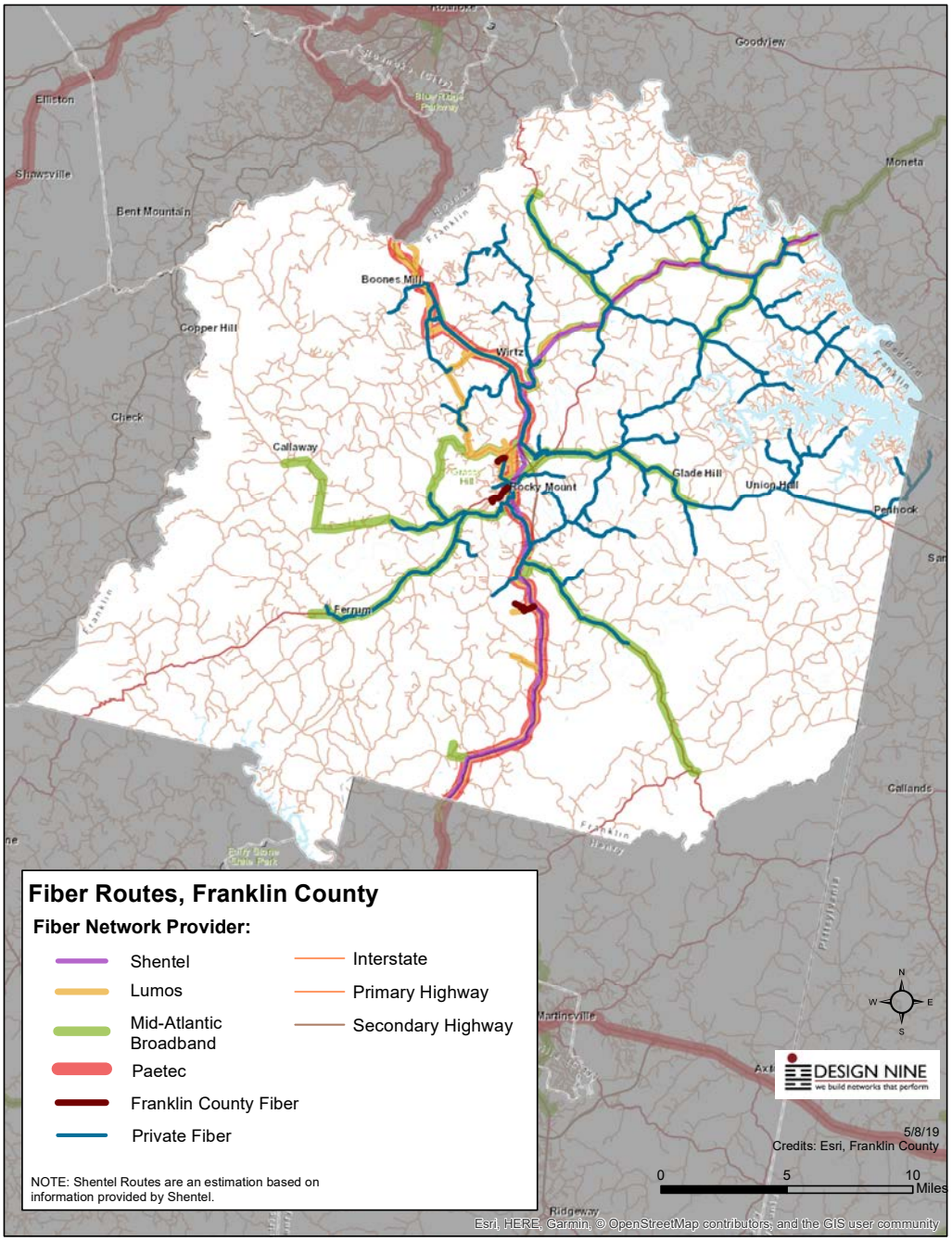
5.9 TOWER ASSETS AND SUB-STATIONS

There are a number of cellular towers in the county. These are clustered along major travel routes, which leaves many areas of the county with marginal or no cellular service. Increased availability of good wireless and/or fiber broadband service would enable many residents and businesses to use inexpensive nano-cell boxes in their home or business. More information on nano-cells is contained in a later section of this report. Appendix B contains a list of known tower owners; this list was developed from the FCC tower registry and from data supplied by Franklin County.



5.10 FIBER ASSETS

Some limited third party (e.g. not incumbent) fiber is in or near the county. These routes are extremely important as more "last mile" broadband improvements are made–competitive ISPs and WISPs can generally get better pricing from companies like Shentel and Lumos than from the telephone or cable companies. Paetec is a long haul fiber firm that is probably leasing fiber pairs from Shentel or Lumos; the company has no apparent service presence in the county (i.e. the fiber just passes through).



6 EXISTING SERVICE AREAS AND SERVICE OPTIONS

Our service provider report provides insights into the services currently available in your county. Our report provides data that show which areas by zip code that are most impacted by poor Internet service and/or the lack of Internet Service Provider options. Because of the unique geography of Franklin County, many Internet Service Providers shown as available online in a particular zip code are likely not available.

NOTE: This data is collected from publicly available data. Service providers often exaggerate their coverage, and the actual availability of some services as represented in the tables below may be lower than the numbers suggest. Two examples would be Cox showing up in zip code 24059 and Consolidated Communications showing in zip code 24137. It is unlikely that any Franklin County residents in those zip codes have access to those services.

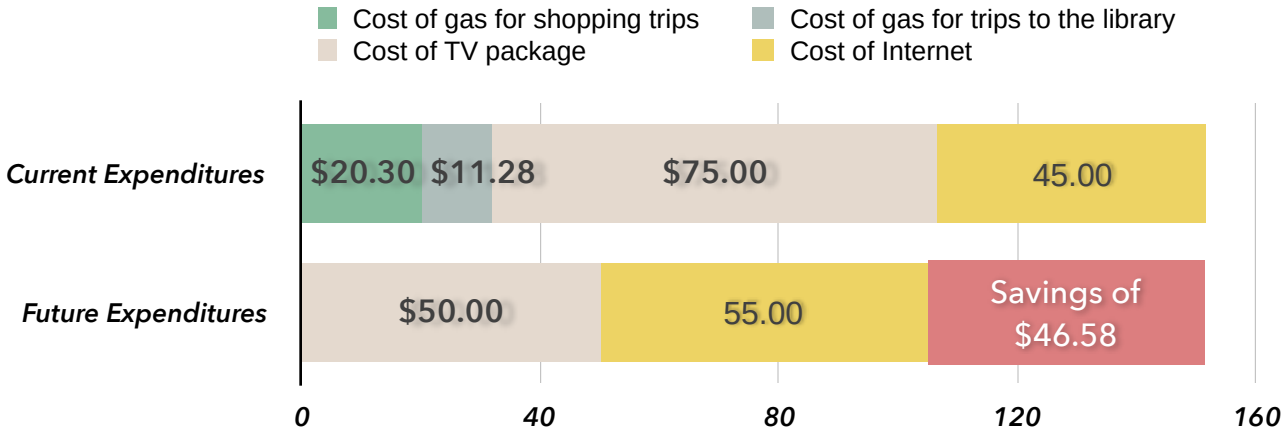
As the following tables and data demonstrate your citizens have the most choice in expensive but slow DSL Internet Service Providers, Most residents have little choice in companies that provide true high-speed Internet. There are eight zip code areas with a high number Franklin County residents dependent on DSL services.

Lack of choice impacts citizens' lives in variety of ways from their budgets to how they spend their time. For the first graph we have used basic CenturyLink DSL at $45 per month with 10 Mbps download as the base service.

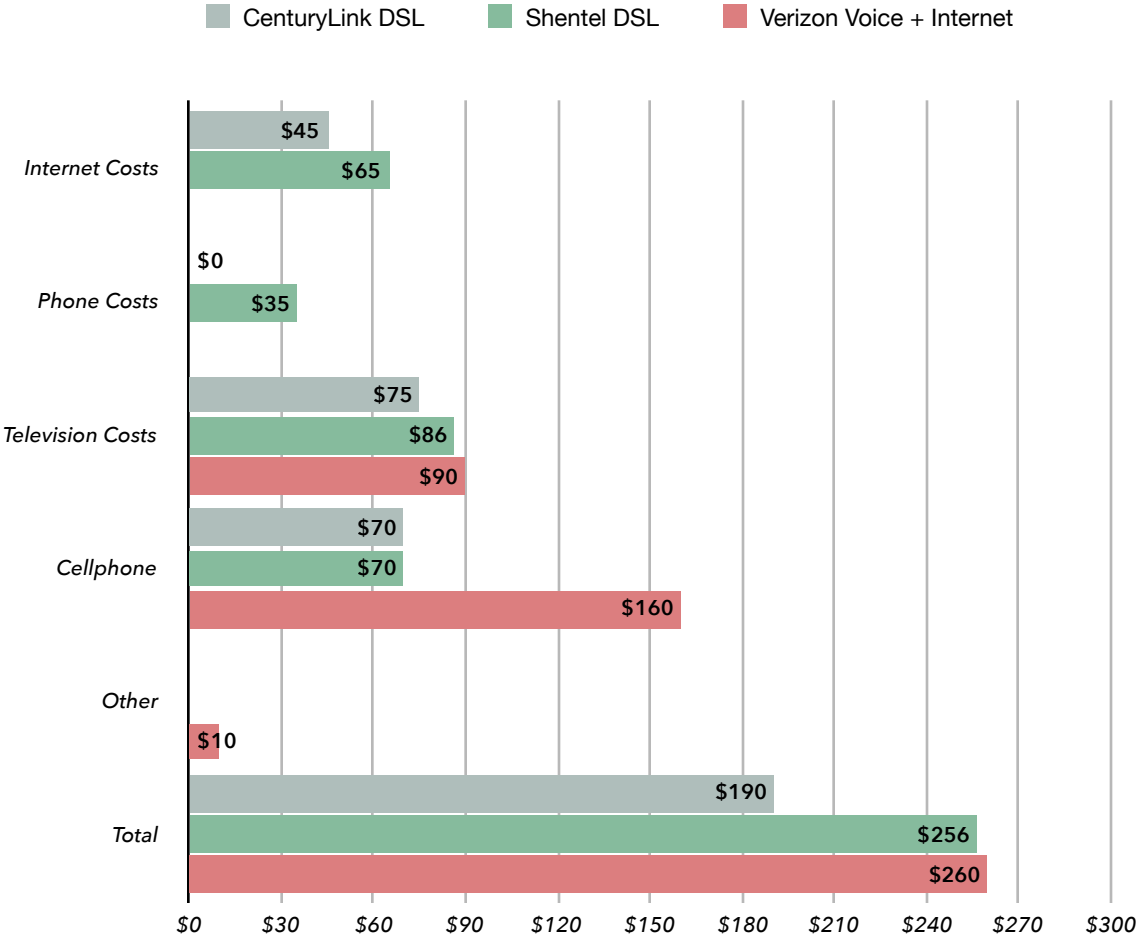
The average household in the United States pays $67 per month for Internet in their home. Smartphones have become an expensive substitute for reasonably priced Internet services. A single smartphone with an unlimited data plan can cost from $60 to $95 per month and adding a single tablet for school work can add an additional $10 to $20 per month before taxes and fees for data. Even "unlimited data" often has limitations after a certain amount of data has been used.

Studies have shown that high-speed broadband can save rural residents up to $754 per year. Our conservative $559 annual savings number illustrated in the chart below is based on actual services available in Franklin County.

Potential Savings with Better Broadband (Phone not included)



Below are graphs showing communication costs for families receiving the Internet in different ways in Franklin County. CenturyLink appears to be the most available service in the County but provides only 10 Mbps download speeds at best and no bundled services. The next most available service is Shentel DSL. Their mid-range bundle package of TV, Internet and phone is $135.90 for the first year with the price going to $185.90 the second year. We have used that Shentel package at its non-promo rate of $185.90 for our base package. For sake of comparison on CenturyLink services without bundling, we have added satellite TV costs. The other costs ($10) provide a tablet for people using their cellphones for Internet needing in order to be able to do school work or other Internet activities. Verizon cellphone Internet costs are based on Verizon's $70 per month 8GB plan with addition 6GB of data purchased at $15 per GB. That totals 14GBs of data with 4 GBs for phone usage and 10 GBs for Internet usage. ***The average monthly cost of these services in Franklin County is $235***.



6.1 ZIP CODE DATA

Zip Code data or Zip Code Tabulation Area information (ZCTA) was compiled using the Melissa website with all population data coming from the 2010 US census which is the most recent for which ZCTA data is available. ZCTA is the geographic unit closest to a zip code for which the US government provides population data. It is a very approximation. Percentages within the county are based on number of US post office addresses that are actually within the county. Maps in the Appendix are from the Melissa site with best effort estimates of area either not in Franklin County or actually in Franklin County.

Franklin Population 2010 by Zip Code- Population Data from US Census

Zip/ ZCTA	USPS Town	% Franklin House-holds in the Zip	DSL	Cable	Fixed Wireless	25 Mbps Coverage	2010 Pop.	Land-Sq-Mi	Density Per Sq Mi
24055	Basset (not a Franklin County town)	5.4%	97%	91%		92%	13,674	86.90	157.35
24059	Fishers Hill (not a Franklin County town)	6.6%	69%	35%	13%	35%	872	23.67	36.85
24065	Boone's Mill	87.7%	84%	63%	31%	68%	6,141	85.33	71.97
24067	Callaway	100%	79%	11%	70%	24%	2,230	56.17	39.70
24088	Ferrum	100%	94%	48%		56%	5,408	117.21	46.14
24092	Glade Hill	100%	77%	94%	26%	94%	3,063	35.55	86.17
24101	Westlake Corner	78.9%	91%	77%	38%	78%	6,132	55.47	110.55
24102	Henry	92.1%	77%	1%	12.7%	57%	1,697	32.08	52.90
24121	Moneta (not a Franklin County town)	37%	72%	46%	50.5%	46%	10,501	94.90	110.65
24137	Penhook	78.9%	57%	42%	29.1%	42%	2,582	74.25	34.78
24151	Rocky Mount	100%	84%	86%	31.8%	90%	20,000	162.52	123.07
24176	Union Hall	100%	77%	84%	11.7%	90%	1,360	21.99	61.86
24184	Wirtz	100%	90%	96%	28.5%	96%	4,705	42.83	109.86

Internet Service Providers & Percent Zip Code Coverage

Zip Code	USPS Town	CenturyLINK DSL	Citizens	Consoli-dated Commun-ications	Verizon	Shentel	Xfinity Cable	Cox	B2X Online Wireles
24055 only 5.4% in Franklin County	Basset (not a Franklin County town)	✔ 97.1%					✔ 95.6%		
24059 No services verified in this area- 6.6% in Franklin County	Fishers Hill (not a Franklin County town)				✔ 69.4%			✔ 79.5%	✔ 13.3%
24065	Boone's	✔ 74.6%			✔ 21.3%	✔ 57.5%		✔ 15.5%	✔ 30.8%
24067	Callaway	✔ 70.1%	✔ 11.8%		✔ 16.4%	✔ 11.1%			✔ 69.9%
24088	Ferrum	✔ 95.2%				✔ 46.8%			
24092	Glade Hill	✔ 72.4%				✔ 92.5%			✔ 26.3%
24101	Westlake Corner	✔ 62.7%			✔ 56.0%	✔ 72.4%	✔ 5.3%		✔ 38.2%
24102	Henry	✔ 84.6%							✔ 12.7%
24121 only 37% in Franklin County	Moneta (not a Franklin County	✔ 33.1%			✔ 45.3%	✔ 48.2%	✔ 11.0%		✔ 50.5%
24137	Penhook	✔ 36.5%		✔ 17.2%		✔ 43.4%			✔ 29.1%
24151	Rocky Mount	✔ 86.4%				✔ 85.1%			✔ 31.8%
24176	Union Hall	✔ 54%				✔ 79.9%			✔ 11.7%
24184	Wirtz	✔ 91.4%				✔ 93%			✔ 28.5%

6.2 LOCAL PRICING DATA

This information provides pricing data and services available from providers in the area for the Franklin County area. Prices, availability and promotional offers change frequently and sometimes vary within a region. Information was compiled using the Broadband Now and the High Speed Internet (.com) websites. Exact availability requires specific street addresses.

Wireline Providers

CenturyLink ✔

$45/mo for 10 Mbps ↓ – Mbps ↑ with 1 TB data cap

$45/mo for 3 Mbps ↓ – Mbps ↑ with 1 TB data cap

Citizens ✔

$79.95/mo for 50 Mbps ↓ 10 Mbps ↑- with no data cap. Setup fee $99.00 includes activation. Installation is free. Modem included. Contract term one year with up to $100 ETF.

$59.95/mo for 25 Mbps ↓ 5 Mbps ↑- with no data cap. Setup fee $99.00 includes activation. Installation is free. Modem included. Contract term one year with up to $100 ETF.

$39.95/mo for 10 Mbps ↓ 2 Mbps ↑- with a 400 GB/month data cap. Setup fee $99.95 installation fee may apply. Modem $8 per month or one-time fee of $99.

Consolidated Communications ✔

$36.70/mo for 15 Mbps ↓ 0.768 Mbps ↑- with no data cap. 1-year promo rate. Regular rate is $75.70. Contract term: 1 year. $1 per month paper invoice fee. Modem with WiFi $8 per month.

$36.70/mo for 20 Mbps ↓ 2 Mbps ↑- with no data cap. 1-year promo rate. Regular rate is $75.70. Contract term: 1 year. $1 per month paper invoice fee. Modem with WiFi $8 per month.

$31.70/mo for 10 Mbps ↓ 0.768 Mbps ↑- with no data cap. 1-year promo rate. Regular rate is $70.70. Contract term: 1 year. $1 per month paper invoice fee. Modem with WiFi $8 per month.

$21.70/mo for 6 Mbps ↓ 0.768 Mbps ↑- with no data cap. 1-year promo rate. Regular rate is $60.70. Contract term: 1 year. $1 per month paper invoice fee. Modem with WiFi $8 per month.

$21.70/mo for 3 Mbps ↓ 0.768 Mbps ↑- with no data cap. 1-year promo rate. Regular rate is $60.70. Contract term: 1 year. $1 per month paper invoice fee. Modem with WiFi $8 per month.

Verizon ✔

$34.99/mo for 3 Mbps 3 Mbps ↓ up to – Mbps ↑

$24.99/mo for 1 Mbps 1 Mbps ↓ up to – Mbps ↑

Shentel ✔

$145.90/mo for 50 Mbps 50 Mbps ↓ 10 Mbps ↑ 500 GB Data Cap. TV 238 channels, Internet and Unlimited Phone. 1- year promo rate. 50 Mbps Internet speed available for $50 per month for 12

months for new Internet customers only. 50 Mbps Internet speeds regularly $99.95. Half Off professional installation with Internet = $49.98 (regularly $99.95)

$135.90/mo for 50 Mbps 50 Mbps ↓ 10 Mbps ↑ 500 GB Data Cap. TV 238 channels, Internet and Phone. 1- year promo rate. 50 Mbps Internet speed available for $50 per month for 12 months for new Internet customers only. 50 Mbps Internet speeds regularly $99.95. Half Off professional installation with Internet = $49.98 (regularly $99.95)

$133.40/mo for 50 Mbps 50 Mbps ↓ 10 Mbps ↑ 500 GB Data Cap. TV 158 channels, Internet and Phone. 1- year promo rate. 50 Mbps Internet speed available for $50 per month for 12 months for new Internet customers only. 50 Mbps Internet speeds regularly $99.95. Half Off professional installation with Internet = $49.98 (regularly $99.95)

Xfinity Cable ✔

$149.99/mo for 1,000 Mbps 1,000 Mbps ↓ and 35 Mbps ↑ with no data cap. TV: Limited Basic + Digital Premier Tier, Xfinity Voice Unlimited, Contract term: 2 years. Setup $0 (Free professional installation. Modem w/WiFi $11 per month

$119.99/mo for 400 Mbps 400 Mbps ↓ and 10 Mbps ↑ with no data cap. TV: Limited Basic + Digital Preferred Tier, Unlimited nationwide calling, Contract term: 2 years. Setup $0 (Free standard shipping of self-install kit. Professional Install is $29.99. Modem w/WiFi $11 per month

$49.99/mo for 100 Mbps 100 Mbps ↓ and 5 Mbps ↑ with no data cap. TV: Choice TV. Setup $0 (Free standard shipping of self-install kit. Professional Install is $29.99. Modem w/WiFi $11 per month

$92.95/mo for 250 Mbps 250 Mbps ↓ and 10 Mbps ↑ with no data cap. Setup $0 (Free standard shipping of self-install kit. Professional Install is $29.99. Modem w/WiFi $11 per month

$89.99/mo for 1,000 Mbps 1,000 Mbps ↓ and 35 Mbps ↑ with no data cap. Setup $59.99 includes professional installation. Modem w/WiFi $11 per month

$89.95/mo for 150 Mbps 150 Mbps ↓ and 5 Mbps ↑ with no data cap. (Free standard shipping of self-install kit. Professional Install is $59.99. Modem w/WiFi $11 per month

$79.99/mo for 400 Mbps 400 Mbps ↓ and 10 Mbps ↑ with no data cap. 1 year promo rate. Regular rate is $99.95. (Free standard shipping of self-install kit. Professional Install is $59.99. Modem w/WiFi $11 per month

$39.99/mo for 60 Mbps 60 Mbps ↓ and 5 Mbps ↑ with no data cap. 1 year promo rate. Regular rate is $74.95. (Free standard shipping of self-install kit. Professional Install is $59.99. Modem w/WiFi $11 per month

Cox Cable ✔

$159.99/mo for 1,000 Mbps 1,000 Mbps ↓ up to 35 Mbps ↑ Unlimited data. TV 250 channels, Internet and Phone. 1- year promo rate, regularly $296.97 per month. Two year contract. Free professional install.

$129.99/mo for 300 Mbps 300 Mbps ↓ up to 30 Mbps ↑ Unlimited data. TV 250 channels, Internet and Phone. 1- year promo rate, regularly $296.97 per month. Two year contract. Free professional install.

$109.99/mo for 300 Mbps 300 Mbps ↓ up to 30 Mbps ↑ Unlimited data. TV 170 channels, Internet and Phone. 1- year promo rate, regularly $278.93 per month. Two year contract. Free professional install.

$89.99/mo for 100 Mbps 100 Mbps ↓ up to 10 Mbps ↑ Unlimited data. TV 140 channels, Internet and Phone. 1- year promo rate, regularly $190.97 per month. Two year contract. Free professional install.

$64.99/mo for 10 Mbps 10 Mbps ↓ up to 1 Mbps ↑ Unlimited data. TV 75 channels, Internet and Phone. 1- year promo rate, regularly $91.98 per month. Two year contract. Free professional install.

Fixed Wireless Providers

B2X Online

Pricing not yet discovered. Speed appears to 4.7 Mbps on the downlink and 1.5 Mbps on the uplink. (Call placed 540 389-7924, No response as of 12/5/18).

Residential Satellite Internet Pricing

HughesNet

$59.99/mo for 25 Mbps ↓ 3 Mbps ↑ 10 GB/mo data cap. Two year contract with up to $400 ETF. Two year prom rate. Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once monthly plan data is use. From 2am-8am, customers have access to 50 GB/month of additional plan data. Setup $99. Modem: $14.99/mo.

$69.99/mo for 25 Mbps ↓ 3 Mbps ↑ 20 GB/mo data cap. Two year contract with up to $400 ETF. Two year promo rate. Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once monthly plan data is use. From 2am-8am, customers have access to 50 GB/month of additional plan data. Setup $99. Modem: $14.99/mo.

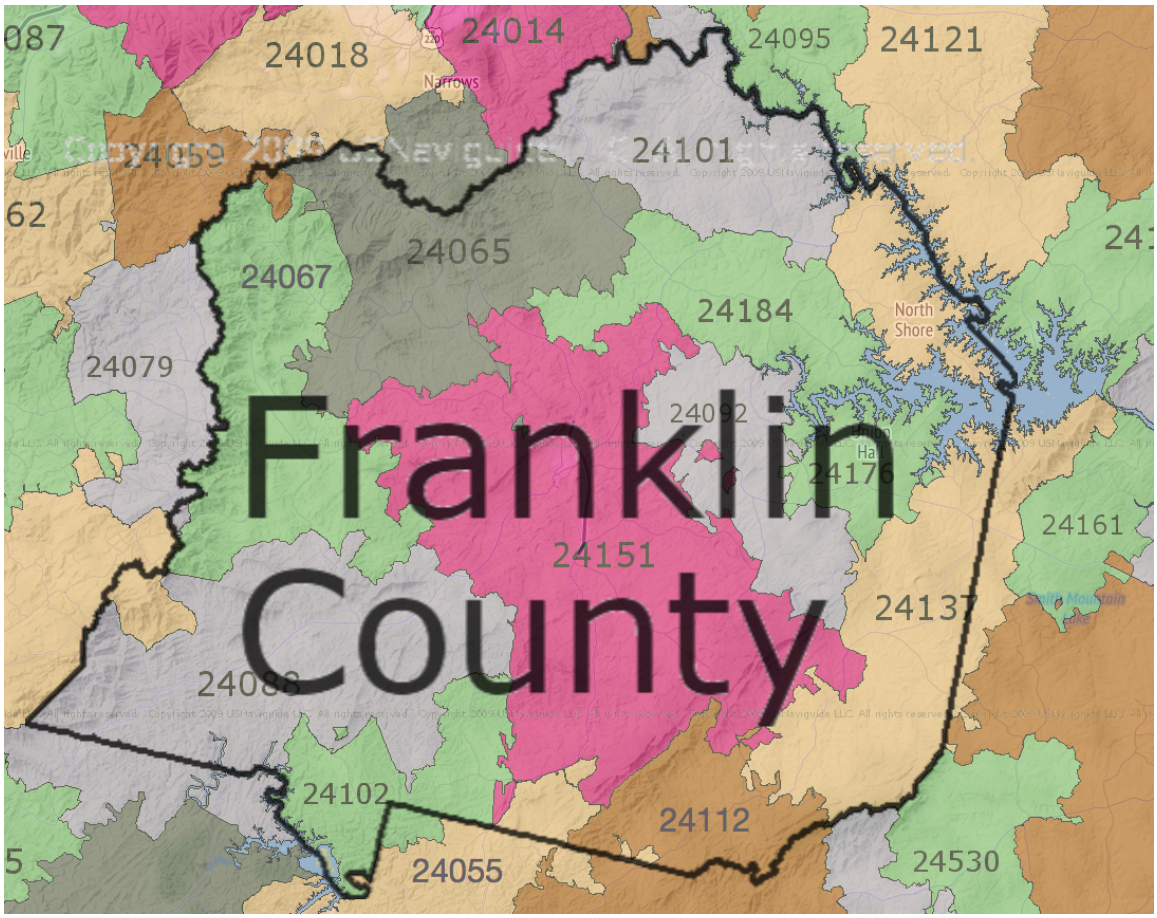
ViaSat/Excede

$50/mo for up to 12 Mbps ↓ Unlimited priority data. $70/mo after three months

$70/mo for 25 Mbps ↓ Unlimited priority data. $100/mo after three months

$100/mo for 25 Mbps ↓ Unlimited priority data. $150/mo after three months

Zip Code Maps



7.1 HOW MUCH BANDWIDTH IS ENOUGH?

Bandwidth needs for the past several years have been growing by an estimated 30% per year, and show no sign of slowing.

This means residential and business bandwidth needs are doubling every three years.

As computers and associated hardware (e.g. video cameras, audio equipment, VoIP phones) become more powerful and less expensive, new applications and services are continually emerging that drive demand for more bandwidth.

In most areas of the county, residents currently have, at best, the FCC 10 Megabits down/1 Megabit up bandwidth. This slow speed service is is impacting economic and community development:

- It limits resident's ability to work from home.
- It limits school children's ability to access the K12 and higher education resources needed to complete homework assignments.
- It limits resident's ability to access cost-saving tele-medicine and tele-health services from home.
- It limits resident's ability shop from home to save money on gas and travel expenses.

"Next generation" is the term used to describe future planning for network connectivity and infrastructure. Next generation broadband reaps substantial benefits. There are several key benefits of "Next-Generation Broadband":

- Dramatically faster file transfer speeds for both uploads and downloads
- The ability to transmit streaming video, transforming the Internet into a far more visual medium
- Means to engage in true-real time collaboration
- The ability to use many applications simultaneously
- Ability to maintain more flexible work schedules by being able to work from home on a part time or full time basis
- The ability to obtain health-related services for an occasional illness and/or long term medical services for chronic illnesses.

Clearly, consumers have a strong interest in a visual medium from when and wherever they are. YouTube is the second most popular search engine after Google, which demonstrates the need to support the infrastructure to transmit streaming video. In addition to video streaming, true-real time collaboration also provides an effective way for people to interact from wherever they are. People can engage in a two-way, real-time collaboration, so that fruitful, visual conversations can be held between friends, family, business associates from the state, country, or internationally.

Because of fiber networks, employees have the capabilities of working from their home. Findings suggest that if all Americans had fiber to the home, this would lead to a 5 percent reduction in gasoline use, a 4 percent reduction in carbon dioxide emissions, $5 billion in lower road expenditures, and 1.5 billion commute hours recaptured.

7.2 RESIDENTIAL BANDWIDTH NEEDS

In Franklin County, most residents and businesses are relying on copper-based services. The table below depicts the bandwidth needed for typical residential services which are available now or will be available in the near future. In a next generation network all services will be delivered over a single network infrastructure which will require a network that can support providing most services to most consumers simultaneously. Today's shared networks (cable and wireless in particular) rely on the "bursty" nature of traffic to provide services to end users. If all end users were consuming their "advertised" bandwidth today's cable and DSL networks would grind to a halt.

Existing cable modem network users are overwhelming the digital cable networks that were upgraded as little as three or four years ago, and the firms have had to artificially reduce the bandwidth available for certain kinds of high bandwidth services (e.g. peer to peer file sharing). Some cable providers have even run into capacity issues with the TV portion of their networks, and some consumers have observed that some HD TV channels have been so highly compressed that picture quality has been noticeably degraded.

	Residential Daytime		**Early Evening**		**Evening and Late Night**		**Snow Day**	
Description	Intermittent Television and Internet use across a small percentage of households.		Increased video, voice and Internet use as children arrive home from school and employees from work.		Peak television and Internet use. Multiple TV's are on, phone and computer being used.		On top of typical daytime traffic children are home from school, and many employees are home working.	
	Concurrent Use	**Mbps**	**Concurrent Use**	**Mbps**	**Concurrent Use**	**Mbps**	**Concurrent Use**	**Mbps**
Telephone	1	0.064	1	0.064	1	0.064	1	0.064
Standard Definition TV	1	2.5	1	2.5	1	2.5	1	2.5
HD TV	1	4	2	8	2	8	3	12
Security System	1	0.25	1	0.25	1	0.25	1	0.25
Internet	1	1.5	1	1.5	2	3	3	4.5
Online Gaming		0.25		0.5		1		1
VPN Connection	0	0	1	2	1	2	2	4
Data Backup		0	1	5	1	5	1	0
Telehealth (subscriber)	1	4	1	4	1	4	0	0
Distance Learning / Workforce Training		0	1	10	1	10	2	20
HD Videoconferencing		0		0		0	1	14
Totals		12.6		33.8		35.8		58.3
5 years from now (Megabits)		**38**		**101**		**107**		**175**
10 years from now (Megabits)		**113**		**304**		**322**		**525**

7.3 ACTIVITIES IN NEIGHBORING COUNTIES

Bedford County recently became the recipient of a substantial VATI (Virginia Telecommunications Initiative) for approximately $1 million. In partnership with Blue Ridge Towers (BRT), the project expects to construct nine new towers the county, and Bedford County will provide space for BRT wireless equipment on two existing county-owned towers. A subsidiary of BRT, BriscNet, will be the ISP for the project. Also included is twenty-one miles of fiber that will be installed by BRT. The fiber will be used to provide connectivity between some of the towers.

In Floyd County, Citizens Telephone Coop has announced a three year plan to install Gigabit fiber to nearly all county homes and businesses. The cost of the project will be financed with Federal funds, one time $199 fees charged to each connected premises, and operating revenue generated by Citizens Coop services.

In Roanoke County, the Roanoke Broadband Authority now has more than sixty miles of middle mile fiber that is marketed primarily to business and wholesale customers.

8.1 CLOSING THE BROADBAND GAP

In most areas of the county, residents and businesses currently have, at best, the FCC 10 Megabits down/1 Megabit up bandwidth. This slow speed service is is impacting economic and community development. Instead, the question is:

"What do businesses and residents of Franklin County need to be able to compete globally over the next thirty years?"

In short, the county today has "little broadband" in the form of DSL, very limited wireless, expensive satellite Internet, and and very limited cable modem service, along with a very limited amount of "big broadband" in the form of fiber to a few businesses and institutions.

If the County and the Authority make investments in broadband and telecommunications infrastructure, it is absolutely critical that those investments are able to scale gracefully to meet business and economic development needs for decades.

To close that gap between the FCC definitions and what the county needs to support future work opportunities and to support K12 and higher education school work, the county needs the following:

Broadband Service	Target Date	Technology	Where Needed
10 Megabits upload/10 Megabits download	2020	Wireless	As much of the county as possible, given funding constraints
20 Megabits upload/10 Megabits download	2020	Wireless	In some locations in the county
50 Megabits upload/10 Megabits download	2021	Wireless, fiber	In some locations in the county
Gigabit upload/Gigabit download	2020	Fiber	In key business and commercial areas
100 Megabits upload/ 100 Megabits download	2021	Fiber	Available to a minimum of 50% of residents in the county

8.2 LIMITING FACTORS

The factors that are limiting broadband availability and affordability in the county includes:

- Low population density - The generally low density of homes and businesses in the the county make it more difficult for competitive service providers (e.g. WISPs) to justify the expense of building towers and offering Internet service.

- Poor service - Like most areas of Virginia, CenturyLink and Verizon have not upgraded infrastructure and DSL service is slow and unreliable.
- Limited cable Internet service - Related to the low density, cable Internet service is very limited.
- Lack of regional entity to manage infrastructure improvements - At the present time, there is no coordinated three county effort to plan broadband infrastructure improvements and coordinate funding and grant applications.
- Difficult terrain for wireless service - The terrain in the county has many low hills, which blocks wireless broadband signals and requires more towers and community poles than some other parts of Virginia.

8.3 CURRENT AND FUTURE USES AND SERVICES

When analyzing future service needs, it is important to take into account ALL services that may be delivered over a broadband connection. "Broadband" is not a service--it is a delivery medium. If we think about broadband using a roads analogy, broadband is the road, not the trucks that use the road. Internet access is a service delivered by a broadband road system, and that Internet service is just one of many services that are in demand. Today, congestion on broadband networks is not due just to increased use of email and Web surfing, but many other services.

This means that current DSL, wireless, and cable modem services are completely inadequate for future needs. Current DSL offerings are in the range of 1 Megabit to 3 Megabits for most residential users, 3 Megabits to 5 Megabits for business DSL users, and there are severe distance limitations on DSL. Higher bandwidth is possible, but as the DSL bandwidth goes up, the distance it can be delivered goes down.

Typical wireless broadband (i.e. not cellular data service) offerings are in the range of 5 Megabit to 10 Megabits. Some wireless providers are rolling out 10-20 Megabit services. As bandwidth increases, the cost of the equipment also increases, and even a 20 Megabit service is well short of the FCC definition of broadband: 25 Megabits down and 3 Megabits up.

Across the U.S., current average bandwidth for cable modem services is typically 10 to 25 Megabits, with cable companies promising much more using the phrase "up to..." to obscure actual bandwidth being delivered.

The challenge for the area is to ensure that the businesses, residents, and institutions have a telecommunications infrastructure in place that will meet future needs.

Distance learning, entertainment, and video conferencing are three major applications of internet video. Distance learning from home with live video feeds requires high performance 2-5 Megabit connections in the near term (next 2-4 years), and over the next 4 to 7 years, there will be many distance learning courses that will incorporate live HD two-way video feeds, enabling students to participate in classroom discussions at a much higher quality level. Distance learning could be an important home-based application for workforce training and retraining.

"U.S. homes now have more than half a billion devices connected to the Internet, according to a study by the NPD Group. Furthermore, the overall number of connected devices per household is 10. This is more than three times the average number of people per household."

The table below lists these and other services that all represent broadband-enabled applications and services that must be available in at least parts of the county if it is to remain economically viable.

Residential and Business	Videoconferencing
	IP TV (Internet Protocol TV)
	HD streaming video
	Ultra hi-def (BluRay) video streaming
	Video on demand (e.g. Netflix)
	Place-shifted video
	Cloud computing services
	Online and cloud-based gaming
	Smart homes, buildings, and appliances, including smart electric meters, AMR (automated meter reading), and AMI (advanced metering infrastructure)
	Remote computer aided design (CAD)
	Work from home jobs
	Business from home
	3D graphic rendering and CGI server farms
	Remote network management and managed services
	Virtual collaboration spaces (e.g. enhanced GoToMeeting, Webex style services)
Public Safety	Intelligent transportation applications (smart road systems)
	Public safety and first responder networks
	Emergency dispatch and coordination
	Webcast agency meetings (e.g. virtual meetings)
	Online training for first responders, fire, and rescue
Society	Broadcast of local sports events
	Videoconferencing of community and town hall meetings for wider participation
	Wider availability of nonprofit and community organization services

Health Care	Teleconsultations
	Telepathology
	Telesurgery
	Remote patient monitoring
	Remote diagnosis
	Remote medical imaging
	Grid computing for medical research
Education and Research	Distance education
	Virtual classrooms
	Remote instrumentation
	Multi-campus collaboration
	Digital content repositories and distribution (digital libraries)
	Data visualization
	Virtual laboratories
	Grid computing for academic research

12 LAST MILE CONNECTIVITY SOLUTIONS

12.1 OVERVIEW OF NETWORK TECHNOLOGIES

In Franklin County, broadband wireless has already become an important strategy for improved Internet access for businesses and residents. But both fiber and wireless technologies and systems are going to be important to meet the goal of improving access to broadband. The rest of this section provides more detail and some specific build out strategies.

Businesses and residents in the county may obtain Internet service:

- With a small radio directly attached to their home or business that receives a signal directly from a towers owned by a private provider, from a County-owned tower (e.g. shared with public safety use), or from a community-owned tower (e.g. a coop).
- With a small radio attached to a utility pole (60 or 70') to improve line of sight to a tower.
- With a small radio directly attached to their home or business that receives a signal from a "community" utility pole. The "community" pole with receive a signal from a distant tower and redistribute it locally to a cluster of customers (typically within a half mile).
- With a fiber connection to the fiber installed in areas where economic development is important, and in other areas as additional fiber network segments are added.

The table below summarizes how fiber and wireless can work together in a variety of ways.

Distribution Type	Access Type	Capacity
Wireless	Wireless	Typical customer connection starting at 5 to 10 Megabits, can be higher, with 50 Meg connections common. More dependent on the capacity of the wireless Distribution link.
Wireless	Fiber	Users can have fiber Gigabit connections locally, but total throughput dependent upon the capacity of the wireless link, which can be up to a Gigabit, depending on distance and budget.
Fiber	Fiber	Any amount of bandwidth needed, with standard connection typically a Gigabit (1,000 Megabits).
Fiber	Wireless	Typical customer connection starting at 5 to 10 Megabits, can be higher, with 50 Meg connections common.

12.2 WIRELESS TECHNOLOGIES

WISPs (Wireless Internet Service Providers) use a wide variety of radio frequencies to deliver fixed point wireless broadband. By "fixed point," this means that these systems are not designed to support roaming in the way that cellular voice/data radios are (that is, mobile phone and data services).

Fixed point broadband is broadcast from a tower to individual homes and businesses (fixed points). Most of the frequencies used require clear line of sight between the tower and the location where service is desired. In Virginia and many parts of the east, tree cover is often an obstacle to getting good service.

The hilly topography of Franklin County can work for or against good wireless broadband service. Towers located on the tops of hills and mountains can provide service over a larger area than a tower in relatively flat terrain, but hills also block the signal. A residence can be a short distance from a large tower, but heavy tree cover or an intervening hill will block service. The solution to this can be addressed in several ways:

More larger towers of 180' to 300'

The taller the tower, the wider the coverage, but as tower height increases, the cost of the tower also increases. Towers taller than 190' require a light at the top to make them visible to low-flying aircraft, and lighted towers are more expensive to erect, and the bulbs have to be changed periodically at significant expense. Many broadband towers are 180' to avoid the additional cost of lighting.

Small cell broadband towers

Small cell broadband towers, often called community poles, are shorter towers or utility poles of typically 60' to 80', located in or very near a cluster of homes. The towers can be wooden utility poles or relatively low cost steel monopoles or steel lattice towers. These towers are located to get above local tree cover so that clear line of sight to a distant taller tower is available. Local access point radios provide service to homes and businesses with line of sight to the pole. In Franklin County, these are going to be an important part of a strategy to get better broadband to rural residents and businesses.

Variety of radio frequencies

WISPs are beginning to deploy a wider range of licensed and unlicensed radio frequencies to overcome distance, bandwidth, and line of sight issues. Traditional 2.4 Ghz and 5.7 Ghz WiFi and WiMax frequencies are being supplemented or replaced with LTE broadband radios that provide better bandwidth and will tolerate light tree cover better (2.5 Ghz, 3.5-3.7 Ghz). Some WISPs are also using lower frequencies (e.g. 900 Mhz) that will travel farther and will also provide better penetration in light tree cover.

12.3 EMERGING WIRELESS TECHNOLOGIES

MIMO Wireless

MIMO (Multiple Input, Multiple Output) describes a variety of technologies that can be summarized as using more than one receive and transmit antenna for wireless data applications. Wireless protocols that are using the MIMO concept include IEEE 802.11n (Wi-Fi), IEEE 802.11ac (Wi-Fi), 4G, LTE (Long Term Evolution), and WiMAX. Each of these protocols use the MIMO technology to increase the amount of available bandwidth in a given section of radio frequency spectrum.

New hardware is required to make effective use of MIMO. While the technology increases wireless bandwidth, the typical amount of bandwidth being used by wireless devices is also increasing

rapidly. Some applications where MIMO is likely to provide noticeable improvements are in home wireless routers, where the effective throughput will be able to better handle the demanding bandwidth requirements of HD and 4K video streams. MIMO is slowly being developed for use with cellular smartphones, but both the phones and the cell tower radios have to be upgraded to support MIMO.

LTE/4G/5G

LTE (Long Term Evolution) is a set of protocols and technologies designed to improve the performance of voice/data smartphones. Like MIMO, both the user phone and the cell tower radios have to be upgraded to support LTE improvements. In 2013, only 19% of U.S. smartphone users were able to take advantage of LTE speeds, although that percentage has been increasing rapidly since then, and more than 85% of the U.S. cellular towers have been upgraded to LTE. As noted previously, the actual bandwidth available to a smartphone user is highly variable and depends on distance from the cell tower, the number of smartphones accessing the same tower simultaneously, and the kinds of services and content being accessed by those users.

The primary purpose of cellular bandwidth caps is to keep cellular users from using too much bandwidth and degrading the overall service. While LTE and MIMO improvements will improve overall cellular service, these technologies are not going to replace fiber to the home and fiber to the business.

In 2017, new fixed broadband wireless systems entered the marketplace using LTE frequencies, and many WISPs have begun to replace existing wireless radio systems with LTE equipment. These LTE systems do not provide any cellular voice services; they are designed specifically to support only broadband/Internet service.

Reports of performance have been mixed. In our conversations with both vendors of these systems and WISPs that have begun testing them, we get two very different stories. The vendors have been conservative in discussing the improvements, while some WISPs have been taking single user test results and suggesting that they will be able to deliver higher speeds at greater distances to all users.

There is little debate that the LTE equipment offers higher bandwidth, at somewhat greater distances, and with somewhat better penetration of light foliage and tree cover. Over the next two to four years, most WISPs will change out most of their existing radio systems for the improved LTE radios.

The much touted 5G wireless technology, as of 2019, is still largely marketing hype. The official standard for 5G radio technologies is planned for release later in 2019, although some companies, like Verizon, have begun trials of the equipment with a few customers.

5G does bring much higher speeds to wireless broadband (e.g. it might be able to deliver 30 to 50 Meg of bandwidth consistently). But 5G has significant limitations that do not make it a good solution in rural areas of the U.S.

The fact that 5G can deliver much higher bandwidth means that 5G cell sites will require fiber connections. This is going to effectively limit 5G deployments to denser urban environments where both customers and fiber are plentiful.

There is no free lunch in the physics of radio frequencies. The higher bandwidth of 5G means that cell sites need to be closer together

To achieve the full benefit of 5G technology, more fiber is needed.

because the 5G frequencies do not travel as far as existing 4G/LTE frequencies currently being used by the cellular industry. Most users will have to be within

Some experts estimate that more than a million miles of new fiber will have to be deployed just to support the 25 largest metro areas in the U.S. 5G will not appear overnight.

As many as 60 cell sites per square mile may be needed to make 5G widely available in a given area. If, as an example, about 25%, or 172 square miles of Franklin County is underserved, a thousand or more cell sites would be needed to provide ubiquitous coverage.

For rural areas, the cost of 5G service may be one of the most significant obstacles. The cellular carriers see the increased customer bandwidth use possible on 5G networks as a major revenue opportunity. While they will increase the "standard" bandwidth package for monthly service, bandwidth caps and rate limiting is likely to keep 5G cellular customers bills high.

White space broadband

White space broadband uses some of the frequencies that were formerly used by analog TV channels. These lower frequencies travel farther and provide better penetration of light foliage. Microsoft has been supporting a number of community white space experiments, and has promised much wider support for this technology, but there are few other users, equipment is still relatively expensive, and few WISPs have ventured into this still largely experimental technology. The Microsoft white space project in southern Virginia, although still underway, serves less than three hundred households and is still regarded as experimental.

12.4 DARK FIBER AND LIT FIBER

About Dark Fiber

Dark fiber is installed in conduit underground and/or hung on utility poles. It is called "dark" because no network electronics are installed to "light" the fiber (using small lasers in a fiber switch). For small municipal/local government fiber installations, dark fiber has a significant advantage in terms of management–very little ongoing operational responsibility is required.

Dark fiber is leased out to service providers, who install their own network electronics in cabinets or shelters attached to the fiber cables. The providers typically lease fiber pairs between the cabinet and their customers, and are responsible for all equipment-related management and maintenance.

Dark fiber networks do not generate large amounts of revenue, but this is offset by very low maintenance costs–primarily an emergency break-fix arrangement with a local or regional firm qualified to splice fiber. Emergency break-fix contracts are usually based on a time and materials basis, so there is little or no expense if there are no fiber breaks.

Other costs include "locates," which are called in to Gopher State One Call (Miss Utility) and are performed by either the local Public Works department or a private sector contractor. For small fiber networks, locate costs are generally modest.

About Lit Fiber

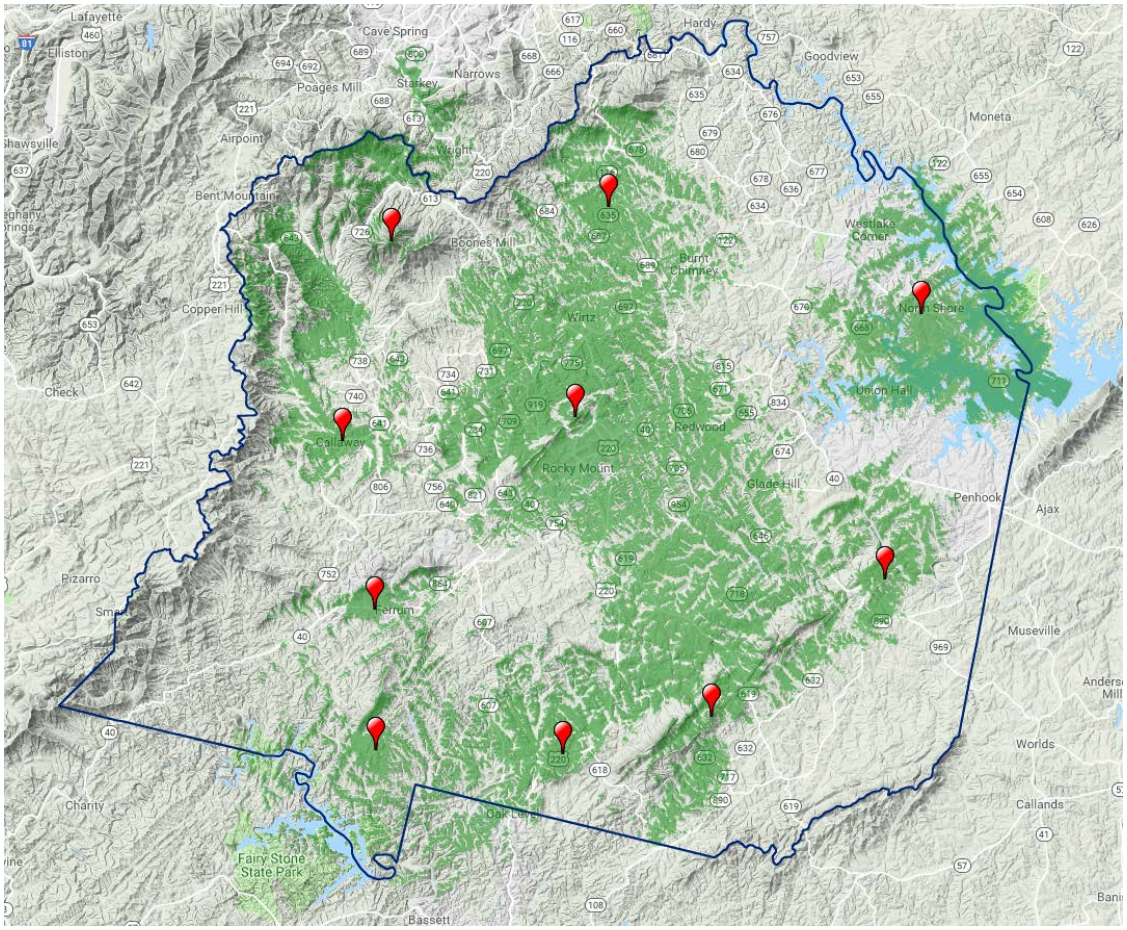
A "lit" fiber network includes the network electronics needed to transmit data over the fiber (using the small lasers in a fiber switch, hence there is light traveling over the fiber cable). In a lit network, "lit circuits" are leased out to service providers rather than fiber pairs. The muni/local government/

community network provides the network electronics, which reduces costs for the service provider –meaning they are able to pay higher lease fees for the circuits they use to deliver services (like Internet) to their customers. Lit networks generate more revenue, but also have higher expenses because the network electronics have to be monitored and managed on a 24/7/365 basis (this task can usually be outsourced at reasonable cost). However, very small fiber deployments often do not pass enough homes or businesses to generate sufficient revenue to cover the higher costs.

Like dark fiber, a lit network incurs break-fix and locate costs as well.

12.5 TERRAIN CHALLENGES

The propagation study map below illustrates the challenge of providing adequate fixed point wireless Internet service in the county. The mountainous terrain, especially in the western portions of the county, shows that even ten towers does not provide an adequate solution. A combination of taller towers (180' in this study) and shorter community poles (as many as 40 or 50) may be needed to provide good service to most areas of the county.

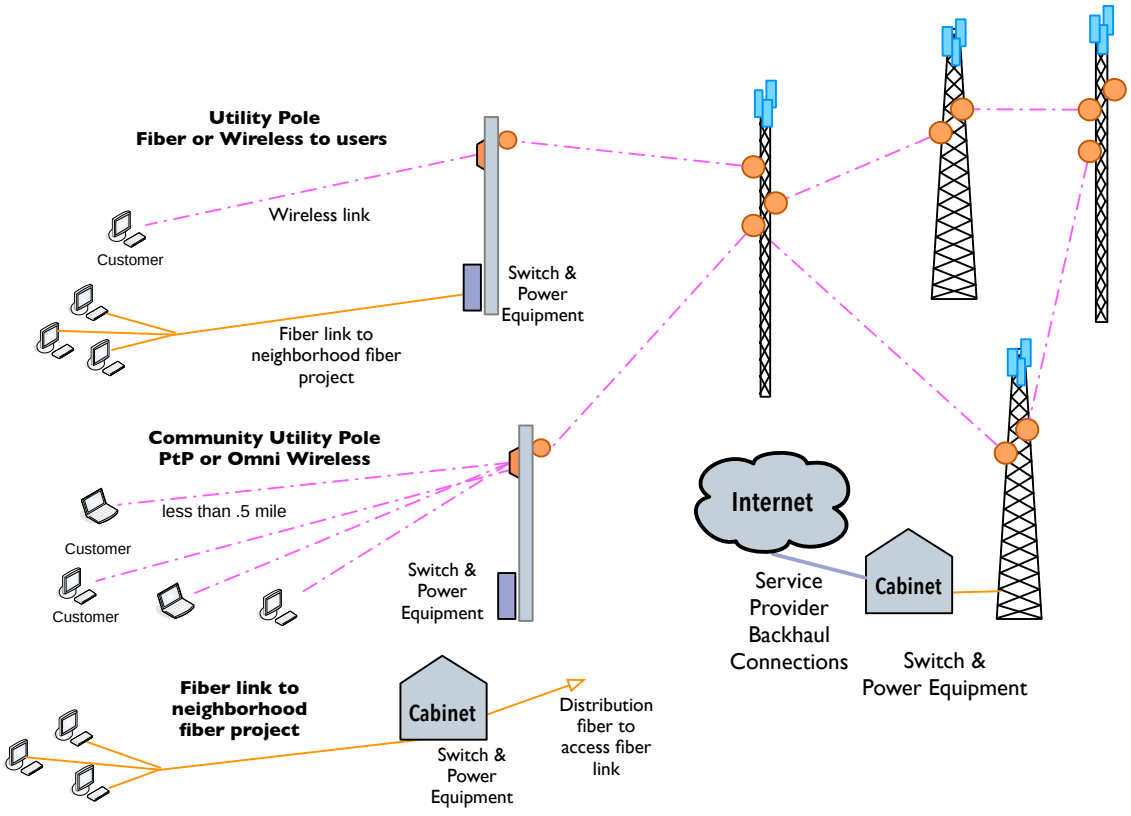


12.6 CONNECTIVITY SOLUTIONS

Both wireless and fiber networks, as well as legacy copper-based networks, all share three primary components. How these are designed and deployed can vary greatly, but all networks have these three parts in some form.

- The **Core Network** provides access to the Internet, a place for service providers (ISPs) to distribute their services locally on the network, and for larger institutional and business customers to meet service providers. The county has both landline and wireless service providers, but there are still areas that are underserved. Each of these providers has their own Core Network, but wireless broadband could be more widely available if additional county-owned towers were available to the private sector providers.
- The **Distribution** portion of the network connects the Core Network with collections of users. A Distribution network can include both fiber and wireless portions of a network.
- The **Access or Last Mile** portion of the network connects residential users and businesses to the network, and like the Distribution network, that connection will be by fiber or by a wireless link.

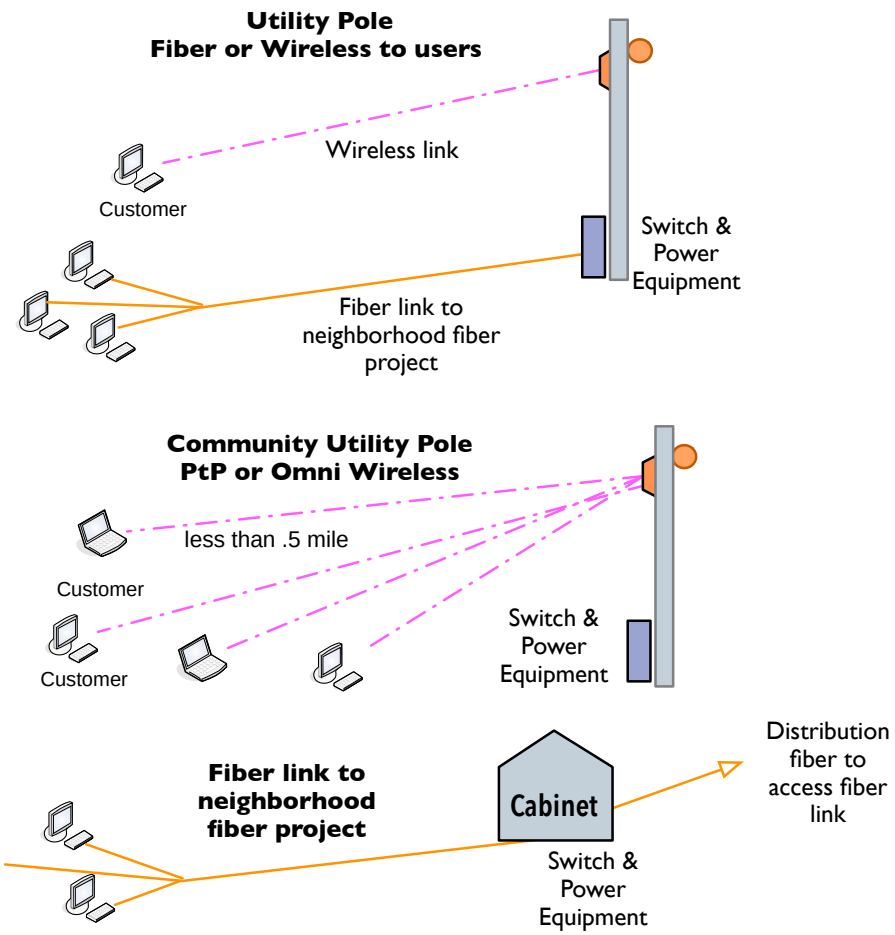
The illustration below shows the full range of technology options (fiber and wireless) and how they can be connected together in various ways to meet the diverse needs of the county. More detail is provided on the following pages.



Last Mile Access

The Last Mile Access is the portion of the network that connects customers to their service provider and the Internet. Both broadband wireless and fiber links can be utilized to provide service. There are several ways that customers can receive service:

- Service providers can install their own local access radios on the Distribution towers, using both point to multi-point and point-to-point radios to deliver service to their customers.
- A single user utility pole (or inexpensive steel lattice tower) can be installed on the property of a single resident or business. A radio at the top of the pole receives service from another tower site (typically one of the Distribution towers).
- A utility pole (or inexpensive steel lattice tower) can be installed near a cluster of homes (e.g. a rural residential sub-division, several homes in close proximity on a rural road). Service providers can install their point to multi-point radios on this pole and provide economical service to several customers from a single pole.
- A utility pole (or inexpensive steel lattice tower) can be installed in a rural subdivision. A service provider installs a point to point radio on the pole, and fiber cable can be run from the pole past several homes to offer fiber service with wireless backhaul.
- Customers near existing fiber can have a fiber drop installed directly to their home or business.



Distribution Network

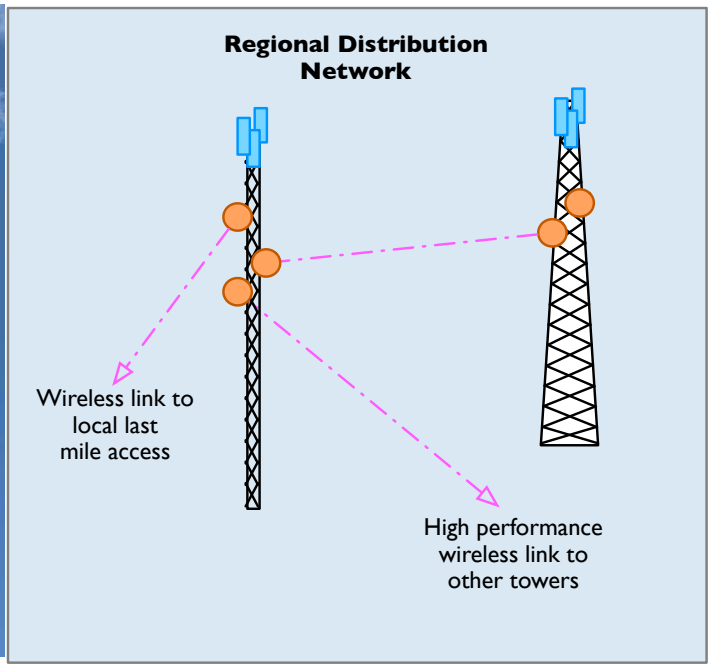
Distribution is the portion of the network between the Distribution sites to the Last Mile Access portion of the network. It is desirable for each distribution site to have a connection back to more than one Distribution site (tower) on a redundant ring. This ring topology protects against hardware failure at the port level and does provide some protection if one of the tower to tower wireless links is disabled by an equipment failure.

These tower sites are typically 120' to 180' tall to provide the height needed to enable Line Of Sight (LOS) between towers, and for local access, to enable service providers to mount point to multi-point radios on the towers.

Towers taller than 199' become subject to FAA regulations because the height can be a potential hazard to airplanes. Towers that exceed 199' usually have to be painted (alternating red/white) and have a blinking light at the top. These requirements increase the long term maintenance costs, but the taller towers can improve line of sight to other towers.

The towers can provide two functions:

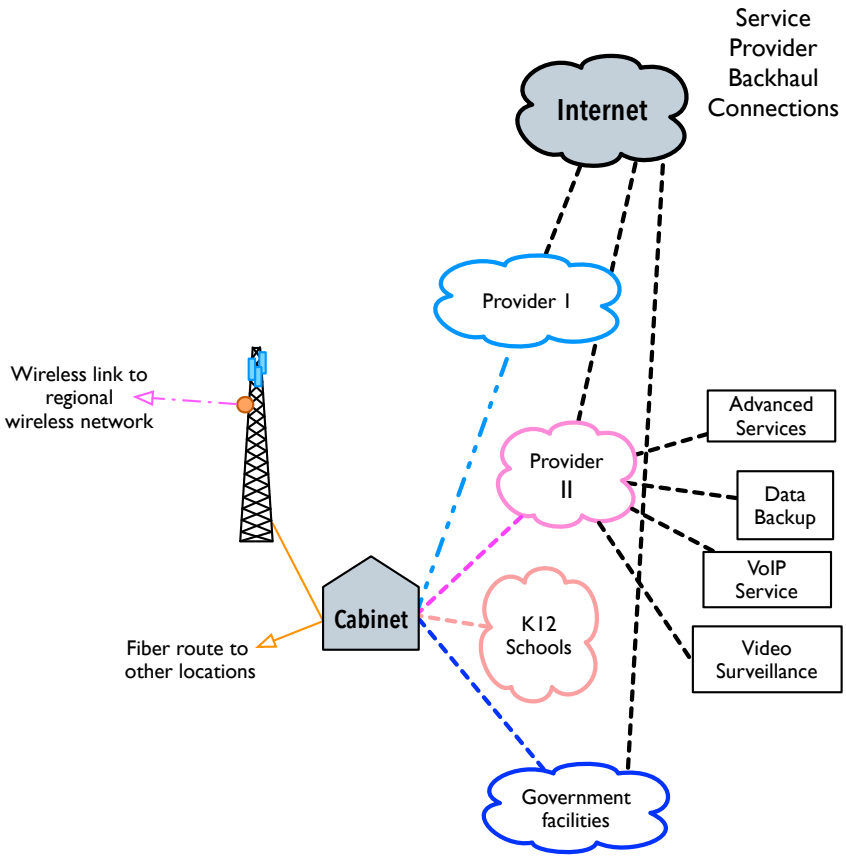
- Space for backhaul connections to other towers in the county.
- Space for local access radios to provide Internet access within 2-3 miles of the tower (or farther with good Line Of Sight).



Core Network and Service Providers

In the past, the telephone company switch office (Central Office, or CO) has provided that function. Today, many communities have either a community-owned data center or a privately owned data center that offers an affordable range of options for customers of broadband services.

The Co-Location facility provides a meet point for various public and private fiber cables and networks to inter-connect. In the county, there are no shared peering points, and a local facility with space available for both public and private uses could help attract additional private sector investments (e.g. a long haul fiber provider builds into the county to connect to this facility because of increased access to customers).



A colocation facility is a controlled environment (i.e. secure, heated, and air-conditioned) room with Internet access through wired and/or wireless systems. The colocation facility is a place where fiber, wireless, and copper-based network facilities meet. It is equipped to house high-end network equipment, servers, and other electronic gear.

A variety of middle layer network components and services can be located within the co-lo including, for example, directory services, replicated content servers, routing services, and other elements needed to deliver new multimedia services to the home and small office from multiple, competing providers.

Characteristics of the colocation facility are:

- A reliable source of AC electric power is required, with backup UPS (Uninterruptible Power Supply) service, and additional power backup available by an onsite generator.
- Controlled access to the facility (e.g. by electronic keycard) 24 hours/day, seven days a week.
- Racks for locating network equipment and servers, and optionally locked cages for equipment racks.
- Sufficient cooling capacity for the network's current and long-term needs.

12.7 SMALL CELL BROADBAND POLES

Line of sight issues are a constant problem for rural residents and businesses, as clear line of sight (or near line of sight) is required for fixed wireless Internet services. Even newer technologies like white space and LTE systems work better with clear line of sight to distant towers.

The increased use of wooden utility poles is already common in some other areas of the country, and increased use of this technique to get the customer CPE radio/antenna above tree cover is a relatively simple solution.

Ownership and Governance

The utility poles would normally be placed on private property, subject to existing or updated ordinances governing the placement of wooden utility poles. The local government would have no responsibility for maintenance and repairs.

Cost Discussion

The cost of placing an eighty foot pole can range from a low of about $2,000 to $7,000 or more, depending on permitting, engineering requirements, and the location of the pole. The Virginia General Assembly recently passed legislation requiring localities to allow small wireless facilities of 50 -feet or less by-right. The County is currently working on amendments to its tower ordinances to allow more flexibility for broadband deployment.

Funding Options

Because these are placed on private land, local government would not have to provide any direct funding. However, the localities could encourage wider use of this option with a public awareness campaign developed in partnership with wireless providers. Local banks could be encouraged to provide low cost financing of the poles so that property owners could make a small interest and principal payment monthly over several years to reduce the financial impact.

Operation and Management Considerations

Local government would incur no ongoing operational or management costs.

Recommendation and Next steps

Given that this strategy requires minimal financial support from the County and that it has the potential of improving broadband access in rural areas of Franklin County quickly, the County should support "by right" permitting of wood utility poles in rural areas, including allowing a minimum of fifteen feet above existing tree cover and subject to a very limited set of restrictions (e.g. a minimum set back from public right of way).

County support for an awareness campaign developed with local wireless service providers would also be beneficial.

12.8 NANO-CELL AND WIFI CALLING SERVICE

A common complaint in the county is the poor cell service in many areas. In some parts of the county, there may be adequate broadband service via DSL or cable modem Internet, but poor cellular phone/data service. There are now two solutions to improving rural cellular service that do not involve the expense or difficulty of attracting and/or building more cellular towers.

WiFi Calling – This approach takes advantage of the WiFi Calling feature that is now common in many late model cellphones. Once the phone is connected to a WiFi network (e.g. in the home using the home's broadband Internet service), the phone will automatically route the call over the WiFi network–phone calls and text work normally, as if the phone is connected to a cellular tower.

Nano-cell Calling – Poor or no cellular service in rural areas can be addressed by promoting the wider use of "nano-cell" devices. These small pieces of equipment are connected to the DSL or wireless broadband connection and provide improved cell service in the home or business. The working distance of these devices is limited, and service generally drops off once you leave the house itself (it may work for some short distance in the yard). These devices work very well and do not require an upgrade to a newer phone. The cellular providers do not always promote the use of these devices, so many cellular users who would benefit from their use are not aware that this option is available. The device averages around $200 retail, but the cellular providers often provide substantial rebates (50% discount or more) and in some cases may provide them at no charge.

If there is success in making more tower space available for WISP use, the improved wireless broadband service will also support use of WiFi calling and/or nano-cell devices.

This strategy is important because improved broadband service can also improve cellular service without the need for more cellular towers, especially in parts of the county where cellular providers have not been able to make the business case for more towers.

Cost Discussion

This strategy does not require any direct funding from the County, but the Broadband Authority should play an active role educating residents and businesses about this option. One strategy would be to prepare a simple one page overview of this option and ask local library branches cot make it available.

Funding Options

No special funding required.

Operation and Management Considerations

None.

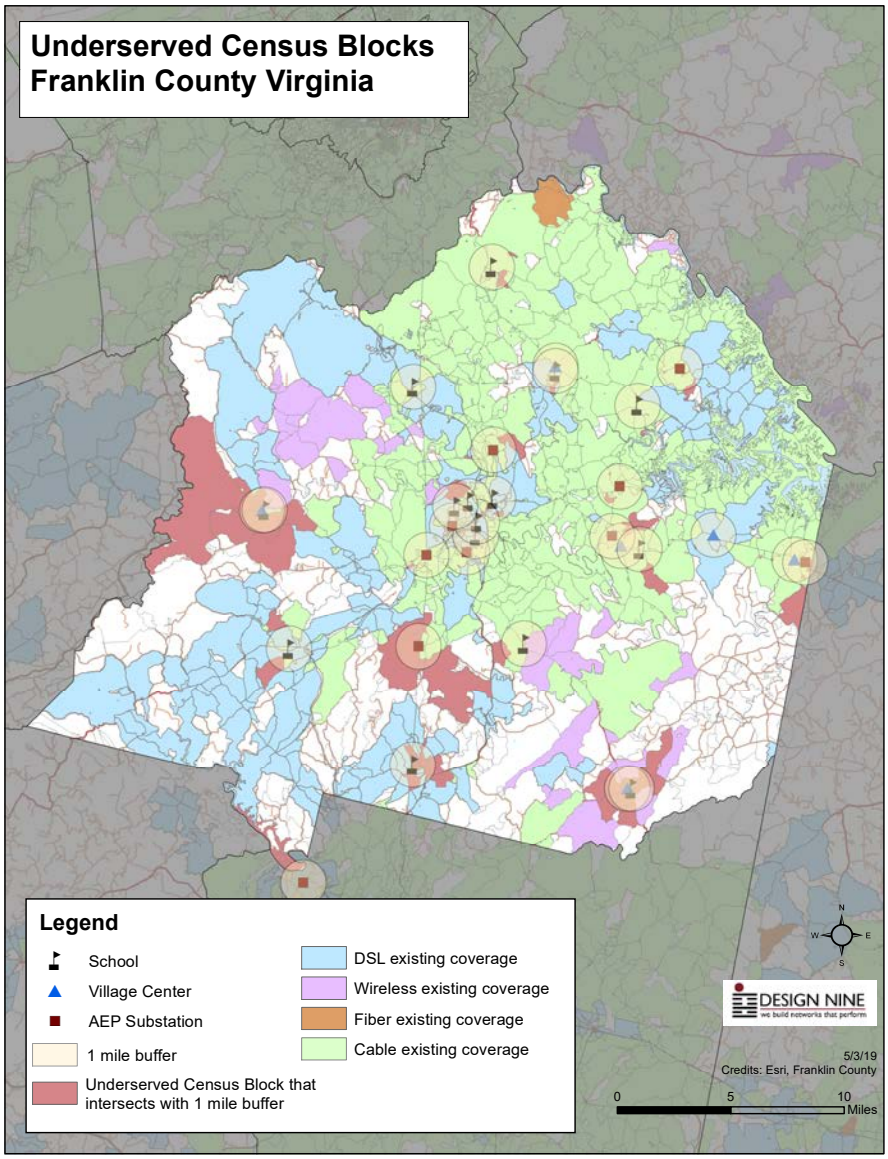
Recommendation and Next Steps

The County could promote awareness of WiFi calling and nano-cell boxes as part of a broader awareness campaign about improving broadband availability.

13 RECOMMENDATIONS FOR IMPLEMENTATION

To develop a county-wide strategy for improving broadband availability, K12 schools, sub-stations, and villages were identified. Fiber is already at all K12 school locations in the county. Sub-stations have been included because of a recent state initiative to encourage AEP and other electric providers in the Commonwealth to build open access fiber to their sub-stations. Fiber availability at sub-stations would allow both the County and/or private sector service providers to expand service in the area around the sub-stations, using the sub-station fiber to support Internet backhaul and to connect the service areas together.

Both wireless service expansion and fiber to the home (FTTH) expansion from the three types of target areas (K12 schools, villages, sub-stations) are possible. The map to the right shows the underserved census block locations in relation to the target areas.



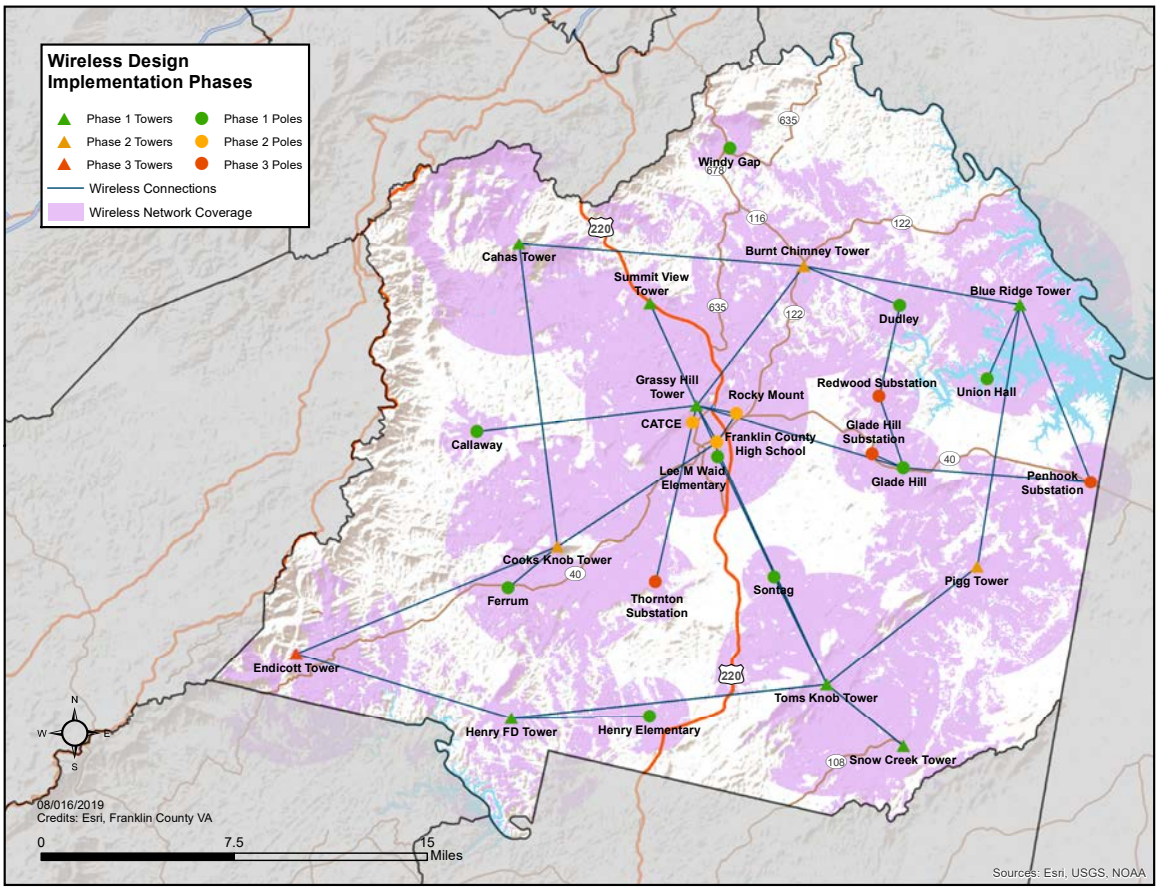
13.1 FIXED POINT WIRELESS EXPANSION

The map below shows the projected wireless broadband coverage in Franklin County, using a network of existing towers, new towers, and shorter community poles. The propagation estimate shows that approximately 65% of the county could receive coverage if clear line of sight or near line of sight is available from a particular home or business.

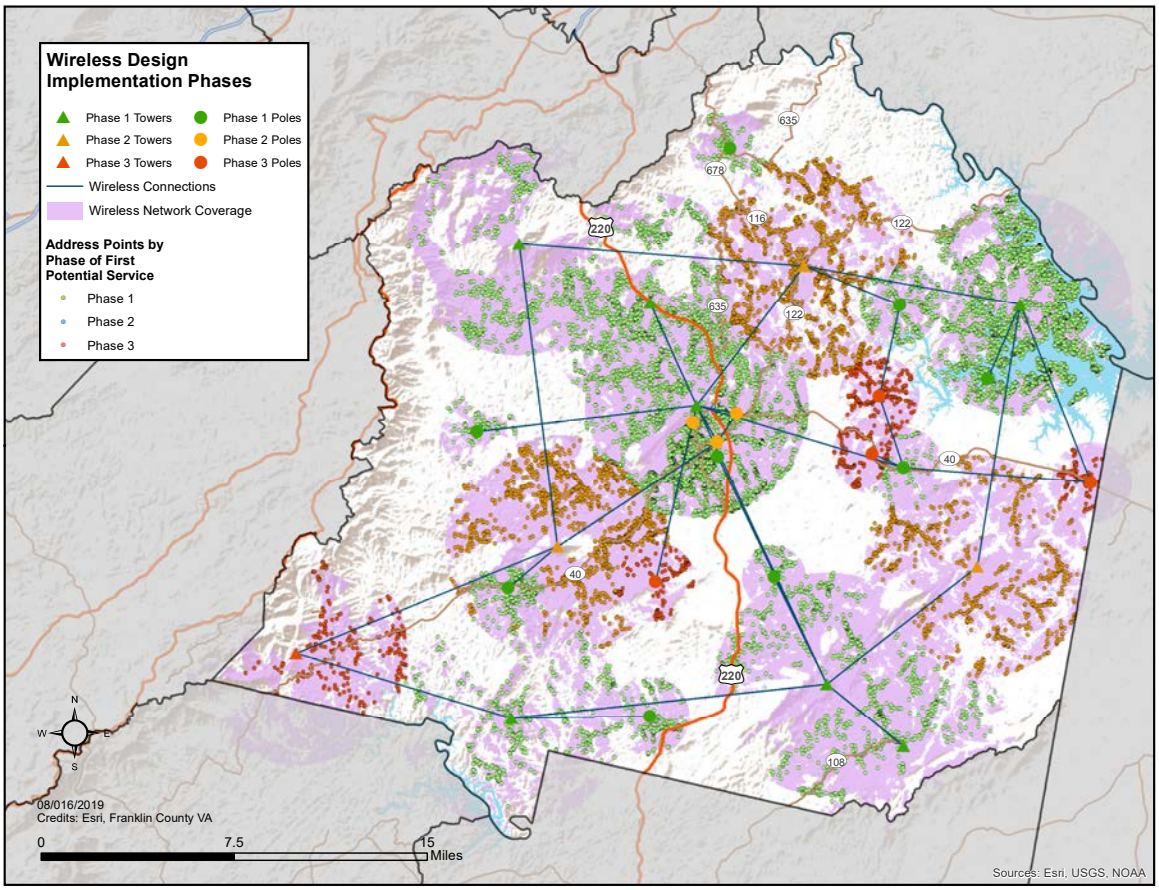
The wireless strategy could be built out in three phases, with the exact phasing of towers and poles somewhat dependent upon the availability of funding. Franklin County intends to apply for VATI funds and Tobacco Commission funds, and may also consider submitting a USDA ReConnect grant application—all of which could support completing some or all of the proposed improvements.

In the map below, the shaded areas show the estimated wireless coverage for each tower or pole. Not all community poles that are recommended in the three phase plan in this chapter are represented on this map—some locations for new community poles should be evaluated after Phase One improvements have been made.

Estimated coverage by fixed point wireless broadband service can vary because of trees, hills, buildings, and other obstacles that may block the line of sight or near line of sight between a customer and a tower or pole.



The map below shows the estimated address points in each propagation survey area.



Phase	Estimated Coverage of Addresses
One	14,237
Two	4,668
Three	910
Total Estimated Coverage	19,815

Phase One Wireless Improvements

PHASE	ITEM	SITE WORK	SITE COSTS	ACCESS EQUIPMENT	ACCESS EQUIPMENT COST	POINT TO POINT	PROJECT MGMT COSTS	TOTAL COST
1	Blue Ridge Group	Tower Improvements	$26,375	Sectors, LTE	$30,303.80	$11,025.00	$5,000.00	$72,704
1	Cahas	New Tower	$170,000	Sectors, LTE	$30,304	$11,025	$14,500	$225,829
1	Callaway Elementary	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
1	Dudley Elementary	New Pole (School)	$7,865	Omni	$7,428.50	$5,512.50	$2,500.00	$23,306
1	Ferrum Elementary	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
1	Glade Hill Elementary	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
1	Grassy Hill Tower	Tower Improvements	$26,375	Sectors, LTE	$30,303.80	$21,760.20	$5,000.00	$83,439
1	Henry Elementary	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
1	Henry Fire Station Tower	Tower Improvements	$26,375	Sectors, LTE	$30,303.80	$5,512.50	$5,000.00	$67,191
1	Lee M Waid	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
1	Snow	New Tower	$170,000	Sectors, LTE	$30,304	$5,512.50	$5,000.00	$210,816
1	Summit View Tower	Tower Improvements	$26,375	Sectors, LTE	$30,304	$5,512.50	$5,000.00	$67,191
1	Sontag Elementary	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
1	Toms Knob	Tower Improvements	$26,375	Sectors, LTE	$30,303.80	$14,030.10	$5,000.00	$75,709
1	Union Hall	New Pole (Village)	$7,865	Omni	$7,428.50	$5,512.50	$5,000.00	$25,806
1	Windy Gap Elementary	New Pole (School)	$7,865	Omni	$7,428.50		$2,500.00	$17,794
							Total Wireless Estimated Cost	**$976,546**

Phase Two Wireless Improvements

PHASE	ITEM	SITE WORK	SITE COSTS	ACCESS EQUIPMENT	ACCESS EQUIPMENT COST	POINT TO POINT COSTS	PROJECT MANAGEMENT COSTS	TOTAL COST
2	Burnt Chimney Elementary	Water Tank Improvement	$26,375.0	Sectors, LTE	$30,303.80		$5,000.00	$61,679
2	CATCE	New Pole (School)	$7,865.00	Omni	$7,428.50	$1,108.80	$2,500.00	$18,902
2	Cooks Knob	Tower Improvements	$26,375	Sectors, LTE	$30,303.80	$11,025	$5,000	$72,704
2	Franklin County High	New Pole (School)	$7,865.00	Omni	$7,428.50		$2,500.00	$17,794
2	Pigg Tower	New Tower	$170,000	Sectors, LTE	$30,303.80	$11,025	$14,500	$225,829
2	Rocky Mount Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	$1,108.80	$2,500.00	$18,902
							Total	$415,810

In Phase 3, the partner ISP will determine the best placement for new poles, based on customer demand.

Phase Three Wireless Improvements

PHASE	ITEM	SITE WORK	SITE COSTS	ACCESS EQUIPMENT	ACCESS EQUIPMENT COST	POINT TO POINT COSTS	PROJECT MGMT COSTS	TOTAL COST
3	Blain Substation	Covered	—	—	—	—	—	—
3	Endicott	New Tower	$170,000	Sectors, LTE	$30,304	$11,025	$14,500	$225,829
3	Frankin Substation	Covered	—	—	—	—	—	—
3	Glade Hill Substation	New Pole (Substation)	$7,865	Omni	$7,428.50	$6,300.00	$2,500.00	$24,093.50
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	ISP Determines Loc.	New Pole	$7,865	Omni	$7,429	$1,109	$2,500	$18,902
3	Orchard Substation	Covered	—	—	—	—	—	—
3	Penhook Substation	New Pole (Substation)	$7,865	Omni	$7,428.50	$2,217.60	$2,500.00	$20,011.10
3	Redwood Substation	New Pole (Substation)	$7,865	Omni	$7,428.50	$2,217.60	$2,500.00	$20,011.10
3	Tank Hill Substation	Covered	—	—	—	—	—	—
3	Thornton Substation	New Pole (Substation)	$7,865	Omni	$7,428.50	$1,109	$2,500	$18,902
							Estimated Total	$516,772

13.2 FIBER TO THE HOME EXPANSION

Using the K12 school and village locations, fiber to the home project costs were developed. Many of the designated villages in Franklin County overlap with K12 school locations, so a total of twelve fiber studies were developed. The map below shows the areas that set evaluated.

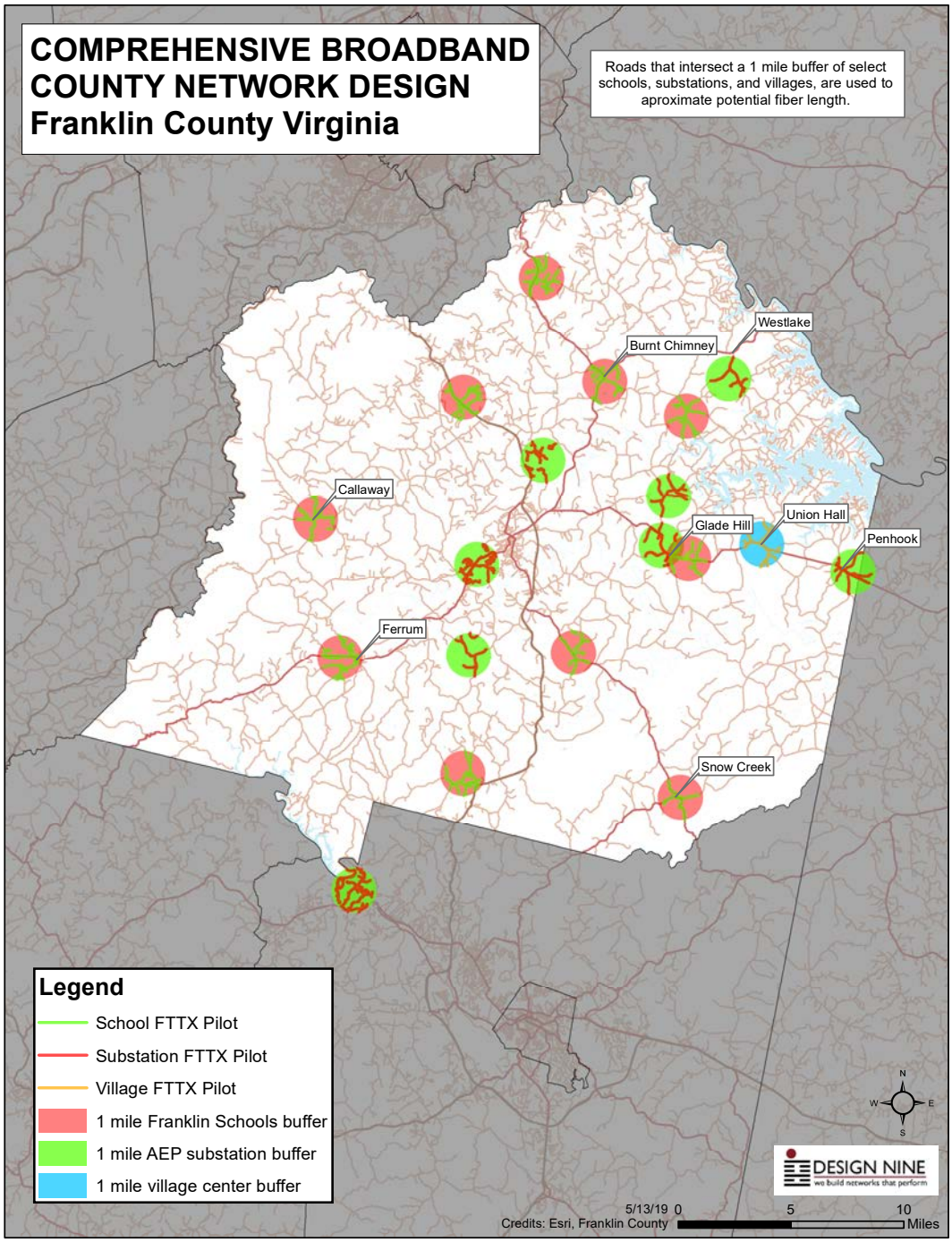
For each location, fiber would be extended from the school or village center to all households within a one mile radius.

Fiber Summary

Phase	Locations	Premises Passed	Premises Connected	Estimated Cost
Phase One	Callaway, Ferrum, Burnt Chimney, Boones Mill	776	467	$5,199,334
Phase Two	Union Hall, Henry, Dudley, Westlake	519	323	$3,699,538
Phase Three	Sontag, Snow Creek, Glade Hill, Windy Gap	390	235	$3,239,451
Totals		**1685**	**1025**	**$12,138,323**
	Notes: **1)** Fiber projects in Villages and near school facilities can be accommodated as funding becomes available. Phasing order may change based on funding. **2)** There are likely to be significant savings if several fiber projects are combined into a single build. Each fiber cost estimate was calculated with the assumption that it was a standalone effort. Budget categories that would see reductions include engineering, project management, and construction.			

The table on the next page shows the summary costs for each of the twelve fiber project areas. The full estimate tables are included in the appendix of this report.

Location	Premises Passed	Premises Connected	Estimated Cost
Union Hall	91	65	$1,009,972
Windy Gap	136	82	$1,140,471
Ferrum	296	178	$1,651,793
Sontag	80	48	$733,291
Snow Creek	86	52	$632,719
Henry	177	106	$1,148,921
Glade Hill	101	61	$946,001
Dudley	118	71	$915,124
Callaway	123	74	$927,440
Burnt Chimney	186	112	$1,072,896
Boones Mill	158	95	$1,334,174
Westlake	133	81	$625,521
	1461	879	$12,138,323


COMPREHENSIVE BROADBAND
COUNTY NETWORK DESIGN
Franklin County Virginia
Roads that intersect a 1 mile buffer of select schools, substations, and villages, are used to aproximate potential fiber length.
Westlake
Burnt Chimney
Callaway
Union Hall
Glade Hill
Penhook
Ferrum
Snow Creek
Legend
School FTTX Pilot
Substation FTTX Pilot
Village FTTX Pilot
1 mile Franklin Schools buffer
1 mile AEP substation buffer
1 mile village center buffer
N
W
E
S
DESIGN NINE
we build networks that perform
5/13/19
Credits: Esri, Franklin County
0
5
10
Miles

13.3 ABOUT IMPLEMENTATION STUDIES

NOTE: The costs contained in these implementation recommendations represent the best information available, based on similar costs from other projects, from vendor price lists, and/or estimates from contractors and construction firms. These estimates are generally reliable for up to six months. Note also that the time of year that the work is bid out can have a substantial effect on the estimate. We use an average weighted value for most costs to try to compensate for this, but as an example, construction work bid out in spring or early summer may have higher costs than a project bid out in late fall or early winter.

Tower Construction

The line items for each named tower include the cost of the tower, site preparation, estimated cost of electric service, generator cost and placement, cost of the tower, and labor to assemble and erect the tower, and backbone equipment.

13.4 WIRELESS CONSTRUCTION COST FACTORS

The cost estimates are developed using the the categories below. For each category, the items, labor, and activities associated with that category are calculated, using vendor price quotes, prices for labor and materials from previous construction projects, and other sources of cost information.

Buildings, Improvements, and Prefabricated Shelters

This category includes any buildings and shelters constructed as well as improvements to the buildings such as redundant HVAC systems, power improvements, fire suppression systems, security and surveillance systems, etc.

Outside Plant Construction Materials

Network construction includes the outside plant materials needed to build the network. Items like conduit, pedestals, cabinets, hand holes, and splice enclosures are all included in network construction.

Outside Plant Construction Labor

Labor is typically included with network construction for the bidding process but is separated here to help identify money that could be saved by leveraging local labor resources. Labor includes the placement of pedestals and hand holes, the underground or aerial placement of conduit, the construction of foundations (pads) for various structures throughout the network, and more.

Several material costs such as concrete and gravel are included in labor depending on the type of job to be performed.

Network Equipment, Software, and Related Costs

Network equipment includes any network electronics that will be used in the network such as routers, switches, and CPE. Network equipment also includes some items that do not use any AC power but fall into a similar category such as patch panels, and patch cables. The equipment cost will vary widely depending on the type of architecture chosen.

Administrative and Legal

Specialized legal counsel will be required to review contracts with service providers, contractors, and other participants in the project. Legal costs can vary with a particular location and tend to go down over time. The most legal work is needed early in the first construction phase to develop business contracts with service providers, to review construction and vendor contracts, and to broker lease agreements for use of public or private property (where network equipment like cabinets or shelters have to be located).

Leases, permits, and rights of way

Some costs will be incurred based on the permitting requirements of the project. If the County is able to place the colocation facility and any cabinets in public right of way or on County properties at no charge, the cost of leases will be lower. If cabinets or shelters have to be placed on private property, the cost of the land or long term leases will increase. The cost of permits needed for crossing wetlands, streams, other sensitive areas, and VDOT permits are also included in this category. Formal leases and negotiated lease payments are more desirable than providing some form of free access to services.

Project Management

Project management for a community network build requires thorough and detailed planning, experience in procuring construction materials for the project, and the ability to oversee and convey project information to contractors through the duration of the project, including construction inspection work (ensuring construction contractors have done their job properly).

Network Design and Engineering

This work include a full design of the outside plant network, cabinet and shelter specifications, and extensive detail (blueprints) that specifies how all fiber cable, towers, buildings, and network equipment is to be installed. These documents have to be completed prior to bidding out any construction work, and are usually included as part of a construction bid package. The detail includes fiber optic cable route determination and size determination, active and passive network equipment selection and placement planning, splicing layouts and documentation, network configuration planning, and all engineering necessary to complete construction.

Network Integration and Testing

Some configuring and testing will take place after the network is built and before it is ready for use. In a dark network this involves labeling and documenting the routes of individual fiber strands, and testing of any other features of the network such as generators, air conditioners, and locks. In an active network the testing and integration includes integration requirements for a dark

fiber network plus the configuring and installation of switches, routers, and other network equipment. Work in this category requires a skilled professional who is familiar with the network architecture and the business model (e.g. open access).

Miscellaneous

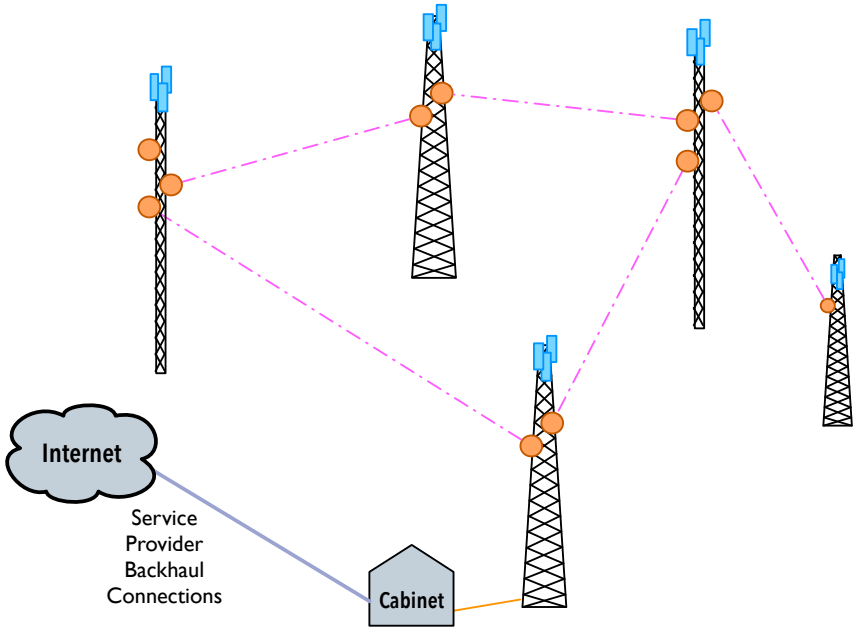
This category provides a small budget for miscellaneous expenses that will arise during the course of construction (e.g., bid advertisement costs, inventory tags, etc.).

Contingencies

The Contingency category is included and calculated as a percentage of the total estimated cost (e.g., 5% of total cost) to provide flexibility in managing the overall budget. Equipment costs can and do change between the time an estimate is made and construction commences. Labor costs can vary depending upon the time of year the work starts, the state of the local economy, and the state of the national economy. Material costs and lead times can vary based on demand on certain industries, energy costs, and location.

13.5 WIRELESS TOWER COST ESTIMATES

This section of the report provides an estimate of the cost of using existing towers to provide improved Internet access. The diagram below shows the logical design of a five tower network. Four of the five towers have adequate line of sight between the towers to build a fully redundant ring between the towers, which will provide much more reliable service (that is, a single tower or equipment failure will not affect service).



Any placement of new towers should be preceded by a careful viewshed analysis (how much area/users are likely to be able to receive service). Site acquisition and site preparation costs can affect the overall cost of such a project. Existing county properties (e.g. fire/rescue stations, county parks, dump transfer sites, etc.) may be candidates for towers. Note that existing towers may require an engineering study to confirm that additional antennas can be added without exceeding the tower load limits.

13.6 TOWER SPACE ONLY COST ESTIMATE

For towers currently owned by the county, and/or State-owned towers (where permission is obtained to lease space) or other stakeholders that might be candidates for project use, modest upgrades to equipment at the base of the tower would make them "broadband-ready."

Upgrades to existing towers typically may include adding or upgrading generators, additional cabinet or shelter space for service provider equipment, and sometime fencing and physical access changes.

Note that this estimate represents a "worst case" scenario. If the site already has a generator that can be used by a new WISP co-locating on the tower, that could reduce the cost by as much as $7,500. If no road improvements are needed and existing electric service does not require a new H-frame and meter, another savings of up to about $3,000 is possible. If the tower has a current certification (i.e. had a formal engineering inspection), additional savings are possible, bringing the 'best case" cost to about $11,000 to $12,000.

TOWER SITE DEVELOPMENT AND IMPROVEMENTS

ITEM/PROJECT	UNITS	UNIT COST (LOW)	UNIT COST (HIGH)	COST (AVG)
Tower Study / Survey	1	$4,500	$7,000	$5,750
Site Development (Clearing, Road Improvements, etc.)	1	$0	$1,500	$750
Small Telecom Cabinet AMPROD AM47P-2636-24RU OR EQUIVALENT, ALUMINUM CABINET - FRONT AND REAR DOORS- HVAC/HEAT - ADJUSTABLE RACK RAILS 19"	1	$6,000	$7,500	$6,750
10kW Liquid Propane Generator	1	$4,000	$6,000	$5,000
Cabinet Foundation and Installation	1	$2,500	$4,000	$3,250
New Power Service / Installation ASSUMES POWER AVAILABLE ON SITE, New meter placement required to support WISP equipment	1	$1,500	$2,500	$2,000
Power System Installation Labor	1	$300	$500	$400
Generator Installation Labor	1	$1,250	$1,700	$1,475
Propane Service Installation TANK FURNISHED / INSTALLED BY LOCAL GAS PROVIDER	1	$750	$1,250	$1,000
Total:				$26,375

13.7 POINT TO POINT BACKHAUL NETWORK

A countywide backhaul network between towers has several desirable characteristics:

- It reduces the cost to providers of being able to affordably offer service on all the towers.
- It increases the reliability and robustness of the WISP services because of the ring design (on at least four of the towers).
- County government data and/or public safety services could also be carried on the backhaul network to provide improved access to some remote facilities.
- K12 schools may be interested in having a redundant network to improve reliability of their existing fiber connections. This can be important during periods when online standardized testing is taking place.

Point to point links are estimated with consideration for the distance required, the bandwidth required, available space on the tower, and frequencies already in use on the tower. In the wireless phase cost estimates equipment is estimated according to the pricing below.

AirFiber 11FX Pair Including Licensing

Item	Units	Unit Cost	Total
AF11X Radio	2	$799.00	$1,598.00
AF11-CA Adapter Kit	2	$49.00	$98.00
AF11FX Duplexer	4	$199.00	$796.00
AF11 X Antenna 11GHz, 35dBi	2	$379.00	$758.00
FCC Licensing	1	$2,000.00	$2,000.00
Shipping @ 5%	1		$262.50
TOTAL			$5,512.50

AirFiber 24 Pair

Item	Units	Unit Cost	Total
AirFiber 24HD	2	$3,000.00	$6,000.00
Shipping at 5%	1		$300.00
TOTAL			$6,300.00

AirFiber 5XHD Pair

Item	Units	Unit Cost	Total
AF5XHD Radio	2	$429.00	$858.00
AirFiber X Antenna 5GHz, 23dBi Slant 45	2	$99.00	$198.00
Shipping at 5%	1		$52.80
TOTAL			$1,108.80

13.8 NEW TOWER ONLY COST ESTIMATE

New towers have a range of configurations and cost options. This estimate is for a new 180' tower with no radio equipment (that is, the cost of the bare tower). If located on existing county properties, the time needed to plan for construction can be shortened. If site acquisition or a site lease (of private property) is required, purchase or lease negotiations can add several months to the process. Note that a full permitting process may be required even if a new tower is placed on existing county-owned property. The permit process can add sixty to one hundred and twenty days to the time needed to put a new tower in service.

ITEM/PROJECT	Units	UNIT COST LOW	UNIT COST HIGH	TOTAL (AVG)
Labor and Contracting: $82,540.00				
Site Development (Clearing, Road Improvements, etc.)	1	$15,000.00	$15,000.00	$15,000.00
New Power Service / Installation	1	$1,250.00	$3,400.00	$2,325.00
180' Guyed Tower Construction Labor & Contracting	1	$50,000.00	$74,750.00	$62,375.00
Cabinet Installation Labor	1	$600.00	$1,000.00	$800.00
Power System Installation Labor	1	$300.00	$575.00	$437.50
Generator Installation Labor	1	$1,250.00	$1,955.00	$1,602.50
Materials: $34,985.00				
180' Guyed Tower Construction Materials	1	$17,000.00	$27,000.00	$22,000.00
Small Telecom Cabinet	1	$4,000.00	$5,500.00	$4,750.00
Cabinet Foundation and Installation Materials	1	$1,000.00	$1,500.00	$1,250.00
10kW Liquid Propane Generator	1	$4,000.00	$6,000.00	$5,000.00
Spare Fuses	1	$10.00	$20.00	$15.00
Power System Installation Materials	1	$20.00	$40.00	$30.00
Samlex 1000W Inverter	1	$350.00	$450.00	$400.00
Samlex SEC1230-UL Battery Charger	1	$200.00	$300.00	$250.00
100ah 12v Non Spillable Backup Battery	4	$250.00	$350.00	$1,200.00
DC Voltage Monitoring Device	1	$40.00	$60.00	$50.00
Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$40.00
Total:				$117,525.00
Project Management, Network Engineering, Testing				$23,505.00
Site Engineering, Surveying, Viewshed Analysis, Etc.				$9,500.00
Misc Fees, Technical Services				$7,500.00
Contingency				$12,000.00
TOTAL (rounded):				$170,000.00

13.9 SMALL CELL BROADBAND UTILITY POLE ACCESS COSTS

A single wooden utility pole with a wireless connection to a 180' tower and local access radios could provide access to any residence with line of sight within a half mile or more. This would spread the cost of pole construction and equipment costs across several households or businesses. There are many areas in the county where there is a cluster of homes along a relatively short stretch of road. All of those homes could share the use of a single local utility pole access site.

V1	VARIABLE	VALUE	NOTES
V2	Weight Variable	5	0-10 scale used in Best Estimate column (10 is best)
V3	Towers	1	Number of Towers
V4	Height	60	Tower Height
V5	Type	Wooden Utility Pole	Tower Type
V7	Backbone Radio System Licensed / Un-licensed	Un-licensed	
V8	Backbone Links	1	
	Site Development (Average)	1,000	

1	ITEM/PROJECT	UNITS	COST (LOW)	COST (HIGH)	TOTAL (LOW)	TOTAL (HIGH)	BEST ESTIMATE
2	Site Development (Clearing, Road Improvements, etc.)	1	- n/a -	- n/a -	- n/a -	- n/a -	$1,000
3	3x3 NEMA Box	1	$300.00	$600.00	$300.00	$600.00	$450
4	New Power Service / Installation	1	$500.00	$1,250.00	$500.00	$1,250.00	$875
5	60' Wooden Utility Pole Construction Materials	1	$2,500.00	$3,500.00	$2,500.00	$3,500.00	$3,000
6	Spare Fuses	1	$10.00	$20.00	$10.00	$20.00	$15
7	Power System Installation Materials	1	$20.00	$40.00	$20.00	$40.00	$30
8	Samlex 1000W Inverter	1	$350.00	$450.00	$350.00	$450.00	$400
9	Samlex SEC1230-UL Battery Charger	1	$200.00	$300.00	$200.00	$300.00	$250
10	100ah 12v Non Spillable Backup Battery	4	$250.00	$350.00	$1,000.00	$1,400.00	$1,200
11	DC Voltage Monitoring Device	1	$40.00	$60.00	$40.00	$60.00	$50
12	Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$35.00	$45.00	$40
13	60' Wooden Utility Pole Construction Labor & Contracting	1	$2,000.00	$3,000.00	$2,000.00	$3,000.00	$2,500
14	Power System Installation Labor	1	$300.00	$500.00	$300.00	$500.00	$400
15	Ubiquiti IsoBeam PTP System	2	$200.00	$400.00	$400.00	$800.00	$600
16	Ubiquiti Access Point + 120° Sector	3	$375.00	$500.00	$1125.00	$1500.00	$1,313
17	Total:				$8,780.00	$13,465.00	$12,122.50

This estimate below includes just the cost of placing the pole and providing electric service to the pole. The WISP leasing the pole would be responsible for providing access radios for local access and for a point to point radio link backhaul connection to another tower (to supply the local Internet service).

1	ITEM/PROJECT	UNITS	COST (LOW)	COST (HIGH)	BEST ESTIMATE
2	Site Development (Clearing, Road Improvements, etc.)	1	0	2000	$1,000
3	3x3 NEMA Box	1	$300.00	$600.00	$450
4	New Power Service / Installation	1	$500.00	$1,250.00	$875
5	60' Wooden Utility Pole Construction Materials	1	$2,500.00	$3,500.00	$3,000
6	Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$40
7	60' Wooden Utility Pole Construction Labor & Contracting	1	$2,000.00	$3,000.00	$2,500
8	Total:				$7,865.00

14 BROADBAND EDUCATION STRATEGIES

Businesses and residents in Franklin County have shared widespread frustration with the current levels of broadband service, especially in the rural areas of the county. The Broadband Authority will have to simultaneously keep all audience segments well-informed with regular updates, but also manage expectations. The Authority is not responsible for a traditional "sales" approach to marketing Internet–that is the job of ISPs and WISPs, but rather the focus must be on "awareness marketing." That is, ensuring that all of the residents, businesses, and various stakeholders and interested parties in the county have enough information to feel like they know what is happening and when, but also understand that this is a problem that has developed over decades, and will take several years to solve.

14.1 RECOMMENDATIONS FOR AN EDUCATION CAMPAIGN

A successful education and awareness plan for the county does not have to be expensive or time consuming. The attributes that need attention are:

- Consistent – Use a single, easy recognized logo, tag line, and message consistently across all platforms–paper, Web, social media, and email.
- Ongoing – Regular updates and news postings on the Authority portion of the County Web site and a complementary Facebook page will keep residents, businesses, and local officials up to date and well-informed about broadband development activities.
- Interesting Content – Posted news items should emphasize quality over quantity. One interesting broadband article per week is better than three marginally interesting articles per week.
- Well-defined Distribution – Distribution of news items should be well understood–as an example, most news items should be posted on the Facebook page.
- Well-defined Goals – The Committee should develop a short list of short term and long term goals that can be described concisely (e.g. one sentence each). Goals should be included as needed and as appropriate on the Web site, on the Facebook page, and on paper media. The goals should also be highlighted in presentations, interviews, and in public meetings.

DISTRIBUTION

Social Media – A dedicated Facebook page is an important part of the education and awareness strategy. Regular posting of news items will keep residents and businesses engaged and seeing those items in their news feeds. Occasional use of "boosted" posts is extremely effective in reaching a wider audience. Boosted posts should be reserved for significant and timely news about the project itself.

Instagram and Twitter can be used occasionally for high profile news announcements.

Perhaps the most important feature of Facebook is the interactivity that is possible between the Broadband Authority and Facebook users. Residents and businesses can "like" and share the

page, but they can also post questions. The Facebook page should be visited regularly by a member of Authority who will review activity, write responses to questions, and pass interesting or important comments on to other Authority members.

Traditional Media – Local newspapers and local radio stations can be a valuable resource for getting news about the work of the Broadband Authority to the wider community, especially for news about work completed (e.g. new WISP coming to the area, new tower completed, etc.).

Web Site – The Authority should consider having an expanded presence on the County Web site. At a minimum, as new infrastructure and service provider agreements are in place, these accomplishments should be described and permanently available via the Web page(s).

Mailing Lists – It will be useful to have one or more "invite only" mailing lists to keep key stakeholders and interested parties informed.

Media Partners – The main Web page on the County Web site and the Facebook page should be linked prominently on partner Web sites (e.g. Chamber of Commerce site, economic development Web pages, etc.).

14.2 MARKETING MATERIALS

The Authority needs only a small amount of printed/PDF materials for distribution. These might include a one page **overview** of the project, **vision and project goals**, and **efforts currently underway**. These materials can be distributed to County Supervisors, placed in libraries, or emailed (as a PDF) to people asking for more information.

Regular posting of news items related to broadband generally and postings related specifically to local broadband efforts can be cross-posted to reach a wider audience. The same news item can be posted to the Facebook page and the Web site.

15.1 JOB AND WORKFORCE CHALLENGES

In most areas of the county, residents and businesses currently have, at best, the FCC 10 Megabits down/1 Megabit up bandwidth. This slow speed service is is impacting economic and community development:

- It limits resident's ability to work from home.
- It limits the ability of the county to retain existing businesses and to attract new businesses and jobs.,

In Franklin County, the real issue as it relates to broadband speeds is the future of work. In eastern Kentucky's rural Jackson and Owsley counties, the People's Rural Telephone Coop has deployed high speed fiber service and the improved infrastructure brought more than 800 new work from home jobs to the two counties. Franklin residents will not have the opportunity to pursue the kinds of jobs that are now available without better and more affordable access to broadband.

A recent study in 95 counties in Tennessee found that improved access to high speed broadband can significantly reduce unemployment rates, especially in rural counties (Broadband Communities, March 2019).

The FCC has defined the next broadband tier (fully served) to be 25 Megabits down/3 Megabits up. The problem with the 25/3 definition is that the upload speed (3 Megabits) is not always going to be adequate to support work from home, especially where home-based workers need to connect to a corporate VPN (Virtual Private Network). Work from home and business from home activities should have, at a minimum, 10 Megabits download and 10 Megabits upload speeds. Higher speed service could include service levels like 25 Megabits down/10 Megabits up. The critical requirement is an upload speed that supports work from home.

If the goal is to enhance business access to broadband, there can be no upper limit on the definition of broadband. Saying that broadband (as an example) is 5 Megabits/second of bandwidth or 10 Megabits/second is to tell the residents and businesses in the county that there will be limits on their work and job opportunities.

Broadband is a community and economic development issue, not a technology issue. The essential question is not, "What system should we buy?" or "Is wireless better or cheaper than fiber?" Instead, the question is:

"What do businesses of Franklin County need to be able to compete globally over the next thirty years?"

In short, the county today has "little broadband" in the form of DSL, very limited wireless, expensive satellite Internet, and and very limited cable modem service, along with a very limited amount of "big broadband" in the form of fiber to a few businesses and institutions.

If the County and the Authority make investments in broadband and telecommunications infrastructure, it is absolutely critical that those investments are able to scale gracefully to meet business and economic development needs for decades.

Two key concepts that should drive community investments in telecom are:

"Broadband" is not the Internet

Bandwidth is not a fixed number

Broadband and "the Internet" are often used interchangeably, but this has led to much confusion. Broadband refers to a delivery system, while "the Internet" is just one of many services that can be carried on a broadband network. The challenge for the County and the Authority is to ensure that businesses and homes have a broadband network with sufficient bandwidth to deliver all the services that will be needed and expected within the next three to four years, including but not limited to "the Internet."

The economic impact on Franklin county can include the following effects:

- Difficulty retaining some existing businesses - As business bandwidth needs continue to increase over the next several years (see Section 8.4), some businesses may need to move out of the area to ensure that they have the right bandwidth to support their business operations.
- Difficulty attracting new businesses - New businesses interested in some of the advantages available in the county (e.g. low cost of living, good recreational opportunities, good workforce ethic, etc.) may be deterred by the cost and limited bandwidth available, and therefore choose other areas to locate.
- Difficulty keeping younger workers and families in the county - Younger workers and families tend to be heavy users of Internet services, and real estate agents are reporting that younger house buyers are reluctant to live in areas with poor Internet service.
- Reductions in real estate value - Homes with poor Internet service are more difficult to sell, leading to reduced prices and then impacting county property taxes negatively.

15.2 BUSINESS BANDWIDTH NEEDS

The table below shows bandwidth consumption for several types of businesses and a projection of the bandwidth needed 5 and 10 years out. The cost of fuel is already affecting business travel decisions, and more and more businesses will invest in HD quality business videoconference systems to reduce the need for travel. These HD systems require substantial bandwidth; a two way HD video conference requires 20-25 Megabits during the conference, and a three way conference requires 30-35 Megabits during the conference. As more workers try to reduce the cost of driving to and from work by working from home, the business location must provide network access (Virtual Private Network, or VPN) to the employees working from home. These home-based workers will make extensive use of videoconferencing to attend routine office meetings remotely and to enhance communications with co-workers, including videoconferences with other home-based workers in the company. A VPN network providing remote access to just two or three home-based employees could require 50 Megabits of bandwidth during normal work hours.

	Large Business		Small Business		Home Based Worker		Business From Home	
Description	A larger business with about 50 workstations.		A small business with 10 to 15 employees, and 7-10 workstations.		A single employee working at home for his/her company.		A home business with one or two employees working at home.	
	Concurrent Use	**Mbps**	**Concurrent Use**	**Mbps**	**Concurrent Use**	**Mbps**	**Concurrent Use**	**Mbps**
Telephone	20	1.28	5	0.32	1	0.064	1	0.064
TV		0		0		0		0
HDTV		0		0		0		0
Credit Card Validation	4	4	1	1		0		0
Security System	1	0.25	1	0.25	1	0.25	1	0.25
Internet	20	30	7	10.5	1	1.5	1	1.5
VPN Connection	5	25		0	1	5		0
Data Backup	5	7.5	1	1.5	1	1.5	1	1.5
Web Hosting	1	2		0		0		0
Workforce Training (online classes)	2	20	1	10	0	0	1	10
HD Videoconferencing	10	100	2	20	1	10	1	10
Telecommuting workers	5	15	2	6	0	0	0	0
Totals		**205.0**		**49.6**		**18.3**		**23.3**
5 years from now (Megabits)	**615**		**149**		**55**		**70**	
10 years from now (Megabits)	**1845**		**446**		**165**		**210**	

16 PARTNERSHIPS AND FUNDING STRATEGIES

16.1 PARTNERSHIP OPPORTUNITIES

The Broadband Authority work will, by necessity, have to include both public and private partners. Among some public and private entities, the common synergies are:

- The need for more bandwidth,
- The need for more affordable bandwidth, and
- The need for more affordable bandwidth to be more widely available.

Potential project partners include:

County government

Franklin County is already a strong supporter of the Broadband Authority, and has been providing staff support, grant application support, and related services.

Public Safety

The Sheriffs departments, fire, and rescue departments all need better access to broadband and improved wireless voice/data communications. Throughout the United States, public safety voice and data communications systems are being upgraded, often at staggering cost. Many of the upgrades include new towers to eliminate "holes" in the served area where first responder, fire, and rescue radios do not work. Combining public safety needs with community broadband needs can bring new sources of funding and cut costs, sometimes dramatically. Elected officials may need to take the lead in this area to ensure that public safety officials work collaboratively with the broadband efforts.

As additional towers and community pole sites are deployed in the county, first responders will benefit from lower Internet costs. Sharing tower space (WISP access and first responder voice/data) is extremely efficient, and all tower improvement and tower construction activities should be coordinated closely. There are some grants and funding sources available for public safety infrastructure like towers that may be available to help support new tower development.

County public safety officials participate regularly in Broadband Authority meetings and are strong supporters of sharing tower space to improve broadband access.

K12 Schools

Franklin County schools have adequate broadband service at existing school locations. But K12 students often lack adequate Internet service at home, and some schools are careful not to assign homework that requires Internet access. Parents consistently report on the burden of having to drive children to a public library or some other WiFi hotspot to get Internet access for school work. Every school in the county should configure a WiFi hotspot outside the building and make it available after school hours, when classroom instruction would be impacted. It would be possible to make this access controlled, so that students would have to a userid/password to use it. The Authority should work with the schools to apply for education grant funds to achieve this goal, and to keep K12 parents informed about broadband activities.

ISPs and WISPs

Internet Service Providers (ISPs) and Wireless Internet Service Providers (WISPs) are important partners, as they will be the companies leasing tower space and/or conduit/fiber infrastructure.

County and Authority telecom investments will be a public/private enterprise, and service providers are the primary customers of the infrastructure. Service providers cannot be taken for granted. Instead, a fair fee structure, high quality infrastructure, excellent maintenance and operations (where needed), and flexibility on business agreements and pricing will be required to recruit and retain service providers.

See the chapter later in this report (***Tower and Service Provider Management***) for more information on how to work with providers. For providers that express interest in using community infrastructure, it will be important to meet with them on a regular basis. These companies may also be partners on grant applications, where it may be required to show that the infrastructure being constructed has a service provider already committed to using it.

Area Businesses

Businesses in the county and the local Chamber of Commerce chapters have an important role to play as advocates for the the work of the Authority. At both the county and state level, businesses that need more affordable and better broadband should ensure that elected officials understand the urgency. The Authority, as part of its marketing program, should ensure that local businesses are kept up to date with work activities, grants, and other efforts (e.g. attend CoC meetings at least quarterly to report on the work of the Broadband Authority).

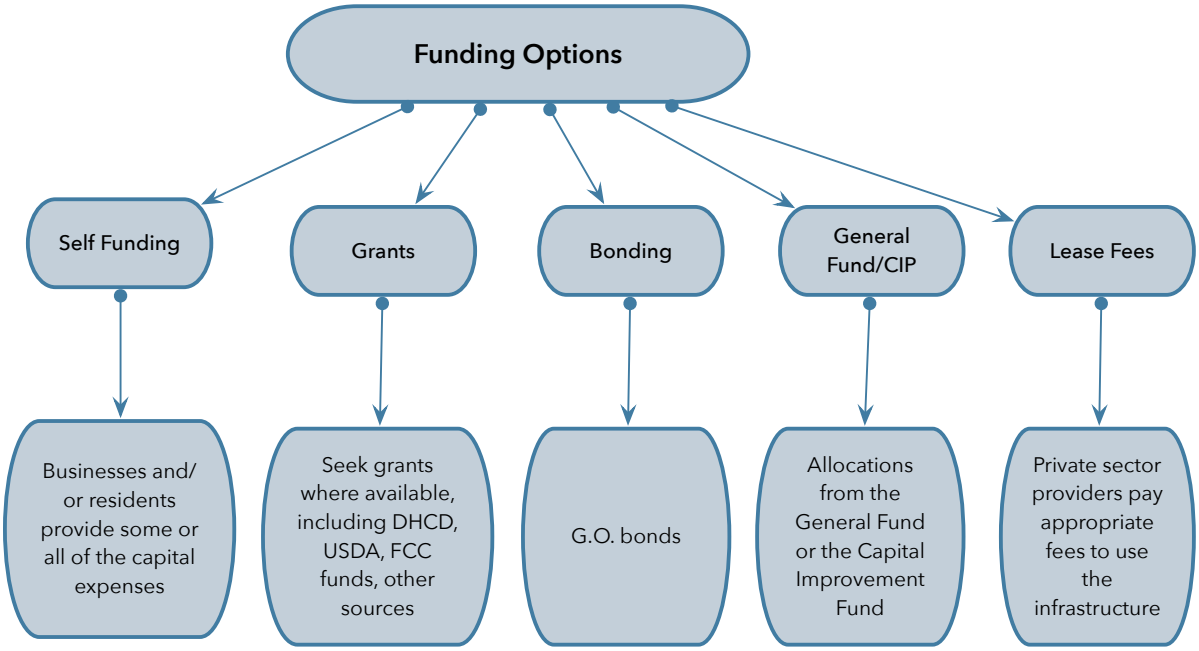
Electric Utilities

Electric utilities are natural partners in any municipal broadband venture. Electric utilities own utility poles, bucket trucks, and the equipment needed to install aerial fiber. Chattanooga's fiber to the premises (FTTx) initiative has enabled millions in savings for the city-owned electric service. When power outages occurs from events like ice storms or tree damage, the utility is able to use the fiber network to very accurately pinpoint where the outage occurs, enabling a more rapid repair of the electric network at less cost.

The Broadband Authority should meet from time to time with AEP to assess their interest in Authority projects, especially if the Authority and the electric utility could collaborate on fiber to electric service substations.

16.2 FUNDING STRATEGIES

It is important to note that any County investment in broadband infrastructure is likely to be passive infrastructure. These assets will have a conservative life span of thirty years or more (e.g. wireless towers, conduit, fiber cable). These types of infrastructure investments create hard assets that have tangible value and can then be leveraged for additional borrowing. The demand for services and the associated fees paid for those services will provide the revenue that will pay back loans over time. There is ample time to recoup not only the initial capital investment, but also to receive regular income from the infrastructure.



The financing of community-owned telecommunications infrastructure faces several challenges with respect to funding.

- Not all local governments are willing to commit to making loan guarantees from other funding sources like property taxes, because the idea of community-owned telecom infrastructure has a limited track record and therefore a higher perceived risk.
- Similarly, citizens are not always willing to commit to the possibility of higher taxes that may be needed to support a telecom infrastructure initiative, for many of the same reasons that local governments are still reluctant to make such commitments: perceived risk and a lack of history for such projects.
- Finally, banks and investors are also more skeptical of community telecom projects because of the relative newness of the phenomenon. By comparison, there are decades of data on the financial performance of water and sewer systems, so the perceived risk is lower.

Somewhat paradoxically, the cost of such a community digital road system is lower when there is a day one commitment to build to any residence or business that requests service. This maximizes the potential marketplace of buyers and attracts more sellers to offer services because of the larger potential market. This is so because:

- Service providers are reluctant to make a commitment to offer services on a network without knowing the total size of the market. A larger market, even if it takes several years to develop, is more attractive.
- Funding agencies and investors that may provide loans and grants to a community network project want to know how the funds will be repaid and/or that grants will contribute to a financially sustainable project. Knowing that the size of the customer base is the maximum possible for a service area helps reduce the perceived risk for providing loans and grants.

Community Reinvestment Act

The Community Reinvestment Act (CRA) was developed forty years ago to encourage banks and savings institutions to help meet the credit needs of their local communities, with a focus on low and moderate income areas of those communities. The Federal agencies that oversee private banks assign a CRA rating to each institution. Banks are often looking for well-planned community efforts that need loans. Such loans can improve a bank's CRA rating.

The CRA was revised in 2016 to encourage banks to support community broadband efforts. A community broadband project may be able to get some loan financing from a local bank that wants to get credit for their CRA work.

HUD Community Development Block Grants

The U.S. Housing and Urban Development CDBG State Program allows the Virginia state government to award grants to smaller units of general local government (e.g. counties, towns) that develop and preserve decent affordable housing, to provide services to the most vulnerable in our communities, and to create and retain jobs. In recent years, CDBG funds have been successfully used for broadband infrastructure development where the local government applicant can show the improvements meet the general guidelines of the program—so grant funds have to spent in low and moderate income areas.

Over a 1, 2, or 3-year period, as selected by the grantee, not less than 70 percent of CDBG funds must be used for activities that benefit low- and moderate-income persons. In addition, each activity must meet one of the following national objectives for the program: benefit low- and moderate-income persons, prevention or elimination of slums or blight, or address community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community for which other funding is not available. More information is available here (https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs).

Virginia Telecom Initiative (VATI)

The Virginia Telecommunication Initiative (VATI) fund is to provide financial assistance to supplement construction costs by private sector broadband service providers to extend service to areas that presently are ***unserved*** (i.e. less than 10 Meg down/1 Meg up) by any broadband provider. The Department of Housing and Community Development (DHCD) manages the appropriation to eligible applicants to provide Last-Mile services to Unserved areas of the State. The VATI program has a target that unserved areas of the Commonwealth have access to broadband speeds of at least 10 Mbps download and 3 Mbps upload. Projects proposing higher speeds in the most cost efficient manner will receive funding priority.

The Virginia legislature has allocated $18M for 2020, significantly more than in previous years. DHCD has not yet released guidelines for the 2020 funds, but applications will most likely be due very early in 2020. Franklin County has submitted a 2019 request with BRISCNET for $465,000, with a $269,451 match amount.

USDA ReConnect Program

The ReConnect program is a new funding program managed by the USDA Rural Development Office. This program is sometimes called the USDA e-Connectivity pilot program. Grant applications can be a combination of 100% grant, 50% grant/50% loan, or 100% loan. $600

million has been allocated to the program, and a wide variety of entities can apply, including non-profits, coops, and state and local governments. Successful applications will require a very credible business plan that shows the project can be financially sustainable. Up to $25 million is available for a 100% grant application. The application deadline for 2019 has passed, but a second round of funding will be available for 2020. USDA ReConnect grants require extensive preparation time to gather data needed for the application. Planning for submission should start at least four months in advance of the deadline. More information is available here: (reconnect.usda.gov). A mapping tool is available on the Web site to show areas that are eligible. To qualify as an eligible area, households must have less than a minimum of 10 Meg down/1 Meg up broadband service.

911 Fees

Improved broadband access in the county can improve household access to 911 services by using broadband Internet to carry 911 voice calls, using one or more strategies to include:

WiFi calling – now a commonly available feature on new cell phones. WiFi calling switches voice telephone call from the cellular network to a nearby WiFi Internet network seamlessly. The reduces the need for additional large cell towers in low density areas of the county.

Nano-cell Devices – Nano-cells are a small box attached to a home wireless router. The nano-cell, which is typically obtained from the cellular provider, enables a cellphone to operate inside the home or business even if there is no cell tower near by.

A modest increase in the 911 fee to improve 911 access in Franklin County could generate funds to support additional broadband towers and community poles. State level legislation would be required to change the 911 fees, so this is a longer term strategy.

Bonding

Revenue bonds are repaid based on the expectation of receiving revenue from the network, and do not obligate the local government or taxpayers if financial targets are not met. In that respect, they are different from general obligation bonds. Many kinds of regional projects (water, sewer, solid waste, etc.) are routinely financed with revenue bonds. We believe many community projects will eventually finance a significant portion of the effort with revenue bonds, but at the present time, the limited financing history of most community-owned broadband networks has limited using revenue bonds.

Selling revenue bonds for a start up municipal network can be more challenging because there is no financial or management history for the venture. Bond investors typically prefer to see two or three years of revenue and expenses and a track record of management success. It would be advisable for the County to have an early conversation with qualified municipal bond counsel to assess the viability of this approach.

Obtaining funding using revenue bonds requires an excellent municipal credit rating and an investment quality financial plan for the operation and management of the network. Revenue bonds must be used carefully, and a well-designed financial model is required to show investors that sufficient cash flow exists to pay back the loans.

General obligation bonds are routinely used by local governments to finance municipal projects of all kinds. G.O. bonds are guaranteed by the good faith and credit of the local government, and are not tied to revenue generated by the project being funded (i.e. revenue bonds). G.O. bonds

obligate the issuing government and the taxpayers directly, and in some cases could lead to increased local taxes to cover the interest and principal payments. Some bond underwriters have indicated a willingness to include telecom funds as part of a larger bond initiative for other kinds of government infrastructure (e.g. adding $1 million in telecom funds to a $10 million bond initiative for other improvements).

In discussions with bond underwriters, it has been suggested that it would be easier to obtain bond funds for telecom if the telecom bonding amount was rolled into a larger water or sewer bond, or some other type of bond request that are more familiar to the bond market.

CAF 2 Funds

The second round of the FCC Connect America Fund (CAF2) continues to provide funds to incumbent and competitive service providers. The funds must be used in unserved or underserved areas as defined by Federal census blocks. To be eligible, a census block could not have been served with voice and broadband of at least 10/1 Mbps (based on Form 477 data) by an unsubsidized competitor or price cap carrier.

The FCC published the final eligible census blocks for the auction on February 6, 2018. The final areas were based on FCC Form 477 data as of December 31, 2016 (the most recent publicly available FCC Form 477 data at the time). So there is a time lag between the determination of a qualifying census block or blocks and the schedule for submitting a bid to serve those areas.

Because many CAF2 qualifying areas are only served by low performance DSL (e.g. less than 10/1 Mbps service), incumbent carriers use the awards to upgrade DSL switches, which is not a long term solution. More recently, competitive carriers are applying for CAF2 funds to provide higher performance broadband wireless and in some cases fiber to the home. Because the use of CAF2 funds are so restricted, it has not had as much impact as many hoped.

A local (e.g. community) broadband entity could apply for CAF2 funds, but the application must include, at a minimum, two years of experience offering broadband service and one year of audited financials. This underscores the importance of getting some service in place to support a longer term goal of applying for CAF2 funds.

Qualified Opportunity Fund Investments

The 2018 Federal tax changes included a little known item called the Investing in Opportunity Act. Opportunity Zones, designated by each state, are eligible for investments that have very attractive tax benefits. The tax advantages include avoidance of most local, state, and Federal taxes, and the ability to have those investments grow and compound tax-free. The intent of the law is to funnel private sector capital gains into low growth and no growth areas of the U.S. by offering substantial tax benefits.

While Opportunity Zones are most likely to attract real estate investments, it should be possible to create Opportunity Zone projects that include telecom infrastructure improvements. As an example, a manufacturing plant investment is made in an Opportunity Zone, along with broadband fiber improvements needed by the plant to support operations.

Opportunity Zones are defined by census tract, and the Census Bureau's Geocoder online tool can provide census tract ID numbers. A link to the list of currently qualified census tracts can be found on this page (https://www.cdfifund.gov/Pages/Opportunity-Zones.aspx).

Coop Membership Fees

If the Authority deemed it useful to create an independent broadband cooperative, coop members would pay a one time membership fee to join the coop. For fiber and wireless improvements, this fee could be set at a level that pays for part or all of the cost of building the fiber to the business or residential premises and/or placing the towers and equipment to deliver wireless service. It may also be possible to work with local banks to provide a financing option (e.g. the membership fee could be paid monthly over a period of several years to reduce the financial burden on a household or business).

The coop membership fee offers the area a way to self-finance a substantial portion of the initial network, as well as providing a long term framework for expansion. Coop membership fees can be collected in advance of providing service.

Lease Fees

Initiatives like tower access and access to local government-owned conduit and fiber can create long term revenue streams from lease fees paid by service providers using that infrastructure. The City of Danville has recovered their entire initial capital investment from lease fees paid by providers on the nDanville fiber network.

Special Assessment/Service District

Communities like Bozeman, Montana and Leverett, Massachusetts have been funding broadband infrastructure improvements with special assessments (in Leverett, $600/year for five years), and in Bozeman, TIF (Tax Increment Funding) is being used in some areas to add telecom conduit, handholes, and dark fiber. In some localities, it is possible to levy a special assessment in a service district designated for a particular utility (like broadband) or other kind of public service.

Charlemont, Massachusetts intends to add an $11/month assessment to every household to build a town-owned Gigabit fiber network that will pass every household in the community. A town-wide vote supported this funding approach. Put in perspective, the average cost of a large, single topping pizza in the U.S. is currently $9 to $12.

A small city in Utah is currently evaluating the potential of a $7-$10 utility tax levied on every household and business to finance a full fiber to the premises build out, including a modest "free" Internet service that would be adequate for email and light Web use. Most households will probably choose to select a higher performance Internet package from a private provider on the network.

The table below shows the kind of funds that could be generated over several time periods. If ten dollars per month were collected from each household for thirty years, it would easily finance the

Franklin County Special Assessment (all 18,963 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
$1	$4,551,120	$6,826,680
$2	$9,102,240	$13,653,360

Franklin County Special Assessment (all 18,963 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
$5	$22,755,600	$34,133,400
$10	$45,511,200	$68,266,800

Individual Service District Examples				
Monthly Assessment Amount	Fifty Homes Five Year Assessment	Fifty Homes Ten Year Assessment	100 Homes Five Year Assessment	100 Homes Ten Year Assessment
$5	$15,000	$30,000	$30,000	$60,000
$10	$30,000	$60,000	$60,000	$120,000
$25	$75,000	$150,000	$150,000	$300,000
$50	$150,000	$300,000	$300,000	$600,000

immediate build out of Gigabit fiber that would pass nearly all homes and businesses in each county. A less amount (e.g. $2/month over twenty years) would easily finance the immediate build out of a comprehensive wide area wireless tower network in Franklin County, as well as some fiber infrastructure.

Property Tax Increase

While raising taxes can be politically very difficult, a very small incremental increase in property taxes, with the increase clearly earmarked specifically designated for broadband development (.e.g. one-quarter cent) might be possible to sell to citizens and businesses. The table below is adjusted to reflect the cost of borrowing over the listed periods of time.

	Assessed property value	Broadband increment	Annual Broadband Fund	Ten Year Aggregate	Twenty Year Aggregate	Thirty Year Aggregate
1/4 of one cent	$6,679,915,940	$0.0025	$150,298	$1,502,981	$3,005,962	$4,508,943
1/2 of one cent	$6,679,915,940	$0.0050	$300,596	$3,005,962	$6,011,924	$9,017,887
1 cent	$6,679,915,940	$0.0100	$601,192	$6,011,924	$12,023,849	$18,035,773

Connection Fees

Tap fees, pass by fees, and connection fees are already commonly used by local governments for utilities like water and sewer. The revenue share model can be strengthened from additional

sources of revenue, including one time pass by fees, connection fees and sweat equity contributions. It is important to note that the Coop Membership Fee can be treated as a connection fee in whole or in part.

Pass By Fees – Pass by fees could be assessed once the fiber passes by the property, just as some communities assess a pass by fee when municipal water or sewer is placed in the road or street– and the fee is assessed whether or not the premise is connected, on the basis that the value of the property has been increased when municipal water or sewer service passes by. At least one study has indicated that properties with fiber connections have a higher value by $5,000 to $7,000 that similar properties without fiber access.

One Time Connection Fees – A one time connection fee can be assessed to property owners (e.g. residents and businesses) when the fiber drop from the street to the premise is installed. This is similar to the kinds of connection fees that are typically charged when a property is connected to a municipal water or sewer system. The fee is used to offset the cost of the fiber drop and the Customer Premise Equipment (CPE) needed to provide the operational access to the network. The connection fee can be modest (e.g. $100) or it can be a larger percentage of the actual cost of the connection. Fiber CPE may range from $250 to $350 and a fiber drop may cost from $200 for a premise very close to the distribution fiber passing along the property to $1,000 or more if the premise is hundreds of feet from the road. One variant would be to charge a minimum connection fee for up to some distance from the road (e.g. $100 for up to 75' and $2 for each additional foot).

There is already some data that indicates that residential property values increase by as much as $5,000 to $7,000 if fiber broadband services are available, so pass by fees can be justified on the basis of increased property values accruing to the property owner. Given the novelty of this approach, pass by fees may need more time to become an accepted finance approach, but tap fees (for installing the fiber cable from the street or pedestal to the side of the home or business) may be easier to use, especially for businesses that may need improved broadband access. Tap fees have the potential of reducing the take rate in the early phases of deployment, but as the value of the network becomes established, it is likely that there will be much less resistance to paying a connection fee.

Grants

Grant funding should be viewed as part of a larger basket of funding. Federal funds from sources like the USDA and the FCC are highly competitive and often come with substantial limitations on who can qualify and how the funds can be used. CDBG funds can support telecom infrastructure construction but must be tied to job creation and/or job retention.

New Markets Tax Credit

New markets tax credits are a form of private sector financing supported by tax credits supplied by the Federal government. The New Markets Tax Credit (NMTC) Program permits taxpayers to receive a credit against Federal income taxes for making qualified equity investments in designated Community Development Entities (CDEs). The CDEs apply to the Federal government for an allotment of tax credits, which can then be used by private investors who supply funds for qualifying community projects. Substantially all of the qualified equity investment must in turn be used by the CDE to provide investments in low-income communities.

The credit provided to the investor totals 39 percent of the cost of the investment and is claimed over a seven-year credit allowance period. In each of the first three years, the investor receives a credit equal to five percent of the total amount paid for the stock or capital interest at the time of purchase. For the final four years, the value of the credit is six percent annually. Investors may not redeem their investments in CDEs prior to the conclusion of the seven-year period.

Throughout the life of the NMTC Program, the Fund is authorized to allocate to CDEs the authority to issue to their investors up to the aggregate amount of $19.5 billion in equity as to which NMTCs can be claimed.

These tax credits can be quite useful, and there may be some areas that qualify. However, it can take up to a year or more to apply and then finally receive NMTC-related cash. This can be a useful long term source of funds.

17 ORGANIZATION AND NETWORK OPERATIONS

With more than a dozen years of operation for a variety of community-owned network infrastructure projects around the country, there is very little "experimentation" that is still necessary. With more than three hundred communities making investments in broadband infrastructure, there is now enough information about what works and what does not work to be able to identify best practice across nearly all areas of operations, planning, management, and finance.

It is now relatively easy to identify the obstacles, challenges, and opportunities that the County is likely to face if it moves forward.

17.1 WISP TOWER LEASE MANAGEMENT

Once existing and/or new towers have space available to lease to WISPs, there are policy and contract decisions that must be evaluated.

- There should be a single public fee schedule for all providers.
- There should be a single tower space agreement that is used for all providers.
- Tower access should be made available in ten foot vertical segments, as high as possible on the tower without interfering with other uses (e.g. public safety antennas). Note that it is unlikely that any tower will have more than two providers on it.
- Leases should be a minimum of two years and should auto-renew if the ISP is meeting performance requirements.
- It may be more effective to have a single lease agreement with access to all towers, and the contract should require the ISP to put equipment on all towers within a certain period of time (e.g. nine to twelve months). This limits ISPs from "cherry picking" towers with more potential customers and ignoring towers in parts of the county with lower population density.
- Monthly tower lease fees should be on the order of $200 to $250 per tower. Higher fees make it difficult for providers to make a business case for the cost of equipment and the extensive marketing required to develop a customer base around a tower.
- If there are two vertical spaces available for lease, the lower segment could be made more attractive to a WISP by offering a reduced lease fee.
- An initial grace period of three to six month should be offered on fees, and/or offer a one year sliding scale of fees (e.g. first three months, fee waived; months four to six, 25% of normal fee; months seven to nine, 50% of normal fee; months ten to twelve, 75% of normal fee). There are many ways to structure the initial fee period, but it is important to recognize that the WISPs incur substantial early costs to develop revenue and customers for a new tower.

- All tower leases should expire on the same date even if started at different times. This allows the regional enterprise to potentially make a smoother transition to a new provider if there are performance issues, and will give the regional entity more leverage and control over the WISPs.
- In contracts, fee reductions should be worded as discounts that can be revoked if performance requirements are not adequately being met.
- There are considerations for ground-space (e.g. WISP cabinets, shelters, H-frames for electric service) that will have to be evaluated at each tower site. If new shelters will be allowed, the regional entity should set minimum standards for new shelters.

Tower Space Revenue Estimate

Tower revenue opportunities are limited. It takes WISPs many months to acquire enough customers on a new tower to break even, and even longer to begin to show a profit. Fees for tower space need to be modest to attract one or two providers, and it is good practice to offer several months of free service while the WISP markets in the new service area and tries to sign up customers.

Because of interference problems, two providers are the most that are desirable on a tower, and offering towers on an exclusive basis (e.g. an open auction for tower space) could bring in more revenue from a single provider.

Sample Tower Leasing Revenue Projection

Service Item	Description	Monthly Fee	Max Number of WISPs per Tower	Projected Annual Revenue
Tower Space on One Tower	10 feet of vertical space leased to one ISP	$200	1	**$2,400**
Tower Space on Three Towers	10 feet of vertical space leased to one ISP	$200	1	**$7,200**
Tower Space for Six Towers	10 feet of vertical space leased to one ISP	$200	1	**$14,400**

Tower Space Operational Expenses

Assumptions include:

- Each provider on a tower will install their own electric service (meter) and pay their own utility costs.
- Site leases on private land can be negotiated for $1000/year with a single up-front payment of $10,000 (for ten years).

If several towers are available (e.g. three, four), there will be some efficiencies gained in costs so that revenue would likely exceed expenses–costs like legal services and insurance will not increase proportionally with more than one tower.

Tower Lease Annual Expense Projections

Budget Item	Description	Annual
Legal Services	Legal counsel on an as-needed basis for review of construction and service contracts, IRU agreements, and other business documents.	**$1,500**
Accounting	Part time accounting and bookkeeping services will be required	**$2,400**
Generator Maintenance/ Fuel	Generators require periodic maintenance and occasional fuel (propane) tank refills.	**$950**
Site Maintenance	Routine tasks like trimming weeds and grass around the tower.	**$600**
Site Leases	Some towers may be placed on private property which would require annual site leases. This will vary depending on the availability of local government properties that may be available for tower placement.	**$1,000**
Insurance	Some insurance is likely to be needed (general liability, unemployment, asset insurance, umbrella policy).	**$2,500**
Total Costs	**Projected annual expenses**	**$8,950**

17.2 OPERATING A DARK FIBER NETWORK

As the network is completed and customers are connected, the project must have resources in place to maintain and repair the dark fiber and conduit if damage occurs (break-fix repair). A plan for the maintenance of the network will need to be developed.

- Outside Plant Maintenance – The project will be responsible for maintaining the conduit and both the lit and dark fiber that is installed in the conduit. These responsibilities will include utility locates, routine maintenance of conduit/fiber (relatively rare), and emergency break-fix (also rare, but requires immediate response).

Passive equipment is equipment that is not addressable on the network (that is, no network electronics), but still plays an important role.

- Fiber patch cables

- FTU - A Fiber Termination Unit is the enclosure mounted to a customer premise where fiber is terminated. ("Wall Box").
- Closures, Splice Cases, or FOSCs are the enclosures in a handhole that protect the splicing from distribution fiber to drop fiber.
- Patch panels (connector types). In a dark fiber installation of the kind planned for the business park in Rocky Mount, a patch panel would be installed in cabinet. Providers would cross-connect their fiber to the Authority fiber via the patch panel.

- Hand holes and vaults - These are part of the fiber network.
- Cabinets, Shelters - Installed as needed to meet the requirements of the dark fiber design. In most cases, a ground-mounted cabinet will be adequate.
- Equipment Racks - The project may wish to offer rack space for provider equipment. A project patch panel will be used to cross connect leased fibers as needed. All patch cable installs and cross-connects will be performed by project staff.

The conduit (and dark fiber, if included) network will require some limited routine maintenance and some unscheduled maintenance. Routine maintenance could include physical inspection of facilities and equipment, and repairs required by normal wear and tear and weather. Unscheduled maintenance could include repairs due to ice and wind damage, vandalism, or other accidental damage (car/truck accidents, snowplow damage, backhoe and other kinds of damage to underground facilities).

Locates

- The budget allocation for locate services must be part of the network's Operations and Maintenance budget. Note that with the purchase of some relatively inexpensive equipment, locates could be done by project staff at significant cost savings.
- The Network will have a membership in the Virginia 811 (Miss Utility) locate service.
- The Network should maintain a list of qualified locate contractors and engage at least one to perform regular locate services for the network. Optionally, project staff can perform locates at significantly less cost with nominal training.

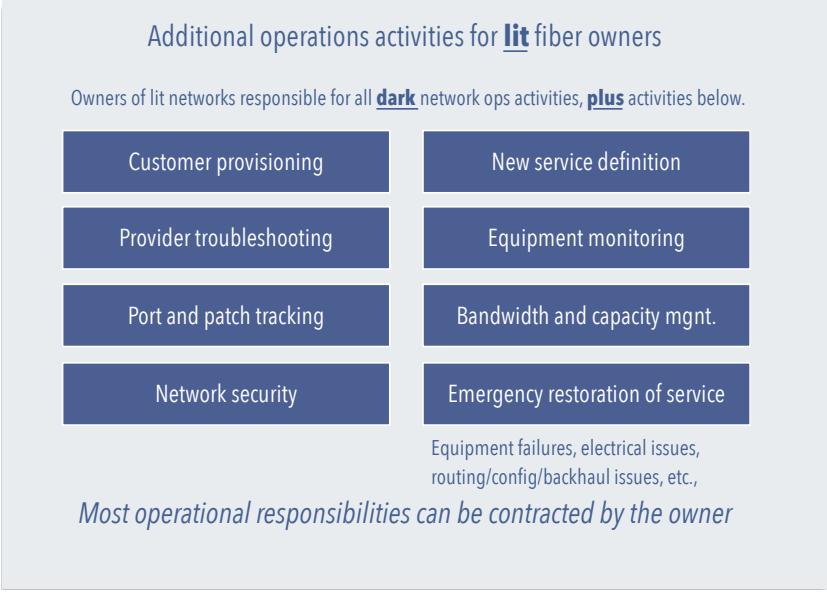
Fiber Strand Management

- Project staff will maintain GIS mapping and documentation of assets for the network.

- If dark fiber has been placed in the conduit network, project staff will track all fiber splices in an appropriate tracking database.
- Project staff can manage break/fix services and procedures with appropriate training and the purchase of a fiber splicing machine.

17.3 OPERATING A LIT FIBER NETWORK

A lit fiber network requires a series of ongoing daily, weekly, and monthly activities. While no lit network is currently under consideration in Franklin County, these activities will not be onerous and can largely be handled on a part time basis.



- Provisioning – When a new customer is connected, a circuit has to be allocated for that customer. Switch configurations have to be updated.
- Troubleshooting – Occasional faults and problems occur, and the source of the issue must be identified and then corrected.
- Port tracking – As customers and services are assigned, the ports and patch panel assignments have to be recorded and tracked.
- Network security – Network switches and services have to be kept up to date with current software patches and security software.
- Service definitions – As customers request new services, these have to be added to the network switches and core network management server.
- Monitoring – Customers expect the network to be available and operational at all times. Automated monitoring alerts and alarms have to be in place to alert network staff of problems. Some one has to be designated to respond to these alerts (i.e. a network problem) around the clock–24/7/365.
- Bandwidth management – Internet backhaul is purchased in increments, and this has to be monitored to ensure that adequate bandwidth is available to customers.
- Emergency restoration – Radios on towers fail due to the harsh environmental conditions: ice, wind, snow, rain, heat, insects, rodents, and birds. Aerial fiber can be damaged by tree limbs, ice, and rodents. Underground

fiber can be damaged by unauthorized digging. A plan has to be in place to address equipment and network failures.

Equipment inventory

- Periodic audits of the network inventory will be especially important during network expansions.

Spares management

- The project will need to store spare equipment, and OSP construction materials in a secure location.
- Non-tagged network inventory such as connectors, patch cables, clamps, and consumables should be included in the spare inventory.

17.4 NETWORK EXPANSION

If the conduit/fiber network is expanded over time, there will be a period of time when some construction is underway. During a network expansion phase, parts and materials have to be ordered, delivered and stored until put into operation. Shipments have to be reconciled with orders prior to payment. The project will construct new conduit segments through the management of contracts with outside firms and contractors.

Construction and Contractor Management Activities

- Build new conduit and install dark fiber as needed.
- Inventory and track all significant equipment, parts, and equipment.
- Reconcile shipped items with shipping tickets and purchase orders.
- Maintain and repair existing fiber facilities as needed.
- Ensure all procurement meets local and state procurement rules.

17.5 TYPICAL CONTRACT SERVICES

Contract services may be used or required as needed, with some services starting prior to service provider or lessee use of the network. For many work roles and responsibilities, this approach helps manage cash flow and will help match revenue and expenses better.

- Project management – Expansion of the network may require the use of a firm to manage the construction process (or the project provides this work).
- Conduit network design and strategy – The project may make occasional use of a network planning firm to help develop expansion routes, assist with pricing strategy, help with service provider negotiation, and other related tasks.
- Conduit network build out – The project, as it expands the network, will typically use a qualified construction firm and/or locally trained and qualified workers to perform the construction.
- Legal services – An attorney will assist as needed with lease agreements and IRU contracts.

- Bookkeeping and accounting – Part time bookkeeping and accounting services will be entirely adequate.
- Marketing services – The project may make occasional use of a local ad agency or marketing firm for assistance with marketing materials (e.g. logo design, Web design, brochure design, etc.).

17.6 OTHER MANAGEMENT ROLES

A wide range of high level activities will take place regularly. Some of the items on this list also appear in other sections of this document, but are listed here to provide a high level overview of key business and management related activities.

Activities

- Provide continuity of leadership and project management.
- Provide monthly reports to grant agencies and other stakeholders and funding sources.
- Meet as needed with interested parties and stakeholders (e.g Chamber of Commerce, Merchants Association, etc.).
- Monitor network performance and assist with customer dispute resolution.
- Manage leases, right of way agreements, and other real estate-related activities.
- Manage contract and work activities of outside plant repair and maintenance contractor.
- Meet with local groups as needed to promote use of the network.
- Represent the project at state level meetings and hearings.
- Meet with visitors and interested parties from other cities and regions.

The project will have the primary responsibility for ensuring that management and administration of the enterprise is handled appropriately.

17.7 ASSET MANAGEMENT

A primary role of the project will be to manage assets owned directly. These assets will include conduit, fiber, cabinets, network electronics, easements, and right of way use. Additionally, these assets have to be managed and tracked during the construction and build out process prior to being put into operation.

The asset management will consist of two primary areas of responsibility:

- Legal contracts, ranging from simple documents of a page or two for property easements, pole attachment rights, or tower access for an antenna to more complex legal documents that might cover twenty or thirty year leases of significant assets. These longer documents will have payment schedules and fee calculations. Legal counsel and review will be required for many if not most of these documents, at least for the first time they are written. Some documents will become "standard" contracts that will likely not require review for each lease unless significant changes are needed.

- Management of hard assets, which will include fiber cable, conduit, and handholes, and other fiber-related materials.

Activities

- Procure and manage leases for access to public right of way, private property
- Select, purchase, and track location and value of passive infrastructure, including fiber, duct, cabinets, and other facilities.

The project will need the help of an attorney to assist with creating leases and other legal documents related to asset management. The network may need additional assistance from qualified legal counsel for occasional review of legal documents. The network will have to maintain a complete inventory of all physical items and real property.

A network inventory management process, which could be as simple as a set of spreadsheets or modest database, with an accompanying process to ensure that data is entered and updated in a timely manner. For all major pieces of equipment (i.e. purchases of more than $100, typically), data like vendor, model number, serial number, date put in service, and service notes will need to be maintained.

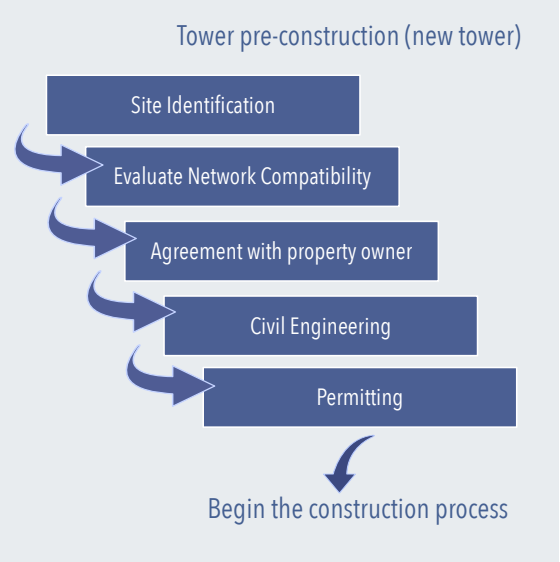
Note that asset management is extremely important, especially fiber strand management. We know of at least one small project that did not maintain adequate strand in-use records and had to install additional fiber cable at significant cost.

17.8 TOWER SITE AND TOWER MANAGEMENT

Tower Site Identification

When a site for a new tower is being considered for use, the diagram below illustrates the steps that need to be followed. For example, if an existing public safety tower or an existing cellular provider tower may have space for fixed point wireless broadband equipment (i.e. co-location).

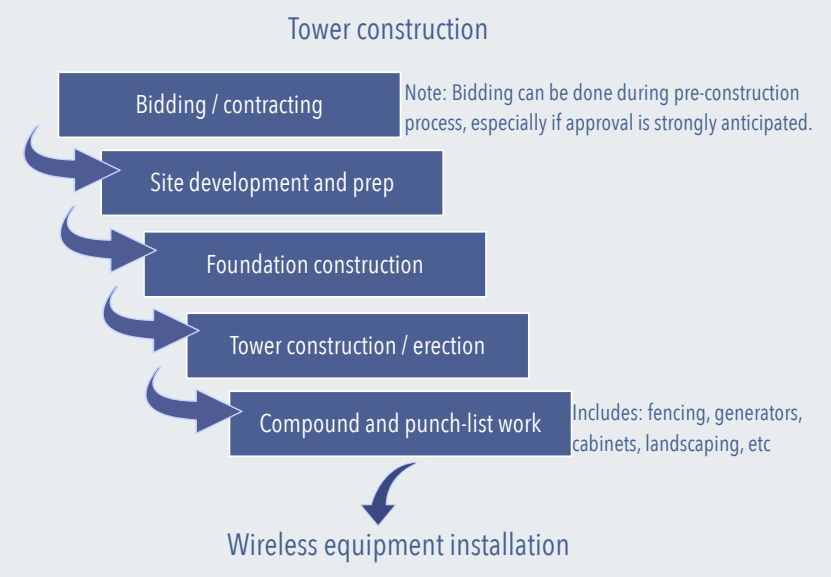
- Site identification – Identify areas of poor service and look for existing towers.
- Network Compatibility – Line of sight to other towers and to key service locations and customers needs to be evaluated. A wireless propagation study and line of sight study will provide the data needed to make this determination.
- Property owner negotiation – A lease has to be negotiated with the property owner. Local government sites (e.g. K12 schools, parks, recreation areas, fire/rescue stations) are candidates for towers because of reduced or no lease fees.



- Engineering – An engineered site plan will be required to as part of the permitting process.
- Leases and permits – A permit to place the tower is required in most localities, and there may be a multi-stage permitting process that can take several months.

Tower Construction

Once the engineering work is completed and a construction permit has been issued, tower construction can proceed. For a typical fixed point wireless tower of 199' feet or less, construction usually takes less than a month, but weather and soil conditions can create delays.



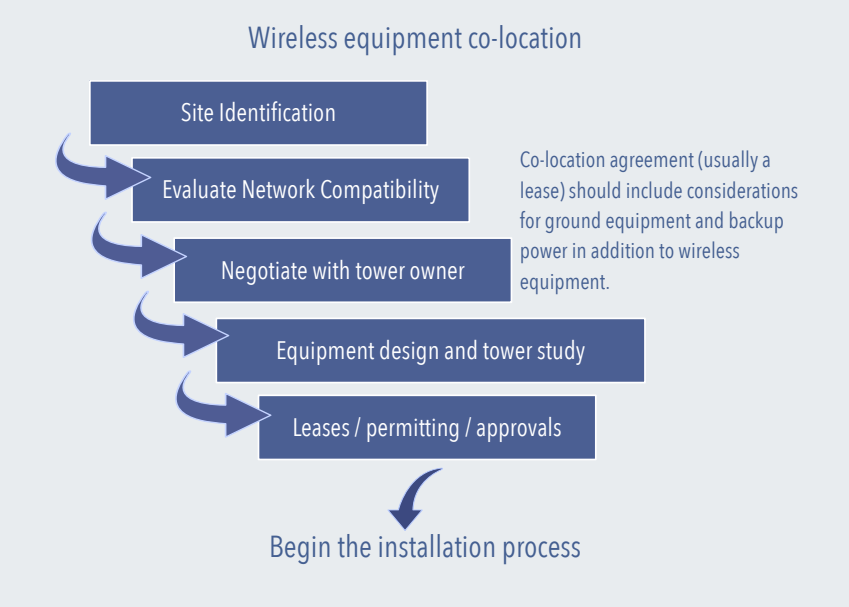
- Bidding and contracting – Bid documents and construction specifications have to be prepared and sent to candidate contractors. Once bids are received, proposals have to be reviewed, and depending upon funding sources, may require review by local government and/or a funding agency prior to awarding a contract.
- Site development – The tower site has to be cleared of trees, brush, and any other obstructions. The area directly around the tower has to be leveled, and electric service (underground or aerial) has be brought to the site. Depending upon the location a road (usually gravel) may have to be placed.
- Foundation construction – Once site clearing and any road work is completed, the foundation for the tower is installed. If it is a guyed tower, guy wire anchors have to be installed.
- Tower construction – Once the foundation is in place, the tower is erected. For towers of 199' or less, this is usually only two days.
- Final work details – Once the tower is in place, final work items are completed, including fencing, generators, fuel tanks, landscaping, and any site restoration work.

Wireless Equipment Co-Location

When an existing tower is being considered for use, the diagram below illustrates the steps that need to be followed. For example, if an existing public safety tower or an existing cellular provider tower may have space for fixed point wireless broadband equipment (i.e. co-location).

- Site identification – Identify areas of poor service and look for existing towers.

- Network Compatibility – If there are towers in the service area, the first step is to determine if a minimum of ten vertical feet of space is available at an appropriate height for broadband wireless equipment. A wireless propagation study will provide the data needed to make this determination.

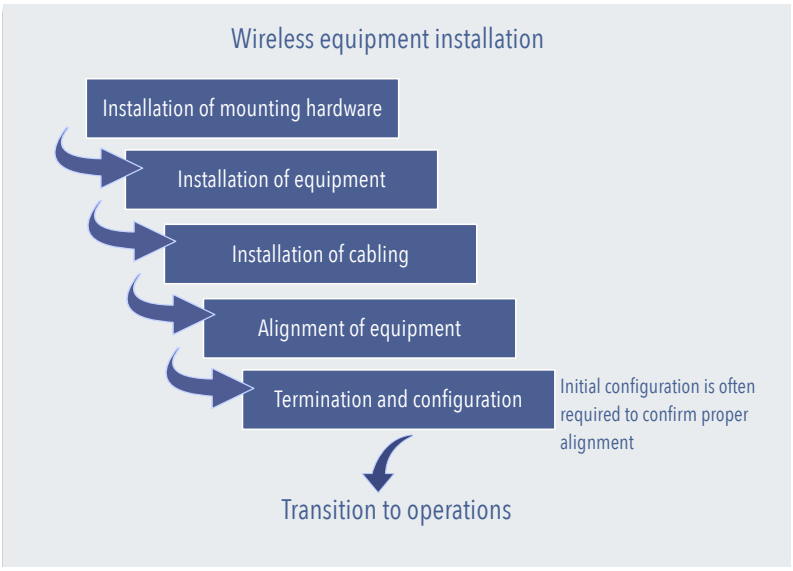


- Tower owner negotiation – If the tower is in a suitable location and if space is available at an appropriate height, a lease has to be negotiated with the tower owner.
- Tower study – An engineering study may be required to determine if the tower is able to support the additional weight and wind load of the equipment. Additional electric service and a cabinet for network electronics may also be needed.
- Leases and permits – If new electric service and/or a cabinet or shelter has to be installed at the sight, local government permits and/or construction approvals may be required.

Wireless Equipment Installation

Wireless equipment installation follows the completion of construction on a new tower or the acquisition of space on an existing tower. Electric power is already in place.

- Mounting hardware – Brackets and other mounting hardware have to attached to the tower at the designated height. This requires a tower climb conducted by a firm with trained tower climbers.
- Equipment installation – Once the mounting hardware is in place, radios are attached to the tower. On the ground, network equipment including



switches, powers supplies, battery backup, and other equipment is installed. A backup generator and fuel tank may also be installed and wired into the equipment cabinet or shelter.

- Cabling installation – Cables are connected between the equipment in the cabinet on the ground to the radios on the tower.
- Alignment of radios – Radios on the tower have to be adjusted. Local access radios that provide service to local customers with line of sight to the tower have to be aligned for optimum coverage. If there are also point to point radios on the tower for connections to other towers or locations, these also have to be aligned. Tower climbers are needed to perform these steps.
- Configuration and testing – Once the physical alignment of the radios is complete and all cabling is connected, the new network equipment is integrated into the rest of the network.

17.9 LEGAL AND REGULATORY

Investments in community telecom infrastructure require attention to local, state, and Federal regulatory issues. The management of telecom infrastructure is a business enterprise that requires a variety of legal contracts, service agreements, maintenance and work agreements, procurement and performance contracts, and corporate legal documents of various kinds.

- Identification of state and Federal laws that may affect operations.
- Development of service provider master agreements and service agreement addendums.
- Leases for easements and rights of way.
- Review of work contracts for consultants, contractors, and engineering firms.
- Review of maintenance and operations agreements.

The project will require the services of an attorney with some demonstrable experience with community telecom agreements. Many attorneys are not familiar with community-owned open access networks, and some time and effort should be made to carefully qualify an attorney or firm prior to hiring them.

18 OBSTACLES, CHALLENGES, AND SUCCESSES

18.1 OBSTACLES AND CHALLENGES

Market Size

Market size is a key consideration for evaluating risk. Market size (called "addressable market," or the number of potential customers) determines the level of interest of service providers, who are the primary customers of an open network. Certain kinds of services are essential to the financial viability of a community network, especially TV and telephone services. While telephone services can be offered affordably in even very small markets, the overhead costs of establishing a local or remote TV head end (equipment that manages and distributes the channels available from a provider) is still relatively expensive compared to providing other services like Internet access. A rule of thumb for evaluating market size is that a minimum of four to five thousand potential residential customers (households) are needed to attract an IP TV provider. Note that fiber is required for adequate TV package offerings.

The county represents a business opportunity for service providers who can make a business case for providing advanced services beyond Internet access, TV, and telephone: home health care, home security monitoring, computer backups, pay per view/video on demand, and other high margin services are going to become increasingly common. Alternatives to existing cable and satellite TV offerings will not become available until fiber connections are more widely available.

Take Rate

Take rate refers to the number of customers that actually subscribe to one or more services. Take rate targets are established in a detailed financial projection, and are adjusted over time as actual take rate data becomes available once the network is in operation. If the take rate is too low, revenues will not meet goals, and lowered revenues may affect the project's ability to pay its bills and maintain and operate the network.

Take rate projections are a significant risk factor in any project of any size, and must be considered carefully. Take rate risk can be managed by only building in areas where businesses or residents (or both) have made a threshold commitment to buy a minimum dollar value of services (e.g. 40% of businesses in a defined area must commit in advance before build out would commence).

For example, if the Authority develops a community pole program in partnership with an ISP, Authority or County funds should not be committed to place a pole until the ISP has collected a specified number of service contracts from residents that could receive service from the community pole.

Funding

Excellent leadership and hard-nosed business management of the enterprise are essential to the project's ability to obtain necessary funding. Although the network may be operated as a government effort, it must be managed with the same attention to costs, revenue, and financial administration as any private sector business. The project must be able to develop and maintain "investment quality" financial reports and business models to attract private sector sources of funding like revenue bonds, municipal leases, commercial loans, and business contributions. If investments are restricted to basic infrastructure like tower sites, fiber, towers, and equipment

shelters, maintenance costs will be relatively low and it should be possible to structure attractive tower space lease rates to cover routine maintenance, minimizing financial risk and requiring limited funding.

Service Providers

While in many respects a community broadband network shares many similarities with other public utilities (e.g. roads, water, sewer) there is one fundamental difference. Other public utilities like water and sewer have a captive audience and the utility is able to operate as a monopoly–meaning the customer base can be taken for granted. Early discussions with service providers have been positive, with at least two providers making requests for additional information about the effort.

A community broadband network is a public/private enterprise, and service providers are the primary customers of the network. Service providers cannot be taken for granted. Instead, a fair fee structure, a high quality network, excellent maintenance and operations processes, and organizational flexibility will be required to recruit and retain service providers.

Projects that are not successful in attracting service providers will fail. Affordable lease rates for tower space and/or fiber connections will attract service providers. Other open access projects(e.g. Danville, VA; New Hampshire FastRoads,; Bozeman Fiber; Utopia/Salt Lake City area) have not had any difficulty getting service providers to use the infrastructure. Indeed, the Utopia project has twenty-three providers on its network.

Franklin County has had a very successful WISP in the county (BitX) for several years, and BriscNet has expressed a strong interest in the Franklin County market. Shentel and Lumos both have fiber in the County and are potential partners, and Mid-Atlantic Broadband (MBC) also has fiber in the county and there are numerous providers on the MBC network that represent additional partner prospects.

Technology

A question that often dominates early discussions of community broadband projects is, "Are we picking the right technology and systems?" Everyone has experienced the rapid obsolescence of computers, cellphones, printers and other IT equipment.

There is always some risk associated with making a substantial investment in a network. However the risk can be managed. In a predominantly fiber network, a large portion of the investment will be dedicated to getting fiber in the ground or on poles throughout the community. Properly installed fiber has a minimum 25 to 30 year useful life, and fiber installed by the telephone companies in the seventies is still in use today. Fiber also has a useful property not shared with other public systems like water, roads, and sewers. The capacity of fiber can be increased without replacing the fiber or adding additional fiber. Instead, fiber capacity can be increased indefinitely by replacing the electronics at each end of the fiber. This means that a community investment in fiber creates a stable, long term asset for the community with long lasting value.

The equipment used to light the fiber has a shorter useful life, and is usually depreciated over a period of 7 to 9 years. Some equipment may remain useful longer than that. Wireless equipment must be replaced much more often (typically 2 to 4 years of useful life) because it is typically exposed to much harsher conditions (extreme heat and cold, lightning strikes, ice, snow, rain, wind).

The primary technology risk is selecting a vendor who provides equipment that does not perform as advertised. This risk can be managed by a careful procurement process which would include a careful analysis of network capacity and features, detailed RFPs that specify equipment features and functions explicitly, and a thorough RFP evaluation process.

Legal and Regulatory Issues

Community-owned broadband projects are subject to state and Federal regulations of various kinds, but unless a project is offering retail services (e.g. the local government is selling Internet, TV, and/or voice services directly to residents and businesses), there are limited regulatory issues. The City of Eagan's AccessEagan Gigabit fiber network has been in operation for seven years, and has four private sector service providers offering services. There has never been an incumbent legal challenge because incumbent providers like Comcast and CenturyLink have been invited to use the network (both have repeatedly declined).

The key strategy is for community-owned projects to adopt the wholesale model of leasing passive infrastructure like towers and dark fiber and for active networks (with network electronics) to lease circuits to providers on a wholesale basis rather than selling retail services. The Utopia project, which offers services in fourteen communities in the Salt Lake City area, has been targeted in the past as a "failed" effort but has overcome some early financial challenges and today has 23 private sector providers offering a wide range of price points and service packages—delivering true choice and competition to citizens and businesses. The wholesale model is not subject to many of the FCC (Federal Communications Commission) regulatory requirements.

18.2 SUCCESSES

Town of Ashland, Virginia

The Town of Ashland recently completed the construction of two miles of conduit and dark fiber that passes by a large number of businesses in the community. The goal is to provide local businesses with more broadband and Internet service options, making more bandwidth available at lower prices. The Town is not going to be an ISP. Dark fiber will be leased out to private sector Internet Service Providers, who will install their own equipment on the fiber network and market directly to businesses in the community. A major regional ISP (Segra) became the first provider on the network, and the Town has begun planning extensions to the network.

Wired Road Broadband Authority

The Wired Road Broadband Authority is owned by Carroll and Grayson counties and the City of Galax, in far southwest Virginia. The enterprise is in its eleventh year. The project started with a single grant of $200,000, and additional state, Federal, and local funds have been used to develop more than $4 million in network assets, including more than 40 miles of fiber and twenty-plus wireless access points. Wireless service covers large areas of the mountainous region, and fiber services are available in the region's business parks and the larger downtown areas. The project continues to develop and evolve, with a major wireless equipment upgrade underway and the completion of a fiber ring between Galax and Hillsville, the two largest towns in the region. Two private sector service providers lease circuits and sell services on the open access network.

Eastern Shore of Virginia Broadband Authority

The ESVBA offers services in Accomack and Northampton counties on the Eastern Shore of Virginia. The Authority, with Federal and state grant assistance, built an 80 mile fiber backbone through both counties in 2009. The network generated modest revenue that provided incremental expansion funds and returned some funds to the two county General Funds. In 2018, the Authority announced a significant expansion plan to bring fiber services to most homes and businesses in the two counties over a period of several years.

Bozeman Fiber

Bozeman Fiber is a community nonprofit formed in 2015 to bring Gigabit fiber services to the business community in the Montana city. The network was completed in 2016, with more than 25 miles of Gigabit fiber constructed to pass many of the city's main business and commercial areas. Five private sector service providers lease capacity on the open access network.

City of Richwood, West Virginia

A water line extension to some rural neighborhoods just outside the City of Richwood has led to a project to leverage the water line work to bring fiber and wireless broadband to those same areas. A nonprofit start up (Richwood Scientific) led by a small group of community leaders has worked with the Region 4 PDC to get a grant to both develop a technical plan and to build a "phase one" portion of the network. The planning work was completed in the fall fo 2018, and construction on the network will begin later in 2019. The project includes two miles of fiber to the home, with a high performance wireless link from the mountain top neighborhood back down into the Richwood Scientific office in town.

Charlemont, MA

The town of Charlemont, Massachusetts has decided to combine a grant from the state with an $11/month/household assessment to build fiber throughout the entire town of 524 households. Comcast had offered to make modest upgrades to the existing copper-based cable network but was asking for nearly half a million dollars from the town. Instead, voters agreed with Town officials to build their own network. Once finished, Internet service will be provided by a private sector ISP. Gigabit fiber Internet service is expected to cost about $80/month with no data caps. Phone service is expected to cost $23 month, and Internet, phone, and several Over The Top (OTT) services like Netflix, Hulu, and YouTube TV is expected to cost around $140/month, or about 15% to 20% less than Comcast service.

Danville, Virginia

The City of Danville, Virginia had high unemployment rates in the early 2000s after most of the city's textile manufacturing jobs had left. City leaders recognized that simply trying to attract traditional manufacturing jobs was not going to be an effective economic development strategy. The City began investing in open access fiber in 2008 and put fiber in five business parks and the downtown area. The City also began working with private developers to re-purpose and rehabilitate empty and underused building in the City's downtown, creating live/work apartments and condos and class A office space. The combination of affordable fiber, improved housing options, class A office space, and a focus on attracting high tech businesses that needed all three (fiber, class A office space, and housing) has revitalized the City and brought hundreds of new jobs to the City's downtown. The fiber network has been in the black for several years, and some revenue is sent to the City's General Fund, while some revenue is used to expand the network into residential areas of the city. Services on the open access network are provided by three private sector ISPs.

Active network: Typically a fiber network that has electronics (fiber switches and CPE) installed at each end of a fiber cable to provide "lit" service to a customer.

Asymmetric connection: The upload and download bandwidth (speed) are not equal. Cable Internet and satellite Internet services are highly asymmetric, with upload speeds typically 1/10 of download speeds. Asymmetric services are problematic for home-based businesses and workers, as it is very difficult to use common business services like two way videoconferencing or to transfer large files to other locations.

Backhaul: Typically refers to a high capacity Internet path out of a service area or locality that provides connectivity to the worldwide Internet.

Colo facility: Colo is short for Colocation. Usually refers to a prefab concrete shelter or data center where network infrastructure converges. A colo or data center can also refer to a location where several service provider networks meet to exchange data and Internet traffic.

CPE: Customer Premises Equipment, or the box usually found in a home or business that provides the Internet connection. DSL modems and cable modems are examples of CPE, and in a fiber network, there is a similarly-sized fiber modem device.

Dark fiber: Dark fiber is fiber cable that does not have any electronics at the ends of the fiber cable, so no laser light is being transmitted down the cable.

Fiber switch: Network electronic equipment usually found in a cabinet or shelter

FTTH/FTTP/FTTx: Fiber to the Home (FTTH), Fiber to the Premises (FTTP), and Fiber to the X (FTTx) all refer to Internet and other broadband services delivered over fiber cable to the home or business rather than the copper cables traditionally used by the telephone and cable companies.

Handhole: Handholes are open bottom boxes with removable lids that are installed in the ground with the lids at ground level. The handholes provide access to fiber cable and splice closures that are placed in the handhole. Handholes are also called **pull boxes**.

IP video: Video in various forms, including traditional packages of TV programming, delivered over the Internet rather than by cable TV or satellite systems.

Latency: The time required for information to travel across the network from one point to another. Satellite Internet suffers from very high latency because the signals must travel a round trip to the satellite in stationary orbit (22,500 miles each way). High latency makes it very difficult to use services like videoconferencing.

Lit network: A "lit"network (or lit fiber) is the same as an active network. "Lit" refers to the fact that the fiber equipment at each end use small lasers transmitting very high frequency light to send the two way data traffic over the fiber.

Passive network: Refers to infrastructure that does not have any powered equipment associated with it. Examples include wireless towers, conduit (plastic duct), handholes, and dark fiber.

Pull boxes: Pull boxes (also called handholes) are used to provide access to fiber cable and splice closures. They are called pull boxes because they are also used during the fiber cable construction process to pull the fiber cable through conduit between two pull boxes.

Splice closures: Splice closures come in a variety of sizes and shapes and are used to provide access to fiber cable that has been cut open to give installers access to individual fiber strands. Splice closures are designed to be waterproof (to keep moisture out of the fiber cable) and can be mounted on aerial fiber cable or placed underground in handholes.

Splicing: The process of providing a transparent joint (connection) between two individual fiber strands so that laser light passes through. A common use of splicing is to connect a small "drop" cable of one or two fiber strands to a much larger (e.g. 144 fiber strand) cable to provide fiber services to a single home or business.

SCADA: Supervisory Control and Data Acquisition. Used by the electric utility industry and some other utilities (e.g. water/sewer) to manage their systems.

Symmetric connection: The upload and download bandwidth (speed) is equal. This is important for businesses and for work from home/job from home opportunities.

Virtual Private Network: A VPN creates a private, controlled access link between a user's computer and a corporate or education network in a different location. VPNs are often encrypted to protect company and personal data. VPNs usually require a symmetric connection (equal upload and download speeds) to work properly.

APPENDIX B: TOWER OWNER DATA

Note that owner locations are different from the actual location of the towers. Franklin County has all towers accurately mapped as to actual location.

CELL_SITE	ADDRESS	CITY	OWNER	STATUS	Map Symbol
Franklin County E911	1247 Summit Drive	Rocky Mount	County of Franklin	Public Safety	Green Tower/County Owned
Fork Mountain Fire Station To			Franklin County	Public Safety	Green Tower/County Owned
Henry Fire Dept	5241 Henry Road	Henry	Franklin County	Public Safety	Green Tower/County Owned
Tom's Knob	1198 Toms Knob Rd	Martinsville	Franklin County	Public Safety	Green Tower/County Owned
Burnt Chimney Water Tank	52 Burnt Chimney Rd Wirtz VA 24184	Wirtz	Franklin County	Proposed	Red Circle/County Watertank
Triton	10704 BOOKER T WASHINGTON HWY	Wirtz	American Tower	In Service	Red Tower/County provided
Hales Ford	16007 BOOKER T WASHINGTON HWY	Moneta	US Cellular	In Service	Red Tower/County provided
Grassy Hill Crown Castle	1245 Summit Drive	Rocky Mount	Crown Castle	In Service	Red Tower/County provided
Briar Mountain Crown Castle	605 BRIARPATCH DR	Rocky Mount	Crown Castle	In Service	Red Tower/County provided
Boones Mill US Cellular	1350 MURRAY KNOB RD	Boones Mill	US Cellular	In Service	Red Tower/County provided
Boones Mill	1350 MURRAY KNOB RD	Boones Mill	Crown Castle	In Service	Red Tower/County provided
Franklin	1889 Brick Church Rd	Rocky Mount	AEP Towers	In Service	Red Tower/County provided
Morningside	148 Northside Dr	Rocky Mount	Crown Castle	In Service	Red Tower/County provided
Briar Mountain US Cellular	605 BRIARPATCH DR	Rocky Mount	US Cellular	In Service	Red Tower/County provided
Windy Gap	1060 Red Valley Rd	Boones Mill	US Cellular	In Service	Red Tower/County provided
Ferrum College	185 FIELDVIEW DR	Ferrum	US Cellular	In Service	Red Tower/County provided
Rocky Mount USCC	135 REDBUD HILL RD	Rocky Mount	US Cellular	In Service	Red Tower/County provided
Cooks Knob	1299 Isolane Road	Callaway	American Electric Power	In Service	Red Tower/County provided
Proposed Verizon Tower	JUBAL EARLY HWY	Boones Mill	Verizon	Proposed	Red Tower/County provided
Highland Paging	1249 Summit Drive	Rocky Mount	Highland Paging	Small	Red Tower/County provided
Valley Communications	1251 Summit Drive	Rocky Mount	Valley Communications	No Carriers	Red Tower/County provided
Valley Communications	1253 Summit Drive	Rocky Mount	Valley Communications	No Carriers	Red Tower/County provided
Proposed nTelos Tower			nTelos	Proposed	Red Tower/County provided
nTelos Tower	1237 Dillards Hill	Union Hall	TowerCo, LLC	In Service	Red Tower/County provided
Oak Level	245 Virgil H. Goode Hwy	Henry	American Tower	In Service	Red Tower/County provided
Fork Mountain		Fork Mountain	Sprint	Public Safety	Red Tower/County provided
Sprint CO Building	South Main Street	Rocky Mount	Sprint	Other	Red Tower/County provided
AEP Transmission	21890 Virgil H. Goode Hwy	Rocky Mount	AEP	In Service	Red Tower/County provided
Roanoke County	11221 SLINGS GAP RD		Unknown	In Service	Red Tower/County provided
Smith Mountain - Bedford			Crown Castle	In Service	Red Tower/County provided
Smith Mountain - Microwave			Unknown	Other	Red Tower/County provided
Smith Mountain -Ranger			Chuck Hurtz	Other	Red Tower/County provided
Smith Mountain - AEP			AEP	Other	Red Tower/County provided

Smith Mountain - Crown			Crown Castle	Other	Red Tower/County provided
US Cellular Burnt Chimney	4312 Booker T. Washington Hwy	Rocky Mount	US Cellular	In Service	Red Tower/County provided
Boardwalk Water Tank	Boardwalk Dr	Moneta	Ron Willard	Proposed	Red Tower/County provided
Fork Mountain Alternate locati			Unknown	Proposed	Red Tower/County provided
US Cellular - Redwood	47 Webster Rd	Glade Hill	US Cellular	In Service	Red Tower/County provided
Nextel Brandy Drive	428 Bandy Drive	Hardy	Nextel	In Service	Red Tower/County provided
Moorman Road nTelos	188 Moorman Road	Hardy	Ntelos	In Service	Red Tower/County provided
CROWELLS GAP	VISTA PARKWAY	Mount Pleasant	Roanoke Co.	Public Safety	Red Tower/County provided
Naff Road Nextel	819 Naff Road	Boones Mill	Nextel	In Service	Red Tower/County provided
Monestry		Callaway	Unknown	Other	Red Tower/County provided
WYTI Radio tower	275 Glenwood Dr	Rocky Mount	Unknown	Other	Red Tower/County provided
Fork Mountain Road	1114 Fork Mountain Road	Bassett	Unknown	Proposed Broadband	Red Tower/County provided
South 220 Broadband	300 Cherokee Hills Rd	Bassett	Unknown	Proposed Broadband	Red Tower/County provided
Gilley's Mountain Ln	351 Gilley's Mountain Ln	Bassett	Unknown	Proposed Broadband	Red Tower/County provided
Henry School	200 Henry School Road	Henry	Unknown	Proposed Broadband	Red Tower/County provided
Providence Church	1993 Providence Church Rd	Henry	Unknown	Proposed Broadband	Red Tower/County provided
Snowcreek 2	25 James Street	Martinsville	Unknown	Proposed Broadband	Red Tower/County provided
Snowcreek 1	107 Snow Creek Road	Martinsville	Unknown	Proposed Broadband	Red Tower/County provided
Snowcreek 3	319 Whittle Lane	Martinsville	Unknown	Proposed Broadband	Red Tower/County provided
Snowcreek 4	5393 Snow Creek Road	Penhook	Unknown	Proposed Broadband	Red Tower/County provided
Snowcreek 6	210 Oriole Road	Rocky Mount	Unknown	Proposed Broadband	Red Tower/County provided
Snowcreek 5	7081 Snow Creek Road	Penhook	Unknown	Proposed Broadband	Red Tower/County provided
Henry 1	2376 Horseshoe Road	Henry	Unknown	Proposed Broadband	Red Tower/County provided
Henry 3	975 Brown Hill Drive	Ferrum	Unknown	Proposed Broadband	Red Tower/County provided
Henry 2	825 Republican Church Road	Ferrum	Unknown	Proposed Broadband	Red Tower/County provided
Needed Site			Unknown	Proposed Need Site	Red Tower/County provided
Needed Site			Unknown	Proposed Need Site	Red Tower/County provided
Needed Site			Unknown	Proposed Need Site	Red Tower/County provided
Needed Site			Unknown	Proposed Need Site	Red Tower/County provided
Proposed Mitchell Tower				Proposed	Red Tower/County provided
Philpott 563368	595 Brown Hill Rd	Ferrum	US Cellular	In Service	Red Tower/County provided
WROV	1609 CAHAS MOUNTAIN RD	Boones Mill		In Service	Red Tower/County provided
WAIDSBORO II		FERRUM		Proposed	Red Tower/County provided
	1654 SCUFFLING HILL RD	ROCKY MOUNT	TOWN OF ROCKY MOUNT	In Service	Red Tower/County provided
Middle Creek Triton	20 MIDDLE CREEK CT	Moneta	American Tower	In Service	Red Tower/County provided
Juggs Gap	1831 Virgil H Goode Hwy	Henry	Crown Castle	In Service	Red Tower/County provided
					Red Tower/County provided
AT&T Boones Mill	2900 JUBAL EARLY HWY	BOONES MILL	AT&T		Red Tower/County provided

Ferrum East	2849 Beech Mt. Rd.	Ferrum	Prime Tower Development	Foundation complete	Red Tower/County provided
B99.9 Tower	2160 WAIDSBORO RD	Rocky Mount	B99.9 Radio Tower	Other	Red Tower/County provided
Verizon Wireless	4351 Webster Rd.	Glade Hill	Frances S. Poindexter Child's Trust/ Charle Poindexter, Trus	199' tall tower	Red Tower/County provided
nTelos Tower	170 Edwardsville Rd	Hardy	nTelos	In Service	Red Tower/County provided
Lovely Valley Rd	1351 Lovely Valley Rd	Wirtz	American Tower	In Service	Red Tower/County provided
Jacks Mountain Rd	1177 Jacks Mountain Rd	Union Hall	Apex Towers LLC	Approved 4/24/2017	Red Tower/County provided
Blue Ridge Group LLC Site	2075 Bluewater Dr Hardy VA 24101	Hardy	Leased	Proposed	Red Tower/County provided
Westlake Water Tank	130 Westlake Rd	Moneta	Ron Willard	In Service	Blue Circle/ Non County Watertank
Park Place Water Tank	110 Pacific Ave	Moneta	James McKelvey	In Service	Blue Circle/ Non County Watertank
Rocky Mount Water Tank	44 Pendleton St	Rocky Mount	Town of Rocky Mount	In Service	Blue Circle/ Non County Watertank
Cooks Knob	1299 Isolane Road	Callaway	American Electric Power	In Service	Blue Tower/Radio Site Matrix
Franklin County E911	1247 Summit Drive	Rocky Mount	County of Franklin	Public Safety	Blue Tower/Radio Site Matrix
CROWELLS GAP	VISTA PARKWAY	Mount Pleasant	Roanoke Co.	Public Safety	Blue Tower/Radio Site Matrix
WROV	1609 CAHAS MOUNTAIN RD	Boones Mill		In Service	Blue Tower/Radio Site Matrix
Tom's Knob	1198 Toms Knob Rd	Martinsville	Franklin County	Public Safety	Blue Tower/Radio Site Matrix
Blue Ridge Group LLC Site	2075 Bluewater Dr Hardy VA 24101	Hardy	Leased	Proposed	Blue Tower/Radio Site Matrix
Prillaman?	975 Brown Hill Drive	Ferrum			Blue Tower/Radio Site Matrix
911 Dispatch Center	70 E Court St #101, Rocky Mount, VA 24151	Rocky Mount	Rocky Mount		Blue Tower/Radio Site Matrix
Ferrum Tower	1299 Isolane Road?	Ferrum		Proposed	Blue Tower/Radio Site Matrix
	3 MI WNW OF HOT SPRINGS	ROCKY MOUNT	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	9.9 MI W	Hot Springs	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	ON TOP BRIER MOUNTAIN 7 MI W OF HWY 220	ROCKY MOUNTA	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	275 GLENWOOD DR	ROCKY MOUNT	WYTI, INC.	FCC Registered	Red Tower/FCC
	MURRAY KNOB ROAD	BOONES MILLS	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	Cherokee Rd (Henry Rd)	Juggs Gap	Crown Communication Inc.	FCC Registered	Red Tower/FCC
	245 Virgil Goode Highway (010282)	Bassett	American Towers, Inc.	FCC Registered	Red Tower/FCC
	664 Red Valley Road	Boones Mill	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	Arthur Circle	Ferrum	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	110 PACIFIC AVE	MONETA	BROOMIK, LLC	FCC Registered	Red Tower/FCC
	130 WESTLAKE ROAD	MONETA	County of Franklin	FCC Registered	Red Tower/FCC
	4250 Booker T. Washington Hwy	Rocky Mount	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	1183 Dillards Hill Road	Union Hall	SBA Towers II LLC	FCC Registered	Red Tower/FCC
	55 Webster Road	Redwood	United States Cellular Corporation	FCC Registered	Red Tower/FCC
	0.09 mi North of SSR 678 (Edwardsville Rd)	Hardy	SBA Towers II LLC	FCC Registered	Red Tower/FCC

Phase One Wireless Improvements

PHASE	ITEM	SITE WORK	SITE COSTS	ACCESS EQUIPMENT	ACCESS EQUIPMENT COST	POINT TO POINTS	PTP BOM	POINT TO POINT COSTS	PROJECT MANAGEMENT COSTS	TOTAL COST
1	Blue Ridge Group Tower	Tower Improvements	$26,375.00	Sectors, LTE	$30,303.80	BH Burnt Chimney PTP Penhook	AF11FX Pair AF11FX Pair	$11,025.00	$5,000.00	$72,704
1	Cahas	New Tower	$170,000.00	Sectors, LTE	$30,304	PTP Cooks PTP Burnt Chimney	AF11FX Pair AF11FX Pair	$11,025	$14,500	$225,829
1	Callaway Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Grassy Hill	√		$2,500.00	$17,794
1	Dudley Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Burnt Chimney	AF11FX Pair	$5,512.50	$2,500.00	$23,306
1	Ferrum Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50				$2,500.00	$17,794
1	Glade Hill Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Grassy Hill PTP Penhook PTP Redwood Substation PTP Glade Hill Substation	√ √ √ √		$2,500.00	$17,794
1	Grassy Hill Tower	Tower Improvements	$26,375.00	Sectors, LTE	$30,303.80	PTP Burnt Chimney Boones Mill Omni PTP Callaway Omni PTP Glade Hill Omni PTP Toms Knob BH Franklin County HS BH Rocky Mount PTP Thornton Substation	AF11FX Pair AF5XHD Pair AF5XHD Pair AF5XHD Pair AF11FX Pair AF24HD Pair AF5XHD Pair √	$21,760.20	$5,000.00	$83,439
1	Henry Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Henry FD	√		$2,500.00	$17,794
1	Henry Fire Station Tower	Tower Improvements	$26,375.00	Sectors, LTE	$30,303.80	PTP Henry ES Omni	AF11FX Pair	$5,512.50	$5,000.00	$67,191
1	Lee M Waid Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Toms Knob	√		$2,500.00	$17,794
1	Snow Creek	New Tower	$170,000.00	Sectors, LTE	$30,304	BH Toms Knob	AF11FX Pair	$5,512.50	$5,000.00	$210,816
1	Summit View Tower	Tower Improvements	$26,375.00	Sectors, LTE	$30,304	BH Grassy Hill	AF11FX Pair	$5,512.50	$5,000.00	$67,191
1	Sontag Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Toms Knob	√		$2,500.00	$17,794
1	Toms Knob	Tower Improvements	$26,375.00	Sectors, LTE	$30,303.80	BH Grassy Hill PTP Snow Creek PTP Sontag PTP Henry FD PTP LM Wade	√ AF5XHD Pair AF24HD AF11FX Pair AF5XHD Pair	$14,030.10	$5,000.00	$75,709
1	Union Hall	New Pole (Village)	$7,865.00	Omni	$7,428.50	BH BRT	AF11FX Pair	$5,512.50	$5,000.00	$25,806
1	Windy Gap Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50				$2,500.00	$17,794
									Total Wireless Estimated Cost	**$976,546**

Phase Two Wireless Improvements

PHASE	ITEM	SITE WORK	SITE COSTS	ACCESS EQUIPMENT	ACCESS EQUIPMENT COST	POINT TO POINTS	PTP BOM	POINT TO POINT COSTS	PROJECT MANAGEMENT COSTS	TOTAL COST
2	Burnt Chimney Elementary	Water Tank Improvement	$26,375.00	Sectors, LTE	$30,303.80	PTP Blue Ridge PTP Dudley Omni PTP Grassy Hill	√ √ √		$5,000.00	$61,679
2	CATCE	New Pole (School)	$7,865.00	Omni	$7,428.50	PTP Rocky Mount ES	AF5XHD Pair	$1,108.80	$2,500.00	$18,902
2	Cooks Knob	Tower Improvements	$26,375	Sectors, LTE	$30,303.80	PTP Ferrum PTP Grassy Hill	AF11FX Pair AF11FX Pair	$11,025	$5,000	$72,704
2	Franklin County High	New Pole (School)	$7,865.00	Omni	$7,428.50				$2,500.00	$17,794
2	Pigg Tower	New Tower	$170,000	Sectors, LTE	$30,303.80	PTP Blue Ridge PTP Toms Knob	AF11FX Pair AF11FX Pair	$11,025	$14,500	$225,829
2	Rocky Mount Elementary	New Pole (School)	$7,865.00	Omni	$7,428.50	BH Franklin High	AF5XHD Pair	$1,108.80	$2,500.00	$18,902
									Total	$415,810

Phase Three Wireless Improvements

PHASE	ITEM	SITE WORK	SITE COSTS	ACCESS EQUIPMENT	ACCESS EQUIPMENT COST	POINT TO POINTS	PTP BOM	POINT TO POINT COSTS	PROJECT MANAGEMENT COSTS	TOTAL COST
3	Blain Substation	Covered	–	–	–	–	–	–	–	–
3	Endicott	New Tower	$170,000.00	Sectors, LTE	$30,304	PTP Cooks PTP Henry FD	AF11FX Pair AF11FX Pair	$11,025	$14,500	$225,829
3	Frankin Substation	Covered	–	–	–	–	–	–	–	–
3	Glade Hill Substation	New Pole (Substation)	$7,865.00	Omni	$7,428.50	PTP Glade Hill Omni	AF24HD	$6,300.00	$2,500.00	$24,093.50
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	ISP Determines Location	New Pole	$7,865.00	Omni	$7,429	TBD	AF5XHD Pair	$1,109	$2,500	$18,902
3	Orchard Substation	Covered	–	–	–	–	–	–	–	–
3	Penhook Substation	New Pole (Substation)	$7,865.00	Omni	$7,428.50	PTP Blue Ridge Group PTP Glade Hill	AF5XHD AF5XHD	$2,217.60	$2,500.00	$20,011.10
3	Redwood Substation	New Pole (Substation)	$7,865.00	Omni	$7,428.50	PTP Glade Hill Omni PTP Dudley Omni	AF5XHD AF5XHD	$2,217.60	$2,500.00	$20,011.10
3	Tank Hill Substation	Covered	–	–	–	–	–	–	–	–
3	Thornton Substation	New Pole (Substation)	$7,865	Omni	$7,428.50	PTP Grassy Hill	AF5XHD Pair	$1,109	$2,500	$18,902
									Estimated Total	$516,772.10

APPENDIX D: ESTIMATED WIRELESS COVERAGE

Site Name	Estimated Number of New Addresses Served
Phase 1	
towers	
Blue Ridge Tower	3434
Grassy Hill Tower	3717
Cahas Tower	588
Summit View Tower	1375
Snow Creek Tower	490
Toms Knob Tower	568
Henry FD Tower	477
poles	
Glade Hill	93
Callaway	113
Sontag	149
Windy Gap	173
Henry Elementary	263
Dudley	336
Ferrum	402
Union Hall	568
Lee M Waid Elementary	1491
Phase 1 total	**14237**
PHASE 2	
towers	
Burnt Chimney Tower	1665
Cooks Knob Tower	1332
Pigg Tower	753
poles	
CATCE	250
Rocky Mount	325
Franklin County Highschool	343
phase 2 total	**4668**
PHASE 3	
towers	
Endicott Tower	247
poles	
Glade Hill Substation	165
Penhook Substation	113
Redwood Substation	245
Thornton Substation	140
Eleven additional poles TBD	unknown
phase 3 total	**910**
Final County-wide total	**19815**