BROADBAND FOR FAYETTE COUNTY

Improving Broadband Access

DESIGN NINE
broadband planners

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1 EXECUTIVE SUMMARY

Fayette County's community and economic future is dependent upon the availability of affordable high speed broadband services--at the bandwidths that will be needed by residents and businesses in the future ("big" broadband), not at today's "little" broadband speeds. The county already has some of the essential elements needed for growth and community prosperity. These include:

- A strong presence as a regional commercial and business hub.
- It is well known as a thriving tourism and recreational destination.
- It has excellent quality of life with a wide variety of recreational and cultural activities for residents.
- It has a low cost of living compared to many other areas of the country.
- It has a workforce with a strong work ethic.

What is lacks is widely available broadband Internet service at affordable prices. Large areas of Fayette County still have to rely on slow, unreliable, poor quality DSL service. There is limited availability of fixed point wireless broadband service. Satellite Internet, while available everywhere in the county, is expensive and is not always suitable for work from home and business from activities. Cable Internet service is only available in a few of the larger towns like Fayetteville.

Affordable high speed Internet is essential to the future growth and prosperity of the county. More and more workers and business people are working from home, either on a part time or a full time basis. New work from home job opportunities are growing rapidly, but most of those jobs require reliable, symmetric Internet service to qualify.

Many business employees are already trying to work more from home more often (e.g. one or two days per week) to reduce travel costs. Some major businesses in other parts of the U.S. are actively planning to have 20% of their workforce work full time from home to reduce employee travel costs and office energy costs. Corporate employees working from home require high bandwidth services to be connected to the office network and to use corporate videoconferencing systems. These corporate network services often require 10-50 Megabit connections.

Broadband has become essential community infrastructure.

Just as communities had to take on the task of building and maintaining roads in the early twentieth century, communities must now provide digital road systems as a matter of community and business survival. These digital road systems must be designed with certain characteristics:

Future oriented

Current usage patterns are not a good predictor of future broadband needs. Network investments in Fayette County must be designed to scale gracefully to support future uses over the next thirty years. Those uses include K12 education, work from home opportunities, tele-medicine and tele-health services, home security, energy management, and many other emerging services and uses. The County should invest in systems that will meet future needs, not current demand. Fayette County of the near future includes:

- Abundant, inexpensive bandwidth locally
- Massive connection to the rest of the world
- Some network redundancy available in at least some areas of the county
- Both fiber and wireless network infrastructure available
- Rich local content from a multitude of sources

Fayette County of the future will be attractive to an emerging new group of businesspeople and entrepreneurs that typically are well-educated, own their own businesses or work for large global corporations, and are making choices about where they lived based on family needs and interests, rather than business interests. This new breed of entrepreneurs and workers place a high value on the kinds of amenities that contribute to a good quality of life–traditional neighborhoods, vibrant downtown areas, a wide range of cultural and recreation opportunities, good schools, and a sense of place. These businesspeople and their families make relocation decisions based on quality of life only where there is abundant and affordable broadband, because broadband is the enabler of this new approach to personal and work life.

Fiscally conservative

County investments in broadband infrastructure should be targeted to support broader community and economic development goals, and should be financially sustainable over the long term.

Fiber and wireless are both important

Both fiber and wireless infrastructure are needed to meet all business and residential needs. Fiber is needed to support the business requirements that are already driving economic development in other communities. Fixed point wireless broadband services are an important "bridge" technology in rural areas where it is important to move homes and businesses from dial-up and "little" broadband quickly. The County should plan for and invest in both fiber and wireless broadband infrastructure.

Public/Private Partnerships

Fayette County broadband investments should be available to any qualified private sector service provider, including incumbent Internet service providers. Companies that use the county-owned infrastructure should pay a fee return for access to tower space (for wireless Internet services) and/or fiber (for fiber to the business and fiber to the home).

Economic development focus

Business needs should be a key factor in targeted county broadband investments. Better Internet to rural areas of Fayette County is needed to support work from home and business home opportunities that can increase wages and attract and retain younger workers as well as entrepreneurs and business people who are looking for the great quality of life in Fayette County and have the ability to work from home. Business parks and commercial/retail areas of the county should have some fiber service available to attract and retain larger employers. And the county needs at least a few fiber to the home neighborhoods to be competitive with other areas of the country where fiber to the home is already common.

Broadband Benefits

There are numerous ways that the County investments in Internet and broadband infrastructure could be beneficial:

- Even modest investments in County-owned infrastructure in key areas targeted for business and community development gives the County and its residents and businesses some freedom from monopoly providers. Leasing out the infrastructure to competitive providers generally lowers prices for broadband services and improves service quality.
- The leased telecom infrastructure will generate some modest revenue to help maintain towers and pay for routine repairs and maintenance.
- A University of California-Davis study found that home-based workers reduced their work-related driving by 90%. This can be very significant for rural residents who may have to drive long distances to work. The same study found that telehealth services that use online consultations reduced transportations costs and reduced the impact of lost wages due to taking time off from work to drive to a medical clinic.
- Fiber can deliver Internet access via controlled access WiFi hotspots for use by County personnel (e.g. Sheriff's Department, Public Works) while mobile.
- The County could provide some free WiFi Internet access for use in downtowns and in County parks. Visitors to the County (e.g. Fayetteville) could be provided information about the area via a Web page when they first access the free Internet (e.g. local restaurants, County services, local attractions, retail shops and stores). The local Chamber of Commerce may be willing to support this venture.
- Real estate agents report that property values increase when homes and businesses have good broadband connectivity.

2 TECHNICAL BROADBAND DEVELOPMENT PLAN

The key to obtaining improved availability of broadband, increased range of service options and competitive pricing is to distribute ownership of infrastructure among a wider range of interested parties beyond the incumbent and competitive providers.

Distributed ownership can take several forms:

- Fayette County and/or the Urban Renewal Authority (URA) own infrastructure and make it available to private-sector companies to lease it and deliver services to customers.
- Public/Private Partnerships (PPPs) with Internet Service Providers. The County or URA may be able to apply for grants not available to private sector companies. The grants can build out wireless and fiber assets, and those assets can be leased affordable to ISPs and WISPs, who also provide some capital and assume responsibility for day to day management and maintenance of the network assets.
- Individual property owners can make investments in infrastructure for their own use, including conduit and/or fiber drop cable from the sides of their homes or businesses to the curb. Property owners can also erect wooden utility poles to obtain improved lines of sight to wireless broadband towers.
- A group of property owners (for example, residential subdivisions, homeowner associations or owners along a section of rural road) can pool funds to erect a utility pole to improve wireless access to the entire group or jointly fund conduit and fiber to their homes, using a wireless or fiber backhaul connection to an ISP.
- Commercial property owners (for example, business park owners, commercial building owners or apartment/condo building owners) can provide conduit and fiber or internal cabling for their properties and make it available to service providers to serve their tenants on a competitive basis.
- Community organizations such as K–12 schools can build infrastructure primarily for their own use and include extra conduit and/or additional fiber for business, community and government use.

Distributed ownership forces incumbent and competitive providers to pay more attention to their customers because their control has been weakened. Once a provider no longer "owns" the customer infrastructure end to end, it is forced to compete on a level playing field with better services, more kinds of services and competitive pricing.

USE THE URA FOR BROADBAND GOVERNANCE

The Fayette County should continue to use the Urban Renewal Authority as the fiscal agent and asset manage for broadband infrastructure improvements.

Three Months	The Broadband Project Team and the URA should work together. A seminal early decision is whether or not the county is prepared to make regular investments in broadband infrastructure and own and manage that infrastructure over the long term. The alternative to hope that deals can be made with private sector companies trying to leverage grant opportunities like CAF2 funds. With the latter, Fayette County has little or no control over their economic future–in many ways similar to the current situation with Frontier. The Broadband Project Team should make a recommendation to elected officials and stakeholders that the URA should take the lead.
Six Months	At least one funding source has been identified and a grant application submitted. The Micrologic opportunity is an excellent opportunity.
One Year	The URA has obtained some initial funding for broadband infrastructure from the County to support infrastructure improvements and grant applications, and the URA and the Broadband Project Team are working together.
Two Years	The URA has achieved widespread awareness of its work. Some early "first phase" projects have brought better Internet to some areas of the county. The URA now has wider support and recognition of its importance.

FOCUS ON IMPROVED WIRELESS BROADBAND ACCESS

County residents and businesses outside of communities with cable Internet service need an alternative to the largely very poor DSL Internet access. Making community and/or County-owned towers available to WISPs (Wireless Internet Service Providers) and provisioning new towers in some underserved areas will support improved Internet service.

Three Months	Identify sources of funding and grants that would support improvements to existing towers and/or build at least 1-3 new towers. The arrangement with Micrologic currently under evaluation may lead to more than three new towers and/or improvements on some existing towers.
Six Months	At least one grant application has been submitted for tower improvements and/or new towers. Meetings with public safety officials and possible private sector WISPs are occurring regularly. A multi-year strategy of improvements on large towers, supplemented by a strategy of funding and rolling out low cost "small cell" broadband community poles is in place.

One Year	At least one grant application has been funded. Additional grant opportunities have been identified. At least one WISP is ready to bring service to upgraded or new towers. Some residents and businesses are receiving expanded Internet service. The first locations for community poles have been identified and funding for those is underway using a combination of local (community) funding and/or grant funding.
Two Years	Several new or upgraded towers now have a WISP offering services from those towers. Additional grant applications have been submitted to continue tower construction and tower improvements. At least fifteen "small cell" community broadband poles have been funded and are providing Internet service.

2.1 FUND FOR SUCCESS

Successful expansion of wireless broadband in the county will be most successful by recognizing that funding will come from a "basket" of funding sources, rather than a single source. Grants, public/private partnerships, some local funds, and other sources may all be needed to achieve success.

Grants can be extremely important in the early stages of an effort to support planning activities and/or to fund a Phase One build out initiative. But grants rarely will allow spending on operational expenses. Grants should be used carefully as one time cash injections to support very specific goals. Communities that have relied too heavily on "the next grant" as a key source of expansion or operational funding usually experience severe financial problems.

Three Months	The Broadband Development Team (BPT) has identified at least three possible sources of funding and grant prospects.
Six Months	The BPT has developed a short term and long term basket of funding sources and is tracking due dates for grant applications.
One Year	At least one source of funding has been successful, allowing the commencement of a "first phase" project.
Two Years	The BPT continues to track and manage funding opportunities. The BPT meets regularly to review grant programs, track dates, and submit grant applications.

2.2 DEVELOP A LONG TERM FUNDING STRATEGY

Grants may not provide sufficient funds to reach the county's long term goals. The BPT should evaluate longer term funding strategies like adding an increment to the 911 fee.

Three Months	The BPT and the URA has evaluated several long term funding strategies and developed a one or two page white paper for elected and appointed officials that provides an overview of the options.
Six Months	Several meetings have taken place with key officials and stakeholders to acquaint them with the long term funding strategies. Feedback has been used to updated the long term funding white paper.
One Year	The BPT continues to promote long term funding strategies, and has identified one or two (e.g. 911 fees) that seem to have the needed political support.
Two Years	At least one strategy has been agreed to in principle, and efforts are underway to implement the funding approach.

2.3 SUPPORT MIDDLE MILE FIBER EFFORTS

While improved broadband wireless service is going to be critical part of any plan, the county needs some middle mile fiber. Changes being considered to state law (e.g. HB2005/SB3) may provide support of accelerated middle mile fiber, but as bandwidth needs for residents and businesses continue to increase (currently 30% increase per year), some fiber will be needed to keep wireless services able to provide the needed performance. Some fiber is also critical to any economic development efforts to attract jobs and businesses to Fayette County.

Three Months	The BPT has included development of middle mile fiber as part of its Vision and Goals statements. The BPT is meeting regularly with the regional middle mile project team to coordinate efforts
Six Months	The BPT continues to keep middle mile fiber development as an important area of focus, with attention to efforts at the state level and with identification of any possible private sector partners (e.g. regional middle mile project, CityNet).
One Year	Some opportunities for limited amounts of middle mile fiber have been identified. Funding development is underway.
Two Years	At least one segment of middle mile fiber has been funded and construction is underway.

2.4 ATTRACT SERVICE PROVIDERS

Once an initial plan is in place to make tower improvements and/or to add towers, WISPs should be invited to meet with Broadband Project Team members to discuss making use of the planned infrastructure. See the **Attracting Service Providers** section for more information.

Three Months	The BPT has met with at least two service providers (e.g. CityNet, MicroLogic) to get feedback on the strategy of making towers available to WISPs. The BPT has received useful feedback about what areas are of most interest to the WISPs.
Six Months	The BPT continues to keep WISPs updated with plans to expand tower access.
One Year	At least one new or improved tower is available for WISP use and one WISP has signed a lease agreement.
Two Years	Additional towers have space available for lease, and a WISP has placed radios on those towers and offering service.

2.5 PUBLIC SAFETY PARTNERSHIPS

The availability of public safety towers and/or new towers can enable new services and applications for police, fire, and rescue in the county. Secure WiFi hotspots can be set up around and near the towers so that reports can be filed from the field using the WiFi Internet connection. Other communities that have done this have found that it saves time and keeps patrol cars out in the field longer.

There are often grants available for public safety voice and data communications improvements (e.g. new towers, upgraded tower facilities) that could also support the broadband initiative. Any public safety tower or communications expenditures should be analyzed to determine if the expenditures can also support expanded broadband access in the county.

Three Months	The BPT has distributed a copy of the report to public safety agencies in the county, and has a Broadband Project Team member designated to follow up regularly.
Six Months	Designated BPT members have had at least one face to face meeting with public safety officials and have reported back to the BPT on funding and tower sharing opportunities.
One Year	The BPT and interested public safety agencies have a strategy in place to upgrade some towers for WISP use, and some grant sources have been identified to support the effort.
Two Years	The BPT and one or more public safety agencies have collaborated on at least two grant applications for joint funding that could include both improved public safety voice/data improvements and wireless broadband improvements.

2.6 PLAN FOR MARKETING AND PUBLIC AWARENESS EFFORTS

If a county-wide broadband initiative moves forward, it will be necessary to have a modest but regular marketing and awareness campaign to ensure that local businesses and residents know that Fayette County is engaged in trying to solve the broadband problem, that they know what service providers are available on the towers, and that they know how to order service.

Service providers will be responsible for sales (that is, selling their services and signing up their own customers), but the Broadband Project Team has a role to ensure general awareness of the team's role facilitating wireless broadband improvements.

Political support for this effort will be essential. There should be a regular and consistent awareness effort to keep local, state, and Federal legislators up to date with both the needs of the county and the activities that are underway.

State and Federal officials can often provide important assistance with information on grant opportunities, provide letters of support for grants, and to provide insight on what kinds of projects and activities are most likely to grant support.

Three Months	The BPT has reviewed the Marketing Plan in this report and has begun developing the recommended materials. A marketing sub-committee is appointed to execute the Marketing Plan.
Six Months	The BPT and the marketing sub-committee has begun circulating its awareness handouts, has created a permanent Web site, and has created a mailing list with key stakeholders, interested parties, and elected officials subscribed.
One Year	The marketing and awareness sub-committee is following a regular set of awareness activities to keep business, residents, and stakeholders informed. The news blog on the Web site and the Facebook page are updated weekly with broadband related news and BPT activities.
Two Years	The marketing and awareness sub-sub-committee continues to keep residents, businesses, and stakeholders in the county up to date with the BPT's activities.

2.7 SET A VISION AND GOALS

Communities that have successfully expanded Internet access options for their citizens and businesses typically started with whatever funding was immediately available, recognizing that the effort may take more than one round of funding or one grant. Experience has shown that once a local government or county has successfully executed even modest improvements (e.g. a single tower upgrade), the track record of success makes it easier to attract follow-on funding and grants.

Three Months	Develop a one paragraph Vision statement and a one page set of short term and long term goals
Six Months	Vision and Goals have been presented to county governments and stakeholders and revised Vision and Goals completed based on feedback

One Year	Projects, grant applications, and other activities are being developed in alignment with Vision and Goals.
Two Years	Some goals have been accomplished. Other goals have been modified or changed. Some goals have been removed because of funding and support issues.

2.8 BROADBAND PROJECT TEAM ACTIVITIES

Three Months	• Continuing regular meetings with the existing broadband team. • Identify several areas (e.g. one or two per county) for a "first phase" effort that could include upgrading existing towers to make them "WISP-ready" and/or designating those areas as candidates for a new tower. • Meet with existing wireless providers and invite them to join the effort. • Discuss and identify funding sources. • For existing towers, meet with tower owners, check the most recent engineering studies, and determine if the towers can support additional antennas. • Meet with the Commissioners to present a recommended "first phase" effort, discuss funding requirements, and get a commitment to form a regional broadband entity (e.g. a nonprofit). • Evaluate potential local, state, and Federal grant sources and identify what projects could qualify for grant funds.
Six Months	• Developing a budget for the chosen "first phase" project (e.g. the first towers to receive improvements for service providers. • Identification of early funding sources and solicitation of funds (e.g. writing grant proposals, state funding, soliciting County-level financial support, private contributions, etc.). • For any new wireless towers, identify available County and private properties that fit the desired service areas. • Solicit input from service providers on use of existing and any new towers that might be planned. • As work begins on up-fitting existing towers (or if one or more new towers is under construction), meet with service providers to develop binding agreements to use the new infrastructure to sell services. • Form the regional entity, appoint an initial advisory board, and develop a short term marketing and awareness strategy.

One Year	• Move forward with Implementation Planning for the "first phase" projects–preparing for construction. • Improvements to existing towers should take only a few months to complete and should be finished in this time frame, making towers ready for WISP use and expanded Internet service. • For new towers, negotiate with property owners, begin any required permitting process prior to construction. • Assuming that funds have been secured, construction of towers may begin as early as month nine or ten.
Two Years	• In the early part of year two, "phase one" improvements would be completed and service providers would be offering improved services. Revenue would be collected from providers using the towers. Financial management of revenue and expenses will begin.

3 THE BROADBAND CHALLENGE

The FCC current definitions of broadband are 10 Megabits/sec down/1 Megabit/sec up and 25 Megabits/sec down/3 Megabits/sec up, but large portions of Fayette County are not able to receive consistent access to even the lesser 10/1 service.

The FCC definitions, however, are focused more on residential entertainment use and less on business needs, especially work from home. Work from home and business from home opportunities require symmetric bandwidth (that is, equal bandwidth up and down), rather than the highly asymmetric current definitions. A 5 Megabits/sec down/5 Megabits/sec up Internet service is superior to the FCC 10/1 rate, and a 10 Megabits/sec down/10 Megabits/sec up Internet service is far better for work from home and small business use than the 25/3 definition. Fortunately, both fixed point wireless service and fiber service can easily deliver symmetric bandwidth.

The current state of broadband in the United States can be described as two very different markets. Many urban areas and larger towns have cable internet service that is considered adequate based on current uses, and a few communities have some fiber. Very few places have fiber widely available throughout the community.

In contrast , smaller communities and rural areas in West Virginia are struggling with inadequate service, including mediocre DSL, expensive satellite Internet service, and a generally limited availability of wireless broadband.

This urban/rural service gap has perpetuated the digital divide. At one time, people usually discussed the digital divide in terms of who could afford broadband and who could not. The "new" digital divide is geographic in nature, with rural areas of the United States being left far behind urban areas in terms of quality and affordability of Internet access.

This new digital divide is leading to unanticipated consequences. The availability of broadband (or the lack of it) is beginning to drive land use decisions, including where people want to work and where they want to live.

Quality of family life is also affected. Where adequate broadband is limited or simply not available, families with school-age children are heavily impacted as more K–12 school systems make increased use of online learning resources that require children have Internet access at home. Design Nine hears frequent complaints from mothers who have to drive their children several times a week to local libraries or even to fast-food restaurants.

A common sight today is a minivan or SUV in the parking lot of a McDonald's at 4 p.m., with a mother and two or three children all working on laptops or tablets.

In numerous surveys we have conducted in West Virginia, there is a rising percentage of people who report that their home is their primary workplace, for either full-time or part-time work. An even high percentage of workers who commute to office locations during the day report that they work from home on nights and weekends.

Broadband is now beginning to affect zoning, land use, real estate values and quality of life. Millennials, who have grown up with the Internet, smartphones, tablets and computers, simply are not interested in living in places that have inadequate broadband.

In West Virginia, despite improvements in wireless technology, the physics of radio frequencies has not been able to overcome line-of-sight challenges, the high cost of building towers in areas with low customer density, and the higher maintenance and repair costs of wireless broadband networks, compared with the more reliable technology and lower maintenance costs of fiber networks.

But regardless of where broadband is deployed, both fiber and wireless providers are carving up service areas to create mini-monopolies. In the fiber business, the rule of thumb is that whoever builds fiber into a neighborhood first "wins" because building two fully duplicated fiber networks to compete for the same customers is simply not economical.

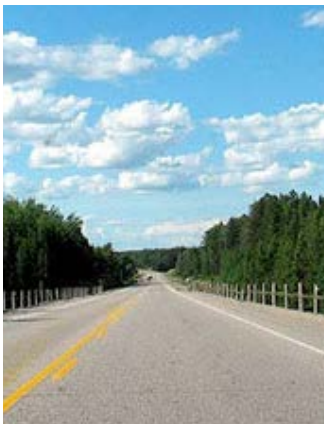
Similarly, wireless internet service providers (WISPs) make efforts not to offer service in any area where there is already a competing WISP, for the same reason that fiber providers avoid areas where competitors are established: It is costly and yields low customer take rates.

The effect could be called the balkanization of American broadband. The main effect of telecom deregulation has been to break up large service area monopolies into many smaller service area monopolies. Though there has been some limited progress in terms of competition, the on-the-ground reality for many broadband users, both residential and business, is a continued lack of service alternatives and ever-increasing prices.

In communities in which there has been some local investment in broadband infrastructure, ranging from empty conduit all the way to a fully provisioned network, the effects have been advantageous. Once useful portions of infrastructure are no longer owned exclusively by telecom providers, service quality usually improves, prices stabilize or decrease, and incumbents begin to spend more on upgrading their infrastructure.

4 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.

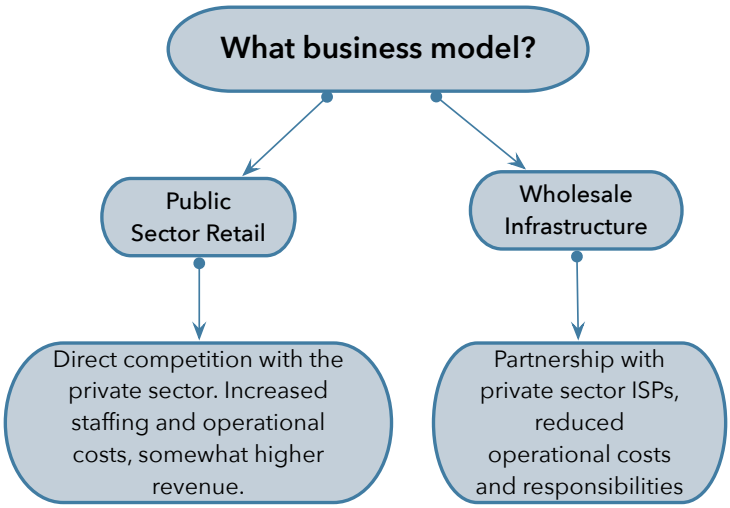
Before the rise of the Internet, digital networks were built largely by the private sector. As broadband has become critical to commerce and economic development, communities with digital roads are more competitive globally.

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.

4.1 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.

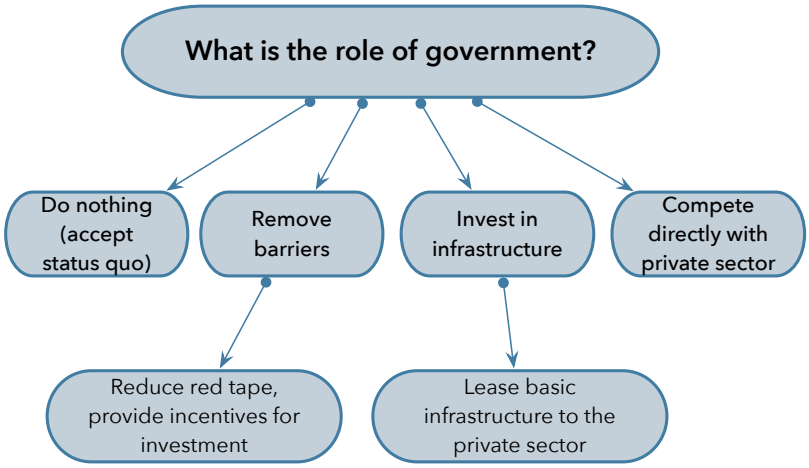
Recommendation

In Fayette County, improved wireless broadband is going to be an important strategy, and WISP access to existing and/or new towers will provide a competitive alternative to improve broadband access in rural areas of the county. Some community-owned fiber is also going to be important to help attract and retain businesses and jobs. Fayette will also benefit from some fiber to the home, even if available in a few locations, to help attract younger workers.

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 wireless towers makes it less expensive for WISPs 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. County only responsible for conduit/dark fiber 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.	The tower space leasing wholesale model 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. Conduit and dark fiber assets also require minimal management.

5 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

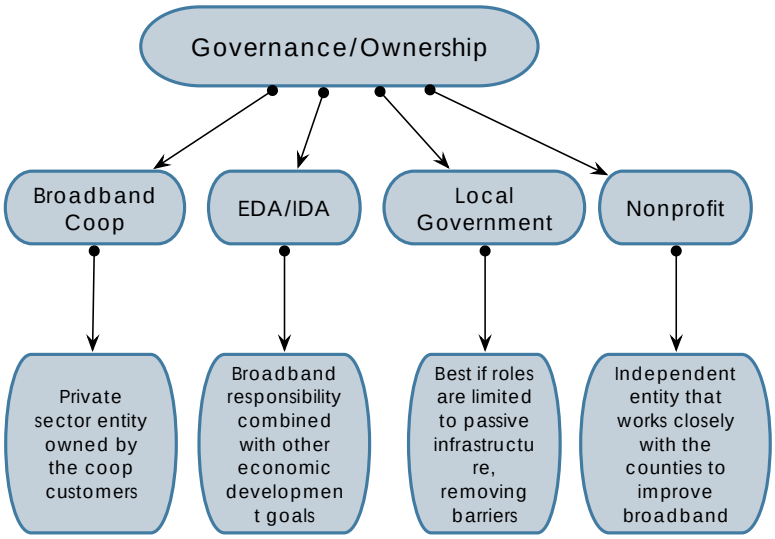
Fayette County can both **remove barriers** and **make targeted investments** in infrastructure. These two activities can be executed in parallel, with investments taking place as funding sources are identified. There are a variety of low cost and no cost efforts, mostly at the policy level, that local governments could 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 attract much needed broadband wireless providers into the county.

6 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.



If the improvements are owned directly by the **county governments**, many of the routine responsibilities could be managed by existing locality staff and departments that might include IT, Public Works, and Planning.

An **EDA or IDA** (Economic Development Agency, Industrial Development Agency) as a nonprofit, could also own and manage telecom assets. In Fayette County, the **Urban Renewal Authority** seems to be a good fit for providing long term fiscal agency and asset management.

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.

In Fayette County, a **broadband coop** may also be a useful option to consider. 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.

5.1 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.

The Broadband Project Team should seek the advice of legal counsel before forming a nonprofit.

5.2 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 county 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 the local governments 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 the county 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.

5.3 GOVERNANCE QUANTITATIVE EVALUATION

Six factors can be evaluated to provide a quantitative 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? Do the communities and local governments 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?

5.4 RECOMMENDATION

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

The Broadband Project Team should collaborate with the **Urban Renewal Authority**. The URA already has a board of directors, has the County's support for economic development, and minimizes the short and long term overhead and administration of another agency.

A coop, while requiring more time attention during formation, could provide a durable long term solution to improving broadband in the county. The nonprofit could be formed to meet short term (next 12-18 months) goals and provide the direction and leadership that would be needed to form a regional broadband coop.

6.1 CURRENT AND FUTURE TECHNOLOGIES

In Fayette County, broadband wireless is going to be 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.

6.2 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 West Virginia and many parts of the east, tree cover is often an obstacle to getting good service.

The hilly topography of West Virginia 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 West Virginia, 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.

6.3 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 was finally released in 2018, although some companies, like Verizon, had already 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 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. In Fayette County's 668 square miles, even only 200 square miles have the household density to justify a 5G deployment as many as 8500 cell sites would be needed to provide ubiquitous coverage, although with careful analysis, that might be reduced to around 4500 cell sites—all of them needing fiber backhaul.

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.

Off the shelf white space equipment is finally becoming available from at least one provider that is working with Microsoft, but the base station radios that are placed on a tower and the accompanying customer radios are still as much as 2-3x more expensive than existing WiFi/WiMax wireless broadband radios that are currently in wide use.

6.4 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 West Virginia 811 (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.

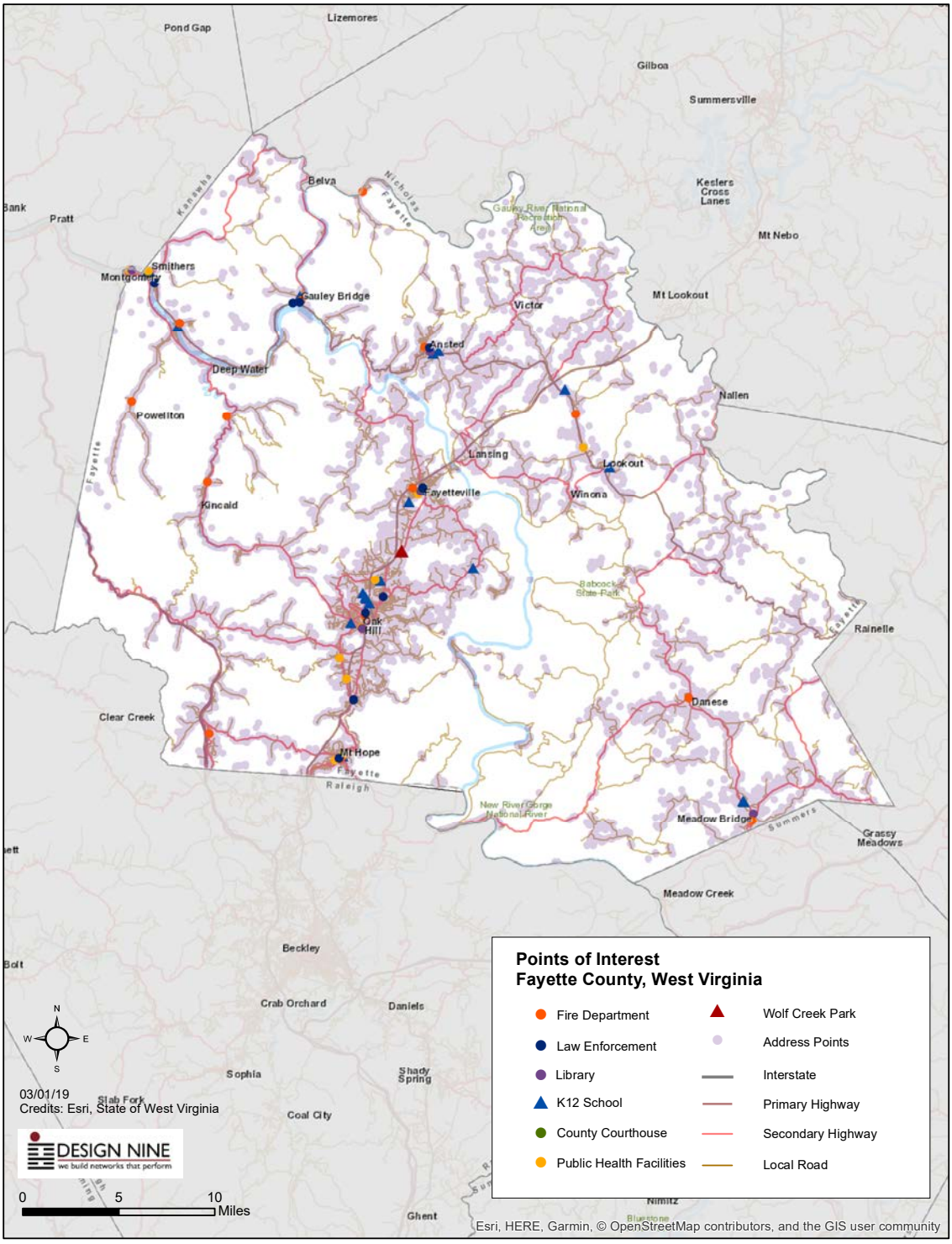
6.5 PUBLIC AND PRIVATE INTERNET INFRASTRUCTURE ASSETS

This section includes:

- 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).
- Towers in various part of the county and HUD eligible project areas. This shows where existing and/or new tower improvements could be included in a HUD grant application.
- Long haul fiber routes through the county, which are important data routes to the rest of the Internet.

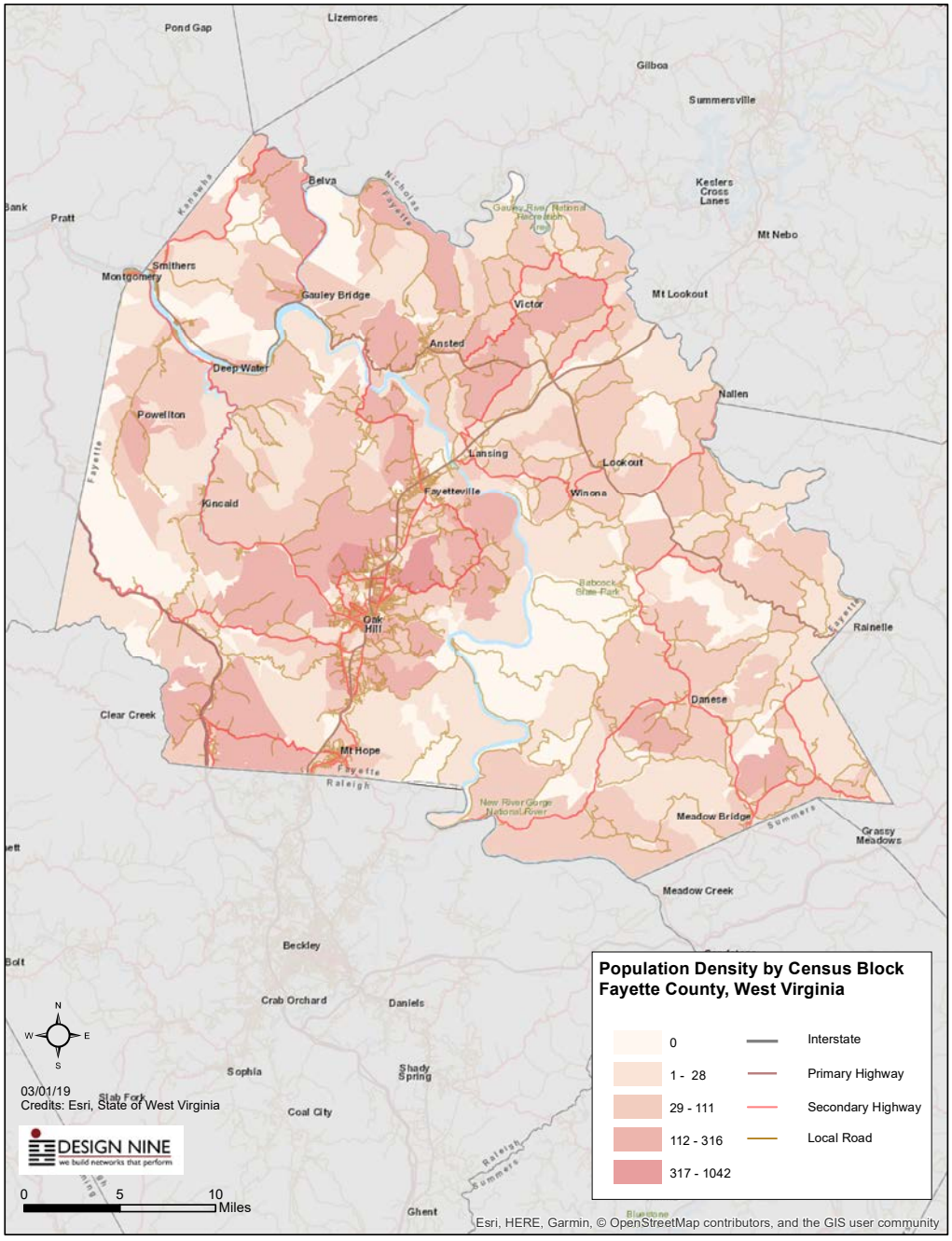
6.6 FAYETTE COUNTY POINTS OF INTEREST

This maps indicates key community assets (e.g. schools, fire/rescue facilities, libraries, etc.). The address point data shows that large parts of the county have very low density, which provides some direction about where wireless services should be located.



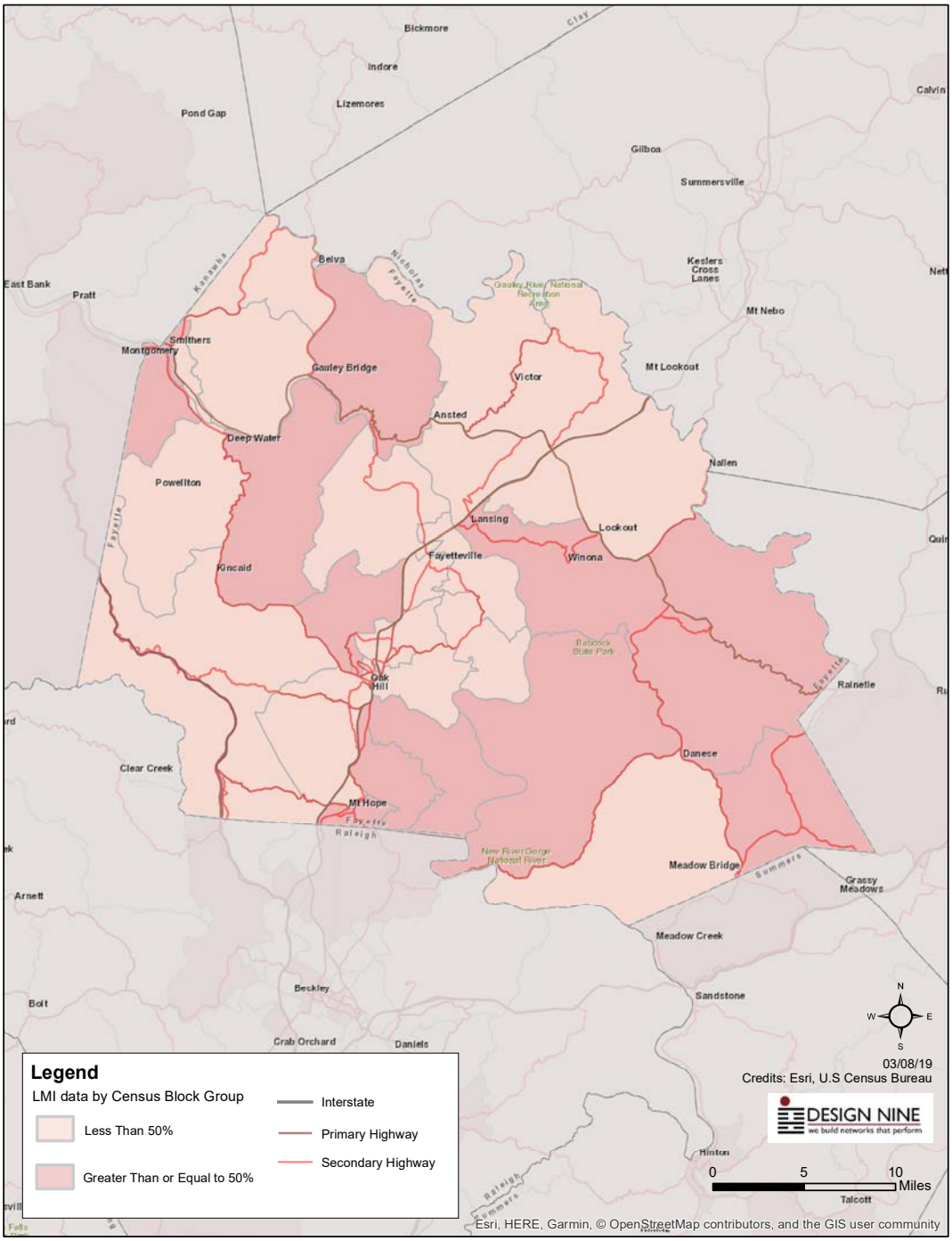
6.7 POPULATION DENSITY BY CENSUS BLOCK

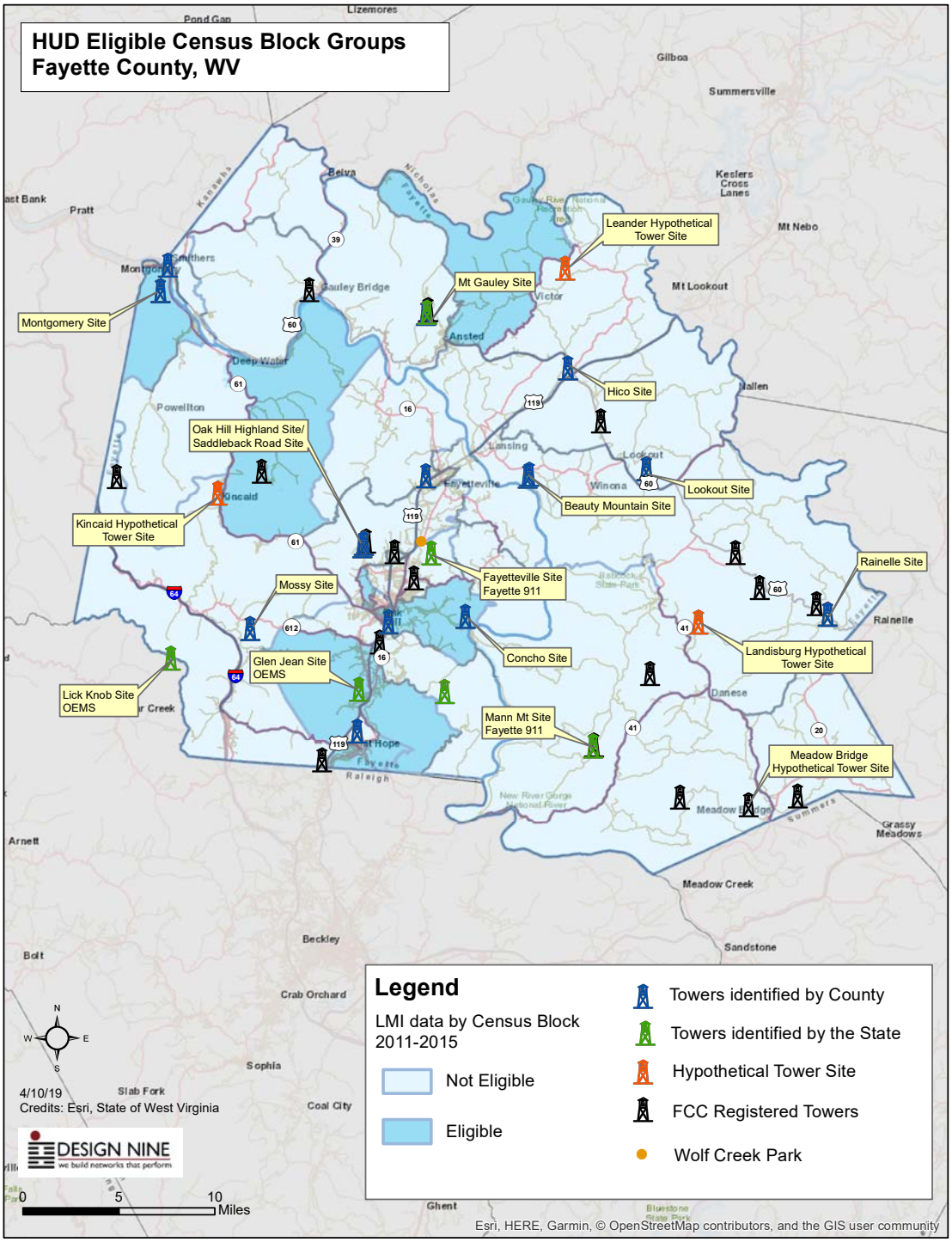
Large areas of Fayette County have very low population density. Build out and distribution of towers could be guided in part by making early investments in areas of need that will serve the most households per dollar spent.



6.8 LMI AND HUD ELIGIBLE AREAS

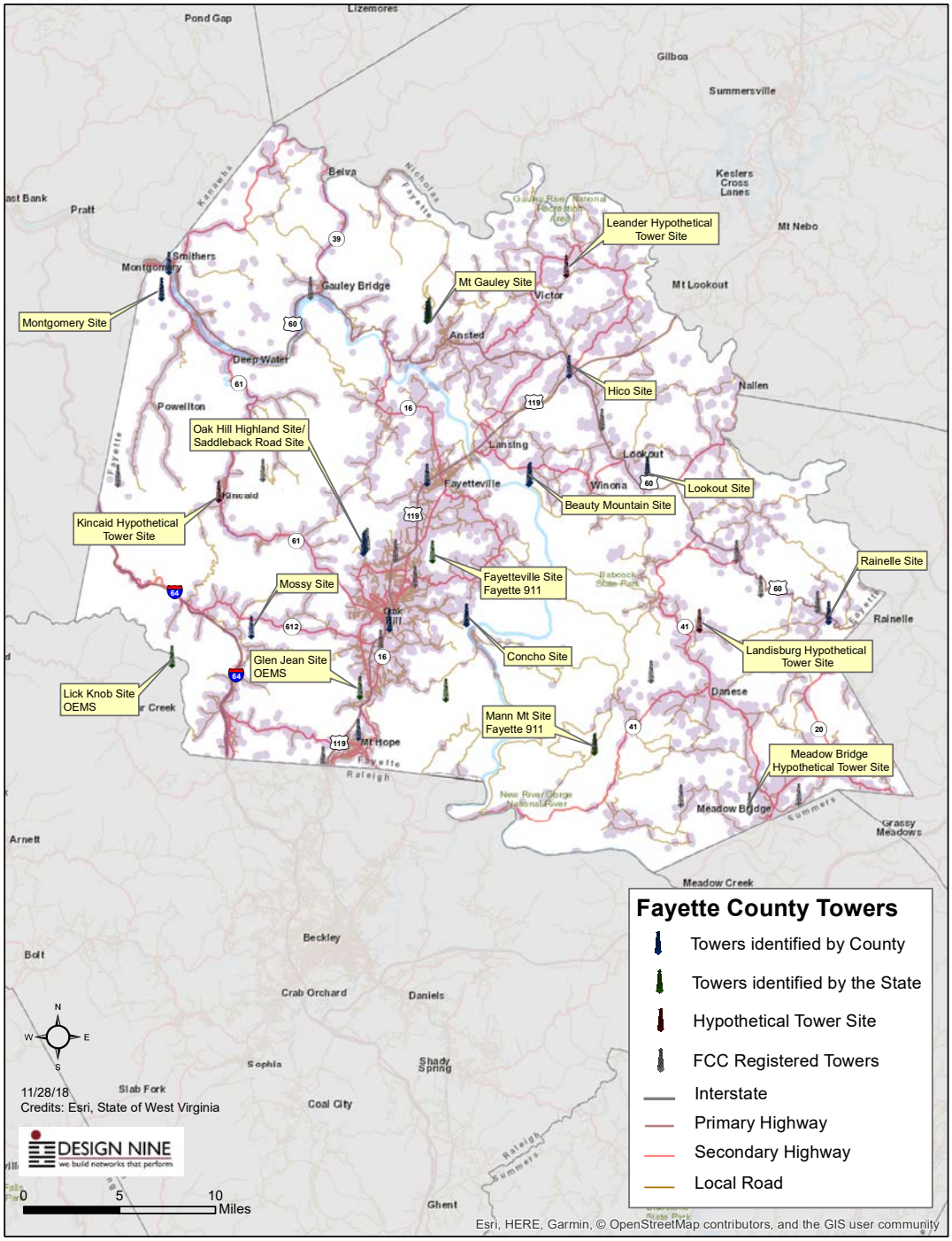
Certain kinds of grants (e.g. CDBG funding) favor LMI (Low and Moderate Income) areas. Large parts of the county would qualify for grants that have a preference for LMI areas.




HUD Eligible Census Block Groups
Fayette County, WV
Montgomery Site
Mt Gauley Site
Leander Hypothetical Tower Site
Hico Site
Lookout Site
Beauty Mountain Site
Oak Hill Highland Site/
Saddleback Road Site
Kincaid Hypothetical
Tower Site
Fayetteville Site
Fayette 911
Mossy Site
Concho Site
Glen Jean Site
OEMS
Lick Knob Site
OEMS
Mann Mt Site
Fayette 911
Rainelle Site
Landisburg Hypothetical
Tower Site
Meadow Bridge
Hypothetical Tower Site
Legend
LMI data by Census Block
2011-2015
Not Eligible
Eligible
Towers identified by County
Towers identified by the State
Hypothetical Tower Site
FCC Registered Towers
Wolf Creek Park
4/10/19
Credits: Esri, State of West Virginia
DESIGN NINE
we build networks that perform
0
5
10
Miles
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

6.9 TOWER ASSETS

The "hypothetical" tower sites listed on the map are sites used in the propagation studies later in this report. The hypothetical sites were chosen to show what kind of wireless broadband coverage a new tower in that location could provide. Towers were identified from FCC, state, and local sources, but not all towers are registered with the FCC or state agencies. The address point data is included to help identify towers that could provide broadband services to the most households.

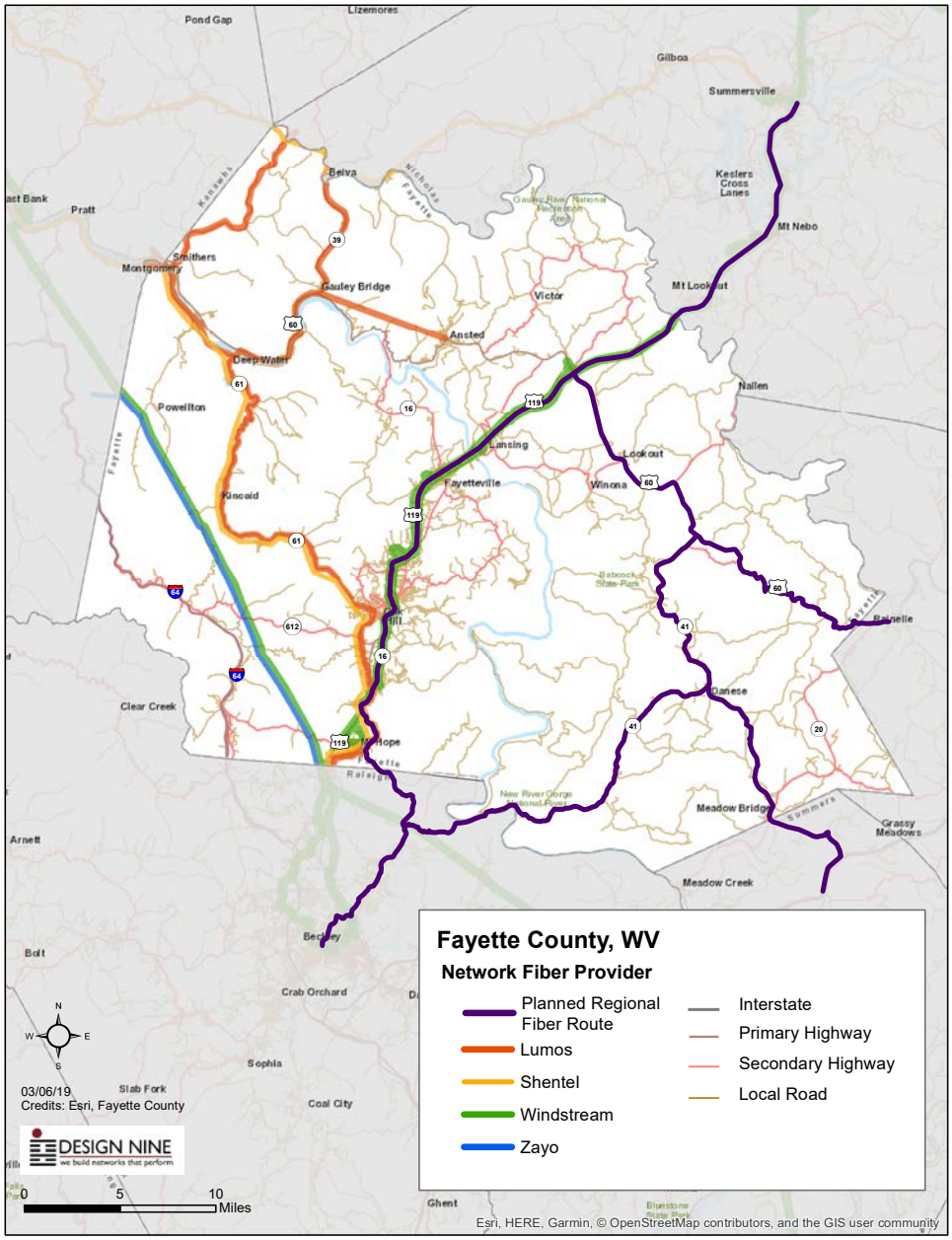


This list shows the owners of towers that have been registered with the FCC. Not all towers are registered in the FCC database.

Longitude	Latitude	Site Name	Tower Owner (?)	Property Owner
-80.813	37.97375	Rainelle1	Rawland 1995 (Highland Cellular)	Myles, David and Pamela
-80.9498	38.06003	Lookout	Co-location (Highland Towers)	SBA Towers III, LLC
-81.039	38.0557	Beauty Mountain	Co-location (Dragan Diversified)	Hatcher, J W
-81.1673	37.90431	Mount Hope	Rawland 2000 (Highland Cellular)	Dragan, Melanie
-81.2481	37.96517	Mossy	Rawland 1996/97 (Highland Cellular)	Pocahontas Surface Interests, Inc. (?)
-81.3158	38.16558	Montgomery	Rawland 1996/97 (Highland Cellular)	Quercus WV LLC (?)
-81.3102	38.18072	Smithers	Co-Location (Crown)	Landquest, LLC
-81.1157	38.15217	Mt Gauley	Rawland 1996/97 (Highland Cellular)	Imperial Colliery Company (?)
-81.0088	38.11972	Hico	Co-location (zoned under Ntelos sold to Highland Towers)	Ross, David W.
-81.1158	38.05581	Fayetteville	Co-Location (Crown) (Tony Property	Crown Communication, Inc.
-81.1637	38.0145	Oak Hill Highland	Rawland 1992 (Highland Cellular)	North Hills Group, Inc. (?) Saddleback
-81.1441	37.96922	Oak Hill South	Co-location (SBA)	Jones, George & Harriett Saddleback
-81.0859	37.97233	Wonderland	Co-location (Dragan Diversified)	Gauley Outdoor Center, Inc.

6.10 FIBER ROUTES IN THE COUNTY

The County has only a limited amount of non-incumbent fiber routes, which makes the area more difficult for WISPs to provide service, as they need affordable fiber access to provide Internet data transport in and out of the county. This challenge can be overcome by using high performance tower to tower (point to point) microwave links, but the limited access to competitive fiber will tend to make wireless broadband services more expensive. A regional middle mile backbone that is currently in the planning stages will be a major benefit to improving access in the county. A ring design is planned, which will give the communities and commercial/ business areas in Fayetteville, Oak Hill, and other communities along the route highly reliable access to Internet. In the eastern part of the county, broadband tower sites should be located on or near the fiber on Route 60 and Route 41, which will increase the reliability and bandwidth at those towers. Similarly, in the western part of the county, where practical, towers should be located along or near the Shentel/Lumos routes to provide better broadband wireless access.



7.1 IDENTIFYING "TRUE" BROADBAND

There is much confusion about the "true" definition of broadband. If the goal is to enhance residential and 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 ability to work from home,
- Limits on their children's ability to access the K12 and higher education resources needed to complete homework assignments,
- Limits on resident's ability to access cost-saving tele-medicine and tele-health services from home,
- Limits on their ability shop from home to save money on gas and travel expenses.

Placing limits on broadband bandwidth is, in a sense, dictating the size of truck that can be used to deliver goods and services. Here is the only appropriate definition of broadband:

Broadband is whatever amount of bandwidth is needed to support the residents and business' ability to participate in the global economy.

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 and residents of Fayette County need to be able to compete globally over the next thirty years?"

In short, Fayette 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 community is to 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 communities 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."

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.

7.2 HOW MUCH BANDWIDTH IS ENOUGH?

"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.

In Fayette County, most residents and businesses are relying on copper-based services. The bandwidth tables below show what is likely to be needed over the the next several years in terms of bandwidth, and the existing copper infrastructure is going to become a limiting factor in economic development.

7.3 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 part or full time 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**	

7.4 RESIDENTIAL BANDWIDTH NEEDS

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**

7.5 FUTURE USE TRENDS

"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

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 Meg down and 3 Meg 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 county 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.

7.6 SERVICE PROVIDER AND SERVICES ANALYSIS

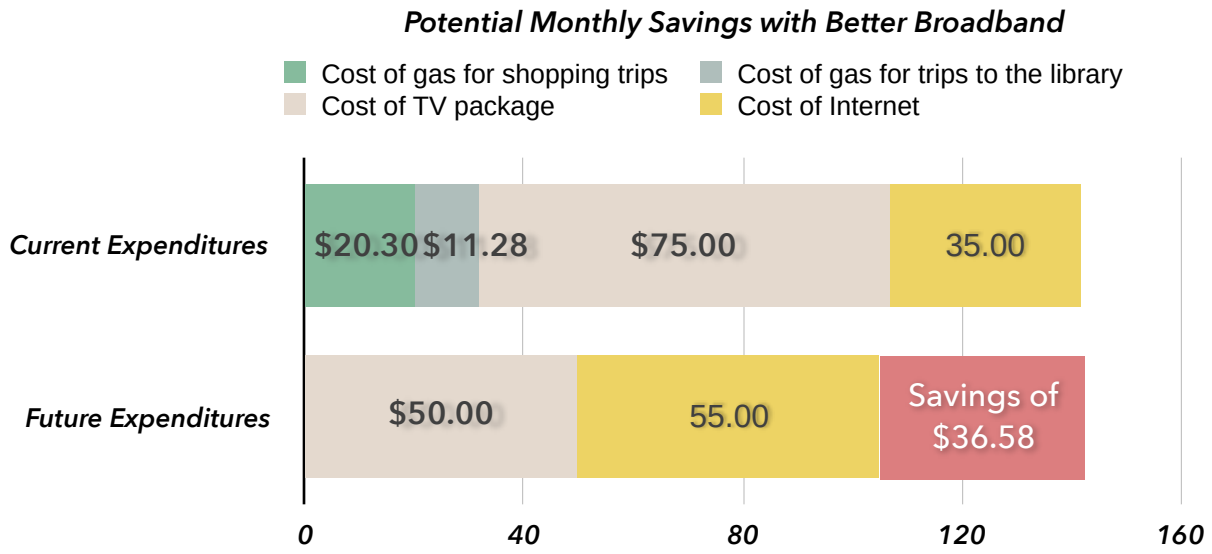
Our service provider report provides key insights into the services currently available in your county. It also provides data that show which areas by zip code are most impacted by poor Internet service and/or the lack of Internet Service provider options. We also provide estimates of the impact that better Internet services with competitive offerings can have on the lives and budgets of your citizens.

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.

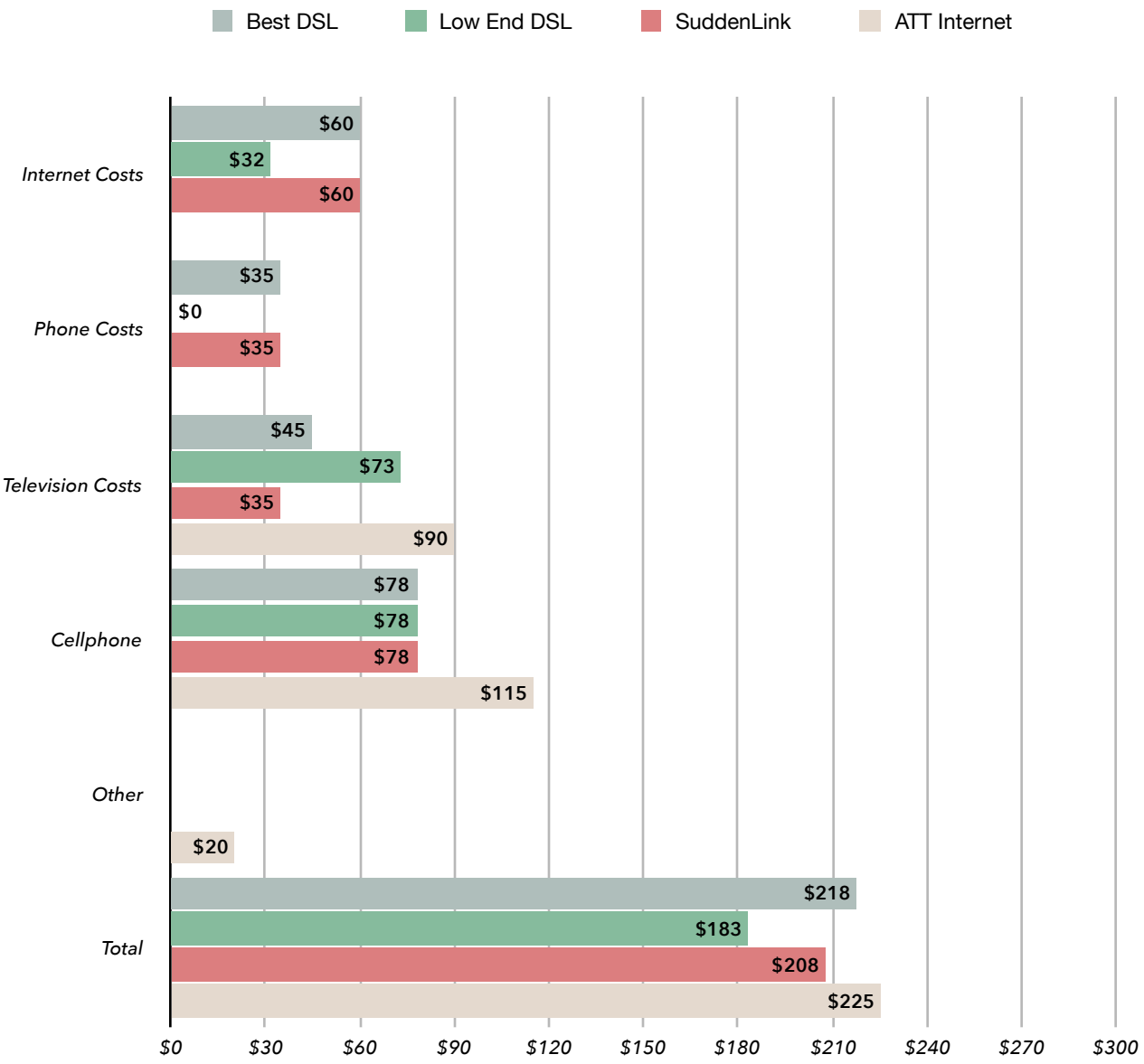
As the following tables and data demonstrate your citizens have little choice in Internet Service Providers. These is no fixed wireless service provider (WISP) that we have been able to verify in your area.

Fayette County has two zip code areas, Mount Olive and Thurmond, that only have a choice of satellite Internet . There are four zip code areas that only have one service provider beyond satellite. This lack of choice impacts citizens' lives in variety of ways from their budgets to how they spend their time.

The average household in the United States pays $67 per month for Internet in their home. Smartphones have become what can be 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.



Unfortunately averages can be misleading for specific areas such as yours. Using the best available data we have constructed graphs showing communication costs for families receiving the Internet in different ways in Fayette County. Even our hypothetical family of two adults, and two children who receive their Internet through the best DSL service do not receive 25 Mbps service but pay over $200 per month for communications charges. Charges for DSL vary from regular rates of $25 per month for basic services (1-year promo rate) with just Internet to $199.95 per month for best DSL Internet speeds 150 Mbps ↓ 10Mbps ↑ including television and telephone. We have used the best Suddenlink bundled package for comparison. It is a one-year promo price and would undoubtedly increase substantially after the promo pricing.



ends.

Fayette County Population 2010 by Zip Code

Zip/ZCTA	Zip Code Area	DSL	Cable	Fixed Wireless	25 Mbps Coverage	2010 Pop.	Land-Sq-Mi	Density Per Sq Mi
25059	Dixie	90%	41%	0%	41%	678	10.77	62.93
25083	Gallagher	83%	72%	0%	72%	672	28.00	24.00
25085	Gauley Bridge	90%	16%	0%	16%	830	13.86	59.90
25115	Kanawha Falls	56%	98%	0%	98%	90	8.07	11.16
25118	Kimberly	100%	45%	0%	45%	998	17.02	58.63
25119	Kincaid	99%	80%	0%	80%	444	11.81	37.59
25136	Montgomery	100%	86%	0%	86%	1,798	8.60	208.97
25139	Mount Carbon	100%	0%	0%	0%	440	0.55	795.66
25161	Powellton	98%	86%	0%	86%	369	11.28	32.71
25173	Robson	84%	75%	0%	75%	452	14.97	30.20
25185	Mount Olive	0%	0%	0%	0%	1,042	0.07	15101.45
25812	Ansted	98%	94%	0%	94%	1,902	18.84	100.95
25831	Danese	100%	0%	0%	0%	1,421	59.76	23.78
25837	Edmond	100%	0%	0%	0%	391	5.46	71.68
25840	Fayetteville	95%	88%	0%	88%	8,179	72.24	113.22
25846	Glen Jean	92%	5%	0%	92%	363	13.07	27.77
25854	Hico	99%	16%	0%	16%	1,101	36.57	30.11
25855	Hilltop	100%	100%	0%	100%	209	0.21	1000.00
25862	Lansing	100%	80%	0%	80%	266	4.34	61.26
25864	Layland	75%	4%	0%	4%	309	22.80	13.55
25868	Lookout	100%	0%	0%	0%	432	12.64	34.17
25880	Mount Hope	93%	84%	0%	84%	6,928	39.50	175.39
25901	Oak Hill	96%	94%	0%	94%	11,920	32.84	362.94
25917	Scarbro	55%	88%	0%	88%	2,139	44.83	47.71
25936	Thurmond	0%	0%	0%	0%	43	14.55	2.96
25938	Victor	79%	77%	0%	77%	1,287	32.50	39.60
25962	Rainelle	95%	70%	0%	70%	3,806	87.26	43.62
25976	Meadow Bridge	84%	3%	0%	3%	2,663	90.09	29.56
26656	Belva	93%	24%	0%	24%	401	8.95	44.80
26680	Nallen	67%	0%	0%	0%	340	27.18	12.51
26690	Swiss	42%	63%	0%	63%	584	28.74	20.32

Internet Service Providers

Zip Code	Zip Code Area	Frontier DSL	Shentel Cable	SuddenLink
25059	Dixie	✔		✔
25083	Gallagher	✔		✔
25085	Gauley Bridge	✔		✔
25115	Kanawha Falls	✔		✔
25118	Kimberly	✔		✔
25119	Kincaid	✔	✔	✔
25136	Montgomery	✔		✔
25139	Mount Carbon	✔		✔
25161	Powellton	✔		✔
25173	Robson	✔		✔
25185	Mount Olive			
25812	Ansted	✔	✔	✔
25831	Danese	✔		
25837	Edmond	✔		
25840	Fayetteville	✔	✔	✔
25846	Glen Jean	✔		✔
25854	Hico	✔	✔	
25855	Hilltop	✔	✔	
25862	Lansing	✔	✔	
25864	Layland	✔		
25868	Lookout	✔		
25880	Mount Hope	✔		✔
25901	Oak Hill	✔	✔	✔
25917	Scarbro	✔	✔	✔
25936	Thurmond			
25938	Victor	✔	✔	
25962	Rainelle	✔		✔
25976	Meadow Bridge	✔		
26656	Belva	✔		✔
26680	Nallen	✔		
26690	Swiss	✔		✔

Satellite Internet Service Providers

HughesNet and Viasat/Exede are available in all zip codes

Wireless Internet Service Providers (WISPs)

There are no Wireless Internet Service Providers that we have been able to find in Fayette County.

Local Pricing Data

This information provides pricing data and services available from providers in the area for Fayette County. Prices and promotional offers changes frequently and sometimes vary by region.

Wireline Providers

Frontier

$80/mo for 90 Mbps ↓ – Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is $171. WiFi router fee waived for 12, $10/mo thereafter.

$75.00/mo for 45 Mbps. 45 Mbps ↓ – Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is $161. WiFi router fee waived for 12 months , $10/mo thereafter.

$70.00/mo for 25 Mbps. 25 Mbps ↓ – Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is $151. WiFi router fee waived for 12 months, $10/mo thereafter.

$30.00/mo for Simply Broadband Plus 18 Mbps. 18.0 Mbps ↓ 1-1.5 Mbps ↑ with no data cap - 2-year promo rate. Get a $100 Visa Reward Card when you order online. Setup fee $75 includes installation. Delivery/handling fee is $9.99. WiFi router fee waived for 12 months, $10/mo thereafter.

$25.00/mo for Simply Broadband Ultra 12 Mbps. 12.0 Mbps ↓ 1-1.5 Mbps ↑ with no data cap - 2-year promo rate. Get a $100 Visa Reward Card when you order online. Setup fee $75 includes installation. Delivery/handling fee is $9.99. WiFi router fee waived for 12 months, $10/mo thereafter.

$20.00/mo for Simply Broadband Core 6 Mbps. 1.1-6 Mbps ↓ 1 Mbps ↑ with no data cap - 2-year promo rate. Get a $100 Visa Reward Card when you order online. Setup fee $75 includes installation. Delivery/handling fee is $9.99. WiFi router fee waived for 12 months, $10/mo thereafter.

Shentel

$199.95/mo for 150 Mbps ↓ 10 Mbps ↑- with a 1000 GB/month data cap. Setup fee $99.95 includes installation Modem $8 per month or one-time fee of $99.

$139.95/mo for 101 Mbps ↓ 10 Mbps ↑- with a 750 GB/month data cap. Setup fee $99.95 includes installation Modem $8 per month or one-time fee of $99.

$79.95/mo for 25 Mbps ↓ 5 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.

$59.95/mo for 10 Mbps ↓ 2 Mbps ↑- with a 500 GB/month data cap. 1-year promo rate. Regular rate is $99.95. Setup fee $99.95 includes installation Modem $8 per month or one-time fee of $99.

$49.95/mo for 5 Mbps ↓ 1 Mbps ↑- with a 250 GB/month data cap. Regular rate is $99.95. Setup fee $99.95 includes installation Modem $8 per month or one-time fee of $99.

SuddenLink

$129.99/mo for 1000 Mbps 100 Mbps ↓ up to 50 Mbps ↑ Unlimited data. TV 225 channels, Internet and Phone. 1- year promo rate.

$109.99/mo for 400 Mbps 400 Mbps ↓ up to 40 Mbps ↑ Unlimited data. TV 290 channels, Internet and Phone. 1- year promo rate.

$99.99/mo for 400 Mbps 400 Mbps ↓ up to 40 Mbps ↑ Monthly data plan 250 GB. TV 225 channels, Internet and Phone. 1- year promo rate.

$79.99/mo for 100 Mbps 100 Mbps ↓ up to 10 Mbps ↑ Monthly data plan 250 GB. TV 225 channels, Internet and Phone. 1- year promo rate.

$84.99/mo for 1,000 Mbps. 1,000 Mbps ↓ 50 Mbps ↑ with no data cap- 1- year promo rate. Regular rate $125/month. Setup fee $0 (Free installation) Modem w/WiFi: $10/month.

$54.99/mo for 400 Mbps. 400 Mbps ↓ 40 Mbps ↑ with no data cap- 1- year promo rate. Regular rate $95/month. Setup fee $0 (Free installation) Modem w/WiFi: $10/month.

$44.99/mo for 200 Mbps. 200 Mbps ↓ – Mbps ↑ with no data cap- 1- year promo rate. Regular rate $85/month. Setup fee $0 (Free installation) Modem w/WiFi: $10/month.

$34.99/mo for 100 Mbps. 100 Mbps ↓ 10 Mbps ↑ with 250 GB/month data cap- 1- year promo rate.

Fixed Wireless Providers

None

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

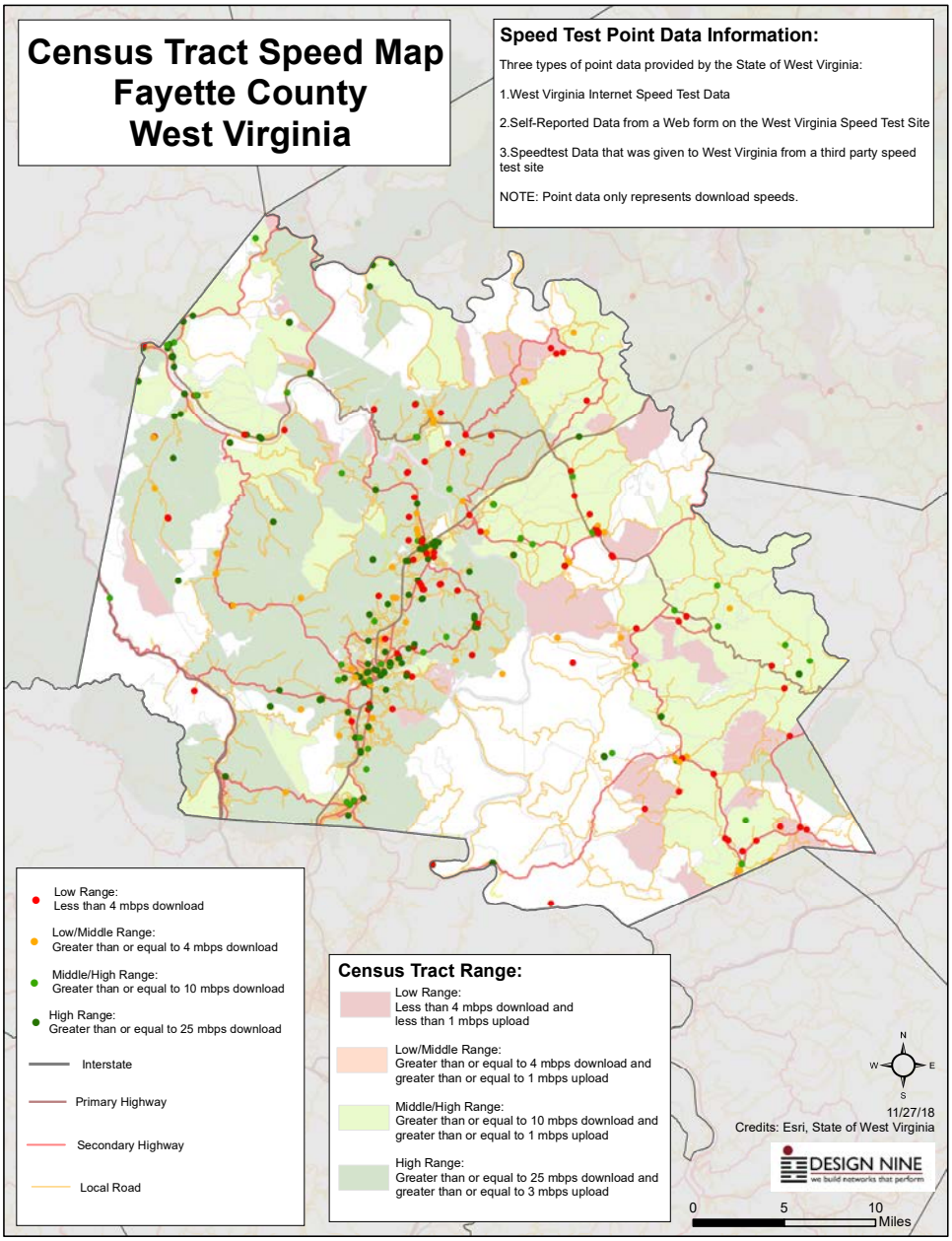
$70/mo for 25 Mbps ↓ Unlimited priority data. $100/mo after three months

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

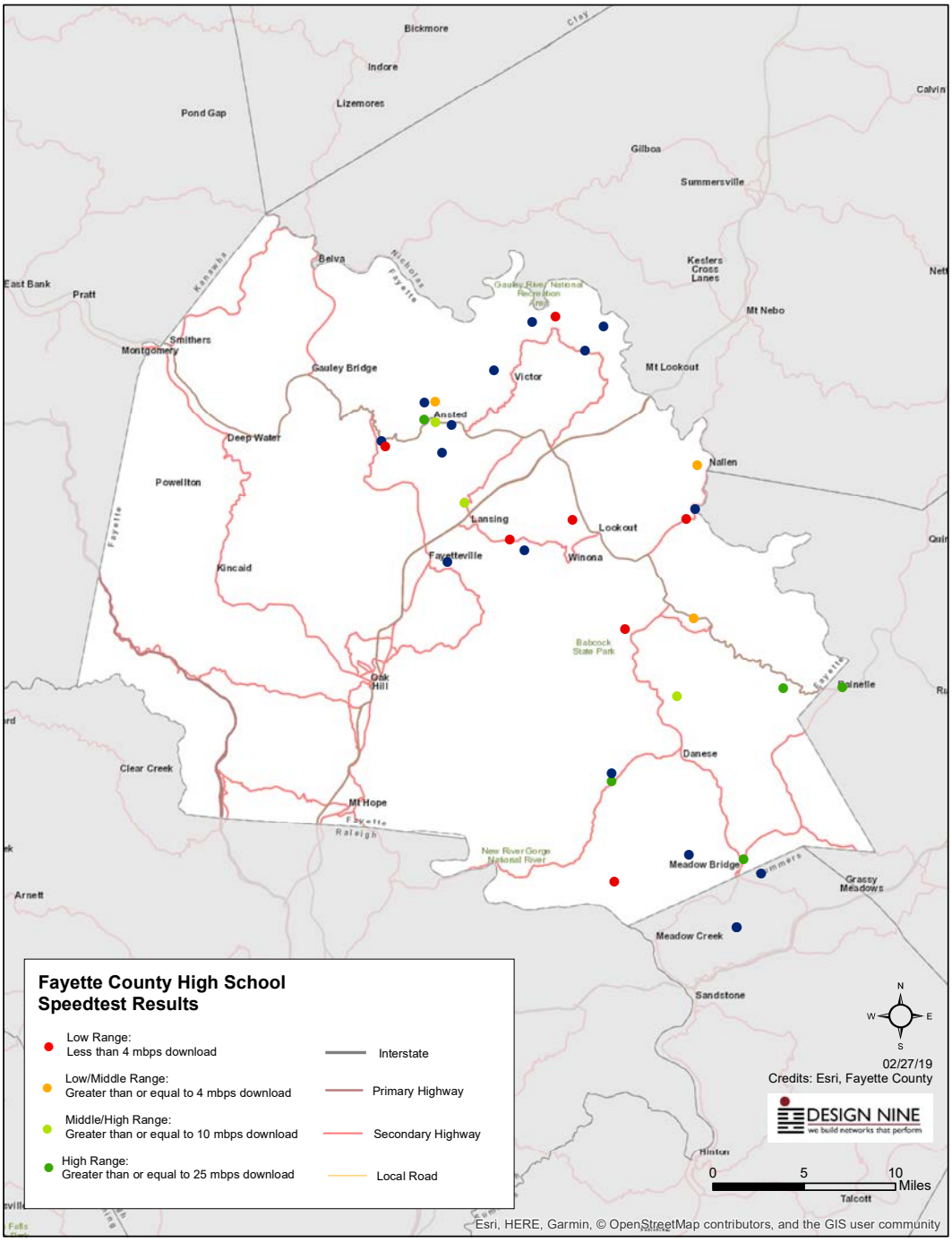
8.1 WEST VIRGINIA SPEED TEST DATA

The state of West Virginia has been encouraging citizens and businesses to run a speed test (https://broadband.wv.gov/internet-speed-test). Not all speed test results are geo-located with an address, but the map below shows some data points and also illustrates, by census tract, the estimated bandwidth speeds available. The census tract data (shaded areas) can be misleading, because the entire census tract may show a higher speed available if just one or two households in the census tract have access to those higher speeds.

After the maps on the next two pages, additional WV speed test data is provided in chart form, which has more data points, and provide a more realistic measurement of available Internet speeds.

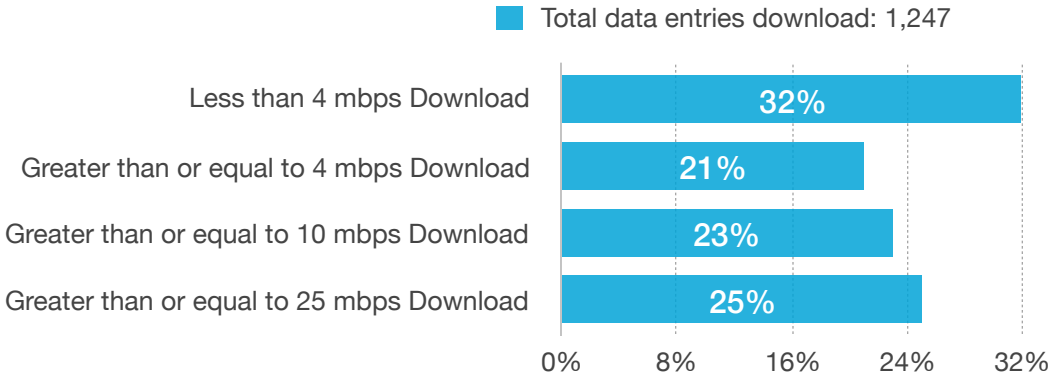


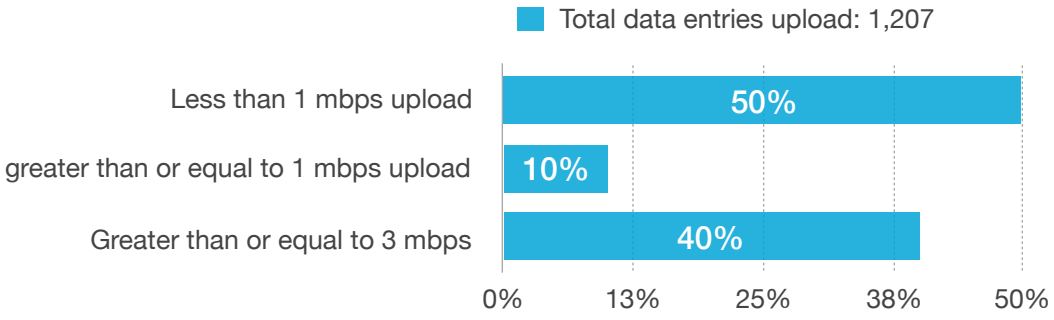
This map illustrates some speed test collected by Fayette County High School students in 2018.



Fayette County: West Virginia Speed-test

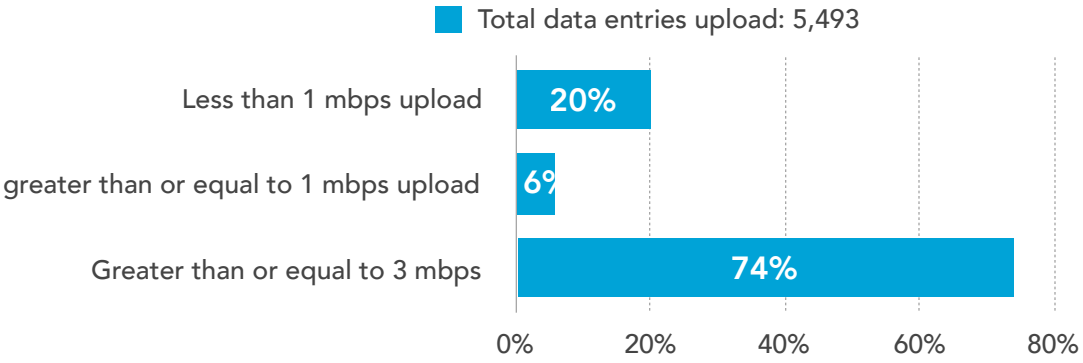
DATA DIRECTLY FROM WEST VIRGINIA	TOTAL DATA ENTRIES DOWNLOAD: 1,247 UPLOAD: 1,207
Less than 4 mbps Download	32%
Greater than or equal to 4 mbps Download	21%
Greater than or equal to 10 mbps Download	23%
Greater than or equal to 25 mbps Download	25%
Less than 1 mbps upload	50%
greater than or equal to 1 mbps upload	10%
Greater than or equal to 3 mbps	40%

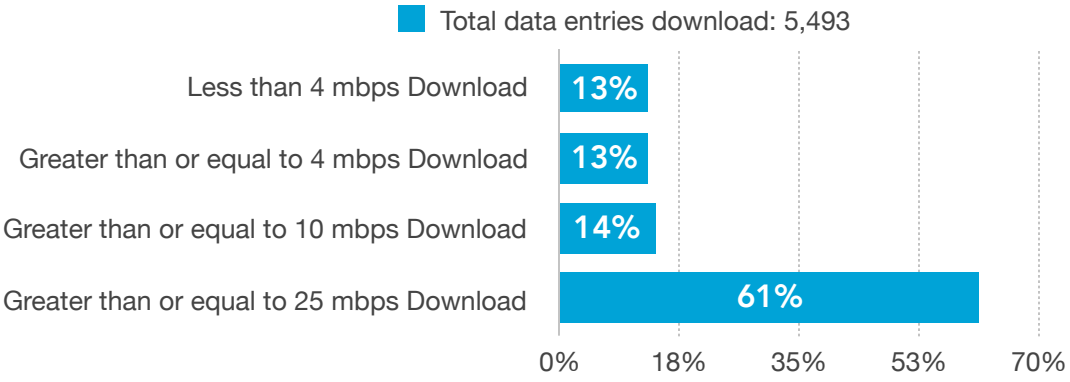




Fayette County: Ookla data

DATA FROM OOKLA	TOTAL DATA ENTRIES DOWNLOAD: 5,493 UPLOAD: 5,493
Less than 4 mbps Download	13%
Greater than or equal to 4 mbps Download	13%
Greater than or equal to 10 mbps Download	14%
Greater than or equal to 25 mbps Download	61%
Less than 1 mbps upload	20%
greater than or equal to 1 mbps upload	6%
Greater than or equal to 3 mbps	74%





9 BROADBAND DEVELOPMENT STRATEGIES

From the meetings with the Broadband Project Team and the meetings with stakeholders, it is clear that there is widespread frustration with the current levels of broadband service. The Broadband Development Team will have to simultaneously keep all audience segments well-informed with regular updates, but also manage expectations. The Broadband Project Team is not responsible for a traditional "sales" approach, 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 in Fayette 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.

Branding

The Broadband Development Team should adopt a logo, a domain name for the Web site and email accounts, and a simple, easy to remember tag line (e.g Get Fayette Connected!) that would be used consistently in all marketing efforts. The logo should be professionally designed to print well in paper materials and display well on Web sites, Facebook, and other electronic media. It will be useful to have some "give away" items that are branded with the logo and tag line to help raise awareness. These might include small items like hats, t-shirts, coffee mugs, bumper stickers, and other "free" items.

Characteristics of a Successful Marketing Plan

A successful marketing plan for the broadband effort 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 Web site and the Facebook page will keep residents, businesses, and local officials up to date and well-informed about broadband development activities.
- Affordable – Avoid using high priced media consultants, SEO advisers, and over-priced marketing agencies. A simple Web site can be hosted for less than $200 per year, and there are a variety of Content Management Systems (CMS) that allow Web sites to be updated quickly and easily without any programming or coding required. For paper materials like fliers, professionally designed templates are available that can be easily edited for a high quality finished product. Paper materials can be printed easily and quickly on high quality, four color glossy paper formats at very low cost. As an example, an 8 1/2 x 11 four color glossy flier can be printed and delivered in 48 hours for as little as twelve cents a copy.
- 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 Web site news blog at the same time as the Facebook page.
- Well-defined Goals – The Broadband Project Team 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 – Facebook needs to be an important part of the marketing strategy. Regular posting of news items to a dedicated "Fayette Broadband" page 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 Project Team and Facebook users. Residents and businesses are already "liking" and "sharing" the page, but they are also posting questions. The Facebook page should be visited at least weekly by a member of Team who will review activity, write responses to questions, and pass interesting or important comments on to other Team members.

Keyword Optimization – Web site should include keywords that are most likely to be used in search engines (e.g. broadband, Fayette County, wireless broadband, WISP, bandwidth, etc.).

Search Engine Optimization Strategy – To ensure that the Web site shows up near the top of search engine results, the site should have a blog-style news page, with regular updates–at least several items per month, and ideally 1-2 news items per week.

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

Web Site – The effort needs a permanent Web site. It does not need to be lengthy and does not need many pages (as few as 10-12 pages may be adequate). A content management system (CMS) should be installed to make updating the site quick and easy. A CMS like Wordpress or Drupal, once configured by an experienced Web developer, will allow fast and easy page updates without any programming or HTML experience. A news blog should be part of the site so that news items can be posted there. A blog that is updated regularly will help the site get a good rating in search engines.

Email – Most Web hosting services will include email and email mailing list support as part their package. Companies like JustHost will provide domain registration, a Web site with CMS support, email addresses, and mailing lists for under $200/year.

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

Marketing Materials

The project 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 Commissioners, 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 news blog.

Target Audience

There are several different groups that should be identified as needing to receive information on a regular basis.

- Residents – Residents can be effectively updated using Facebook and occasional other use of social media. Facebook works extremely well for this kind of project, and residents should be encouraged to "share" and "like" the Facebook page. Facebook "boosts," used sparingly for major announcements, are very effective and are relatively inexpensive.
- Businesses – Businesses are most easily kept informed by regular updates at Chamber and merchants association meetings.
- County Commissioners – The Broadband Project Team should plan to make a regular quarterly update at a scheduled County Commissioner meeting.
- County Departments - Regular meetings with planning, GIS, and public works staff in the county (perhaps 2 times per year) will be important, with regular email and phone call interaction in between meetings. Planning staff can provide information on new private towers that have applied for permits, and can identify other opportunities for the Broadband Project Team to have an impact (e.g. new industrial/commercial areas that might need fiber, new rural residential developments, etc.).
- Public Safety – Regular meetings with public safety officials will be important to ensure that grant funding is coordinated jointly for the most benefit of both groups.
- Healthcare Providers – Health care providers, because of the electronic medical records (EMR) requirements, are big users of Internet access and bandwidth. The use of telemedicine and telehealth services is increasing steadily, and health care providers are often the heaviest users of bandwidth in a county after K12 schools. They can be early customers for expanded service.
- K12 Schools and Higher Education – While schools generally have adequate bandwidth, they are often interested in a second (redundant) Internet connection, so they could be major customers for services being offered by new providers.
- ISPs – ISPs will be the primary users of any infrastructure investments made in Fayette County. It will be very important to give interested providers regular updates on activities.
- State Legislators – Changes in laws and funding opportunities at the state level could accelerate the goals of the effort. Regular updates by email and in-person meetings will be important.

Budget

The budget for marketing can be modest, but should be enough to support the recommended ongoing awareness effort. An example budget might include:

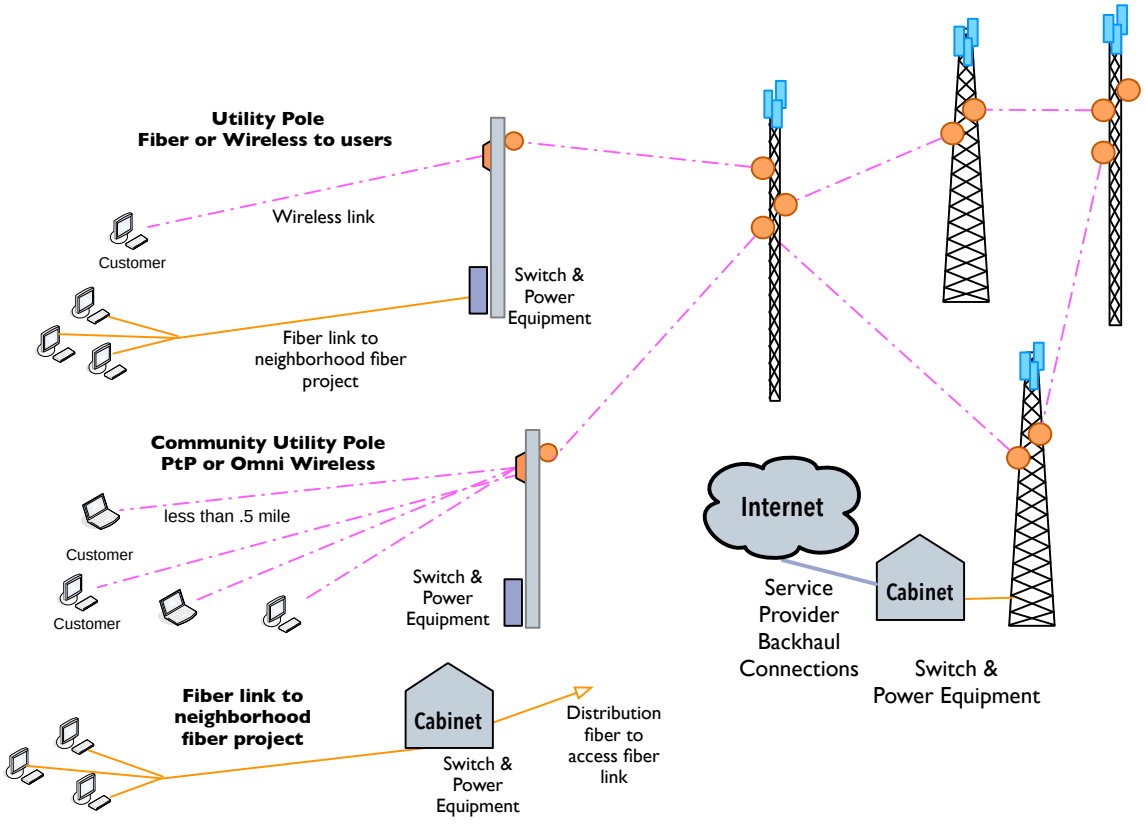
Budget Item	Annual Budget Allocation
Web and email hosting	$200
Printing of marketing materials	$900
Web design work	$1,000
“Give away” items	$750
Graphic design support	$1,500
Paid advertising (e.g. Facebook boosts)	$500
Total	$4,850

10.1 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. Fayette 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.

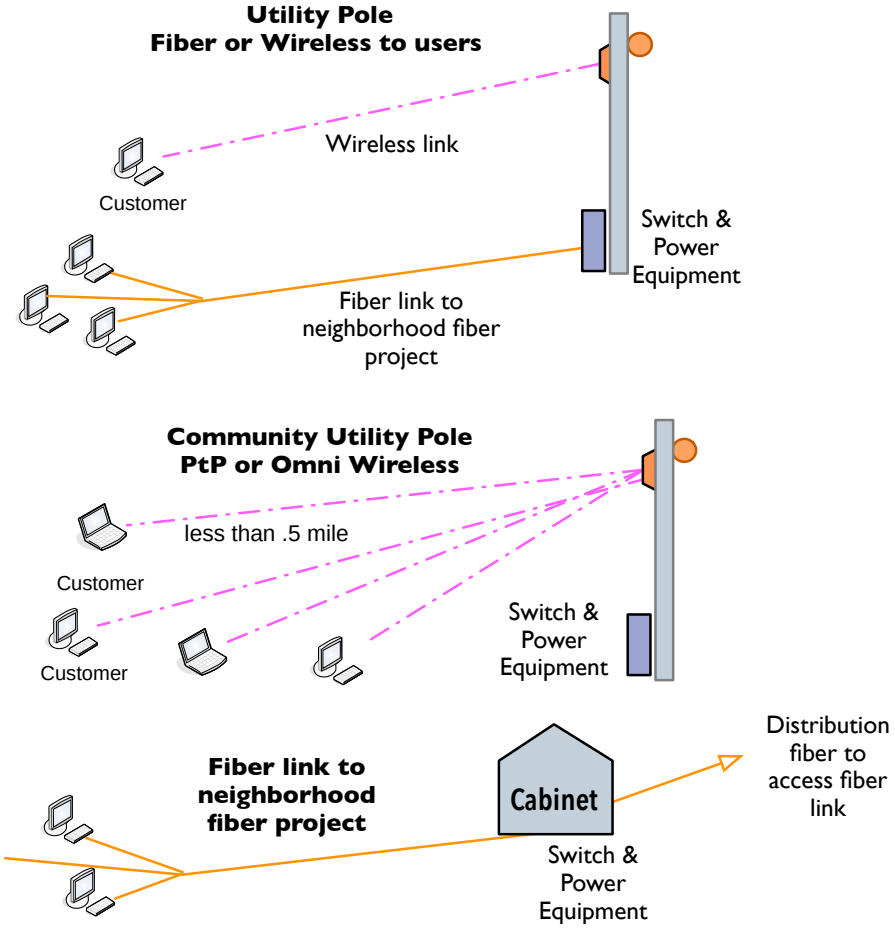
The illustration below shows the full range of technology options (fiber and wireless) and how they can be connected together in various ways to meet the diverse needs of Fayette County. More detail is provided on the following pages.



10.2 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.



10.3 DISTRIBUTION NETWORK

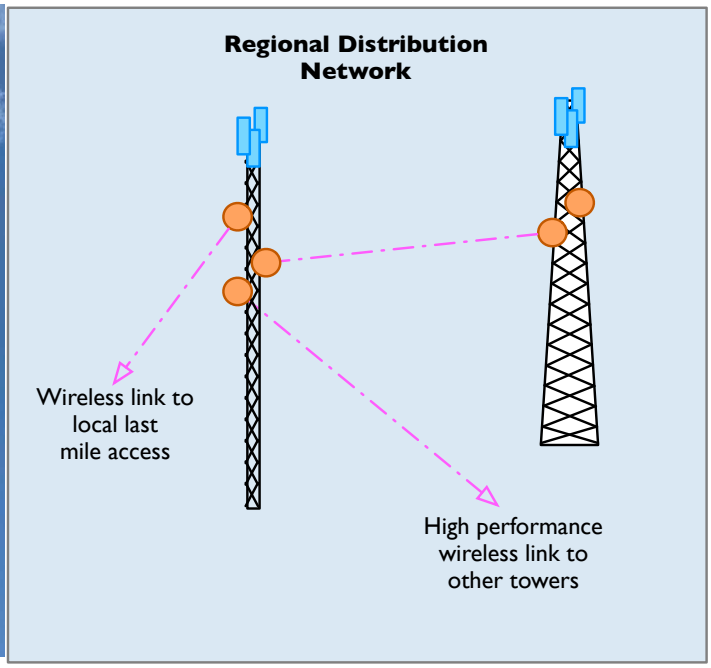
Distribution is the portion of the network between the Distribution sites to the Last Mile Access portion of the network. It is desirable for each distribution site to have a connection back to more than one Distribution site (tower) on a redundant ring. This ring topology protects against hardware failure 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:

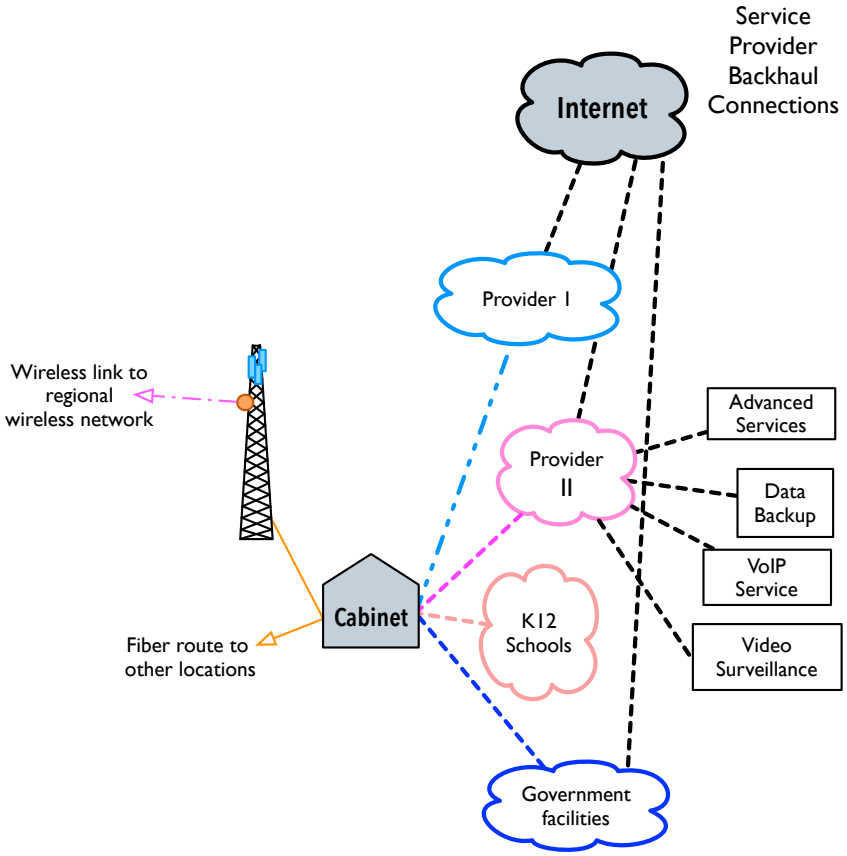
- Space for backhaul connections to other towers in the county.
- Space for local access radios to provide Internet access within 2-3 miles of the tower (or farther with good Line Of Sight).



10.4 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 Fayette 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.

10.5 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. Some counties provide "by right" permitting of these poles if they are placed on private property, which can reduce the cost of installing them.

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 a locality and has the potential of improving broadband access in rural areas quickly, the localities 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.

10.6 NANO-CELL CELLULAR 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.

This problem can be addressed by promoting the wider use of "nano-cell" devices. These small pieces of equipment are connected to the DSL modem 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 a large amount of bandwidth. If there is success in making more tower space available for WISP use, the improved wireless broadband service will also support use of these small appliances.

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.

This strategy is interesting 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 local governments, but if an coop or nonprofit is formed, that entity could develop play role educating residents and businesses about this option. Prior to formal development of an independent entity, the broadband task force could provide information about nano-cells, and the local libraries could provide information about this as well.

Funding Options

No special funding required.

Operation and Management Considerations

None.

Recommendation and Next Steps

The broadband task force could promote awareness of the nano-cell boxes as part of a broader awareness campaign about improving broadband availability.

10.7 MEET-ME BOX AND FIBER DROP STRATEGY

In some of the larger towns, some smaller communities, rural neighborhoods, and subdivisions, "meet me" boxes could be installed. A meet me box is a telecom cabinet with fiber cables installed between the cabinet and nearby homes and/or buildings. Providers only have to reach the meet-me box, lowering their costs. Both wireline and wireless providers can use this infrastructure. This approach can also be used to provide fiber services in business and industrial parks. A small Virginia county installed five miles of fiber in their business park and was able to attract a Tier One provider to provide service to an existing business (a manufacturing plant that was going to leave if the county did not help them get better Internet service).

The dark fiber approach minimizes operational costs. Service providers would install their own equipment in the cabinet and would pay a small monthly lease fee for the fiber strands they use to connect customers to their services.

Ownership and Governance

The meet-me boxes and related fiber, conduit, and handholes could be owned by the County or by a coop or nonprofit.

Cost Discussion

For a meet-me box installed in a "main street" area (e.g in an alley behind commercial/retail buildings) with relatively inexpensive and short fiber drop cables into nearby buildings, the lower end of an installation might start at $35,000. For a box installed in a rural sub-division that requires distribution conduit/fiber and drop cables, the cost to connect 25 homes might start at $175,000 on the low end and increase as the number of homes connected increases. Larger numbers of homes or businesses will each add to the cost, but adding more connected premises also increases the value of the infrastructure and increases the revenue potential.

Funding Options

In some areas, where it can be shown that this infrastructure is going to keep existing jobs and/or add new jobs, CDBG funds may be available to support the initial capital costs. Some local match (e.g. 10% to 20%) may also be required.

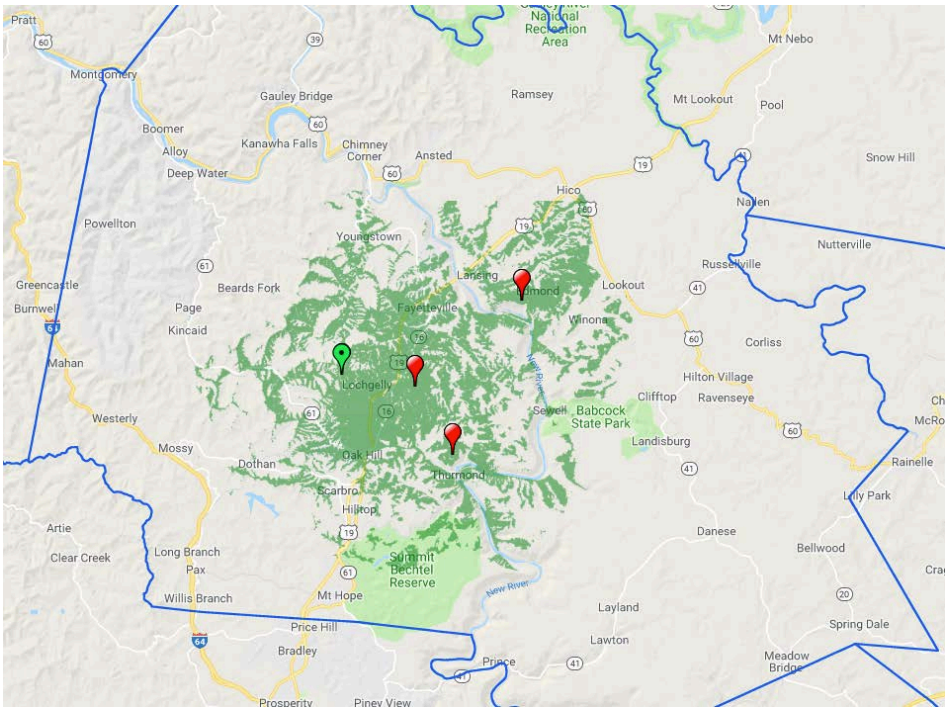
Providers will pay monthly lease fees for the fiber strands they use to connect customers, and these fees will cover some or all of the ongoing operational costs. The greater the number of connected customers, the larger the revenue potential.

11 PROPAGATION STUDIES

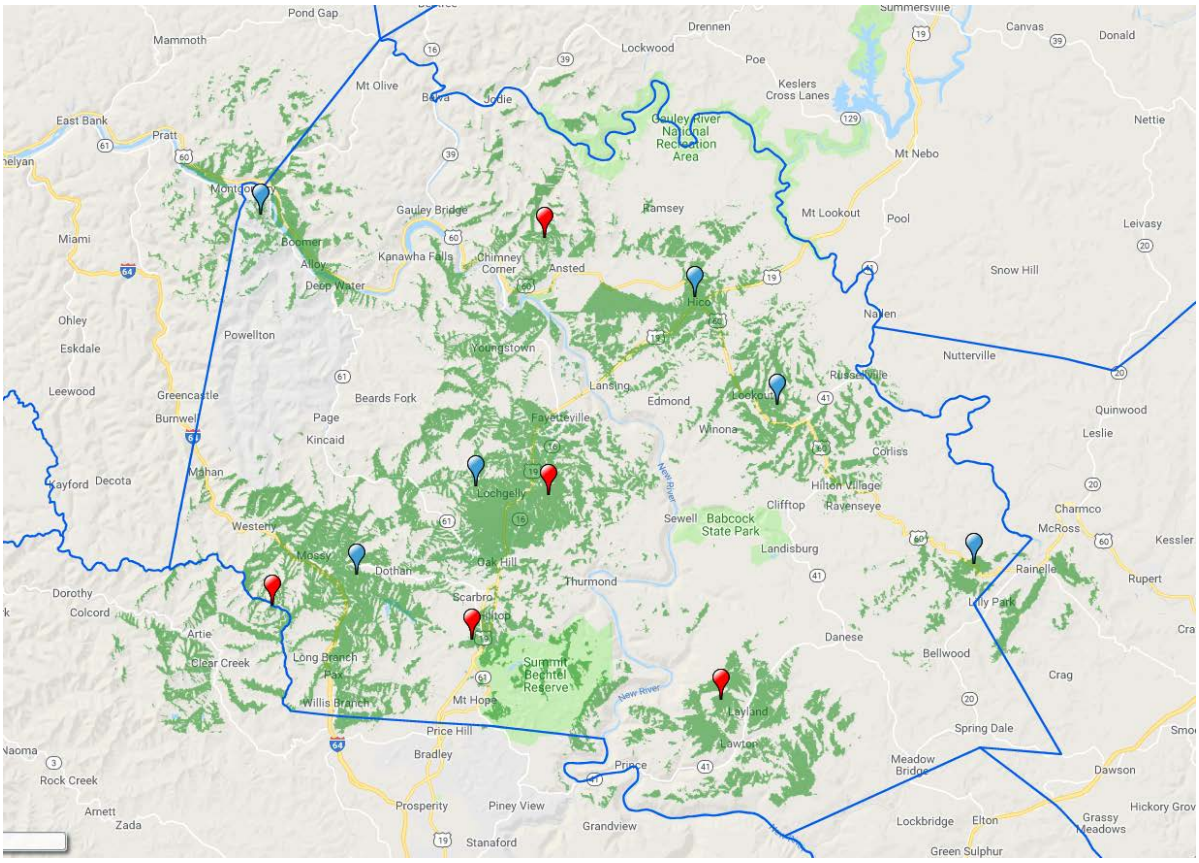
The topography of the county and the location of some of the county-owned towers indicates that large areas of the county could receive improved broadband and Internet service if WISPs (Wireless Internet Service Providers) co-located on those towers. The shaded green areas indicate locations where there appears to be a clear line of sight between a tower and a given location. The wireless signals can be blocked by tree cover; while the propagation software does adjust estimates based on tree cover, some homes or businesses in the green areas could be blocked by trees.

The topography of the county is quite difficult, particularly on the western side of the county. Some of the maps on the following pages highlight the many elevation changes. The tall towers shown in these studies (new and existing) will have to be supplemented by "small cell" community poles placed where there is a cluster of homes that could be served with wireless broadband from a community pole. The community pole has to have clear line of site to a taller tower, but the local pole could provide good quality symmetric broadband service to nearby homes and businesses.

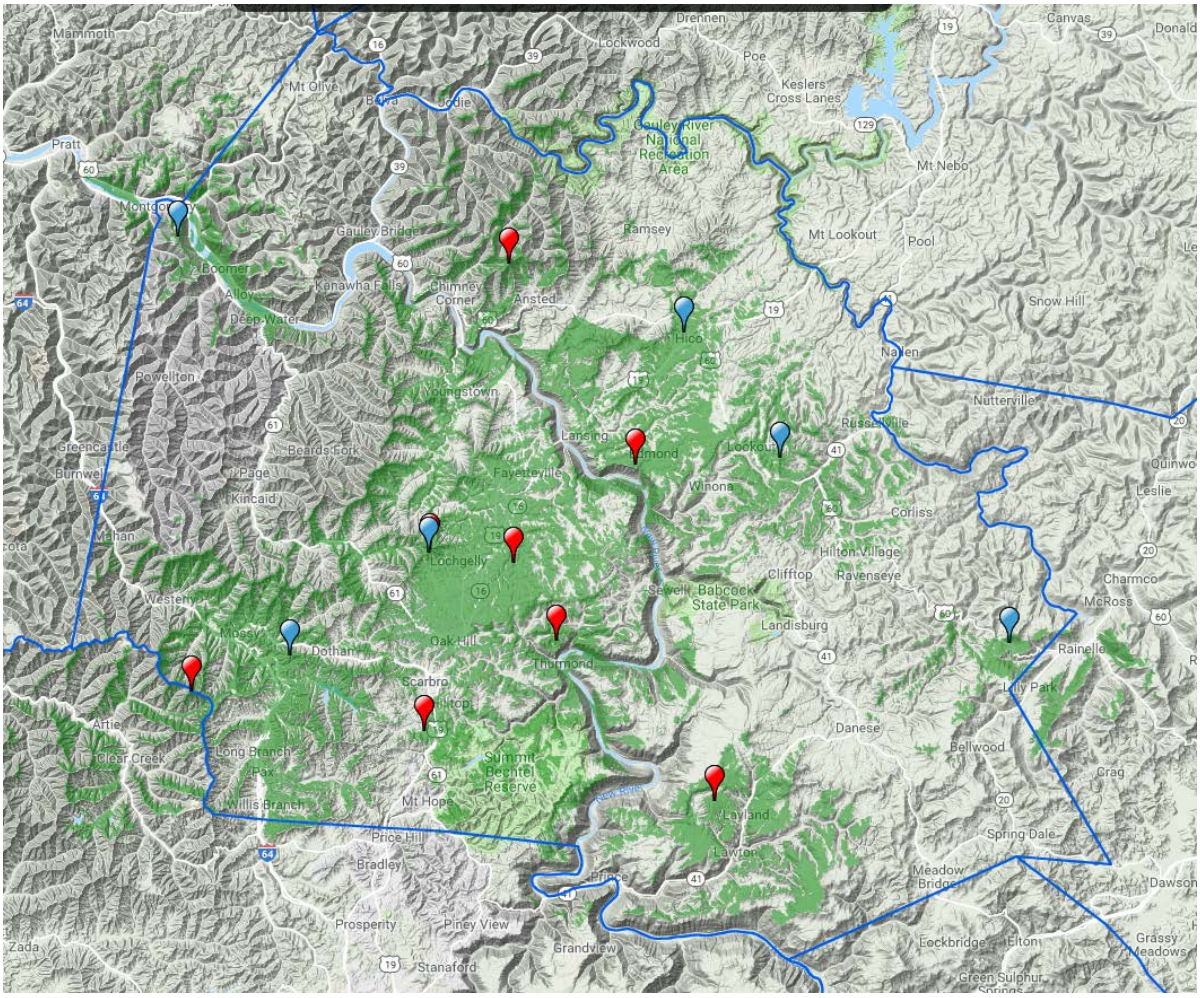
This map shows the projected propagation using three existing towers and one new tower in the center of the county, where there are fewer hills.



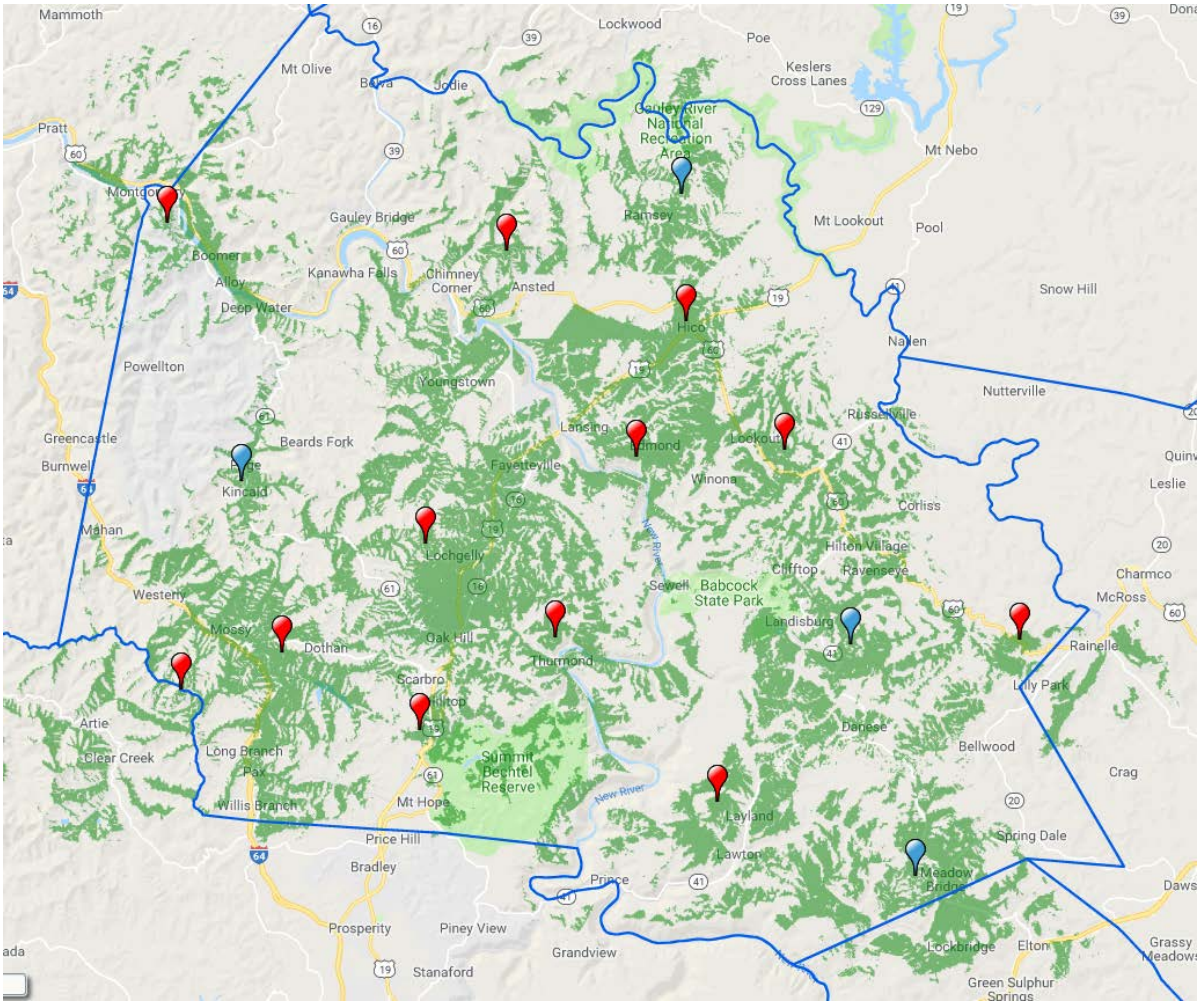
In this study, existing (red) towers are supplemented with hypothetical (new) towers (blue) to illustrate likely propagation to cover larger portions of the county.



This study highlights the difficult terrain in the western part of the county. The hypothetical (blue) towers were placed to try to match some of the higher household density areas in rural parts of the county.



This final study shows that even with sixteen new and existing towers, it is still difficult to provide wireless broadband throughout the county, The assumption here is that all new towers would be 180' high, to avoid the extra expense associated with towers that are more than 199'. Towers of 200' or more fall under FAA rules that require a light at the top and may be also required to be painted red/white–the maintenance of a lit and/or painted tower can be significantly higher.



12 PRELIMINARY DESIGN AND COST ESTIMATES

NOTE: The costs contained in these estimates 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.

12.1 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 City is able to place the colocation facility and any cabinets in public right of way or on City 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 WVDOT 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

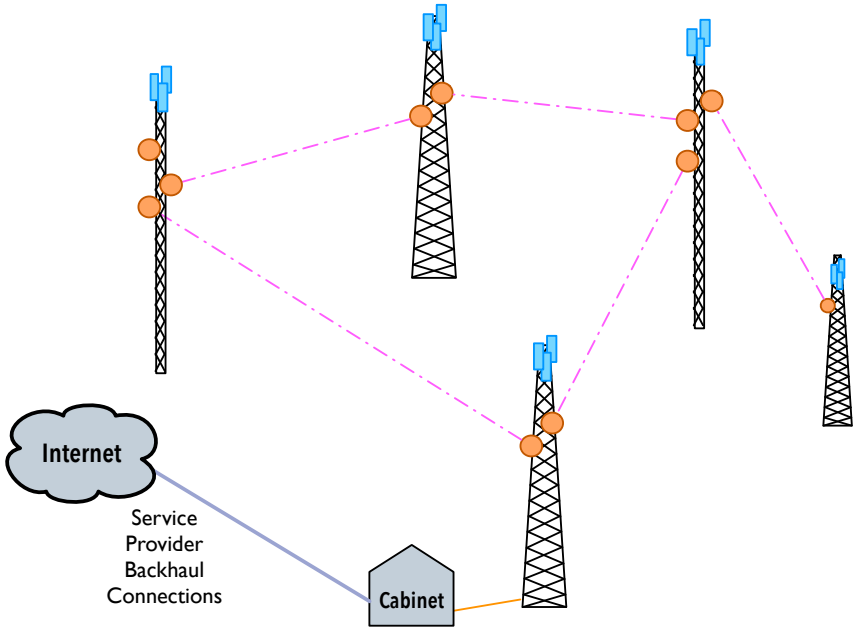
This category provides a small budget for miscellaneous expenses that will arise during the course of construction (e.g., bid advertisement costs, inventory tags, etc.).

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.

12.2 WIRELESS TOWER COST ESTIMATES

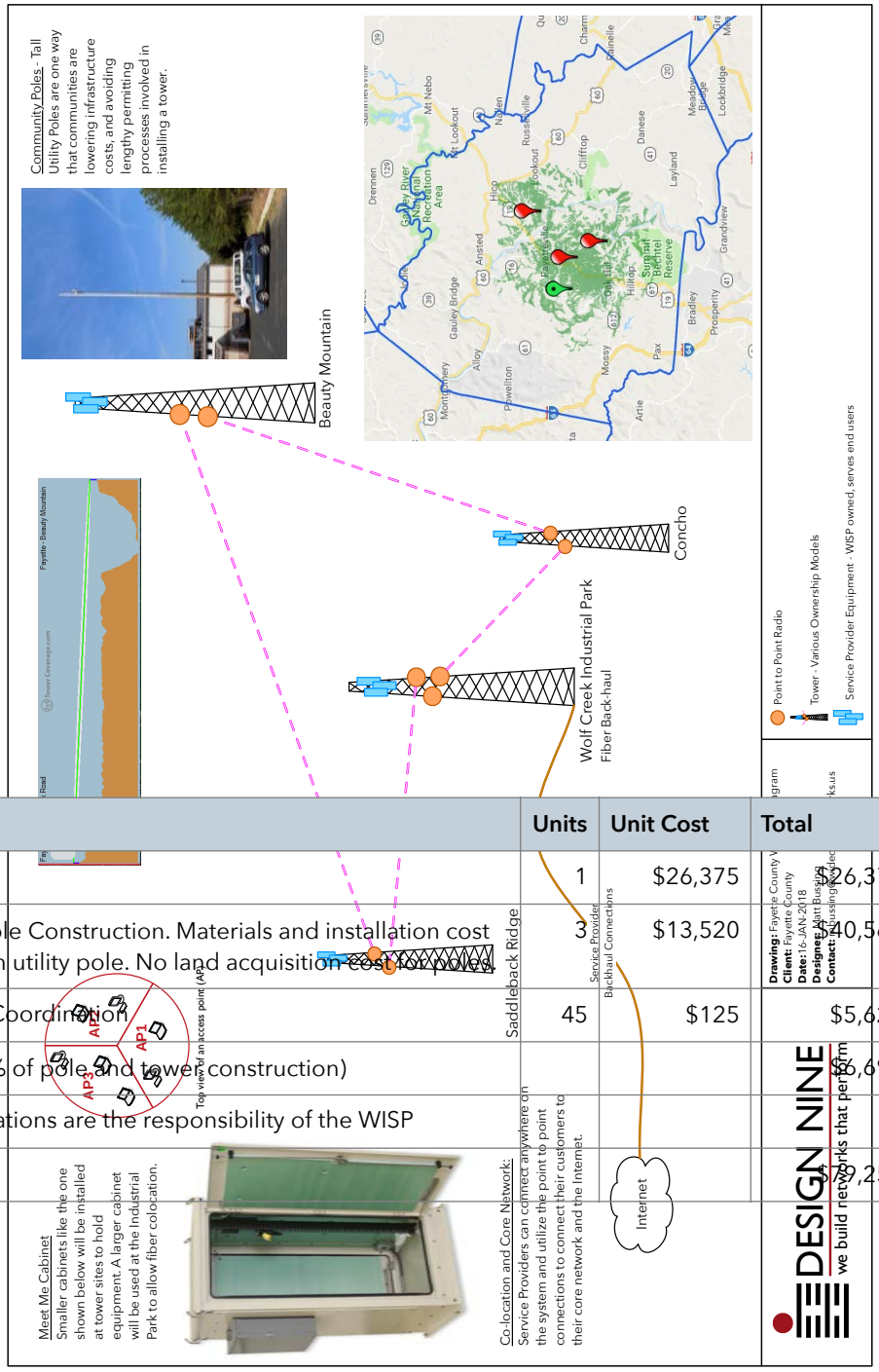
This section of the report provides an estimate of the cost of using existing towers to provide improved Internet access. The diagram below shows the logical design of a five tower network. Four of the five towers have adequate line of sight between the towers to build a fully redundant ring between 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.

12.3 EXAMPLE OF SMALL POINT TO POINT NETWORK

This diagram provides an example of what a four tower network would look like, with high performance point to point links between the four towers and local access point radios on each tower. The point to point network design illustrates how a fully redundant network operates. In this example, any one tower could have a complete radio failure and service would not be interrupted on the other towers as long as there were Internet feeds on two different towers (the illustration shows only one).



Item	Units	Unit Cost	Total
Tower Fit-up	1	$26,375	$26,375
Neighborhood Pole Construction. Materials and installation cost for 50-60' wooden utility pole. No land acquisition cost for poles.	3	$13,520	$40,560
Service Provider Coordination	45	$125	$5,625
Contingency (10% of pole and tower construction)			$6,694
*Customer Installations are the responsibility of the WISP			
TOTAL			$79,254

12.4 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, CHANGE FROM POWER UTILITY TO COUNTY	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

12.5 POINT TO POINT BACKHAUL NETWORK

A county-wide 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 especially important during periods when online standardized testing is taking place.

As an example, if four towers had line of sight between them, a total of four point to point links will be needed, with a Gigabit of capacity on each link. The table below summarizes the total cost of the equipment (radios and antennas) for all four links. The estimated cost of a single link is $28,900.

POINT TO POINT SYSTEM EQUIPMENT

ITEM/PROJECT	UNITS	UNIT COST (LOW)	UNIT COST (HIGH)	COST (AVG)
Wireless Point to Point Equipment (per link) AVIAT WTM4000 SYSTEM OR EQUIVALENT, INCLUDES EQUIPMENT CABLING POWER SUPPLIES, FCC LICENSE COORDINATION, SOFTWARE LICENSES GIGABIT	4	$19,000	$22,000	$82,000
Cat5E Cabling per 1000' Case CABLING ON SITE - RADIO CABLING INCLUDED IN EQUIPMENT BID	4	$135	$150	$570
Cable Attachement Hardware	4	$300	$500	$1,600
Wireless Equipment Mounting Hardware GENERIC LIGHTWEIGHT FACE MOUNT OR LEG MOUNT HARDWARE KITS, SITE-SPECIFIC	4	$400	$650	$2,100
Tower Site Switch SMALL CISCO/JUNIPER OR EQUIVALENT	4	$1,000	$2,000	$6,000
Cable Management	4	$75	$150	$450
Point to Point Equipment Installation (per link)	4	$3,500	$5,000	$17,000
Power System Installation Materials	4	$20	$40	$120
Power System Installation Labor	4	$300	$500	$1,600
Samlex 1000W Inverter	4	$350	$450	$1,600
Samlex SEC1230-UL Battery Charger	4	$200	$300	$1,000
100ah 12v Non Spillable Backup Battery	4	$250	$350	$1,200
DC Voltage Monitoring Device	4	$40	$60	$200
Unmanaged Rack Mount PDU (6O)	4	$35	$45	$160
Total:				$115,600

12.6 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: $82,640.00				
Site Development (Clearing, Road Improvements, etc.)	1	$15,000.00	$15,000.00	$15,000.00
New Power Service / Installation	1	$1,250.00	$3,450.00	$2,350.00
180' Guyed Tower Construction Labor & Contracting	1	$50,000.00	$74,750.00	$62,375.00
Cabinet Installation Labor	1	$600.00	$1,150.00	$875.00
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: $35,735.00				
180' Guyed Tower Construction Materials	1	$17,500.00	$27,500.00	$22,500.00
Small Telecom Cabinet	1	$4,000.00	$6,000.00	$5,000.00
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:				$118,375.00
Project Management, Network Engineering, Testing				$23,675.00
Site Engineering, Surveying, Viewshed Analysis, Etc.				$9,500.00
Misc Fees, Technical Services				$7,500.00
Contingency				$11,837.50
TOTAL:				$170,887.50

12.7 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.

Community poles should only be located where a WISP and/or the community has made a minimum customer subscription commitment for the improved broadband service.

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	WISP is responsible for radios and network equipment
V8	Backbone Links	1	Typically a link to a taller tower
	Site Development (Average)	$1,000.00	Poles need to be placed in locations with good line of sight to other poles or towers and where electric service and road access require minimal new construction

1	ITEM/PROJECT	UNITS	BEST ESTIMATE
2	Site Development (Clearing, Road Improvements, etc.)	1	$1,000
3	3x3 NEMA Box	1	$450
4	New Power Service / Installation	1	$875
5	60' Wooden Utility Pole Construction Materials	1	$3,000
6	Miscellaneous parts and materials	1	$175
7	Power System Installation Materials	1	$30
8	DC Voltage Monitoring Device	1	$50
9	Unmanaged Rack Mount PDU (6O)	1	$40
10	60' Wooden Utility Pole Construction Labor & Contracting	1	$2,500
11	Power System Installation Labor	1	$400
12	Project coordination and management	1	$5,000
13	Contingency (10% of costs)	1	$1,352
14	Total:		$13,520.00

12.8 WOLF CREEK FIBER COST ESTIMATE

The Wolf Creek Business Park has telecom conduit in place, so a cost study was completed to examine the cost of adding fiber to existing conduit, plus adding additional handholes in front of currently unoccupied parcels.

Fayette - Wolf Creek Fiber Infrastructure Analyses

0	ITEM/PROJECT	ESTIMATED
1	Total cost per mile	$152,239.04
2	Distribution construction cost per mile	$115,101.09
3	Distribution cost per mile (no drops)	$103,972.45
4	Cost per building connected	$31,361.24
5	Average cost of a drop to connect after primary construction is completed	$2,250.00

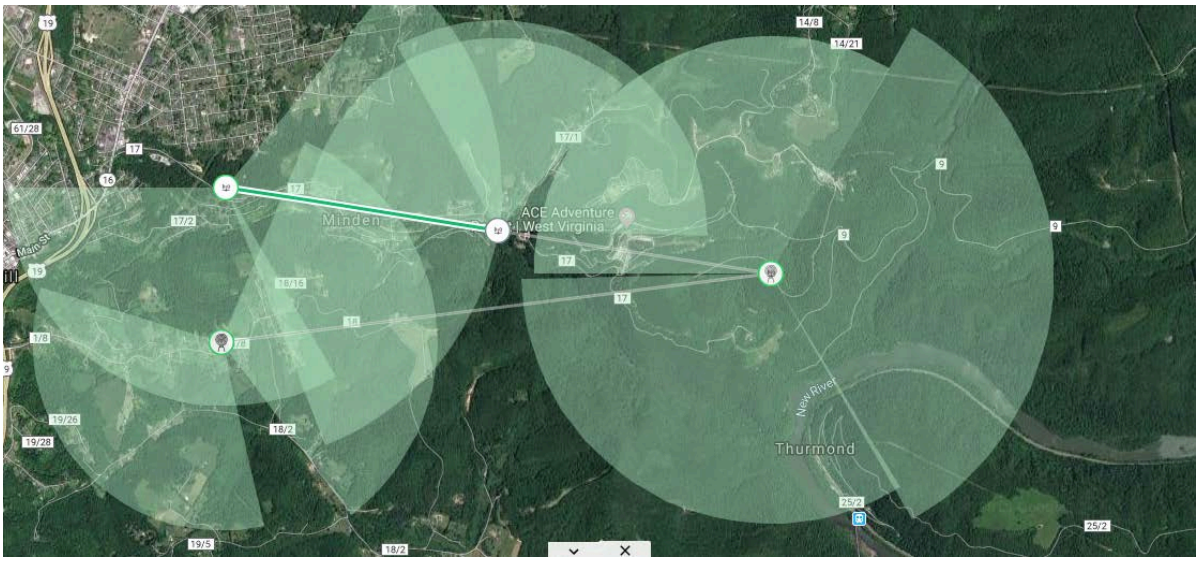
Fayette - Wolf Creek Fiber Cost Summary

0	ITEM/PROJECT	ESTIMATED
1	Fayette - Wolf Creek Fiber Construction Materials	$35,281.88
2	Fayette - Wolf Creek Fiber Distribution Labor	$53,955.00
3	Fayette - Wolf Creek Fiber Structures, Cabinets, and Equipment	$17,854.75
4	Fayette - Wolf Creek Fiber Drop Construction	$11,462.50
5	Network Construction Subtotal	$118,554.13
6	Project Management, Network Engineering, Integration, and Testing	$17,783.12
7	Engineering, Permitting	$2,963.85
8	Misc Fees, Advertising, Technical Services	$2,500.00
9	Bookkeeping and Administration	$750.00
10	Other Costs Subtotal	$23,996.97
11	Project Total	$142,551.10
12	Contingency at 10%	$14,255.11
13	Project Total (with contingency)	$156,806.21

12.9 HUD ELIGIBLE BROADBAND WIRELESS PROJECTS

Concho Tower Area

This project includes improvements at the existing Concho tower as well as three neighborhood poles. All improvements are located inside a HUD-eligible census block. Space on the Concho tower would be leased to a qualified WISP (Wireless Internet Service Provider), and space on the neighborhood poles would also be leased out to the WISP. The WISP would be responsible for placing their own access radios and point to point radio equipment. The illustration below shows the potential coverage area. The Concho tower is center right in the image, and the three neighborhood poles are to the left. The combination of the three community poles with their overlapping coverage area shows how the low cost poles can provide improved coverage when linked to a taller tower.



The table below provides an estimate of costs.

Community Poles in All HUD Eligible Areas

There are five HUD eligible areas in Fayette County, and they represent some of the most rural and poorly served areas as well. Because of the terrain in Fayette County, community poles will be needed in many areas to provide improved access even with more taller towers available to one or more WISPs.

If three to seven community poles were placed in each of the five HUD eligible areas, with an average of five pole per area, a total of twenty-five poles would provide much improved wireless broadband coverage. The table below provides the cost estimate for twenty-five poles.

The estimate assumes that poles would be placed in areas where electric service and road access is already convenient and would require minimal new construction. The poles are going to be located in or very near existing clusters of homes (where road access and power will be nearby).

Community poles should only be located where a WISP and/or the community has made a minimum customer subscription commitment for the improved broadband service.

1	ITEM/PROJECT	UNITS	BEST ESTIMATE	Total Cost
2	Site Development (Clearing, Road Improvements, etc.)	25	$1,000	$25,000
3	3x3 NEMA Box	25	$450	$11,250
4	New Power Service / Installation	25	$875	$21,875
5	60' Wooden Utility Pole Construction Materials	25	$3,000	$75,000
6	Miscellaneous parts and materials	25	$175	$4,375
7	Power System Installation Materials	25	$30	$750
8	DC Voltage Monitoring Device	25	$50	$1,250
9	Unmanaged Rack Mount PDU (6O)	25	$40	$1,000
10	60' Wooden Utility Pole Construction Labor & Contracting	25	$2,500	$62,500
11	Power System Installation Labor	25	$400	$10,000
12	Project coordination and management	25	$5,000	$125,000
13	Contingency (10% of costs)	25	$1,352	$33,800
14	Total:		$13,520.00	$338,000.00

12.10 FAYETTE COUNTY IMPROVEMENTS PROJECT COST ESTIMATE

In Fayette County, there may be up to four existing towers that may have space available for one or two WISPs. Based on the propagation study for the county, at least six additional 180' towers will be needed to provide additional coverage. The terrain is extremely difficult for wireless propagation, and the tall towers would have to supplemented by at least 30 "small cell" broadband community poles, which would extend the reach of the taller towers.

If the towers include a point to point backhaul network between towers, at least 12 point to point links (two radios, one on each tower) would be recommended to provide some redundancy. Adding several more links would improve overall redundancy at some additional cost.

Not all improvements listed in the table below would have to be completed at once, and it would be realistic to expect that this could take two to three years to raise funds and construct all of the items.

It is important to note that for existing towers, a site survey conducted with the cooperation of the tower owner is required to determine the suitability of a particular tower for WISP use.

Project Type	Estimated number of Items	Per Item Estimated Cost	Total
Improvements to existing towers	4	$26,375	$105,500
New towers of 180'	6	$170,887	$1,025,322
Small cell community broadband poles	25	$12,122	$303,050
Point to point tower backhaul links	10	$28,900	$289,000
Wolf Creek Park Fiber Improvements	1	$156,806	$156,806
		Total	$1,879,678

13 NETWORK OPERATIONS OPTIONS

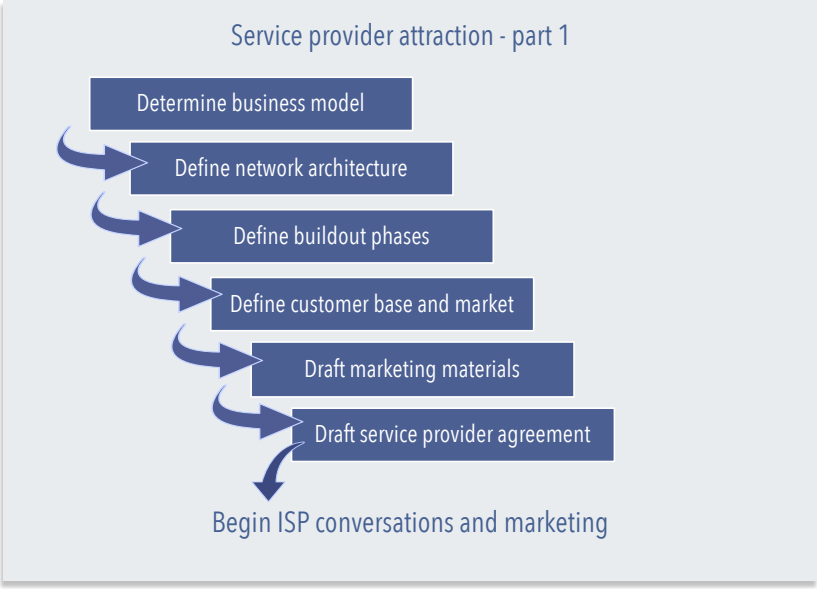
A variety of ongoing activities will have to take place once the first portions of the network are completed and ready for service.

- Network Operations – Dark fiber and conduit networks require little or no ongoing monitoring or support, but the project will have to have procedures and processes in place to receive notification of damage and to manage the repairs.
- Network Maintenance – Routine maintenance of a conduit/dark fiber network will be limited, but non-routine/emergency maintenance support must be in place as soon as the network has customers. Fiber is occasionally damaged (e.g. tree limb falling on aerial fiber, backhoe damaging buried fiber), and a qualified firm must be available to make repairs within two to four hours. This service is usually outsourced to a qualified private sector company.
- Business Administration – The network will have a relatively small number of retail customers at the start. Prudent and careful financial management is needed for accounts receivables and accounts payables, along with other normal bookkeeping activities--chart of accounts maintenance, bank deposits, check writing, and other tasks. A local accounting/bookkeeping firm should be able to handle the modest bookkeeping and accounting tasks on a part time basis, or a project member with bookkeeping experience could handle most of the routine bookkeeping tasks. An accounting firm will be needed to prepare certain kinds of financial reports and to provide fiscal oversight. The network revenue and direct expenses should be maintained as a separate set of financial records from the parent organization to provide complete transparency about the financial position of the project.
- Marketing and Awareness – An ongoing modest awareness/marketing campaign is required to ensure that businesses and residents are aware of the effort and its benefits.

13.1 ATTRACTING PROVIDERS

The Wireless Internet Service Provider (WISP) business is challenging. Setting the high cost of towers aside, a WISP placing equipment on a newly available tower must engage in a significant marketing and sales effort to identify customers who want service. Because most broadband wireless frequencies, including the new LTE frequencies, require or work best with line of sight between the customer and the tower, the WISP, even after identifying a potential customer, must often send a technician to the prospective customer location to determine if line of sight or near line of sight is available. It is common that a low hill, a building, trees, or other vegetation will degrade or block the signal.

If line of sight or near line of sight is available at the customer location, a second visit to install the customer antenna may be required before the customer can receive service. At this point, the WISP may have spent several hundred dollars on the acquisition of a single customer, and it can take many months of service before the WISP will even break even.



The cost of tower access be one of the most expensive parts of offering wireless Internet service. If a WISP has capital funds, it must choose where to place towers and smaller poles very carefully, and few WISPs have the capital to build enough towers to cover an entire county.

Just as government builds roads to enable commerce and services offered by the private sector, local government can also build towers to enable Internet services. Space on those towers is offered to WISPs for modest fees with the goal of expanding and improving Internet access.

Historically, tower space lease fees have been high because early lessees were cellular companies offering high margin cellphone and data services. Vertical space on a county-owned tower or water tank often range between $1200 and $2500 per month. But the business margins on fixed point wireless Internet are much lower, and tower lease fees should set at levels that allow WISPs to make a business case to spend the additional capital for radios and related equipment on a new tower.

Working With WISPs

- The County should have a single public fee schedule for all providers.
- The County should have 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.
- If a WISP is applying for space on an existing tower, no certified engineering plans should be required, but if a structural analysis is needed to determine wind and tower loading will not exceed tower specifications, the County may have the WISP bear some or all of the cost of that study. Note that there appears to be high variability in the cost of these studies, and the County should be careful to keep the structural analysis costs as low as possible.
- If an existing shelter is available at the base of a tower and rack space for WISP equipment is available within that shelter, electric power should simply be provided as part of a very modest lease fee for rack space. If there is no space available in the shelter (e.g. lack of space or dedicated for public safety use), then the WISP should just install an H-frame and have their own electric meter installed in an area designated by the County at the base of the tower.
- 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.
- The County should offer an initial grace period on fees of three to six months, 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 County to potentially make a smoother transition to a new provider if there are issues, and will give them more leverage and control over the service.
- In contracts, fee reductions should be worded as discounts that can be revoked by the County if performance requirements are not adequately being met.
- The County should describe what is available for ground-space (e.g. WISP cabinets, shelters, H-frames for electric service) that may be provided by the County (e.g. a shared generator) and/or indicate what the WISP has to provide at the base of the tower. If new shelters will be allowed, the County should set minimum standards for new shelters.

Managing WISP Risk

The low household density in many area of Fayette County means that there may only be one or two (at most) WISPs interested in leasing tower space. This introduces the risk of a de facto monopoly for wireless broadband service. Over time, the dominant WISP may be able to raise rates more often than needed because of limited competition, offer mediocre customer service, and/or provide poor quality Internet service.

There are several strategies to minimize these risks:

The contracts with WISPs should have well defined performance requirements that are specific enough that the County (or URA) can regularly monitor and assess performance.

The contract performance requirements should be strictly enforced.

WISPs should be required to attend a twice yearly performance review in which any performance issues and recurring customer complaints can be addressed.

Where grant funds are used to develop new towers or fiber assets, the County should retain ownership of those assets over the long term. Where a WISP contributes cash to a grant proposal, those funds should be spent on network equipment and similar assets that need to be managed by the WISP or fiber service provider rather than the County. This provides for distributed ownership needed to encourage service providers to offer excellent service at fair prices.

13.2 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**

13.3 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).

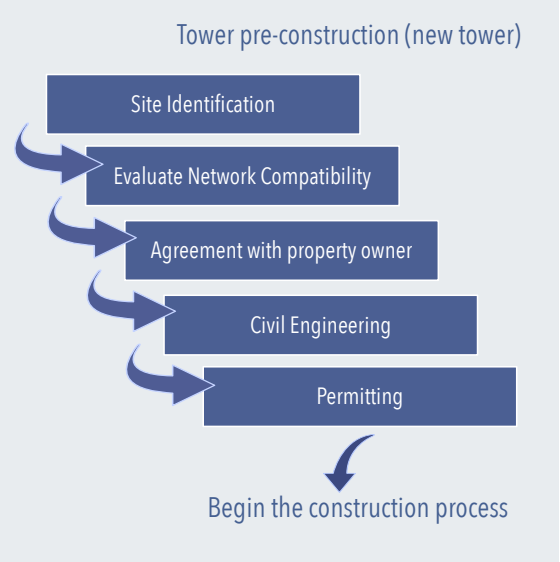
If several towers are available (e.g. three, four), there will be some efficiencies gained in costs so that revenue would likely exceed expenses–costs like legal services and insurance will not increase proportionally with more than one tower.

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**

13.4 TOWER SITE IDENTIFICATION

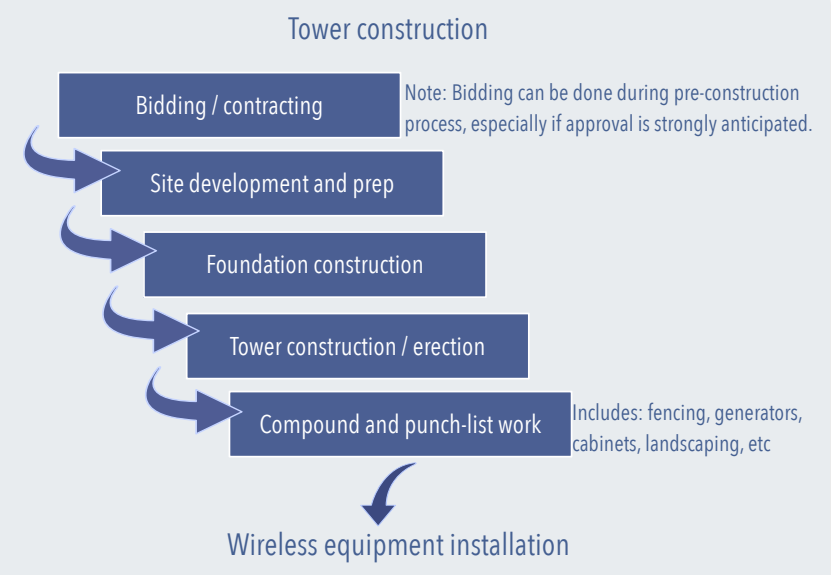
When a site for a new tower is being considered for use, the diagram below illustrates the steps that need to be followed. For example, if an existing public safety tower or an existing cellular provider tower may have space for fixed point wireless broadband equipment (i.e. co-location).



- 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.

13.5 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.

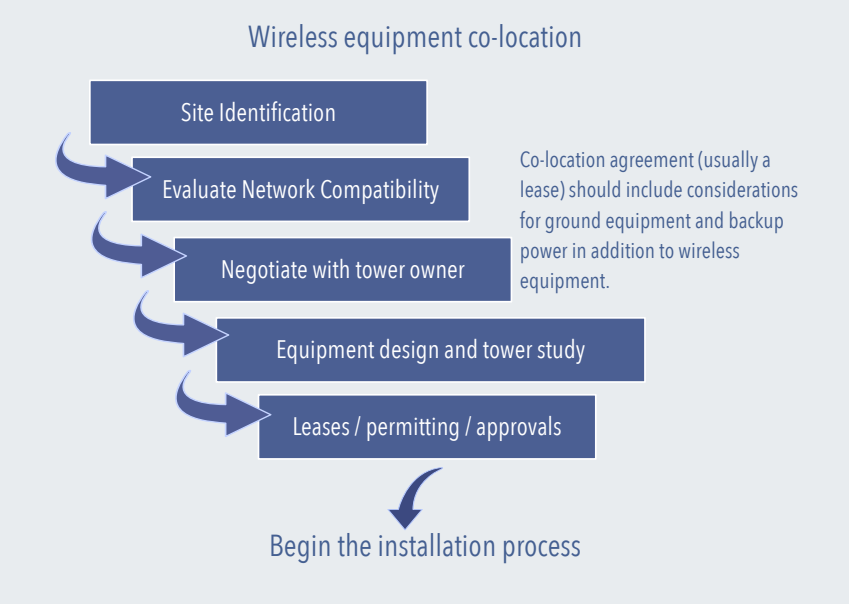


- Bidding and contracting – Bid documents and construction specifications have to be prepared and sent to candidate contractors. Once bids are received, proposals have to be reviewed, and depending upon funding sources, may require review by local government and/or a funding agency prior to awarding 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.

13.6 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).

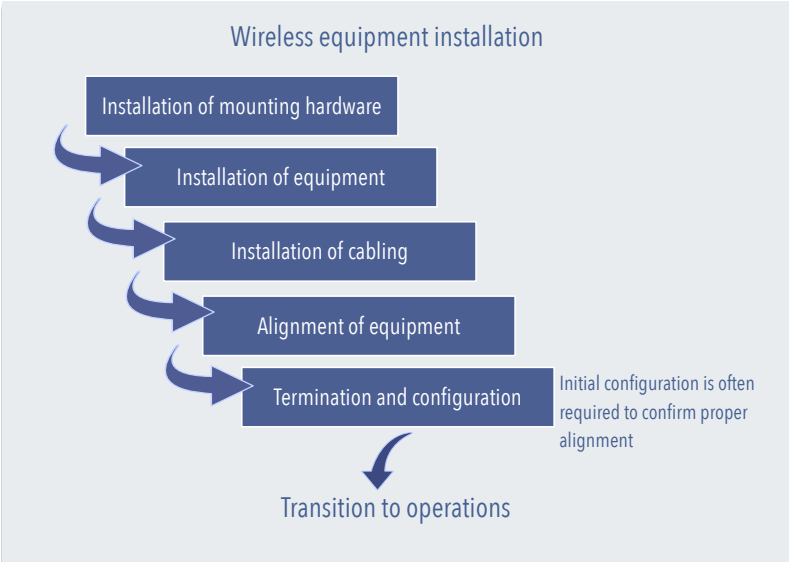
- Site identification – Identify areas of poor service and look for existing towers.
- Network Compatibility – If there are towers in the service area, the first step is to determine if a minimum of ten vertical feet of space is available at an appropriate height for broadband wireless equipment. A wireless 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.

13.7 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.

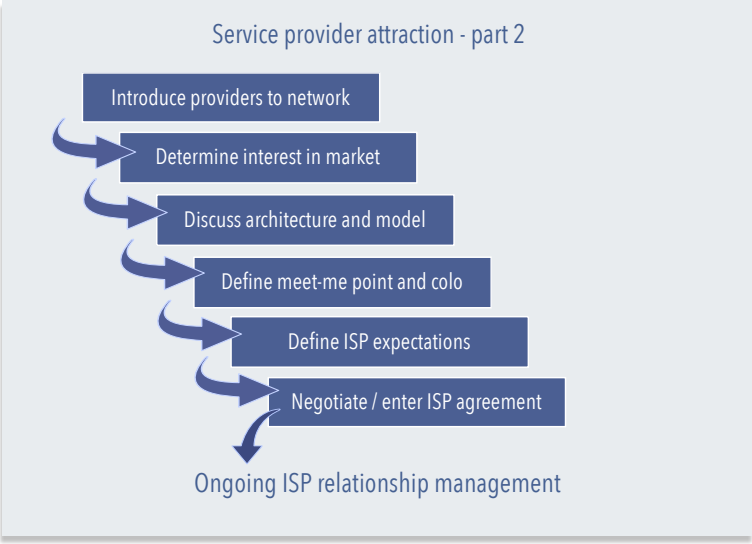


- Mounting hardware – Brackets and other mounting hardware have to attached to the tower at the designated height. This requires a tower climb conducted by a firm with trained tower climbers.
- Equipment installation – Once the mounting hardware is in place, radios are attached to the tower. On the ground,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

13.8 TOWER MANAGEMENT

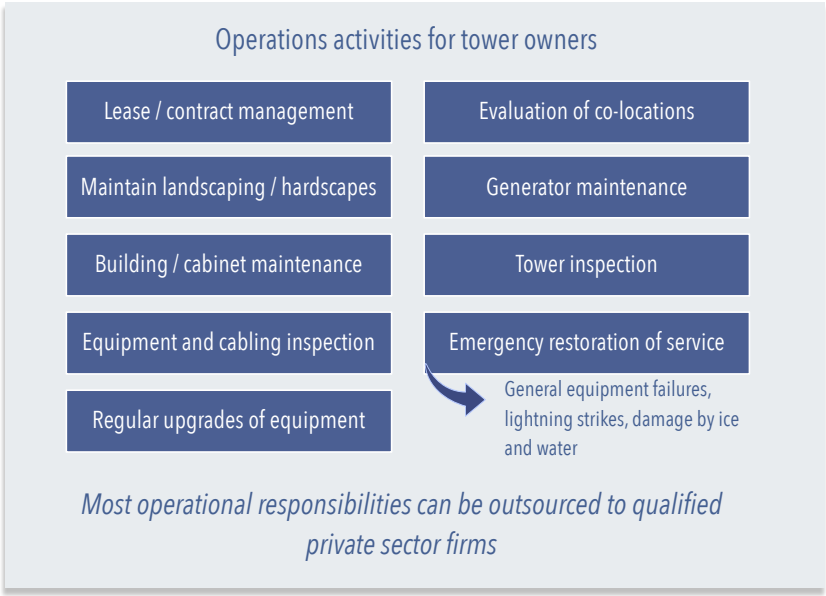
A modest application fee (e.g. $200) for tower access should be nominal for WISPs; high application fees discourage WISPs from evaluating new tower opportunities.

Revenue sharing arrangements instead of a fixed lease fee are more difficult to manage. While the argument for revenue sharing seems to make sense (i.e. WISPs pay as they acquire customers), in practice, it requires the tower owner to have access to the accounting and financial records of the business, which can be challenging to enforce. It is also a financial disincentive for the WISP, as the fees that they have to pay for tower access continue to increase without end.



- Use a single public fee schedule for all providers.
- Use a single tower space agreement for all providers.
- Tower access should be made available in ten foot vertical segments or on a per attachment basis, 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.
- If a WISP is applying for space on an existing tower, no certified engineering plans should be required, but if a structural analysis is needed to determine wind and tower loading will not exceed tower specifications, the tower owner may have the WISP bear some or all of the cost of that study. Note that there appears to be high variability in the cost of these studies, and the tower owner should be careful to keep the structural analysis costs as low as possible.
- For a typical tower, identify two (2) ten foot spaces (where space is available) on existing towers and designate/reserve those for WISP use. The spaces should be as high as possible on each tower without interfering with other local government and public safety use. The lease cost of the lower space should be at least 20% less than the higher space. Tell WISPs exactly what space is available at each tower and at what heights; this makes it easier for WISPs to evaluate the potential market that could be served from each tower.
- If an existing shelter is available at the base of a tower and rack space for WISP equipment is available within that shelter, electric power should simply be provided as part of a very modest lease fee for rack space. If there is no space available in the shelter (e.g. lack of space or dedicated for public safety use), then the WISP should just install an H-frame and have their own electric meter installed in an area designated at the base of the tower.

- 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 service area (e.g. county) with lower population density.



- Monthly tower lease fees should be on the order of $200 to $250 per tower or an equivalent per attachment fee (e.g. $50-$75 per attachment). 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.
- Consider offering an initial grace period on fees of three to six months, 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 tower owner to potentially make a smoother transition to a new provider if there are issues, and will give them more leverage and control over the service.
- In contracts, fee reductions should be worded as discounts that can be revoked if performance requirements are not adequately being met.
- Describe what is available for ground-space (e.g. WISP cabinets, shelters, H-frames for electric service) that may be provided (e.g. a shared generator) and/or indicate what the WISP has to provide at the base of the tower. If new shelters will be allowed, set minimum standards for new shelters.

13.9 OPERATING A DARK FIBER NETWORK

As a network is completed (e.g Wolf Creek Park fiber expansion) 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 Wolf Creek Park, this would be located in a cabinet near the entrance to the Park.
- Hand holes and vaults - These are part of the fiber network.

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.

13.10 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.

13.11 ASSET MANAGEMENT

A primary role of the project will be to manage assets owned directly. These assets will include conduit, fiber, cabinets, 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.

13.12 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.

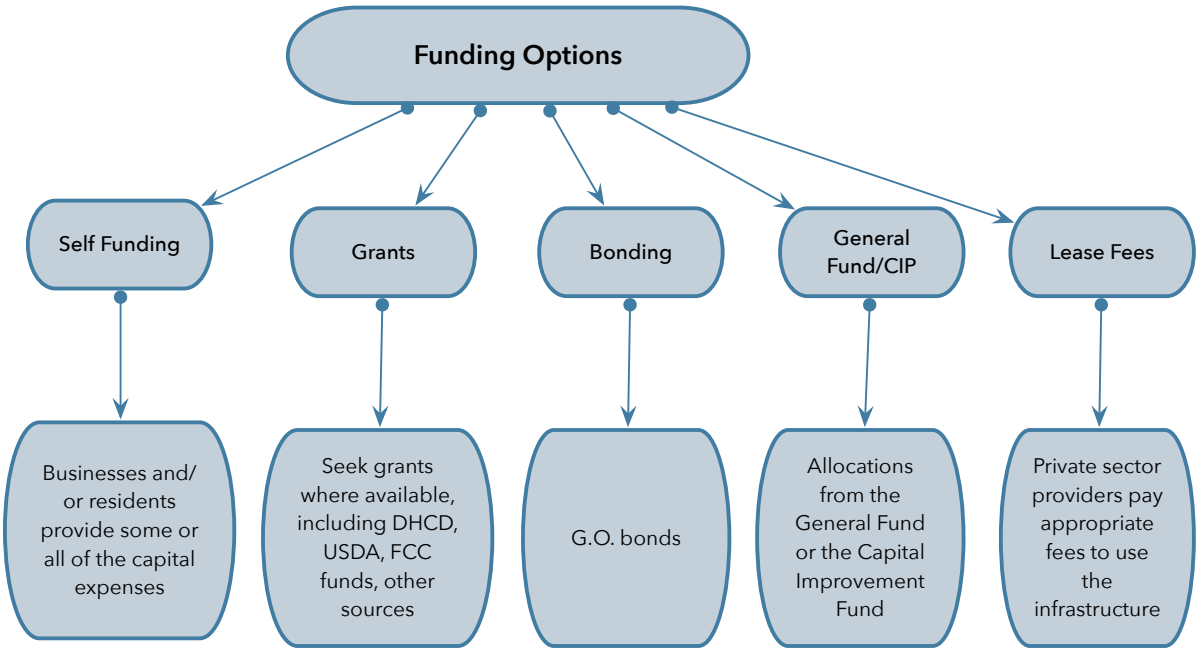
- Identification of state and Federal laws that may affect operations.

- 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.

14 PRELIMINARY INFRASTRUCTURE APPLICATIONS AND FUNDING

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.

WV 2019 broadband Expansion Act

In early 2019, the West Virginia legislature has been evaluating legislation named the Broadband Expansion Act (House Bill 2005, and Senate Bill 3). The statute is designed to make it easier and less expensive to build broadband infrastructure in underserved parts of the state. The bill has three major parts:

It creates the "Wireless Technology Business Property Valuation Act," which would make it less expensive for telecommunications and broadband internet companies to build more towers, particularly in rural parts of the state. The tax treatment of the towers would be changed to reduce property taxes on the towers–making it less expensive to build and maintain those towers.

The bill would also include a "Make-Ready Pole Access" provision. This portion of the law would require electric utilities companies to evaluate using their utility poles to expand broadband access.

The bill also creates the "West Virginia Small Wireless Facilities Deployment Act," which would make it easier for ISPs and cellular providers to use the state's existing rights of way and utility poles to place the next generation of wireless and broadband technologies. 5G services could be deployed more quickly in West Virginia if this is included in the final bill.

Both the West Virginia House and Senate have voted in favor of a combined bill (HB 2005 and SB 3), but the bill was still not passed into law as of late February (2019).

Coop Membership Fees

Coop members 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 county a way to self-finance a substantial portion of the initial network, as well as providing a long term framework for expansion.

ARC Power Grants

Fayette County qualifies for ARC (Appalachian Regional Commission) grants. POWER (Partnerships for Opportunity and Workforce and Economic Revitalization) is a congressionally funded initiative that targets federal resources to help communities and regions that have been affected by job losses in coal mining, coal power plant operations, and coal-related supply chain industries due to the changing economics of America's energy production.

The Appalachian Regional Commission uses an index-based county economic classification system to identify and monitor the economic status of Appalachian counties. The system compares each county's averages for three economic indicators—three-year average unemployment rate, per capita market income, and poverty rate—with national averages. The resulting values are summed and averaged to create a composite index value for each county. Each county in the nation is then ranked, based on its composite index value. Counties are designated as distressed, at-risk, transitional, competitive, or attainment, based on their ranking in the index. Designations are revised annually using the most current data available. Morgan is currently ranked as "transitional" for 2019.

The three counties should consider applying for this grant opportunity. To get started, the CCRBDC should contact the state ARC program manager to request a pre-application package. The local development district can also provide guidance on a project's eligibility for funding and assistance in preparing a grant application. More information is available here (https://www.arc.gov/funding/ARCGrantsandContracts.asp) and here (https://www.arc.gov/funding/power.asp).

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 West 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).

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. Applications are due by April 29th, 2019. 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 Fayette County could generate funds to support additional broadband towers and community poles. See the tables above in the Special Assessment section of this chapter.

Opportunity Zones

An Opportunity Zone is an economically-distressed community where new investments, under certain conditions, may be eligible for preferential tax treatment. Localities qualify as Opportunity Zones if they have been nominated for that designation by the state and that has been approved by the Internal Revenue Service. Opportunity Zones are designed to create tax incentives for private investors to make investments that can encourage economic development and job creation in distressed communities. Opportunity Zones would be of most use for Internet Service Providers who could use the tax benefits to make a business case to improve Internet access in a qualifying area (zone).

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).

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.

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 fiber connections to every home and business in the County.

A lesser amount (e.g. $2/month over twenty years) would easily finance the immediate build out of a comprehensive wide area wireless tower network in Fayette County, as well as some fiber infrastructure.

Fayette County Special Assessment (all 17,697 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
$1	$4,247,280	$6,370,920
$2	$8,494,560	$12,741,840
$5	$21,236,400	$31,854,600
$10	$45,511,200	$68,266,800

If a county-wide assessment is not considered feasible, it may be possible to identify individual areas of the county where a majority of residents agree to a special assessment, similar to the way that Home Owner Associations (HOAs) impose special assessment for sub-division repairs and improvements.

On a small scale, community poles to improve fixed broadband wireless service to a cluster of homes could be easily financed with a $10/month, five year assessment ($120/year).

Individual Service District Examples					
Monthly Assessment Amount	Twenty Homes Five Year Assessment	Fifty Homes Five Year Assessment	Fifty Homes Ten Year Assessment	100 Homes Five Year Assessment	100 Homes Ten Year Assessment
$5	$6,000	$15,000	$30,000	$30,000	$60,000
$10	$12,000	$30,000	$60,000	$60,000	$120,000
$25	$30,000	$75,000	$150,000	$150,000	$300,000
$50	$60,000	$150,000	$300,000	$300,000	$600,000

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.

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 is limited and 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.

The state of West Virginia has been providing both planning funds and some implementation funds to localities. This could be an important source of initial funding for Fayette County.

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.

APPENDIX A: GLOSSARY

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.

Gigabit: One thousand Megabits

GPON: A newer PON (Passive Optical Network) equipment design that provides improved bandwidth and performance over older PON network equipment.

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.

Megabit: One thousand bits

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.

PON: A Passive Optical Network uses optical splitters to distribute the optical signal to homes and businesses. PON networks require less powered network equipment near customers, which reduces costs. PON networks also use less fiber, which also reduces costs, especially in rural fiber deployments where the homes per road mile is relatively low. Older PON network equipment designs have been replaced by new GPON (Gigabit PON) equipment that provides more bandwidth to customers and performs nearly as well as Active Ethernet.

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.