BROADBAND FOR THE GILBERT AREA OF MINGO COUNTY

Broadband Assessment and Plan

DESIGN NINE
broadband planners

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1 STUDY GOALS

This broadband study had a goal of developing recommendations for improved and affordable broadband service in five areas of Mingo County:

- Town of Gilbert
- Gilbert Creek
- Justice
- Horsepen
- Wharncliffe

There are seven documents that constitute the full study:

- Broadband Recommendations – this report.
- Town of Gilbert Technical Design – technical network design details for the network in the town.
- Gilbert Creek Technical Design – technical network design details for the network in Gilbert Creek.
- Justice Technical Design – technical network design details for the network in Justice.
- Horsepen Technical Design – technical network design details for the network in the Horsepen area.
- Wharncliffe – technical network design details for the network in the Wharncliffe area.
- Vendor Details – specifications and information on equipment used to develop the network designs and cost estimates.

1.1 SUMMARY OF RECOMMENDED INFRASTRUCTURE IMPROVEMENTS

If all the infrastructure recommendations in the following sections are built out as described, the table on the next page summarizes the total cost wireless networks in each of the five study areas. Each network would be capable of delivering 25 Meg down/3 Meg up Internet service, and would support symmetric service (e.g. 10 Meg down/10 Meg up) needed by some businesses and/or work from jobs.

Given the size of the individual projects and the expected effort and time needed to raise funds and to apply for grants, a minimum of nine to twelve months should be anticipated to plan, fund, and construct all poles and backhaul connections. Some residents and businesses could begin receiving service within the first year.

The map on the following page shows the network, with more detail in the separate network design documents and in following sections in this document. The terrain in the Gilbert area of Mingo County is very difficult, with most homes and businesses clustered along river and creek valleys with higher hills on each side that block wireless signals. Because of the winding nature of the roads in the area, many community poles are required because line of sight along the roadways is very limited.

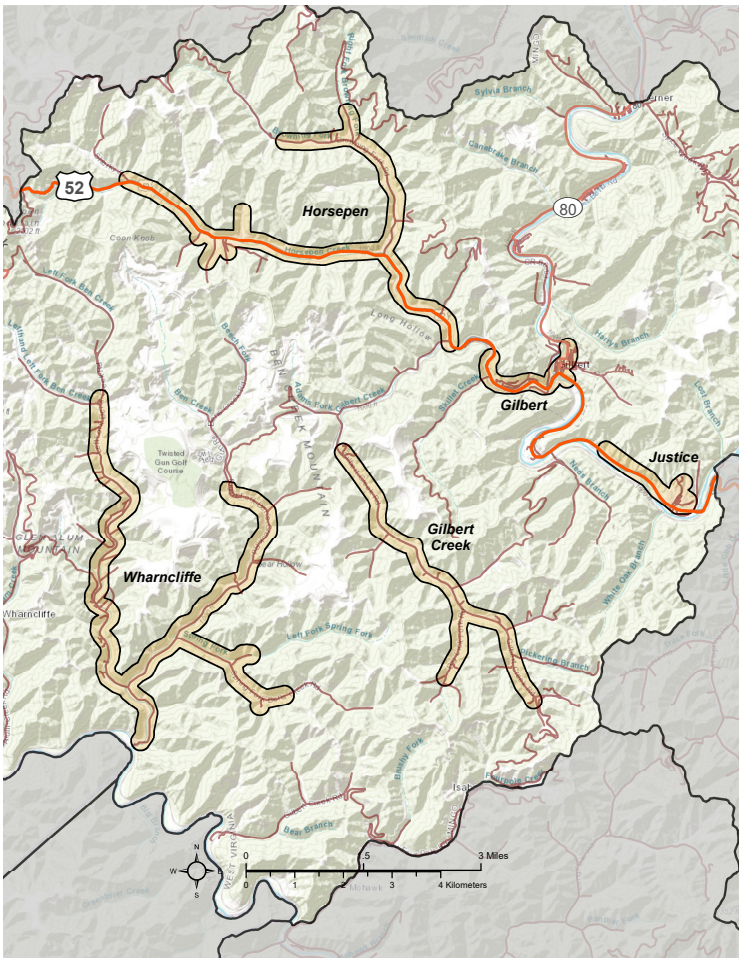
Project Type	Total
Gilbert	$138,151
Gilbert Creek	$311,827
Horsepen	$361,137
Justice	$43,607
Wharncliffe	$713,279
Gilbert Downtown Wifi	$81,264
Public Safety Wifi (2APs per Network)	$33,130
Total Estimated Cost	$1,682,395

It is important to note that applying for a grant for any of the five areas will likely include additional time for grant preparation and grant review by the granting agency. The time needed for these two activities will vary but could be between three and nine months.

The equipment and vendors in the network design were selected to provide accurate cost estimates using off the shelf, widely available components. There are other vendors available with comparable performance and pricing that could be substituted as needed.

There are two challenges for this effort that will require attention if funding efforts move forward:

- Connectivity between the five study areas is not straightforward. The terrain is difficult with very poor line of sight for wireless connections. It may actually be less expensive to run fiber (aerial or underground) between the communities to create a single network.
- A decision will have to made about providing Internet access via a private provider or as a community utility.



2 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.

In many areas of West Virginia, the low population density may require some state and local government infrastructure investment to attract private sector service providers.

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.

3 TECHNICAL ANALYSIS AND CONNECTIVITY SOLUTIONS

3.1 OVERVIEW OF THE TECHNOLOGY

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

Businesses and residents in the county may obtain Internet service:

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

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

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

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

More larger towers of 180' to 300'

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

Small cell broadband utility poles

Small cell broadband utility poles, 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 Mingo County, these are going to be an important part of a strategy to get better broadband to rural residents and businesses.

Variety of radio frequencies

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

3.4 EMERGING WIRELESS TECHNOLOGIES

MIMO Wireless

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

New hardware is required to make effective use of MIMO. While the technology increases wireless bandwidth, the typical amount of bandwidth being used by wireless devices is also increasing rapidly. Some applications where MIMO is likely to provide noticeable improvements are in home wireless routers, where the effective throughput will be able to better handle the demanding bandwidth

requirements of HD and 4K video streams. MIMO is slowly being developed for use with cellular smartphones, but both the phones and the cell tower radios have to be upgraded to support MIMO.

LTE/4G/5G

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

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

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

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

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

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

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

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

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

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. If, as an example, about 25%, or 172 square miles of Mingo County is underserved, a thousand or more cell sites would be needed to provide ubiquitous coverage.

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

White space broadband

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

3.5 DARK FIBER AND LIT FIBER

About Dark Fiber

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

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

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

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

About Lit Fiber

A "lit" fiber network includes the network electronics needed to transmit data over the fiber (using the small lasers in a fiber switch, hence there is light traveling over the fiber cable). In a lit network, "lit circuits" are leased out to service providers rather than fiber pairs. The muni/local government/community network provides the network electronics, which reduces costs for the service provider—meaning they are able to pay higher lease fees for the circuits they use to deliver services (like Internet) to their customers. Lit networks generate more revenue, but also have higher expenses because the

network electronics have to be monitored and managed on a 24/7/365 basis (this task can usually be outsourced at reasonable cost). However, very small fiber deployments often do not pass enough homes or businesses to generate sufficient revenue to cover the higher costs.

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

3.6 TERRAIN CHALLENGES

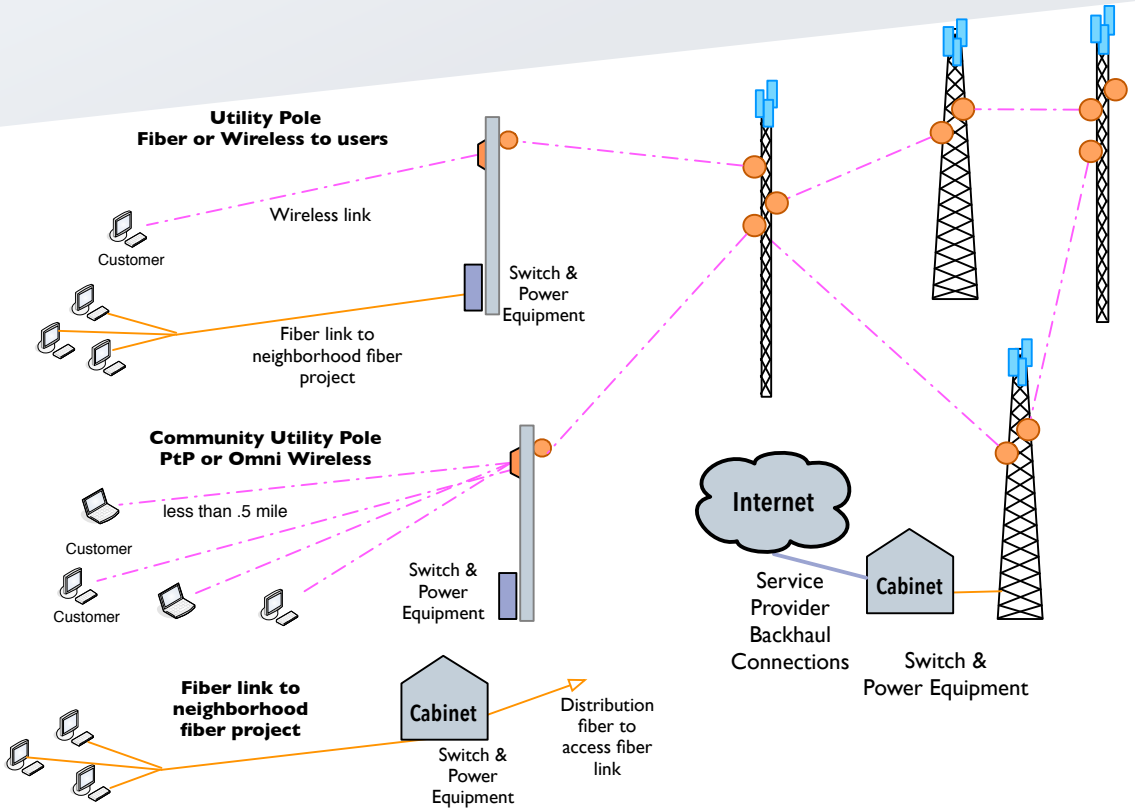
The propagation study map below illustrates the challenge of providing adequate fixed point wireless Internet service in the county. The mountainous terrain throughout the County shows that many towers and community poles will be needed to near an adequate solution using fixed point broadband wireless. In some areas, the difficulty of obtaining line of sight for a radio link between two locations may dictate using fiber in place of wireless. As an example, in Richwood, West Virginia, a group of about seventy-five homes along two and a half miles of road led to a fiber to the home solution that was less expensive than broadband wireless, primarily due to the cost of bringing electric service to many community poles. A combination of taller towers and shorter community poles (as many as 40 or 50 in the study areas of this report) may be needed to provide good service to most areas of the county.

3.7 CONNECTIVITY SOLUTIONS

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

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

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



Access

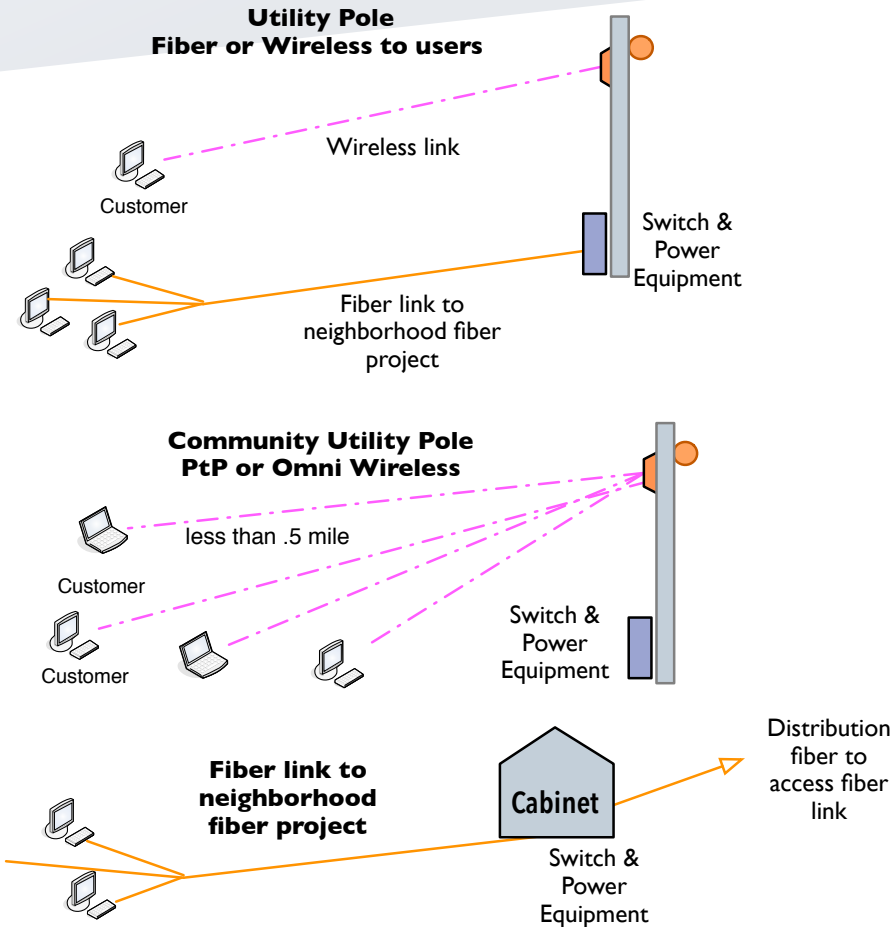
The Last Mile Access is the portion of the network that connects customers to their service provider and the Internet. Both broadband wireless and fiber links can be utilized to provide service. There are several ways that customers can receive service:

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

Distribution Network

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

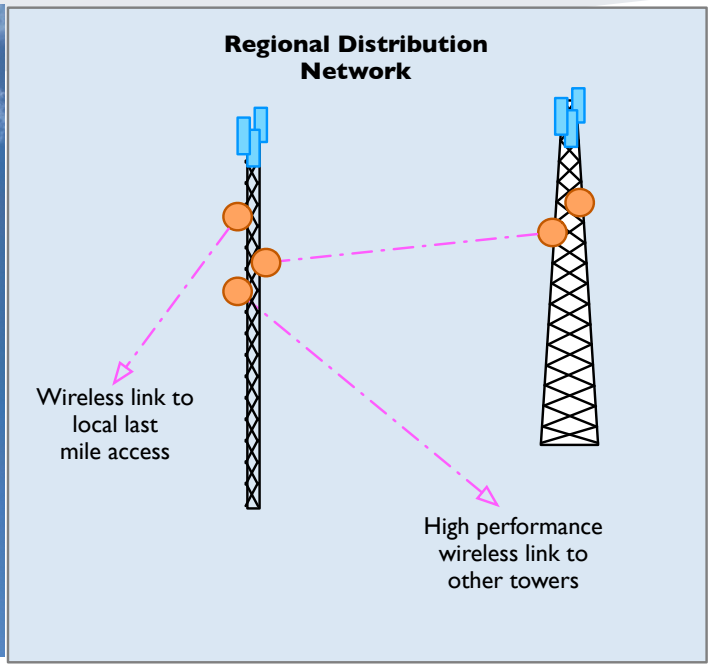
These tower sites are typically 120′ to 180′ tall to provide the height needed to enable Line Of Sight (LOS) between towers, and for local access, to enable service providers to mount point to multi-point radios on the towers.



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

The towers can provide two functions:

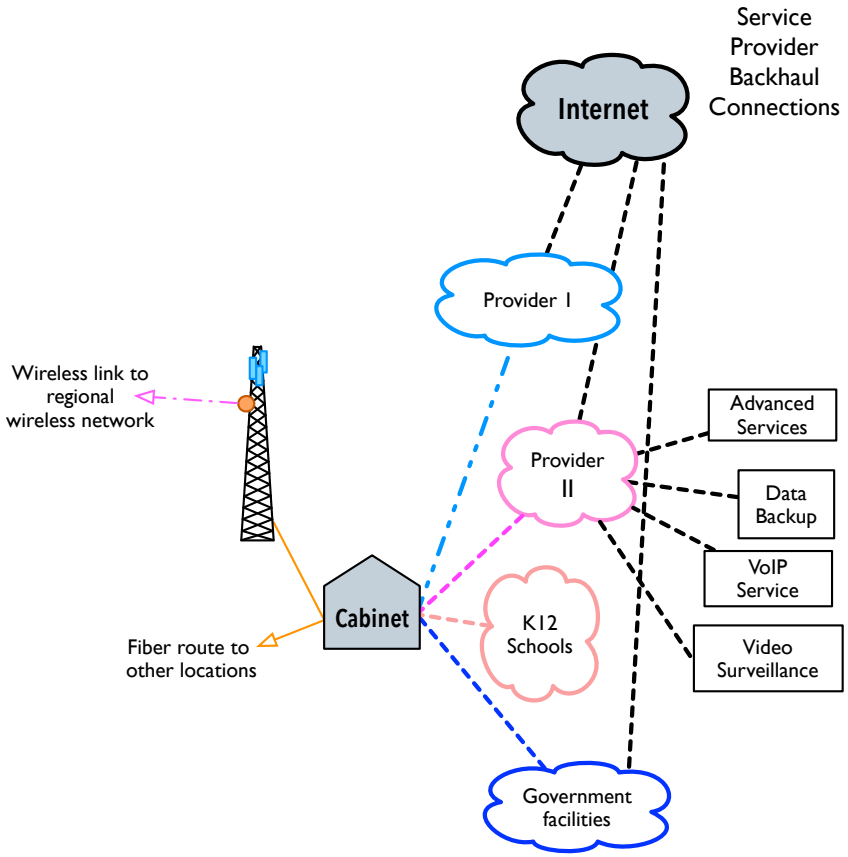
- Space for backhaul connections to other towers in the county.
- Space for local access radios to provide Internet access within 2-3 miles of the tower (or farther with good Line Of Sight).



Core Network and Service Providers

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

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



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

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

In the study areas, this function can be met by space in the Gilbert Town Hall.

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 is desirable.
- Controlled access to the facility (e.g. by electronic keycard) 24 hours/day, seven days a week. Service providers need to be able to gain access to the equipment room as needed, and work activities performed at night or on weekends is common.
- 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. Equipment rooms require both a cool air input vent and an air return vent.

3.8 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.

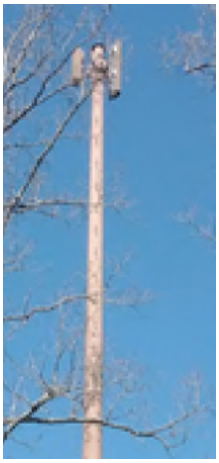
The increased use of wooden utility poles is already common in some other areas of the country, and increased use of this technique to get the customer CPE radio/antenna above tree cover is a relatively simple solution.

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.

Recommendation and Next steps

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

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

3.8 NANO-CELL AND WIFI CALLING SERVICE

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

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

Nano-cell Calling – Poor or no cellular service in rural areas can be addressed by promoting the wider use of "nano-cell" devices. These small pieces of equipment are connected to the DSL or wireless broadband connection and provide improved cell service in the home or business. The working distance of these devices is limited, and service generally drops off once you leave the house itself (it may work for some short distance in the yard). These devices work very well and do not require an upgrade to a newer phone.

The cellular providers do not always promote the use of these devices, so many cellular users who would benefit from their use are not aware that this option is available. The device averages around $200 retail, but the cellular providers often provide substantial rebates (50% discount or more) and in some cases may provide them at no charge.

The improved wireless broadband service will also support use of WiFi calling and/or nano-cell devices.

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

4 GAP, MARKET, AND CURRENT USE ANALYSIS

4.1 CURRENT BROADBAND ENVIRONMENT

Our service provider report provides key insights into the services currently available in Mingo County. It also provides data that show which zip code areas are most impacted by poor Internet service and/or the lack of Internet Service provider options.

Seven of your twelve zip code areas have 25% or less coverage of services that provide at least 25 Mbps download speeds. Though King Street Wireless is listed as available in three of your zip codes, calls to the service provider have gone answered and we have not been able to verify service availability. Nine more zip codes have no fixed wireless Internet Service Providers even listed. Five of your zip code areas have 25% or less residents with access to cable services. Seven of your zip codes have more DSL coverage than cable. Very few of your residents have real choice in broadband.

The average household in the United States pays $67 per month for Internet in their home. Usually rural areas either pay more and/or get a lot less for their money.

One of the significant recent trends is using a smartphone as your sole Internet connection. Smartphones have become a substitute for wireline Internet services. According to Telecompetitor, the average home used 268.7 GB of data in 2018. That was an increase of 33% over the previous year. Assuming the same increase from 2018 to 2019, the average monthly data usage in 2019 would approach 30 GBs which is above many cell phone plan limits. A single smartphone with an unlimited data plan can be found for $70 plus fees and taxes per month. However, there may be significant limitations on speeds after 22 GBs of data in congested areas. However price and availability outweigh the disadvantages for many. According to a June 2019 Pew Research Center Report, "37% of Americans now go online mostly using a smartphone, and these devices are increasingly cited as a reason for not having a high-speed internet connection at home." Cost of regular broadband services is also one of the reasons people use their smartphones. AT&T which we have used in our graph has average speeds of 37.1 Mbps download and 12.9 Mbps upload in Mingo County. However, averages especially for cell phones can be misleading for specific areas.

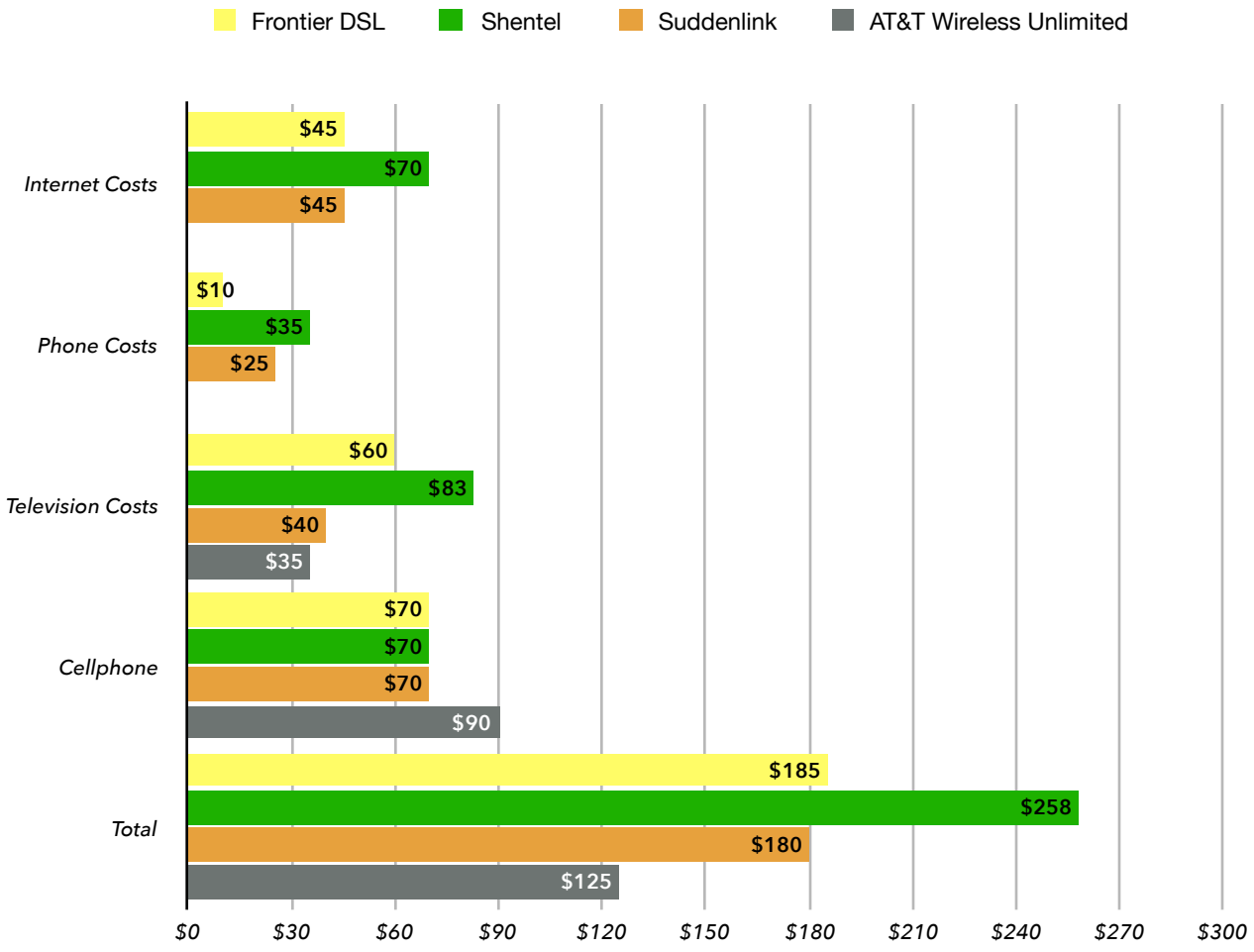
Using the best available data, we have constructed a graph showing sample communication costs for families receiving the Internet in different ways in Mingo County. In order to make comparisons accurate we have included sample cell phone costs in the total.

Mingo County does have DSL meeting advertised download speeds of better than 25 Mbps. We have used Frontier DSL for the representative DSL costs but speeds are very slow at best. Shentel cable is the most widely available cable services and does have wireline services exceeding both 25 Mbps download and 3 Mbps upload specifications. Many of the rates are promo rates that will go up. We have also included in the graph Suddenlink Cable which has a package that exceeds the 25/3 minimum and is available in four zip codes. We use non-promo prices in our graph whenever possible.

Even assuming they are okay with the speed and choice on the lowest priced services we found, your typical Mingo County family using the least expensive wireline services, SuddenLink, that meet 25/3 guidelines would spend $2160 annually for Internet, TV, phone, and/or cellphone. That price compares to $1500 for using a cellphone which likely would not meet the 25/3 speed guidelines. Also that $1500

annually does not include all the extra fees that cellphone companies typically add. There could also be data overages that a typical family might face if they picked the wrong plan. Some estimates have the average US unlimited cell phone plan with hardware costing as much at $115 monthly.

Our graph shows communication costs for families receiving the Internet in different ways in Mingo County. For sake of comparing Frontier DSL services to other bundle services, we have added satellite TV costs. AT&T's Unlimited and More plan with additional access for a tablet comes with a 15 GB hotspot. There are significant streaming and data limitations on the AT&T and More plan. However, it appears to be the best package for someone using their phone as their only Internet access. The Direct TV package which we added to the AT&T package for television is a promo price. While the AT&T package is cheapest, the only phone included is one cell phone. Other bundled packages, Frontier, Shentel and Suddelink have a standard telephone plus a cell phone. ***The average monthly cost of the services presented on the graph in Mingo County is from $125 a month to $258 per month***.



Zip Code Data

Zip Code data or Zip Code Tabulation Area information (ZCTA) was compiled using the Melissa website with all population data coming from the 2010 US census which is the most recent for which ZCTA data is available. ZCTA is the geographic unit closest to a zip code for which the US government provides population data. It is an approximation of what is available. Percentages within the county are based on number of US post office addresses that are actually within the county.

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

Zip/ ZCTA	USPS Town	% House-holds in the Zip	DSL	Cable	Fixed Wireless	25 Mbps Coverage	2010 Pop.	Land-Sq-Mi	Density Per Sq Mi
24846	ISABAN	20%	38.5%	0%	0%	0%	244	7.16	34.09
25608	BAISDEN	100%	100%	100%	0%	100%	1,004	13.73	73.14
25621	GILBERT	100%	100%	81%	46.8%	81%	2,155	45.63	47.23
25650	VERNER	90.5%	100%	0%	81.2%	0%	547	24.34	22.47
25651	WHARNCLIFFE	100%	97%	0%	37.2%	0%	737	25.15	29.30
25661	WILLIAMSON	100%	100%	39%	0%	39%	6,837	58.22	117.44
25666	BREEDEN	100%	0%	0%	0%	0%	654	28.47	22.97
25670	DELBARTON	99.6%	95%	73%	0%	68%	5,829	93.78	62.16
25671	DINGESS	100%	69%	3%	0%	3%	1,286	31.50	40.83
25672	EDGARTON	100%	0%	70%	0%	0%	408	8.57	47.62
25674	KERMIT	39.2%	95%	67%	0%	67%	3,202	44.94	71.26
25676	LENORE	100%	98%	25%	0%	25%	1,250	29.34	42.60
25678	MATEWAN	100%	78%	100%	12.7%	32%	1,595.00	25.34	62.96
25690	RAGLAND	100%	100%	0%	0%	0%	249.00	1.76	141.88
25692	RED JACKET	100%	44%	100%	0%	22%	1,021.00	9.93	102.81
25696	VARNEY	100%	78%	100%	0%	32%	1,021.00	9.93	102.81
25699	WILSONDALE	7.6%	0%	0%	8.5%	0%	295.00	1.96	150.20

Internet Service Providers & Percent Zip Code Coverage

Zip Code	USPS Town	FRONTIER DSL	LUMOS	INTERMOUNTAIN CABLE	SHENTEL CABLE	SUDDENLINK	XFINITY	KiNG ST WIRELESS
24846	ISABAN	38.5%						
25608	BAISDEN	100%			100%			
25621	GILBERT	96.1%		3.2%	98.2%		12%	46.8%
25650	VERNER	95.4%			92.7%			81.2%
25651	WHARNCLIFFE	91.2%			98.8%			37.2%
25661	WILLIAMSON	92%	2.5%	17.3%		86.9%		
25666	BREEDEN							
25670	DELBARTON	90.1%		15.5%	55.8%	51.5%		
25671	DINGESS	24.3%						
25672	EDGARTON			20.3%				
25674	KERMIT	92.8%				62%		
25676	LENORE					25%		
25678	MATEWAN	66.4%		20.9%	44.6%			12.7%
25690	RAGLAND	95.6%			100%	63.9%		
25692	RED JACKET	52.1%		29.7%		3.4%		
25696	VARNEY	96.3%			100%			
25699	WILSONDALE							8.5%

NOTES

BREEDEN ZIP 25666 AND WILSONDALE ZIP 25699

Broadband Now was unable to provide verification of any Service Providers offering services in these two areas except potentially King Street wireless in 25699.

LOCAL PRICING DATA

This information provides pricing data and services available from providers in the area of the Town of Gilbert. Prices, availability and promotional offers change frequently and sometimes vary depending on street address. Information was compiled using Broadband Now (.com), High Speed Internet (.com), InMyArea (.com), and Internet Service Provider (ISP) websites. Exact availability requires specific street addresses.

Wireline Providers

FRONTIER DSL

$27.99/mo for 6 Mbps ↓ – Mbps ↑ with no data cap. Installation fee waived for self-install or professional installation is $75. Equipment delivery/handling fee is $9.99. Modem 10/mo.

$34.99/mo for 25 Mbps ↓ – Mbps ↑ with no data cap. One year promo rate. Installation is $75 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

$44.9/mo for 45Mbps ↓ – Mbps ↑ with no data cap. One year promo rate. Setup is $40 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

$37.99/mo for 6 Mbps ↓ – Mbps ↑ with no data cap including voice service. Installation fee waived for self-install or professional installation is $75. Equipment delivery/handling fee is $9.99. Modem 10/mo.

$44.99/mo for 12 Mbps ↓ – Mbps ↑ with no data cap with no data cap including voice service. One year promo rate. Installation is $75 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

$44.99/mo for 25 Mbps ↓ – Mbps ↑ with no data cap with no data cap including voice service. One year promo rate. Setup is $40 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

$54.99/mo for 25 Mbps ↓ – Mbps ↑ with no data cap with no data cap including voice service. One year promo rate. Setup is $40 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

INTERMOUNTAIN CABLE

$59.00 for 25X 25 Mbps ↓ 5 Mbps ↑ with 1,000 GB data- Modem with WiFi: $8.25 per month.

$89.00 for 50X 50 Mbps ↓ 5 Mbps ↑ with 1,000 GB data- Modem with WiFi: $8.25 per month.

$129.00 for 100X 100 Mbps ↓ 10 Mbps ↑ with 1,500 GB data- Modem with WiFi: $8.25 per month.

$179.00 for 300X 300 Mbps ↓ 20 Mbps ↑ with 2,000 GB data- Modem with WiFi: $8.25 per month.

$209.00 for 500X 500 Mbps ↓ 40 Mbps ↑ with 3,000 GB data- Modem with WiFi: $8.25 per month.

LUMOS

$44.95/mo for 25 Mbps ↓ 10 Mbps ↑ with no data cap.

$59.95/mo for 50 Mbps ↓ 10 Mbps ↑ with no data cap.

$74.95/mo for 100 Mbps ↓ 20 Mbps ↑ with no data cap.

SHENTEL

$130.40 for 50 Mbps with 50 Mbps ↓ 10 Mbps ↑, Advanced TV, Unlimited Local and Long Distance Calling. Bundle saving of $35 per month. Promo pricing will increase by $49.95 at end of 12 months. Monthly modem fee of $8 per month. Total non-promo pricing with modem $188.35 per month.

$145.90 for 50 Mbps with 50 Mbps ↓ 10 Mbps ↑, Ultimate TV, Unlimited Local and Long Distance Calling. Bundle saving of $35 per month. Promo pricing will increase by $49.95 at end of 12 months. Monthly modem fee of $8 per month. Total non-promo pricing with modem $203.85 per month.

$135.90 for 50 Mbps with 50 Mbps ↓ 10 Mbps ↑, Ultimate TV, Unlimited Local Calling. Bundle saving of $35 per month. Promo pricing will increase by $49.95 at end of 12 months. Monthly modem fee of $8 per month. Total non-promo pricing with modem $193.85 per month.

$199.95 for 150 Mbps with1 TB data- Internet only

$139.95 for 101 Mbps with 750 GB data- Internet only

$79.95 for 25 Mbps with 400 GB data- Internet only

$59.95 for 10 Mbps with 300 GB data- Internet only

$49.95 for 5 Mbps with 250 GB data- Internet only

SUDDENLINK CABLE

$89.99/mo for Triple Play 100 Mbps ↓ and 10 Mbps ↑ Premier TV . Unlimited Calling. 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$99.99/mo for for Triple Play 200 Mbps ↓ and 20 Mbps ↑ Premier TV. Unlimited Calling. 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$109.99/mo for for Triple Play 400 Mbps ↓ and 40 Mbps ↑ with no data cap. Premier TV. Unlimited Calling. 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$139.99/mo for for Triple Play 940 Mbps ↓ and 50 Mbps ↑ with no data cap Premier TV. Unlimited Calling. 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$64.99/mo for Double Play 100 Mbps ↓ and 10 Mbps ↑ with 250 GB month data cap. Select TV . 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$64.99/mo for Double Play 200 Mbps ↓ and 20 Mbps ↑ Value TV. 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$74.99/mo for Double Play 400 Mbps ↓ and 40 Mbps ↑ with no data cap. Value TV . 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$74.99/mo for Double Play 400 Mbps ↓ and 40 Mbps ↑ with no data cap. Value TV . 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$84.99/mo for Double Play 100 Mbps ↓ and 10 Mbps ↑ Premier TV . 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$104.99/mo for Double Play 940 Mbps ↓ and 50 Mbps ↑ with no data capPremier TV . 1-year promo rate. 1 year contract. Rate will be increased $10/ month for months 13-24. Modem w/WiFi $10 per month

$34.99/mo for Internet 100 Mbps ↓ and 10 Mbps ↑ with 250 GB month data cap. 1 year contract. Setup $49 includes standard installation. Modem w/WiFi $10 per month

$44.99/mo for Internet 200 Mbps ↓ and 20 Mbps ↑ 1 year contract. Modem w/WiFi $10 per month

$54.99/mo for Internet 400 Mbps ↓ and 40 Mbps ↑ no data cap. 1 year contract. Modem w/WiFi $10 per month

$84.99/mo for Internet 4940 Mbps ↓ and 50 Mbps ↑ no data cap. 1 year contract. Modem w/WiFi $10 per month

XFINITY CABLE (ONLY AVAILABLE IN GILBERT)

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

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

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

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

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

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

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

$34.99/mo for Performance Internet 60 Mbps ↓ and 5 Mbps ↑ some areas have ! TB data cap. 1 year promo rate. Regular rate is $74.95. (Free standard shipping of self-install kit. Modem w/WiFi $11 per month

$49.95/mo for Performance Starter Internet 15 Mbps ↓ and 2 Mbps ↑ some areas have ! TB data cap. 1 year promo rate. Regular rate is $74.95. Modem w/WiFi $11 per month

$54.99/mo for Blast Internet 150Mbps ↓ and 10 Mbps ↑ some areas have ! TB data cap. 1 year promo rate. Regular rate is $94.95. Modem w/WiFi $11 per month.

$64.99/mo for Extreme Pro 400 Mbps ↓ and 10 Mbps ↑ some areas have ! TB data cap. 1 year promo rate. Regular rate is $99.95. Modem w/WiFi $11 per month

$74.99/mo for Gigabit Internet 1,000 Mbps ↓ and 35 Mbps ↑ Some areas have ! TB data cap. 1 year promo rate. Regular rate is $104.95. Modem w/WiFi $11 per month

Fixed Wireless Providers

KING STREET WIRELESS

Pricing undiscovered. Availability unconfirmed. Speed available 1 Mbps ↓ and .2 Mbps ↑ (according to InMyArea) Potentially services being added in Gilbert area according to this map: http://www.kingstreetwireless.com/state/west-virginia/

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. 50 GB/mo of additional data to use during off-peak hours (2am-8am). No Hard Data Limits- Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once month plan data is used. Setup $99 includes lease set-up fee. Standard Installation is free. 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. 50 GB/mo of additional data to use during off-peak hours (2am-8am). No Hard Data Limits- Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once month plan data is used. Setup $99 includes lease set-up fee. Standard Installation is free. Modem: $14.99/mo.

$99.99/mo for 25 Mbps ↓ 3 Mbps ↑ 30 GB/mo data cap. Two year contract with up to $400 ETF. 50 GB/mo of additional data to use during off-peak hours (2am-8am). No Hard Data Limits- Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once month plan data is used. Setup $99 includes lease set-up fee. Standard Installation is free. Modem: $14.99/mo.

$149.99/mo for 25 Mbps ↓ 3 Mbps ↑ 50 GB/mo data cap. Two year contract with up to $400 ETF. 50 GB/mo of additional data to use during off-peak hours (2am-8am). No Hard Data Limits- Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once month plan data is used. Setup $99 includes lease set-up fee. Standard Installation is free. Modem: $14.99/mo.

VIASAT/EXEDE

$50/mo for up to 12 Mbps ↓ with no data cap. 3-month promo rate. Regular rate is $70. Contract term two years. After 40 GB of data usage, your data may be prioritized behind other customers during network congestion. Setup with free standard installation $0. Modem w/WiFi $10 per month.

$70/mo for 25 Mbps ↓ with no data cap. 3-month promo rate. Regular rate is $100. Contract term two years. After 60 GB of data usage, your data may be prioritized behind other customers during network

congestion. Setup with free standard installation $0. Modem w/WiFi $10 per month. Setup with free standard installation $0. Modem w/WiFi $10 per month

$100/mo for 30 Mbps ↓ with no data cap. 3-month promo rate. Regular rate is $150. Contract term two years. After 100 GB of data usage, your data may be prioritized behind other customers during network congestion. Setup with free standard installation $0. Modem w/WiFi $10 per month

4.2 FUTURE BROADBAND NEEDS

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

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

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

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

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

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

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

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

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

Residential Bandwidth Needs

In Mingo County, most residents and businesses are relying on copper-based services. The table below depicts the bandwidth needed for typical residential services which are available now or will be available in the near future. In a next generation network all services will be delivered over a single

network infrastructure which will require a network that can support providing most services to most consumers simultaneously. Today's shared networks (cable and wireless in particular) rely on the "bursty" nature of traffic to provide services to end users. If all end users were consuming their "advertised" bandwidth today's cable and DSL networks would grind to a halt.

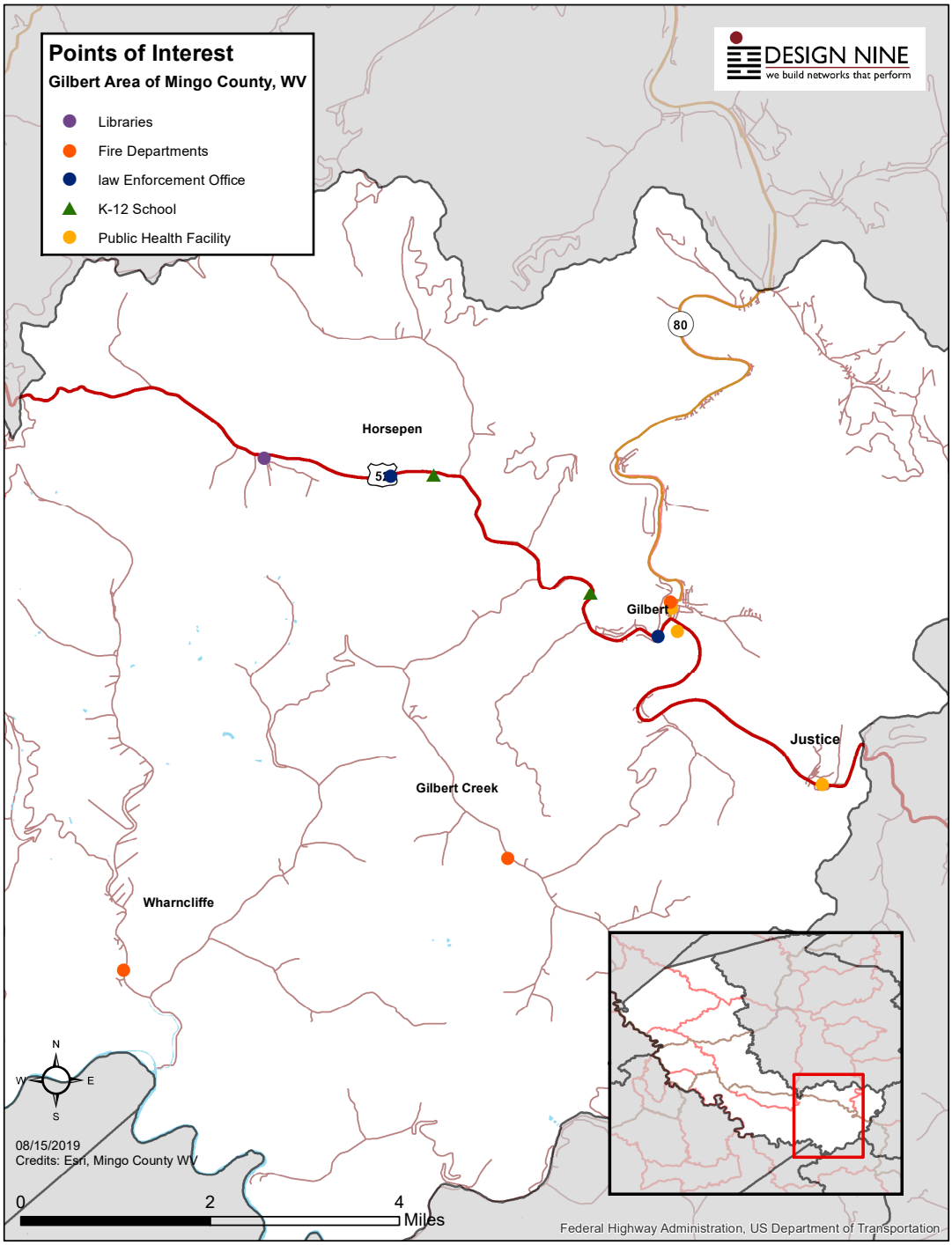
Existing cable modem network users are overwhelming the digital cable networks that were upgraded as little as three or four years ago, and the firms have had to artificially reduce the bandwidth available for certain kinds of high bandwidth services (e.g. peer to peer file sharing). Some cable providers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

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

4.3 MINGO COUNTY SPEED TEST DATA

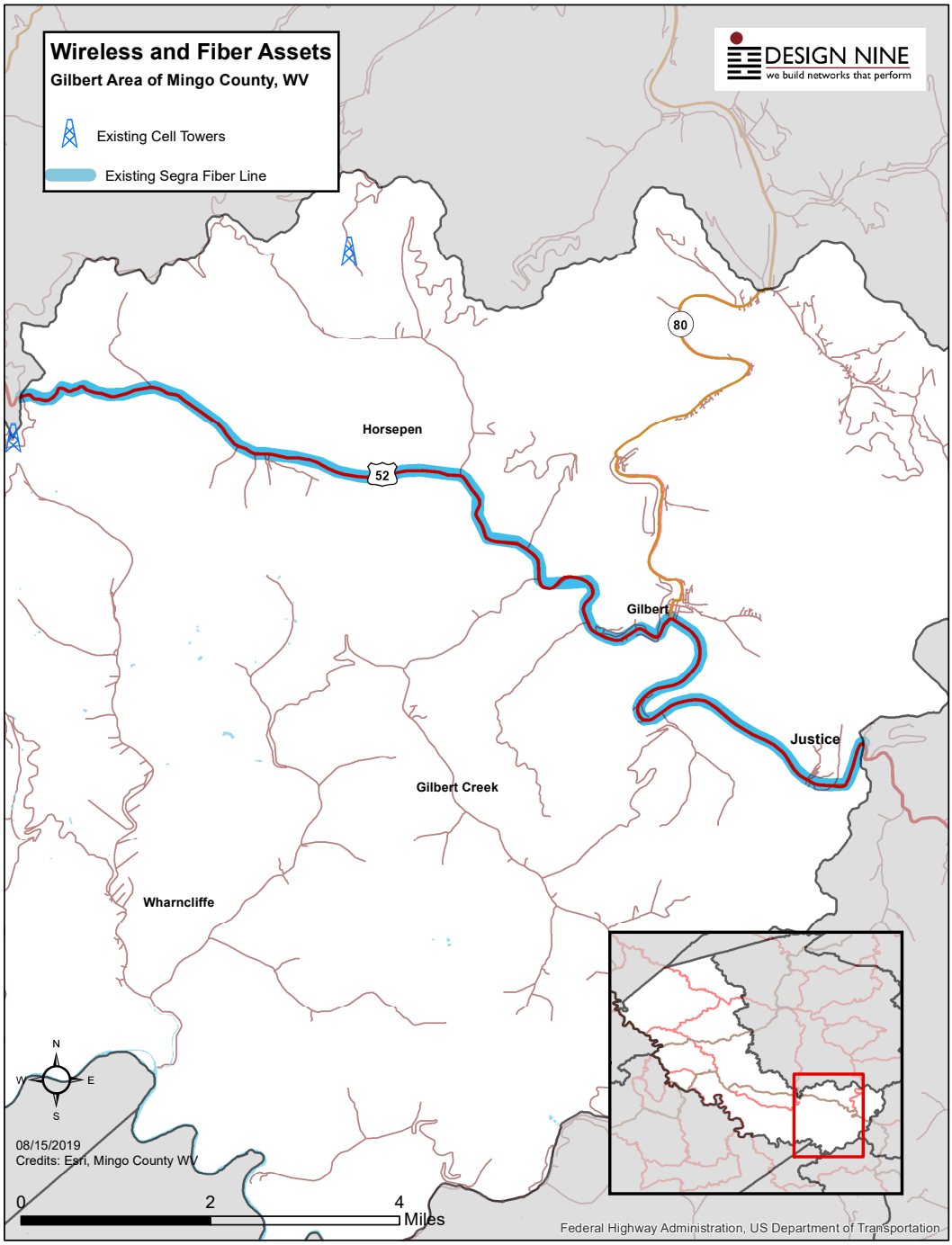
Currently waiting for speed test data from the WV state GIS office.

5.1 POINTS OF INTEREST IN THE AREA

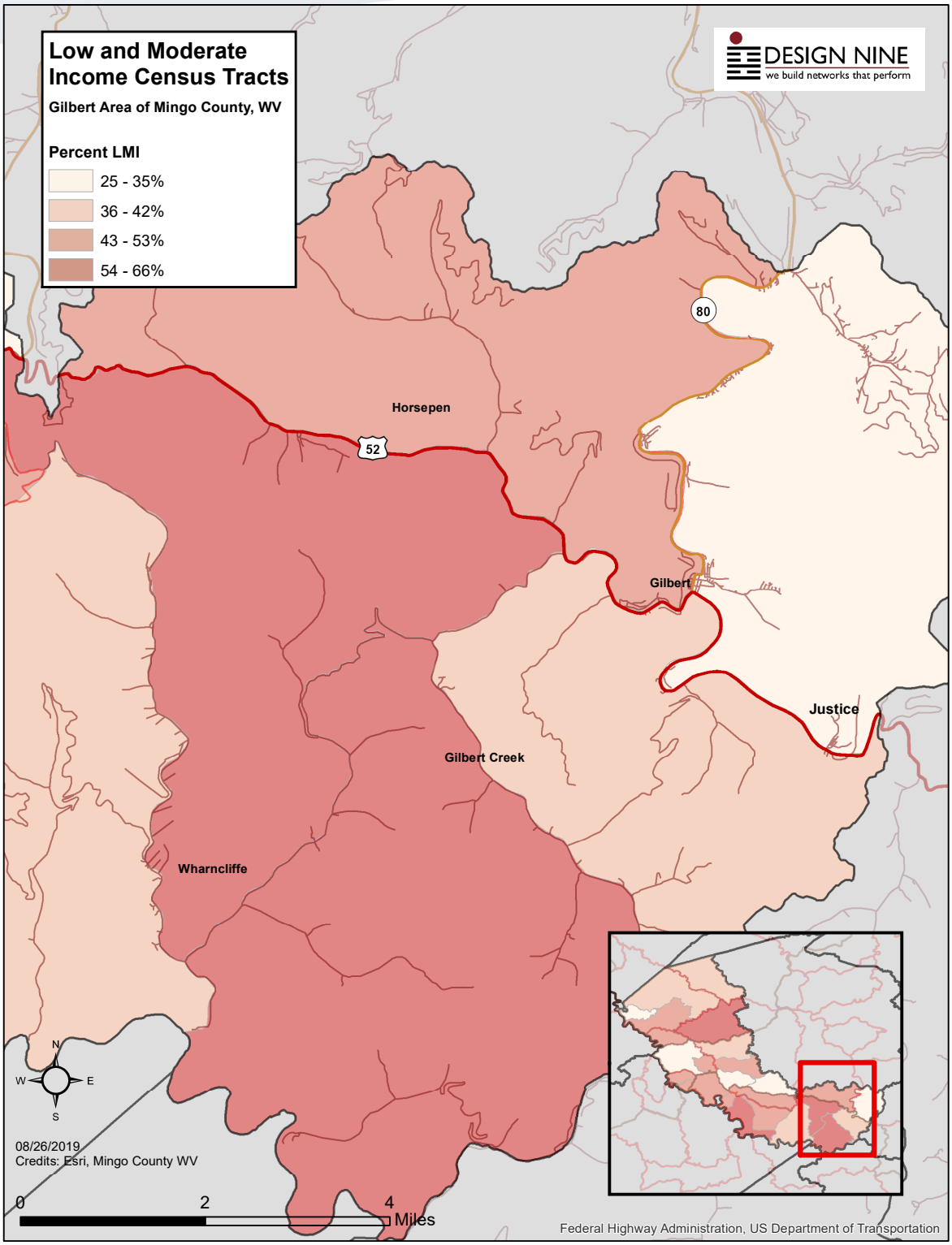


5.2 TOWERS AND FIBER IN THE AREA

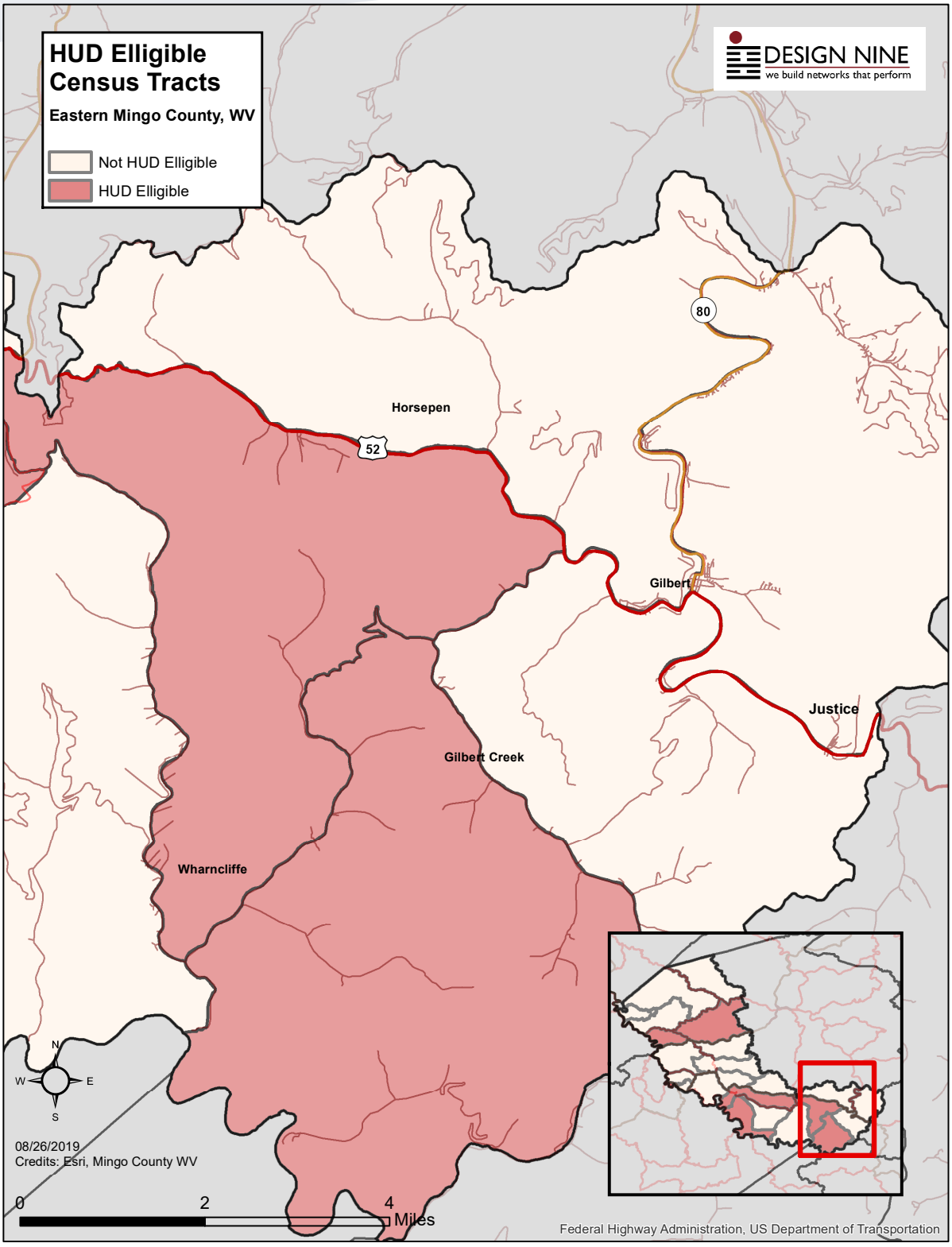
Shentel and Frontier both have fiber in the Gilbert area but do not provide public access to their routes. Segra is the new company name for Lumos. Segra does not appear to offer any retail services in Gilbert, but they may be interested in doing so if the network is constructed.



5.3 LOW AND MODERATE INCOME AREAS



5.4 HUD GRANT ELIGIBLE AREAS



6 BROADBAND DEVELOPMENT PLAN, DESIGN, AND COST ESTIMATES

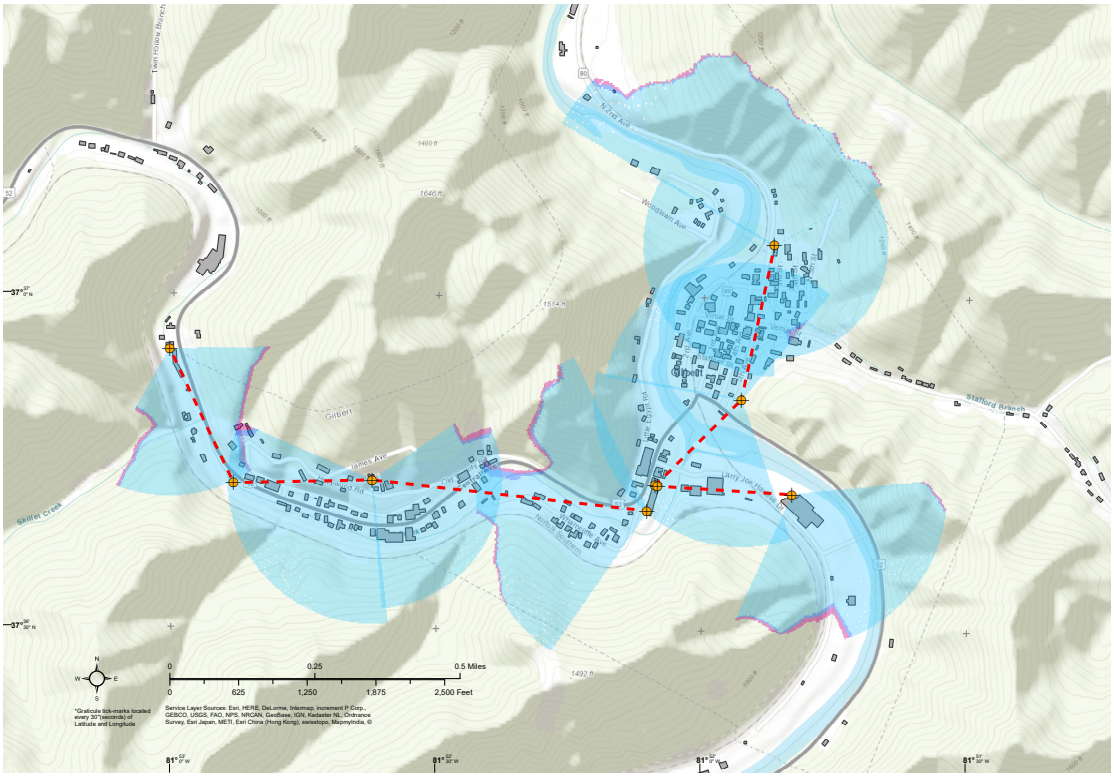
6.1 TOWN OF GILBERT

Technical Design

The Town of Gilbert network has been designed to provide two different kinds of Internet access:

- Public WiFi access that would be available to residents and visitors. This would be intended for casual use by residents and visitors in Gilbert. Bandwidth will support email, Web browsing, and social media activities, but would not support bandwidth intensive services like video streaming (TV, movies, video chats, etc.).
- Fixed point broadband Internet service for use by residents and businesses. This service would be a fee-based Internet service that would support normal Internet-based services and activities. This would include email, Web browsing, K12 and higher ed online resources, telemedicine and telehealth, work from home, voice and video calls, entertainment, and video/TV streaming.

Gilbert is surrounded by tall hills, so a total of eight access points are required. Most of these access points require placement of a wooden utility pole and access to electric service. From the map below, the blue shaded areas indicated the coverage areas projected by the propagation studies that have been completed. A full network technical design has been provided as a separate document.



Cost Estimates

There are two cost estimate tables for Gilbert. On this page is the estimated cost of the subscriber-based network. Residents and businesses would subscribe to wireless based Internet services (see the table at the bottom of the page.

GILBERT Subscriber-based Network

ITEM	UNITS	UNIT COST	TOTAL
New Poles	6	$12,375.00	$74,250.00
Pole Mounted Cabinet	6	$1,200.00	$7,200.00
Padlock	6	$15.00	$90.00
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	6	$150.00	$900.00
UBNT - 5Ghz AirPrism Gen2	13	$225.67	$2,933.71
UBNT - v5TI Sector Antenna	13	$216.24	$2,811.12
Tower Site Switch - UBNT ERPOE5	7	$161.26	$1,128.82
AirFiber 24 HD	12	$3,000.00	$36,000.00
Cabling (1000' boxes)	2.5	$135.00	$337.50
Project management and network Integration	1	$12,500.00	$12,500.00
TOTAL			$138,151.15

Suggested Internet Services

Service Item	Description
Residential Internet	10 Meg down/1 Meg up
Residential Internet	25 Meg down/ 3 Meg up
Business Internet	5 Meg down/5 Meg up
Business Internet	10 Meg down/10 Meg up
Business Internet	20 Meg down/20 Meg up

This cost estimate is for the public WiFi network that would be available for visitors and residents as they travel in the downtown area. Limits would be enforced on both bandwidth and time used. This is not intended or designed to be a free alternative to the subscriber-based service. Bandwidth available to a user will support casual uses (e.g. email, Web access, social media uploads, etc.) but would not support video streaming, heavy use of two way video (e.g. Skype) and other bandwidth intensive services.

GILBERT DOWNTOWN WIFI

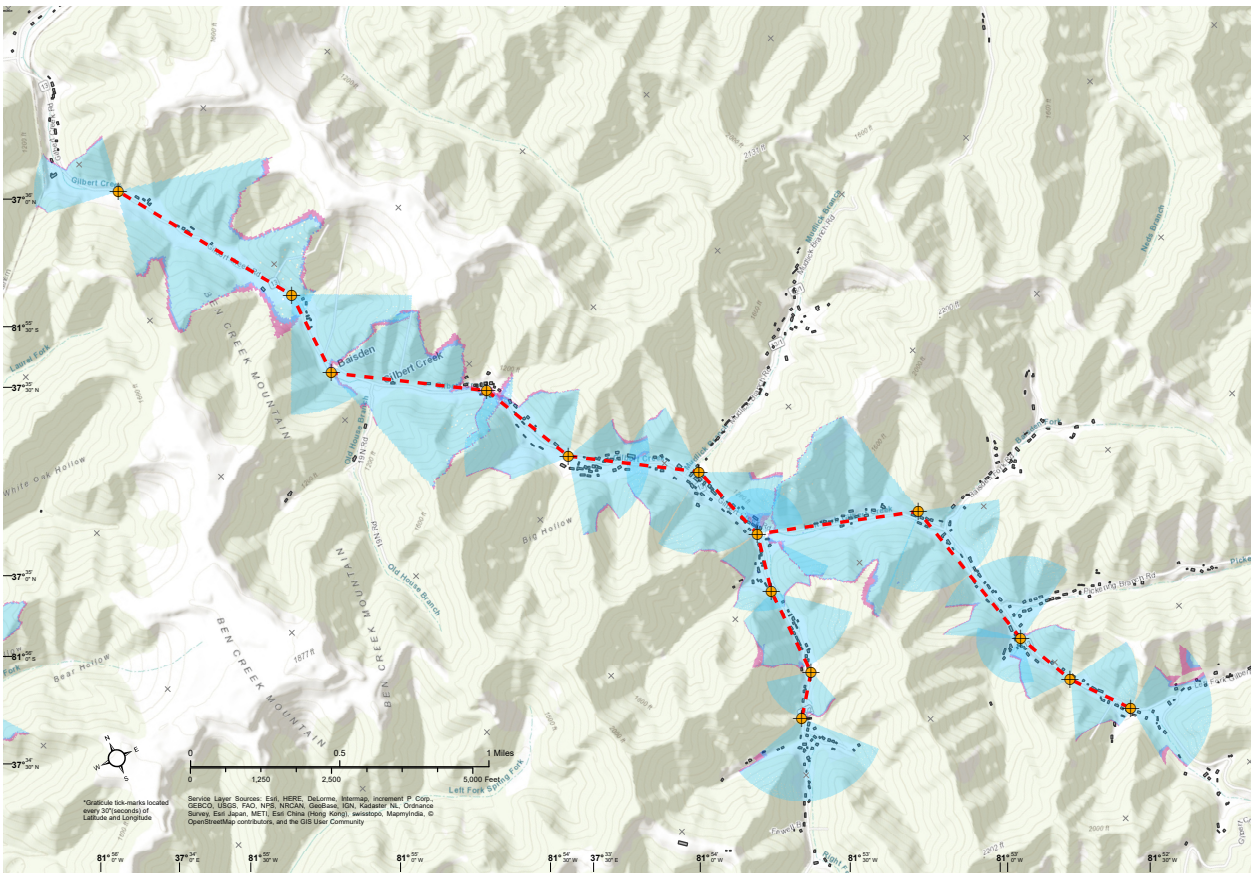
ITEM	UNITS	UNIT COST	TOTAL
Access Point *Ubiquiti UniFi Outdoor Mesh AP*	28	$99	$2,772
Electrical Fit-up Installation of circuit and electrical box on street lights, buildings, or other attachment points.	28	$100	$2,800
Mounting Box and Hardware	28	$75	$2,100
Padlock	28	$15	$420
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	28	$150	$4,200
UPS	28	$300	$8,400
Cabling (per site)	28	$25	$700
Hotspot site switch At each site with a fiber drop a switch will be required to connect the WiFi system. *Ubiquiti Unifi Switch 8 with SFP*	28	$199	$5,572
Installation cost (per site)	28	$1,500	$42,000
Project management and integration	1	$12,300	$12,300
TOTAL			**$81,264.00**

6.2 GILBERT CREEK

Technical Design

Gilbert Creek is similar to the other study areas. Utility poles are used for both the local network access and the point to point access needed between poles to provide contiguous service in the entire area.

A full network technical design has been provided as a separate document.



Cost Estimate

Fourteen poles are needed for this network.

GILBERT CREEK

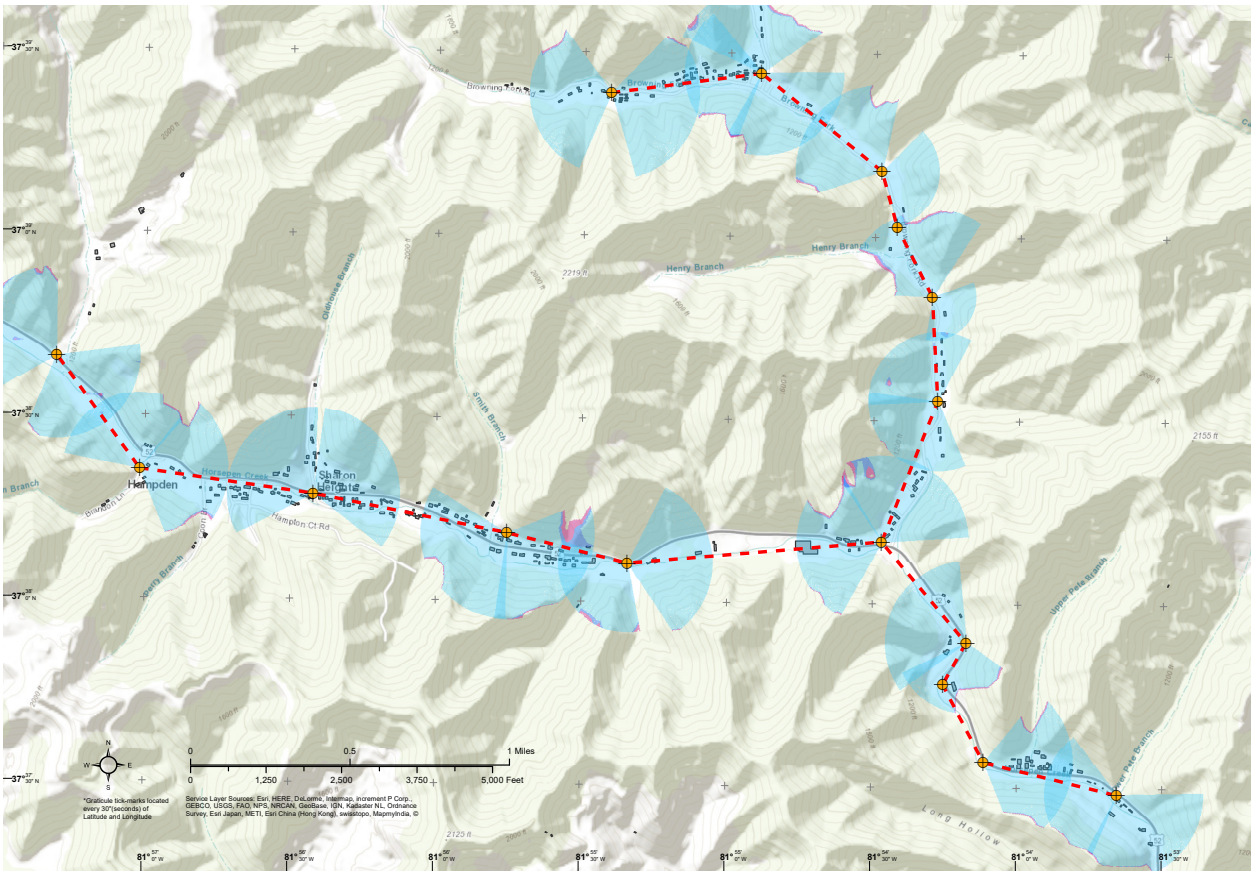
ITEM	UNITS	UNIT COST	TOTAL
New Poles	14	$12,375	$173,250
Pole Mounted Cabinet	14	$1,200	$16,800
Padlock	14	$15	$210
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	14	$150	$2,100
UBNT - 5Ghz AirPrism Gen2	20	$226	$4,513
UBNT - v5TI Sector Antenna	20	$216	$4,325
Tower Site Switch - UBNT ERPOE5	14	$161	$2,258
AirFiber 24 HD	26	$3,000	$78,000
Cabling (1000’ boxes)	4.6	$135	$621
Project management and network Integration	1	$29,750	$29,750
TOTAL			$311,827

6.3 HORSEPEN

Technical Design

Horsepen covers a larger area, but the network design is similar to the other study areas. Utility poles are used for both the local network access and the point to point access needed between poles to provide contiguous service in the entire area.

A full network technical design has been provided as a separate document.



Cost Estimate

Sixteen poles are required for Horsepen.

HORSEPEN

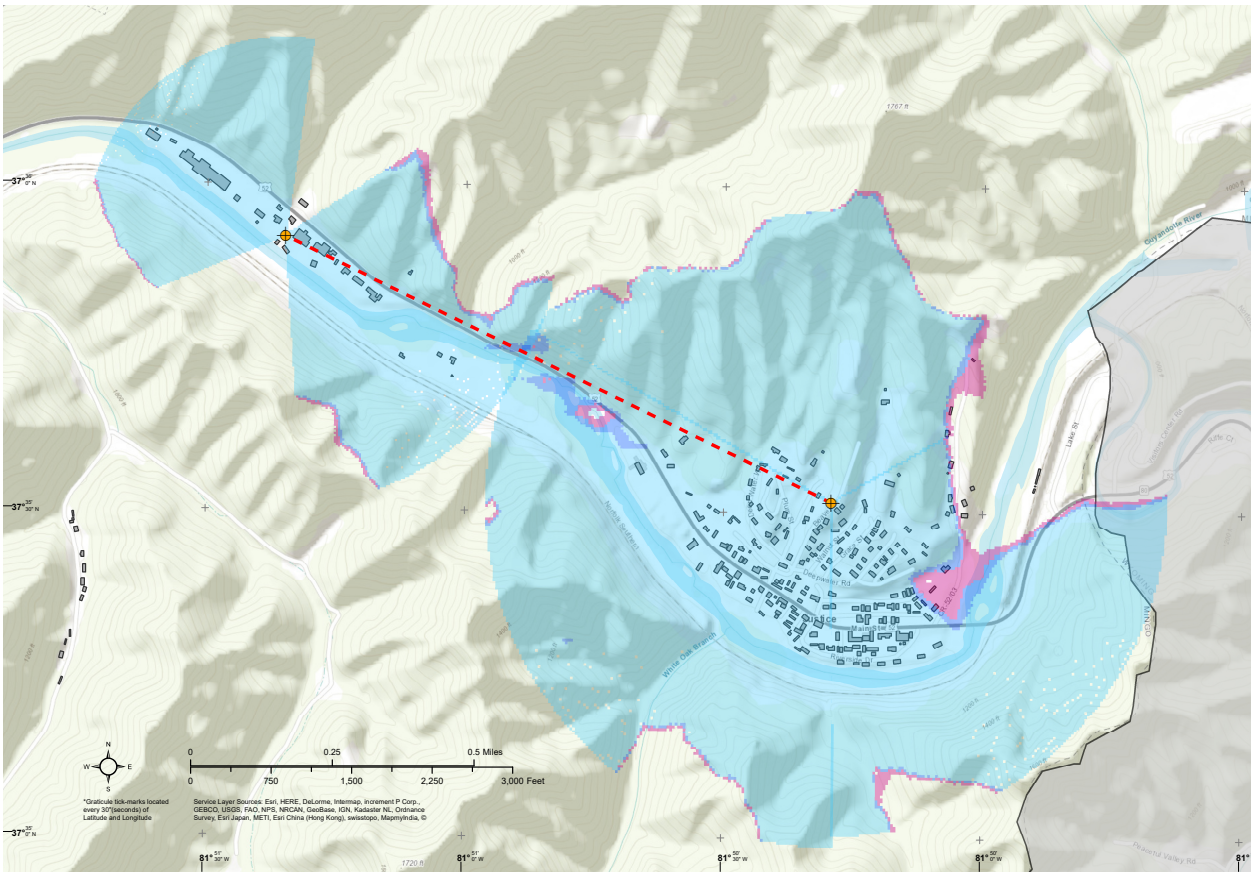
ITEM	UNITS	UNIT COST	TOTAL
New Poles	16	$12,375	$198,000
Pole Mounted Cabinet	16	$1,200	$19,200
Padlock	16	$15	$240
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	16	$150	$2,400
UBNT - 5Ghz AirPrism Gen2	30	$226	$6,770
UBNT - v5TI Sector Antenna	30	$216	$6,487
Tower Site Switch - UBNT ERPOE5	16	$161	$2,580
AirFiber 24 HD	30	$3,000	$90,000
Cabling (1000' boxes)	6	$135	$810
Project management and network Integration	1	$34,650	$34,650
TOTAL			$361,137

6.4 JUSTICE

Technical Design

Justice covers a smaller area, but the network design is similar to the other study areas. Utility poles are used for both the local network access and the point to point access needed between poles to provide contiguous service in the entire area.

A full network technical design has been provided as a separate document.



Cost Estimate

Justice is much smaller than the other study areas, and two poles will provide good service.

JUSTICE

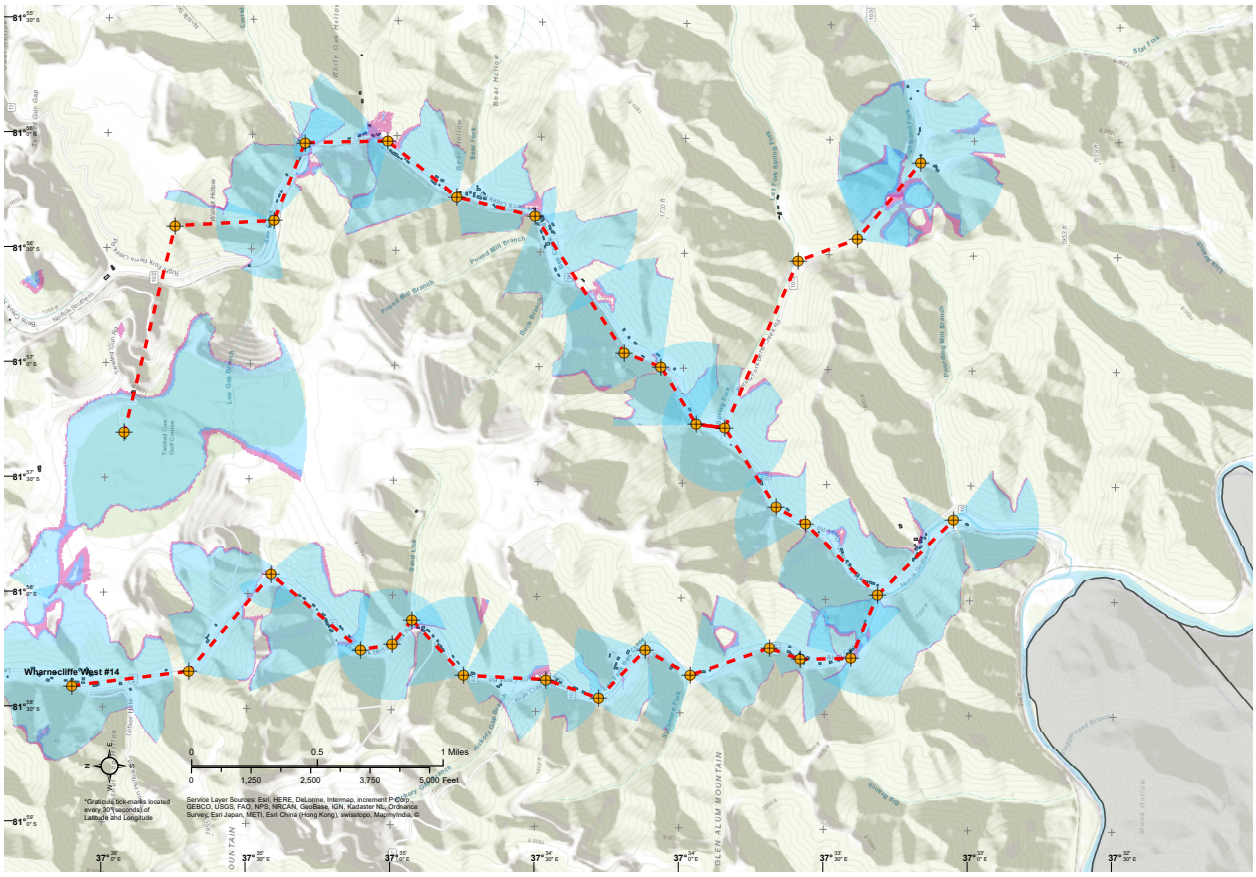
ITEM	UNITS	UNIT COST	TOTAL
New Poles	2	$12,375	$24,750
Pole Mounted Cabinet	2	$1,200	$2,400
Padlock	2	$15	$30
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	2	$150	$300
UBNT - 5Ghz AirPrism Gen2	5	$226	$1,128
UBNT - v5TI Sector Antenna	5	$216	$1,081
Tower Site Switch - UBNT ERPOE5	2	$161	$323
AirFiber 24 HD	2	$3,000	$6,000
Cabling (1000' boxes)	0.7	$135	$95
Project management and network Integration	1	$7,500	$7,500
TOTAL			$43,607

6.5 WHARNCLIFFE

Technical Design

Wharncliffe is the largest of the five study areas, and so is the most expensive to construct. Utility poles are used for both the local network access and the point to point access needed between poles to provide contiguous service in the entire area.

A full network technical design has been provided as a separate document.



Cost Estimate

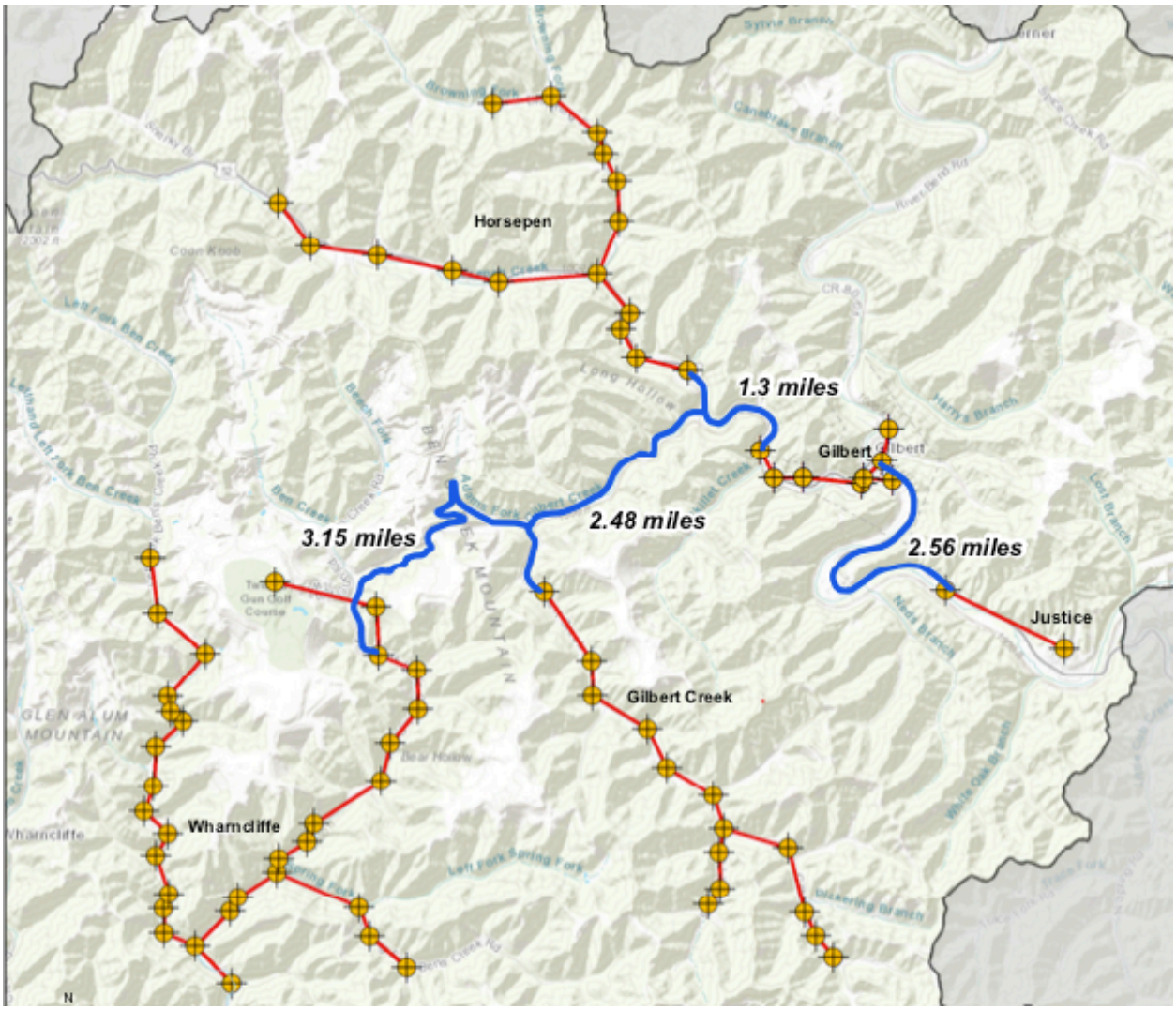
Thirty-two poles are needed to cover the much larger community of Wharncliffe.

WHARNCLIFFE

ITEM	UNITS	UNIT COST	TOTAL
New Poles	32	$12,375	$396,000
Pole Mounted Cabinet	32	$1,200	$38,400
Padlock	32	$15	$480
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	32	$150	$4,800
UBNT - 5Ghz AirPrism Gen2	28	$226	$6,319
UBNT - v5TI Sector Antenna	22	$216	$4,757
OMNI -	6	$300	$1,800
Tower Site Switch - UBNT ERPOE5	32	$161	$5,160
AirFiber 24 HD	60	$3,000	$180,000
Cabling (1000' boxes)	8.8	$135	$1,188
Project management and network Integration	1	$74,375	$74,375
TOTAL			$713,279

6.6 INTER-COMMUNITY CONNECTIONS AND PUBLIC SAFETY

The map below shows the road miles between the five study areas—approximately ten miles in total. At about an estimated $80,000 per mile for underground fiber, it would cost $800,000 to connect all five communities together with fiber. It would take as many as four new towers, as a cost of about $200,000 per tower, to develop microwave point to point radio links between the communities. Investing in fiber would be more advantageous from a long term economic development perspective, and could help draw new residents to the area and fiber to the home becomes available along the routes.



With respect to the wireless networks, it would be possible to add restricted access public safety WiFi hotspots in each area. This would allow public safety officials (e.g. sheriff deputies, etc.) to securely access data and information without traveling back to the main office in Williamson.

PUBLIC SAFETY WIFI

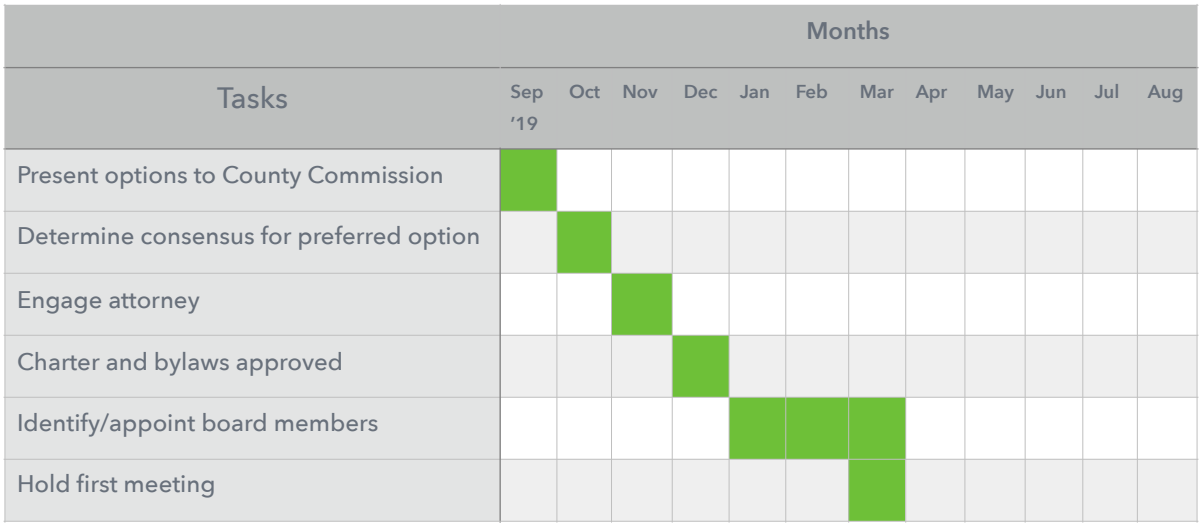
ITEM	UNITS	UNIT COST	TOTAL
Access Point *Ubiquiti UniFi Outdoor Mesh AP*	10	$99	$990
Electrical Fit-up Installation of circuit and electrical box on street lights, buildings, or other attachment points.	10	$100	$1,000
Mounting Box and Hardware	10	$75	$750
Padlock	10	$15	$150
Misc. Cabling and Hardware, Surge Protector, Cable Management, Rack Shelf, etc.	10	$150	$1,500
UPS	10	$300	$3,000
Cabling (per site)	10	$25	$250
Hotspot site switch At each site with a fiber drop a switch will be required to connect the WiFi system. *Ubiquiti Unifi Switch 8 with SFP*	10	$199	$1,990
Installation cost (per site)	10	$1,500	$15,000
Integration project management	1	$8,500	$8,500
TOTAL			**$33,130**

7 PRE-IMPLEMENTATION ACTIVITIES

7.1 ESTABLISH GOVERNANCE ENTITY

An ownership and governance entity will have to be established to own the network assets and to provide oversight of the network. Most day to day tasks like network monitoring, routine maintenance, and emergency repairs can be outsourced to a qualified for profit or non profit firm, so the entity may only need a board and support as needed from the County and the Planning Districts for activities like grant application preparation.

Activity	Description	Discussion	Tasks
Establish the ownership entity	There will be substantial management and network efficiencies if the long range plan is to create an entity that can provide improved Internet coverage throughout Mingo County over time.	A county development **authority** or a **nonprofit** are both options. A **broadband coop** is also an option. A Broadband Development Authority would have board members appointed by the County Commission.. A nonprofit is the simplest approach. A nonprofit could have bylaws that require ex officio board members appointed by the County Commission, but there would be limited direct accountability.	• Meet with the County Commission to present the two options and develop a consensus on which option is preferred. • Once a decision has been made, engage legal counsel to develop a corporate charter and bylaws. The county attorney may be able to do this work. • Identify qualified board members for initial terms of service. At least three, and no more than five board members is recommended. • Some of the board members should have a strong background in business management or grant writing. • Hold the first meeting.



7.2 GOVERNANCE ACTIVITIES

Activity	Description	Discussion	Tasks
Set project and funding goals	Define project vision and broad goals. Set one, two, and three year funding goals aligned with report recommendations.	Project and funding goals should be reviewed and updated regularly.	• Develop one paragraph Vision statement. • Develop one page set of short and long term goals.
Identify year one grant opportunities	Meet with regional planning officials and state officials to review grant opportunities.	Set priorities for grant opportunities.	• Identify one or two year one grant opportunities. • Identify public and private grant partners. • Develop timeline for completing grant application.
Begin execution of marketing plan	It will be necessary to have a modest but regular marketing and awareness campaign to ensure that local businesses and residents know that the county and the localities like Gilbert are engaged in trying to solve the broadband problem	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 area and the activities that are underway.	• County Web site page has been created for the effort • Mailing list for stakeholders and interested parties has been created. • Facebook page is updated regularly. • Facebook comments are checked regularly and responses are posted.

Typical Timeline	Months											
Tasks	Sep' 19	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Establish Grant working committee												
Review Vision Statement and Goals												
Develop short and long term goals												
Identify year one grant opportunities												
Identify grant partners												
Develop timeline for grant application												
Set up Web page on Mingo County Web site												
Set up stakeholder mailing list												
Update Facebook page regularly												
Respond regularly to FB inquiries												

7.3 SERVICE PROVIDER ATTRACTION

Activity	Description	Discussion	Tasks
Attract Internet Service Providers (ISPs, WISPs)	One or more service providers will be needed to lease poles, and/or manage the network, and to partner for grant funds.	CityNet may be an excellent candidate and should be approached first. Micrologic, Segra (was Lumos) and Shentel may also be interested.	• Once the County Commission have approved the plan, contact CityNet, Shentel, Segra and Micrologic. • Schedule individual meetings with the ISPs to present project goals and objectives. • Assess interest of the companies in public-private partnership. • If interest is positive, reach agreement on which grant opportunities to pursue jointly and in what area. • Develop an MOU (Memo of Understanding) that identifies what tasks the WISP will perform for grant application and what project will perform.

Typical Timeline	Months											
Tasks	Sep '19	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug
Contact WISPs												
Schedule individual meetings												
Assess interest in partnerships												
Schedule meetings to discuss grant opportunities												
Develop MOUs as needed for grants that will be pursued jointly												

7.4 GRANT APPLICATION ACTIVITIES

Activity	Description	Discussion	Tasks
Develop a grant application	The grant application process, from start to award announcement, can be nine to twelve months.	Broadband grant application requirements have become more stringent over time, with more grant agency oversight and review. Careful planning is essential to develop a successful application.	• Once a grant opportunity has been identified, review grant requirements to determine if the project can qualify. For example, some grants require two years of financial history. • Identify regional agency that will assist (e.g. Region II PDC). • Begin contacting potential ISP partners. • If the project qualifies, identify at least two people to take the lead to prepare application. • Prepare a task list of all grant materials requirements and identify data needed. • Develop a timeline for developing sections of the grant. • Identify requirements for letters of support and matching funds and develop timeline to solicit and collect commitments. • Complete all sections of grant application with assistance from public and private partners. • Submit grant application.

Typical Timeline	Months											
Tasks	1	2	3	4	5	6	7	8	9	10	11	12
Determine grant qualifications												
Identify regional council partner												
Identify ISP or WISP partner if needed												
Appoint grant team												
Create grant task list												
Prepare timeline and assign tasks to partners												
Identify matching fund requirements and letters of support to solicit and collect as needed												
Complete all sections of the grant application												
Submit grant												
Grant agency review												
Awards announcement												

7.5 PARTNERS

ISPs and WISPs

Internet Service Providers (ISPs) and Wireless Internet Service Providers (WISPs) are important partners, as they will be the companies leasing tower space and/or conduit/fiber infrastructure. CityNet and MicroLogic should both be contacted to assess their interest in the effort, and Richwood Scientific, a nonprofit technology company in Richwood, may also be interested in managing the network and/or providing the Internet service.

Frontier, Segra (formerly Lumos) and Shentel, as wireline providers of wholesale Internet, should also be contacted for pricing and to gauge their interest in being an Internet provider for the network. Segra/Lumos, on other community owned projects, has indicated interest in becoming a partner. Segra does not appear to offer any retail services in the area, and may not have a Point Of Presence (POP), but might be willing to create a POP if the Town of Gilbert network is constructed.

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

For providers that express interest in using community infrastructure, it will be important to meet with them on a regular basis. These companies may also be partners on grant applications, where it may be required to show that the infrastructure being constructed has a service provider already committed to using it.

State of West Virginia

The West Virginia legislature has been evaluating legislation in several areas that could improve broadband availability in the state (e.g. making it easier for electric utilities to provide middle mile fiber). The state also runs an ongoing speed test site and makes that data available to local governments (and studies like this one). Speed test data is important for grant applications, as the Federal sources of unserved and underserved census blocks are provided by incumbent providers. An examination of the distribution of survey data illustrates this, as that data shows large parts of all three counties have very poor service. Federal grants do allow applicants to submit alternative data, which is why the survey data and speed test is important. The Gilbert project team should ensure that state representatives for the area get regular written updates of activities and needs, and face to face meetings several times a year are extremely important.

Area Businesses

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

Electric Utilities

Electric utilities are natural partners in any municipal broadband venture. Electric utilities own utility poles, bucket trucks, and the equipment needed to install aerial fiber. Chattanooga's fiber to the

premises (FTTx) initiative has enabled millions in savings for the city-owned electric service. When power outages occurs from events like ice storms or tree damage, the utility is able to use the fiber network to very accurately pinpoint where the outage occurs, enabling a more rapid repair of the electric network at less cost.

Electric providers in the county could become an important part of the long term solution if West Virginia SB3/HB2005 (Broadband Enhancement) legislation becomes law.

Broadband Coop

Forming a broadband coop may be on of the most effective ways of creating a partnership with a diverse and robust set of public and private members (partners) that could include residents, businesses, schools, health care providers, public safety, and local government in Mingo County. Coops can raise some funds through membership fees, which can be assessed in advance of providing service.

Membership levels and fees can be set to reflect the value of the improved connection to the user. As an example, a residential membership fee might be $100, a small business membership fee might be $200, and a large business membership fee might be $500. A coop would be an alternative to forming a nonprofit or a broadband development authority. The USDA has a long history of lending funds to coops, which could be another advantage.

8 FINANCES AND FUNDING OPTIONS

The financing of new broadband infrastructure by local government 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, a perceived risk and a lack of history for such projects.

Several options exist for Mingo County and the communities of the Gilbert area.

8.1 WV 2019 BROADBAND EXPANSION ACT

In 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.

8.2 HUD COMMUNITY DEVELOPMENT BLOCK GRANTS

The U.S. Housing and Urban Development (HUD) CDBG State Program allows the West Virginia state government to award grants to smaller units of general local government that develop and preserve decent affordable housing to provide services to the most vulnerable in counties and towns 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. These 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% 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, prevent or eliminate 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 at: https://www.hud.gov/program_offices/comm_planning/communitydevelopment/programs.

8.3 USDA RECONNECT PROGRAM

The ReConnect program is a new funding program managed by the United States Department of Agriculture (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. Six-hundred million dollars has been allocated to the program, and a wide variety of entities can apply, including non-profits, co-ops, 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. A due date for applications for 2020 has not been announced, but for 2019, applications had to be submitted by April 23rd. More information is available at: 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 Mbps down and 1 Mbps up broadband service.

USDA ReConnect applications require extensive preparation time. A minimum of six months should be budgeted to put together a grant team, review the application guide and requirements, and to collect all the necessary forms, letters, maps, and information needed for the application.

8.4 911 FEES

Improved broadband access in the region 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. This is now a commonly available feature on new cell phones. WiFi calling switches voice telephone calls 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 rural areas of the six counties could generate funds to support additional broadband towers and community poles. See the tables above in the Special Assessment section of this chapter.

8.5 OPPORTUNITY ZONES

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.

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 the nomination 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 or 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 at: https://www.cdfifund.gov/Pages/Opportunity-Zones.aspx. Mingo County does have qualified Opportunity Zones.

8.6 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, like water, sewer, and solid waste projects, 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 startup 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 counties 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 (GO) bonds are routinely used by local governments to finance municipal projects of all kinds. GO 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. GO 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, for example 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.

8.7 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 Mbps down and 1 Mbps up (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 of less than 10 Mbps down and 1 Mbps up, 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, 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 services in place to support a longer term goal of applying for CAF2 funds.

8.8 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.

8.9 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 co-op 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 than similar properties without fiber access.

One-Time Connection Fees. A one-time connection fee can be assessed to property owners 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 at about $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, for example $100 for up to 75 ft from the road, $2 for each additional foot.

There is already some data that indicate 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.

8.10 ARC POWER GRANTS

Mingo County qualifies for Appalachian Regional Commission (ARC) grants. Partnerships for Opportunity and Workforce and Economic Revitalization (POWER) 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.

ARC 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 with national averages for three economic indicators: three-year average unemployment rate, per capita market income, and poverty rate. 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. Mingo County has been ranked as “distressed” for 2020, meaning it has some advantage in eligibility ranking for grants and awards.

The County should consider applying for this grant opportunity. To get started, Mingo County 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 at: https://www.arc.gov/funding/ARCGrantsandContracts.asp and at: https://www.arc.gov/funding/power.asp.

8.11 SPECIAL ASSESSMENT OPTIONS

Using very modest amounts collected from Mingo County households over a period of several years has the potential of funding a full coverage fixed wireless build out for the County with just a one cent property tax earmark.

A per household special assessment of just $1/month (over thirty years) provides enough revenue to provide the needed towers and wireless infrastructure to get better service to nearly all residences and businesses in the County.

Property Tax Earmark for Broadband

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 might be possible to sell to citizens and businesses. The table below is adjusted to reflect the cost of borrowing over the listed periods of time.

A one cent property tax earmark, for a property assessed at $63,900, would be about $6.39/year increase.

	Estimated Assessed Property Value	Broadband increment	Annual Broadband Fund	Ten Year Aggregate	Twenty Year Aggregate	Thirty Year Aggregate
1/4 of one cent	$710,887,500	$0.0025	$17,772	$177,722	$355,444	$533,166
1/2 of one cent	$710,887,500	$0.0050	$35,544	$355,444	$710,888	$1,066,331
1 cent	$710,887,500	$0.0100	$71,089	$710,888	$1,421,775	$2,132,663

Special Assessment/Service District Approach

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 $10-$12 monthly 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.

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

Mingo County Special Assessment (all 11,125 households)		
Monthly Assessment Amount	**Twenty Year Assessment**	**Thirty Year Assessment**
$1	$2,670,000	$4,005,000
$2	$5,340,000	$8,010,000
$5	$13,350,000	$20,025,000
$10	$26,700,000	$40,050,000

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

12 NETWORK OPERATIONS OPTIONS

12.1 APPROACHES TO OPERATIONS

Business Model Options

For the proposed infrastructure in each of the study areas, there are two business model options.

- **Pole Lease Only** – In this model, only the poles are installed, and all of the poles are then leased out to a private sector service provider, who would install their own equipment, manage the network, and sell the retail Internet services.
- **Fully Functional Network / Private Internet Provider** – In this model, all of the network equipment and radios needed to create a fully functional network are installed on the poles, and the network is leased to a service provider, who would manage all of the equipment, be responsible for repairs and maintenance, and sell retail Internet services.
- **Fully Functional Network / Nonprofit Internet Provider** – In this model, all of the network equipment and radios needed to create a fully functional network are installed on the poles, and the network is managed by a county development authority or a community nonprofit. The entity would be responsible for the network and sell retail Internet services. Most repairs, monitoring, and maintenance could be outsourced to qualified firms, including creating jobs and technical capacity as part of the effort.

Given the low density of households in the area and the difficult terrain, attracting a private sector provider is the highest priority in this first phase of project development. If a private provider cannot be found, the network can be operated as a nonprofit community enterprise—-this approach would require careful business planning.

12.2 BACKHAUL AND INTERNET CONNECTIVITY

Line of Sight and Backhaul Considerations

Line of sight is extremely limited in the study areas. The network designs included with this study focused on using utility poles for two reasons:

- First, the narrow valleys and steep terrain limits the effectiveness of taller (e.g. 180′ and higher) towers. The many hills create viewshed shadows where a residence or business would not receive an adequate wireless signal even though the straight line distance to a tower may be short because of an intervening (blocking) hill. The use of shorter utility poles placed along existing roadways provides better service coverage to more homes and businesses.
- Second, the use of the shorter utility poles reduces the costs of maintenance. With radio equipment installed at 55′ to 60′ above ground, that equipment can be accessed, repaired, and replaced using widely available bucket trucks or lift equipment. Radios mounted above that height (e.g. on a 180′ tower) require certified and trained tower climbers that sharply increases repair and maintenance costs.

There are two backhaul issues:

Backhaul Connectivity Between Study Areas – Because of the limited line of sight generally in the area, connecting the five study areas together to create a single operational network will require either an extensive additional set of radios or fiber between the study areas. The terrain may actually drive the solution to fiber. The least expensive solution is likely to be an agreement with Frontier or the electric utility to mount aerial fiber on existing poles.

Backhaul to an Internet Meet Point – Shentel has indicated that it intends to upgrade its fiber service in the Town of Gilbert, and this is likely to be the least expensive solution to obtaining a wholesale package of Internet. Shentel should also be approached as a possible candidate ISP, although they may not be interested in taking on a wireless network in the area. CityNet and MicroLogic are also ISPs that may be interested, and Richwood Scientific, a non profit technology enterprise in Richwood, may also be interested in assisting with both network management and providing Internet service.

12.3 INTERNET SERVICE PLANNING AND DEVELOPMENT

- Development of the plan to offer Internet services should take time and effort during the early formation of the network. During the network build up, there must be a parallel and regular effort to develop the financial and technical aspects of the service, identify a source of wholesale Internet backhaul, and develop business and marketing strategies for their proposed service.
- Internet service fees should be reviewed annually and adjusted upward or downward if necessary to ensure both the guaranteed network performance and to meet the network financial goals.
- Once customers are on the network, the network manager/operator will provide routine support for customers, including the set up, configuration, and testing of new services, troubleshooting problems, and providing customer support.
- Once the project signs an agreement with an Internet provider, time will be needed to connect the wholesale provider fiber to the network, install equipment, and configure their network for the new services.

Once the project is ready to begin providing retail services, the enterprise becomes operational and a variety of ongoing tasks and activities begin to take place.

12.4 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.

12.5 REVENUE AND EXPENSE PROJECTIONS

Wireless Internet service is a challenging business. It takes many months to acquire enough customers on a new network to break even, and even longer to begin to show a profit.

The revenue projections below are based on retail prices. Expense projections are on the next page, and these projections are somewhat independent of the ownership entity (e.g. a for profit company or a non profit/county enterprise).

Sample Revenue Projection

Service Item	Description	Monthly Fee	Projected Customers	Projected Annual Revenue
Residential Internet	10 Meg down/1 Meg up	$50	250	**$150,000**
Residential Internet	25 Meg down/ 3 Meg up	$65	75	**$58,500**
Business Internet	5 Meg down/5 Meg up	$75	25	**$22,500**
Business Internet	10 Meg down/10 Meg up	$95	15	**$17,100**
Business Internet	20 Meg down/20 Meg up	$125	10	**$15,000**
			Total Projected Annual Revenue	**$263,100**

Network operational expenses can vary, and will have to be managed closely to achieve financial targets. A modest but regular marketing and awareness effort will be absolutely critical to success. The expense projections below assume a county or nonprofit effort.

If a service provider leases the network infrastructure, the provider would collect the revenue and therefore would be responsible for all associated network expenses listed below. A profit sharing agreement might be possible in that scenario.

Gilbert Area Network 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	**$3,600**
Marketing and Awareness	Marketing materials, maintenance of social media advertising and awareness, promotional materials, part time marketing person	**$45,000**
Sales Commissions	Direct sales commission paid for every new customer signing up for service (e.g. $100 for each new customer)	**$10,000**
Site Leases	Some poles will be placed on private property which would require annual site leases. Site leases for poles should be discouraged wherever possible, as it is a long term (perpetual) expense. $100-$250 per year is recommended.	**$1,000**
Internet	Wholesale cost of Internet if the network is operated as a community enterprise.	**$21,600**
Network Monitoring	The network will require 24/7/365 monitoring, fault detection, troubleshooting, and service provision.	**$66,000**
Repairs and Maintenance	The network will require both routine and emergency repairs. This can be outsourced to a qualified for profit or non profit firm	**$60,000**
Replacement Parts and Equipment	Equipment will have to be replaced from time to time, and new customers and/or expansion of the network will require additional equipment and spare parts.	**$40,000**
Insurance	Some insurance is likely to be needed (general liability, unemployment, asset insurance, umbrella policy).	**$5,500**
Total Costs	**Projected annual expenses**	**$254,200**

13 COMMUNICATIONS AND OUTREACH STRATEGIES

A successful marketing plan for the project 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. Facebook can be extremely effective in spreading information about the effort, and a Facebook page should be entirely adequate during the development period of the project. A permanent Web site is probably not needed until the network is ready to offer service.

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 Goals – The project 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.

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.

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 Committee 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 each 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 Committee 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 the tri-county area. 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.

Activity	Description	Discussion	Tasks
Pole Site Development	Identify a site for a pole and manage installation.	If this phase is included in a grant application, it will be important to have MOUs (Memorandum Of Understanding) for each site that grants permission from the building or property owner to locate a pole.	• Get property owner agreement • Confirm participation by ISP partner. • Identify Owner's Representative for project management and construction oversight. • Finalize network equipment and network design. • Prepare public procurement bid documents for pole installation and equipment purchases. • Bid procurement process, including bid release and bid review. • Secure any needed permits. • Pole construction takes place. • Network equipment installation, configuration, and testing. • Site ready for service.

14.1 POLE SITE IDENTIFICATION

When a site for a new community pole is being considered for use, there are several steps required.

- Site identification – Identify areas of poor service and look for existing towers. Pole sites should be selected, as much as practical, to be near existing roads and electric service to minimize the cost of road access and the cost of extending electric service.
- Network Compatibility – Line of sight from the pole 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 may be required to as part of the permitting process. For a utility pole, there may be only a modest or no site plan required.
- Leases and permits – A permit to place the pole is required in most localities, and the permitting process, if required, could take several months.

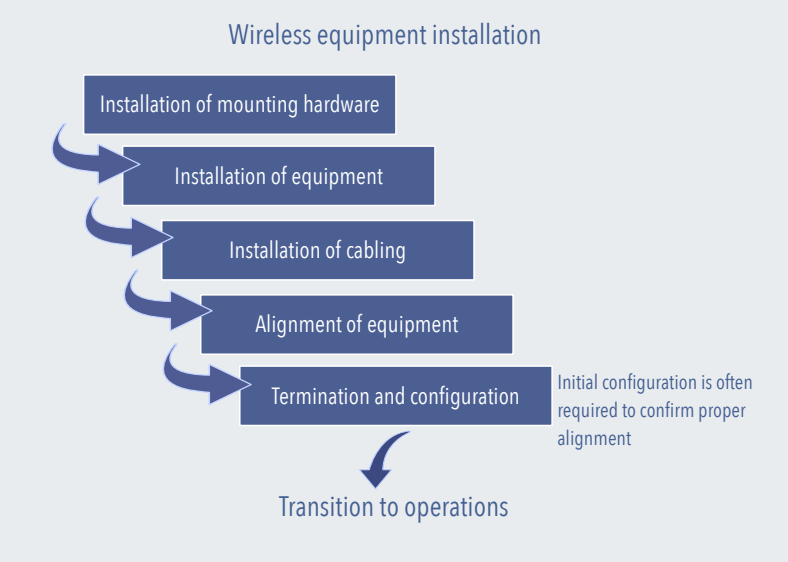
14.2 POLE CONSTRUCTION

Once the initial site work is completed and any permitting work has been completed, pole placement can proceed. Pole placement can usually be completed in a single day, but electric service (including meter placement) could take a week or two or longer, and depends on the electric utility.

- Bidding and contracting – Bid documents and pole 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 pole site has to be cleared of trees, brush, and any other obstructions. The area directly around the pole 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.
- Pole placement – Once site clearing and any road work is completed, the pole is installed. Once the pole is in place, electric service to the pole (including meter placement) comes next.
- Final work details – Once the pole is in place, final work items are completed, including installation of the radios, installation of a small pole-mounted equipment cabinet, network equipment installation and testing, and radio alignment work required (i.e. alignment of the point to point radios to the designated tower or pole for backhaul. In some locations, fencing, generators, and fuel tanks may optionally be included.

14.3 WIRELESS EQUIPMENT INSTALLATION

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

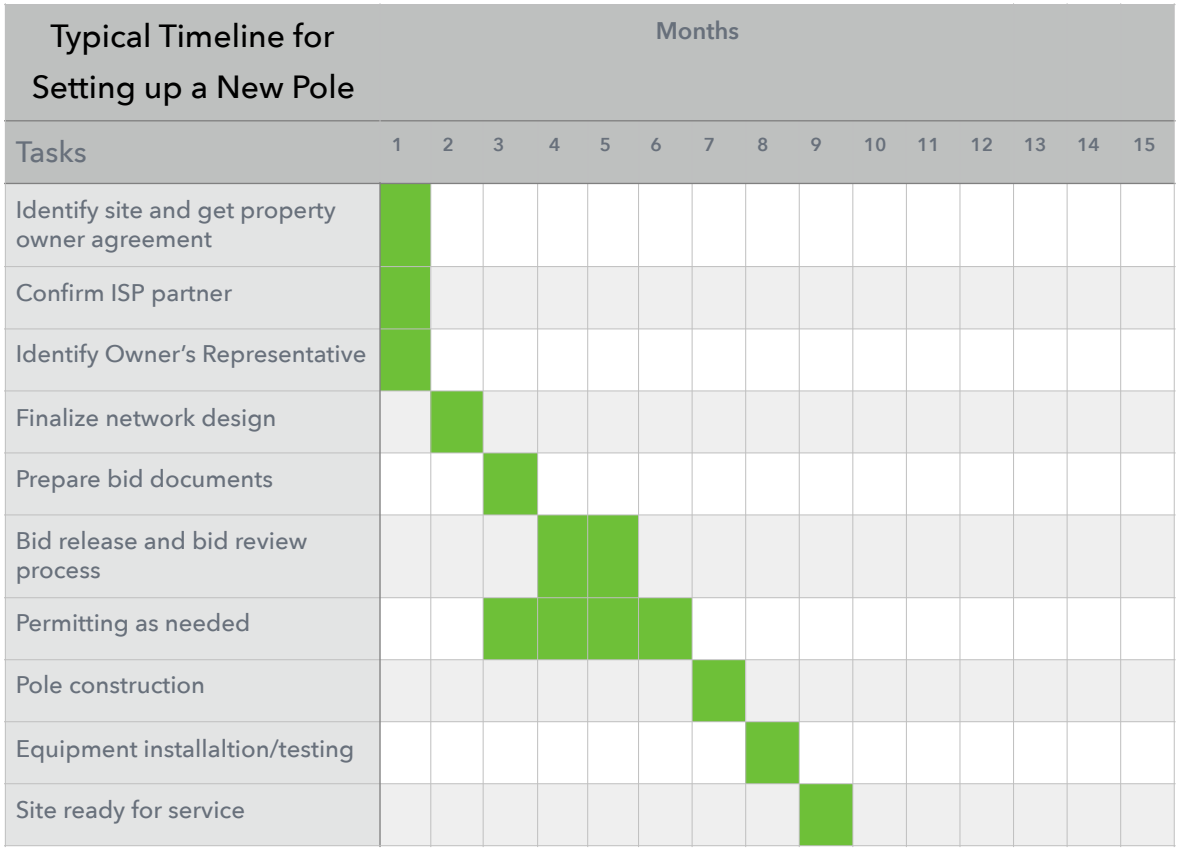


- Mounting hardware – Brackets and other mounting hardware have to attached to the pole at the designated height. This requires a bucket truck or lift (can be rented as needed).
- Equipment installation – Once the mounting hardware is in place, radios are attached to the pole. In the cabinet on the pole, 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 pole to the radios on the pole.
- Alignment of radios – Radios on the pole have to be adjusted. Local access radios that provide service to local customers with line of sight to the pole have to be aligned for optimum coverage. If there are also point to point radios on the pole for connections to other poles or locations, these also have to be aligned. A bucket truck or lift will be required.
- 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.

14.4 TIMELINE

The timeline and schedule below describes the process for placement of a single pole. For the projects proposed in the study areas, with multiple poles, the site work required on most sites could be done in parallel. Once funds are in place, none of the individual projects (e.g. Town of Gilbert, Justice Creek, etc.) should take no more than nine to twelve months start to finish.

The largest variable that could affect the schedule is the identification of the pole sites and obtaining the property owner agreements to locate a pole on private property. Given the poor service in the area, most property owners should be receptive to having a pole placed on their property given that much improved Internet service will become available.



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.

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.

MST: Multiport Service Terminals are widely used in fiber to the home deployments to connect individual home drop cables to larger distribution cables on poles or in handholes. Pre-connectorized drop cables snap into the MST ports and do not require any splicing.

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

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

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

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

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

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

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