MORGAN COUNTY BROADBAND

Improving Broadband Access

DESIGN NINE
broadband planners

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BROADBAND FOR MORGAN COUNTY

Broadband has, over the past twenty years, become critical infrastructure for communities. Routine activities of both residents and businesses now often require Internet access. K12 schools continue to expand the use of Internet-enabled learning resources, and children in households with inadequate Internet service are at a severe disadvantage. Work from home and business from home activities are increasing, making business class broadband availability in rural parts of the County an economic development issue.

Broadband, or perhaps more correctly, the lack of adequate broadband, has become a crisis in America's smaller towns and communities. The larger incumbent providers are making the bulk of their investments in urban and suburban areas of the country, with generally very limited and often reluctant improvements in more rural communities. Rural communities that have developed community-owned networks have service and pricing that is superior to what is available in most urban areas.

The FCC has set targets of 10 Meg down/1 Meg up and 25 Meg down/3 Meg up as their definitions of 'broadband," but large portions of Morgan County are not able to receive consistent access to even the lesser 10/1 service.

The County should focus on providing basic broadband infrastructure like upgrades to existing towers and new towers in underserved areas of the County and stay out of the retail Internet business. Much like the way communities manage roads, Morgan County can provide shared tower space to Internet Service Providers and lease tower access to those private sector service providers.

Despite the enormous pressure from citizens and businesses to "solve the broadband problem," community leaders must recognize that the solution will arrive incrementally over a period of several years, and must manage community expectations.

A broadband survey of residents and businesses was conducted as part of this study, and a very large number of comments were received (see the full business and residential survey data in the separate survey report). Residents and businesses wrote long and passionate descriptions of their challenges with existing broadband service in the county.

94% of residents responding to the broadband survey want better Internet service.

Only 13% of respondents are satisfied with their current Internet provider.

40% indicate that availability of broadband Internet is affecting where they choose to live.

86% of businesses responding to the broadband survey want better Internet access.

Only 4% of businesses are "very satisfied" with their current Internet service.

65% of businesses that responded need employees to be able to work from home

I work from home 2 days a week and use video conferencing several times a day to attend/run meetings. High speed and dependable network access is a must, and my current provider has good days and bad days at the moment.

I am seriously considering moving. I think I made a BIG mistake when I retired, and my wife and I moved here to WV." Home camera monitoring, work smart home Netflix and Hulu Frontier is not able to provide a reliable level of service.

Very frustrated with Frontier's promises of faster speeds, we pay for far faster than we have ever received.

We need better internet in the Cherry Run area. Half the time our internet is down and we don't have it at all for a few days sometimes weeks. Frontier is the worst internet provider and we do not have any other option out that way.

Frontier DSL is a HORRIBLE service (always up and down) and the download speed, in this day and age, is deplorable (< 3 mb download)! More and more people are starting to work from home (like I do) so if Morgan county wants this demographic to move to this county then they need to make a BIG CHANGE to internet availability within the county. If something doesn't happen in my area in the near future with the availability of BROADBAND I just may have to move, I work from home and need a REAL, repeat, REAL, internet connection.

We are forced to connect through Frontier and on average the maximum speed we get is 1.40 mbps download and 0.44 upload. In order to work from home I am forced to connect via an AT&T hotspot. Because of the expense, I can not use the hot spot for other devices.

Overpriced and very slow speed. We have two connections, one for the business and one for the residence. Every time we see adds on TV for Internet connections in nearby cities we feel like crying. One hour away and they get 500 Mbits for $50 while we pay $100 for 2.5! That is almost criminal.

I am in IT professional who works from home 3-4 days a week. As such, I require dependable, high-speed internet to do my job. I use Frontier DSL as my primary internet service provider because Frontier does not limit my data. I pay for Excede satellite as my 'back-up". Both services are slow and often unreliable. Obviously, it is every expensive to maintain 2 services - but I don't have any options.

A key question is "**How does Morgan County benefit from telecom infrastructure investments?**" There are numerous ways that County investments in wireless tower improvements and/or new towers could be beneficial:

- Even modest investments in County-owned infrastructure in key areas targeted for business and community development gives the County and its residents and businesses some freedom from monopoly providers. Leasing out the infrastructure to competitive providers generally lowers prices for broadband services and improves service quality.
- The leased telecom infrastructure will generate some modest revenue to help maintain towers and pay for routine repairs and maintenance.

- A University of California-Davis study found that home-based workers reduced their work-related driving by 90%. This can be very significant for rural residents who may have to drive long distances to work. The same study found that telehealth services that use online consultations reduced transportations costs and reduced the impact of lost wages due to taking time off from work to drive to a medical clinic.
- Fiber can deliver Internet access via controlled access WiFi hotspots for use by County personnel (e.g. Sheriff's Department, Public Works) while mobile.
- The County could provide some free WiFi Internet access for use in downtowns and in County parks. Visitors to the County (e.g. Berkeley Springs) could be provided information about the area via a Web page when they first access the free Internet (e.g. local restaurants, County services, local attractions, retail shops and stores). The local Chamber of Commerce may be willing to support this venture.
- Real estate agents report that property values increase when homes and businesses have good broadband connectivity.

GETTING STARTED

With more than a dozen years of operation for a variety of community-owned network infrastructure projects around the country, there is very little "experimentation" that is still necessary.

With more than seven hundred communities making investments in broadband infrastructure, there is now enough information about what works and what does not work to be able to identify best practice across nearly all areas of operations, planning, management, and finance.

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

Focus	Description
Focus on Improved Wireless Broadband Access	Morgan County residents and businesses outside of communities with cable Internet service need an alternative to the largely very poor DSL Internet access. Making County-owned towers available to WISPs (Wireless Internet Service Providers) and provisioning new towers in some underserved areas will support improved Internet service.
Fund for Success	Successful expansion of wireless broadband in the County will be most successful by recognizing that funding will come from a "basket" of funding sources, rather than a single source. Grants, public/private partnerships, some County funds, and other sources may all be needed to achieve success.
Use grants as supplemental funding	Grants can be extremely important in the early stages of an effort to support planning activities and/or to fund a Phase One build out initiative. But grants rarely will allow spending on operational expenses. Grants should be used to supplement other sources of funding and as one time cash injections to support very specific goals. Communities that have relied too heavily on "the next grant" as a key source of expansion or operational funding usually experience severe financial problems.
Manage expectations	Most of the recommended improvements can be completed in about a year given sufficient funding. If funding is limited and/or needs to spread over more than one year, the County should manage citizen and business expectations by explaining both the short term and long term objectives.
Do something	Communities that have successfully expanded Internet access options for their citizens and businesses typically started with whatever funding was immediately available, recognizing that the effort may take more than one round of funding. Experience has shown that once a local government has successfully executed even modest improvements (e.g. a single tower upgrade), the track record of success makes it easier to attract follow-on funding and grants.

Focus	Description
Plan for marketing and public awareness efforts	If a County-wide broadband initiative moves forward, it will be necessary to have a modest but regular marketing and awareness campaign to ensure that local businesses and residents know that the County is engaged in trying to solve the broadband problem, that they know what service providers are available on the towers, and that they know how to order service. Service providers will be responsible for sales (that is, selling their services and signing up their own customers), but the County has a role to ensure general awareness of the new providers and the County's role facilitating wireless broadband improvements.
Attracting Service Providers	Once an initial plan is in place to make tower improvements and/or to add towers, WISPs should be invited to meet with County officials to discuss making use of the planned infrastructure.
Public Safety Partnerships	The availability of County-Owned public safety towers can enable new services and applications for police, fire, and rescue in the county. Secure WiFi hotspots can be set up around and near the towers so that reports can be filed from the field using the WiFi Internet connection. Other communities that have done this have found that it saves time and keeps patrol cars out in the field longer. There are often grants available for public safety voice and data communications improvements (e.g. new towers, upgraded tower facilities) that could also support the broadband initiative. Any public safety tower or communications expenditures should be analyzed to determine if the expenditures can also support expanded broadband access in the County.

MOVING THE EFFORT FORWARD

A TIMELINE FOR SUCCESS

Next Three Months

With the release of the report, some short term activities that should take place, including:

- Update tower lease agreement and fees.
- Continue regular meetings on broadband activities and issues.
- Discuss the option of providing a backhaul network between the existing towers.
- Meet with existing wireless providers and invite them to join the effort.
- Discuss and identify funding sources.
- For existing towers, meet with tower owners, check the most recent engineering studies, and determine if the towers can support additional antennas, especially the backhaul antennas (which are larger than the WISP access antennas.

Months Four to Six

With a broad strategy in place, a group of leaders will be needed to provide support, promote the project within the County, and to help develop the funding strategy. Other tasks and activities include:

- Developing a budget for the chosen "first phase" project (e.g. the first towers to receive improvements for service providers.
- Identification of early funding sources and solicitation of funds (e.g. writing grant proposals, state funding, soliciting County financial support, private contributions, etc.).
- For any new wireless towers, identify available County and private properties that fit the desired service areas.
- Solicit input from service providers on use of existing and any new towers that might be planned.
- As work begins on up-fitting existing towers (or if one or more new towers is under construction), meet with service providers to develop binding agreements to use the new infrastructure to sell services.

Months Seven to Twelve

Assuming that some funding has been identified and secured, move forward with Implementation Planning for the "first phase" projects–preparing for construction. That work may include:

- Improvements to existing towers should take only a few months to complete and should be finished in this time frame, making towers ready for WISP use and expanded Internet service.
- For new towers, negotiate with property owners, begin any required permitting process prior to construction.
- Assuming that funds have been secured, construction of towers may begin as early as month nine or ten.

YEAR TWO

In the early part of year two, "phase one" improvements would be completed and service providers would be offering improved services. Revenue would be collected from providers using the towers. Financial management of revenue and expenses will begin.

BROADBAND INFRASTRUCTURE AS A UTILITY

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

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

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

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

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

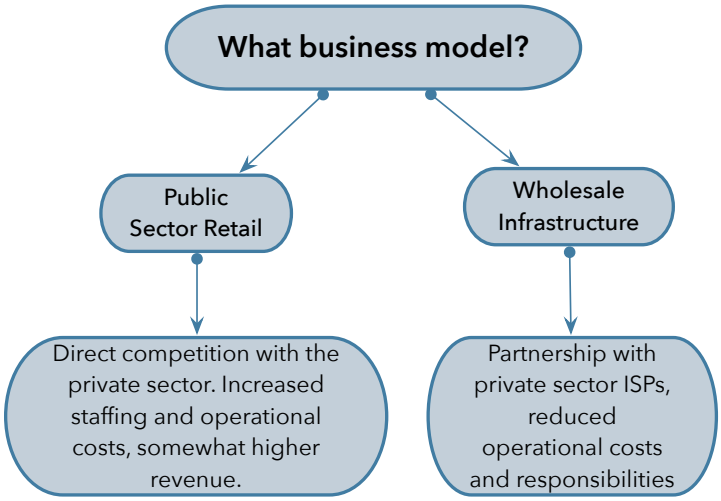
The time has come to recognize that it is inefficient and wasteful to build full duplicated digital road systems, which only raise the cost of telecom services to all public and private users. Networks that share capacity among a wide variety of public and private users have a lower cost of construction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

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

THE SHARED INFRASTRUCTURE BUSINESS MODEL

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

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



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

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

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

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

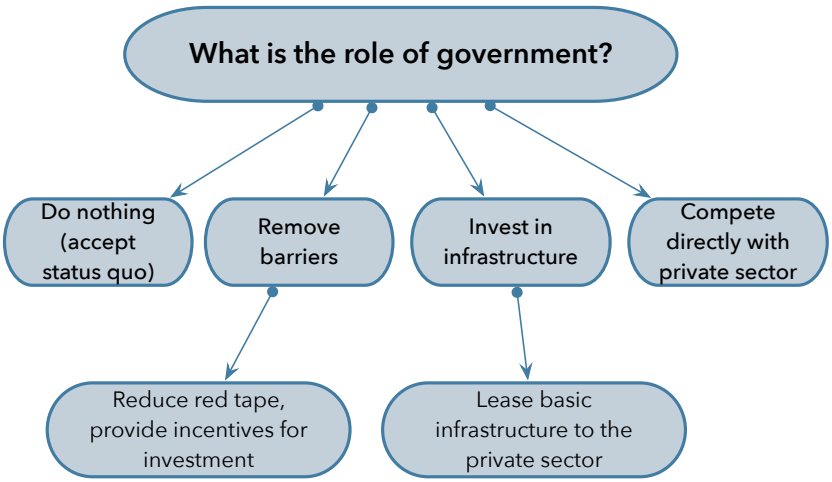
Recommendation

In Morgan County, improved wireless broadband is going to be an important strategy, and WISP access to existing and/or new towers could provide an important strategy to improve broadband access in rural areas of the county.

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

WHAT IS GOVERNMENT'S ROLE?

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



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

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

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

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

Recommendation

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

As just one example, County planners could work with developers to help them realize that installing conduit and related infrastructure in new subdivisions is an inexpensive way to increase the potential sales price on the homes. No special funding is required from the County.

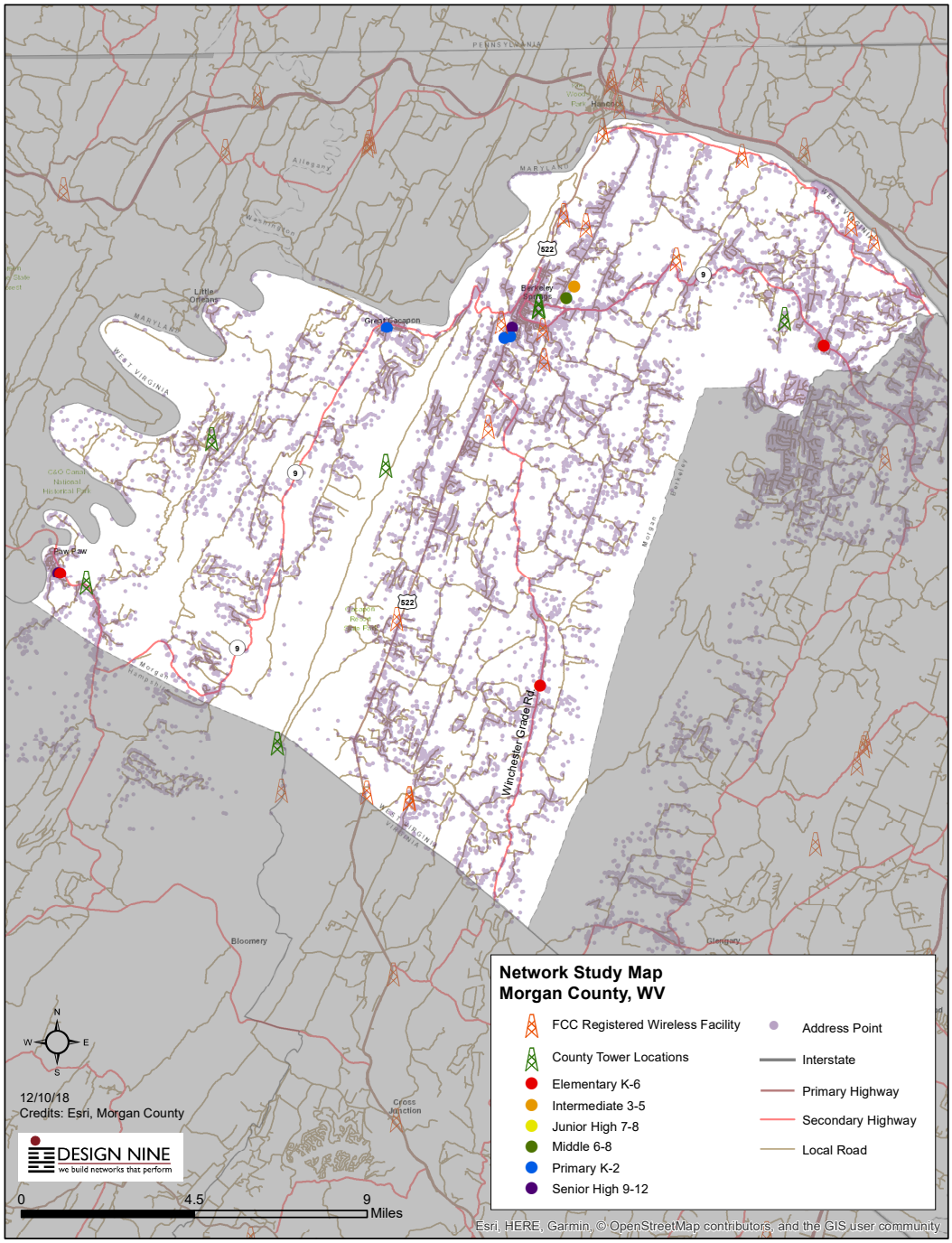
EXISTING ASSETS AND DEMOGRAPHY

The maps on the following pages include:

- Points of interest, including household density (an important factor when evaluating new service areas).
- LMI Areas of the county (Low and Moderate Income). Very important for certain kinds of grants.
- HUD grant eligible areas of Morgan County
- West Virginia speed test data results
- Towers in various parts of the area. These are taken from the FCC tower registry and other sources. The FCC registry which includes both cell towers and other kinds of towers (e.g. radio/TV broadcast towers, public safety towers).
- Long haul fiber routes through the county, which are important data routes to the rest of the Internet.

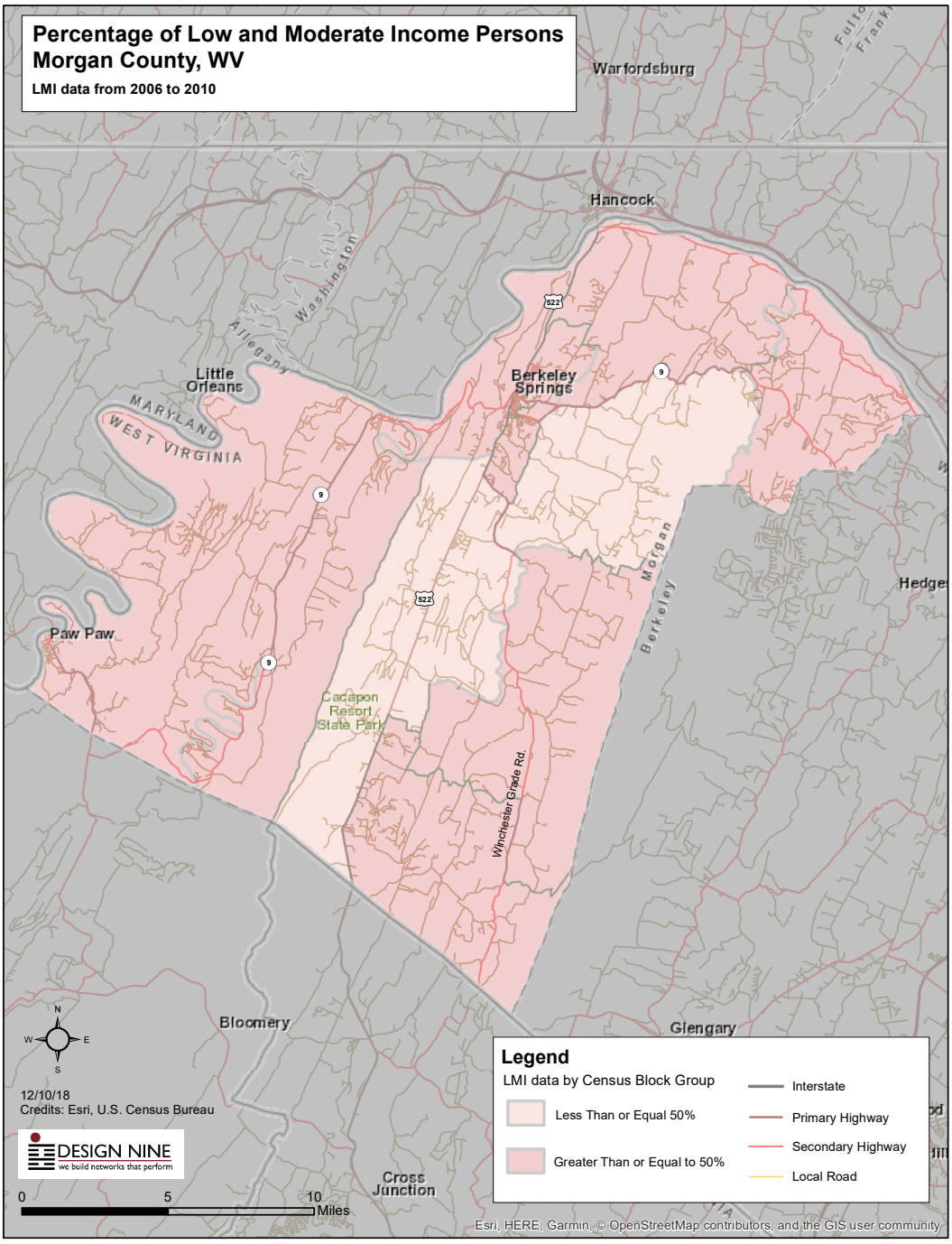
POINTS OF INTEREST

County-owned towers are in locations where WISPs, if they put equipment on those towers, could improve broadband access over large portions of Morgan County.



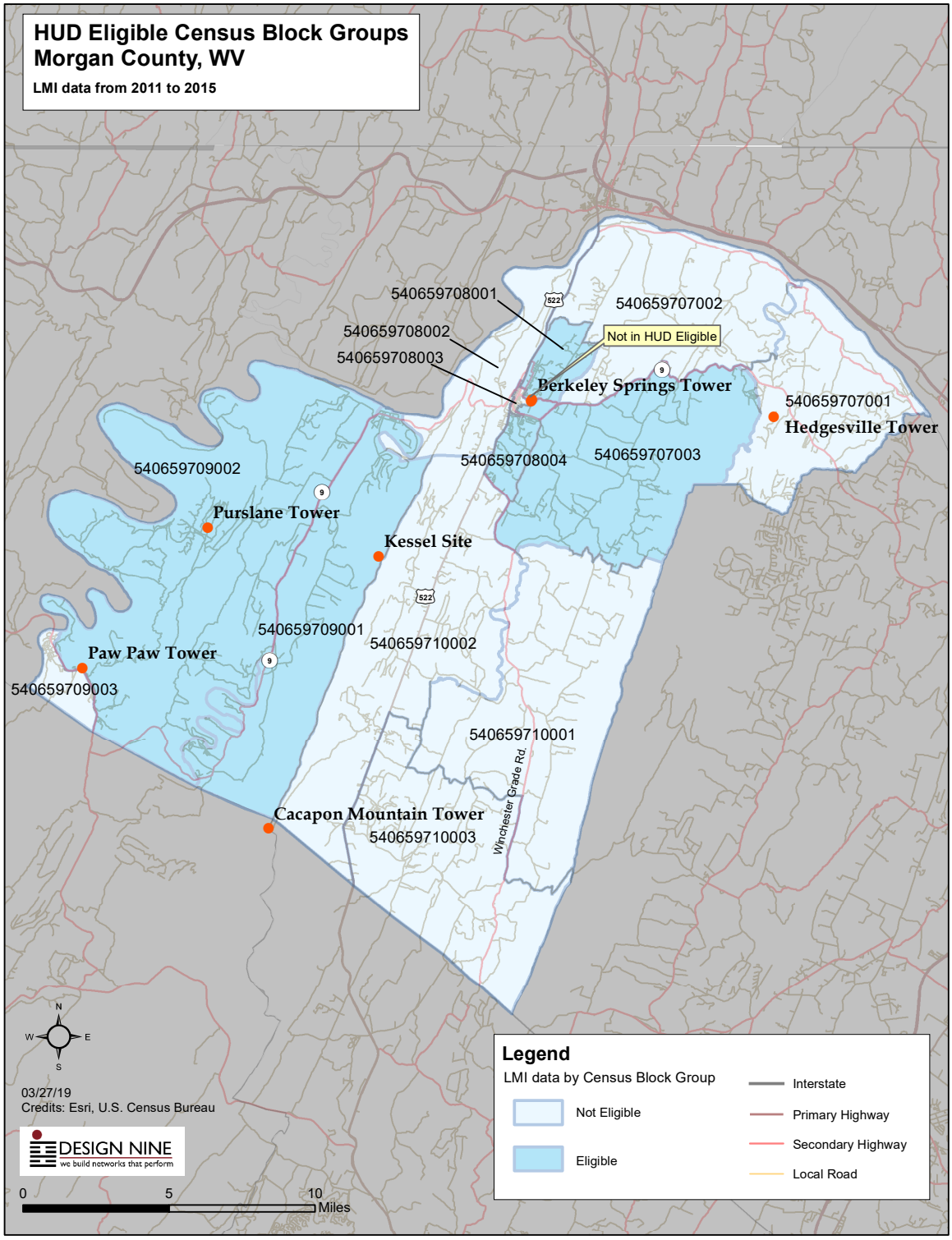
LMI AREAS OF THE COUNTY

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



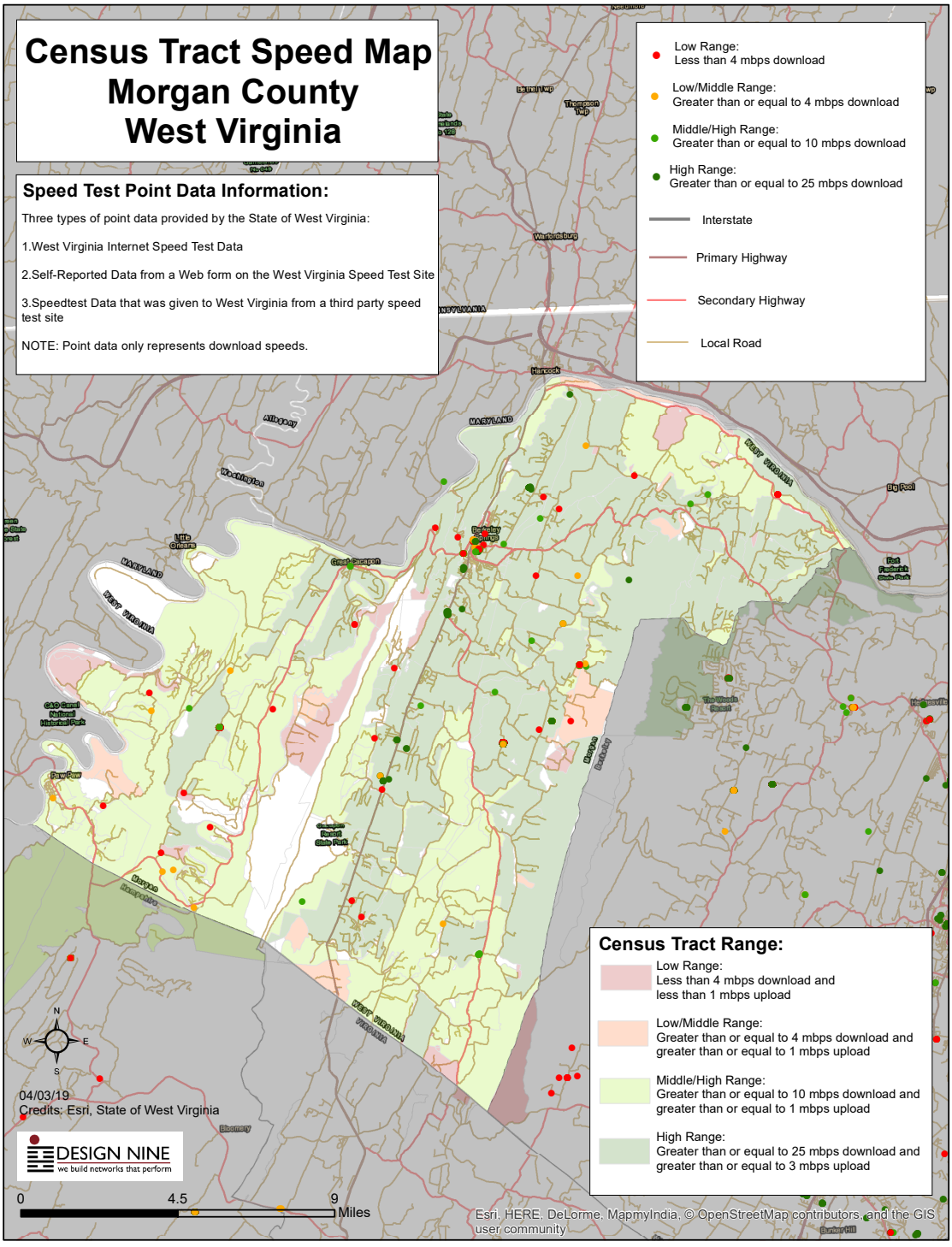
HUD GRANT ELIGIBLE AREAS

This map shows the census blocks in the county that qualify for HUD grants (typically CDBG funds).



WV SPEED TEST DATA

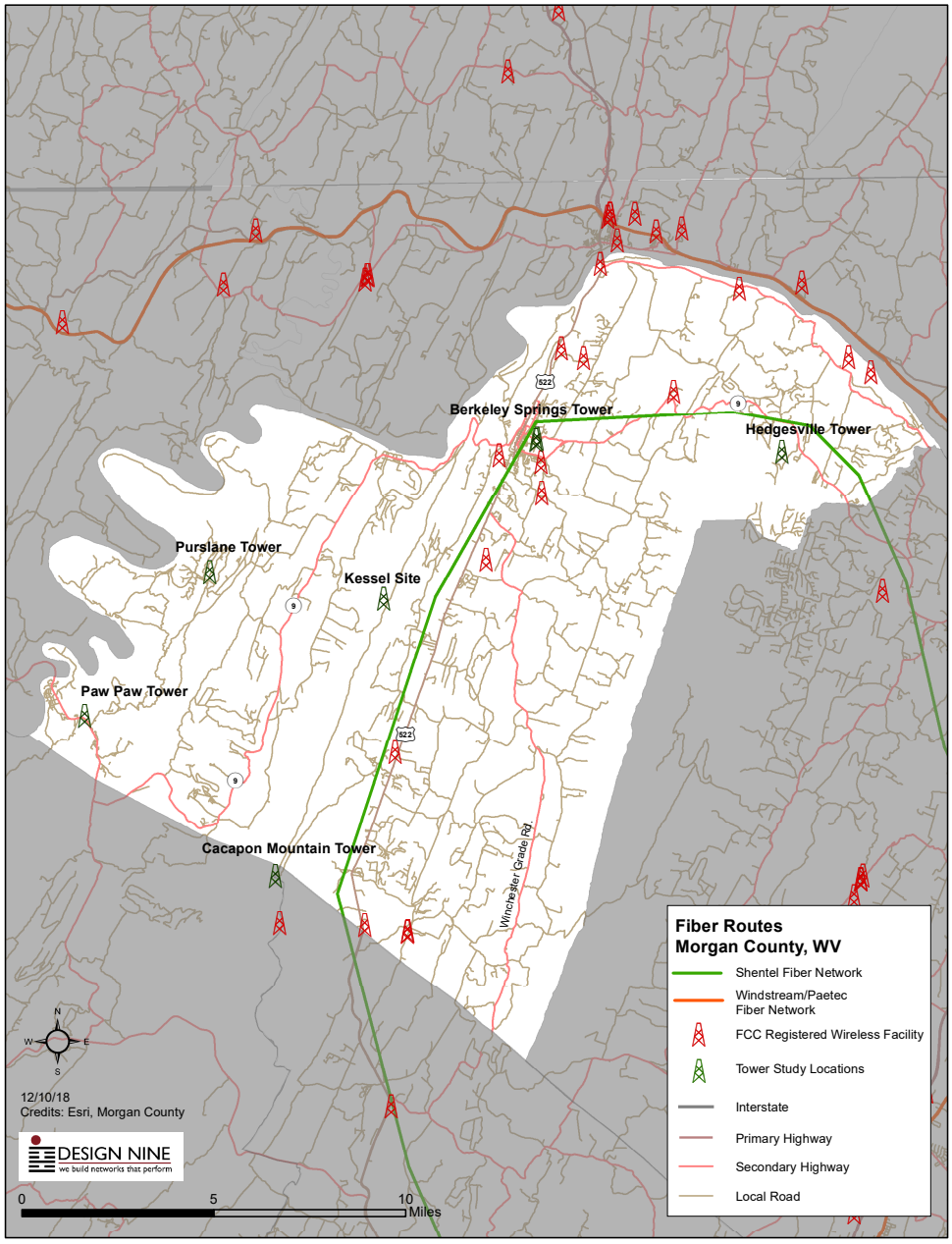
The data used to generate this map was provided by the state of West Virginia, which has been encouraging residents to use an online speed test to collect information about broadband services in the state. Not all data had geo-located addresses included.



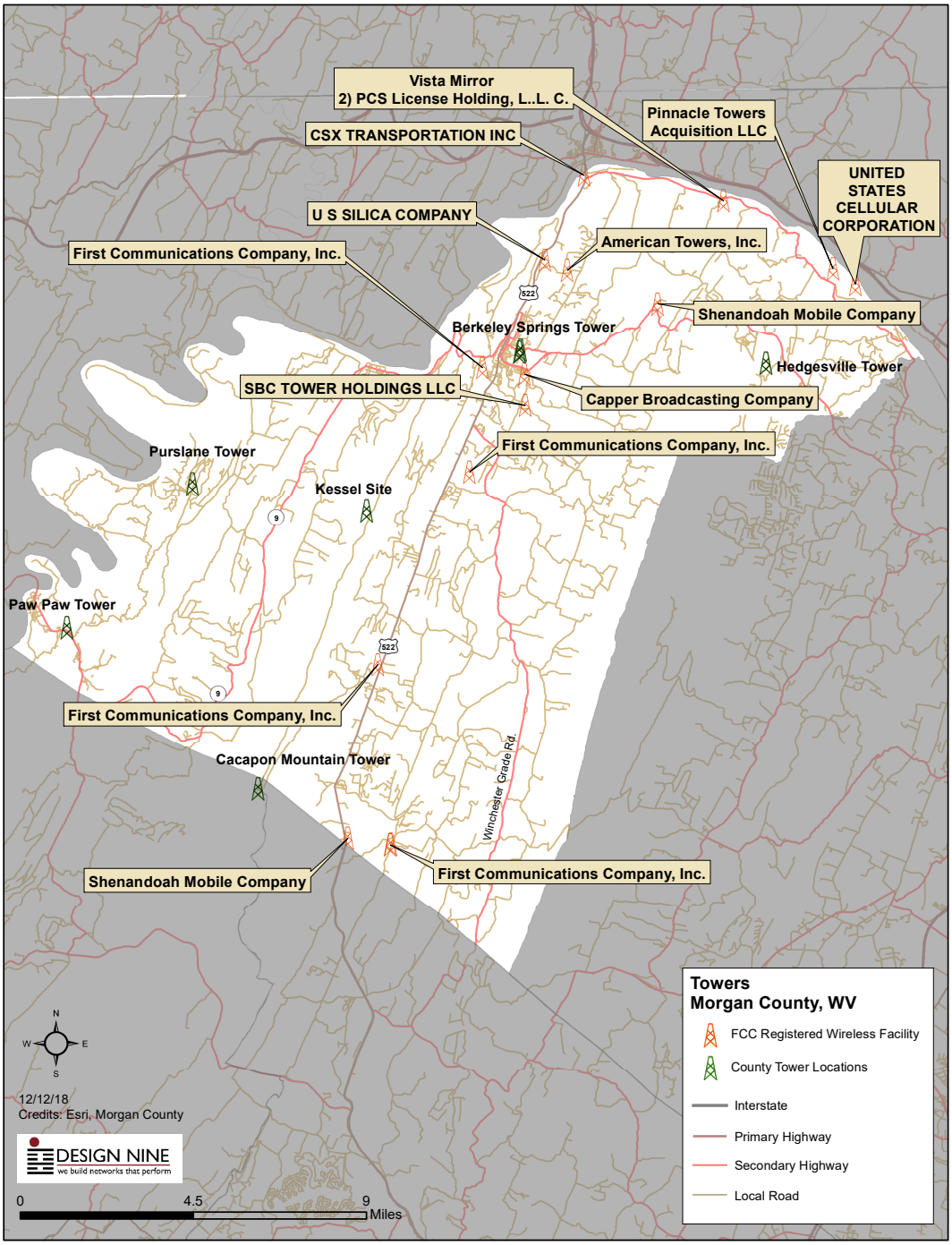
TOWER AND FIBER ASSETS

There are a number of cellular towers in the county. These are clustered along major travel routes, which leaves many areas of the county with marginal or no cellular service. Increased availability of good wireless and/or fiber broadband service would enable many residents and businesses to use inexpensive nano-cell boxes in their home or business. More information on nano-cells is contained in a later section of this report.

Some limited third party (e.g. not incumbent) fiber is in or near the county. These routes are extremely important as more "last mile" broadband improvements are made–competitive ISPs and WISPs can generally get better pricing from companies like Shentel, Windstream, and Paetec than from Frontier or the cable companies.

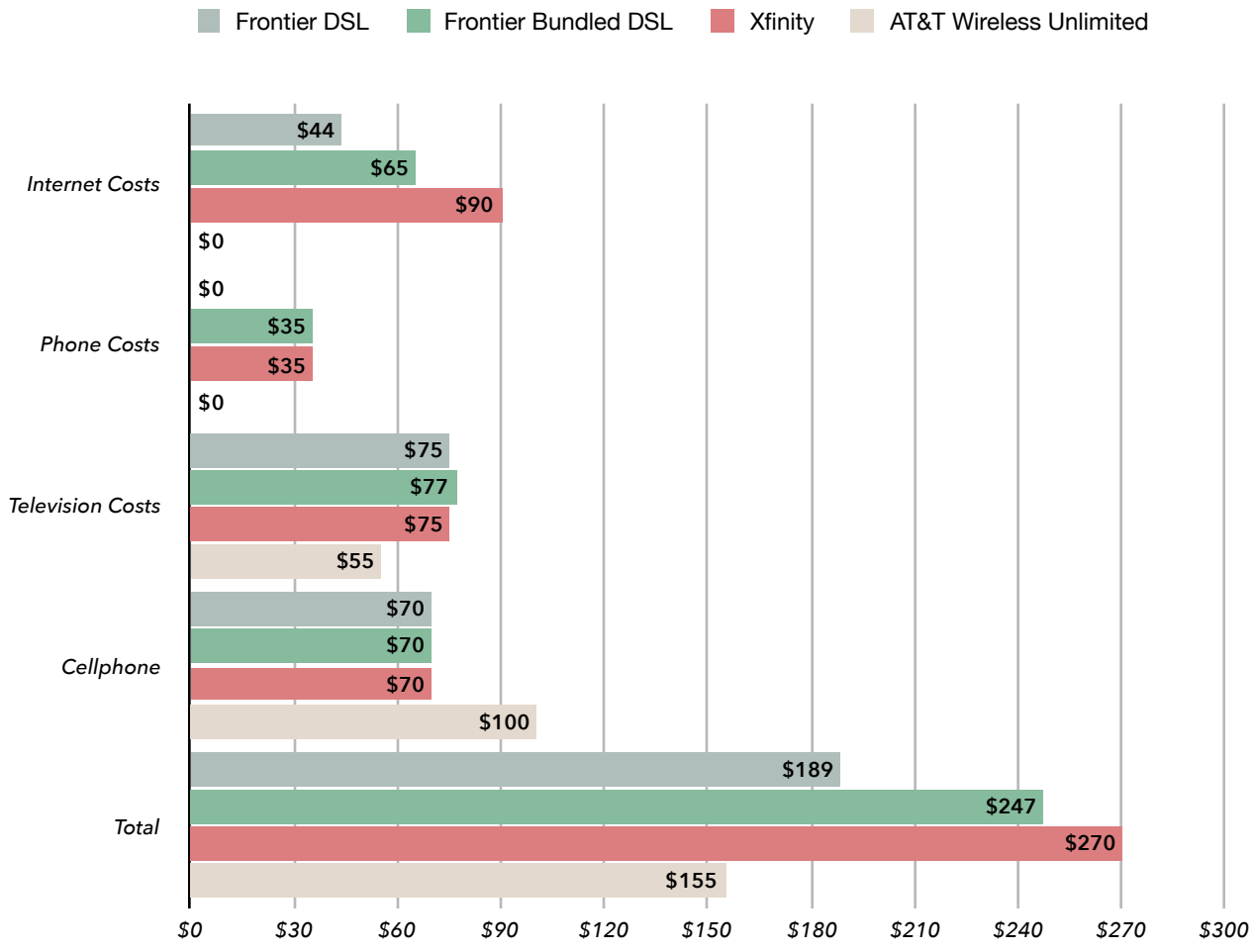


This map shows the owners of towers that have been registered with the FCC. Not all towers are registered in the FCC database.



SERVICE PROVIDER ANALYSIS

Below are graphs showing communication costs for families receiving the Internet in different ways in Morgan County. Frontier DSL appears to be the most available service in the County. Their bundled $70/mo for 25 Mbps ↓ – Mbps ↑ with no data cap including TV and phone is highly discounted. We estimate the true cost after the promo ends would be much closer to their satellite bundled services at $176.98 per month. We have used an estimated $177 non-promo price for our base Frontier bundled package for this graph. For sake of comparison on Frontier DSL services without bundling, we have added satellite TV costs. We have used AT&T Unlimited and More plan with additional access for a tablet which comes with a 15 GB hotspot. There are significant streaming and data limitations on the AT&T and More plan. 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 packages, Frontier and Xfinity have a standard telephone plus a cell phone. ***The average monthly cost of these services in Morgan County is $215.14***.



Zip Code Data

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

Internet Service Providers & Percent Zip Code Coverage

Zip Code	USPS Town	Frontier DSL	Lumos	Xfinity Cable	Armstrong Cable	Atlantic Broadband	Armstrong Fiber	Morgan Wireless	Skyburst Wireless
25411	Berkeley Springs	✔ 96.9%	✔ 6.4%	✔77.8%				✔ % unknown	
25422	Great Cacapon	✔ 91.5%		✔ 39.7%				✔ % unknown	
25427	Hedgesville	✔ 96.9%		✔ 78.3					✔ 41%
25434	Paw Paw	✔ 96.3%			✔ 3.9%	✔ 1.6%	✔3.9%		

Morgan County Population 2010 by Zip Code- Population Data from US Census

Zip/ ZCTA	USPS Town	% Morgan House-holds in the Zip	DSL	Cable	Fixed Wireless	25 Mbps Coverage	2010 Pop.	Land-Sq-Mi	Density Per Sq Mi
25411	Berkeley Springs	100%	100%	81%	Unknown %	81%	12,633	140.45	89.94
25422	Great Cacapon	99.7%	91%	36%	Unknown %	36%	1,700	69.96	24.30
25427	Hedgesville-not a Morgan County town	16.1%	98%	91%	41%	91%	14,322	135.92	105.37
25434	Paw Paw	34.5%	100%	0%	0%	0%	2,521	68.13	37.00

LOCAL PRICING DATA

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

Wireline Providers

FRONTIER✔

$106.99 + $69.99 for Dish with sports for $176.98 for 12 Mbs ↓ Installation $75, Broadband router $10/month. Two year promotional price. Two-agreement with maximum $120 ETF. Premium Channels: 3 Mos. Free: After 3 mos., you will be billed $30/mo. for Showtime, Starz and DISH Movie Pack unless you call to cancel.

$80/mo for 90 Mbps ↓ – Mbps ↑ with no data cap. Custom Essentials TV. Vantage Voice Unlimited. 2-year promo rate. Wi-Fi Router fee waived for 12 months, $10/mo. thereafter.

$75/mo for 45 Mbps ↓ – Mbps ↑ with no data cap. Custom Essentials TV. Vantage Voice Unlimited. 2-year promo rate. Wi-Fi Router fee waived for 12 months, $10/mo. thereafter.

$70/mo for 25 Mbps ↓ – Mbps ↑ with no data cap. Custom Essentials TV. Vantage Voice Unlimited. 2-year promo rate. Wi-Fi Router fee waived for 12 months, $10/mo. thereafter.

$30/mo for 18 Mbps ↓ 1 to 1.5 Mbps ↑ with no data cap. Two year promo rate. Installation is $75 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

$25/mo for 12Mbps ↓ 1 to 1.5 Mbps ↑ with no data cap. Two year promo rate. Installation is $75 and equipment delivery fee is $9.99/. Modem with Wi-Fi 10/mo.

$20/mo for 1.1 to 6 Mbps ↓ 1 Mbps ↑ with no data cap. Two year promo rate. Installation is $75. Modem with Wi-Fi 10/mo.

LUMOS✔

$74.95/mo for 100 Mbps ↓ 20 Mbps ↑ Modem included.

$59.95/mo for 50 Mbps ↓ 10 Mbps ↑ Modem included

$44.95/mo for 25 Mbps ↓ 10 Mbps ↑ Modem included

ARMSTRONG CABLE ✔

$99.95/mo for 400 Mbps 400 Mbps ↓ 25 Mbps ↑ 2,000 GB Data Cap. Setup $0 (Free installation) Modem Included.

$99.95/mo for 500 Mbps 500 Mbps ↓ 25 Mbps ↑ 2,000 GB Data Cap. 3-month promo rate. Regular rate is $149.95. Setup $0 (Free installation) Modem Included.

$60.95/mo for 300 Mbps 300 Mbps ↓ 20 Mbps ↑ 2,000 GB Data Cap. 6-month promo rate. Regular rate is $77.95. Setup $0 (Free installation) Modem Included.

$39.95/mo for 100 Mbps 100 Mbps ↓ 10 Mbps ↑ 1,000 GB Data Cap. 6-month promo rate. Regular rate is $62.95. Setup $0 (Free installation) Modem Included.

$34.95/mo for 12 Mbps 12 Mbps ↓ 1 Mbps ↑ 200 GB Data Cap. 6-month promo rate. Regular rate is $62.95. Setup $0 (Free installation) Modem Included.

ATLANTIC BROADBAND ✔

$49.99/mo for 250 Mbps 250 Mbps ↓ 20 Mbps ↑ No Data Cap. 1-year promo rate. Regular rate is $89.99. Without Auto pay rate increase $10 per month for first twelve months then $20 per month. Setup $0 (Free installation) Modem w/WiFi $10/mo.

$39.99/mo for 50 Mbps 50 Mbps ↓ 6 Mbps ↑ No Data Cap. 1-year promo rate. Regular rate is $64.99. Without Auto pay rate increase $10 per month for first twelve months then $20 per month. Setup $0 (Free installation) Modem w/WiFi $10/mo.

XFINITY CABLE ✔

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

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

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

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

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

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

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

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

ARMSTRONG FIBER ✔

$199.95/mo for 1,000 Mbps 1,000 Mbps ↓ and 1,000 Mbps ↑ Setup $0 includes free installation.

$74.95/mo for 100 Mbps 100 Mbps ↓ and 100 Mbps ↑ Setup $0 includes free installation.

$54.95/mo for 25 Mbps 25 Mbps ↓ and 4 Mbps ↑ Setup $0 includes free installation.

Fixed Wireless Providers

MORGAN WIRELESS ✔

$64.99/mo for 25 Mbps 25 Mbps ↓ and - Mbps ↑. $150 Setup. Two year contract

$69.99/mo for 25 Mbps 25 Mbps ↓ and - Mbps ↑. $200 Setup. One year contract

SKYBURST WIRELESS ✔

Pricing not yet discovered.

Residential Satellite Internet Pricing

HUGHESNET

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

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

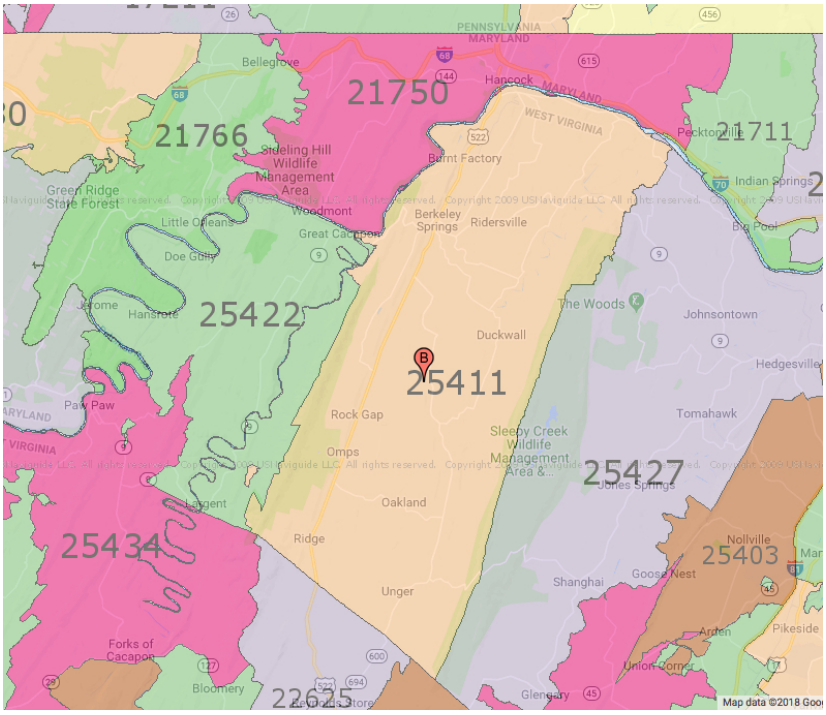
VIASAT/EXCEDE

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

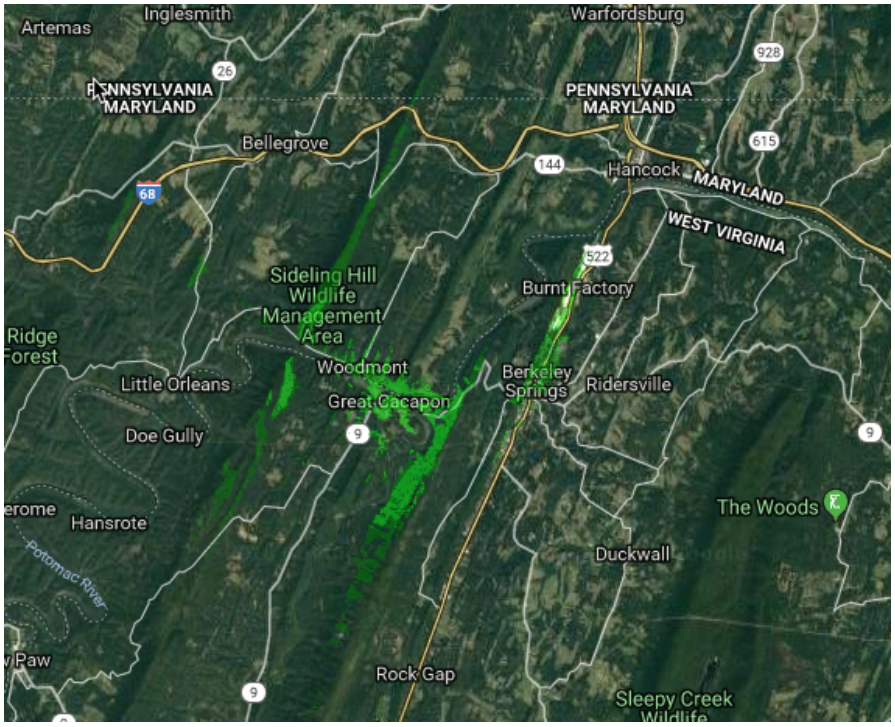
$70/mo for 25 Mbps ↓ Unlimited priority data. $100/mo after three months

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

Zip Code Map



Estimate of Current Broadband Wireless Coverage



UNDERSTANDING BROADBAND NETWORKS

In Morgan County, broadband wireless is going to be an important strategy for improved Internet access for businesses and residents. But both fiber and wireless technologies and systems are going to be important to meet the goal of improving access to broadband. The rest of this section provides more detail and some specific build out strategies. There are three major parts of any modern network:

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 of the county 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.

WIRELESS TECHNOLOGIES

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

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

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

More larger towers of 180' to 300'

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

Small cell broadband towers

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

Variety of radio frequencies

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

EMERGING WIRELESS TECHNOLOGIES

MIMO Wireless

MIMO (Multiple Input, Multiple Output) describes a variety of technologies that can be summarized as using more than one receive and transmit antenna for wireless data applications. Wireless protocols that are using the MIMO concept include IEEE 802.11n (Wi-Fi), IEEE 802.11ac

(Wi-Fi), 4G, LTE (Long Term Evolution), and WiMAX. Each of these protocols use the MIMO technology to increase the amount of available bandwidth in a given section of radio frequency spectrum.

New hardware is required to make effective use of MIMO. While the technology increases wireless bandwidth, the typical amount of bandwidth being used by wireless devices is also increasing rapidly. Some applications where MIMO is likely to provide noticeable improvements are in home wireless routers, where the effective throughput will be able to better handle the demanding bandwidth requirements of HD and 4K video streams. MIMO is slowly being developed for use with cellular smartphones, but both the phones and the cell tower radios have to be upgraded to support MIMO.

LTE/4G/5G

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

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

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

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

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

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

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

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

There is no free lunch in the physics of radio frequencies. The higher bandwidth of 5G means that cell sites need to be closer together because the 5G frequencies do not travel as far as existing 4G/LTE frequencies currently being used by the cellular industry. Most users will have to be within

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

As many as 60 cell sites per square mile may be needed to make 5G widely available in a given area. In Morgan County's 230 square miles, as many as 3,000 cell sites would be needed to provide ubiquitous coverage, although with careful analysis, that might be reduced to around 2,000 cell sites—all of them needing fiber backhaul.

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

White space broadband

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

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.

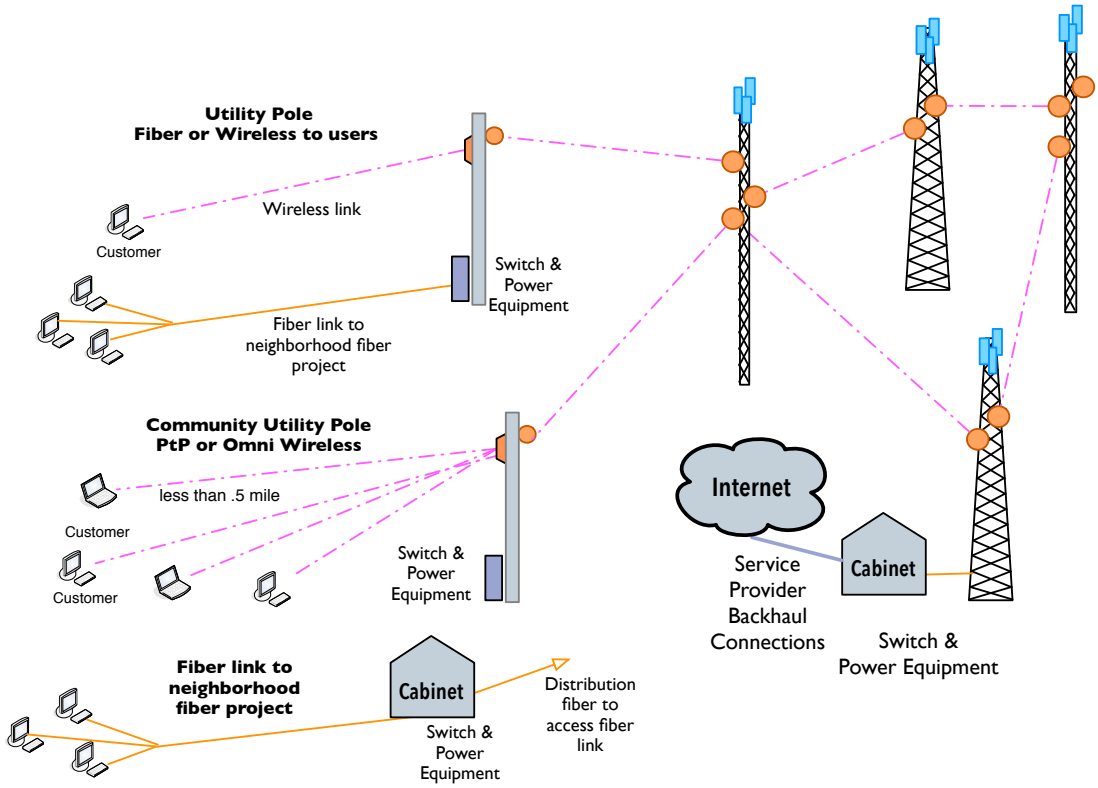
Like dark fiber, a lit network incurs break-fix and locate costs as well.

NETWORK COMPONENTS OVERVIEW

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.

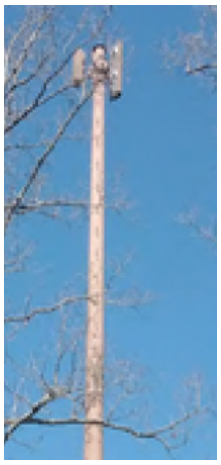
- The **Core Network** provides access to the Internet, a place for service providers (ISPs) to distribute their services locally on the network, and for larger institutional and business customers to meet service providers. Morgan County has both landline and wireless service providers, but there are still areas of the county 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 Morgan County. More detail is provided on the following pages.

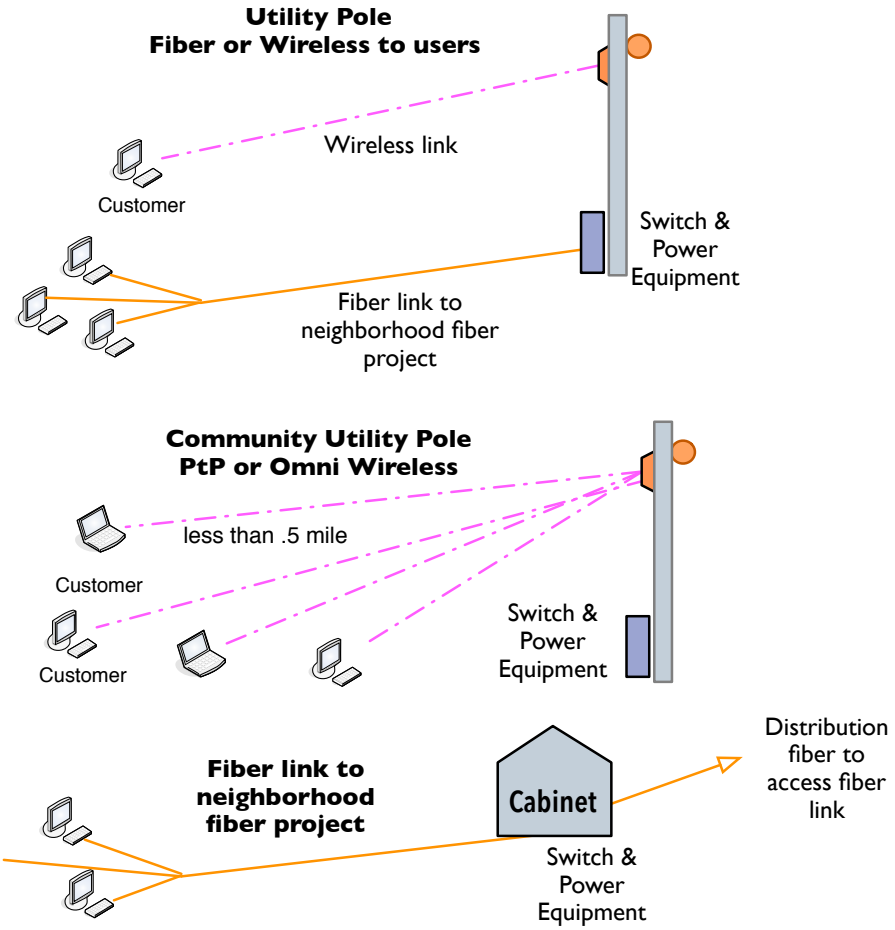


Last Mile Access

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



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

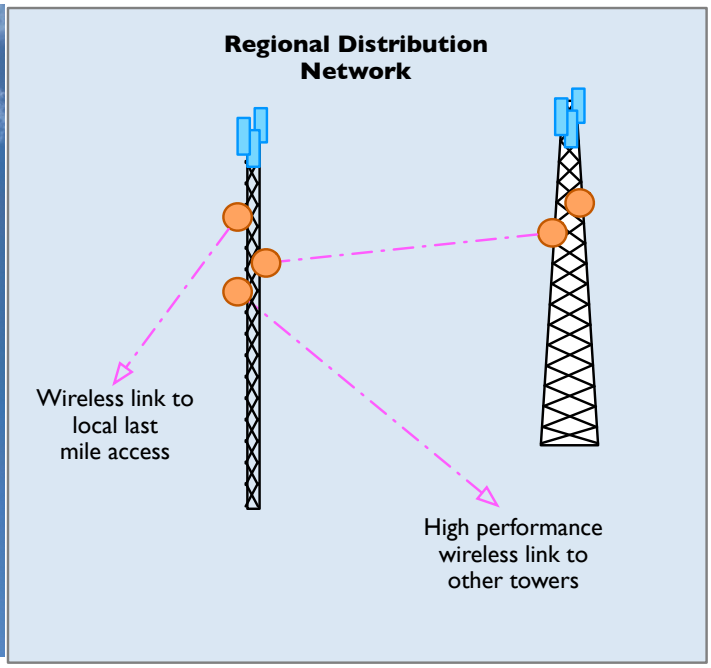


Distribution Network

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

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

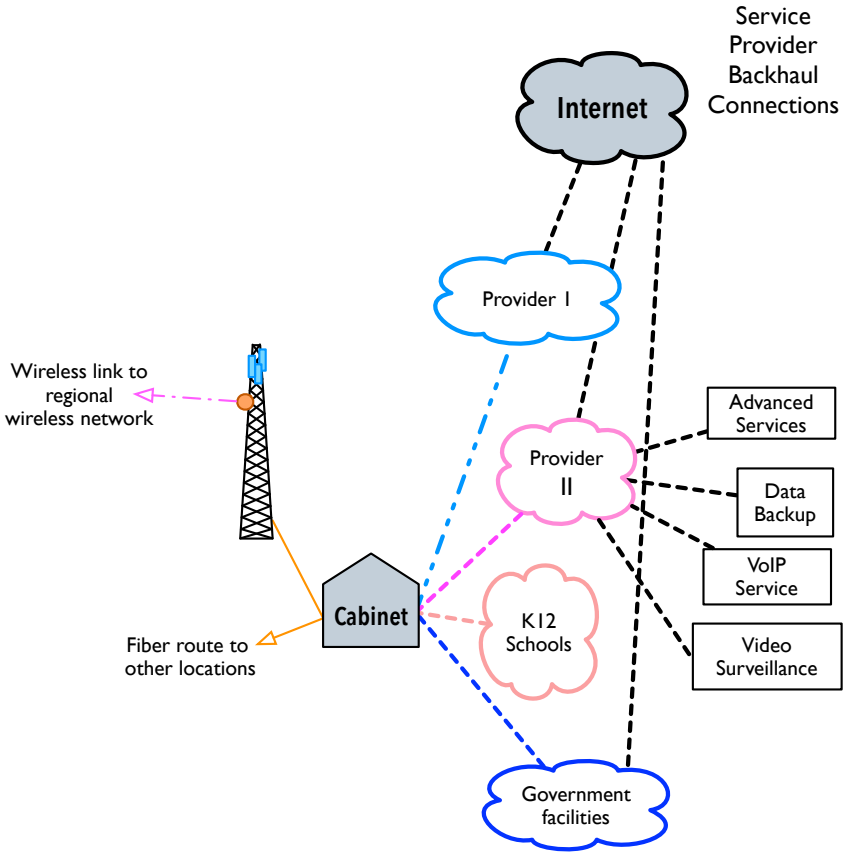


Core Network and Service Providers

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 Morgan County, there are no shared peering points, and a local facility with space available for both public and private uses could help attract additional private sector investments (e.g. a long haul fiber provider builds into the county to connect to this facility because of increased access to customers).

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



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

Characteristics of the colocation facility are:

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

SMALL CELL BROADBAND POLES

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

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

Ownership and Governance

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

Cost Discussion

The cost of placing an eighty foot pole can range from a low of about $2,000 to $7,000 or more, depending on permitting, engineering requirements, and the location of the pole. Some counties provide "by right" permitting of these poles if they are placed on private property, which can reduce the cost of installing them.

Funding Options

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

Operation and Management Considerations

Local government would incur no ongoing operational or management costs.

Recommendation and Next steps

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

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

NANO-CELL AND WIFI CALLING SERVICE

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

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

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

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

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

Cost Discussion

This strategy does not require any direct funding from the local governments, but if an coop or nonprofit is formed, that entity could develop play role educating residents and businesses about this option. Prior to formal development of an independent entity, the CCR Broadband Development Committee could provide information about nano-cells, and the local libraries could provide information about this as well.

Funding Options

No special funding required.

Operation and Management Considerations

None.

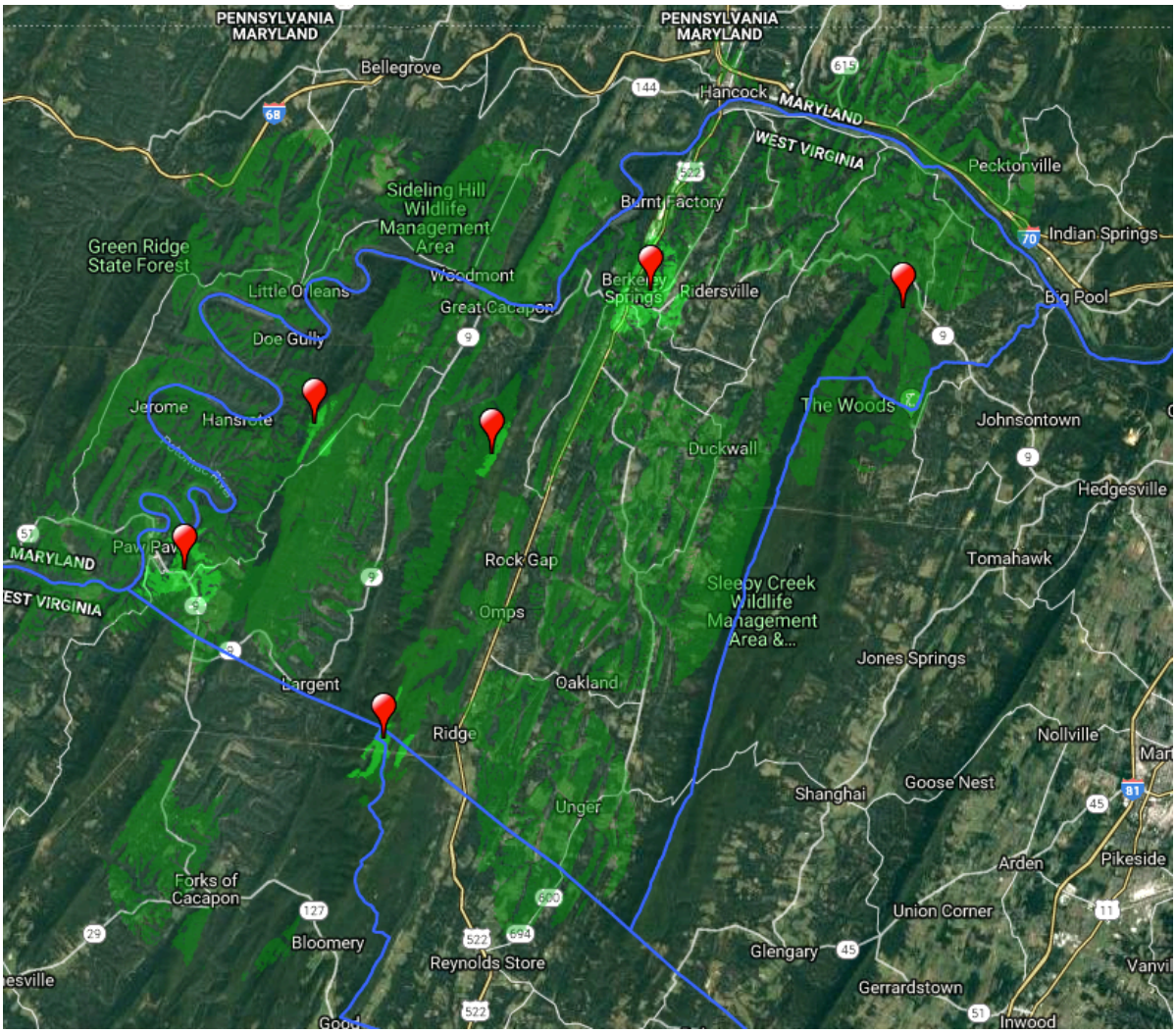
Recommendation and Next Steps

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

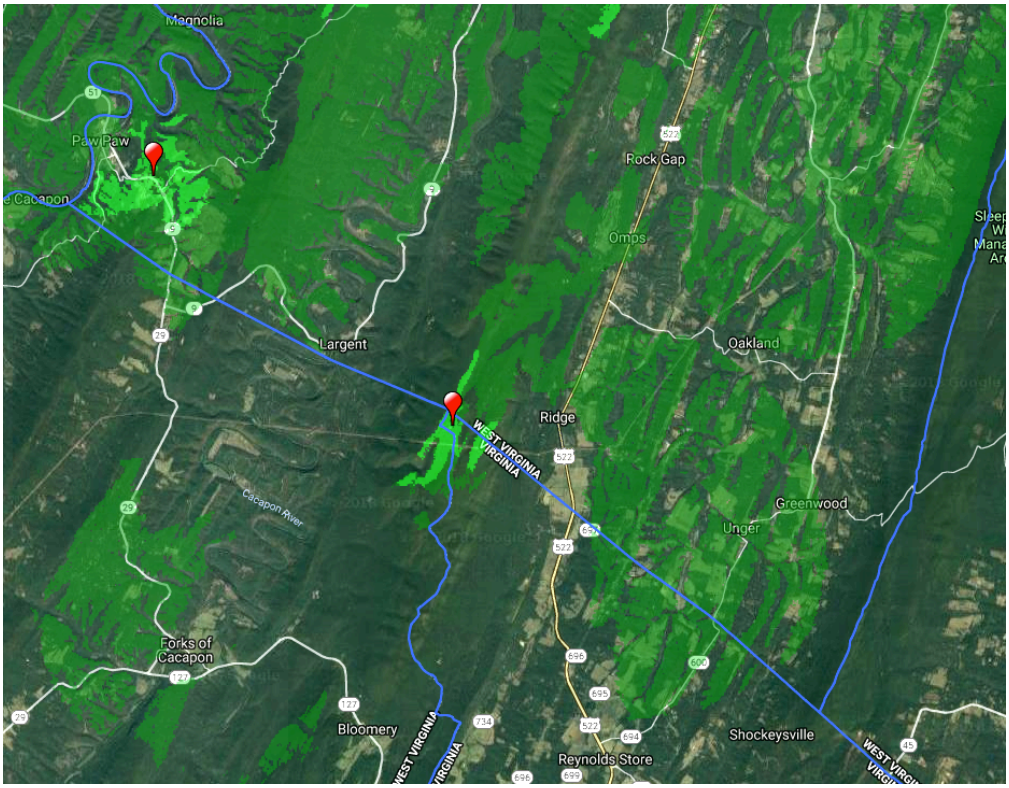
IMPROVED WIRELESS FOR MORGAN COUNTY

PROPAGATION STUDIES

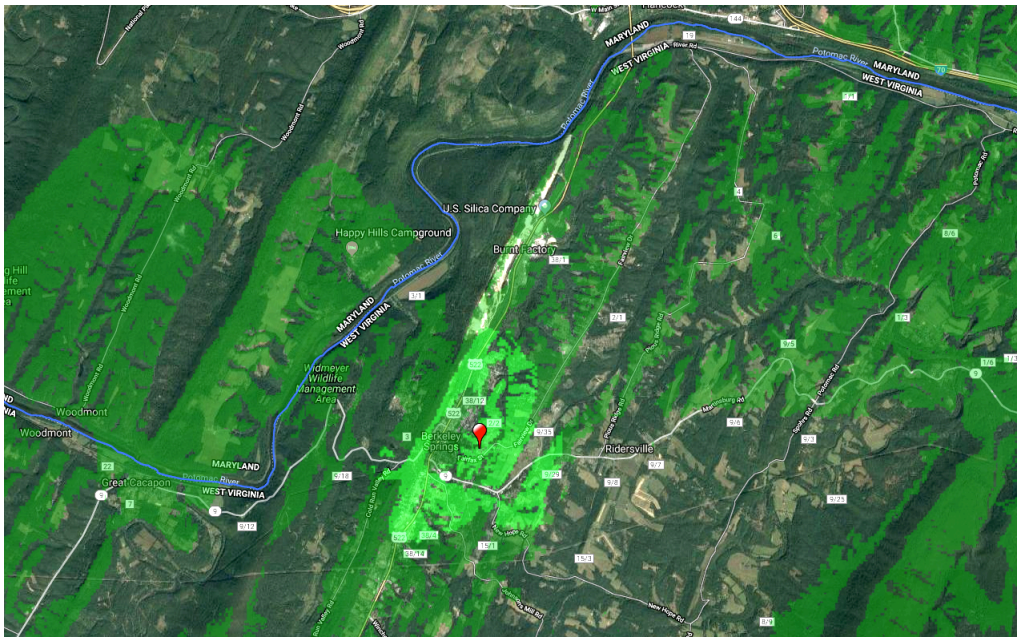
The topography of the county and the location of some of the county-owned towers indicates that large areas of the county could receive improved broadband and Internet service if WISPs (Wireless Internet Service Providers) co-located on those towers. The shaded green areas indicate locations where there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



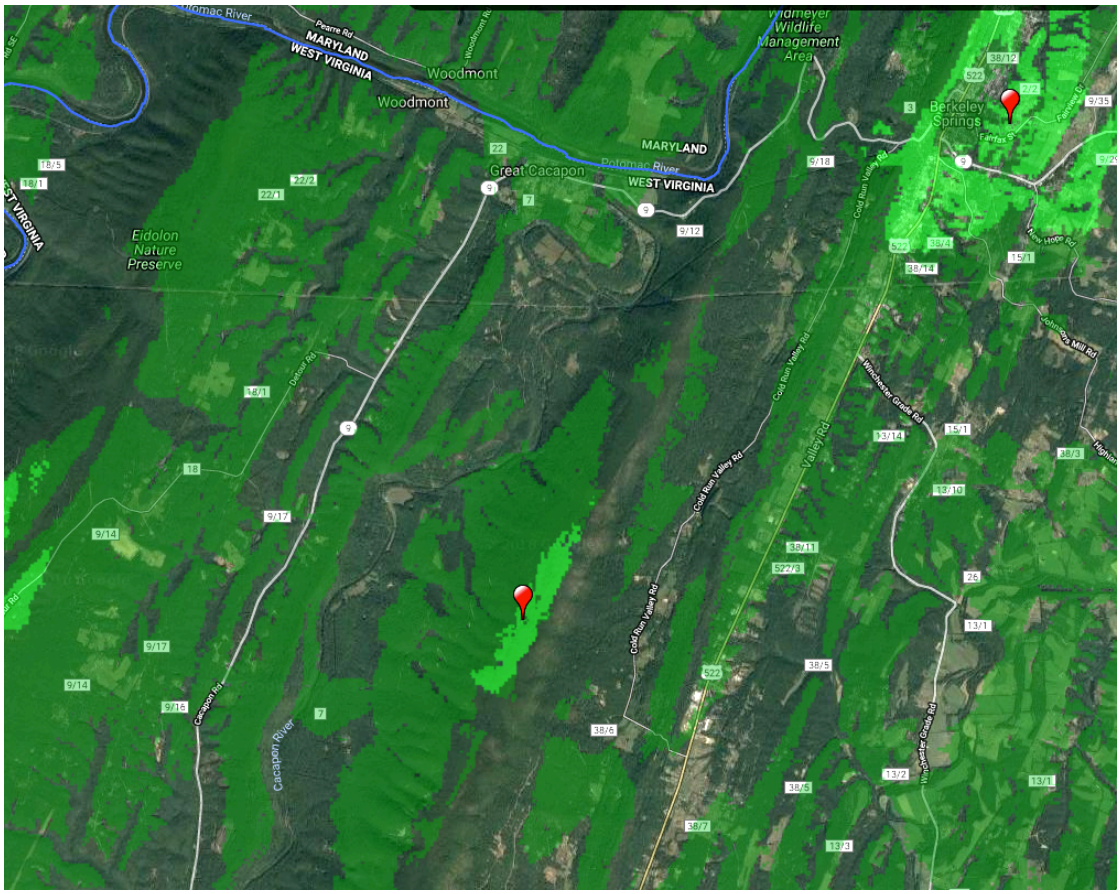
Cacapon Tower Propagation



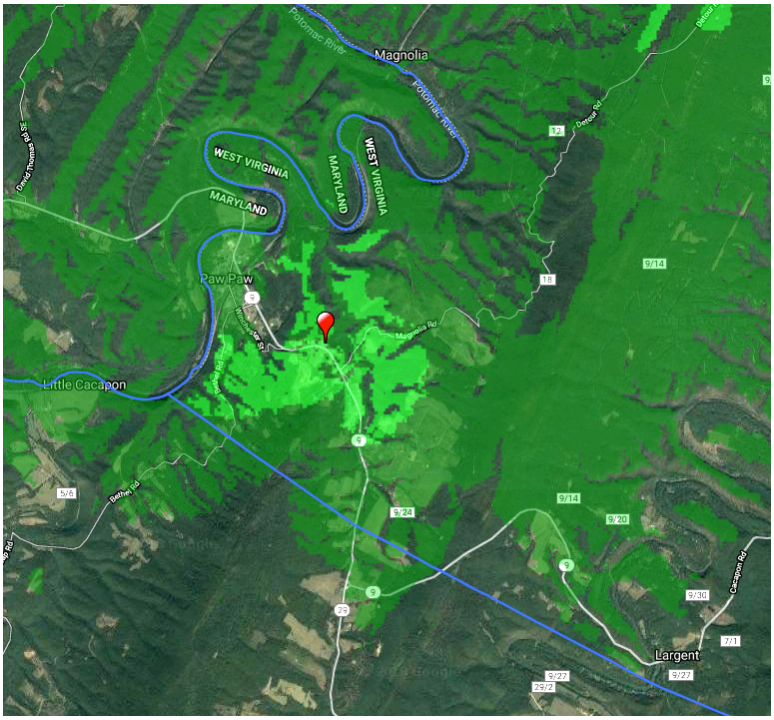
Berkeley Springs Tower Propagation



Kessel Tower Propagation



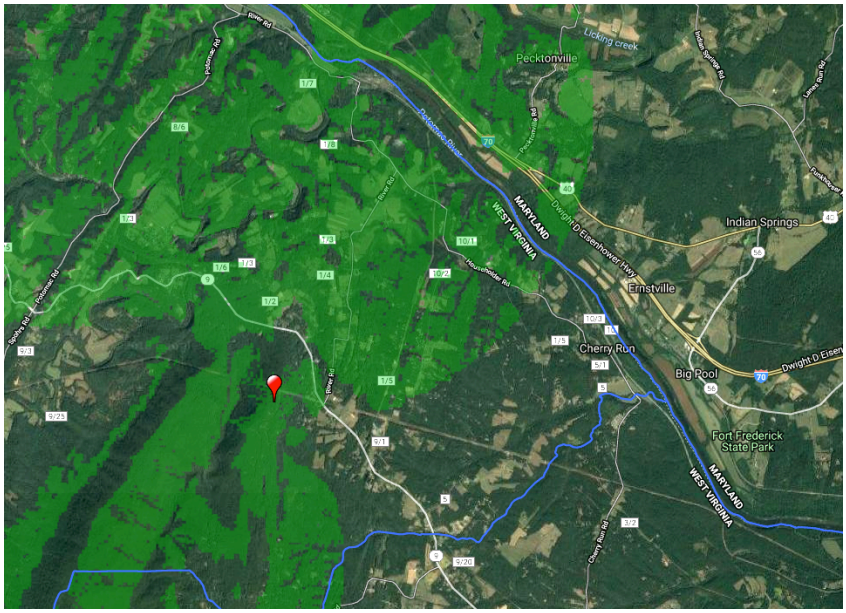
Paw-paw Tower Propagation



Purslane Tower Propagation

Short Mountain Tower Propagation

While there is an existing cellular tower in this area, the fees to place WISP equipment on this tower are likely to be prohibitive. To provide improved coverage in this area of the county, a new 180' to 199' foot tower is recommended.



COST ESTIMATES

ABOUT COST STUDIES

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

Tower Construction

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

WIRELESS CONSTRUCTION COST FACTORS

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

Buildings, Improvements, and Prefabricated Shelters

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

Outside Plant Construction Materials

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

Outside Plant Construction Labor

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

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

Network Equipment, Software, and Related Costs

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

Administrative and Legal

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

Leases, permits, and rights of way

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

Project Management

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

Network Design and Engineering

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

Network Integration and Testing

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

equipment. Work in this category requires a skilled professional who is familiar with the network architecture and the business model (e.g. open access).

Miscellaneous

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

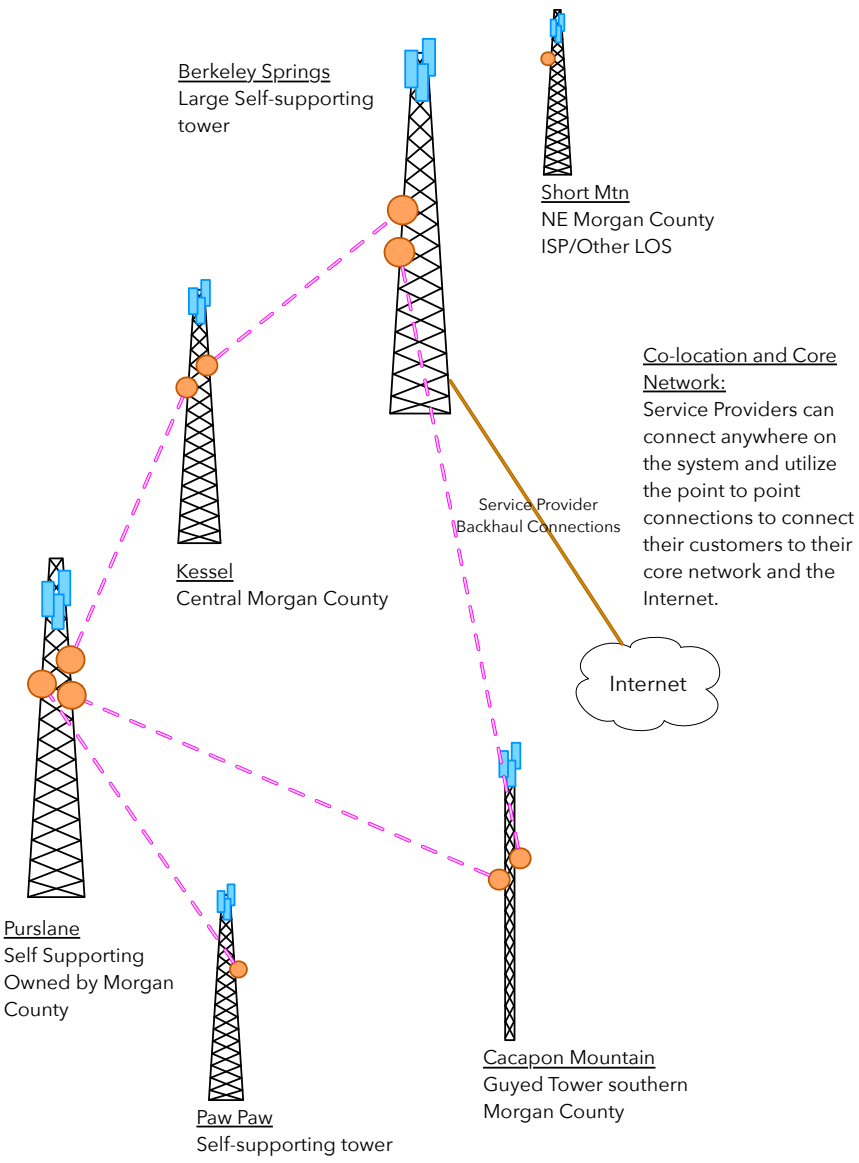
Contingencies

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

WIRELESS TOWER COST ESTIMATES

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

The Paw Paw tower has line of sight to the Purslane tower but we were not able to identify a clear line of sight to any other tower. Similarly, the proposed Short Mountain tower does not have line of sight to any of the other towers. This does not preclude making the Paw Paw and Short Mountain towers available to WISPs, but backhaul between the towers reduces costs and improves reliability. It may be that one or two new towers may be needed to reach coverage goals.



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

TOWER- SPACE ONLY COST ESTIMATE

For towers currently owned by Morgan County or other stakeholders that might be candidates for project use, modest upgrades to equipment at the base of the tower would make them "broadband-ready."

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

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

TOWER SITE DEVELOPMENT AND IMPROVEMENTS

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

If four towers (Berkeley Springs, Kessel, Purslane, and Paw Paw) receive site and tower improvements, the "worst case" scenario is shown in the table below. As noted above, the "best case" for improvements to six towers could much lower, and in the range of $75,000 to $90,000. We would note that one site would require road improvements (the Kessel tower). The most significant variable that can affect costs is generator availability. While many of the sites have generators, they may not be available for shared use by WISPs.

Note that it may be better to replace the existing Kessel tower (only 120') with a taller 180' foot tower.

TOWER SITE DEVELOPMENT AND IMPROVEMENTS: Four Towers

ITEM/PROJECT	UNITS	UNIT COST (LOW)	UNIT COST (HIGH)	COST (AVG)
Tower Study / Survey	4	$4,500	$7,000	$23,000
Site Development (Clearing, Road Improvements, etc.)	4	$0	$1,500	$3,000
Small Telecom Cabinet AMPROD AM47P-2636-24RU OR EQUIVALENT, ALUMINUM CABINET - FRONT AND REAR DOORS- HVAC/HEAT - ADJUSTABLE RACK RAILS 19"	4	$6,000	$7,500	$27,000
10kW Liquid Propane Generator	4	$4,000	$6,000	$20,000
Cabinet Foundation and Installation	4	$2,500	$4,000	$13,000
New Power Service / Installation ASSUMES POWER AVAILABLE ON SITE, CHARGE FROM POWER UTILITY TO COUNTY	4	$1,500	$2,500	$8,000
Power System Installation Labor	4	$300	$500	$1,600
Generator Installation Labor	4	$1,250	$1,700	$5,900
Propane Service Installation TANK FURNISHED / INSTALLED BY LOCAL GAS PROVIDER	4	$750	$1,250	$4,000
Total:				$105,500

NEW TOWER COST ESTIMATE

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

ITEM/PROJECT	Units	UNIT COST LOW	UNIT COST HIGH	TOTAL (AVG)
Labor and Contracting: $82,640				
Site Development (Clearing, Road Improvements, etc.)	1	$15,000	$15,000	$15,000
New Power Service / Installation	1	$1,250	$3,450	$2,350
180' Guyed Tower Construction Labor & Contracting	1	$50,000	$74,750	$62,375
Cabinet Installation Labor	1	$600	$1,150	$875
Power System Installation Labor	1	$300	$575	$438
Generator Installation Labor	1	$1,250	$1,955	$1,603
Materials: $35,735				
180' Guyed Tower Construction Materials	1	$17,500	$27,500	$22,500
Small Telecom Cabinet	1	$4,000	$6,000	$5,000
Cabinet Foundation and Installation Materials	1	$1,000	$1,500	$1,250
10kW Liquid Propane Generator	1	$4,000	$6,000	$5,000
Spare Fuses	1	$10	$20	$15
Power System Installation Materials	1	$20	$40	$30
Samlex 1000W Inverter	1	$350	$450	$400
Samlex SEC1230-UL Battery Charger	1	$200	$300	$250
100ah 12v Non Spillable Backup Battery	4	$250	$350	$1,200
DC Voltage Monitoring Device	1	$40	$60	$50
Unmanaged Rack Mount PDU (6O)	1	$35	$45	$40
Total:				$118,375
Project Management, Network Engineering, Testing				$23,675
Site Engineering, Surveying, Viewshed Analysis, Etc.				$9,500
Misc Fees, Technical Services				$7,500
Contingency				$11,838
TOTAL:				$170,888

SMALL CELL BROADBAND UTILITY POLE ACCESS COSTS

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

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

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

1	Utility Pole Estimate—Pole Only and No Radios						
2	ITEM/PROJECT	UNITS	COST (LOW)	COST (HIGH)	TOTAL (LOW)	TOTAL (HIGH)	BEST ESTIMATE
3	Site Development (Clearing, Road Improvements, etc.)	1	- n/a -	- n/a -	- n/a -	- n/a -	$1,000
4	3x3 NEMA Box	1	$300.00	$600.00	$300.00	$600.00	$450
5	New Power Service / Installation	1	$500.00	$1,250.00	$500.00	$1,250.00	$875
6	60' Wooden Utility Pole Construction Materials	1	$2,500.00	$3,500.00	$2,500.00	$3,500.00	$3,000
7	Spare Fuses	1	$10.00	$20.00	$10.00	$20.00	$15
8	Power System Installation Materials	1	$20.00	$40.00	$20.00	$40.00	$30
9	Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$35.00	$45.00	$40
10	60' Wooden Utility Pole Construction Labor & Contracting	1	$2,000.00	$3,000.00	$2,000.00	$3,000.00	$2,500
11	Total:				$5,365.00	$8,455.00	$7,910.00

POINT TO POINT BACKHAUL NETWORK

A County-owned backhaul network between towers has several desirable characteristics:

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

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

POINT TO POINT SYSTEM EQUIPMENT

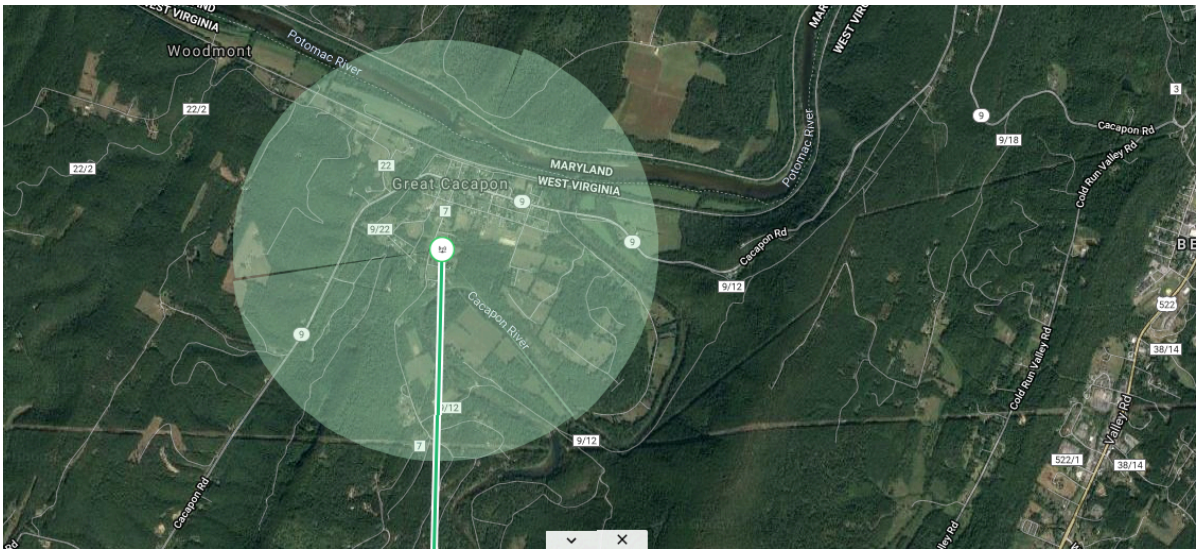
ITEM/PROJECT	UNITS	UNIT COST (LOW)	UNIT COST (HIGH)	COST (AVG)
Wireless Point to Point Equipment (per link) AVIAT WTM4000 SYSTEM OR EQUIVALENT, INCLUDES EQUIPMENT CABLING POWER SUPPLIES, FCC LICENSE COORDINATION, SOFTWARE LICENSES GIGABIT	5	$19,000	$22,000	$102,500
Cat5E Cabling per 1000' Case CABLING ON SITE - RADIO CABLING INCLUDED IN EQUIPMENT BID	5	$135	$150	$713
Cable Attachement Hardware	5	$300	$500	$2,000
Wireless Equipment Mounting Hardware GENERIC LIGHTWEIGHT FACE MOUNT OR LEG MOUNT HARDWARE KITS, SITE-SPECIFIC	5	$400	$650	$2,625
Tower Site Switch SMALL CISCO/JUNIPER OR EQUIVALENT	5	$1,000	$2,000	$7,500
Cable Management	5	$75	$150	$563
Point to Point Equipment Installation (per link)	5	$3,500	$5,000	$21,250
Power System Installation Materials	5	$20	$40	$150
Power System Installation Labor	5	$300	$500	$2,000
Samlex 1000W Inverter	5	$350	$450	$2,000
Samlex SEC1230-UL Battery Charger	5	$200	$300	$1,250
100ah 12v Non Spillable Backup Battery	5	$250	$350	$1,500
DC Voltage Monitoring Device	5	$40	$60	$250
Unmanaged Rack Mount PDU (6O)	5	$35	$45	$200
Total:				$144,500

GREAT CACAPON HUD ELIGIBLE PROJECT

The Great Cacapon area could be served with improved wireless broadband by erecting a 60' community pole with backhaul to the Kessel tower. This is a fully outfitted project with all radios and related equipment needed to provide service. If funded, all equipment should be leased out to a qualified WISP, who would then be responsible for all maintenance and upkeep for the duration of the lease (e.g. three to five years). Three 120 degree sector radios would be mounted on the community pole, and the illustration below shows the potential coverage in Great Cacapon.

This approach—a fully equipped access point complete with a backhaul radio link—could be leased out for around $1,000/month—would sharply reduce the cost a WISP would have to make to serve the designated area.

A second option would be to simply place a utility pole in the community and make the pole space available to a WISP that has signed a lease agreement with the County.



Option One: Fully Equipped Community Pole

Great Cacapon Community Pole with complete network equipment and radios	Units	Unit Cost	Total
Tower Fit-up	1	$26,375.00	$26,375.00
Neighborhood Pole Construction Materials and installation cost for 50-60' wooden utility pole. No land acquisition cost for poles.	1	$7,880.00	$7,880.00
Ubiquiti AF24 PTP Radio Gigabit PTP Radios between neighborhood pole locations. Used for short distances.	0	$1,497.00	$0.00
Licensed Point to Point Link	1	$19,000.00	$19,000.00
Point to Point Mounting Hardware Standoffs for utility poles or non-penetrating rooftop mounts for building installs.	2	$200.00	$400.00
Ubiquiti Rocket Prism 5ghz AP Access Point Radio for fixed wireless broadband	3	$249.00	$747.00
Ubiquiti 60-120 sector antenna Adjustable width sector antenna for fixed wireless broadband.	3	$170.00	$510.00
Ubiquiti IsoStation 5ghz CPE Customer premise radio equipment for fixed wireless broadband. Backhaul radio for public Wifi Hotspots	45	$129.00	$5,805.00
CPE Mounting Hardware (J-Mounts)	45	$13.00	$585.00
Ubiquiti Toughswitch Pro Site switch for fixed wireless broadband and Wifi hotspots with a backhaul. Not all wifi hotspots will have dedicated backhaul.	2	$189.00	$378.00
UPS Battery backup systems will allow the WiFi hotspot to operate for a short time without grid power. For the hotspots, this is optional, but a plus when considering natural disasters or other emergency scenarios.	2	$300.00	$600.00
Cabling	1	$135.00	$135.00
Installation Costs for PTP Links	1	$2,000.00	$2,000.00
Installation Costs for Access Points - Per Site	2	$2,000.00	$4,000.00
Equipment and Construction Procurement	45	$125.00	$5,625.00
Network Configuration and Testing (hourly)	45	$125.00	$5,625.00
Network Design and Engineering	135	$125.00	$16,875.00
Contingency			$6,228.50
*Customer Installations are the responsibility of the service provider.			
TOTAL			$68,513.50

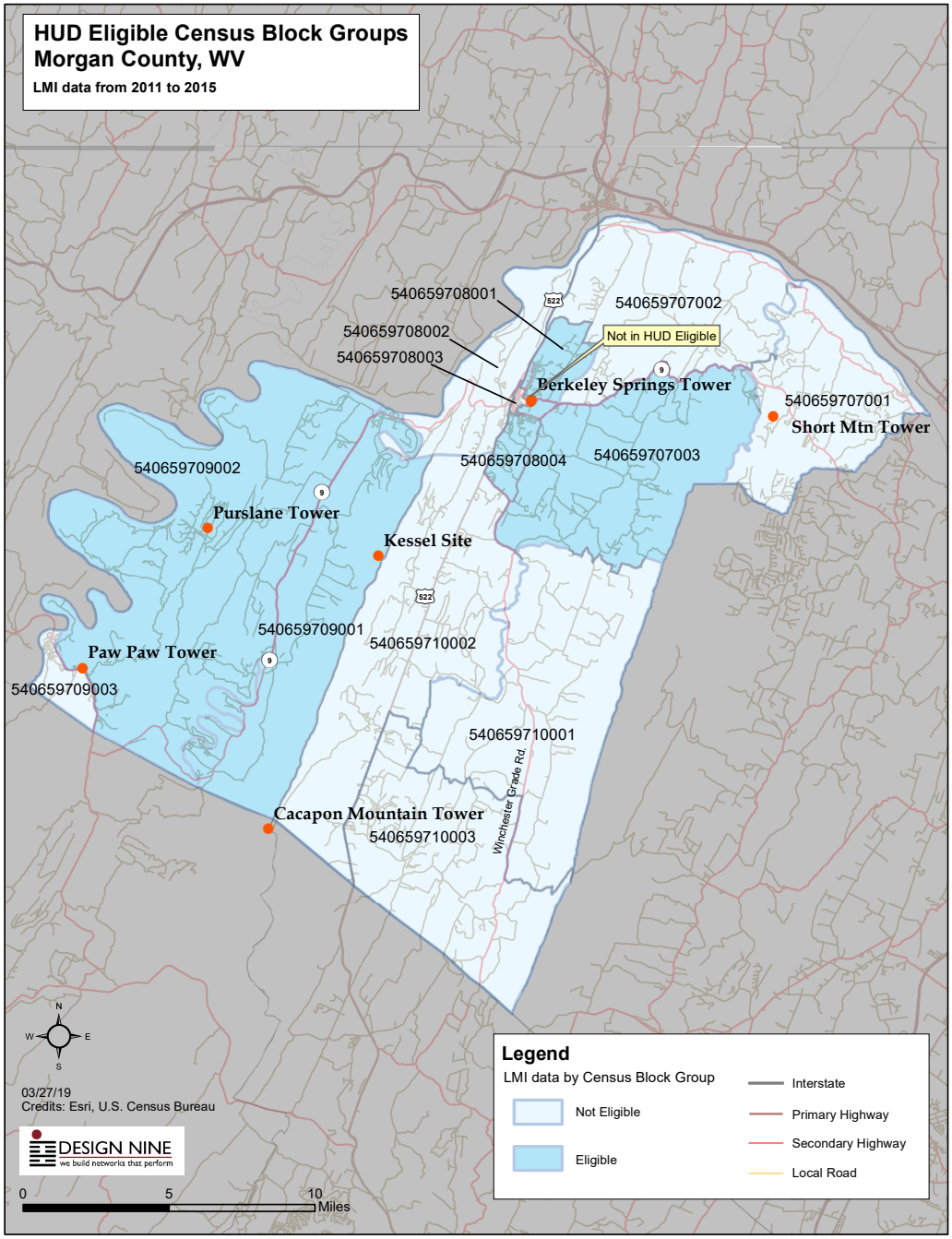
Option Two: Community Pole Only

A second option would be to simply place a community pole in Great Cacapon and lease it a service provider for a modest fee (e.g. $100/month). The WISP would be responsible for placing the access radios and the point to point backhaul to another tower of their choice.

1	Utility Pole Estimate—Pole Only and No Radios						
2	ITEM/PROJECT	UNITS	COST (LOW)	COST (HIGH)	TOTAL (LOW)	TOTAL (HIGH)	BEST ESTIMATE
3	Site Development (Clearing, Road Improvements, etc.)	1	- n/a -	- n/a -	- n/a -	- n/a -	$1,000
4	3x3 NEMA Box	1	$300.00	$600.00	$300.00	$600.00	$450
5	New Power Service / Installation	1	$500.00	$1,250.00	$500.00	$1,250.00	$875
6	60' Wooden Utility Pole Construction Materials	1	$2,500.00	$3,500.00	$2,500.00	$3,500.00	$3,000
7	Spare Fuses	1	$10.00	$20.00	$10.00	$20.00	$15
8	Power System Installation Materials	1	$20.00	$40.00	$20.00	$40.00	$30
9	Unmanaged Rack Mount PDU (6O)	1	$35.00	$45.00	$35.00	$45.00	$40
10	60' Wooden Utility Pole Construction Labor & Contracting	1	$2,000.00	$3,000.00	$2,000.00	$3,000.00	$2,500
11	Total:				$5,365.00	$8,455.00	$7,910.00

HUD ELIGIBLE TOWERS OPPORTUNITY

Three County-owned towers (Paw Paw, Purslane, and Kessel) are in HUD Eligible census blocks. The Short Mountain location, where a new tower is needed, is just slightly east of a HUD eligible area. The propagation coverage would not change appreciably if a suitable tower location could found just slightly west (see the map on this page). If applying for grant funds, this would be an opportunity to replace the existing Kessel tower (only 120') with a taller 180' tower.



So the tower improvements for two of the four existing County towers and the cost of a new tower could become the basis for a HUD grant. A summary cost estimate table is shown below.

HUD Eligible Tower Opportunity

ITEM/PROJECT	ESTIMATED
Tower Site improvements for Paw Paw and Purslane	$52,750
Point to Point System Equipment for four towers	$115,600
New tower in the Short Mountain area	$170,888
New 180' tower to replace existing 120' Kessel tower	$170,888
Network Construction Subtotal	$510,126
Project Management, Network Engineering, Integration, and Testing	$102,025
Engineering, Permitting	$76,519
Misc Fees, Advertising, Technical Services	$10,000
Bookkeeping and Administration	$2,500
Other Costs Subtotal	$191,044
Project Total	$701,170
Contingency at 10%	$70,117
Project Total (with contingency)	$771,287

In the HUD eligible areas, it would also be useful to place community poles, and if the County just located and placed the poles in areas that have clusters of 15-50 homes and leased the poles out to a provider, many more homes would be able to get improved service because the community pole overcomes the problem of some homes not having clear line of sight to a taller tower. The table below provides an estimate of costs for twenty poles

1	Utility Pole Estimate for HUD Eligible Areas			
2	ITEM/PROJECT	UNITS	Per Pole Cost	Total Cost
3	Site Development (Clearing, Road Improvements, etc.)	20	$1,000	$20,000
4	3x3 NEMA Box	20	$450	$9,000
5	New Power Service / Installation	20	$875	$17,500
6	60' Wooden Utility Pole Construction Materials	20	$3,000	$60,000
7	Spare Fuses	20	$15	$300
8	Power System Installation Materials	20	$30	$600
9	Unmanaged Rack Mount PDU (6O)	20	$40	$800
10	60' Wooden Utility Pole Construction Labor & Contracting	20	$2,500	$50,000
11	Total:		$7,910	$158,200

OVERALL PROJECT ESTIMATE

If all four existing County-owned towers receive improvements, a new tower is constructed in the Short Mountain area, and the backhaul network is funded, the table below shows the estimated "worst case" cost for the effort.

This estimate does not include every possible variation of tower and pole improvements and additions, but provides a summary of major cost areas. If

Morgan County Wireless Improvements Cost Summary

ITEM/PROJECT	ESTIMATED
Tower Site Improvements for Paw Paw, Purslane, BS towers	$79,125
Point to Point System Equipment	$144,500
New tower in the Short Mountain area	$170,888
Replacement 180' tower for Kessel	$170,888
Twenty community poles in HUD Eligible areas	$158,200
Network Construction Subtotal	$723,601
Project Management, Network Engineering, Integration, and Testing	$144,720
Engineering, Permitting	$108,540
Misc Fees, Advertising, Technical Services	$10,000
Bookkeeping and Administration	$2,500
Other Costs Subtotal	$265,760
Project Total	$989,361
Contingency at 10%	$98,936
Project Total (with contingency)	$1,088,297

FINANCIAL PROJECTIONS

TOWER SPACE REVENUE ESTIMATE

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

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

Sample Tower Leasing Revenue Projection

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

TOWER SPACE OPERATIONAL EXPENSES

Assumptions include:

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

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

Tower Lease Annual Expense Projections

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

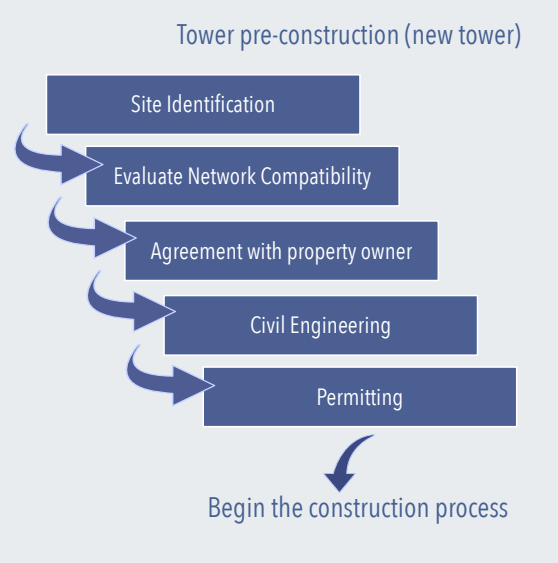
PLANNING FOR SUCCESS

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

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

Tower Site Identification

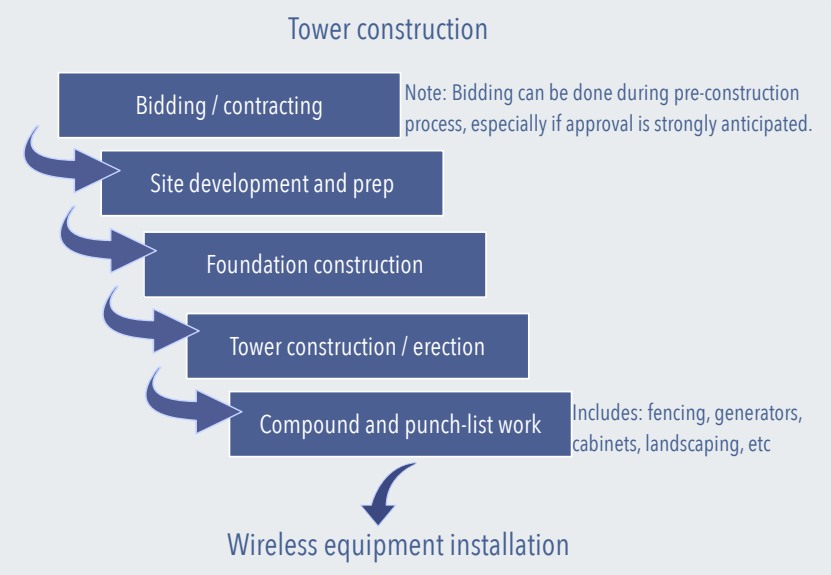
When a site for a new tower is being considered for use, the diagram below illustrates the steps that need to be followed. For example, if an existing public safety tower or an existing cellular provider tower may have space for fixed point wireless broadband equipment (i.e. co-location).



- Site identification – Identify areas of poor service and look for existing towers.
- Network Compatibility – Line of sight to other towers and to key service locations and customers needs to be evaluated. A wireless propagation study and line of sight study will provide the data needed to make this determination.
- Property owner negotiation – A lease has to be negotiated with the property owner. Local government sites (e.g. K12 schools, parks, recreation areas, fire/rescue stations) are candidates for towers because of reduced or no lease fees.
- Engineering – An engineered site plan will be required to as part of the permitting process.
- Leases and permits – A permit to place the tower is required in most localities, and there may be a multi-stage permitting process that can take several months.

Tower Construction

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

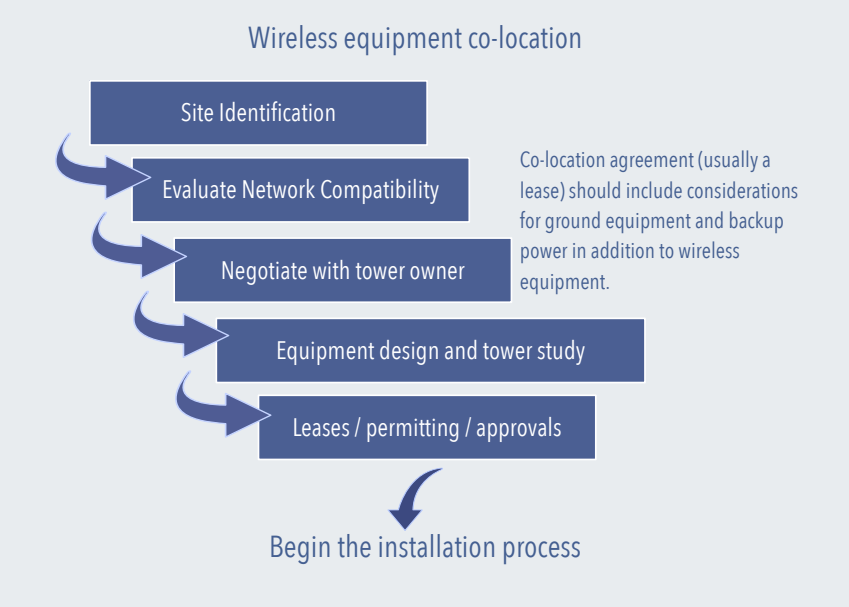


- Bidding and contracting – Bid documents and construction specifications have to be prepared and sent to candidate contractors. Once bids are received, proposals have to be reviewed, and depending upon funding sources, may require review by local government and/or a funding agency prior to awarding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

Wireless Equipment Co-Location

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

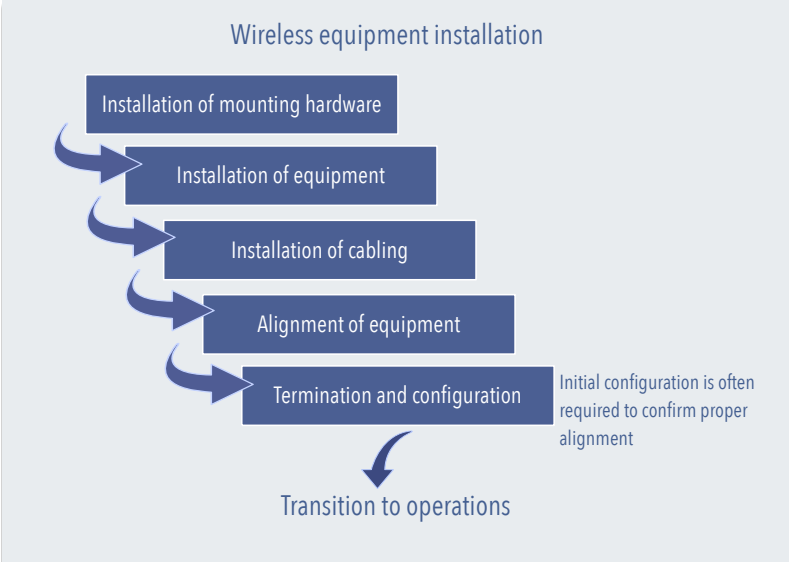
- Site identification – Identify areas of poor service and look for existing towers.
- Network Compatibility – If there are towers in the service area, the first step is to determine if a minimum of ten vertical feet of space is available at an appropriate height for broadband wireless equipment. A wireless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



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

Wireless Equipment Installation

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



- Mounting hardware – Brackets and other mounting hardware have to attached to the tower at the designated height. This requires a tower climb conducted by a firm with trained tower climbers.
- Equipment installation – Once the mounting hardware is in place, radios are attached to the tower. On the ground, network equipment including switches, powers supplies, battery backup, and other equipment is installed. A backup generator and fuel tank may also be installed and wired into the equipment cabinet or shelter.
- Cabling installation – Cables are connected between the equipment in the cabinet on the ground to the radios on the tower.
- Alignment of radios – Radios on the tower have to be adjusted. Local access radios that provide service to local customers with line of sight to the tower have to be aligned for optimum coverage. If there are also point to point radios on the tower for connections to other towers or locations, these also have to be aligned. Tower climbers are needed to perform these steps.
- Configuration and testing – Once the physical alignment of the radios is complete and all cabling is connected, the new network equipment is integrated into the rest of the network.

RISK FACTORS, LEGAL, AND REGULATORY ISSUES

MARKET SIZE

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

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

TAKE RATE

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

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

FUNDING

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

tower space lease rates to cover routine maintenance, minimizing financial risk and requiring limited funding.

SERVICE PROVIDERS

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

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

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

TECHNOLOGY

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

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

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

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

LEGAL AND REGULATORY ISSUES

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

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

TOWER AND SERVICE PROVIDER MANAGEMENT

ATTRACTING PROVIDERS

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

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

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

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

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

TOWER MANAGEMENT RECOMMENDATIONS

Morgan County's existing **Co-Location of Private Telecommunications Facilities Package** describes the County policies for private use of County-owned towers and the leasing process, and contains an application form and draft agreement. Some changes to the current policies and fees should be evaluated per the items listed below.

- The current application fees and leasing fees should be simplified for WISPs. Among the changes that should be considered are single modest application fee (e.g. $200) for whatever space a WISP needs on a tower and at the base of the tower.
- Revenue sharing arrangements instead of a fixed lease fee are more difficult to manage. While the argument for revenue sharing seems to make sense (i.e. WISPs pay as they acquire customers), in practice, it requires

the County to have access to the accounting and financial records of the business, which can be challenging to enforce. It is also a financial disincentive for the WISP, as the fees that they have to pay for tower access continue to increase without end.

- The County should have a single public fee schedule for all providers.
- The County should have a single tower space agreement that is used for all providers.
- Tower access should be made available in ten foot vertical segments, as high as possible on the tower without interfering with other uses (e.g. public safety antennas). Note that it is unlikely that any tower will have more than two providers on it.
- If a WISP is applying for space on an existing tower, no certified engineering plans should be required, but if a structural analysis is needed to determine wind and tower loading will not exceed tower specifications, the County may have the WISP bear some or all of the cost of that study. Note that there appears to be high variability in the cost of these studies, and the County should be careful to keep the structural analysis costs as low as possible.
- Section Eight (Standard of Work) of the Application Package should be reviewed by a licensed structural engineer and updated as needed. The Motorola document 68-81089E5O appears to be obsolete (no longer available).
- The County should identify two (2) ten foot spaces (where space is available) on existing towers and designate/reserve those for WISP use. The spaces should be as high as possible on each tower without interfering with other County and public safety use. The lease cost of the lower space should be at least 20% less than the higher space. Telling WISPs exactly what space is available at each tower and at what heights makes it easier for WISPs to evaluate the potential customer market that could be served from each tower.
- If an existing shelter is available at the base of a tower and rack space for WISP equipment is available within that shelter, electric power should simply be provided as part of a very modest lease fee for rack space. If there is no space available in the shelter (e.g. lack of space or dedicated for public safety use), then the WISP should just install an H-frame and have their own electric meter installed in an area designated by the County at the base of the tower.
- Leases should be a minimum of two years and should auto-renew if the ISP is meeting performance requirements.
- It may be more effective to have a single lease agreement with access to all towers, and the contract should require the ISP to put equipment on all towers within a certain period of time (e.g. nine to twelve months). This limits ISPs from "cherry picking" towers with more potential customers and ignoring towers in parts of the county with lower population density.
- Monthly tower lease fees should be on the order of $200 to $250 per tower. Higher fees make it difficult for providers to make a business case for the cost of equipment and the extensive marketing required to develop a customer base around a tower.

- The County should offer an initial grace period on fees of three to six months, and/or offer a one year sliding scale of fees (e.g. first three months, fee waived; months four to six, 25% of normal fee; months seven to nine, 50% of normal fee; months ten to twelve, 75% of normal fee). There are many ways to structure the initial fee period, but it is important to recognize that the WISPs incur substantial early costs to develop revenue and customers for a new tower.
- All tower leases should expire on the same date even if started at different times. This allows the County to potentially make a smoother transition to a new provider if there are issues, and will give them more leverage and control over the service.
- In contracts, fee reductions should be worded as discounts that can be revoked by the County if performance requirements are not adequately being met.
- The County should describe what is available for ground-space (e.g. WISP cabinets, shelters, H-frames for electric service) that may be provided by the County (e.g. a shared generator) and/or indicate what the WISP has to provide at the base of the tower. If new shelters will be allowed, the County should set minimum standards for new shelters.

The County has several existing towers that are available for expanded WISP use. Most of the towers will require little or no upgrades or modifications to attract one or two WISPs. Note that given the relatively low density of households in the County, the wireless broadband market will probably support no more than two WISPs per tower.

In the **Cost Estimates** section of this report, a point to point backhaul network is proposed between the County towers. If the County can identify the funds needed to add this to the existing towers, there are several benefits:

- It reduces the capital costs for WISPs that want to lease tower space. Using the backhaul network, a WISP can connect it's Internet service to a single location (tower) and use the backhaul network to deliver that service to the other connected towers. The cost of bandwidth on the backhaul network should be modest–just enough to cover maintenance and repairs.
- Without the shared point to point network, if two providers want to lease tower space, each provider has to pay for the cost of its own backhaul network, which ultimately duplicates infrastructure and raises customer costs.
- A single backhaul network reduces wind loads and structural loading on the tower.
- The backhaul network can also be shared with other County uses, including public safety (e.g. private secured WiFi hotspots for the Sheriff's Department, other first responders) and the K12 schools (a redundant Internet service to reduce or eliminate outages on the school wired network).

CASE STUDIES: WHAT OTHER COMMUNITIES ARE DOING

CITY OF RICHWOOD, WEST VIRGINIA

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

TOWN OF ASHLAND, VIRGINIA

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

WIRED ROAD BROADBAND AUTHORITY

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

BOZEMAN FIBER

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

CHARLEMONT, MA

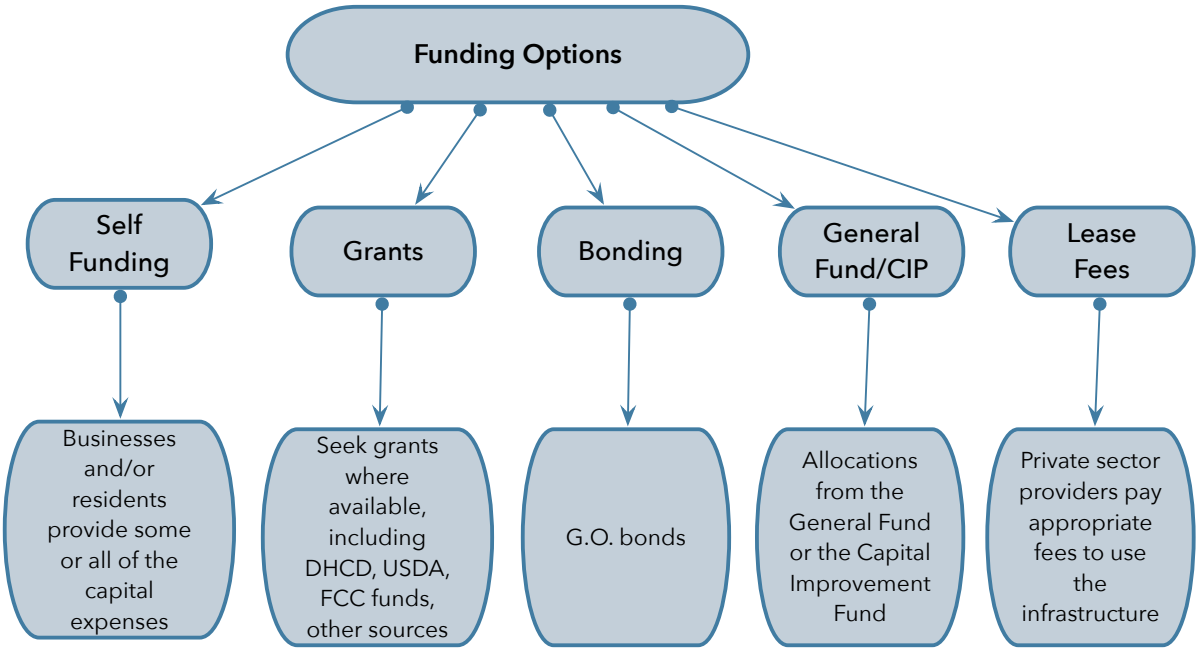
The town of Charlemont, Massachusetts has decided to combine a grant from the state with an $11/month/household assessment to build fiber throughout the entire town of 524 households. Comcast had offered to make modest upgrades to the existing copper-based cable network but was asking for nearly half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

DANVILLE, VIRGINIA

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

FINANCING OPTIONS

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



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

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

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

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

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

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

WV 2019 BROADBAND EXPANSION ACT

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

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

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

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

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

HUD COMMUNITY DEVELOPMENT BLOCK GRANTS

The U.S. Housing and Urban Development CDBG State Program allows West Virginia state government to award grants to smaller units of general local government (e.g. counties, towns)

that develop and preserve decent affordable housing, to provide services to the most vulnerable in our communities, and to create and retain jobs. In recent years, CDBG funds have been successfully used for broadband infrastructure development where the local government applicant can show the improvements meet the general guidelines of the program—so grant funds have to spent in low and moderate income areas.

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

COMMUNITY REINVESTMENT ACT

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

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

USDA RECONNECT PROGRAM

The ReConnect program is a new funding program managed by the USDA Rural Development Office. This program is sometimes called the USDA e-Connectivity pilot program. Grant applications can be a combination of 100% grant, 50% grant/50% loan, or 100% loan. $600 million has been allocated to the program, and a wide variety of entities can apply, including non-profits, coops, and state and local governments. Successful applications will require a very credible business plan that shows the project can be financially sustainable. Up to $25 million is available for a 100% grant application. Applications are due by April 29th, 2019. More information is available here: (reconnect.usda.gov). A mapping tool is available on the Web site to show areas that are eligible. To qualify as an eligible area, households must have less than a minimum of 10 Meg down/1 Meg up broadband service.

SPECIAL ASSESSMENT/SERVICE DISTRICT

Communities like Bozeman, Montana and Leverett, Massachusetts have been funding broadband infrastructure improvements with special assessments (in Leverett, $600/year for five years), and in Bozeman, TIF (Tax Increment Funding) is being used in some areas to add telecom conduit, handholes, and dark fiber. In some localities, it is possible to levy a special assessment in a service district designated for a particular utility (like broadband) or other kind of public service. Charlemont, Massachusetts intends to add an $11/month assessment to every household to build

a town-owned Gigabit fiber network that will pass every household in the community. A town-wide vote supported this funding approach.

As an example, a $10/month special broadband assessment on Morgan County households would, over twenty years, generate all the funds needed to build Gigabit fiber to every home and business in the county. Put in perspective, the average cost of a large, single topping pizza in the U.S. is currently $9 to $12.

The table below shows the kind of funds that could be generated over several time periods. If ten dollars per month were collected from each household for thirty years, it would easily finance the immediate build out of Gigabit fiber that would pass nearly all homes and businesses in the county.

Morgan County (7303 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
$1	$1,752,720	$2,629,080
$2	$3,505,440	$5,258,160
$5	$8,763,600	$13,145,400
$10	$17,527,200	$26,290,800

911 FEES

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

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

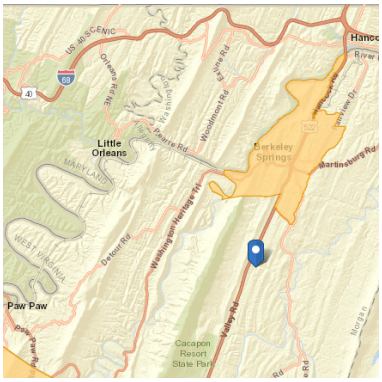
Nano-cell Devices – Nano-cells are a small box attached to a home wireless router. The nano-cell, which is typically obtained from the cellular provider, enables a cellphone to operate inside the home or business even if there is no cell tower near by.

A modest increase in the 911 fee to improve 911 access in rural areas of the county could generate funds to support additional broadband towers and community poles. In Morgan County, a $2/month increase in the 911 fee could, over twenty years, generate as much as $3 million in funds to improve broadband access in the county.

OPPORTUNITY ZONES

An Opportunity Zone is an economically-distressed community where new investments, under certain conditions, may be eligible for preferential tax treatment. Localities qualify as Opportunity Zones if they have been nominated for that designation by the state and that has been approved by the Internal Revenue Service. Opportunity Zones are designed to create tax incentives for private investors to make investments that can encourage economic development and job

creation in distressed communities. Opportunity Zones would be of most use for Internet Service Providers who could use the tax benefits to make a business case to improve Internet access in a qualifying area (zone).



Opportunity Zones are defined by census tract, and the Census Bureau's Geocoder online tool can provide census tract ID numbers. A link to the list of currently qualified census tracts can be found on this page (https://www.cdfifund.gov/Pages/Opportunity-Zones.aspx). An area in and around Berkeley Springs has been designated an Opportunity Zone (see map to the right).

ARC POWER GRANTS

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

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

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

BONDING

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

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

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

General obligation bonds are routinely used by local governments to finance municipal projects of all kinds. G.O. bonds are guaranteed by the good faith and credit of the local government, and are not tied to revenue generated by the project being funded (i.e. revenue bonds). G.O. bonds obligate the issuing government and the taxpayers directly, and in some cases could lead to increased local taxes to cover the interest and principal payments. Some bond underwriters have indicated a willingness to include telecom funds as part of a larger bond initiative for other kinds of government infrastructure (e.g. adding $1 million in telecom funds to a $10 million bond initiative for other improvements).

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

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.

CONNECTION FEES

Tap fees, pass by fees, and connection fees are already commonly used by local governments for utilities like water and sewer. The revenue share model can be strengthened from additional sources of revenue, including one time pass by fees, connection fees and sweat equity contributions. It is important to note that the Coop Membership Fee can be treated as a connection fee in whole or in part.

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

One Time Connection Fees – A one time connection fee can be assessed to property owners (e.g. residents and businesses) when the fiber drop from the street to the premise is installed. This is similar to the kinds of connection fees that are typically charged when a property is connected to a

municipal water or sewer system. The fee is used to offset the cost of the fiber drop and the Customer Premise Equipment (CPE) needed to provide the operational access to the network. The connection fee can be modest (e.g. $100) or it can be a larger percentage of the actual cost of the connection. Fiber CPE may range from $250 to $350 and a fiber drop may cost from $200 for a premise very close to the distribution fiber passing along the property to $1,000 or more if the premise is hundreds of feet from the road. One variant would be to charge a minimum connection fee for up to some distance from the road (e.g. $100 for up to 75' and $2 for each additional foot).

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

NEW MARKETS TAX CREDIT

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

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

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

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

APPENDIX A: GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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