
BROADBAND FOR CLAY, CALHOUN, AND ROANE COUNTIES

Improving Broadband Access



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Disclaimer

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1 EXECUTIVE SUMMARY

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 three counties 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 Megabits down/1 Megabits up and 25 Megabits down/3 Megabits up as their definitions of "broadband," but large portions of three counties are not able to receive consistent access to even the lesser 10/1 service. Note that Meg, Megabits, and Megabits/second all refer to the way that bandwidth is measured, and the three terms are used interchangeably in discussions of bandwidth.

Clay, Calhoun, and Roane counties should focus on providing basic broadband infrastructure like upgrades to existing towers and new towers in underserved areas of the region and stay out of the retail Internet business. Much like the way communities manage roads, the three county governments can lease tower space to Internet Service Providers, install community wireless poles to serve small clusters of residents and businesses, and develop modest dark fiber projects to help attract service providers and to support economic development activities.

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 Clay, Calhoun, and

More than 95% of residents responding to the broadband survey want better Internet service.

Less than 10% of respondents are satisfied with their current Internet provider.

More than 25% indicate that availability of Internet is affecting where they choose to live.

97% of businesses responding to the broadband survey want better Internet access.

Only 6% of businesses are "very satisfied" with their current Internet service.

72% of businesses that responded need employees to be able to work from home

Roane. The survey responses make it very clear that residents and businesses want and need better and more affordable access to broadband Internet.

A key question is **Why do the three counties need improved telecom infrastructure?**

- Even modest investments in community or local government-owned infrastructure in key areas targeted for business and community development gives the area and its residents and businesses some freedom from monopoly providers. Leasing out the infrastructure to competitive providers creates competition, which generally lowers prices for broadband services and improves service quality.
- If the three counties hope to attract new businesses and jobs, improved broadband and more affordable business class broadband is going to be essential to support economic development efforts.
- From the survey results, 19% of survey respondents are already working from home. The continually evolving Internet Economy continues to create new home-based job opportunities, but reliable and affordable broadband service is a requirement. With better broadband, more residents could find good-paying home-based jobs. As a side benefit, home-based work can create substantial savings for households. 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.
- More and more health care services can be delivered over reliable high speed broadband connections, including doctor visits, regular consultations for the chronically ill, and even prescriptions can now be provided over a two-way video connection. For the elderly and chronically ill, online access to medical services can save time and money, and can actually improve quality of life—more frequent interaction with health care professionals can improve health outcomes. The UC-Davis study mentioned above also found that telehealth services that use online consultations reduced transportation costs and reduced the impact of lost wages due to taking time off from work to drive to a medical clinic. This can be important to older residents who want to live independently as long as possible. Improved access to medical services via broadband can save money and improve health care outcomes.
- 28% of survey respondents reported that the availability of Internet access was affecting where they chose to live. The long term community and economic health of the region depends on being able to attract new residents, and to be able to keep at least some young people and young married couples living in the three counties. Improved broadband addresses a long term challenge to keep the region attractive to younger people who tend to be heavy users of broadband services.

Next Steps

- A Regional Effort - Clay, Calhoun, and Roane counties should work together to address the inadequate broadband availability and affordability issues in the region. Grant funding agencies tend to prefer regional collaboration for these efforts.
- A Permanent Organization - The effort needed to improve broadband infrastructure in the three county area will require a permanent organization with a single focus on broadband. A regional development authority that includes all three counties should be formed with an exclusive focus on broadband for the region. The broadband development authority would act as the fiscal agent as needed for grants and funding

opportunities. It would also provide the long term continuity of leadership needed for successful implementation of the recommendations coming out of this study.

- Adequate Financial Support - The CCRBDC needs financial support from the three counties to be able to complete its mission. While grant funds will provide the bulk of the funding for infrastructure improvements, the CCRBDC (i.e. the nonprofit) will require regular annual financial support from each of the three counties.
- Articulate a Vision - Some very small communities have achieved great success improving broadband infrastructure by setting a clear vision and aligning activities with the vision. The CCRBDC should answer the question, "Where do we want to be in five years?" The context of the answer must include not just broadband needs but should be aligned with broader county-level and regional community and economic development goals.
- Visits to Communities with Projects Underway - The CCRBDC should visit some communities that have been able to make progress and/or have successfully completed some projects. These communities can provide valuable insights and advice.
- A Mix of Technologies - There is no one technology that is going to meet all of the needs of the businesses, residents, and institutions of Clay, Calhoun, and Roane counties. Fixed point wireless will be extremely important as part of mix of solutions. Because of the difficult terrain, a mix of taller towers and smaller wireless utility poles will be required. The region will also need some fiber to the home and fiber to some downtown areas to enhance economic development and to help retain and attract business and jobs.
- A Multi-Year Effort - A minimum of three years will be needed to obtain funding and to build out the infrastructure recommended in this report. It will be important manage expectations—a regular and consistent awareness effort will be required to ensure that citizens and businesses understand the CCRBDC vision and know that regular progress is being made.

Report Documents

Clay County Broadband Survey Results – This report contains the results of a residential broadband survey and a business broadband survey conducted in late fall of 2018 and early winter of 2019 (21 pages).

Calhoun County Broadband Survey Results – This report contains the results of a residential broadband survey and a business broadband survey conducted in late fall of 2018 and early winter of 2019 (21 pages).

Roane County Broadband Survey Results – This report contains the results of a residential broadband survey and a business broadband survey conducted in late fall of 2018 and early winter of 2019 (29 pages).

Broadband Recommendations (this document) – This report provides an extensive review of key policy, funding, and planning issues, including a review of current service providers in the region, current and future bandwidth needs, marketing recommendations, a gap analysis, potential partnerships, what other communities are doing to improve broadband, and attracting service providers to the region (125 pages).

Phased Broadband Plan – Contains a phased approach for building out improved broadband infrastructure for each of the three counties (67 pages).

2 RECOMMENDATIONS AND IMPLEMENTATION MEASURES

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 three counties are likely to face if it moves forward.

2.1 OBTAIN SUPPORT OF REPORT RECOMMENDATIONS

The CCRBDC should obtain formal support of the recommendations contained in this report from each of the three County Commissions and request start up funds from each of the three counties. Initial funding would be used to pay for the cost of forming a regional broadband development authority and other early expenses related to the development of the regional broadband strategy (e.g. domain, Web, and email hosting, letterhead, promotional materials, etc.).

Two Months	CCRBDC has presented the broadband strategy and funding request to all three County Commissions.
Four Months	All three County Commissions have formerly endorsed the CCRBDC broadband strategy and committed initial funding.

2.2 FORM CCRBDC SUB-COMMITTEES

The CCRBDC should form two working committees:

- Grant Sub-Committee - Three CCRBDC members should be appointed to this committee. These members will identify grant opportunities, submit them to the full CCRBDC for approval to apply, and manage the grant application process for each grant.
- Awareness Sub-Committee - This sub-committee should have two members responsible for putting the Marketing Plan in this report into practice.

2.3 SET PROJECT AND FUNDING GOALS

The CCRBDC should review the recommendations in this report and set one, two, and three year project and funding goals. These goals should be used to assist the Grant Sub-Committee in which grants to apply for and which projects and areas should be included in each grant application. The project and funding goals document should be reviewed and updated twice yearly.

Three Months	Develop a one paragraph Vision statement and a one page set of short term and long term goals
Six Months	Vision and Goals have been presented to county governments and stakeholders and revised Vision and Goals completed based on feedback. Projects, grant applications, and other activities are being developed in alignment with Vision and Goals.
One Year	Some goals have been accomplished. Other goals have been modified or changed. Some goals have been removed because of funding and support issues.
Two Years	Goals document has been reviewed yearly and updated to reflect funding successes, changed priorities, and new opportunities.

2.4 FORM A REGIONAL BROADBAND DEVELOPMENT AUTHORITY

Regional broadband initiatives are usually able to accomplish more for less cost—networks don’t recognize political boundaries, and there are construction and operational efficiencies to a regional network. A regional development authority with membership of all three counties should be formed to begin executing the region’s multi-year plan. Part of those plans could be a long term goal of forming a coop to complement the nonprofit.

Three Months	A seminal early decision is whether or not the region is prepared to make investments in broadband infrastructure and own and manage that infrastructure over the long term. The alternative to hope that deals can be made with private sector companies trying to leverage grant opportunities like CAF2 funds. With the latter, the three counties have little or no control over their economic future—in many ways similar to the current situation with Frontier. The CCRBDC must make a recommendation to elected officials and stakeholders on this issue.
Six Months	If the regional support for community ownership of infrastructure exists, a development authority has been formed and an initial board of directors (5-7 directors) and an advisory board with a more expansive membership has also been formed.
One Year	If the development authority has been formed, the board meets regularly, has obtained some initial funding from the three counties to support startup activities, and the authority is directing the development of funding and marketing activities.
Two Years	The authority has achieved widespread awareness of its work. Some early “first phase” projects have brought better Internet to some areas of the three counties. The nonprofit now has wider support and recognition of its importance.

2.5 APPLY FOR IMMEDIATE GRANT OPPORTUNITIES

The CCRBDC should agree on applying for at least two grant opportunities in the next twelve months, and then appoint a working sub-committee to manage the completion of the grant applications.

Three Months	<p>At least two grant opportunities have been identified (e.g. HUD/CDBG, ARC POWER, other state level funds).</p> <ul style="list-style-type: none"> • Grant applications have downloaded. • Grant Sub-Committee members have met with the Regional Intergovernmental Council and the West Virginia Development Office. • A timeline has been developed for each grant application and all materials needed to complete the grant application have been identified.
Six Months	<p>Grant applications have been submitted or are largely complete and ready for submission by the required due dates.</p>

2.6 EXECUTE THE MARKETING PLAN

If an area-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 three counties are engaged in trying to solve the broadband problem, that they know what service providers are available on the towers, and that they know how to order service.

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

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

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

Three Months	<p>The CCRBDC has reviewed the Marketing Plan in this report and has begun developing the recommended materials. A marketing sub-committee has been appointed to execute the Marketing Plan.</p>
Six Months	<p>The CCRBDC and the marketing sub-committee has begun circulating its awareness handouts, has created a permanent Web site, and has created a mailing list with key stakeholders, interested parties, and elected officials subscribed.</p>

One Year	The marketing and awareness sub-committee is following a regular set of awareness activities to keep business, residents, and stakeholders informed. The news blog on the Web site and the Facebook page are updated weekly with broadband related news and CCRBDC activities.
Two Years	The marketing and awareness sub-sub-committee continues to keep residents, businesses, and stakeholders in the three county area up to date with the BDC's activities.

2.7 DEVELOP A LONG TERM FUNDING STRATEGY

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

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

2.8 EVALUATE FORMING A BROADBAND COOP

As one possible long term funding strategy, the CCRBDC should consider forming a tri-county broadband coop. Coops can collect membership fees in advance of providing services, which could be one long term funding approach.

Rural businesses and residents need a strong advocate for broadband. Improvements to broadband access and affordability are more likely to be successful if there is a single entity that has primary responsibility for those improvements. A coop, with early developmental assistance from the three county governments and other interested parties and stakeholders could provide an ideal long term solution to broadband in the region.

Ownership and Governance

A Board of Directors has to be appointed to lead the formation and early development of the coop. Board members should have substantial management and business experience. Not all members need to have a telecom background.

Early Areas of Attention

Coop formation will require retaining legal counsel with significant prior experience with coops. Most utility-focused coops in the U.S. were formed sixty to eighty years ago; typical coops formed recently are often retail (e.g. coop grocery stores) or agricultural (e.g. beekeeping, organic farming, etc.). Inexperienced legal counsel could be very expensive.

Early start up costs may require funding from grants or donations.

A key early task will be defining the appropriate membership levels and setting the right membership fees for each level. Adjustments can be made to these membership categories later, but it will be easier to grow the coop membership quickly if membership categories are developed with care.

Three Months	As part of the BDC’s long term funding strategy development, the coop approach is evaluated carefully.
Six Months	If the CCRBDC believes the coop approach has merit, a one page overview of the coop concept for the three counties is being delivered in face to face meetings with stakeholders, interested parties, and elected officials.
One Year	If the support is in place for a regional coop, a qualified coop lawyer has been retained to develop the charter for the organization, assist with development of bylaws, and provide recommendations on membership classes and fees.
Two Years	If the coop formation decision was positive, the coop has been formed, a board of directors has been appointed, and membership fees are being collected. The coop takes over many of the responsibilities and activities of the nonprofit. The nonprofit remains part of the long term strategy, especially for applying for certain kinds of grants.

2.9 FOCUS ON IMPROVED WIRELESS BROADBAND ACCESS

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

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

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

2.10 FUND FOR SUCCESS

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

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

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

2.11 SUPPORT MIDDLE MILE FIBER EFFORTS

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

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

2.12 ATTRACT SERVICE PROVIDERS

Once an initial plan is in place to make tower improvements and/or to add towers, WISPs should be invited to meet with committee members to discuss making use of the planned infrastructure. See Section 14 (**Attracting Service Providers**) for more information.

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

2.13 PUBLIC SAFETY PARTNERSHIPS

The availability of public safety towers and/or new towers can enable new services and applications for police, fire, and rescue in the three counties. 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 region.

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

2.14 CCRBDC ACTIVITIES TIMELINE

Three Months	<ul style="list-style-type: none"> • Continuing regular meetings with the existing broadband committee. • Identify several areas (e.g. one or two per county) for a “first phase” effort that could include upgrading existing towers to make them “WISP-ready” and/or designating those areas as candidates for a new tower. • Meet with existing wireless providers and invite them to join the effort. • Discuss and identify funding sources. • For existing towers, meet with tower owners, check the most recent engineering studies, and determine if the towers can support additional antennas. • Meet with the Commissioners in all three counties to present a recommended “first phase” effort, discuss funding requirements, and get a commitment to form a regional broadband entity (e.g. a nonprofit). • Evaluate potential local, state, and Federal grant sources and identify what projects could qualify for grant funds.
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<p>Six Months</p>	<ul style="list-style-type: none"> • Developing a budget for the chosen “first phase” project (e.g. the first towers to receive improvements for service providers. • Identification of early funding sources and solicitation of funds (e.g. writing grant proposals, state funding, soliciting County-level financial support, private contributions, etc.). • For any new wireless towers, identify available County and private properties that fit the desired service areas. • Solicit input from service providers on use of existing and any new towers that might be planned. • As work begins on up-fitting existing towers (or if one or more new towers is under construction), meet with service providers to develop binding agreements to use the new infrastructure to sell services. • Form the regional entity, appoint an initial advisory board, and develop a short term marketing and awareness strategy (e.g. continued use of the CCR Broadband Facebook page).
<p>One Year</p>	<ul style="list-style-type: none"> • Move forward with Implementation Planning for the “first phase” projects—preparing for construction. • Improvements to existing towers should take only a few months to complete and should be finished in this time frame, making towers ready for WISP use and expanded Internet service. • For new towers, negotiate with property owners, begin any required permitting process prior to construction. • Assuming that funds have been secured, construction of towers may begin as early as month nine or ten.
<p>Two Years</p>	<ul style="list-style-type: none"> • In the early part of year two, “phase one” improvements would be completed and service providers would be offering improved services. Revenue would be collected from providers using the towers. Financial management of revenue and expenses will begin.

3 MARKETING PLAN

From the survey results and the meetings with stakeholders, it is clear that there is widespread frustration with the current levels of broadband service. The CCRBDC will have to simultaneously keep all audience segments well-informed with regular updates, but also manage expectations. The Committee is not responsible for a traditional “sales” approach to marketing, but rather the focus must be on “awareness marketing.” That is, ensuring that all of the residents, businesses, and various stakeholders and interested parties in the region have enough information to feel like they know what is happening and when, but also understand that this is a problem that has developed over decades, and will take several years to solve.

3.1 BRANDING

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

3.2 CHARACTERISTICS OF A SUCCESSFUL MARKETING PLAN

A successful marketing plan for the region does not have to be expensive or time consuming. The attributes that need attention are:

- Consistent – Use a single, easy recognized logo, tag line, and message consistently across all platforms—paper, Web, social media, and email.
- Ongoing – Regular updates and news postings on the Web site and the Facebook page will keep residents, businesses, and local officials up to date and well-informed about broadband development activities.
- Affordable – Avoid using high priced media consultants, SEO advisers, and over-priced marketing agencies. A simple Web site can be hosted for less than \$200 per year, and there are a variety of Content Management Systems (CMS) that allow Web sites to be updated quickly and easily without any programming or coding required. For paper materials like fliers, professionally designed templates are available that can be easily edited for a high quality finished product. Paper materials can be printed easily and quickly on high quality, four color glossy paper formats at very low cost. As an example, an 8 1/2 x 11 four color glossy flier can be printed and delivered in 48 hours for as little as twelve cents a copy.
- Interesting Content – Posted news items should emphasize quality over quantity. One interesting broadband article per week is better than three marginally interesting articles per week.
- Well-defined Distribution – Distribution of news items should be well understood—as an example, most news items should be posted on the Web site news blog at the same time as the Facebook page.

- **Well-defined Goals** – The Committee should develop a short list of short term and long term goals that can be described concisely (e.g. one sentence each). Goals should be included as needed and as appropriate on the Web site, on the Facebook page, and on paper media. The goals should also be highlighted in presentations, interviews, and in public meetings.

3.3 DISTRIBUTION

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

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

Perhaps the most important feature of Facebook is the interactivity that is possible between the CCRBDC and Facebook users. Residents and businesses are already “liking” and “sharing” the page, but they are also posting questions. The Facebook page should be visited at least weekly by a member of Committee who will review activity, write responses to questions, and pass interesting or important comments on to other Committee members.

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

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

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

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

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

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

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

3.4 MARKETING MATERIALS

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

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

3.5 TARGET AUDIENCE

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

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

- State Legislators – Changes in laws and funding opportunities at the state level could accelerate the goals of the effort. Regular updates by email and in-person meetings will be important.

3.6 BUDGET

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

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

4 SURVEY RESULTS SUMMARY

In the fall of 2018, the CCRBDC conducted a residential and business survey. Both surveys were available online. Additionally, a paper version of the survey was mailed to all households in all three counties. The residential survey had a link to the online business survey as well. Both residential and business surveys were distributed and widely disseminated using social media, mailing lists, and direct mail. The direct mail portion of the survey included mailing a residential survey to every USPS street address in each of the three counties. A total of 1,223 residential responses were received, and 38 business responses were received. The large number of residential responses provides valuable data on current and future broadband needs that can be used in grant applications. The response rate is 9.3% of total households, which is a statistically robust response.

A brief summary of significant results of the survey is below, and a full analysis of the results is available as a separate report.

The final question in both the business and residential survey was "Any other comments?", and those responding to the surveys submitted hundreds of comments. Many of them were passionate descriptions of the problems they struggle with because of inadequate broadband.

Because of the length of the comments and data, the complete results of the surveys are available as a separate document, but listed below are some of the results.

Business Survey

- 97% of business respondents want better Internet access.
- 97% of businesses indicated that the Internet is essential to their business.
- 100% indicated that the Internet is important to the success of their business over the next five years.
- Only 6% of businesses are "satisfied" or "very satisfied" with their current Internet service.
- 46% of the businesses that responded are home-based.
- 72% of businesses that responded need employees to be able to work from home.

Residential Survey

- 98% of respondents want better Internet service.
- 95% of residents are "not satisfied" or "only somewhat satisfied" with current Internet service.
- 57% of respondents indicated they have no alternative to their current Internet provider.
- 29% of residents have 7 or more Internet-connected devices in their home.
- 33% of respondents would work from home if they had better Internet.
- 27% indicate that availability of broadband Internet is affecting where they choose to live.

A very large number of comments were received, and all of them are included in the separate Survey report. Here is a sample of some of the comments.

Quality Internet service today is a necessity, as almost all aspects of our lives depend on it. I can't even get what I was promised.

The Internet is only 3 Mbps at its highest speed and experiences frequent disconnects. Frontier tech rarely comes to the home when called. The situation with the Internet makes it impossible to continue my education and I have to drive to my father's home to submit school work online. My wife frequently has trouble loading web pages just to pay bills. Our family is seriously considering moving out of state due to the poor Internet access. The cost of the service we currently have is outrageous for the service they provide but we have no other options at our home.

I home school my two kids and it makes it very hard when I don't have good internet connection.

Internet drops at least once a day, speed has never exceeded 1.6 Mbps and usually is as slow as dial up.

When the weather is bad, I cannot travel to my job which is over an hour away with relative safety. I VPN from home via my work laptop. However this is usually a chore in of itself. Satellite is an option here but it is too expensive. Cellular is the only other option and its poor at best.

High Speed internet would have such a great impact for our community in Clay County. It has hindered businesses coming to the area, it is causing people to move from the area that require it for work, and it prevents our students from achieving their full potential because they do not have access to the internet speeds that would allow them to do their school work.

We live in a rural Calhoun county, and the landline phone is only Frontier-- Internet is mostly Frontier, the only thing we have here, the cell service is terrible... for people with health problems it is really scary at times. We need another option for service in this county besides Frontier.

I have lived in Calhoun County all my life, and now because of the poor Internet service my husband and I are looking for somewhere to move that has high speed Internet service.... I was eligible for a work at home nursing position however my internet speed was to slow for the position.

5 STAKEHOLDER EVALUATION PROCESS

Design Nine conducted a series of stakeholder meetings over the course of several months. Participants at the meetings contributed valuable insights on the broadband situation in the three counties.

An extensive broadband survey effort was also completed during the planning process. Both residential and business surveys were distributed and widely disseminated using social media, mailing lists, and direct mail. The direct mail portion of the survey included mailing a residential survey to every USPS street address in each of the three counties. A total of 1,223 residential responses were received, and 38 business responses were received. The large number of residential responses provides valuable data on current and future broadband needs that can be used in grant applications. The response rate is 9.3% of total households, which is a statistically robust response. A brief summary of significant results of the survey is in Section 4 of this report, and a full analysis of the results is available as a separate report.

Visit on 9/10/18

Jack Maytum, Senior broadband Analyst, attended a Roane County Broadband Committee Board of Directors Meeting at the Roane County Board of Education Office, Spencer, WV.

Prior to the meeting Jack Maytum met with Matt Erb, Broadband Committee Chairman, to discuss the committee's history and plan direction for the course of the broadband study.

Attendees at the broadband committee meeting included:

Matthew Erb, Chairman	CCRBDC	Chairman
Martin "Rick" Atkinson III	CCRBDC	WV House of Delegates
J. Matthew Jack	CCRBDC	President WV Stone Works
Jim Bostick	CCRBDC	VP WV Stone Works
Kim Davis	CCRBDC	Exec. Dir., Roane Cty Chamber Commerce
Mark Whitley	CCRBDC	Exec. Dir., Roane Cty Econ Dev Authority
Lisa Messiner	CCRBDC	Community Outreach

Following the meeting Jack Maytum spent the afternoon with J. Matthew Jack and Jim Bostik at their business, Western Union Stone Works, discussing the positive effects of better broadband on their business and in the Roane County community.

All members of the committee considered the poor condition of telecom services within Calhoun, Clay and Roane counties to be a serious impediment to economic development.

Rick Atkinson is attempting to improve the broadband opportunity through the development of technical training courses at regional community colleges. The courses would provide skilled workers with technical skills in fields such as underground and aerial fiber cable installation, network operation and project planning. Rick considered that these technical courses would serve

a dual purpose: provide the necessary skills to install and maintain a new generation of broadband networks for the local community and allow young community graduates to find well-paying jobs in their local community.

Lisa Messiner provides community outreach services to schools and coordinates meetings with teachers, school administrators and parents. Starting in elementary school, students in the counties are considered to be at a disadvantage because they are unable to receive and transmit assignments to their school networks because poor residential broadband connections at their homes.

Both Kim Davis and Mark Whitney are directly involved with Roane County's economic development. They recognize that even a small improvement in broadband services in the local business community will improve the living standard of all county residents.

J. Matthew Jack and Jim Bostik founded Western Union Stone Works in one of the largest, now abandoned, sweater mill in the U.S. The two founders will make a substantial capital investment in their firm which is located in the outskirts of Spencer. Following the broadband committee meeting Jack Maytum spent the afternoon with at their business, Western Union Stone Works, discussing the positive effects of better broadband on their business and in the Roane County community.

Visits on 10/25/18 - 10/26/18

2nd visit by Design Nine, Inc. Analyst Jack Maytum for community outreach on 10/25-26. Met with Dr. Victor Vega, Provost and Vice President of Academic Affairs at Glenville State College about establishing a training program for broadband network technicians (Reference from WV Rep. Martin Atkinson III). Dr Vega was interested in a proposal to add a network technician track to the catalogue of Glenville State's technical training courses

Jack led a presentation to community business, education and county leaders on 10/26/19 at First Neighborhood Bank boardroom. This meeting was arranged by Roane County broadband committee member John Norman, Public Relations Director, First Energy Corp.

Presentation to community business, education and county leaders on 10/26 at First Neighborhood Bank boardroom. This meeting was arranged by Roane County broadband committee member John Norman, Public Relations Director, First Energy Corp.

Attendees at the meeting included:

Eric Simmons	Poca Valley Bank
Daniel Davis	Roane County Schools (IT Director)
Michael Hicks	Calhoun County Commissioner
Reta Varder	First Neighborhood Bank
Danny Harper	Roane County Family Health Care
Jeanette Atkinson	First Neighborhood Bank
Doug Douglass	Conserv
Richard Duncan	Roane County Schools (Superintendent)

David Haney	E&H Manufacturing
John Norman	First Energy Corp
Jim Bostic	BSM, Inc.
Steve Seabolt	First Energy Corp (Monpower)
John Cole	Poca Valley Bank (CIO)
Phil Holcomb	Chestnut Ridge Winery
Mark Whitney	Roane County Economic Development Authority (Executive Director)
Kim Davis	Roane County Chamber of Commerce (Executive Director)

Most members of the business community were unsatisfied with the currently available broadband options in Clay, Calhoun and Roane counties. David Haney, E&H Manufacturing, had recently received a quote for more than \$5,000 per month for Internet service from Frontier Communications.

The group considered financial options relating to the construction of a county-owned broadband network. Most members were in agreement that financial grants would be required to initiate construction and that a certain level of user fees would be supported by the community to operate and maintain the network. John Norman, First Energy Corp, indicated that his company has considered the potential of installing fiber optic cables along First Energy poles and offer broadband services to business and residents throughout the counties.

Visit on 1/24/19

Design Nine, Inc. Analyst Jack Maytum made a presentation on the Broadband Study Project to Clay County broadband stakeholders at the Clay County Courthouse.

Attendees at the meeting included:

Connie Kinder	Clay County Commissioner and CCR Broadband Committee Member
Greg Fitzwater	Clay County Commissioner
William Gross	CCR Broadband Committee Member
Barry McCure	CCR Broadband Committee, Clay County Bank
Becky Pritt	Clay County E-911
Donna Salisbury	Salisbury Auto Salvage/FRN
Andy Waddell	Delta, WYAP
Geoff Hamrick	Clay County Schools
Mitch DeBoard	CCR Broadband Committee Member
Daniel Tanner	D&L Contracting, Walker Creek Farm
Beverly Pierson	Clay County PSD
Tami Hughes	Clay County PSD
Donny Triplet	Clay County Sheriff
Jerry Linkinoggor	BoE

Laura McGlothlin	Advantage Home Care
Lisa Taylor	Advantage Home Care
George Workmon	Big Otter UFD
Fran King	King's Trucking and Wreckage Service

The primary topic of interest to the attendees was the desire for a reasonably affordable improvement to the unacceptably poor level of broadband service throughout Clay County, particularly in the more rural areas of the county.

The primary topic of interest to the attendees was the desire for a reasonably affordable improvement to the unacceptably poor level of broadband service throughout Clay County, particularly in the more rural areas of the county. While about 35% of the county has access to higher speed cable connectivity through Suddenlink, almost all of those connections are in the metropolitan Clay area. The balance of the county relies on Frontier DSL, with lower speeds and less reliability, expensive cell phone or satellite TV.

Most attendees expressed an interest in a county-delivered broadband offering and would be willing to transfer from their current provider to such a service. Some would be willing to pay more if the proposed offering allowed them to work from home at least part of the time. Some others would consider starting a home-based business if their broadband connection was reliable and not cost prohibitive.

In particular, business representatives need a reliable communications system to support remote payments, orders to suppliers, document transfer, teleconferences and connections to data providers.

Several attendees spoke about the need to retain young residents in the county to provide for future economic growth. The trend of young adults leaving the county for school and jobs in larger cities was accelerating and they felt that lack of a modern communication system in Clay county was a prime factor.

Visit on 1/24/19

Design Nine, Inc. Analyst Jack Maytum made a presentation on the Broadband Study Project to Calhoun County broadband stakeholders at the Calhoun County Banks boardroom at 2pm.

Attendees at the meeting included:

Kelli Whytsell	Calhoun County Superintendent of Schools
Charles Thomas	CCRDBC Broadband Committee Member
Martha Haymaker	Calhoun Banks
Brad Stevens	Calhoun Banks
William Gross	CCR Broadband Committee Member
Diane Ludwig	Little Kanawha Area Development Corp
Chip Westfall	Calhoun County Commission
Kevin Helmick	President, Calhoun County Commissioner

Because of the professional characteristics of the attendees at this meeting, the topic centered on the role of government in the establishment of a broadband network. Chip Westfall felt that there are no other capital projects in Calhoun County more worthy of attention than the broadband deficit. Diane Ludwig, while recognizing the importance of a modern broadband network for the economic growth of Calhoun County, was concerned about the funding required to develop such a system. She felt that the residents and businesses in the county could not make the financial investment in such a system.

Kelli Whytsell spoke forcefully about the importance of a robust county-wide broadband network. While the schools have adequate network speeds for their administrative requirements, many of the students in the largely rural county have no access to Internet at their homes. Such school work is increasingly being distributed digitally to students and the students cannot connect to the education system to collect and submit school assignments. She said that this circumstance will have detrimental effects on the future development of the county.

William Gross focused on the importance of a modern communications system for general business development.

Martha Haymaker and Brad Stevens, our hosts for the meeting at Calhoun Banks, made no comment.

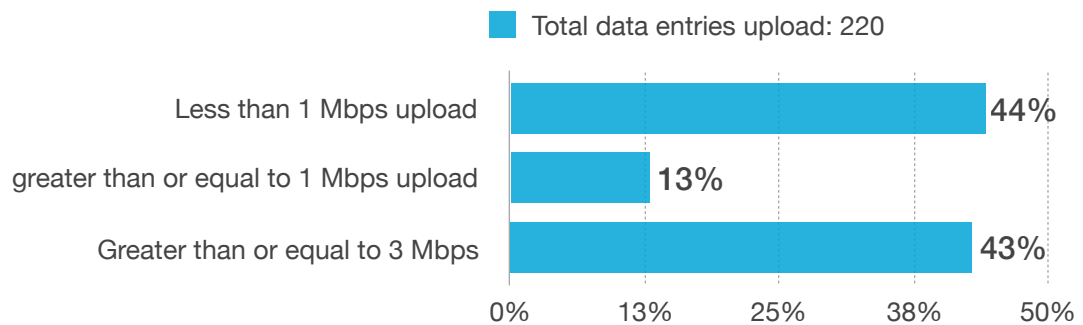
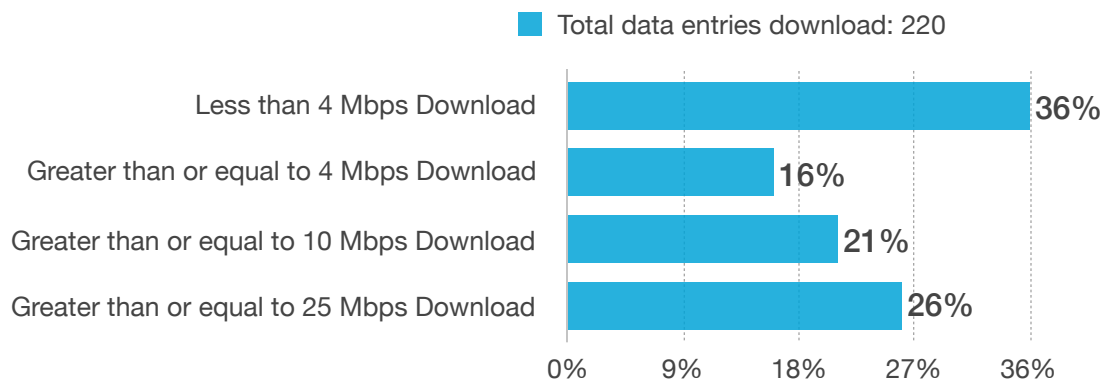
6 ASSET ANALYSIS AND SPEED TEST DATA

In addition to the 1,233 residential surveys received and the 38 business surveys, speed test data obtained from the State of West Virginia provides an additional 2,311 data points, for a total data set of 3,544 speed test and survey responses. This data will be extremely valuable when included in grant applications, where it may be important to provide alternative documentation of poor broadband service (that is, an alternative to the FCC broadband map). Later in this section of the report are maps that show geo-coded responses to the CCRBDC survey, and there is additional data summaries from the two speed test data sets from the state. Not all the state-provided data included addresses.

6.1 CLAY COUNTY DETAILED SPEED TEST DATA

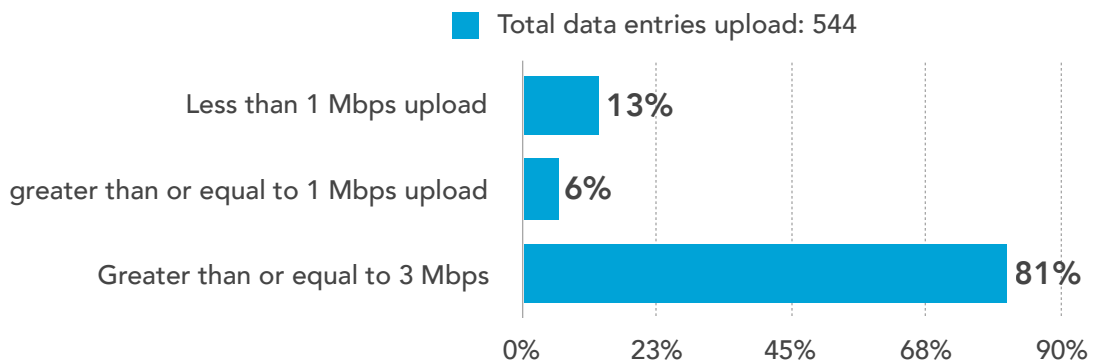
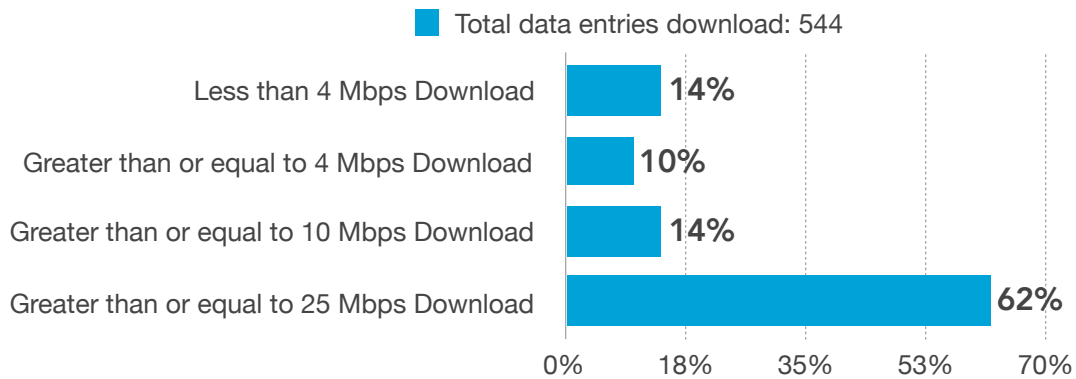
Clay County: West Virginia Speed-test

DATA DIRECTLY FROM WEST VIRGINIA	TOTAL DATA ENTRIES DOWNLOAD: 220 UPLOAD: 220
Less than 4 Mbps Download	36%
Greater than or equal to 4 Mbps Download	16%
Greater than or equal to 10 Mbps Download	21%
Greater than or equal to 25 Mbps Download	26%
Less than 1 Mbps upload	44%
greater than or equal to 1 Mbps upload	13%
Greater than or equal to 3 Mbps	43%



Clay County: Ookla data

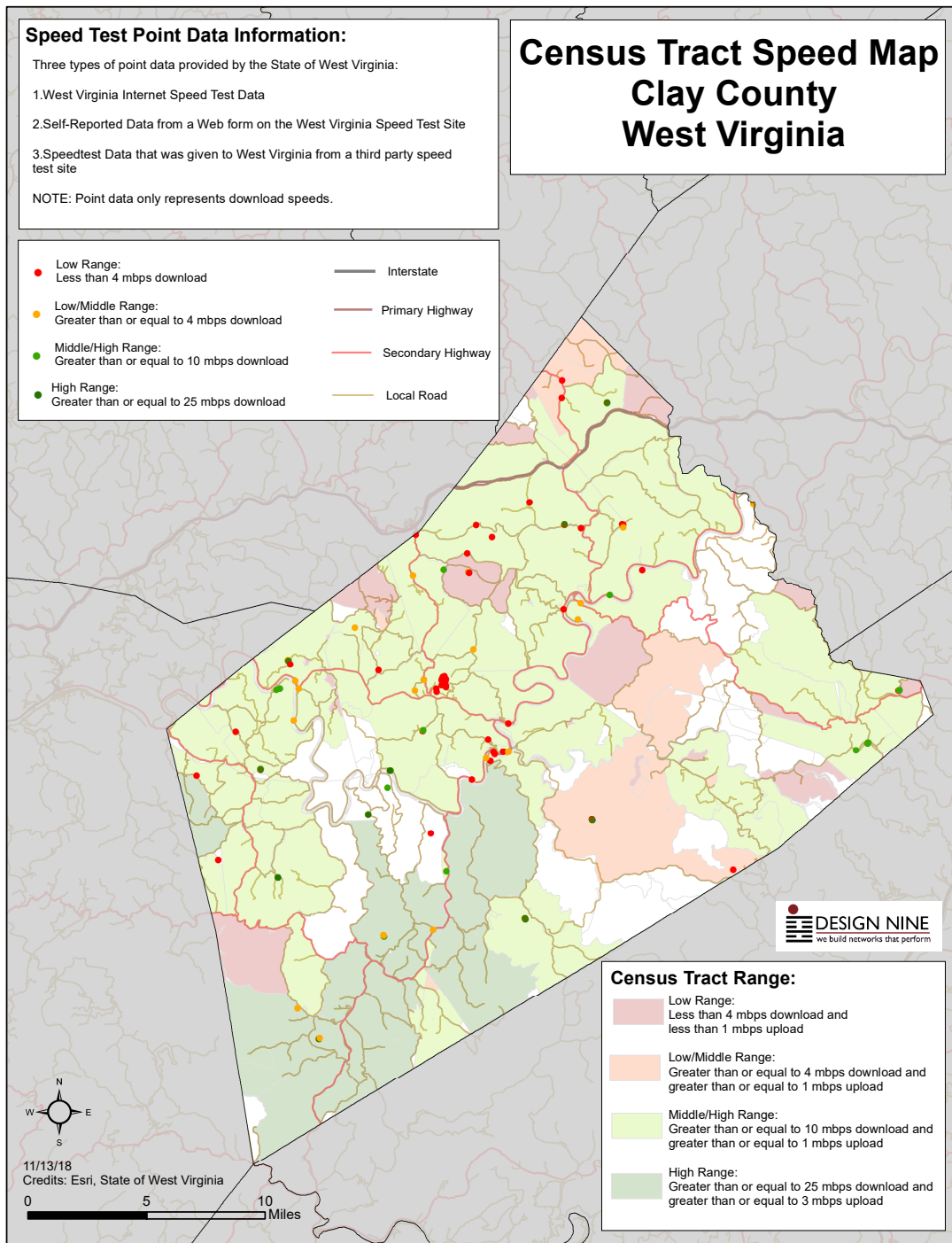
DATA FROM OOKLA	TOTAL DATA ENTRIES DOWNLOAD: 544 UPLOAD: 544
Less than 4 Mbps Download	14%
Greater than or equal to 4 Mbps Download	10%
Greater than or equal to 10 Mbps Download	14%
Greater than or equal to 25 Mbps Download	62%
Less than 1 Mbps upload	13%
greater than or equal to 1 Mbps upload	6%
Greater than or equal to 3 Mbps	81%



Ookla is a third party speed test site that has provided the State with data. It is not geo-located.

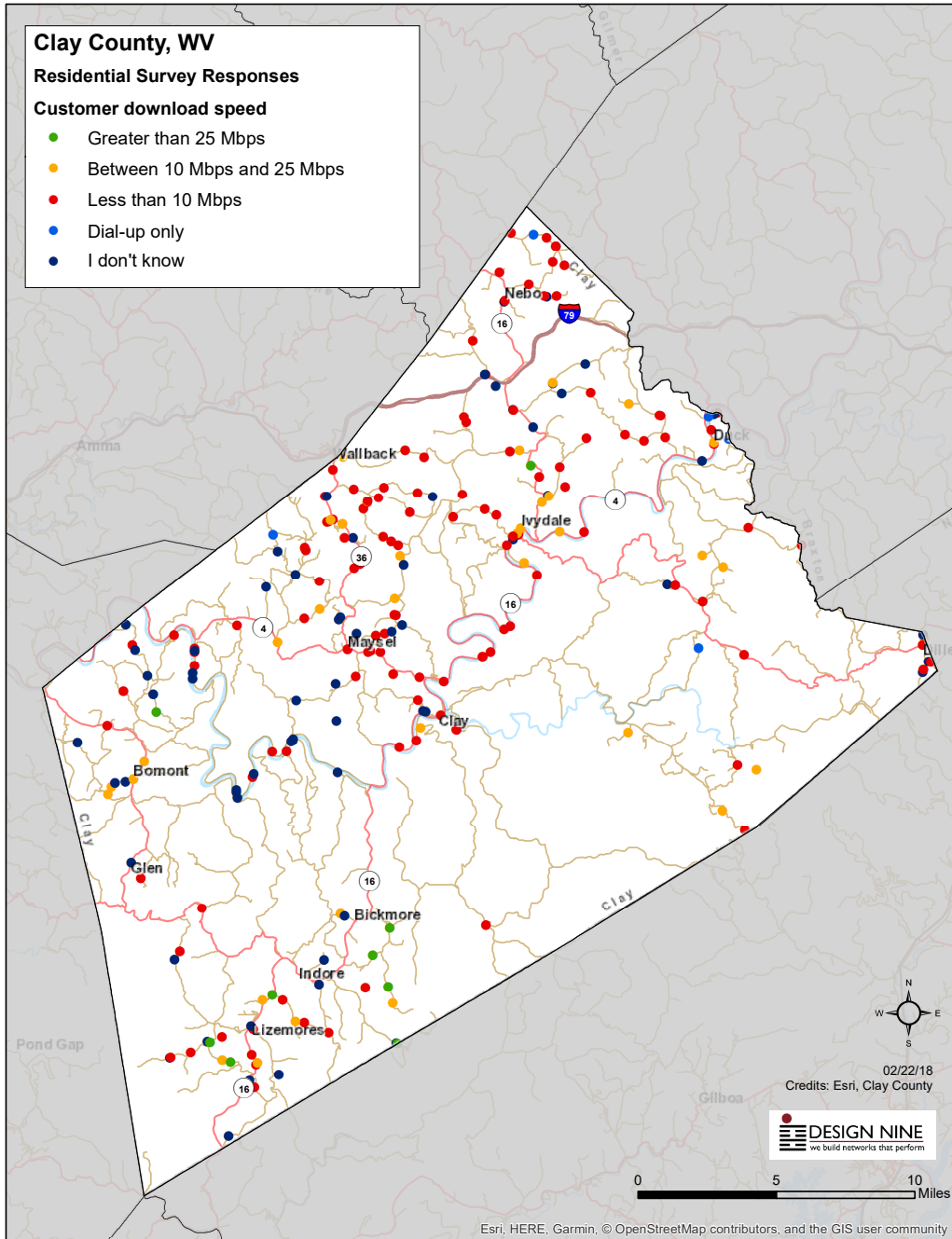
Speed Test Map

The data on this map is taken from several different West Virginia speed test data sources.



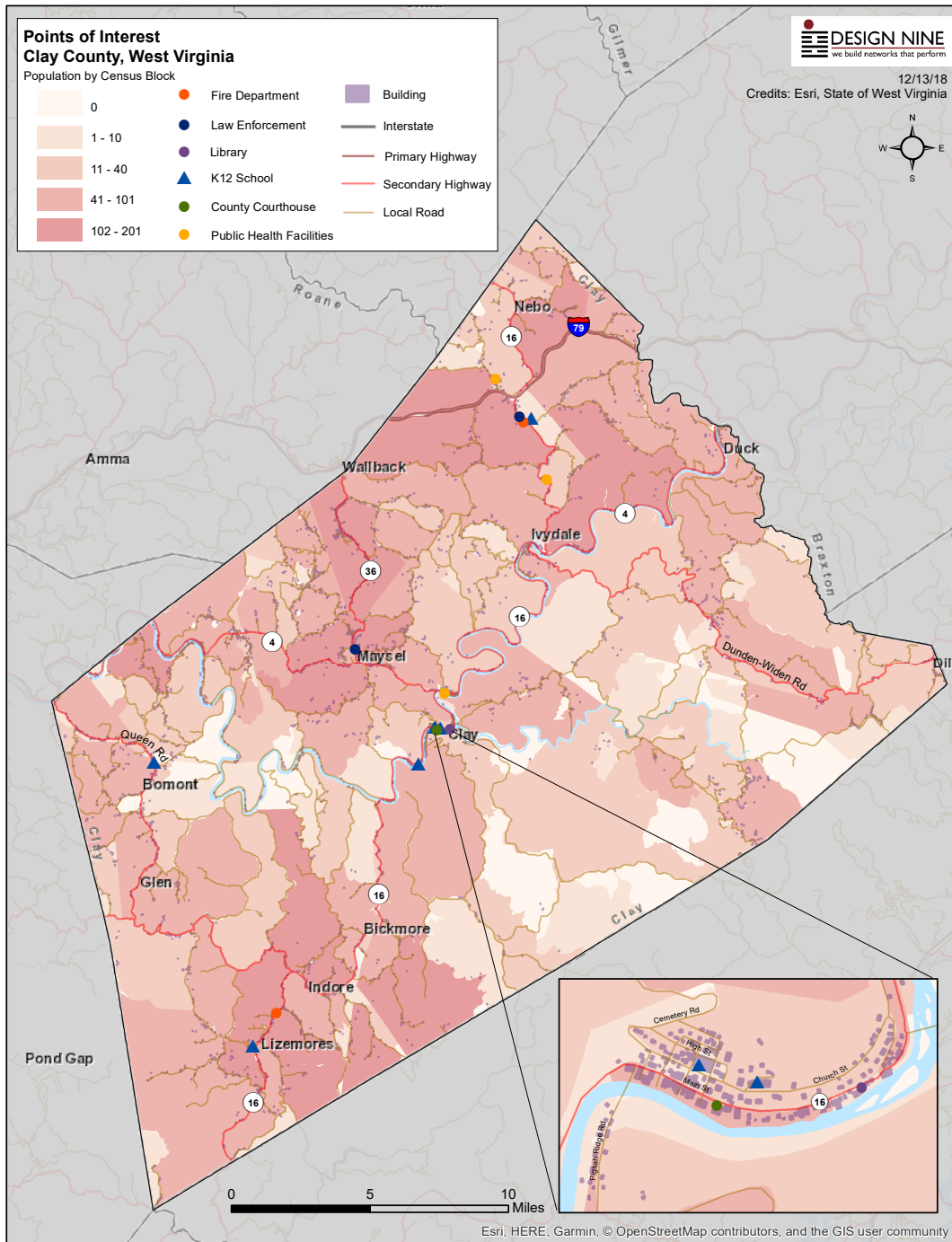
Survey Response Data

The map below shows the download speeds reported by residents responding to the broadband survey conducted as part of this study and report.



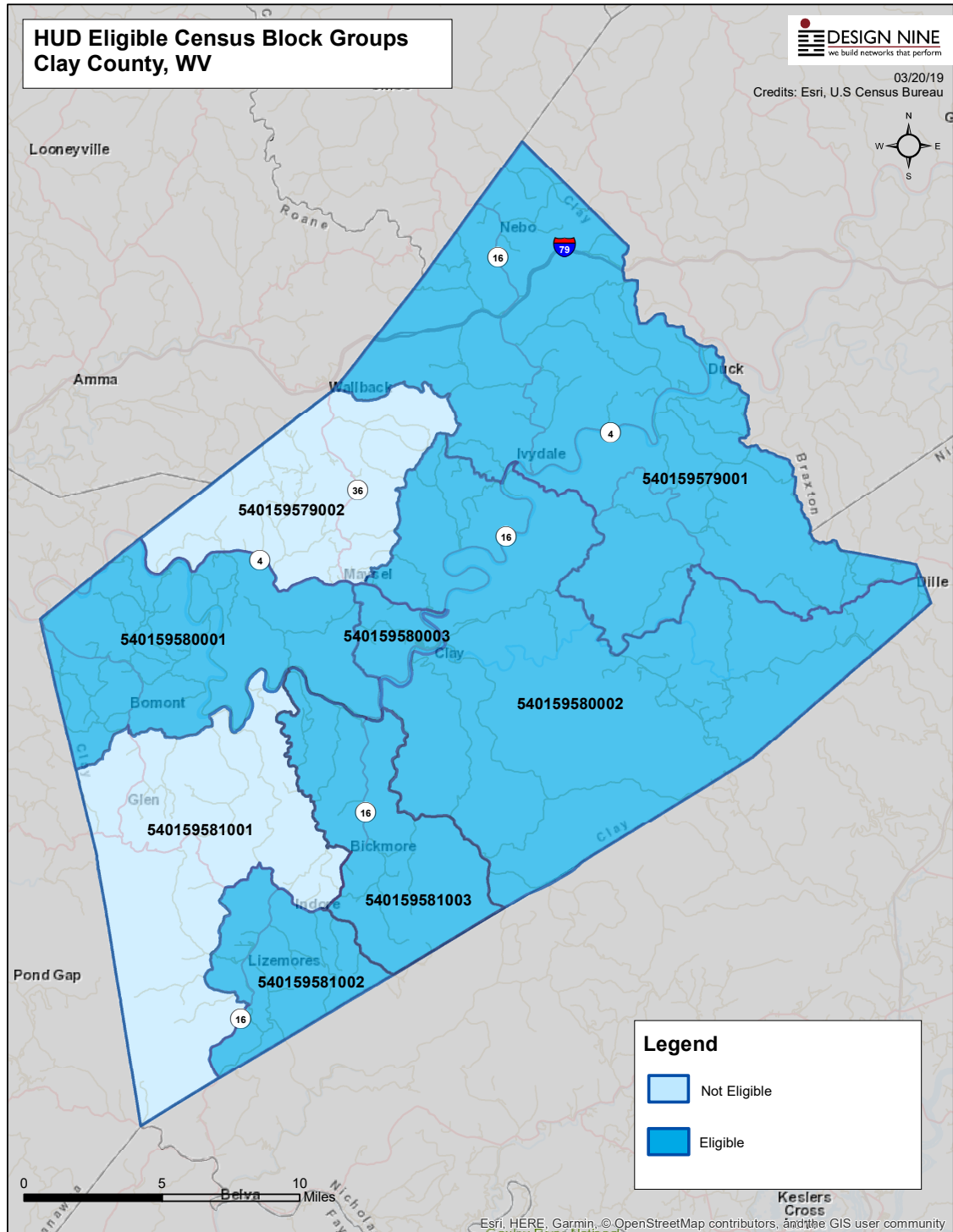
6.2 CLAY COUNTY GIS AND MAP DATA

Points of Interest



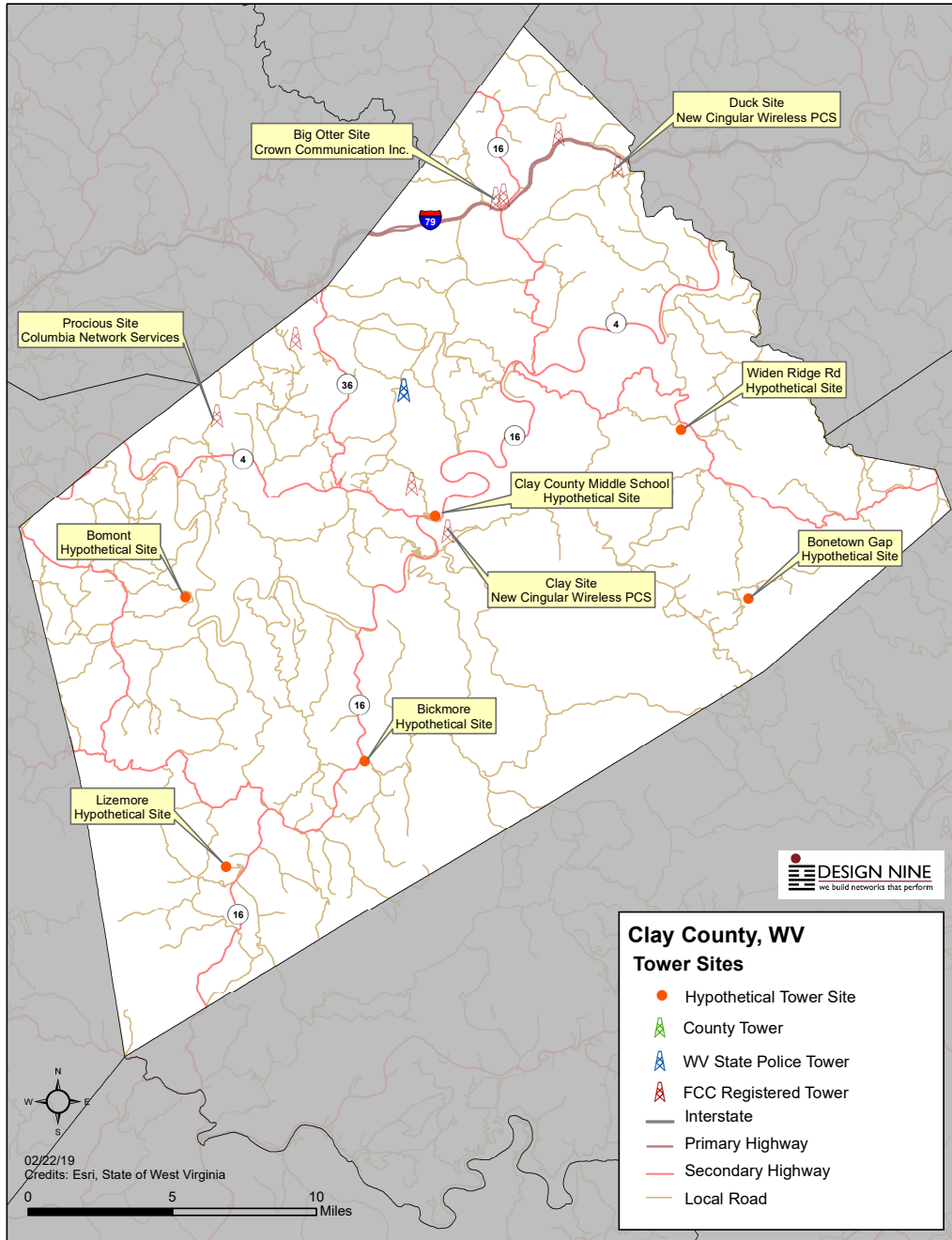
HUD/CDBG/LMI Areas

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



Tower Assets

The “hypothetical” tower sites listed on the map are sites used in the propagation studies later in this report. The hypothetical sites were chosen to show what kind of wireless broadband coverage a new tower in that location could provide. Towers were identified from FCC, state, and local sources, but not all towers are registered with the FCC or state agencies.



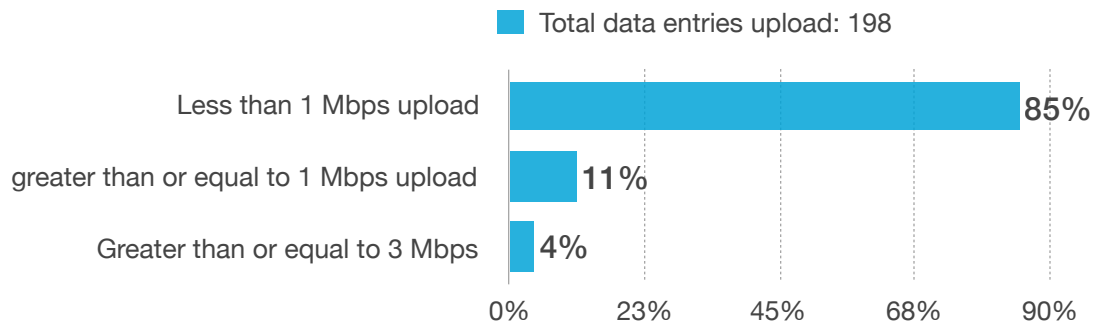
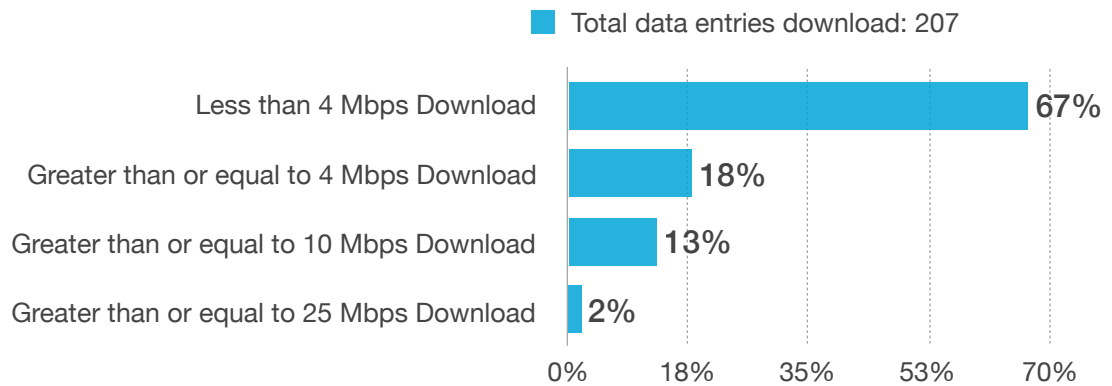
This list shows the owners of towers that have been registered with the FCC. Not all towers are registered in the FCC database.

Entity	Latitude	Longitude	Location
Lloyd Hoff Holding Corporation dba Portapage	38.5456	-81.1456	WALLBACK
COLUMBIA NETWORK SERVICES CORPORATION	38.5153	-81.185	PROCIUS
DAWSON, TOM	38.4886	-81.0875	CLAY
Crown Communication Inc.	38.6001	-81.0454	Ivydale
NEW CINGULAR WIRELESS PCS, LLC	38.6126	-80.9842	Duck
NEW CINGULAR WIRELESS PCS, LLC	38.4699	-81.0694	Clay
NEW CINGULAR WIRELESS PCS, LLC	38.6015	-81.0414	Big Otter
TowerCo II LLC	38.6257	-81.0139	Clay

6.3 CALHOUN COUNTY DETAILED SPEED TEST DATA

Calhoun County: West Virginia Speed-test

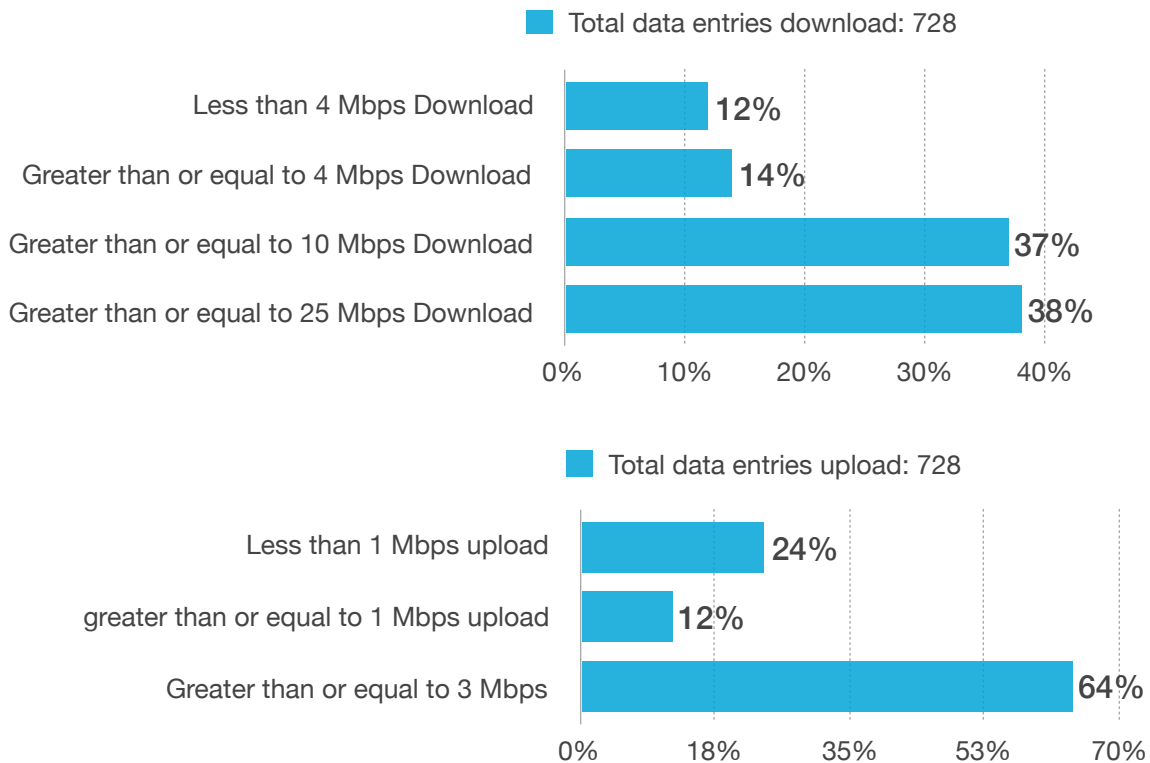
DATA DIRECTLY FROM WEST VIRGINIA	TOTAL DATA ENTRIES DOWNLOAD: 207 UPLOAD: 198
Less than 4 Mbps Download	67%
Greater than or equal to 4 Mbps Download	18%
Greater than or equal to 10 Mbps Download	13%
Greater than or equal to 25 Mbps Download	2%
Less than 1 Mbps upload	85%
greater than or equal to 1 Mbps upload	11%
Greater than or equal to 3 Mbps	4%



Calhoun County: Ookla Data

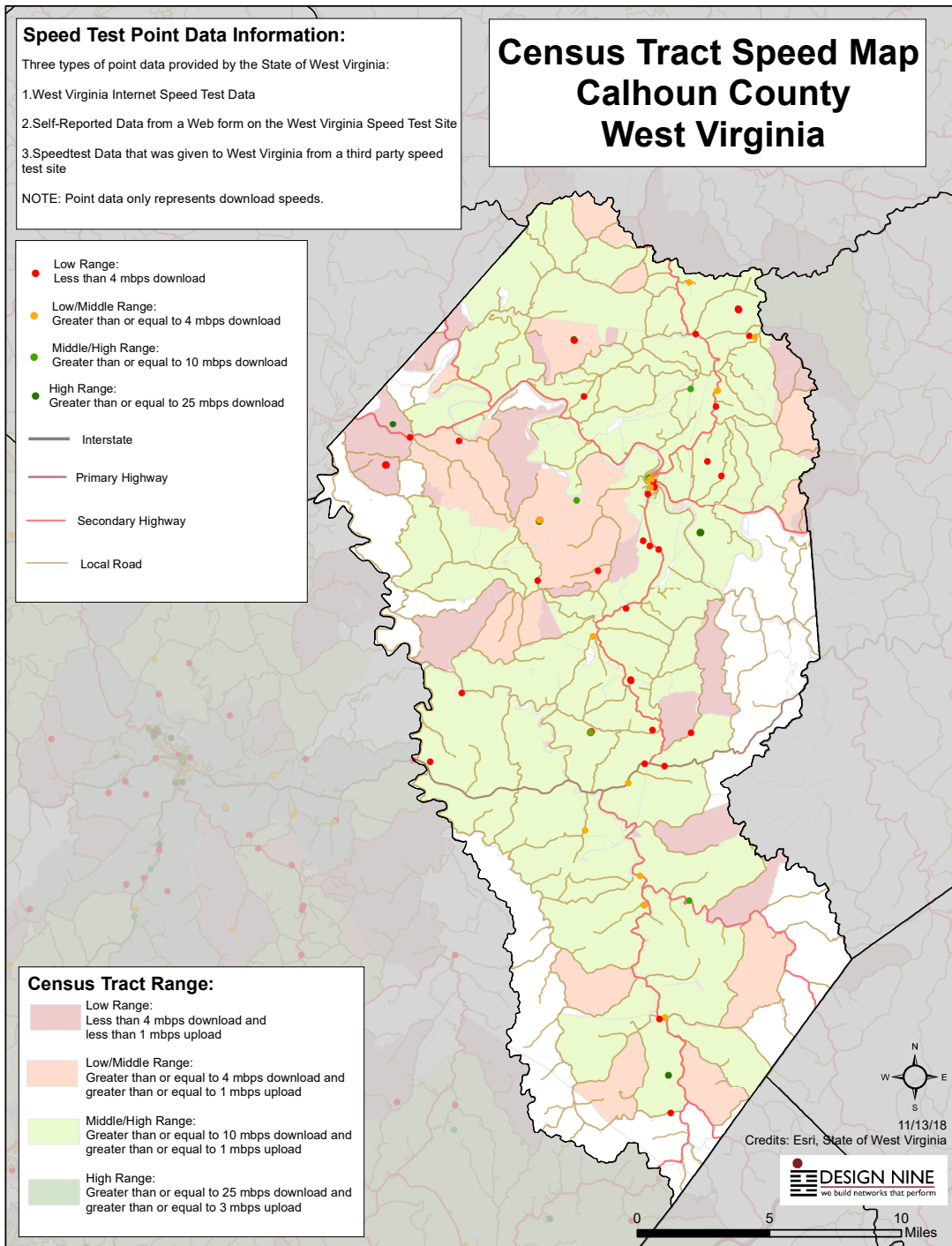
DATA FROM OOKLA	TOTAL DATA ENTRIES DOWNLOAD: 728 UPLOAD: 728
Less than 4 Mbps Download	12%
Greater than or equal to 4 Mbps Download	14%
Greater than or equal to 10 Mbps Download	37%
Greater than or equal to 25 Mbps Download	38%
Less than 1 Mbps upload	24%
greater than or equal to 1 Mbps upload	12%
Greater than or equal to 3 Mbps	64%

Ookla is a third party speed test site that has provided the State with data. It is not geo-located.



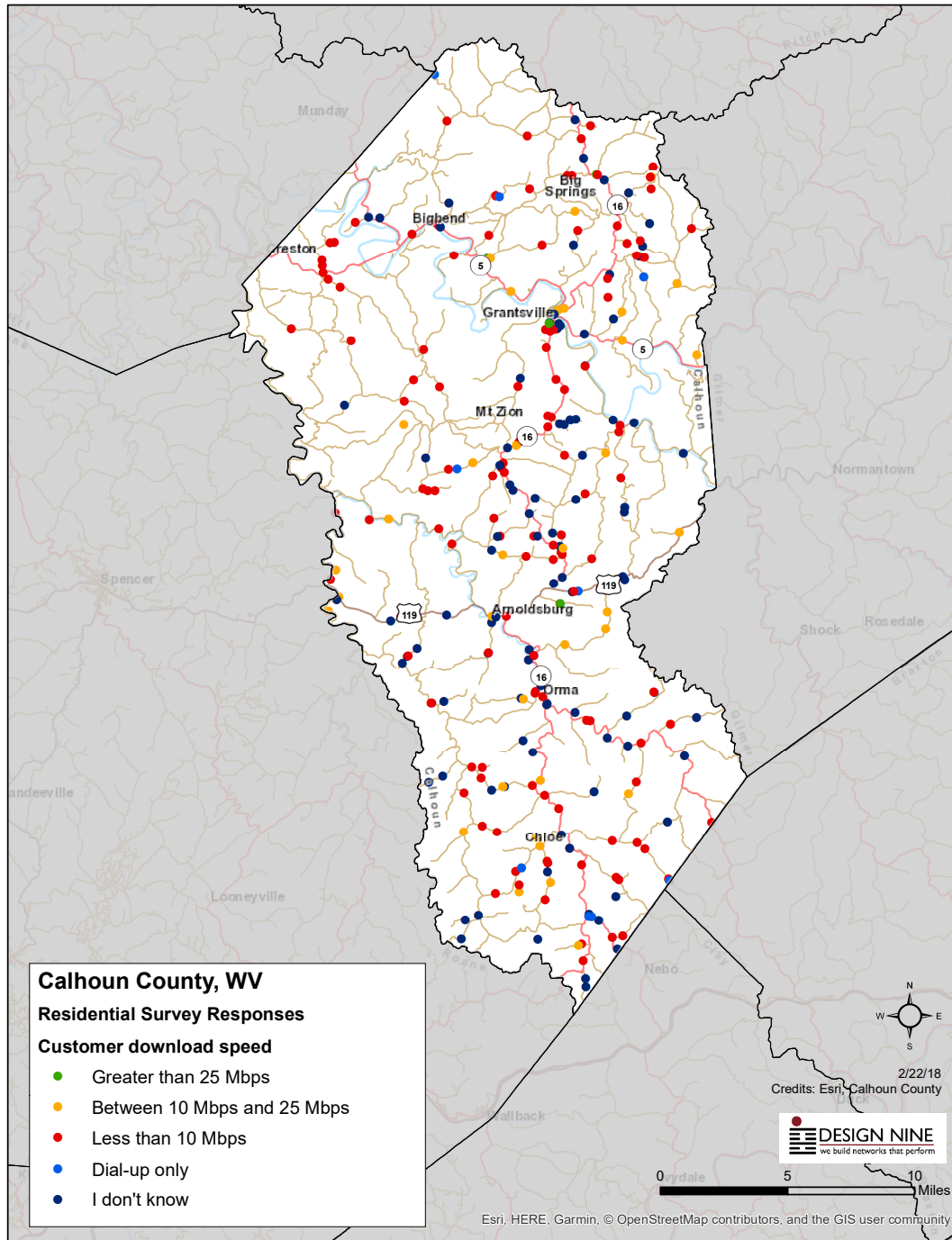
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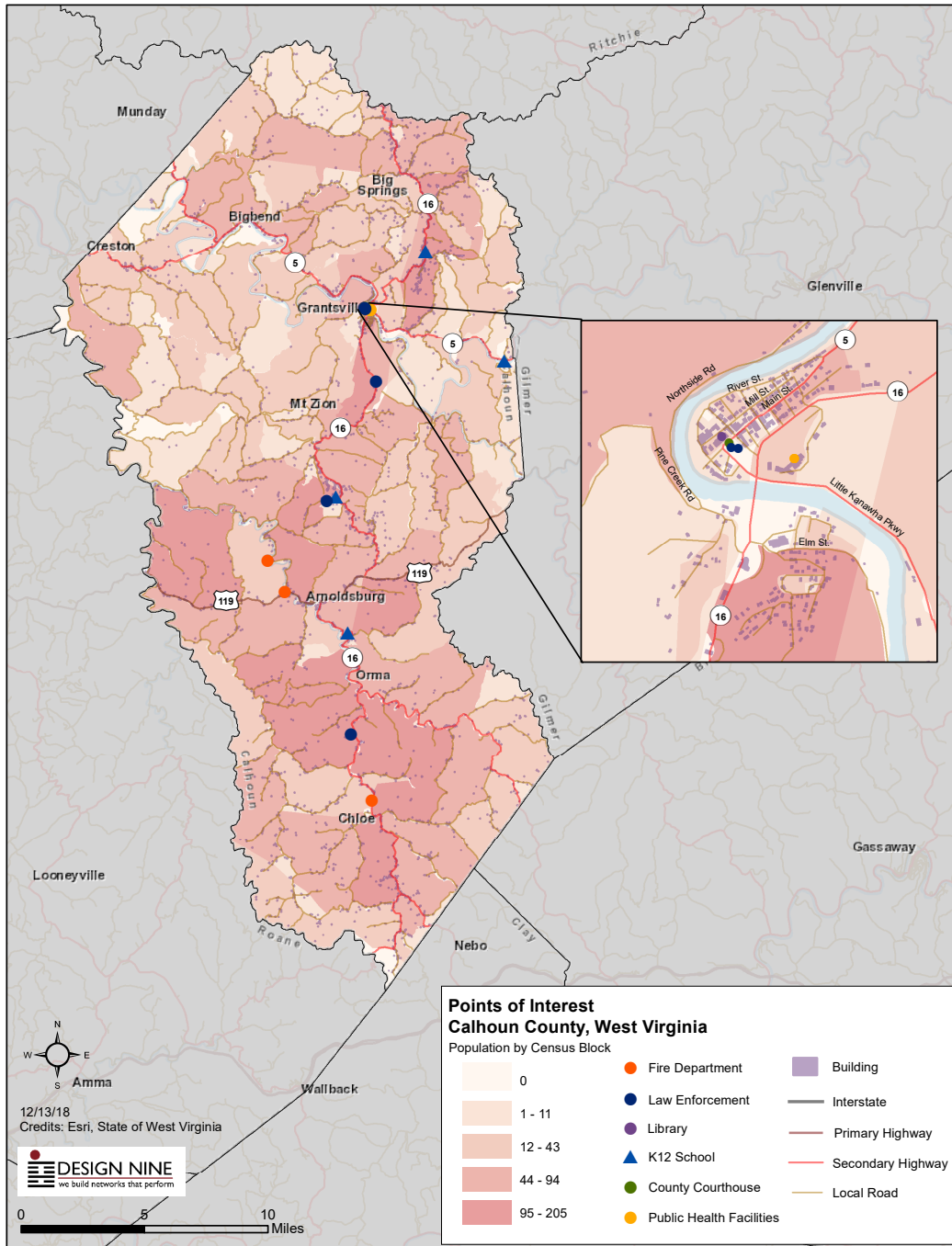
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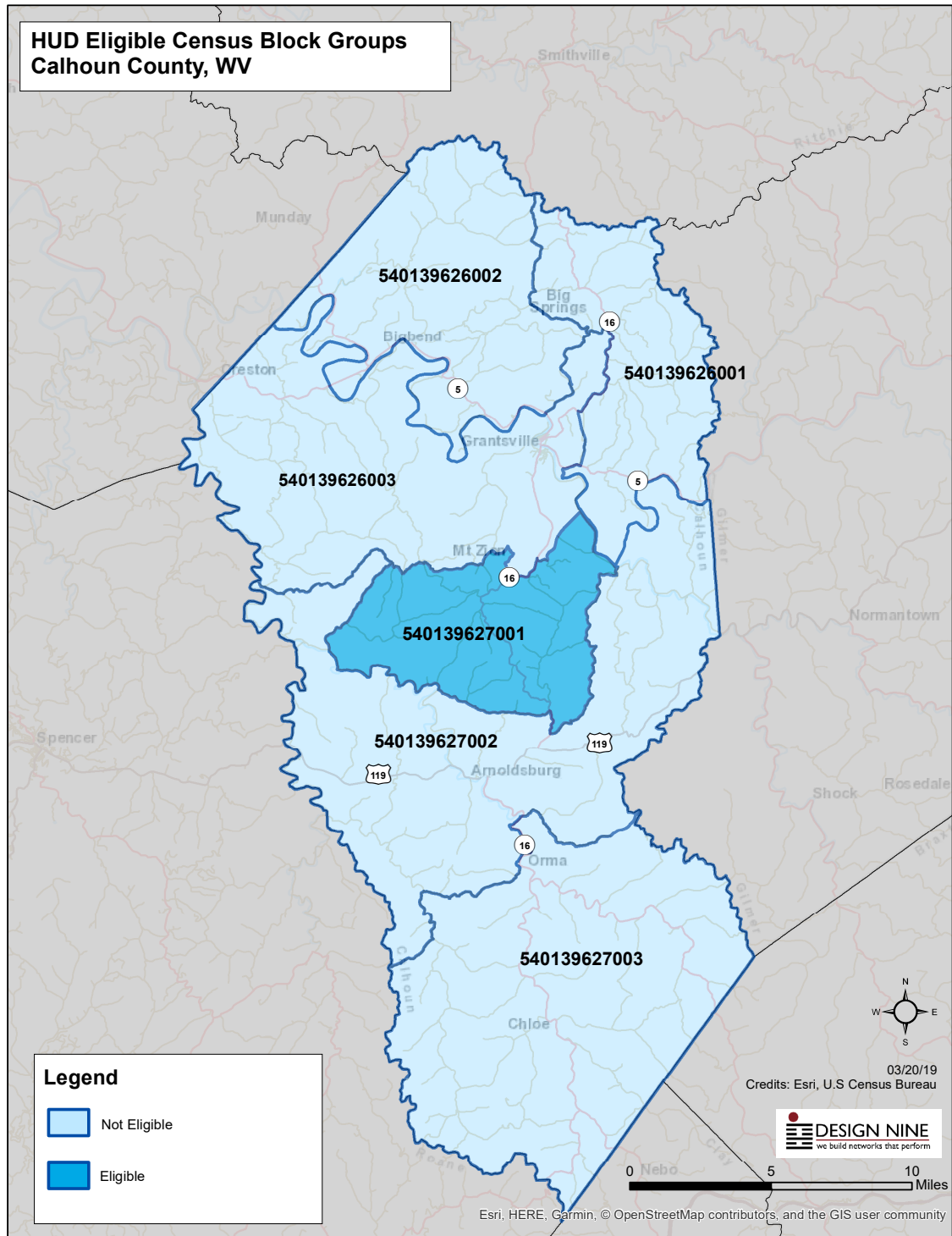
6.4 CALHOUN COUNTY GIS AND MAP DATA

Points of Interest



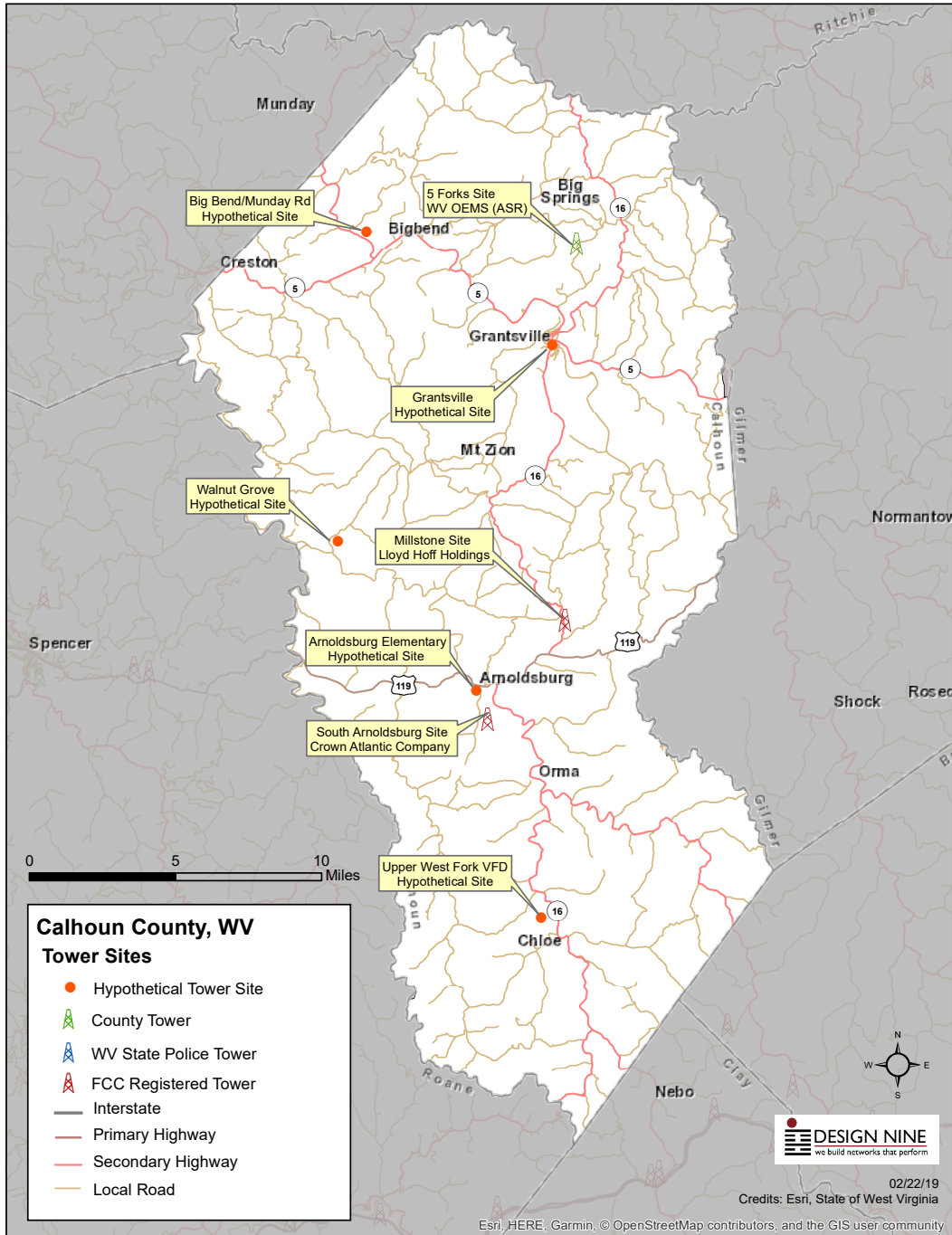
HUD/CDBG/LMI Areas

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



Tower Assets

The “hypothetical” tower sites listed on the map are sites used in the propagation studies later in this report. The hypothetical sites were chosen to show what kind of wireless broadband coverage a new tower in that location could provide. Towers were identified from FCC, state, and local sources, but not all towers are registered with the FCC or state agencies.



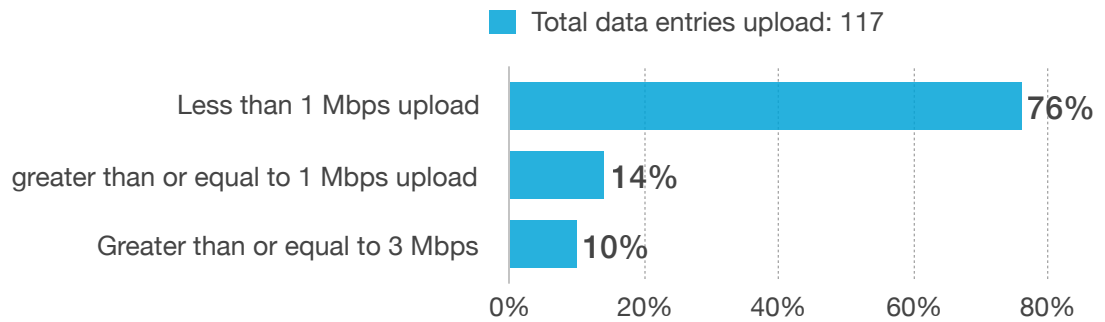
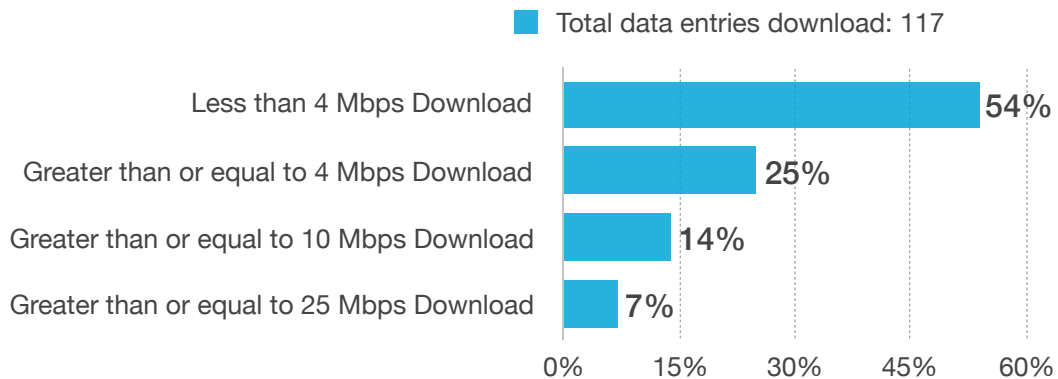
This list shows the owners of towers that have been registered with the FCC. Not all towers are registered in the FCC database.

ENTITY	Latitude	Longitude	Location
Lloyd Hoff Holding Corporation dba Portapage	38.8145	-81.0878	MILLSTONE
CROWN ATLANTIC COMPANY, LLC	38.7763	-81.126	ARNOLDSBURG
State of West Virginia, DHHR/BPH State Trauma Emergency Care System	38.9594	-81.082	Grantsville

6.5 ROANE COUNTY DETAILED SPEED TEST DATA

Roane County: West Virginia Speed-test

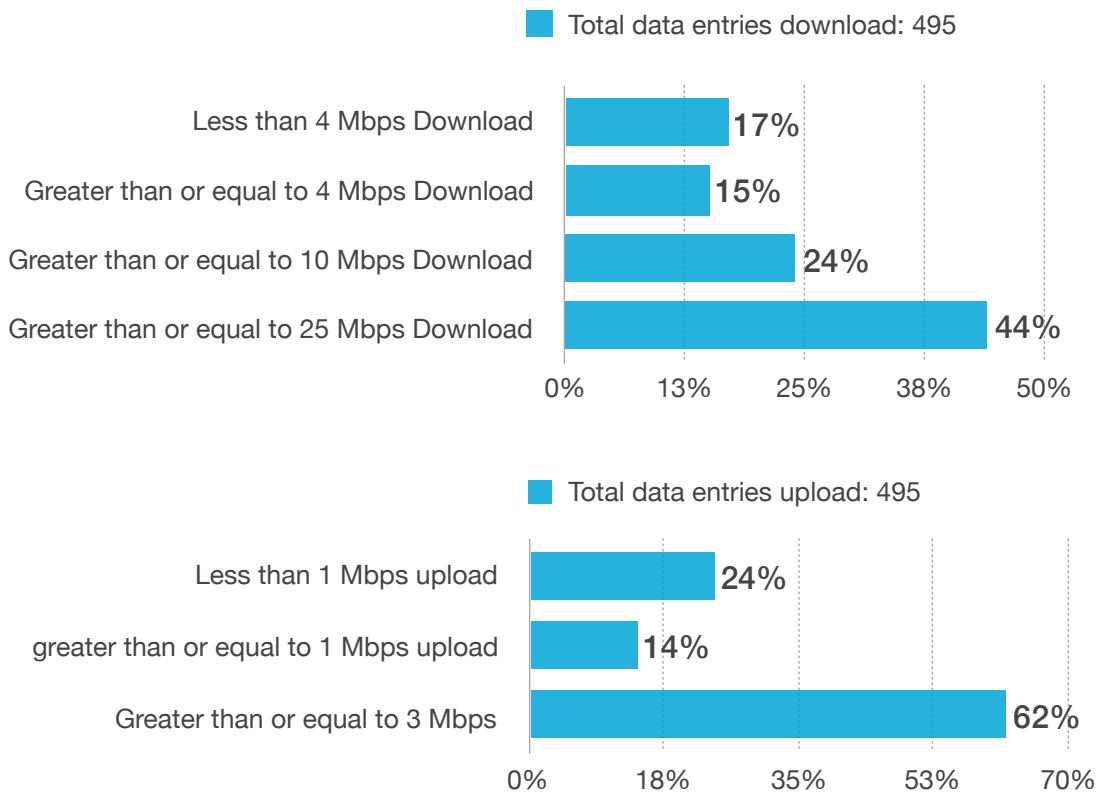
DATA DIRECTLY FROM WEST VIRGINIA	TOTAL DATA ENTRIES DOWNLOAD: 117 UPLOAD: 117
Less than 4 Mbps Download	54%
Greater than or equal to 4 Mbps Download	25%
Greater than or equal to 10 Mbps Download	14%
Greater than or equal to 25 Mbps Download	7%
Less than 1 Mbps upload	76%
greater than or equal to 1 Mbps upload	14%
Greater than or equal to 3 Mbps	10%



Roane County: Ookla Data

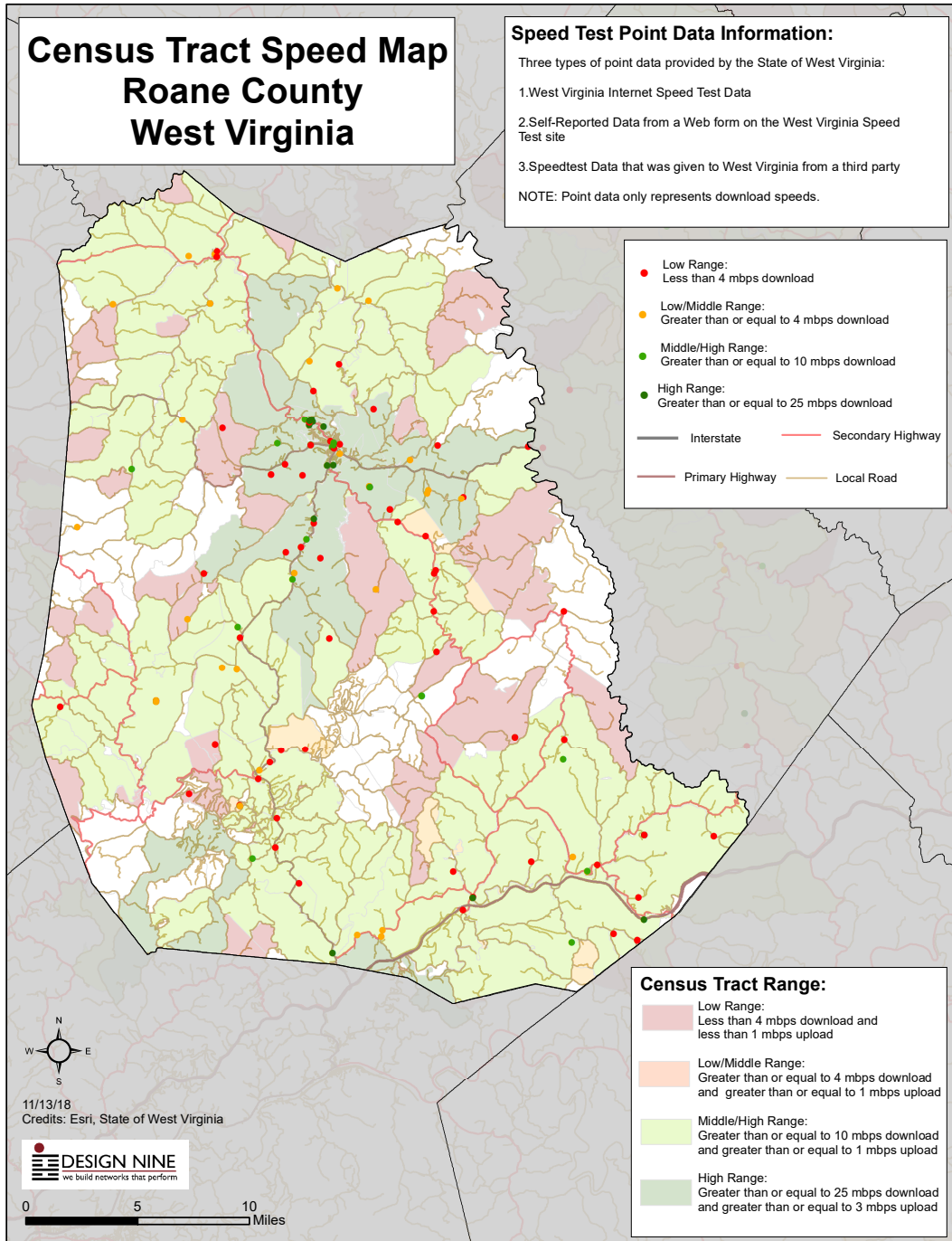
DATA FROM OOKLA	TOTAL DATA ENTRIES DOWNLOAD: 495 UPLOAD: 495
Less than 4 Mbps Download	17%
Greater than or equal to 4 Mbps Download	15%
Greater than or equal to 10 Mbps Download	24%
Greater than or equal to 25 Mbps Download	44%
Less than 1 Mbps upload	24%
greater than or equal to 1 Mbps upload	14%
Greater than or equal to 3 Mbps	62%

Ookla is a third party speed test site that has provided the State with data. It is not geo-located.



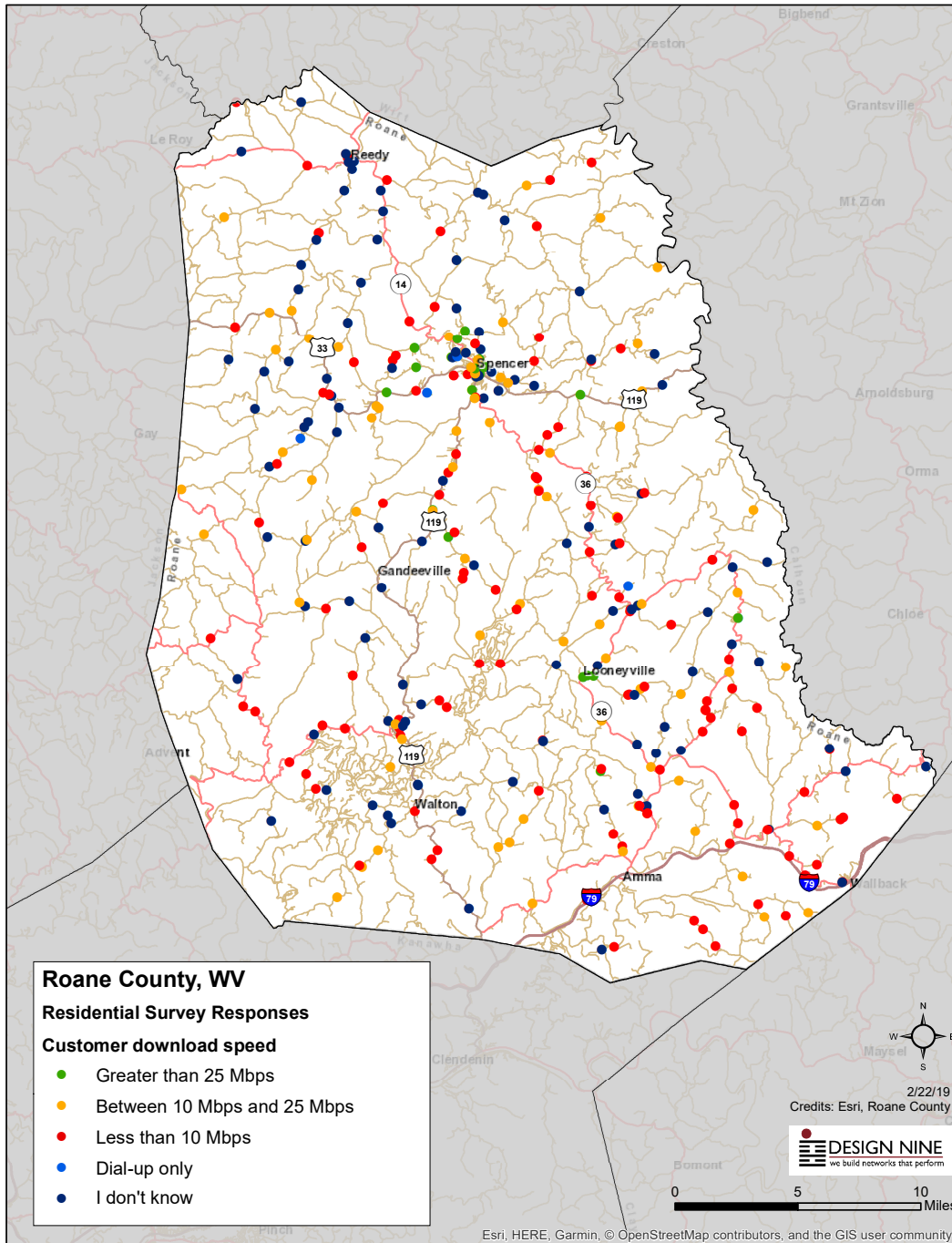
Speed Test Map

The data on this map is taken from several different West Virginia speed test data sources.



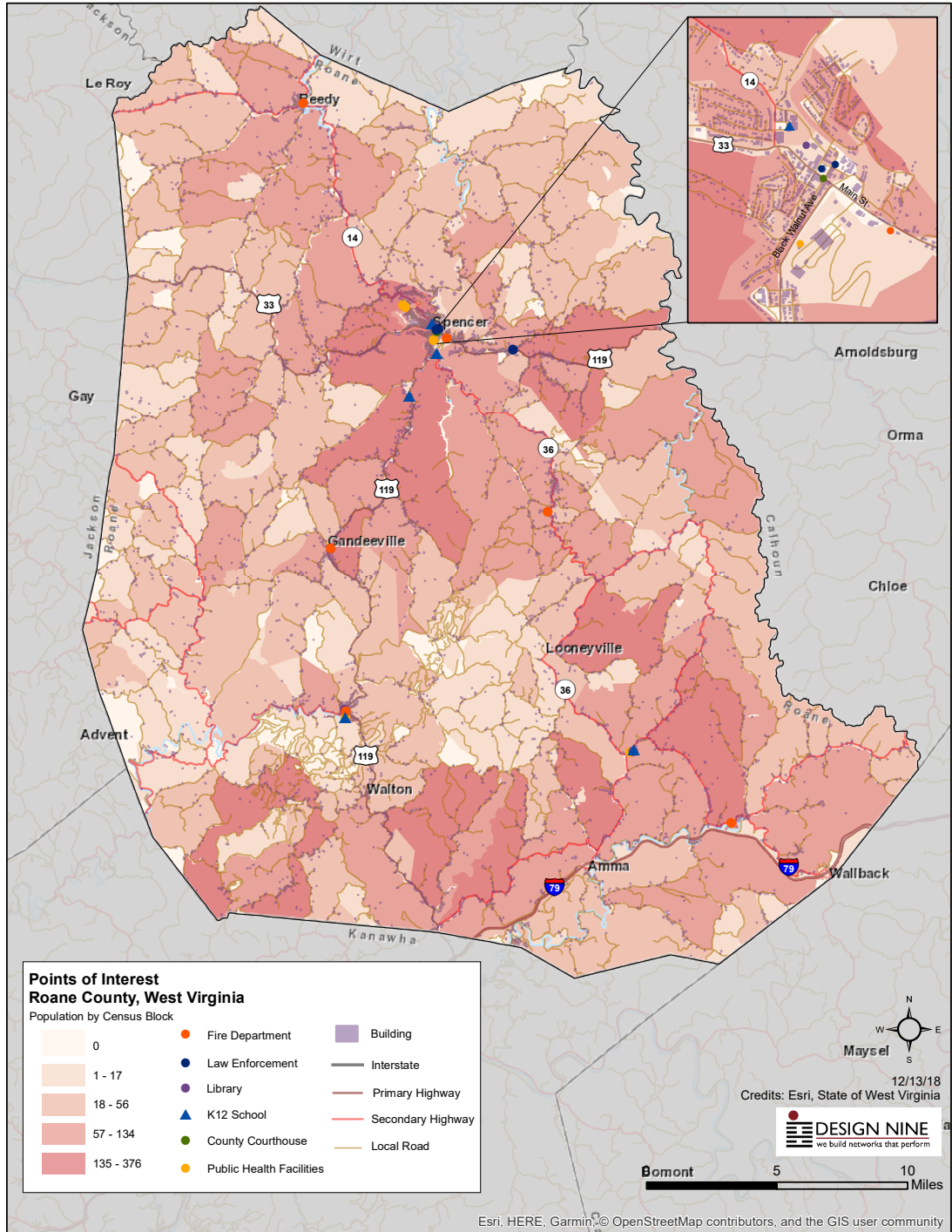
Survey Response Data

The map below shows the download speeds reported by residents responding to the broadband survey conducted as part of this study and report.



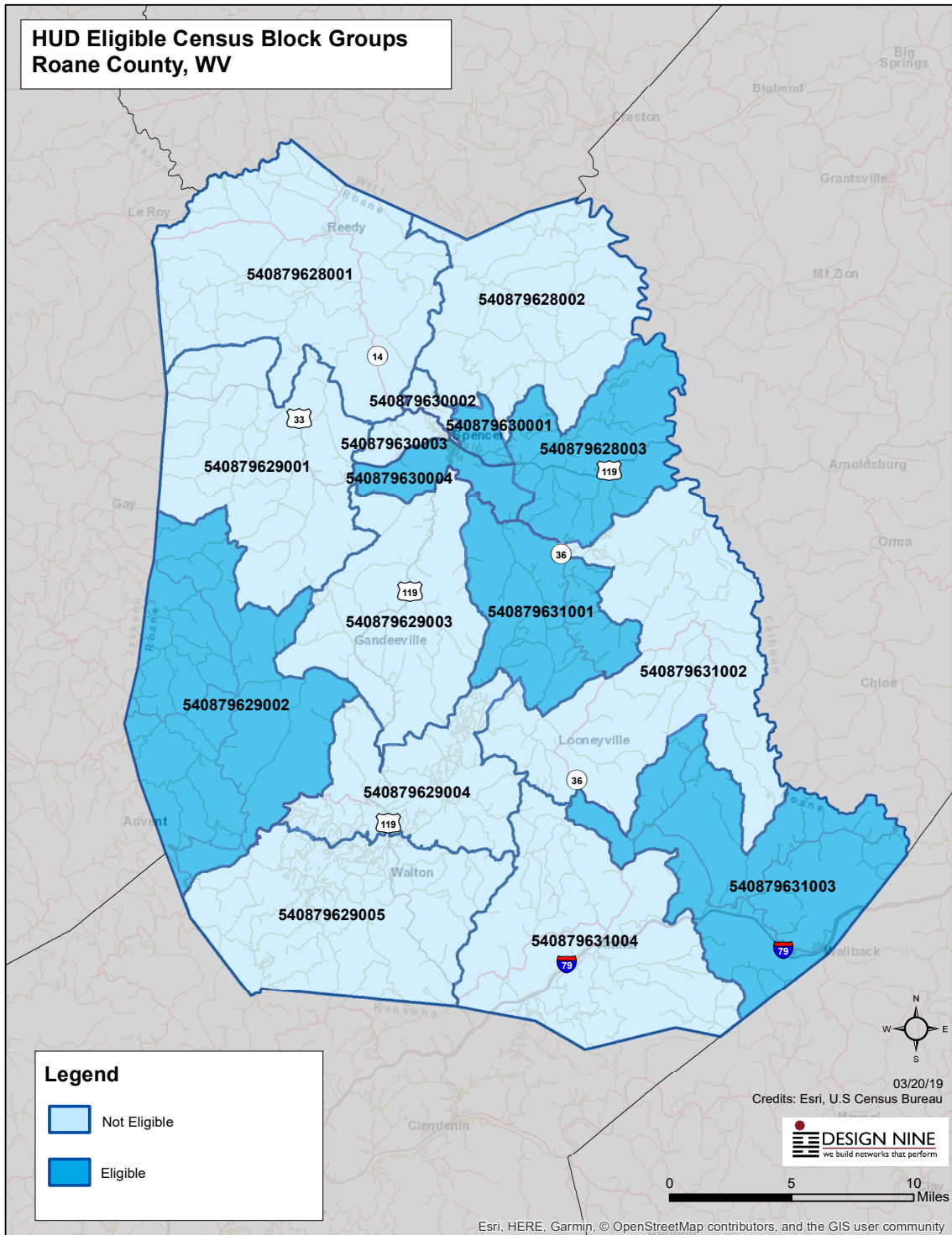
6.6 ROANE COUNTY GIS AND MAP DATA

Points of Interest



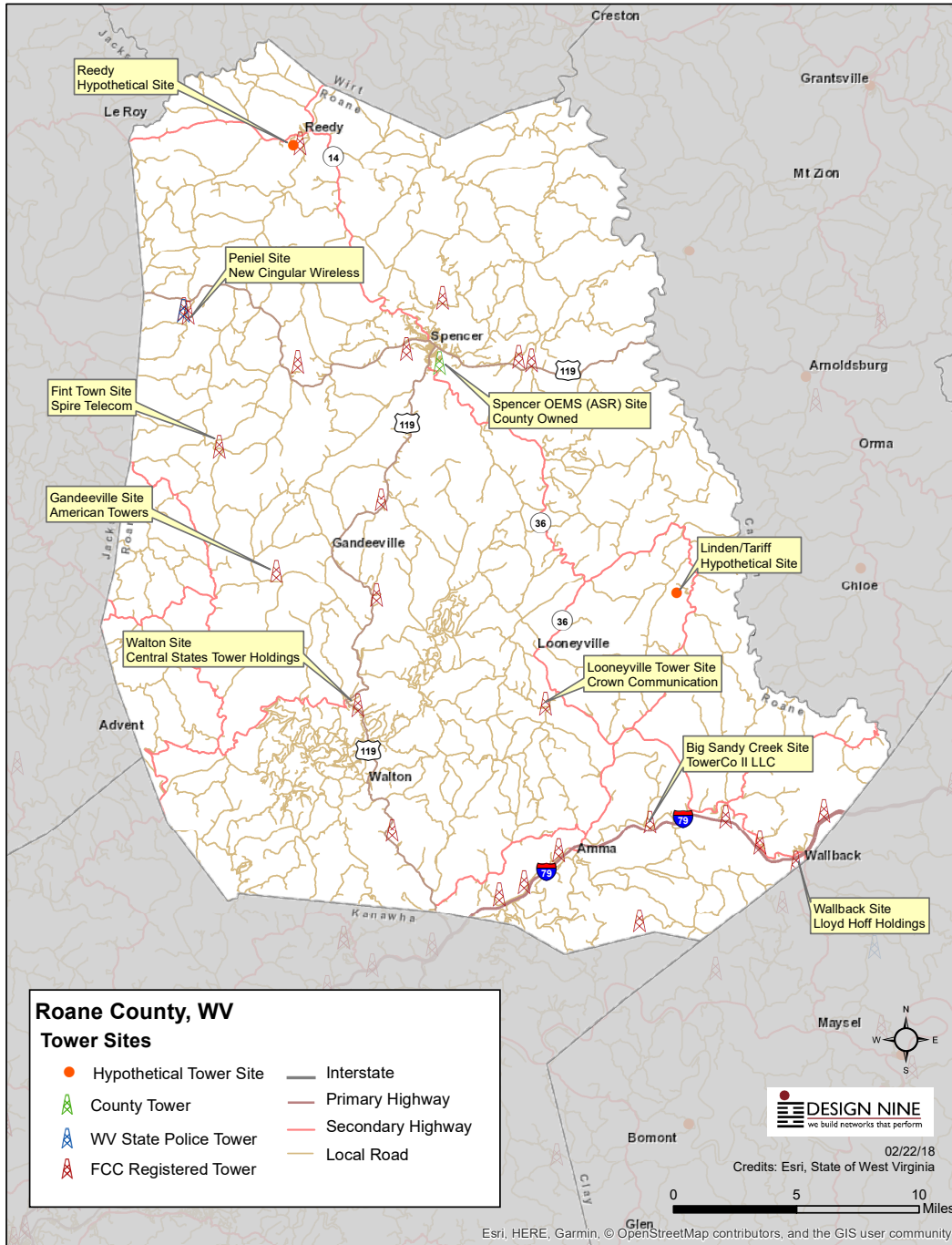
LMI Areas

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



Tower Assets

The “hypothetical” tower sites listed on the map are sites used in the propagation studies later in this report. The hypothetical sites were chosen to show what kind of wireless broadband coverage a new tower in that location could provide. Towers were identified from FCC, state, and local sources, but not all towers are registered with the FCC or state agencies.

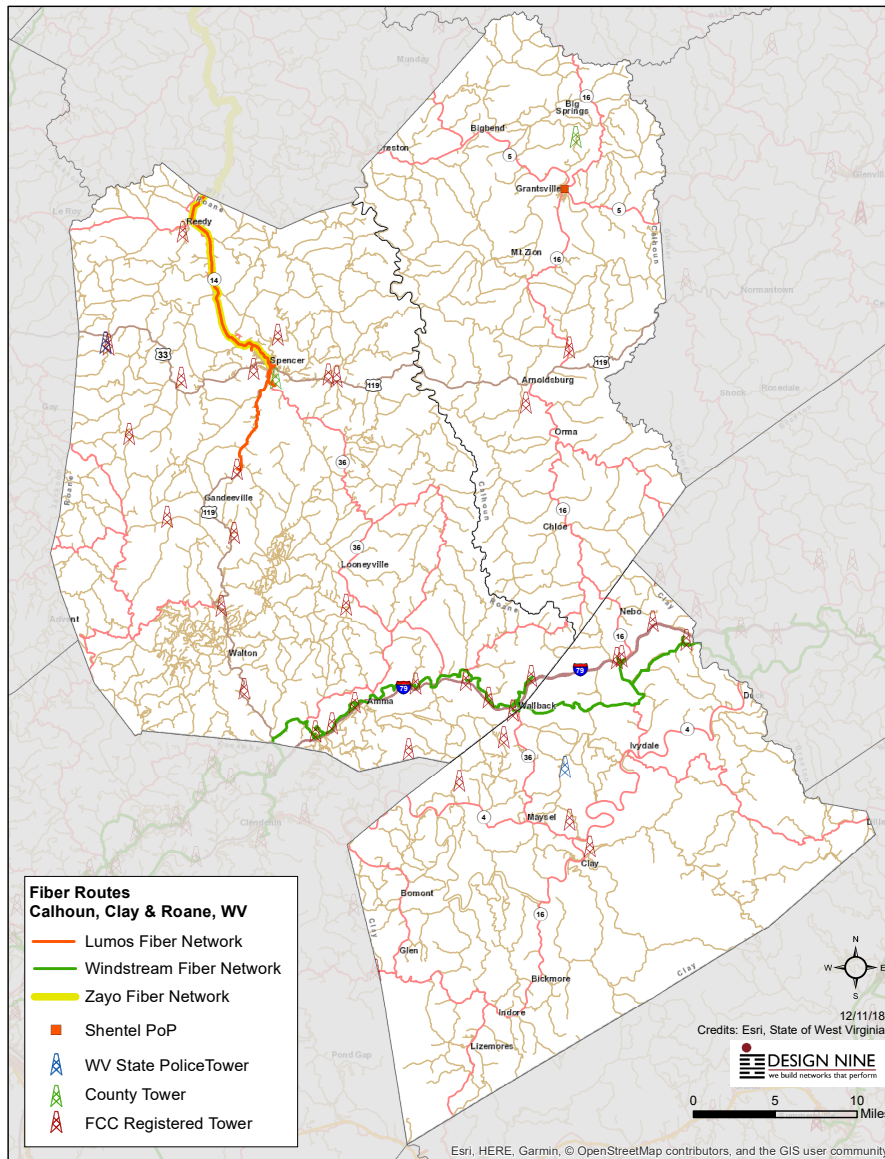


This list shows the owners of towers that have been registered with the FCC. Not all towers are registered in the FCC database.

ENTITY	Latitude	Longitude	Location
NEW CINGULAR WIRELESS PCS, LLC	38.6371	-81.2848	LOONEYVILLE
American Towers, Inc.	38.6977	-81.443	GANDEEVILLE
Lloyd Hoff Holding Corporation dba Portapage	38.7961	-81.3006	SPENCER
CNG Transmission Corporation	38.5372	-81.2297	FLAG KNOB MOUNTAIN
Spire Telecom, LP	38.755	-81.4767	FLINTTOWN
CROWN ATLANTIC COMPANY, LLC	38.7997	-81.3666	SPENCER
NEW CINGULAR WIRELESS PCS, LLC	38.8164	-81.495	PENIEL
CROWN ATLANTIC COMPANY, LLC	38.818	-81.4975	Gay
Star Communications Inc	38.7945	-81.2932	Spencer
Crown Communication Inc.	38.5696	-81.2772	Amma
Crown Communication Inc.	38.5852	-81.1791	Newton
American Towers, Inc.	38.5729	-81.1589	Newton
American Towers, Inc.	38.5551	-81.2975	Glendenin
TowerCo II LLC	38.5827	-81.2236	Left Hand
WV PCS Alliance, L.C. d.b.a. NTELOS	38.5879	-81.1213	Wallback
New Cingular Wireless PCS, LLC	38.5638	-81.1376	WALLBACK
Boggs Aviation, LLC	38.8231	-81.3453	Spencer
Cellco Partnership	38.5496	-81.312	Clendenin
Central States Tower Holdings, LLC	38.7305	-81.3814	Spencer
Central States Tower Holdings, LLC	38.6867	-81.3841	Gandeeville
Central States Tower Holdings, LLC	38.6363	-81.3952	Walton
Central States Tower Holdings, LLC	38.5789	-81.3751	Clendenin
American Towers, Inc.	38.7938	-81.4306	Spencer
WV WISP LLC.	38.8941	-81.4292	Reedy

6.7 FIBER ROUTES IN THE REGION

The region has only a limited amount of non-incumbent fiber routes, which makes the area more difficult for WISPs to provide service, as they need affordable fiber access to provide Internet data transport in and out of the region. This challenge can be overcome by using high performance tower to tower (point to point) microwave links, but the limited access to competitive fiber will tend to make wireless broadband services more expensive.



7 INCUMBENT PROVIDERS AND CURRENT SERVICES ANALYSIS

7.1 SERVICE PROVIDER ANALYSIS

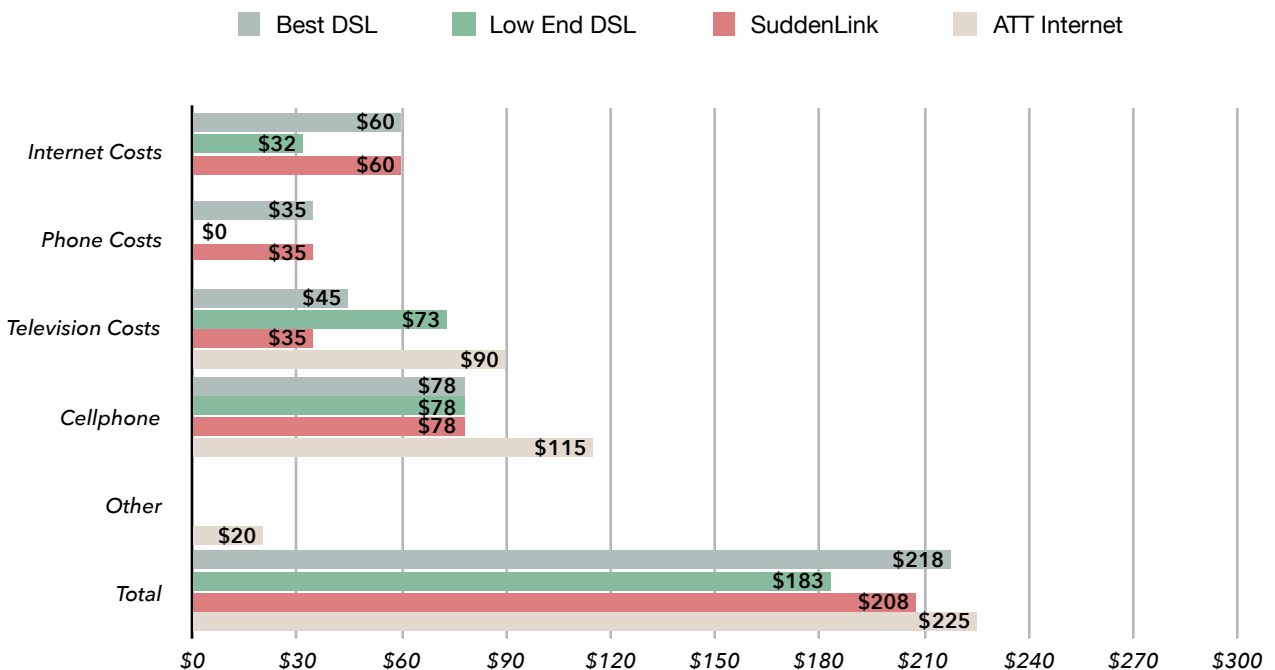
Our service provider report provides key insights into the services currently available in your counties. It also provides data that show which areas by zip code are most impacted by poor Internet service and/or the lack of Internet Service provider options. We also provide estimates of the impact that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

NOTE: This data is collected from publicly available data. Service providers often exaggerate their coverage, and the actual availability of some services as represented in the tables below may be lower than the numbers suggest.

Calhoun County is number three followed by Clay County at number five on the list of counties with the lowest cost of living in West Virginia. Roane County is number seventeen on the same list. All three counties receive an "A" for cost of living and either an "A" or "B" for cost of housing. Lack of high quality Internet services is a major limiting factor on economic development.

As the following tables and data demonstrate your citizens have very little choice in Internet Service Providers. There are essentially no fixed wireless service providers (WISPs) that we have been able to verify in your area. This lack of choice impacts citizens' lives in variety of ways from their budgets to how they spend their time.

The average household in the United States pays \$67 per month for Internet in their home. Smartphones have become what can be an expensive substitute for reasonably priced Internet services. A single smartphone with an unlimited data plan can cost from \$60 to \$95 per month and adding a single tablet for school work can add an additional \$10 to \$20 per month before



taxes and fees for data. Even “unlimited data” often has limitations after a certain amount of data has been used.

Unfortunately averages can be misleading for for specific area such as yours. Using the best available data we have constructed graphs showing communication costs for families receiving the Internet in different ways in Clay, Calhoun and Roane Counties. Even our hypothetical family of two adults, and two children who receive their Internet through the best DSL service do not receive 25 Mbps service but pay over \$200 per month for communications charges. Charges for DSL vary from regular rates of \$20 per month for basic with just Internet to \$171 per month for best DSL Internet speeds 115 Mbps ↓ 12 Mbps ↑ including television and telephone. SuddenLink pricing is low because their pricing appears to be unadvertised promo pricing which is almost guaranteed to go up substantially after the first year.

Calhoun, Clay, and Roane Counties Population 2010 by Zip Code

Zip/ZCTA	Counties	DSL	Cable	Fixed Wireless	25 Mbps Coverage	2010 Pop.	Land-Sq-Mi	Density Per Sq Mi
25005	Roane	97%	0%	0%	0%	12,633	140.45	89.94
25019	Clay	95%	56%	0%	56%	1,700	69.96	24.30
25045	Clay, Roane	84%	55%	0%	55%	14,322	135.92	105.37
25071	Roane	83%	91%	0%	83%	2,521	68.13	37.00
25030	Clay	11%	96%	0%	11%	414	15.53	26.67
25043	Clay	87%	3%	0%	3%	1,659	119.47	13.89
25063	Clay	51%	2%	0%	2%	1,797	86.73	20.72
25088	Clay	31%	98%	0%	98%	164	15.55	10.55
25111	Clay	95%	55%	0%	55%	694	30.70	22.60
25125	Clay	90%	46%	0%	46%	1,011	26.92	37.56
25133	Clay	98%	31%	0%	31%	922	15.93	57.86
25141	Clay	100%	0%	0%	0%	195	5.73	34.04
25164	Clay, Roane	76%	5%	0%	5%	1,257	30.29	41.50
25211	Clay	100%	0%	0%	0%	135	7.97	16.94
25234	Calhoun	85%	11%	0%	11%	1,200	46.21	25.97
25235	Calhoun, Clay	70%	0%	0%	0%	949	34.29	27.67
25261	Calhoun	98%	14%	0%	0%	335	10.79	31.04
25243	Roane	54%	4%	0%	4%	899	47.30	19.01
25244	Roane	88%	8%	0%	8%	732	29.46	24.85
25251	Roane	99%	44%	0%	44%	429	14.85	28.89
25252	Roane	77%	30%	0%	30%	1,071	58.76	18.23

Zip/ZCTA	Counties	DSL	Cable	Fixed Wireless	25 Mbps Coverage	2010 Pop.	Land-Sq-Mi	Density Per Sq Mi
25259	Roane	62%	22%	0%	22%	699	37.93	18.43
25266	Roane	100%	47%	0%	47%	797	37.78	21.10
25267	Calhoun	70%	0%	0%	0%	758	67.39	11.25
25268	Calhoun	77%	0%	0%	0%	871	39.57	22.01
25270	Roane	93%	31%	0%	31%	972	39.85	24.39
25276	Roane	91%	82%	0%	82%	7,752	169.97	45.61
25285	Clay	100%	31%	0%	31%	595	11.16	53.34
25286	Roane	84%	36%	0%	36%	1,692	68.88	24.56
26136	Calhoun	100%	86%	0%	86%	644	26.76	24.07
26137	Calhoun	89%	38%	0%	0%	939	52.36	17.93
26141	Calhoun	65%	0%	0%	0%	364	33.88	10.74
26143	Calhoun	78%	64%	0%	47%	4,547	145.62	31.23
26147	Calhoun	99%	80%	0%	0%	2,188	46.12	47.44
26151	Calhoun	70%	16%	0%	0%	558	24.51	22.76
26617	Clay	45%	5%	0%	5%	187	7.47	25.05
26636	Calhoun	28%	0%	0%	0%	487	29.05	16.77
26638	Calhoun	40%	0%	0%	0%	178	16.27	10.94

Wireline Internet Service Providers

Zip Code	Frontier DSL	Shentel	SuddenLink	Armstrong
25005	✓			
25019	✓		✓	
25045	✓		✓	
25071	✓		✓	✓
25030	✓			
25043	✓		✓	
25063	✓			
25088	✓			
25111	✓		✓	
25125	✓		✓	

Zip Code	Frontier DSL	Shentel	SuddenLink	Armstrong
25133	✓			
25141	✓			
25164	✓			
25211	✓			
25234	✓			
25235	✓			
25261	✓	✓		
25243	✓			
25244	✓			
25251	✓			
25252	✓		✓	
25259	✓			
25266	✓			
25267	✓			
25268	✓			
25270	✓		✓	
25276	✓		✓	
25285	✓			
25286	✓		✓	
26136	✓	✓		
26137	✓	✓		✓
26141	✓			
26143	✓		✓	✓
26147	✓	✓		
26151	✓	✓		
26617	✓			
26636	✓			
26638	✓			

This information provides pricing data and services available from providers in the area for the counties of Calhoun, Clay, and Roane.

7.2 WIRELINE PROVIDERS

Frontier

\$105/mo for 115 Mbps ↓ 12 Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is \$171.

\$95.00/mo for 90 Mbps. 90 Mbps ↓ 8.0 Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is \$161.

\$90.00/mo for 45 Mbps. 45 Mbps ↓ 6.0 Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is \$151.

\$85.00/mo for 12 Mbps. 12 Mbps ↓ 1.5 Mbps ↑ with no data cap- TV and Unlimited Phone. 2-year promo rate. Regular rate is \$136.

\$100.00/mo for 115 Mbps. 115 Mbps ↓ 12.0 Mbps ↑ with no data cap- TV. 2-year promo rate. Regular rate is \$151.

\$90.00/mo for 90 Mbps. 90 Mbps ↓ 8.0 Mbps ↑ with no data cap- TV. 2-year promo rate. Regular rate is \$141.

\$80.00/mo for 12 Mbps. 12 Mbps ↓ 1.5 Mbps ↑ with no data cap- TV. 2-year promo rate. Regular rate is \$116.

\$80.00/mo for 24 Mbps. 24 Mbps ↓ 3.0 Mbps ↑ with no data cap- TV. 2-year promo rate. Regular rate is \$126.

\$30.00/mo for Simply Broadband Plus 18 Mbps. 18.0 Mbps ↓ 1-1.5 Mbps ↑ with no data cap - 2-year promo rate. Get a \$100 Visa Reward Card when you order online. Setup fee \$75 includes installation Modem with WiFi \$10 per month.

\$30.00/mo for Simply Broadband Ultra 12 Mbps. 12.0 Mbps ↓ 1-1.5 Mbps ↑ with no data cap- 2-year promo rate. Get a \$100 Visa Reward Card when you order online. Setup fee \$75 includes installation Modem with WiFi \$10 per month.

\$20.00/mo for Simply Broadband Core 6 Mbps. 1.1 and 6.0 Mbps ↓ 1 Mbps ↑ with no data cap 2-year promo rate. Setup fee \$75 includes installation Modem with WiFi \$10 per month.

Shentel

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

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

\$79.95/mo for 25 Mbps ↓ 5 Mbps ↑- with a 400 GB/month data cap. Setup fee \$99.95 installation fee may apply. Modem \$8 per month or one-time fee of \$99.

\$50.00/mo for 50 Mbps ↓ 10 Mbps ↑- with a 500 GB/month data cap. 1-year promo rate. Regular rate is \$99.95. Setup fee \$99.95 includes installation Modem \$8 per month or one-time fee of \$99.

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

SuddenLink

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

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

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

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

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

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

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

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

Armstrong

\$149.95/mo for 500 Mbps. 500 Mbps ↓ 25 Mbps ↑ with 2TB/month data cap- Modem included Setup fee \$0

\$99.95/mo for 400 Mbps. 500 Mbps ↓ 25 Mbps ↑ with 2TB/month data cap- Modem included Setup fee \$0

\$62.95/mo for 100 Mbps. 100 Mbps ↓ 10 Mbps ↑ with 1TB/month data cap- Modem included Setup fee \$0

\$55.95/mo for 300 Mbps. 300 Mbps ↓ 20 Mbps ↑ with 2000 GB/month data cap- Modem included Setup fee \$0 Six month promo rate. Regular rate is \$77.95

\$34.95/mo for 12 Mbps. 12 Mbps ↓ 1 Mbps ↑ with 200 GB/month data cap- Modem included Setup fee \$0 Six month promo rate.

7.3 FIXED WIRELESS PROVIDERS

None verifiable.

7.4 RESIDENTIAL SATELLITE INTERNET PRICING

HughesNet

\$59.99/mo for 25 Mbps ↓ 3 Mbps ↑ 10 GB/mo data cap. Two year contract with up to \$400 ETF. Two year prom rate. Speeds will be reduced and will typically be in the range of 1 to 3 Mbps once

monthly plan data is use. From 2am-8am, customers have access to 50 GB/month of additional plan data. Setup \$99. Modem: \$14.99/mo.

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

ViaSat/Excede

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

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

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

8 GAP ANALYSIS

8.1 CLOSING THE BROADBAND GAP

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

- It limits resident's ability to work from home.
- It limits the ability of three counties to retain existing businesses and to attract new businesses and jobs.,
- It limits school children's ability to access the K12 and higher education resources needed to complete homework assignments.
- It limits resident's ability to access cost-saving tele-medicine and tele-health services from home.
- It limits resident's ability shop from home to save money on gas and travel expenses.

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

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

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

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

"What do businesses and residents of Clay, Calhoun and Roane need to be able to compete globally over the next thirty years?"

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

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

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

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

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

“Broadband” is not the Internet

Bandwidth is not a fixed number

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

The economic impact on Clay, Calhoun, and Roane counties can include the following effects:

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

- Reductions in real estate value - Homes with poor Internet service are more difficult to sell, leading to reduced prices and then impacting county property taxes negatively.

8.2 LIMITING FACTORS

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

- Low population density - The generally low density of homes and businesses in the three counties make it more difficult for competitive service providers (e.g. WISPs) to justify the expense of building towers and offering Internet service.
- Poor service from Frontier - Like most areas of West Virginia, Frontier has not upgraded infrastructure and Frontier DSL service is slow and unreliable.
- Limited cable Internet service - Related to the low density, cable Internet service is very limited.
- Lack of regional entity to manage infrastructure improvements - At the present time, there is no coordinated three county effort to plan broadband infrastructure improvements and coordinate funding and grant applications.
- Difficult terrain for wireless service - The terrain in the three county area has many low hills, which blocks wireless broadband signals and requires more towers and community poles than some other parts of West Virginia.
- Difficulty attracting Wireless Internet Service Providers (WISPs) - The reasons listed above increase the difficulty of attracting WISPs to the three county area.

8.3 HOW MUCH BANDWIDTH IS ENOUGH?

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

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

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

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

- Dramatically faster file transfer speeds for both uploads and downloads
- The ability to transmit streaming video, transforming the Internet into a far more visual medium
- Means to engage in true-real time collaboration
- The ability to use many applications simultaneously
- Ability to maintain more flexible work schedules by being able to work from home on a part time or full time basis

- The ability to obtain health-related services for an occasional illness and/or long term medical services for chronic illnesses.

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

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

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

8.4 BUSINESS BANDWIDTH NEEDS

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

	Large Business		Small Business		Home Based Worker		Business From Home	
Description	A larger business with about 50 workstations.		A small business with 10 to 15 employees, and 7-10 workstations.		A single employee working at home for his/her company.		A home business with one or two employees working at home.	
	Concurrent Use	Mbps	Concurrent Use	Mbps	Concurrent Use	Mbps	Concurrent Use	Mbps
Telephone	20	1.28	5	0.32	1	0.064	1	0.064
TV		0		0		0		0
HDTV		0		0		0		0
Credit Card Validation	4	4	1	1		0		0
Security System	1	0.25	1	0.25	1	0.25	1	0.25
Internet	20	30	7	10.5	1	1.5	1	1.5

	Large Business		Small Business		Home Based Worker		Business From Home	
VPN Connection	5	25		0	1	5		0
Data Backup	5	7.5	1	1.5	1	1.5	1	1.5
Web Hosting	1	2		0		0		0
Workforce Training (online classes)	2	20	1	10	0	0	1	10
HD Videoconferencing	10	100	2	20	1	10	1	10
Telecommuting workers	5	15	2	6	0	0	0	0
Totals		205.0		49.6		18.3		23.3
5 years from now (Megabits)	615		149		55		70	
10 years from now (Megabits)	1845		446		165		210	

8.5 RESIDENTIAL BANDWIDTH NEEDS

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

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

Description	Residential Daytime		Early Evening		Evening and Late Night		Snow Day	
	Concurrent Use	Mbps	Concurrent Use	Mbps	Concurrent Use	Mbps	Concurrent Use	Mbps
	Intermittent Television and Internet use across a small percentage of households.		Increased video, voice and Internet use as children arrive home from school and employees from work.		Peak television and Internet use. Multiple TV's are on, phone and computer being used.		On top of typical daytime traffic children are home from school, and many employees are home working.	
Telephone	1	0.064	1	0.064	1	0.064	1	0.064
Standard Definition TV	1	2.5	1	2.5	1	2.5	1	2.5
HD TV	1	4	2	8	2	8	3	12
Security System	1	0.25	1	0.25	1	0.25	1	0.25

	Residential Daytime		Early Evening		Evening and Late Night		Snow Day	
Internet	1	1.5	1	1.5	2	3	3	4.5
Online Gaming		0.25		0.5		1		1
VPN Connection	0	0	1	2	1	2	2	4
Data Backup		0	1	5	1	5	1	0
Telehealth (subscriber)	1	4	1	4	1	4	0	0
Distance Learning / Workforce Training		0	1	10	1	10	2	20
HD Videoconferencing		0		0		0	1	14
Totals		12.6		33.8		35.8		58.3
5 years from now (Megabits)		38		101		107		175
10 years from now (Megabits)		113		304		322		525

8.6 CURRENT AND FUTURE USES AND SERVICES

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

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

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

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

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

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

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

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

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

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

9 CURRENT AND FUTURE TECHNOLOGIES

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

Businesses and residents in the region 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 will receive a signal from a distant tower and redistribute it locally to a cluster of customers (typically within a half mile).
- With a fiber connection to the fiber installed in areas where economic development is important, and in other areas as additional fiber network segments are added.

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

Distribution Type	Access Type	Capacity
Wireless	Wireless	Typical customer connection starting at 5 to 10 Megabits, can be higher, with 50 Megabit 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 Megabit connections common.

9.1 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.

9.2 EMERGING WIRELESS TECHNOLOGIES

MIMO Wireless

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

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

LTE/4G/5G

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

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

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

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

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

The much touted 5G wireless technology, as of 2019, is still largely marketing hype. The official standard for 5G radio technologies was finally released in 2018, although some companies, like Verizon, had already begun trials of the equipment with a few customers.

5G does bring much higher speeds to wireless broadband (e.g. it might be able to deliver 30 to 50 Megabits 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 Clay County's 342 square miles, as many as 3,500 cell sites would be needed to provide ubiquitous coverage, although with careful analysis, that might be reduced to around 2,200 cell sites—all of them needing fiber backhaul. Calhoun and Roane counties would require similar numbers of 5G small cell sites.

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

White space broadband

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

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

9.3 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.

10 SIMILAR PROJECTS: WHAT OTHER COMMUNITIES ARE DOING

10.1 MORGAN COUNTY

Morgan County, West Virginia plans to both upgrade some existing County-owned towers and possibly add more towers to make the County more attractive to WISPs. The County is currently reviewing its existing tower lease agreements and studying revisions to its tower space lease fees. The goal is to have more space available for WISPs at lower cost to provide residents and businesses with both better broadband service and more choice of providers.

10.2 HAMPSHIRE COUNTY

Hampshire County, West Virginia used a modest USDA grant and local match funds to build a Gigabit fiber network in the Capon Bridge area of the county. The impetus for the effort was a local Amazon fulfillment center that could not expand to add more jobs because the existing Internet service was both slow and expensive. Costs were kept low by utilizing existing utility poles for placement of the fiber cable; the poles were in good shape and make-ready costs were very low. Planning for a second phase expansion is underway to make Gigabit fiber service available in some neighborhoods adjacent to the existing fiber route.

10.3 CITY OF RICHWOOD

The Richwood area recently completed a broadband study to determine the cost and technical design for fiber and some wireless service in two areas close to the City of Richwood. The impetus for the effort was a new water line that will be constructed in 2019. The technical design identified an area of 50+ homes near the city that will receive Gigabit fiber service (FTTH), using a high performance wireless link between a downtown building and the rural neighborhood. A community nonprofit will manage the network once it is built. This is planned as the first phase of a build out that will eventually include Gigabit fiber in the downtown area of Richwood, fiber to the home in some additional rural neighborhoods, and affordable fixed point wireless broadband services both within the city limits and in nearby areas. Some early planning is underway to look at nearby communities in Nicholas County that could eventually be connected to the new network.

10.4 TOWN OF ASHLAND

The Town of Ashland, Virginia recently completed construction of two miles of dark fiber that passes many of the businesses in that community. A major regional Internet provider is expected to sign up to be the first provider on the network. Town staff have been trained to manage 811 (Miss Utility) calls and to do locates on the conduit and fiber. The Town leaders initiated the project in response to local businesses asking for more choice of providers and more bandwidth at lower prices.

10.5 WIRED ROAD BROADBAND AUTHORITY

The Wired Road Broadband Authority in mountainous southwest Virginia is a regional network owned by two adjacent counties (Carroll and Grayson) and the City of Galax. The open access fiber and wireless network has two providers offering competitive services. The effort started in 2007 with a single \$200,000 grant, and over the past ten years, the network has been able to attract more than \$4 million in grants and local funding. The network has more than twenty wireless broadband access points and towers and over 40 miles of fiber. A current expansion project expects to add as many as fifteen community broadband poles in Carroll County to further expand wireless access.

10.6 CHARLES CITY COUNTY

Charles City County is a small rural county in eastern Virginia with a population of 7,256. The County initiated a broadband improvement project in 2014 when the county's largest employer indicated that it might have to leave because of the high cost and poor service from the local Internet provider. The County was able to combine a CDBG grant with local funds to build 6.5 miles of fiber in the business park, and was able to attract a Tier One national Internet company to provide service to the manufacturer, along with a smaller ISP that sells Internet to many of the smaller businesses in the park.

10.7 CHARLEMONT, MA

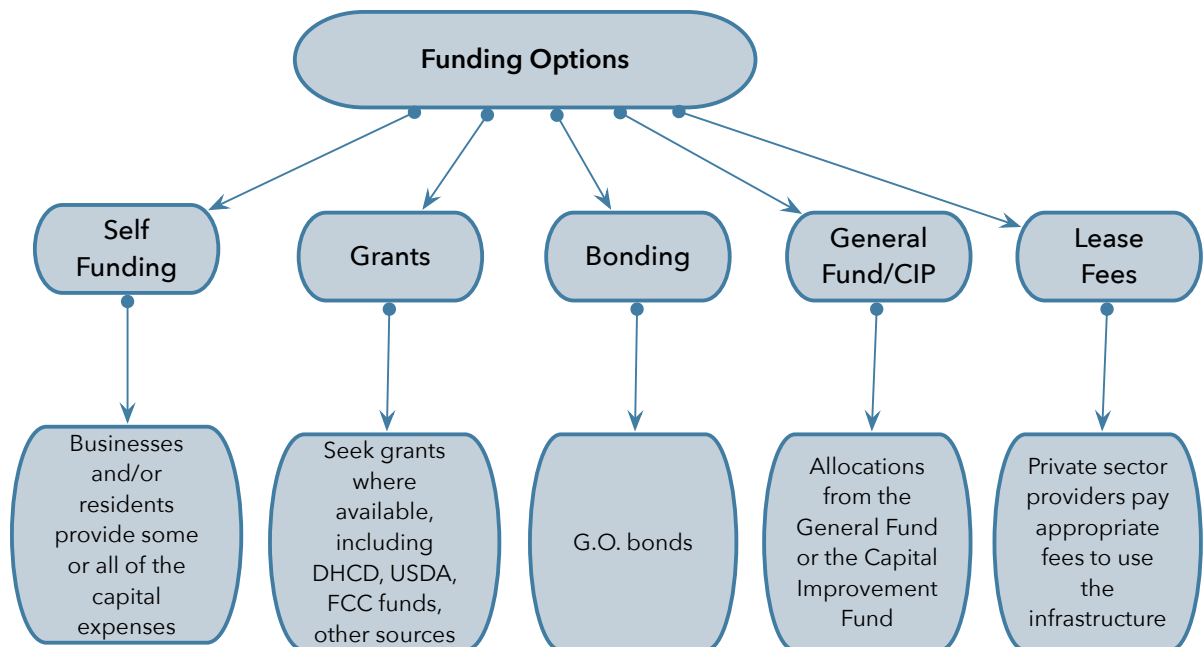
The town of Charlemont, Massachusetts has decided to combine a grant from the state with an \$11/month/household assessment to build fiber throughout the entire town of 524 households. Comcast had offered to make modest upgrades to the existing copper-based cable network but was asking for nearly half 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.

10.8 DANVILLE, VIRGINIA

Danville had high unemployment rates in the early 2000s after most of the city's 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 fiber in 2008 and put fiber in five business parks and the downtown area. The City also began working with private developers to rehabilitate empty and underused building in the City's downtown, creating live/work apartments, 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 those amenities has revitalized the City and brought hundreds of new jobs to downtown. The fiber network has been in the black for several years; 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.

1.1 FUNDING SUGGESTIONS

It is important to note that any investment by any of the three counties in broadband infrastructure should be focused on 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.

11.1 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).

11.2 COOP MEMBERSHIP FEES

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

The coop membership fee offers the area a way to self-finance a substantial portion of the initial network, as well as providing a long term framework for expansion.

11.3 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.

11.4 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).

11.5 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 Megabit down/1 Megabit up broadband service.

11.6 911 FEES

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

WiFi calling – 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 three counties could generate funds to support additional broadband towers and community poles. See the tables above in the Special Assessment section of this chapter.

11.7 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>).

11.8 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 counties to have an early conversation with qualified municipal bond counsel to assess the viability of this approach.

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

General obligation 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.

11.9 CAF 2 FUNDS

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

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

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

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

11.10 QUALIFIED OPPORTUNITY FUND INVESTMENTS

The 2018 Federal tax changes included a little known item called the Investing in Opportunity Act. Opportunity Zones, designated by each state, are eligible for investments that have very attractive tax benefits. The tax advantages include avoidance of most local, state, and Federal taxes, and the ability to have those investments grow and compound tax-free. The intent of the law is to funnel private sector capital gains into low growth and no growth areas of the U.S. by offering substantial tax benefits. While Opportunity Zones are most likely to attract real estate investments, it should be possible to create Opportunity Zone projects that include telecom infrastructure improvements. As an example, a manufacturing plant investment is made in an Opportunity Zone, along with broadband fiber improvements needed by the plant to support operations.

11.11 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.

11.12 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.

11.13 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 the region.

11.14 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.

11.15 ARC POWER GRANTS

Clay, Calhoun, and Roane counties all qualify 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. Clay, Calhoun, and Roane all have been ranked as "distressed" for 2019, meaning they have the highest eligibility ranking for grants and awards.

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>).

12 POTENTIAL PARTNERS, SYNERGIES, AND SHARING OPPORTUNITIES

The CCRBDC broadband work in Clay, Calhoun, and Roane counties will by necessity have to include both public and private partners. Among some public and private entities, the common synergies are:

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

Potential project partners include:

12.1 LOCAL GOVERNMENT

The county governments of Clay, Calhoun, and Roane must play a significant and steady role in this effort because the future economic and community health of the region is at stake. The residential survey has indicated that nearly 30% of residents see the availability of good broadband as a factor in where they will live.

12.2 PUBLIC SAFETY

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

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

12.3 K12 SCHOOLS

The schools in the three counties have Internet service from Frontier that was funded by the broadband stimulus grants of several years ago. But K12 students often lack adequate Internet service at home, and some schools are careful not to assign homework that requires Internet access. Parents consistently report on the burden of having to drive children to a public library or some other WiFi hotspot to get Internet access for school work. Every school in the three counties

should configure a WiFi hotspot outside the building and make it available after school hours, when classroom instruction would be impacted. It would be possible to make this access controlled, so that students would have to a userid/password to use it. The CCRBDC should work with the schools to apply for education grant funds to achieve this goal, and to keep K12 parents informed about broadband activities.

12.4 ISPS AND WISPS

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

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

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

12.5 STATE OF WEST VIRGINIA

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

12.6 AREA BUSINESSES

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

12.7 ELECTRIC UTILITIES

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

First Energy and other electric providers in the region could become an important part of the long term solution if West Virginia SB3/HB2005 (Broadband Enhancement) legislation becomes law.

12.8 BROADBAND COOP

Forming a broadband coop may be one of the most effective ways of creating a tri-county partnership with a diverse and robust set of public and private members (partners) that could include residents, businesses, schools, health care providers, public safety, and local government. More information on the coops and how they are formed is contained in **Appendix A (Governance and Ownership Options)**.

13 LEGAL, AND REGULATORY ISSUES

13.1 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.

13.2 WORKING WITH WISP TOWER LEASES

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

- There should be a single public fee schedule for all providers.
- There should be a single tower space agreement that is used for all providers.
- Tower access should be made available in ten foot vertical segments, as high as possible on the tower without interfering with other uses (e.g. public safety antennas). Note that it is unlikely that any tower will have more than two providers on it.
- Leases should be a minimum of two years and should auto-renew if the ISP is meeting performance requirements.
- It may be more effective to have a single lease agreement with access to all towers, and the contract should require the ISP to put equipment on all towers within a certain period of time (e.g. nine to twelve months). This limits ISPs from "cherry picking" towers with more potential customers and ignoring towers in parts of the region with lower population density.
- Monthly tower lease fees should be on the order of \$200 to \$250 per tower. Higher fees make it difficult for providers to make a business case for the cost of equipment and the extensive marketing required to develop a customer base around a tower.
- If there are two vertical spaces available for lease, the lower segment could be made more attractive to a WISP by offering a reduced lease fee.

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

14 PRELIMINARY DESIGN MODELING

14.1 REDUNDANCY, AFFORDABILITY, AND CONNECTIVITY

Redundancy

Redundancy in networks is achieved by duplicating key portions of the network, so that if one component or network segment fails, the duplicated equipment or alternate network route automatically handles the traffic from the failed portion of the network and service is not interrupted. In rural and residential networks, it is rarely affordable to include more than a limited amount of redundancy. A typical network design, given sufficient budget, will try to include redundancy on core network routes, but it is usually too expensive to provide redundancy to all users.

Some network users do need redundancy because of the critical nature of their activities, and this includes public safety, health care (e.g. hospitals often have two or three Internet providers), utilities (it is not unusual for electric utilities to build a ring network connecting all of their substations), and some types of businesses (e.g. manufacturers using just in time parts management).

Affordability

Affordability is a factor influenced by geography (e.g. household density), funding, technology, and revenue. As a general rule of thumb, denser business and residential areas can provide improved broadband at less cost than lower density areas. Indeed, a major challenge in the three counties is that household density tends to be low, which drives costs up. Wireless broadband, for that reason, is going to be an important part of the solution in the tri-county area. Available funding, via grants and other sources of money, will be a major influence in what gets built where and when it gets built. Over a long enough time frame, (e.g. five to seven years), it should be possible to get improved affordable broadband to most homes and businesses in the three counties, with an early focus on wireless broadband.

Connectivity

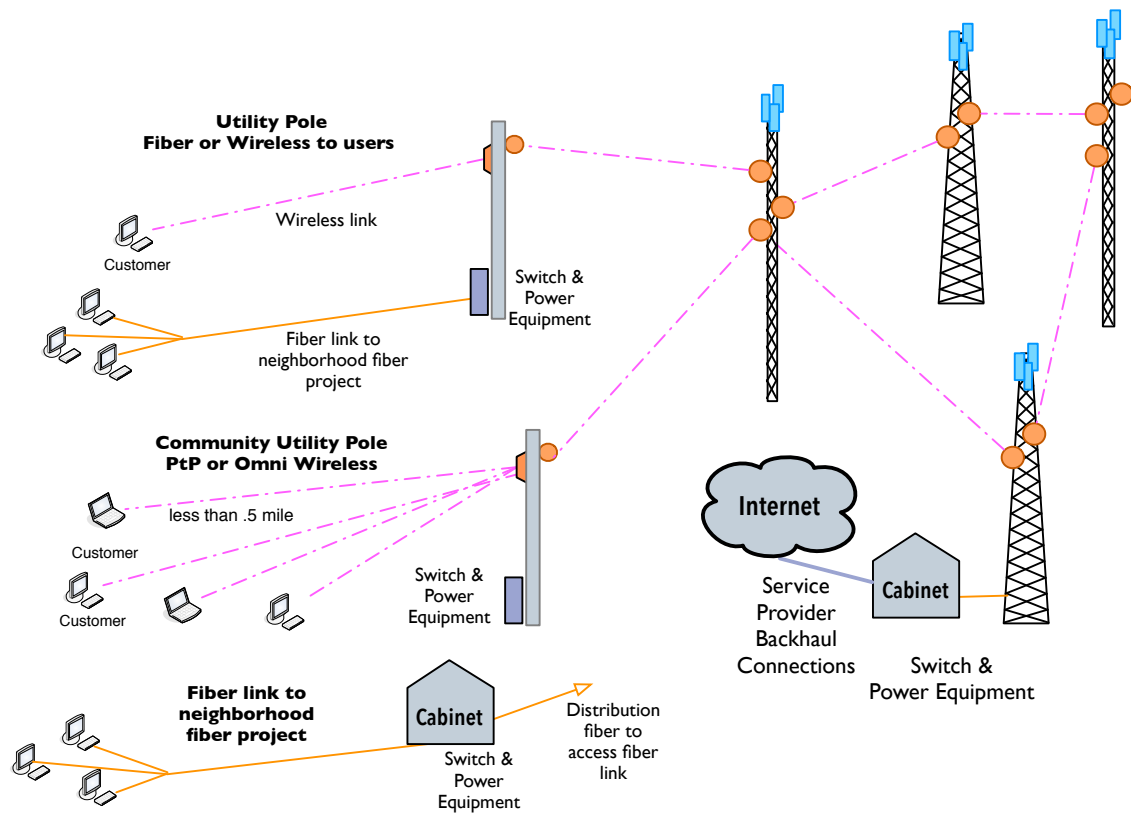
Connectivity is determined by the technology system, which would include copper-based networks (e.g. DSL, cable modem), satellite, fiber, and wireless. A long term goal for the three counties should be fiber connectivity to most homes and businesses. The short term goal should be much wider availability of wireless broadband to replace the poor DSL in the three counties and to offer a less expensive alternative to satellite broadband, which is expensive and has higher latency than terrestrial networks, making it more difficult (or impossible) to use for work from home users.

14.2 PRELIMINARY NETWORK DESIGN

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

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

The illustration below shows the full range of technology options (fiber and wireless) and how they can be connected together in various ways to meet the diverse needs of the three counties. More detail is provided on the following pages and in Section 14 of this report.



Last Mile Access

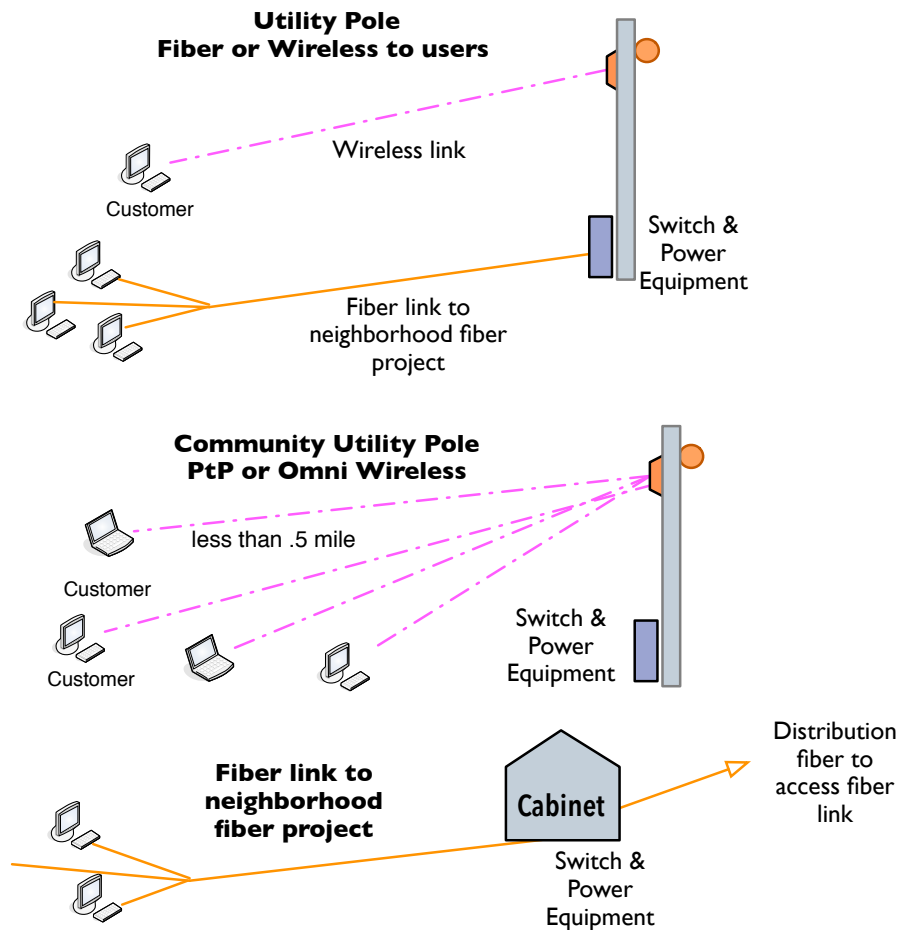
The Last Mile Access is the portion of the network that connects customers to their service provider and the Internet. Both broadband wireless and fiber links can be utilized to provide service. There are several ways that customers can receive service:

- 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 "small cell" broadband 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.

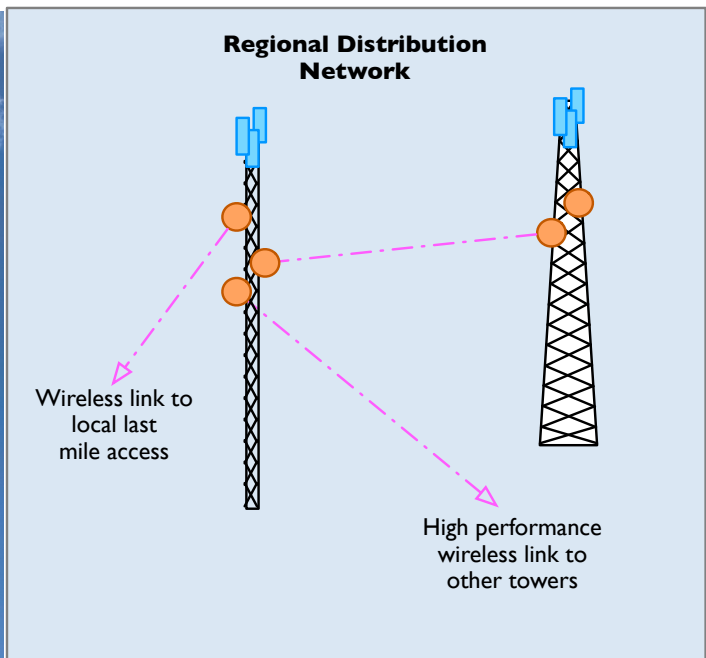
This ring topology protects against hardware failure at the port level and does provide some protection if one of the tower to tower wireless links is disabled by an equipment failure. Broadband radio vendors like Ubiquiti and Mimosa make affordable, high performance point to point radios that can be used to develop a regional network. Redundancy can be built into the design by have some (or all) of the towers connected to at least two other towers (that is, two point to point links per tower).

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

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

The towers can provide two functions:

- Space for backhaul connections to other towers in the counties and the region.
- Space for local access radios to provide Internet access within 2-3 miles of the tower (or farther with good Line Of Sight).
- Links to "small cell" broadband community poles. In the tri-county area, the community poles will be essential to provide broad coverage.



Core Network and Service Providers

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

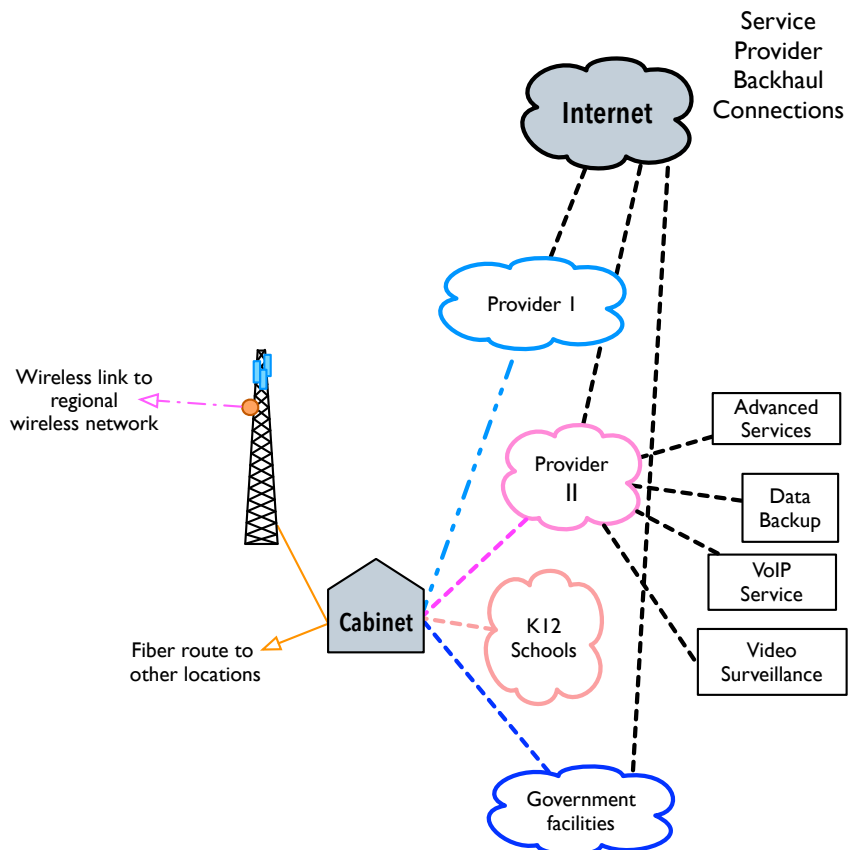
The Co-Location facility provides a meet point for various public and private fiber cables and networks to inter-connect. In the three counties, there are no shared peering points, and a local facility with space available for both public and private uses could help attract additional private sector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



14.3 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).

Support from the three county governments for an awareness campaign developed with local wireless service providers would also be beneficial.



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



15 BUSINESS AND FINANCIAL MODELING

There are three financial issues that have to be addressed:

Capital Expenditures – The cost of building network infrastructure is a significant expense but not insurmountable. Community water and sewer projects, on a per mile basis, are much more expensive than broadband fiber and broadband wireless. Grants, local sources of funding (e.g. Capital Improvement funds, etc.) and user fees are common sources of money for the cost of building the network.

Revenue – Some revenue can be derived from the network infrastructure once it has been built. For wireless infrastructure like towers, Wireless Internet Service Providers (WISPs) will pay modest monthly fees for tower access. In a similar fashion, fiber and conduit can be leased out to ISPs. Revenue from towers and conduit/dark fiber can usually be set to cover normal and ordinary operational costs, but if those fees also have to pay back the cost of capital expenditures, a long payback period should be expected (e.g. twenty to thirty years).

Expenses – Well-designed broadband systems, focused on passive infrastructure like towers, conduit, handholes, and dark fiber, require only minimal maintenance, and incur very little day to day operational responsibilities. Towers require just a few maintenance tasks that include generator maintenance, generator fuel management, and weed/grass control around the base of the tower. Conduit and dark fiber, properly designed and installed, have virtually no day to day maintenance. A reserve fund is needed for emergency break-fix, when a fiber cable is broken and requires repair.

Because it is possible to cover most maintenance costs from lease fees, the financial challenge is primarily funding the capital expenditures. A straightforward way of doing this is to find a way to spread the capital expenditure costs across the largest number of households possible. Even very small amounts of a few dollars, collected over a period of twenty to thirty years, can fund very extensive broadband infrastructure.

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

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

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 each county. A less amount (e.g. \$2/month over twenty years) would easily finance the immediate build out of a comprehensive wide area wireless tower network in each of the counties.

Clay County (4020 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
\$1	\$964,800	\$1,447,200
\$2	\$1,929,600	\$2,894,400
\$5	\$4,824,000	\$7,236,000
\$10	\$9,648,000	\$14,472,000

Roane County (6161 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
\$1	\$1,478,640	\$2,217,960
\$2	\$2,957,280	\$4,435,920
\$5	\$7,393,200	\$11,089,800
\$10	\$14,786,400	\$22,179,600

Calhoun County (3268 households)		
Monthly Assessment Amount	Twenty Year Assessment	Thirty Year Assessment
\$1	\$784,320	\$1,176,480
\$2	\$1,568,640	\$2,352,960
\$5	\$3,921,600	\$5,882,400
\$10	\$7,843,200	\$11,764,800

15.1 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

15.2 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 often be negotiated for \$1000/year with a single up-front payment of \$10,000 (for ten years). Some property owners are willing to provide space just to get better Internet access for themselves and nearby neighbors.

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

16 HUD ELIGIBLE PROJECTS

16.1 CDBG/HUD ELIGIBLE PROJECT - CLAY

In Clay County, a pilot fixed wireless broadband solution could be funded in the Clay community. The project described below is in a HUD eligible census block.

When considering a small deployment on this scale it is critical to identify a source of backhaul, and a WISP that will support the network.

Construction of 4 neighborhood poles in the Clay community could bring broadband coverage to the area. Small scale projects such as this will be essential in pursuing higher goals like Countywide coverage.

There is no tower required to construct the Clay project. The town could be served with 4 neighborhood poles as shown in the diagram below. Each pole would be 60' in height and can be serviced by bucket trucks, boom lifts, and other rentable equipment. The design maximizes the use of unlicensed frequencies. Access points should be properly adjusted to minimize RF noise in the environment.

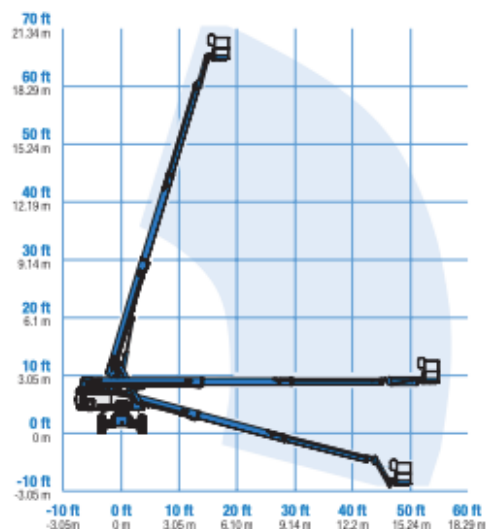
Neighborhood poles

Neighborhood poles are chosen in part to reduce costs of installation and maintenance.

A key advantage of neighborhood poles is that certified tower climbers are not needed to install and maintain equipment. The chart to the right describes the range of motion of a Genie S™-60 telescoping boom lift.

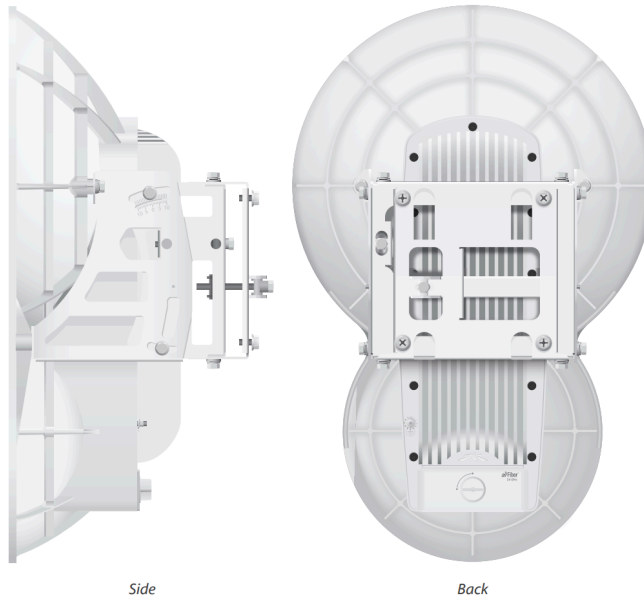


RANGE OF MOTION S™-60



Ubiquiti AirFiber radios for short point to point links

For short point to point links, the network will utilize Ubiquiti AirFiber radios. These radios operate in the 24ghz spectrum, and can achieve very high throughput speeds.



1.5+ Gbps
Real Data Throughput

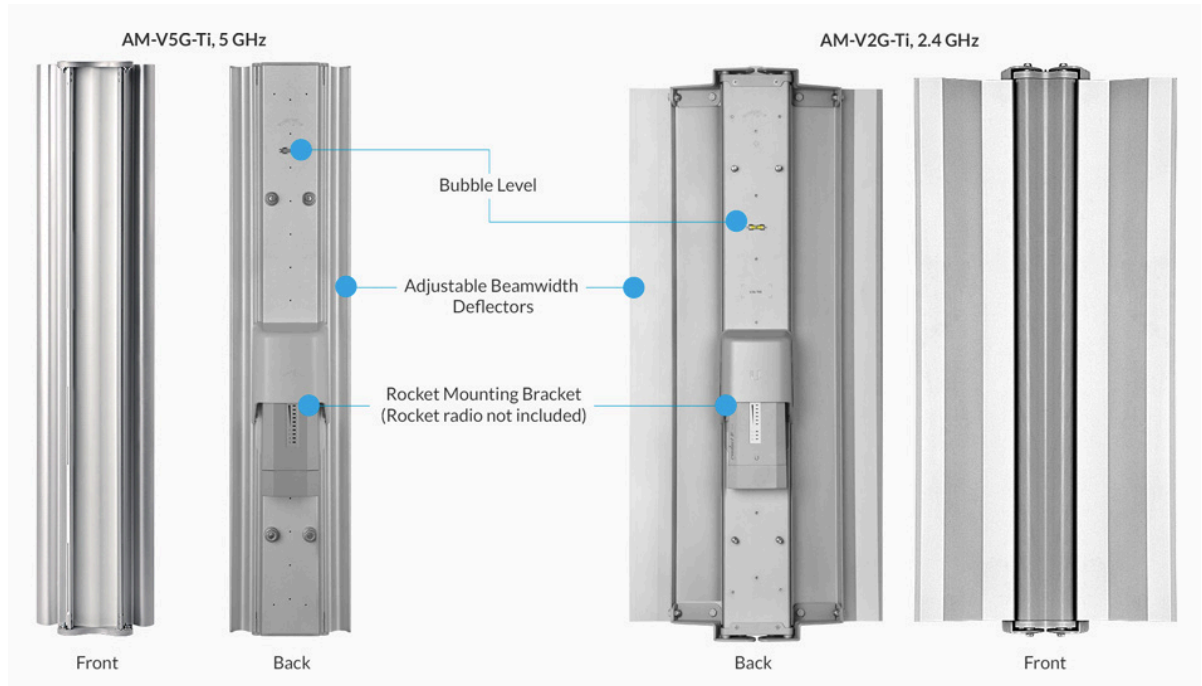
24 GHz
License-Free

13+ km
Extreme Range

HDD
TDD FDD

Ubiquiti 5GHz access points

An access point radio is placed on a tower or neighborhood pole and provides a pie shaped coverage area that multiple customers can connect to. The radios and the antenna for an access point are purchased separately. In this case the network will utilize Ubiquiti Rocket Prism radios for the access point, along with an adjustable 60-120° sector antenna. During the installation the coverage of the antenna will be tuned to match it's installation location. At locations where a wide coverage area is needed 3 access points with 120° coverage areas will be installed. At other locations that target a certain street or a narrow coverage area the width of the access point may be reduced to minimize RF noise.



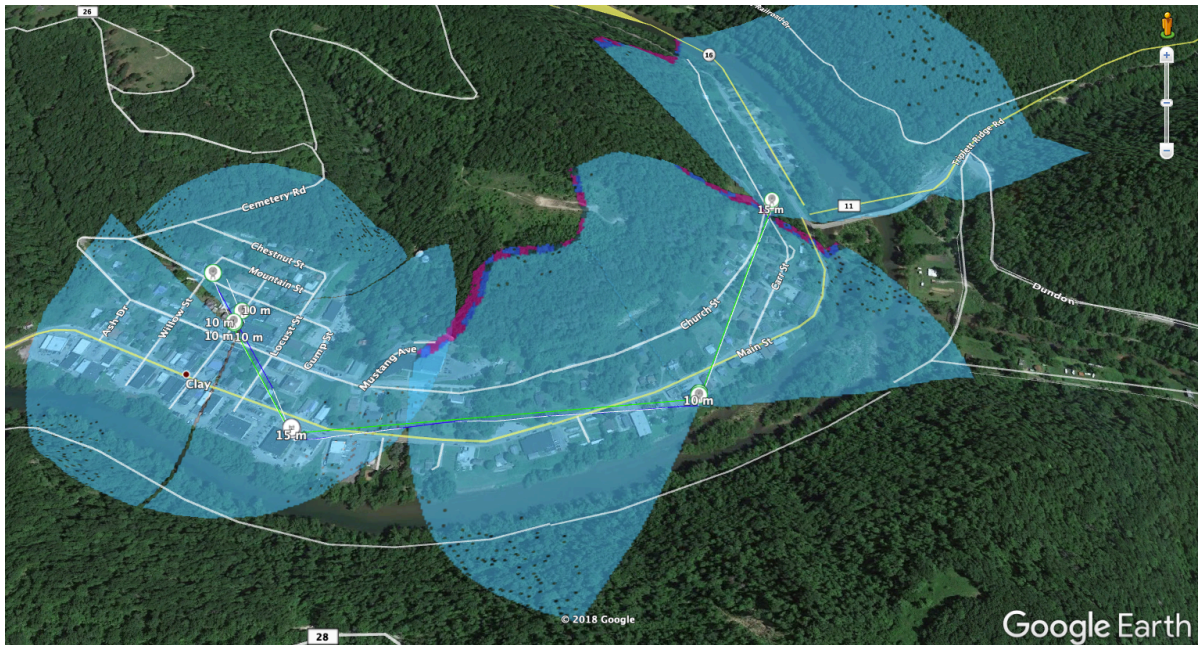
Customer Premise Equipment (CPE)

The CPE radio is a small device that is installed on a customer's home. The radio faces one of the access points and connects wirelessly. In situations where a home does not have a view of the access point, the CPE may be placed on a mounting pole in the yard or another location. There are a variety of CPE radio models for various frequencies. In Clay, the Ubiquiti IsoStation CPE will be the initial model deployed. The size of the IsoStation is small and the device is designed to handle interference.



Coverage Area

In Clay, the Coverage Area shown below can be expected from the network. The targeted investment solves the coverage area in this community. Some buildings that are obstructed by trees or other obstacles may need to install a pole/mast to increase the height of their device, or a repeater may need to be installed with a neighbor to solve line of sight issues for a customer.



Clay HUD Eligible Project Cost Estimate

Item	Units	Unit Cost	Total
Tower Fit-up	0	\$26,375.00	\$0.00
Neighborhood Pole Construction Materials and installation cost for 50-60' wooden utility pole. No land acquisition cost for poles.	4	\$7,880.00	\$31,520.00
Ubiquiti AF24 PTP Radio Gigabit PTP Radios between neighborhood pole locations. Used for short distances.	6	\$1,497.00	\$8,982.00
Licensed Point to Point Link	0	\$19,000.00	\$0.00
Point to Point Mounting Hardware Standoffs for utility poles or non-penetrating rooftop mounts for building installs.	6	\$200.00	\$1,200.00
Ubiquiti Rocket Prism 5ghz AP Access Point Radio for fixed wireless broadband	6	\$249.00	\$1,494.00
Ubiquiti 60-120 sector antenna Adjustable width sector antenna for fixed wireless broadband.	6	\$170.00	\$1,020.00
Ubiquiti IsoStation 5ghz CPE Customer premise radio equipment for fixed wireless broadband. Backhaul radio for public Wifi Hotspots	90	\$129.00	\$11,610.00
CPE Mounting Hardware (J-Mounts)	90	\$13.00	\$1,170.00

Item	Units	Unit Cost	Total
Ubiquiti Toughswitch Pro Site switch for fixed wireless broadband and Wifi hotspots with a backhaul. Not all wifi hotspots will have dedicated backhaul.	4	\$189.00	\$756.00
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.	4	\$300.00	\$1,200.00
Cabling	2	\$135.00	\$270.00
Installation Costs for PTP Links	3	\$2,000.00	\$6,000.00
Installation Costs for Access Points - Per Site	4	\$2,000.00	\$8,000.00
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			\$6,982.70
*Customer Installations are the responsibility of the service provider.			
TOTAL			\$76,809.70

16.2 HUD ELIGIBLE PROJECT - ROANE

The Roane project covering Spencer WV includes co-location on an existing tower, construction of 3 neighborhood poles and installation of 5 access points. Detailed costs on the tower colocation are discussed earlier in this report. The project in Spencer will utilize the same technologies as were discussed in the previous section (14.10).

Coverage

Colocation on the tower, along with 2 supplementary access points on neighborhood poles provides good coverage in the community.



Roane Hud Eligible Project Cost Estimate

Item	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.	3	\$7,880.00	\$23,640.00
Ubiquiti AF24 PTP Radio Gigabit PTP Radios between neighborhood pole locations. Used for short distances.	6	\$1,497.00	\$8,982.00
Licensed Point to Point Link	0	\$19,000.00	\$0.00
Point to Point Mounting Hardware Standoffs for utility poles or non-penetrating rooftop mounts for building installs.	6	\$200.00	\$1,200.00
Ubiquiti Rocket Prism 5ghz AP Access Point Radio for fixed wireless broadband	5	\$249.00	\$1,245.00
Ubiquiti 60-120 sector antenna Adjustable width sector antenna for fixed wireless broadband.	5	\$170.00	\$850.00
Ubiquiti IsoStation 5ghz CPE Customer premise radio equipment for fixed wireless broadband. Backhaul radio for public Wifi Hotspots	75	\$129.00	\$9,675.00
CPE Mounting Hardware (J-Mounts)	75	\$13.00	\$975.00
Ubiquiti Toughswitch Pro Site switch for fixed wireless broadband and Wifi hotspots with a backhaul. Not all wifi hotspots will have dedicated backhaul.	4	\$189.00	\$756.00

Item	Units	Unit Cost	Total
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.	4	\$300.00	\$1,200.00
Cabling	2	\$135.00	\$270.00
Installation Costs for PTP Links	3	\$2,000.00	\$6,000.00
Installation Costs for Access Points - Per Site	4	\$2,000.00	\$8,000.00
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			\$6,727.80
*Customer Installations are the responsibility of the service provider.			
TOTAL			\$74,005.80

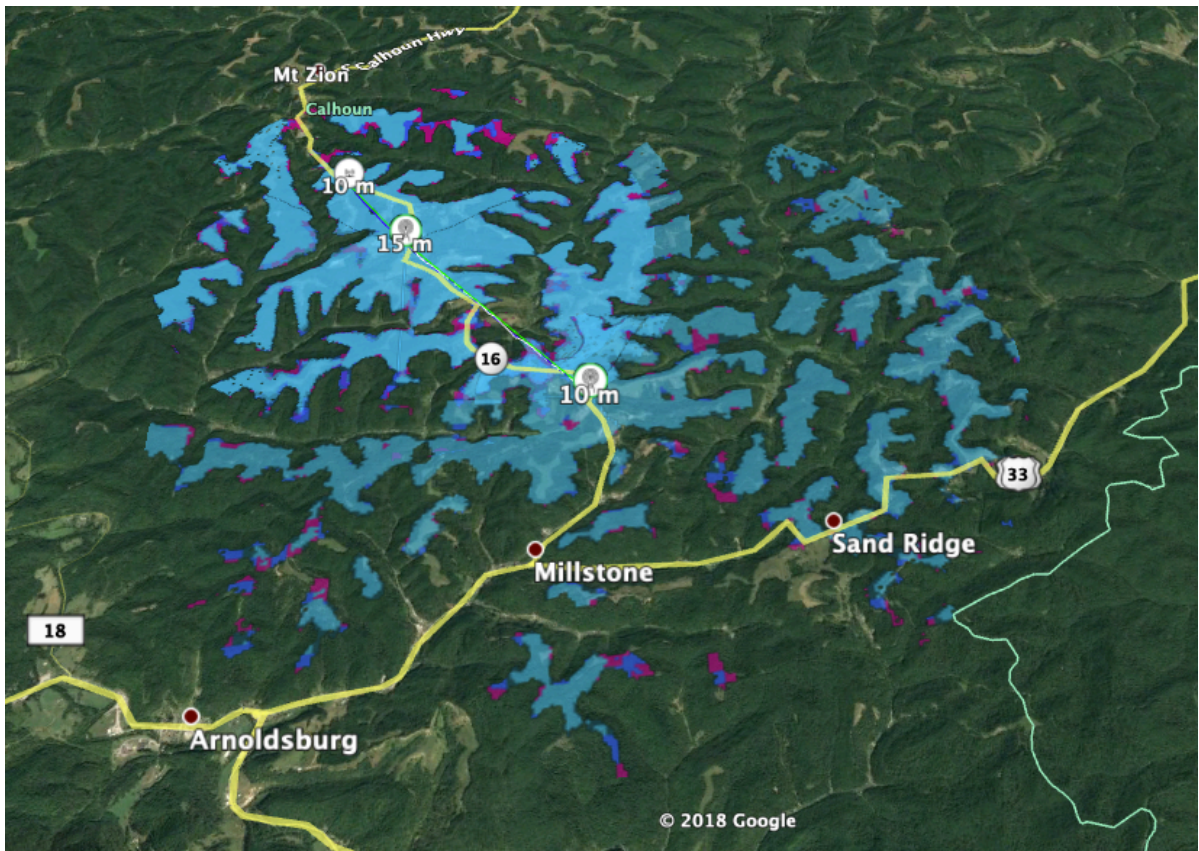
16.3 HUD ELIGIBLE PROJECT - CALHOUN

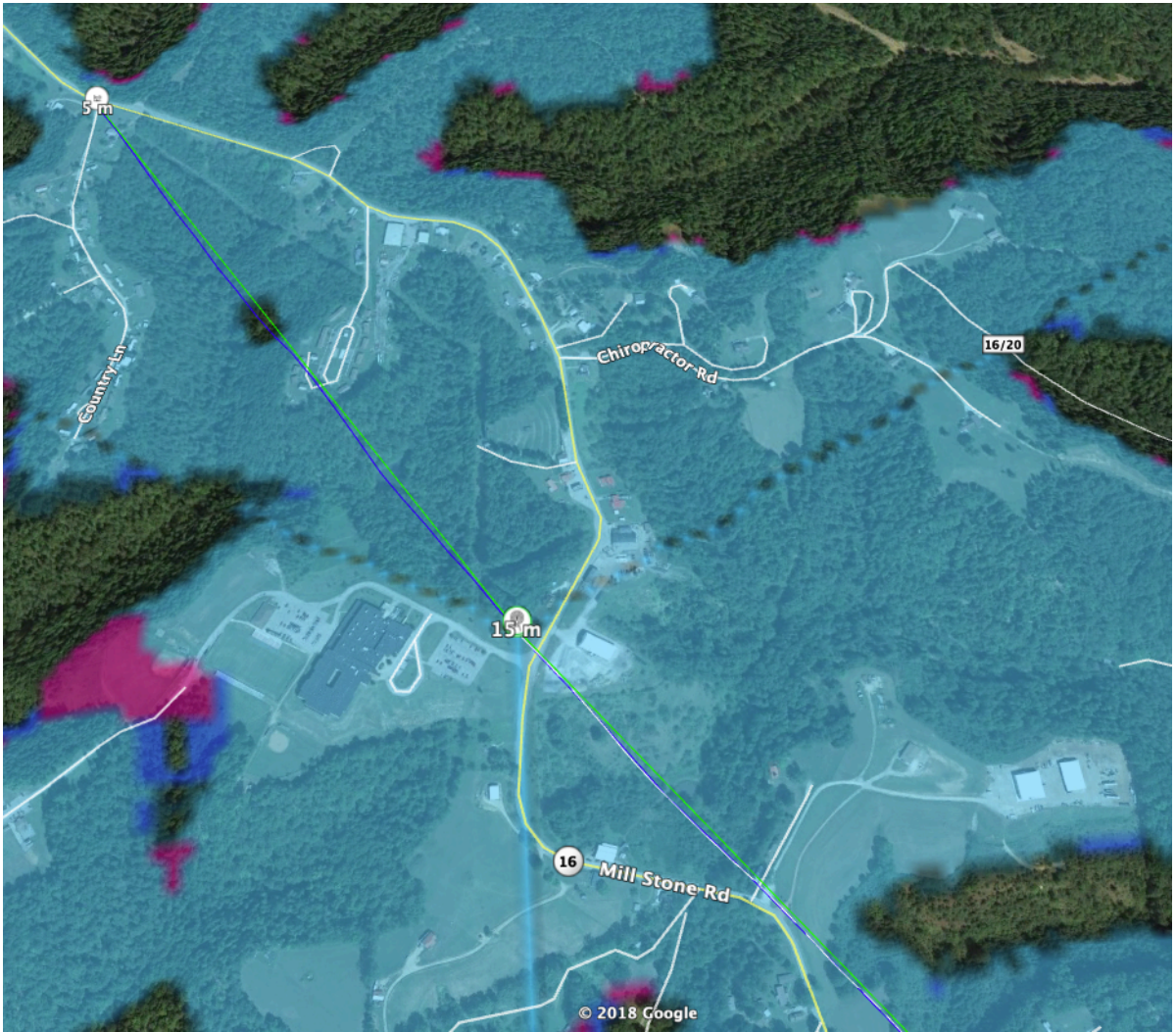
There is only one HUD/CDBG eligible block in Calhoun County. This project proposes to serve the community in that block and is centered on the Calhoun County Middle/High School. The project in Calhoun will utilize the same technologies as were discussed in the first HUD eligible projects section (Section 14.10).

In Calhoun, three neighborhood poles will be installed to serve the community. The network is approximately halfway between Arnoldsburg and Mt. Zion.

Coverage

The neighborhood poles provide coverage to most of the ridge-top community in this area.





Above: Calhoun County Middle/High School

Calhoun HUD Eligible Cost Estimate

Item	Units	Unit Cost	Total
Tower Fit-up	0	\$26,375.00	\$0.00
Neighborhood Pole Construction Materials and installation cost for 50-60' wooden utility pole. No land acquisition cost for poles.	3	\$7,880.00	\$23,640.00
Ubiquiti AF24 PTP Radio Gigabit PTP Radios between neighborhood pole locations. Used for short distances.	4	\$1,497.00	\$5,988.00
Licensed Point to Point Link	0	\$19,000.00	\$0.00

Item	Units	Unit Cost	Total
Point to Point Mounting Hardware Standoffs for utility poles or non-penetrating rooftop mounts for building installs.	4	\$200.00	\$800.00
Ubiquiti Rocket Prism 5ghz AP Access Point Radio for fixed wireless broadband	7	\$249.00	\$1,743.00
Ubiquiti 60-120 sector antenna Adjustable width sector antenna for fixed wireless broadband.	7	\$170.00	\$1,190.00
Ubiquiti IsoStation 5ghz CPE Customer premise radio equipment for fixed wireless broadband. Backhaul radio for public Wifi Hotspots	70	\$129.00	\$9,030.00
CPE Mounting Hardware (J-Mounts)	70	\$13.00	\$910.00
Ubiquiti Toughswitch Pro Site switch for fixed wireless broadband and Wifi hotspots with a backhaul. Not all wifi hotspots will have dedicated backhaul.	3	\$189.00	\$567.00
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.	3	\$300.00	\$900.00
Cabling	2	\$135.00	\$270.00
Installation Costs for PTP Links	2	\$2,000.00	\$4,000.00
Installation Costs for Access Points - Per Site	3	\$2,000.00	\$6,000.00
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			\$5,952.30
*Customer Installations are the responsibility of the service provider.			
TOTAL			\$65,475.30

17 PLANNING FOR SUCCESS

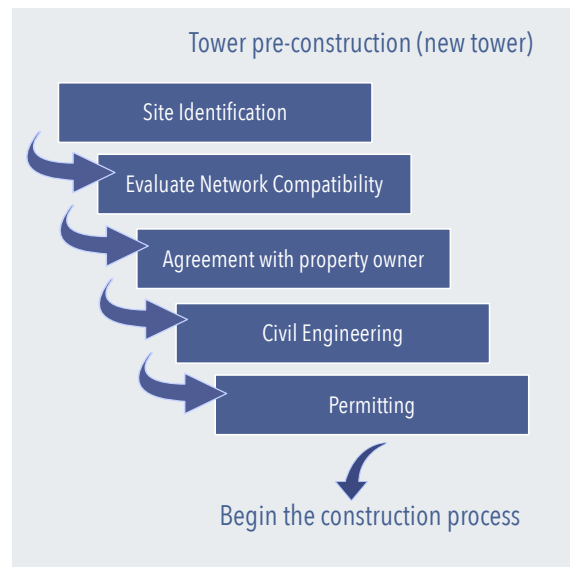
More than a dozen years of operating information is available from a variety of community-owned network infrastructure projects around the country. There is very little “experimentation” that is still necessary. With more than three hundred communities making investments in broadband infrastructure, 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 three county region 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).

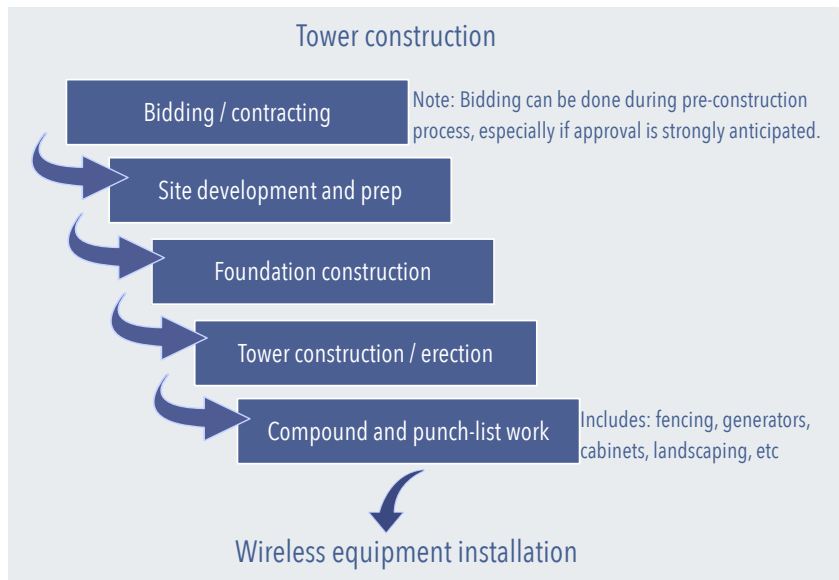
- Site identification – Identify areas of poor service and look for existing towers.
- Network Compatibility – Line of sight to other towers and to key service locations and customers needs to be evaluated. A wireless propagation study and line of sight study will provide the data needed to make this 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.

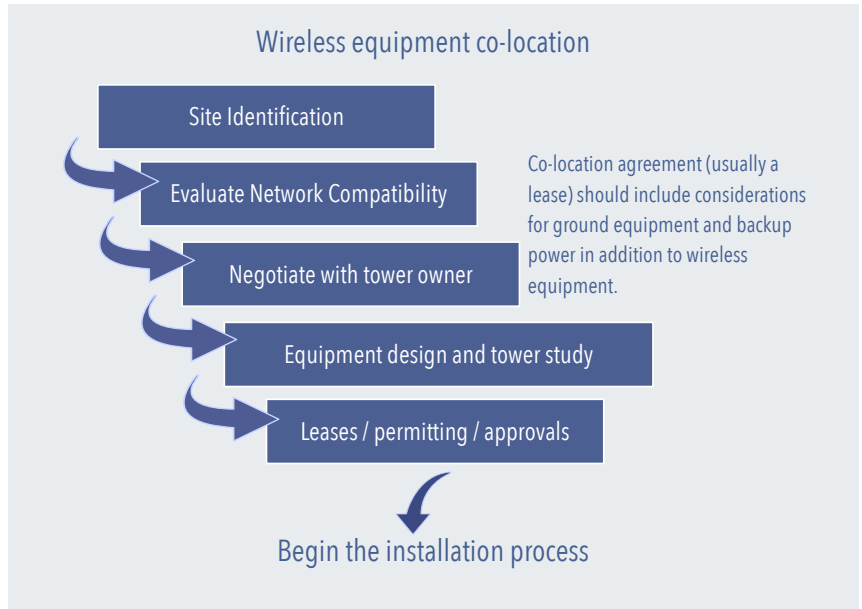
- Bidding and contracting – Bid documents and construction specifications have to be prepared and sent to candidate contractors. Once bids are received, proposals have to be reviewed, and depending upon funding sources, may require review by local government and/or a funding agency prior to awarding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

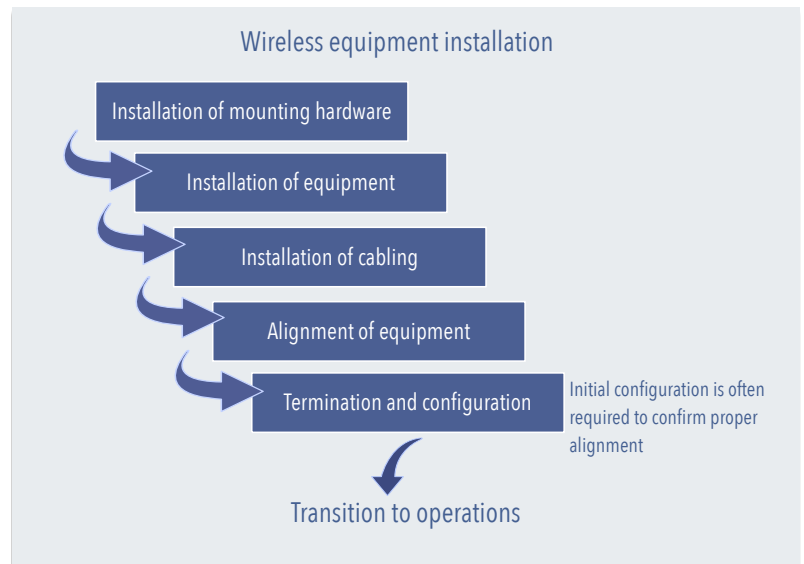


- Tower owner negotiation – If the tower is in a suitable location and if space is available at an appropriate height, a lease has to be negotiated with the tower owner.
- Tower study – An engineering study may be required to determine if the tower is able to support the additional weight and wind load 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 be 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, power 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.

18 TOWER AND SERVICE PROVIDER MANAGEMENT

18.1 ATTRACTING PROVIDERS

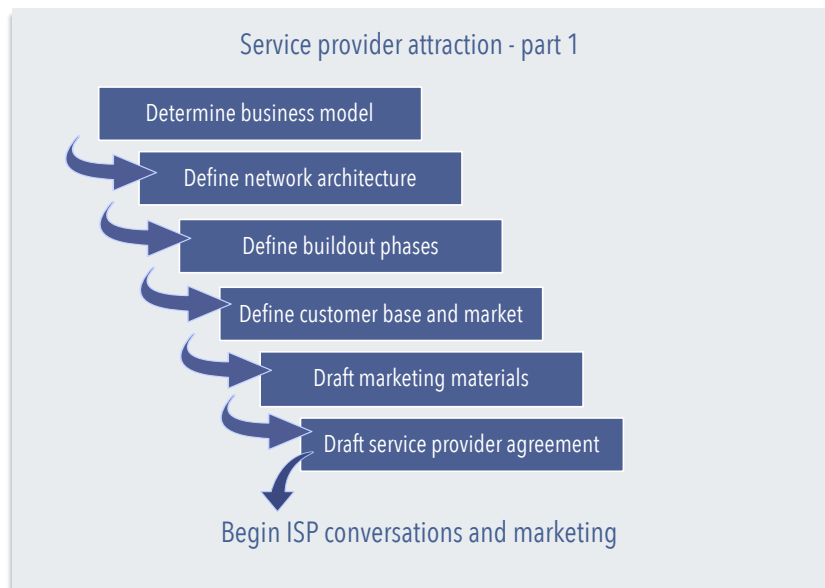
The Wireless Internet Service Provider (WISP) business is challenging. Setting the high cost of towers aside, a WISP placing equipment on a newly available tower must engage in a significant marketing and sales effort to identify customers who want service. Because most broadband wireless frequencies,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

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

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

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

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

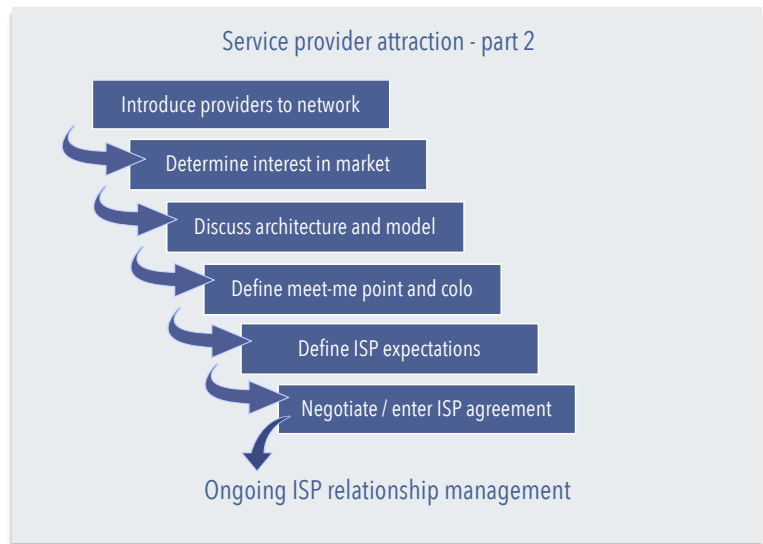


18.2 TOWER MANAGEMENT

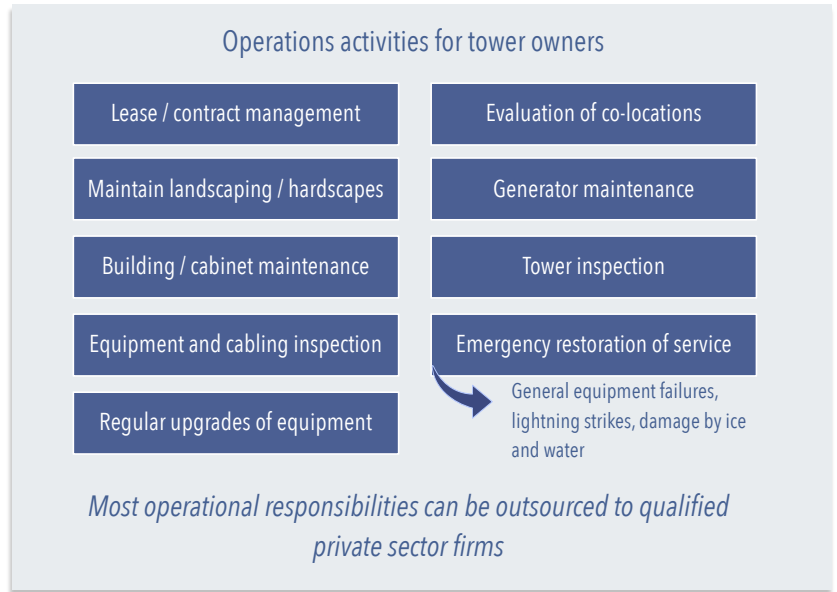
A modest application fee (e.g. \$200) for tower access should be nominal for WISPs; high application fees discourage WISPs from evaluating new tower opportunities.

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

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



- Leases should be a minimum of two years and should auto-renew if the ISP is meeting performance requirements.
- It may be more effective to have a single lease agreement with access to all towers, and the contract should require the ISP to put equipment on all towers within a certain period of time (e.g. nine to twelve months). This limits ISPs from “cherry picking” towers with more potential customers and ignoring towers in parts of the service area (e.g. county) with lower population density.



- Monthly tower lease fees should be on the order of \$200 to \$250 per tower or an equivalent per attachment fee (e.g. \$50-\$75 per attachment). Higher fees make it difficult for providers to make a business case for the cost of equipment and the extensive marketing required to develop a customer base around a tower.
- Consider offering an initial grace period on fees of three to six months, and/or offer a one year sliding scale of fees (e.g. first three months, fee waived; months four to six, 25% of normal fee; months seven to nine, 50% of normal fee; months ten to twelve, 75% of normal fee). There are many ways to structure the initial fee period, but it is important to recognize that the WISPs incur substantial early costs to develop revenue and customers for a new tower.
- All tower leases should expire on the same date even if started at different times. This allows the tower owner to potentially make a smoother transition to a new provider if there are issues, and will give them more leverage and control over the service.
- In contracts, fee reductions should be worded as discounts that can be revoked if performance requirements are not adequately being met.
- Describe what is available for ground-space (e.g. WISP cabinets, shelters, H-frames for electric service) that may be provided (e.g. a shared generator) and/or indicate what the WISP has to provide at the base of the tower. If new shelters will be allowed, set minimum standards for new shelters.

APPENDIX A: BROADBAND INFRASTRUCTURE AS A UTILITY

There is a growing consensus, particularly among rural governments, that the time has come to begin viewing 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. 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.

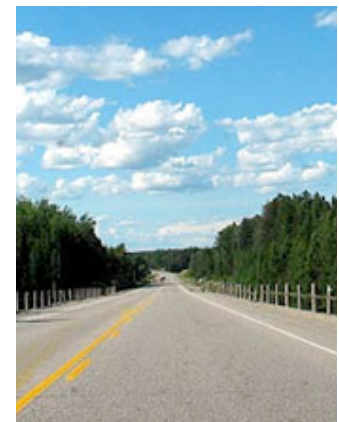


Airports are another example of a shared utility infrastructure—it is much more efficient to build a single airport that is made available to several airlines, with each airline paying access fees to the airport authority.

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.

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.

Before the rise of the automobile, most roads were built largely by the private sector. 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.



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.

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.

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 expense.	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 expense.
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.

APPENDIX B: THE SHARED INFRASTRUCTURE BUSINESS MODEL

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

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

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

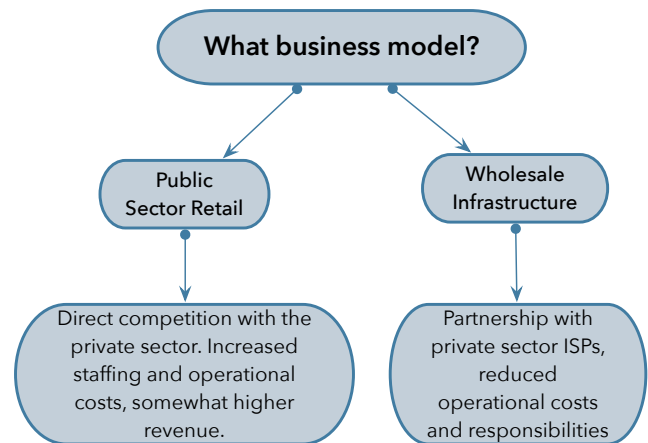
A new business model became possible: wholesale leasing of the cable/wireless infrastructure to private sector service providers, which unbundles the infrastructure from the services. A side effect of this unbundling is that it becomes much easier to determine what a customer is actually paying for a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

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

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

Recommendation

In the three county region, 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 region.



APPENDIX C: THE BENEFITS OF DISTRIBUTED OWNERSHIP

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

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

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

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

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

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

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

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

19% of Roane survey respondents indicated they are trying to work from home part or full time

17% of Clay survey respondents indicated they are trying to work from home part or full time

15% of Calhoun survey respondents indicated they are trying to work from home part or full time

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

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

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

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

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

DISTRIBUTED OWNERSHIP

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

Distributed ownership can take several forms:

- Local government can own infrastructure and make it available to private-sector companies to lease it and deliver services to customers.
- Individual property owners can make investments in infrastructure for their own use, including conduit and/or fiber drop cable from the sides of their homes or businesses to the curb. Property owners can also erect wooden utility poles to obtain improved lines of sight to wireless broadband towers.
- A group of property owners (for example, residential subdivisions, homeowner associations or owners along a section of rural road) can pool funds to erect a utility pole to improve wireless access to the entire group or jointly fund conduit and fiber to their homes, using a wireless or fiber backhaul connection to an ISP.
- Commercial property owners (for example, business park owners, commercial building owners or apartment/condo building owners) can provide conduit and fiber or internal cabling for their properties and make it available to service providers to serve their tenants on a competitive basis.

- Community organizations such as K-12 schools can build infrastructure primarily for their own use and include extra conduit and/or additional fiber for business, community and government use.

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

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.

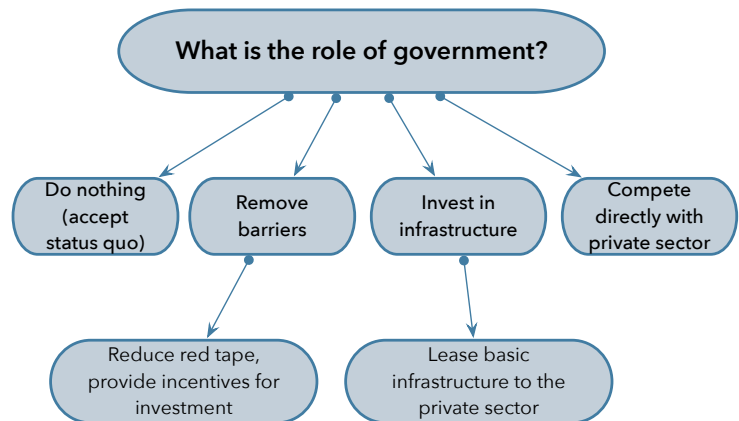
Do nothing is to accept that businesses and residents in the area will have to continue to use whatever is available, despite the cost and bandwidth limitations that limit what many are able to do online.

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.



RECOMMENDATIONS

The local county governments 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 focus on keeping the cost of permitting and constructing new wireless towers as low as possible.

As one example, investments in improvements to existing county-owned towers and/or adding new county-owned towers could help attract needed broadband wireless providers into the region.

Local governments have a range of options when they evaluate distributed ownership of telecommunications infrastructure:

- Space can be made available on existing county and state owned towers. Leasing space on an existing tower help attract a WISP to a new area by lowering the capital costs associated with developing a new market area.
- Where government-owned towers do not exist, county government or a regional entity can build new towers to expand the available service area for a WISP or WISPs that would lease space on the new towers.
- Empty conduit, ideally with several empty tubes, may also be an option, especially in new rural sub-divisions, where the developer may be willing to make the investment if the county government or a regional entity is willing to take responsibility for it once the construction of the neighborhood is complete. Empty conduit can be leased to private sector providers to generate an ongoing revenue stream. If the conduit is installed concurrently with street repairs, sidewalk upgrades, and/or grinding of streets prior to resurfacing, the construction cost can be lower. The long-term benefits include reduced street maintenance and repairs in the future because providers no longer have to cut streets and sidewalks to install their own conduit. Even in small communities where this is being done, multiple providers show interest in leasing conduit in business areas of the community.
- If a local government installs dark fiber in conduits (while leaving some tubes empty for conduit leasing), the potential revenue is higher than if it only installs conduit. If it installs fiber drops into commercial and retail business buildings, businesses in those building will potentially have more provider options and better (competitive) pricing for internet, voice and other IP-related services.

Managing conduit and dark fiber networks is practical for even very small communities because there are virtually no day-to-day operational responsibilities for the two systems, unlike an end-to-end “lit” networks with fiber switches and customer-premises equipment.

Non-government entities like HOAs, neighborhood associations or nonprofits gain access to public right of way in the same way incumbents and service providers do, by following the local construction permitting process. A network design firm or local engineering firm can manage the paperwork easily.

By owning a pole or tower, residents have more control over how they get service (wireless broadband can be a dramatic improvement over poor copper landline DSL) and from whom they purchase service. Similarly, a neighborhood that provides its own financing for broadband infrastructure ensures that lack of adequate broadband does not depress property values or make homes in the neighborhood more difficult to sell.

As work, school, and leisure activities increasingly require more and more bandwidth, communities that want better internet services, competitive services and better pricing have a way forward: investing in and owning some broadband infrastructure. If the cost of that infrastructure is spread over several years, even small communities can afford world-class fiber and wireless services with a choice of providers and services. The alternative is to continue to see more areas in which a single provider exercises monopoly control over the services offered and ever-increasing prices.

APPENDIX D: GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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