Broadband Recommendations

Meeker County, Minnesota

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DESIGN NINE
broadband planners

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Bringing Better Broadband to Meeker County

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

> "Rather than wait for incumbent ISPs to build the network your cities want and need, you can take control of your own broadband futures. Rather than thinking of yourselves as taxers and regulators, which has been the traditional role, you can think of yourselves as facilitators of the kind of services you've been begging the incumbents to provide for years."
>
> Gigi Sohn, FCC Chief Counsel

Broadband, or perhaps more correctly, the lack of adequate broadband, has become a crisis in rural America. 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 rural communities. One bright spot is that independent telephone and electric coops are beginning to take on the challenge of bringing better service to their members, and are generally deploying Gigabit fiber networks. Somewhat ironically, rural communities that have coop support or have developed community-owned networks have service and pricing that is superior to what is available in most urban areas.

The FCC recently redefined "broadband" to be 25 Megabits download speed and 3 megabits upload speed (25/3). In most rural areas of the town, the existing DSL services are unable to deliver even the older FCC broadband definition of 10 Megabits down, 1 Megabit up (10/1).

The economic future of Meeker County depends upon the availability of affordable high speed broadband services at bandwidths needed to conduct business, both now and in the future. Businesses large and small are already heavy users of the Internet. Their bandwidth needs continue to increase. Over the past twenty years, typical bandwidth use has doubled every two years. The current patchwork approach of incremental network improvements being pursued by the incumbent telephone and cable companies will leave Meeker County businesses, students

and residents further and further behind other communities in terms of broadband infrastructure. Improved broadband affordability and accessibility will:

- Enable new telemedicine and telehealth services that can lower health costs and improve outcomes,
- Provide equality of access to K12 and higher education, students, and
- Create increased opportunities for job creation and business attraction and retention.

Nationally, Gigabit fiber service is the standard "minimum" when talking about economic development, business and jobs attraction, and retention. While Gigabit fiber service is available in limited areas of Meeker County, it is expensive and not affordable for most businesses.

- **Form public/private partnerships** — A key role of the County will be to create incentives for existing and new providers to expand service availability and affordability. The County should not offer retail Internet services, and would not compete with private sector providers.
- **Improve broadband wireless access** — The County should work to make space available for Wireless Internet Service Providers (WISPs) for broadband access. Water tanks, existing County-owned towers, and some new towers can be used to make affordable wireless more accessible and affordable for businesses and residents.
- **Deploy some fiber in downtown areas** — Fiber availability in downtowns like Eden Valley and Litchfield could attract more businesses to those downtowns, bringing jobs and more economic activity to those parts of the communities. Existing service providers would pay modest lease fees for use of the fiber and would deliver services like Internet and voice telephone services to fiber-connected businesses.

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.

There is plenty of money for broadband—the problem right now is that most of it is being put in envelopes every month and mailed out of the county and most of the time out of the state. The table below illustrates that over the next 30 years, Meeker residents, businesses, and institutions, very conservatively, will spend as much as six hundred million dollars on telecommunications services. The challenge for Meeker is to capture a very small portion (as little as 5%) to obtain the world's best network for every resident and business in the county.

Meeker 30 Year Estimated Telecom Expenditures			
Estimated Internet Access Type	Households still on dial-up	Households with "little" broadband cable modem/DSL/wireless	Households with no Internet
Total households	8,590		
Total businesses	569		
Estimated Household %	2%	93%	5%
Number of households	172	7,989	430
Average monthly telecom expenditures	Phone service: $50 Cable/satellite TV: $85 Dial up Internet: $20	Phone service: $50 Cable/satellite TV: $85 Broadband Internet: $45	Phone service: $50 Cable/satellite TV: $85
Annual cost/household	$1,860	$2,160	$1,620
30 year expenditure	$9,586,440	$517,667,760	$20,873,700
Total residential expenditures	$548,127,900		
Total community expenditures	$630,347,085		

A word about the report content and organization may be helpful at the outset. This subject area is a very challenging one for governments. The complex technical nature of the undertaking sometimes makes the policy issues hard to assess. This report attempts to assist in this regard by providing technical information which can be thought of as informational or educational, in the body of the report and in several appendices.

Infrastructure Investment Goals

In Meeker County, improvements in broadband infrastructure will:

- Make targeted investments in modern high performance wireless and fiber broadband infrastructure that provides the county with an economic development tool to retain existing businesses, attract new businesses, and help create jobs.
- Provide businesses and residents with a wider choice of competitive service providers and a choice of Internet-based services at a variety of affordable price points.
- Make investments that give local and regional service providers the opportunity to provide improved services to more customers at lower cost.
- Support small businesses, home-based businesses, and home-based workers with broadband infrastructure than gives them with better access to affordable Internet access and Internet-based business services.

Next Steps

The County must consider several early phase tasks and activities: Next steps include:

- Read and review the report, especially the comments provided by residents and businesses as part of the broadband survey.
- Identify key ideas and concepts that may be important to future economic development initiatives.
- Meet with elected and community leaders to discuss these key ideas and concepts in more detail.
- Evaluate the ownership options (i.e. County ownership, nonprofit, coop) and determine a best fit for Meeker County. Note that these options are not mutually exclusive—it may be desirable to have some County broadband assets investments alongside a coop or nonprofit effort.
- If leaders and stakeholders believe that telecom and broadband investments are needed to support the long term goals of the county, a project team should be assembled to move the effort forward.
- Begin close coordination with county-level and any regional public safety tower projects, which could provide a valuable source of funding where towers could support dual use—public safety voice/data communications and wireless broadband access.
- Identify additional planning funds to support detailed network design activities for both the wireless and fiber portions of the planned network.

Broadband Infrastructure as a Utility

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

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

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

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

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

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

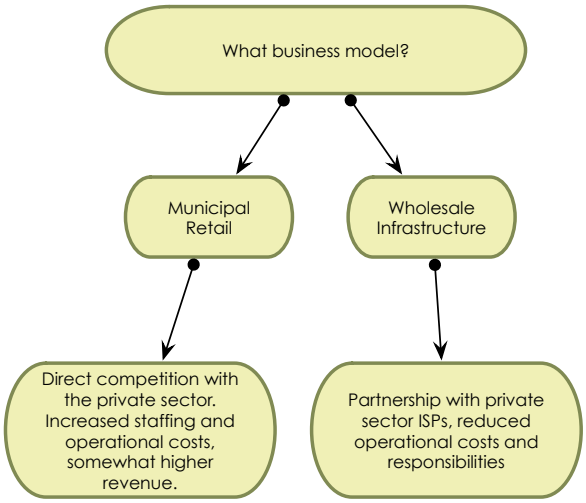
A UTILITY COMPARISON		
SHARED ROADS	SHARED AIRPORTS	SHARED TELECOM
Historically, roads have been built and maintained by the community for the use of all, especially private firms that want to use them to deliver goods and services.	Airports are built and maintained by a community or region as an economic and community development asset. Both public and private users benefit from the shared use of a single, well-designed airport	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 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.

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.

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. Can be a dark fiber approach, lit fiber approach, and/or wireless towers.
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 lit network approach requires hard-nosed business management experience. It is important to identify prospective service providers early in the process.

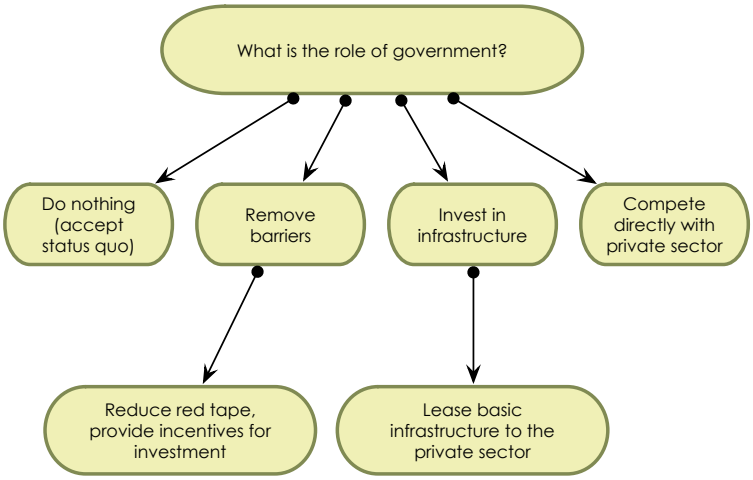
In the wholesale infrastructure business model, local government investments are limited to passive infrastructure like conduit, dark fiber, and wireless tower space. Services for businesses and residents are offered by private sector providers offering Internet, TV, telephone and other data services.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

Recommendation

In Meeker county, improved wireless broadband is going to be an important strategy, and WISP access to existing and/or new county towers could provide an important strategy to improve broadband access in rural areas of the county. A dark fiber or lit fiber initiative, either as a County project or as a separate entity (e.g. a broadband coop) is viable if enough homes are connected (see the financial analysis later in this report).

What is Government's Role?

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



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

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

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

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

Recommendation

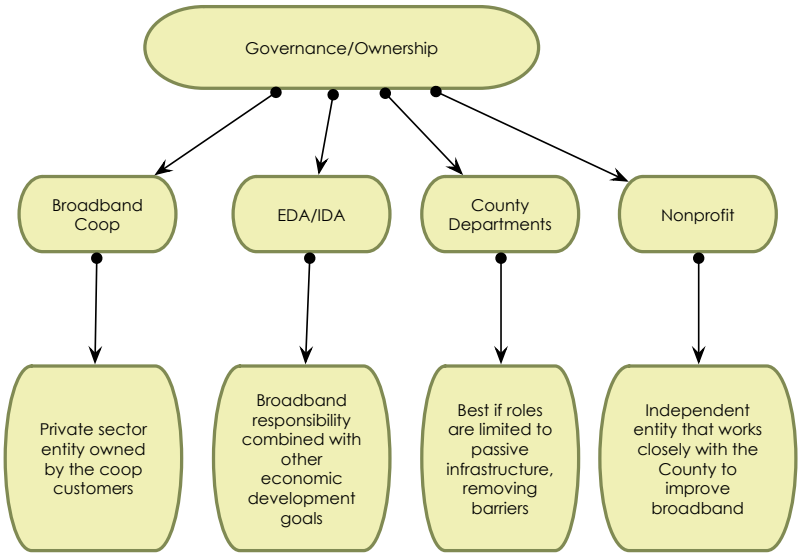
The County can both remove barriers and make targeted investments in infrastructure. These two activities can be executed in parallel, with investments taking place as funding sources are identified. There are a variety of low cost and no cost efforts, mostly at the policy level, that local governments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

As just one example, county planners could work with developers to help them realize that installing conduit and related infrastructure in new subdivisions is an inexpensive way to increase the potential sales price on the homes. No special funding is required of the County, but over time, if residential growth continues in Meeker County, more homes and neighborhoods would improved broadband infrastructure.

Governance Options

For whatever infrastructure improvements the County may make, there will be a limited number of essential roles.

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



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

An EDA or IDA (Economic Development Agency, Industrial Development Agency) as a nonprofit, could also own and manage telecom assets, but County funds and County participation would have to be managed carefully to avoid the state restrictions on local government investments.

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

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

Forming an Coop

The primary advantages of an Coop as opposed to the County pursuing projects independently include:

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

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

Recommendation

There may be a role for investments by the County, especially if public safety tower needs can be combined with improved broadband wireless tower needs in underserved areas of the county. A coop, while requiring more time attention during formation, could provide a durable long term solution to improving broadband in Meeker County.

How Much Broadband is Needed?

What is Broadband?

There is much confusion about the "true" definition of broadband. If the goal is to enhance neighborhood 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 immediately tell businesses in Meeker that there will be structural limits on their ability to do business in the future–it is dictating the size of truck that can be used to deliver goods and services. Here is the only appropriate definition of broadband:

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

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

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

In short, Meeker County today has "little broadband" in the form of DSL, wireless, satellite and 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. This drives the solution towards an integrated fiber and wireless system, rather than a wireless only service orientation. Wireless is able to provide basic Internet access needs, but is not able to support advanced video and multimedia services. Some off the shelf business videoconferencing systems in use today require a minimum of 50 megabits of bandwidth--beyond the capabilities of any affordable wireless system (cellular data networks are approaching this level of bandwidth at off-peak times, but with punishingly expensive bandwidth caps). Two key concepts that should drive community investments in telecom are:

"Broadband" is not the Internet

Bandwidth is not a fixed number

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

Bandwidth needs for the past decade have been growing by 25% to 50% per year, and show no sign of slowing. 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.

Fiber networks use lightpaths to place one or more wavelengths (paths) of light on a single fiber. High end commercial equipment already in production is routinely placing 40+ lightpaths on a single fiber, with each lightpath capable of carrying data at gigabit speeds.

This technology has already begun to move down to ordinary business and residential network equipment, with inexpensive off the shelf customer premises equipment (CPE) using two lightpaths on a single fiber—effectively cutting the amount of fiber needed to serve customers by half.

In Meeker County, a mix of technologies, including fixed broadband wireless, Gigabit fiber, legacy copper networks, and satellite broadband will be part of a basket of broadband solutions.

Current and Future Broadband Needs

"Next generation" is the term used to describe future planning for the next step in network connectivity and infrastructure. There seems to be an emphasis on deploying fiber-to-the-home (FTTH). But why? By pulling fiber deeper into the neighborhood and providing greater access to connectivity, this allows the infrastructure to be in place to accommodate future communication needs, capacities, and innovations. Because of the U.S. demographic bulge that occurred during the baby boom after World War II caused exurban migration, the U.S. is currently the only country where fiber is being deployed in largely suburban areas with single family homes. In countries like Japan and Korea, fiber to the apartment is widely available, in part because the cost of delivering fiber to a high rise apartment building that might have 500 subscribers is much lower than the build cost of fiber to 500 single family homes in a sub-division.

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.

Significance of Big Bandwidth for the Future

According to a report from the World Bank on information and communications technologies, for every ten additional broadband subscribers out of 100 inhabitants are correlated in high income countries with GDP growth increases of 1.21%.

Prosperity

As suggested from the statistic above, the Internet generates growth. In more than a handful of countries, GDP growth doubled to over 21% due to the Internet. Although some jobs have been eliminated due to the emergence of the Internet, nearly 1.2 million jobs have been created over the past 15 years from the Internet. The McKinsey's global SME survey suggests that 2.6 jobs were created for every one destroyed.

Health Care Delivery

Some experts have suggested that healthcare costs can potentially be cut by $80 billion annually by the expanded delivery of health care using high speed broadband. The cost of health care continues to rise annually. For instance, health care as a share of U.S. GDP almost doubled from 8.8 percent to 15.3 percent in 2005, and ten years later, costs continue to rise.

Some insurance companies (e.g. Anthem/Blue Cross) are now offering online access to health care professionals (i.e. doctors and nurses) for routine medical illnesses (e.g. fevers, flu, colds, sore throats, etc). Users of this service have to have robust Internet access and a Web cam. Prescriptions are sent directly to the customer's drug store at any time of day or night.

Electronic prescribing has become common. Electronic prescribing cuts medical transaction costs by eliminating the need for confirmation phone calls and faxes and reduces the chance of health risks due to prescription delays.

Government and Civic Life

The term E-Government refers to networked information technologies online to serve constituents. The Internet cuts costs for many state governments from reducing the paper trail to expediting services through the Web like renewing drivers' licenses and paying taxes.

Furthermore, E-government will become a setting for online based discussions between constituents and bureaucrats. This allows for greater transparency in hopes of garnering a better perception of how government functions. More local and state governments and the federal government are attempting to involve constituents through webinars, blogs, wikis, and videos.

Education

Students benefit greatly through the use of computers and Internet. Nearly every public school in America has access to the Internet. In 2007, there were 180,000 more instructional computers in the schools than in 2006. Students who attend schools without access to computers and the Internet may be ill prepared for the work place. The prevailing use of information technologies in not only the United States, but also globally, is a clear indicator that future prosperity is in the hands of students who are able to understand and use the pertinent tools.

Use Trends

The County faces a challenge in economic development infrastructure with primarily "little broadband" (i.e. DSL, wireless, and cable services) when many communities, regions, and countries have already made the decision to focus resources on the development of "big broadband," which is typically fiber with a minimum capacity of 100 megabits or Gigabit to the premises.

- A third of IBM employees work from home at least part time, and the company has reported annual savings of $110 million.
- FTTH users work more from home, reducing traffic congestion.
- In a recent Broadband Communities magazine report, fiber to the premises adds $5000 to $6000 to the sales price of the house. The same report indicated that the take rate for services for homes passed by fiber is approaching 50% (that is, half of all homes passed by fiber are switching to the new option of fiber delivered services).
- Fiber to the home users say they are able to work from home more often, averaging 7.3 workdays per month, reducing their carbon footprint and decreasing wear and tear (and maintenance) on roads.
- By late 2015, about 20% of homes in the U.S. had been passed by fiber, but incumbents like Verizon and AT&T have ceased deploying fiber in smaller and rural communities. Verizon FiOS is being deployed mostly in areas where the company has already built fiber, and Verizon has shown little interest in improving service in rural areas.
- 9% of home-based businesses report fiber is critical to success (the county has many home-based workers and businesses).
- Older users want telepresence and telemedicine services.
- Users of fiber have higher satisfaction rates with the service than any other option. It is worth noting that wireless comes in second, which will be important in the county. DSL and cable services have the lowest satisfaction ratings.
- Younger residents want collaboration tools and the ability to work from home.

- 82% of home buyers who already have fiber will not buy a home without it.
- 68% of buyers who don't have fiber now want it (only 62% rate green space as most important).
- 49% would cancel fiber service last if forced to cut living costs.

Future Use Trends

"U.S. homes now have more than half a billion devices connected to the Internet, according to a study by the NPD Group. Furthermore, the overall number of connected devices per household, according to a 2014 OECD study, is 10. This is more than three times the average number of people per household."

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

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

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

When analyzing future service needs, it is important to take into account ALL services that may be delivered over a broadband connection. As we noted in the previous section, "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 1 megabit to 5 megabits. Some wireless providers are rolling out 10-15 megabit services, but wireless does not scale up well with respect to cost. As bandwidth increases, the cost of the equipment also increases, and even a 15 megabit service is well short of the FCC projections of the need for 50 megabits of bandwidth in the near term. Wireless performance and capacity is heavily dependent upon backhaul (the local connection to the provider's core network); if this connection is also wireless, the bandwidth available at the access point is shared among all users, even if the rated capacity of an individual connection is 15 megabits. In other words, if the backhaul capacity is 100 megabits, and twenty local users are sharing that capacity, actual bandwidth available to any single user may be much lower than 15 megabits. If all the users are trying to watch video at the same time (not uncommon in early evening), performance can suffer drastically.

Across the U.S., current average bandwidth for cable modem services is typically 10 to 20 megabits, with cable companies promising "up to..." twenty or thirty megabits. It is important to note that cable providers make heavy use of the phrase "up to" in their advertising, and it is not unusual to see ads promoting cable modem speeds of "up to 30 megabits." However, that amount of bandwidth is shared among many users (often 200 or more) in a neighborhood, which results in much lower average speeds, and during peak use times in residential areas, the actual bandwidth available to a single household may be less than one megabit.

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

Distance learning, entertainment, and video conferencing are three major applications of internet video. Distance learning from home with live video feeds will require high performance 2+ 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. Some Idaho community colleges offer "hybrid courses" where a student attends several class sessions at the college and the remaining sessions online from their home, the library, or another location.

Massive Open Online Courses (MOOCs) are now being offered by many colleges and universities, and provide an important and affordable way to obtain certifications and/or college credit in virtually any topic. But many of these classes rely heavily on video to deliver course content, and so an excellent Internet connection is a requirement.

Entertainment will also drive bandwidth demand from the home, and the popularity of video sites like YouTube and Netflix provide a good indication of the long term demand for video in many forms, including:

- Live feeds (e.g. live TV shows, sports coverage, and live news reports).
- Video on demand (TV shows available for viewing at any time, rather than at scheduled times).
- Movies on demand (instead of going to the video store).
- Two way video conversations (family, friends).
- Video stored on home computers and distributed across the Internet (e.g. videos of grand-children, family activities).
- Local video content streamed live or from a server (e.g. high school football games, other sporting events, council meetings, other civic activities).

Business Bandwidth Needs

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

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

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 an access 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.

In fact, they already are; some cable providers have begun to receive heavy criticism for undocumented manipulation of data traffic. 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 when compared to the same channel delivered by satellite.

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

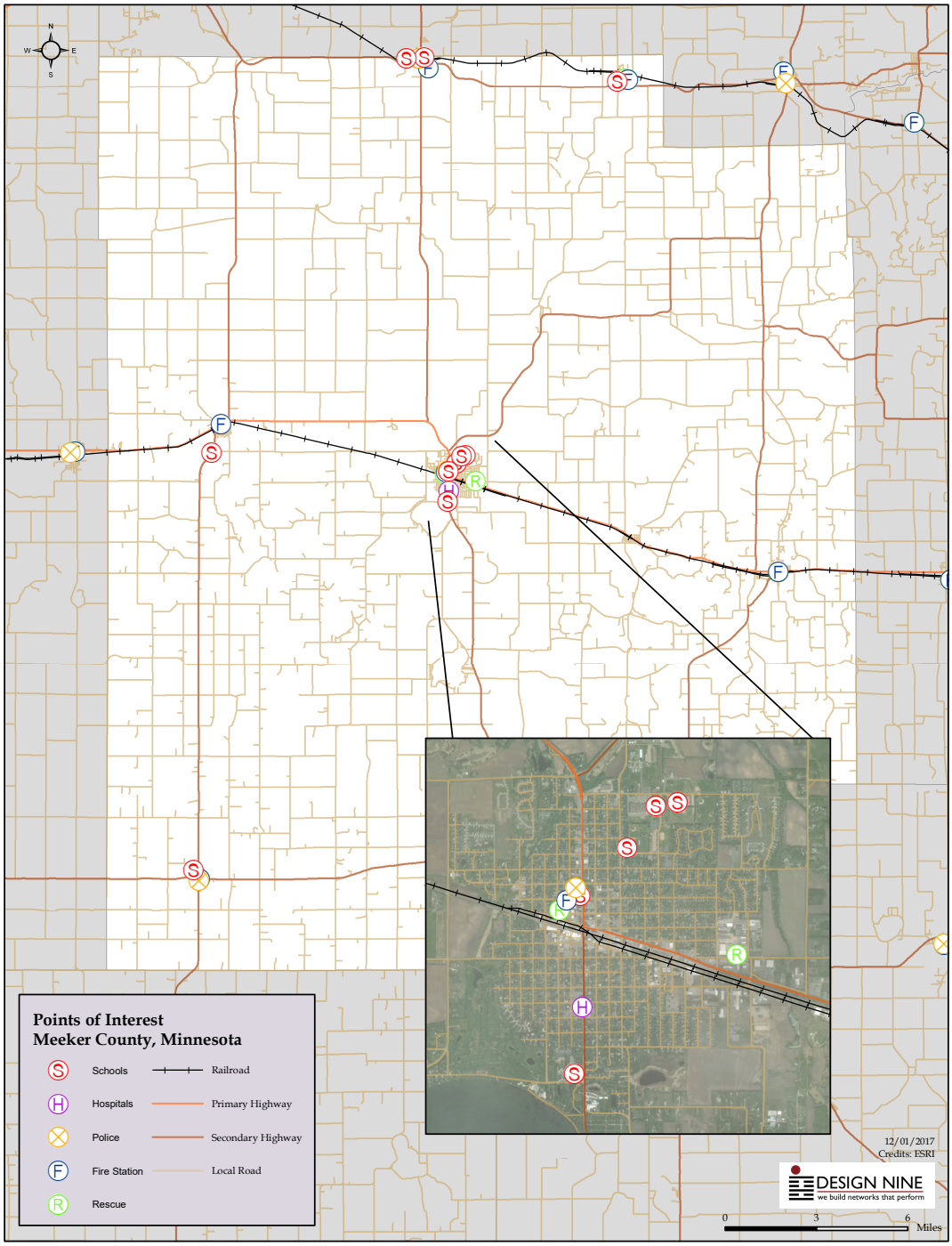
Broadband Assessment and Demand

Existing Assets and Demography

The maps on the following pages include:

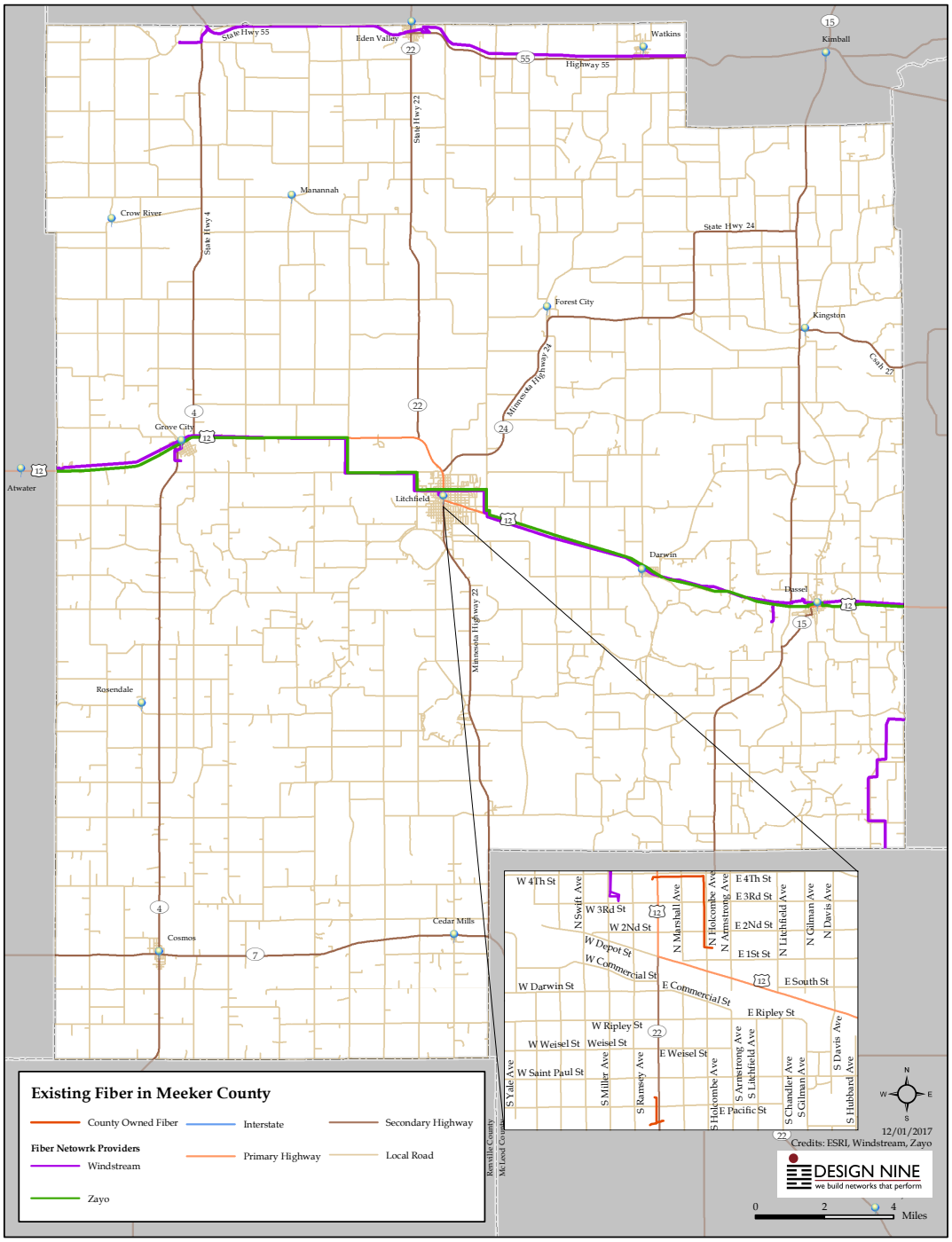
- Points of interest, including household density (an important factor when evaluating new service areas).
- Towers in various parts of the area. These are taken from the FCC tower registry and other sources. The FCC registry which includes both cell towers and other kinds of towers (e.g. radio/TV broadcast towers, public safety towers).
- Long haul fiber routes through the county, which are important data routes to the rest of the Internet.

Points of interest in Meeker County. There are a large number of public and private schools in the county, and it might be possible to develop a partnership with the schools to create a kind of distributed "anchor tenant" opportunity



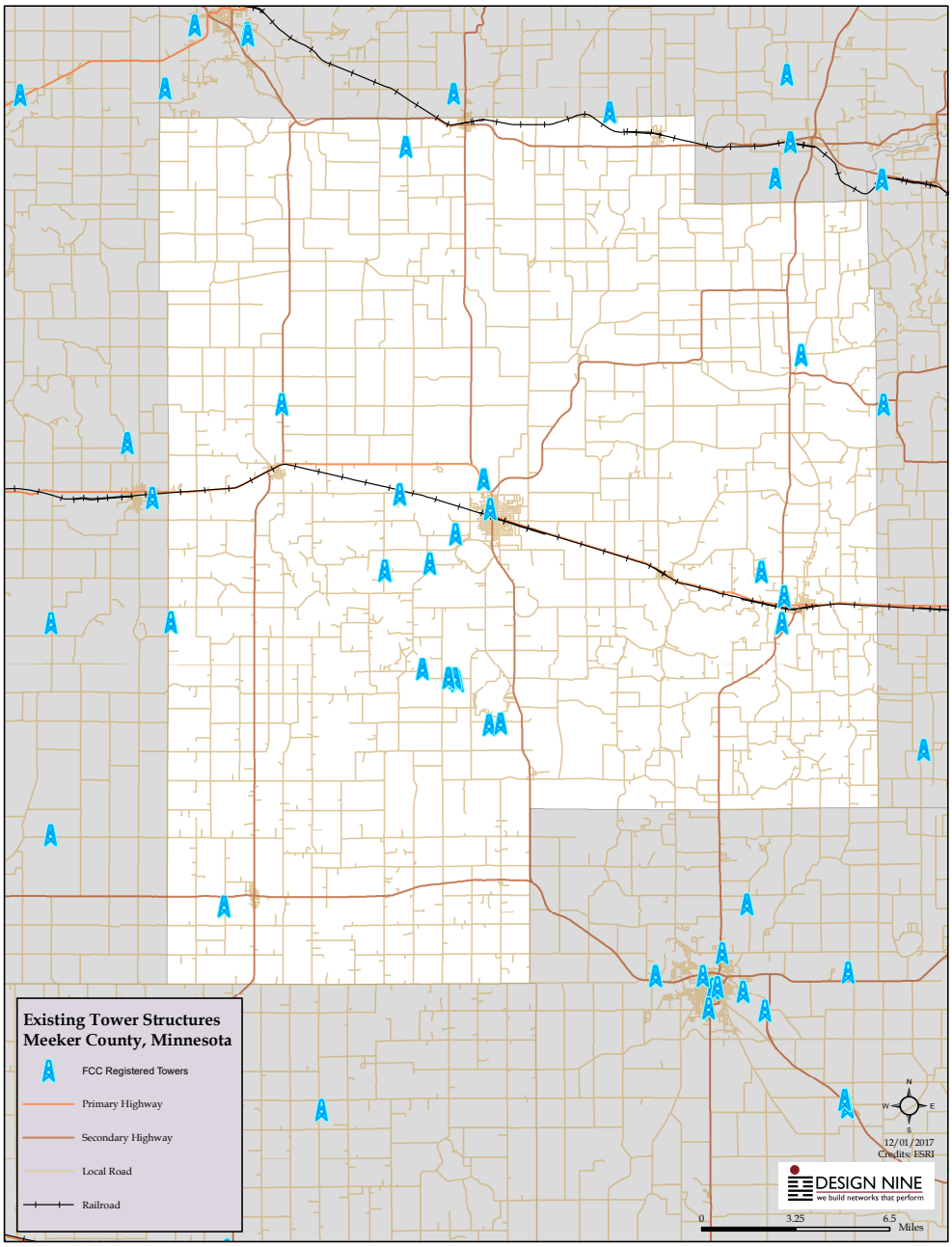
Fiber Assets

The County has some long haul fiber passing through it, which is a major advantage. Local fiber initiatives would be able to easily connect to one or more of these long haul fiber routes and bring in competitive fiber services.



Tower Assets

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



Local Service Provider Pricing Data

The information below provides pricing data and services available from providers in the area for zip codes 55324, 55325, 55329, 55350, 55353, 55355, 55382, 55389, 56209, 56228, 56243, and 56362.

Summary Wireline Internet Service Providers

Zip Code	Arvig	CenturyLink	Frontier	Mediacom Cable	Nu-Telecom	Spectrum Cable	TDS	Windstream
55324		✔		✔	✔			
55325	✔	✔		✔	✔	✔		
55329	✔							
55350				✔	✔			
55353	✔	✔					✔	✔
55355		✔		✔	✔			
55382	✔	✔	✔					✔
55389	✔	✔						
56209			✔	✔			✔	
56228			✔	✔	✔			
56243	✔	✔	✔	✔				
56362	✔			✔			✔	✔

Summary Fixed Wireless Internet Service Providers

Zip Code	LTD Broadband	NU-Telecom	MVTV Wireless	Broadband	Cityscape	Airlink	Cloudnet	Gardonsville Telephone
55324	✔	✔	✔	✔				
55325	✔	✔	✔	✔	✔			
55329			✔		✔			
55350	✔	✔	✔	✔				
55353	✔				✔	✔		
55355	✔	✔	✔	✔				
55382	✔				✔			
55389			✔		✔			
56209			✔				✔	
56228	✔	✔	✔	✔				
56243		✔	✔	✔			✔	
56362			✔					✔

The Zip Code table indicates that there are alternate providers in a zip code, but not all locations within a zip code may be able to get service.

Meeker County Population 2010 by Zip Code

Zip Code	2010 Population	Land-Sq-Mi	Density Per Sq Mile	Internet options other than DSL and Satellite
55324	1234	35.137	35.12	5
55325	4610	76.925	59.93	7
55329	2118	50.324	42.09	2
55350	18280	160.70	113.75	5
55353	3162	84.392	37.47	3
55355	9656	172.922	55.84	5
55382	3563	70.635	50.44	2
55389	2643	74.342	35.55	2
56209	2339	97.791	23.92	3
56228	882	58.86	14.98	5
56243	1725	93.579	18.43	5
56362	5844	147.069	39.74	3

Wireline Zip Code 55324

Mediacom Cable

$49.99/mo for 60 Mbps ↓ 60 Mbps ↑5 Mbps 1 year promo rate-regular rate $69.99. Modem $10/mo, Setup: $99.99 (Includes standard installation. Activation fee is $10.)

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

NU-Telecom DSL

$49.95/mo for 14 Mbps ↓ 14 Mbps with no data cap.

$59.95/mo for 28 Mbps ↓ 28 Mbps with no data cap.

$74.95/mo for 55 Mbps ↓ 55 Mbps with no data cap.

Fixed Wireless Zip Code 55324

Xtratyme- no Public pricing available

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

NU-Telecom

$69.95/mo for 6 Mbps ↓ 6Mbps

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

$99.95/mo for 25 Mbps ↓ 25 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

Broadband

$74.95/mo for 10 Mbps ↓ 10 Mbps ↑1 Mbps with a 150 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

$99.95/mo for 25 Mbps ↓ 25 Mbps ↑3 Mbps with a 225 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

Wireline Zip Code 55325

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

Spectrum Cable

$44.99/mo for up to 100 mbps with no data cap, 1 year promo rate. Regular rate is $64.99. Setup: $44.99. Modem included.

NU-Telecom DSL

$49.95/mo for 14 Mbps ↓ 14 Mbps with no data cap.

$59.95/mo for 28 Mbps ↓ 28 Mbps with no data cap.

$74.95/mo for 55 Mbps ↓ 55 Mbps with no data cap.

Mediacom Cable

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/month.

Arvig DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

Fixed Wireless Zip Code 55325

Xtratyme- no Public pricing available

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

NU-Telecom

$69.95/mo for 6 Mbps ↓ 6Mbps

CITYSCAPE

$129.95/mo for 10Mbps ↓ 10Mbps ↑1.5 Mbps with no data cap, modem included.

MVTV WIRELESS

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

$99.95/mo for 25 Mbps ↓ 25 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

BROADBAND

$74.95/mo for 10 Mbps ↓ 10 Mbps ↑1 Mbps with a 150 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

$99.95/mo for 25 Mbps ↓ 25 Mbps ↑3 Mbps with a 225 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

WIRELINE ZIP CODE 55329

ARVIG DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

FIXED WIRELESS ZIP CODE 55329

XTRATYME- NO PUBLIC PRICING AVAILABLE

CITYSCAPE

$129.95/mo for 10Mbps ↓ 10Mbps ↑1.5 Mbps with no data cap, modem included.

MVTV WIRELESS

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

WIRELINE ZIP CODE 55350

NU-TELECOM DSL

$49.95/mo for 14 Mbps ↓ 14 Mbps with no data cap.

$59.95/mo for 28 Mbps ↓ 28 Mbps with no data cap.

$74.95/mo for 55 Mbps ↓ 55 Mbps with no data cap.

MEDIACOM CABLE

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/month.

Nu-Telecom Fiber - no public pricing available

Fixed Wireless Zip Code 55350

Xtratyme- no Public pricing available

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

NU-Telecom

$69.95/mo for 6 Mbps ↓ 6Mbps

Broadband

$74.95/mo for 10 Mbps ↓ 10 Mbps ↑1 Mbps with a 150 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

$99.95/mo for 25 Mbps ↓ 25 Mbps ↑3 Mbps with a 225 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

Wireline Zip Code 55353

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

Arvig DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$65/mo for 100 mbps ↓ 10 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

TDS DSL *

$29.95/mo for 15 mbps, download speeds of 6 to 15 Mbps ↓ max upload of 0.768 Mbps ↑. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months

$29.95/mo for 25 mbps, download speeds of 18 to 15 Mbps ↓ max upload of 1.5 to 5 Mbps ↑. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months

$29.95/mo for 50 mbps, download speeds of ↓ 6 to 15 Mbps ↑ max upload of 0.768 Mbps. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months

*Price and service may vary by location

Windstream

$60/mo for 25 Mbps ↓ 25 Mbps Includes one-time $100 bill credit Setup: $50 (Includes Internet activation and free self-installation) Professional installation is $35 Modem w/ WIFI $9.99/month

$70/mo for 50 Mbps ↓ 50 Mbps Includes one-time $100 bill credit Setup: $50 (Includes Internet activation and free self-installation) Professional installation is $35 Modem w/ WIFI $9.99/month

Fixed Wireless Zip Code 55353

Xtratyme- no Public pricing available

cityscape

$129.95/mo for 10Mbps ↓ 10Mbps ↑1.5 Mbps with no data cap, modem included.

AirLink Wireless

$89.99/mo for 10Mbps ↓ 10Mbps ↑ 2 Mbps with no data cap, modem included. Setup $199.99 (includes installation)

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

Wireline Zip Code 55355

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

NU-Telecom DSL

$49.95/mo for 14 Mbps ↓ 14 Mbps with no data cap.

$59.95/mo for 28 Mbps ↓ 28 Mbps with no data cap.

$74.95/mo for 55 Mbps ↓ 55 Mbps with no data cap.

Mediacom Cable

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/ month.

Fixed Wireless Zip Code 55355

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included

Xtratyme- no Public pricing available

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

NU-Telecom

$69.95/mo for 6 Mbps ↓ 6Mbps

Broadband

$74.95/mo for 10 Mbps ↓ 10 Mbps ↑1 Mbps with a 150 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

$99.95/mo for 25 Mbps ↓ 25 Mbps ↑3 Mbps with a 225 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

Wireline Zip Code 55382

Windstream

$60/mo for 25 Mbps ↓ 25 Mbps Includes one-time $100 bill credit Setup: $50 (Includes Internet activation and free self-installation) Professional installation is $35 Modem w/ WIFI $9.99/month.

$70/mo for 50 Mbps ↓ 50 Mbps Includes one-time $100 bill credit Setup: $50 (Includes Internet activation and free self-installation) Professional installation is $35 Modem w/ WIFI $9.99/month.

Arvig DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$65/mo for 100 mbps ↓ 10 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

Frontier DSL

$25/mo for 12 Mbps ↓ 1.5 Mbps ↑ 2 year promo rate. Contract term 2 years. 1 year of Amazon Prime. Modem w/WIFI $5/month.

$30/mo for 18 Mbps ↓ 1.5 Mbps ↑ 2 year promo rate. Contract term 2 years. 1 year of Amazon Prime. Modem w/WIFI $10/month.

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

Fixed Wireless Zip Code 55382

Xtratyme- no Public pricing available

CITYSCAPE

$129.95/mo for 10Mbps ↓ 10Mbps ↑1.5 Mbps with no data cap, modem included.

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

Wireline Zip Code 55389

Arvig DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$65/mo for 100 mbps ↓ 10 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

Fixed Wireless Zip Code 55389

Xtratyme- no Public pricing available

cityscape

$129.95/mo for 10Mbps ↓ 10Mbps ↑1.5 Mbps with no data cap, modem included.

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included.

Wireline Zip Code 56209

Frontier DSL

$25/mo for 12 Mbps ↓ 1.5 Mbps ↑ 2 year promo rate. Contract term 2 years. 1 year of Amazon Prime. Modem w/WIFI $5/month.

Mediacom Cable

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/month.

TDS DSL *

$29.95/mo for 15 mbps, download speeds of 6 to 15 Mbps ↓ max upload of 0.768 Mbps ↑. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months.

$29.95/mo for 25 mbps, download speeds of 18 to 15 Mbps ↓ max upload of 1.5 to 5 Mbps ↑. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months.

$29.95/mo for 50 mbps, download speeds of ↓ 6 to 15 Mbps ↑ max upload of 0.768 Mbps. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months.

*Price and service may vary by location.

Fixed Wireless Zip Code 56209

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included.

Xtratyme- no Public pricing available

Cloudnet

$69.99/mo for 7 Mbps ↓ 1.5 Mbps ↑ Contract term 2 years. 10% discount with yearly billing Setup: $0.

Wireline Zip Code 56228

Frontier DSL

$25/mo for 12 Mbps ↓ 1.5 Mbps ↑ 2 year promo rate. Contract term 2 years. 1 year of Amazon Prime. Modem w/WIFI $5/month.

Mediacom Cable

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/month.

NU-Telecom DSL

$49.95/mo for 14 Mbps ↓ 14 Mbps with no data cap.

$59.95/mo for 28 Mbps ↓ 28 Mbps with no data cap.

$74.95/mo for 55 Mbps ↓ 55 Mbps with no data cap.

Fixed Wireless Zip Code 56228

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included.

Xtratyme- no Public pricing available

LTD Broadband

$70/mo for 10 Mbps ↓ 10 Mbps ↑2 Mbps with no data cap

NU-Telecom

$69.95/mo for 6 Mbps ↓ 6Mbps

Broadband

$74.95/mo for 10 Mbps ↓ 10 Mbps ↑1 Mbps with a 150 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

$99.95/mo for 25 Mbps ↓ 25 Mbps ↑3 Mbps with a 225 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

Wireline Zip Code 56243

CenturyLink DSL

$45/mo for 10 Mbps ↓ 10 Mbps with a 1024 GB data cap. Free $25 reward card when you order online. Modem $10/mo or one-time $100 fee.

Mediacom Cable

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/month.

Arvig DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$65/mo for 100 mbps ↓ 10 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

Frontier DSL

$25/mo for 12 Mbps ↓ 1.5 Mbps ↑ 2 year promo rate. Contract term 2 years. 1 year of Amazon Prime. Modem w/WIFI $5/month.

Fixed Wireless Zip Code 56243

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included.

Xtratyme- no Public pricing available

Cloudnet

$69.99/mo for 7 Mbps ↓ 1.5 Mbps ↑ Contract term 2 years. 10% discount with yearly billing Setup: $0.

NU-Telecom

$69.95/mo for 6 Mbps ↓ 6Mbps

Broadband

$74.95/mo for 10 Mbps ↓ 10 Mbps ↑1 Mbps with a 150 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

$99.95/mo for 25 Mbps ↓ 25 Mbps ↑3 Mbps with a 225 GB/mo data cap, contract term 2 years. Setup: Installation charges start at $150.

Wireline Zip Code 56362

Windstream

$60/mo for 25 Mbps ↓ 25 Mbps Includes one-time $100 bill credit Setup: $50 (Includes Internet activation and free self-installation) Professional installation is $35 Modem w/ WIFI $9.99/month.

$70/mo for 50 Mbps ↓ 50 Mbps Includes one-time $100 bill credit Setup: $50 (Includes Internet activation and free self-installation) Professional installation is $35 Modem w/ WIFI $9.99/month.

Mediacom Cable

$49.99/mo for 60 mbps ↓ 5 Mbps ↑ w/ no data cap, 1-year promo rate. Regular rate $69.99. Setup: $99.99 (Includes standard installation. Activation fee is $10.) Modem $10/ month.

Arvig DSL

$45/mo for 25 mbps ↓ 3 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$50/mo for 50 mbps ↓ 5 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

$65/mo for 100 mbps ↓ 10 Mbps ↑ Arvig phone service is required for listed price. A la carte price may be higher.

TDS DSL *

$29.95/mo for 15 mbps, download speeds of 6 to 15 Mbps ↓ max upload of 0.768 Mbps ↑. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months.

$29.95/mo for 25 mbps, download speeds of 18 to 15 Mbps ↓ max upload of 1.5 to 5 Mbps ↑. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months.

$29.95/mo for 50 mbps, download speeds of ↓ 6 to 15 Mbps ↑ max upload of 0.768 Mbps. 1-year promo rate. Regular rate is $64.95. $100 processing fee applies. Setup: $14.95. Modem w/WIFI $6.95 per months.

*Price and service may vary by location.

Fixed Wireless Zip Code 56362

MVTV Wireless

$74.95/mo for 10 Mbps ↓ 10 Mbps Setup: $114.95 (Includes membership, installation and activation) Modem included.

Xtratyme- no Public pricing available

Gardonsville Telephone

$74.95/mo for 3 mbps ↓ Contract term 1 year. Setup: $59.95 (Includes installation) Modem $2.99/month.

Residential Satellite Internet

Zip codes 55324, 55325, 55329, 55350, 55353, 55355, 55382, 55389, 56209, 56228, 56243, and 56362.

HughesNet

$49.99/mo for 25 Mbps ↓ 3 Mbps ↑ 10 GB/mo data cap. Two year contract. 50 GB/mo of FREE data (2am–8am). Once monthly plan data is used, data speeds will be reduced to as low as or lower than 1-3 Mbps until the next billing period. Setup: $0 (Free standard installation.) Modem: $14.99/mo

$59.99/mo for 25 Mbps ↓ 3 Mbps ↑ 20 GB/mo data cap. 2-year promo rate. Regular rate is $69.99. Two year contract. 50 GB/mo of FREE data (2am–8am). Once monthly plan data is used, data speeds will be reduced to as low as or lower than 1-3 Mbps until the next billing period. Setup: $0 (Free standard installation.) Modem: $14.99/mo.

$79.99/mo for 25 Mbps ↓ 3 Mbps ↑ 30 GB/mo data cap. 2-year promo rate. Regular rate is $99.99. Two year contract. 50 GB/mo of FREE data (2am–8am). Once monthly plan data is used, data speeds will be reduced to as low as or lower than 1-3 Mbps until the next billing period. Setup: $0 (Free standard installation.) Modem: $14.99/mo

$99.99/mo for 25 Mbps ↓ 3 Mbps ↑ 50 GB/mo data cap. 2-year promo rate. Regular rate is $129.99. Two year contract. 50 GB/mo of FREE data (2am–8am). Once monthly plan data is used, data speeds will be reduced to as low as or lower than 1-3 Mbps until the next billing period. Setup: $0 (Free standard installation.) Modem: $14.99/mo

$69.99/mo for 25 Mbps ↓ 3 Mbps ↑ 35 GB/mo data cap. 2-year promo rate. Regular rate is $129.99. Two year contract. Data Allowance: Daytime Data 25 GB (8am-6pm), Anytime Data 10 GB. Data speeds will be reduced and will typically be in the range of 1 to 3 Mbps once monthly plan data is used. Setup: $99.99 ((Includes lease set-up fee and free standard installation) Modem: $14.99/mo

ViaSat/Exede

Note that ViaSat/Exede is not providing any guaranteed upload speeds for some packages, but these typically range between 1-3 Megabits.

$30/mo for 12 Mbps ↓ - -↑ Mbps with 12 GB/mo data cap. 3-month promo rate. Regular rate is $50. Two year contract. Free Zone (unmetered data) from 3 am to 6am daily. Once monthly priority data is used, speeds reduced to up to 1-5 mbps during the day, but may slow more after 5 p.m. Setup: $0 (Free standard installation.) Equipment Fee: $9.99/mo or one-time $299.99.

$50/mo for 12 Mbps ↓ - - Mbps ↑ with 25 GB/mo data cap. 3-month promo rate. Regular rate is $75. Two year contract. Free Zone (unmetered data) from 3 am to 6am daily. Once monthly priority data is used, speeds reduced to up to 1-5 mbps during the day, but may slow more after 5 p.m. Setup: $0 (Free standard installation.) Equipment Fee: $9.99/mo. or one-time $299.99.

$75/mo for 12 Mbps ↓ - - Mbps ↑ with 50 GB/mo data cap. 3-month promo rate. Regular rate is $100. Two year contract. Free Zone (unmetered data) from 3 am to 6am daily. Once monthly priority data is used, speeds reduced to up to 1-5 mbps during the day, but may

slow more after 5 p.m. Setup: $0 (Free standard installation.) Equipment Fee: $9.99/mo. or one-time $299.99.

$100/mo for 25Mbps ↓ - - Mbps ↑ with no data cap. 3-month promo rate. Regular rate is $150. Two year contract. After 150 GB of data usage, data is prioritized behind other customers during network congestion. Modem: $9.99/mo. or one-time $299.99.

$99.99/mo for 15 Mbps ↓ 4 Mbps ↑ with 20 GB/mo. data cap. Two year contract. Setup $299.99 includes standard installation. Modem included.

Business Satellite Internet HughesNet

$69.99/mo for 1-3 Active users

$99.99/mo for 5 Active users- medium connectivity

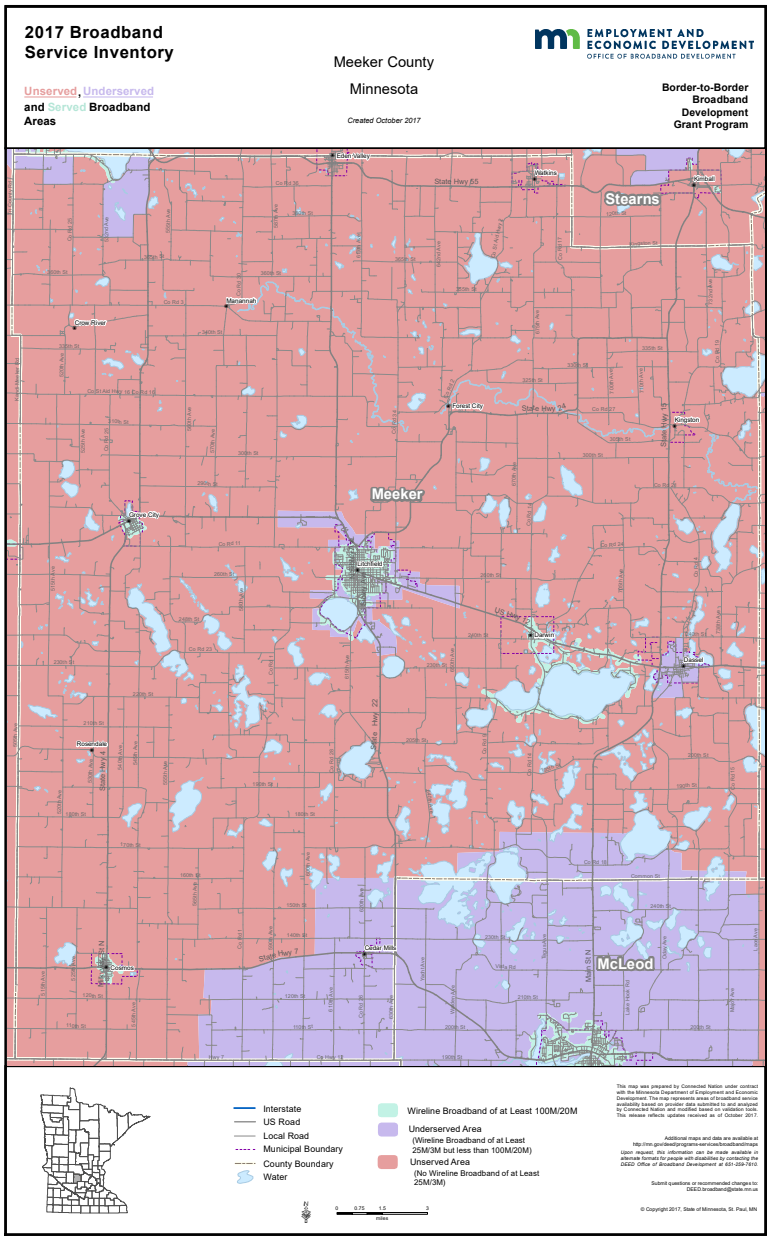
$149.99/mo for 5 Active users- higher connectivity

$269.99/mo for 10 Active users- heavy duty connectivity

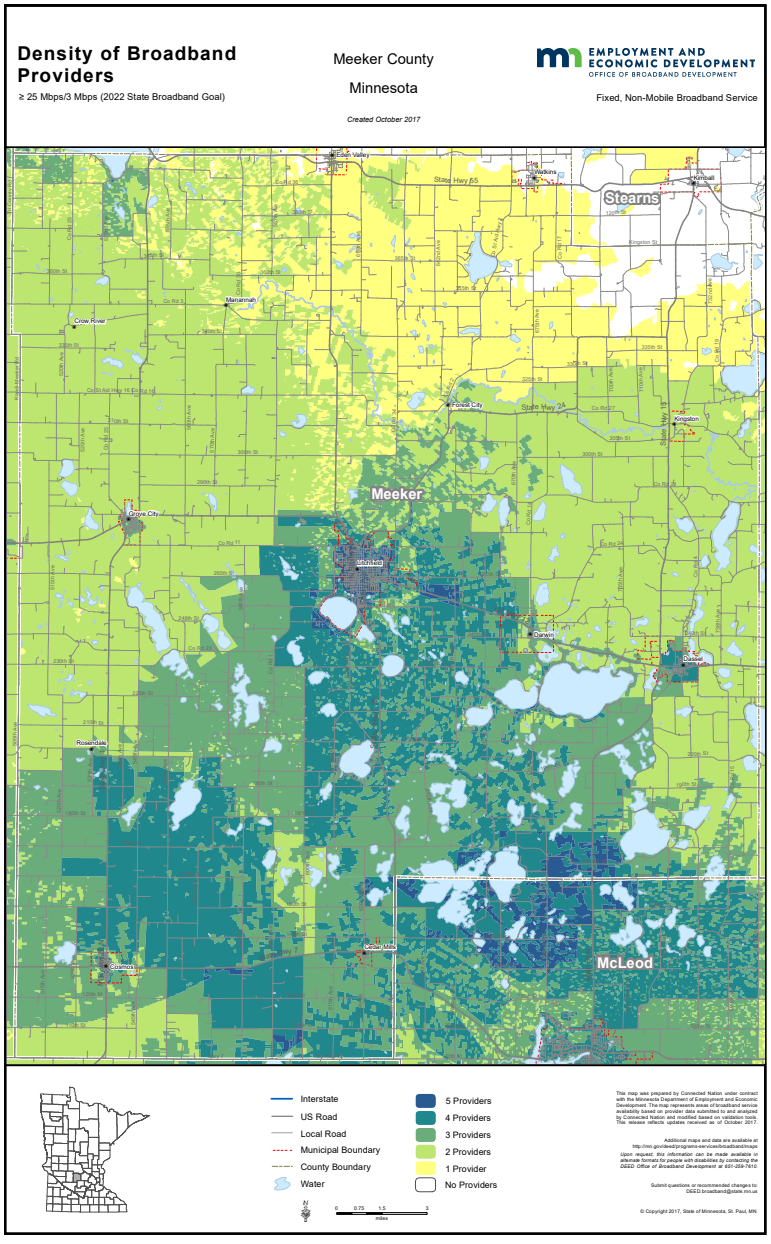
$469.99/mo for 15+ Active users- heaviest connectivity

IDENTIFYING NEED

The map below has been developed by the Minnesota Office of Broadband Development, and provides an estimate of served (light blue areas with wireline service of at least 25 Meg down and 3 Meg up), underserved (pale purple—very few areas of less than 10 Meg down, 5 Meg up), and unserved (red, which are areas with no wireline service of at least 25 Meg down, 3 Meg up). Many of the red areas have access to DSL, fixed point wireless broadband, and/or cellular data service.



The map below, also prepared by the Minnesota Office of Broadband Development, shows the density of service providers in the county. A few locations, in the larger population areas (green), have two or three providers available, the yellow areas indicate only one provider is available, and most of the county (white) is shown with no providers, although as noted in the previous map, DSL, fixed point wireless broadband, and/or cellular data is available to at least some residents and businesses.



Improving Broadband Access

In Meeker County, both fiber and wireless technologies and systems are going to be important to meet the goal of improving access to broadband. The rest of this section provides more detail and some specific build out strategies. There are three major parts of any modern network:

- 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. Meeker County has several private sector wireless service providers, but there are still areas of the county that are underserved. Each of these providers has their own Core Network, but wireless broadband could be more widely available if additional community-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 individual users and businesses to the network, and like the Distribution network, that connection will be by fiber or by a wireless link.

Businesses and residents in the county may obtain Internet service:

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

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

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

Dark Fiber and Lit Fiber

About Dark Fiber

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

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

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

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

About Lit Fiber

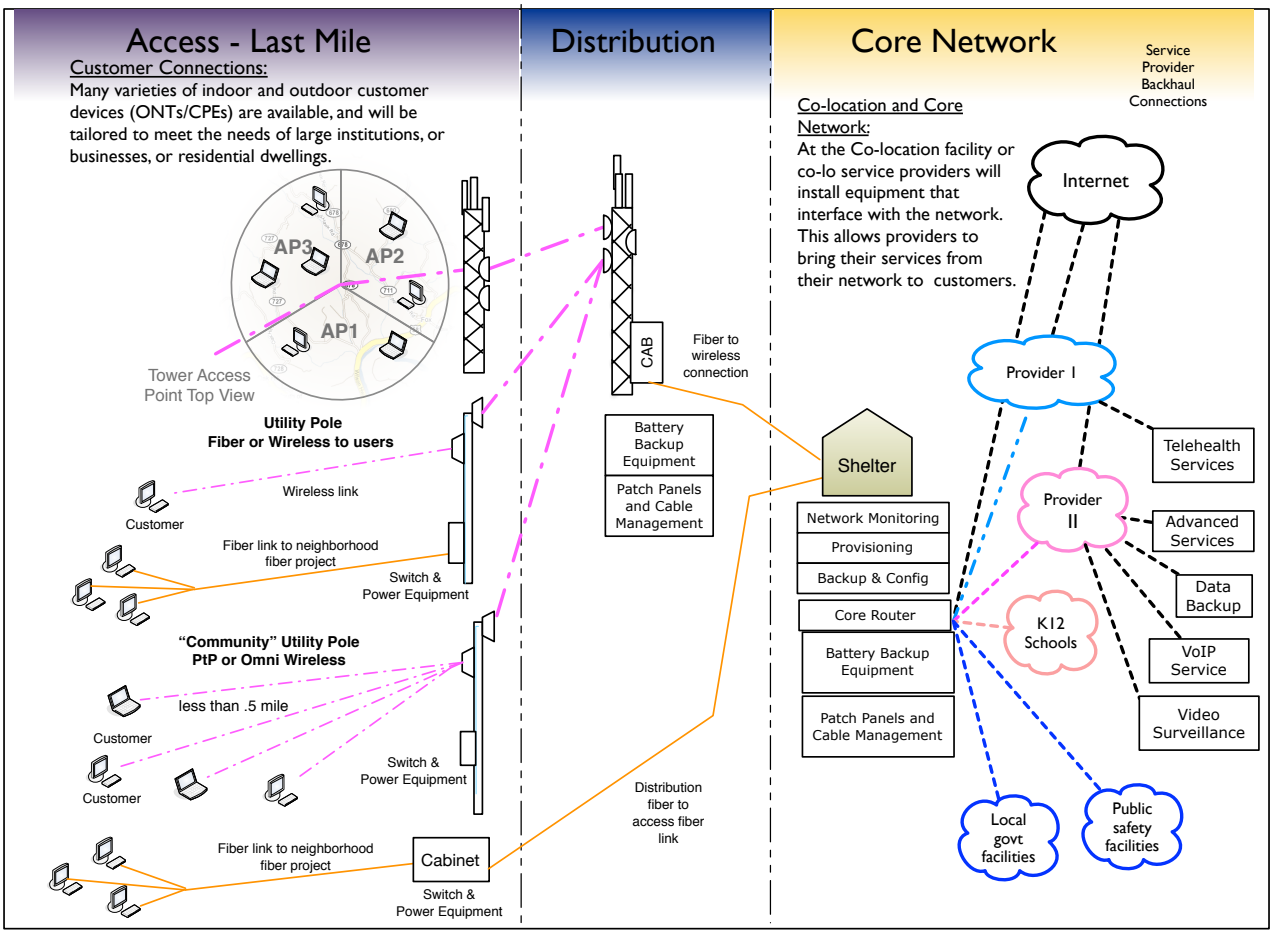
A "lit" fiber network includes the network electronics needed to transmit data over the fiber (using the small lasers in a fiber switch, hence there is light traveling over the fiber cable). In a lit network, "lit circuits" are leased out to service providers rather than fiber pairs. The muni/local government/community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

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

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

Network Components Overview

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 Meeker County. More detail is provided on the following pages.

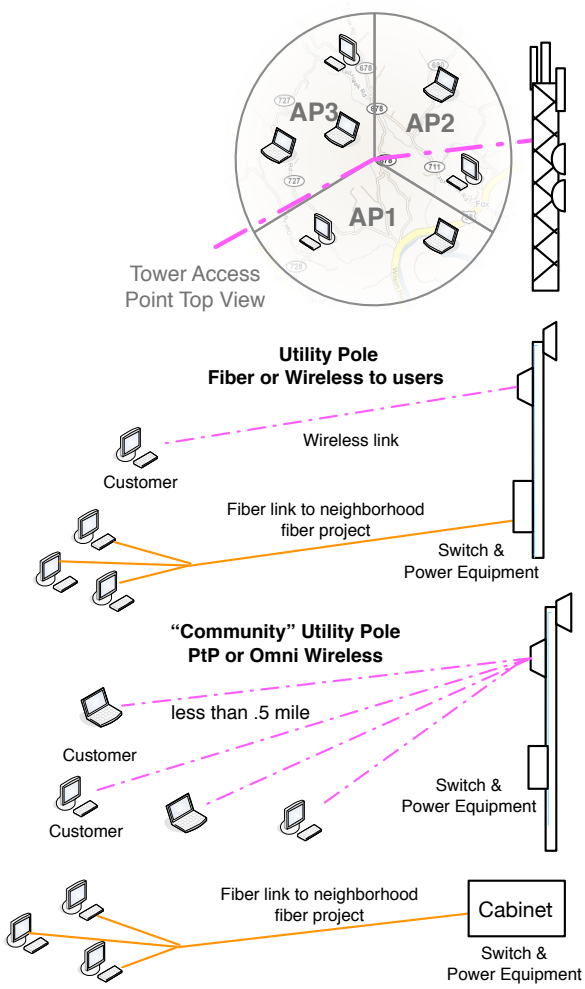


Last Mile Access

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

There are several ways that customers can receive service:

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

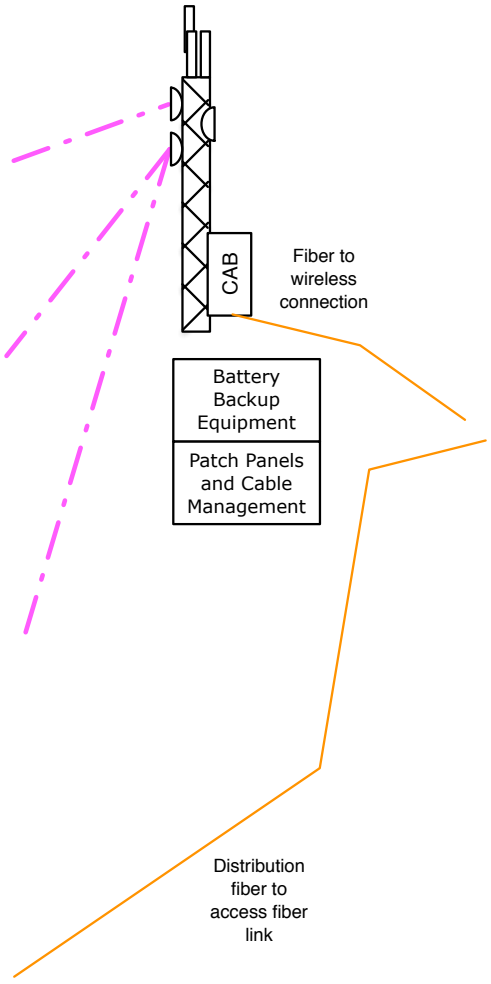


Distribution Network

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

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

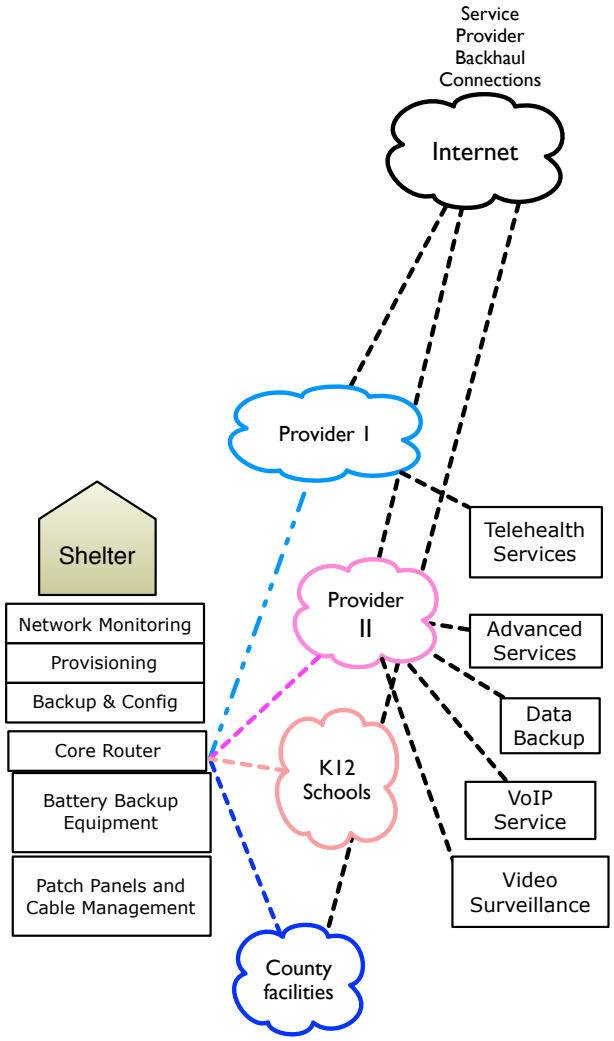
- Space for backhaul connections to other towers in the county.
- Space for local access radios to provide Internet access within 2-3 miles of the tower (or farther with good Line Of Sight).



Core Network and Service Providers

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

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



A colocation facility is a controlled environment (i.e. secure, heated, and air-conditioned) room with Internet access through wired and/or wireless systems. The colocation facility is a place where fiber, wireless, and copper-based network facilities meet. It is equipped to house high-end network equipment, servers, and other electronic gear. A variety of middle layer network components and services can be located within the co-lo including, for example, directory services, replicated content servers, routing services, and other elements needed to deliver new multimedia services to the home and small office from multiple, competing providers.

Characteristics of the colocation facility are:

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

Current Technology Options

In Meeker County, there is no one technology that is going to provide a "one size fits all" solution for homes, businesses and institutions. Over time, fiber connections will become more widely available, just as basic telephone and electric service became more widely available over a period of years in the early part of the twentieth century. This section provides an overview of current and future broadband technologies.

TELEPHONE/DSL

DSL (Digital Subscriber Loop) technology utilizes existing copper twisted pair telephone lines to provide broadband services. There are many variants of DSL, and the differences among them are primarily bandwidth and distance. Most DSL systems are limited to a maximum of 18,000 cable feet from a telephone switch or remote access module (DSLAM). Faster variants of DSL are limited to as little as a few thousand feet, making the service areas inconsistent from a subscriber perspective. A neighbor a few houses away from a home with DSL service may be told that no DSL service is available (because of the cable limitations). Current low cost DSL residential service offerings are priced competitively compared to cable modem service, but also tend to be much slower.

Because of the requirement to deploy DSL equipment close to subscribers, many areas of the country with older telephone copper-based local cable are at a distinct disadvantage for DSL. It is not uncommon in rural areas to have cable runs of many miles (from a telephone switch), making DSL impractical without substantial equipment upgrades. Even if a home or business is located within the prescribed distance to DSL equipment, older copper twisted pair cable may not be capable of handling the DSL signal properly. In some cases, speed of the service is degraded, and in other cases, DSL may not work at all.

The primary problem with DSL is the lack of capacity over the long term. In an optimum DSL situation, with high quality cable plant and subscribers close to DSL switches, the fastest DSL is limited to 15 to 20 megabits under these optimum conditions and short distances from network nodes or switches. Most homes will never be able to receive DSL services at those speeds because of sub-optimal service conditions, including old physical plant and distance. DSL cannot provide the capacity needed by businesses and residents in the near future.

From an local network investment standpoint DSL is a mediocre option at best given several limitations. In addition to the limitations above, DSL supports a single service (typically Internet) and a single Service Provider. While additional services may be provided "over-the-top" of the DSL Internet connection, those services are limited by the capacity of the primary service.

DSL CHARACTERISTICS	
Bandwidth DSL is particularly plagued by line noise and distance limitations. As such the bandwidth in this table should be viewed as an "up to" limit and delivered bandwidth may be less.	DSL - 1.544Mbps (ITU=T G991.1) ADSL - 8 Mbps/640 Kbps (ANSIT1.413) ADSL2 - 12 Mbps/768 kbps (ITU-T G992.3) ADSL2+ - 24 Mbps/768 kbps (ITU-T G.992.5) VDSL - 52 Mbps/2.3 Mbps (ITU-T G993.1) VDSL2 - max sum in both directions 200 Mbps @ 1600' G.Fast - max sum in both directions 1 Gbps @ 328'
Line sharing	Individual subscribers do not share their upload/download speeds, but each cabinet will only support up to a maximum of what it is provisioned for. This is particularly important in rural networks where the cabinet are often provisioned with synchronous telecommunications services which are severely limited in bandwidth.
Latency	Latency is not an issue in DSL last mile connections, but due to bandwidth limitations at the cabinet, may be a factor due to queueing and competition for bandwidth at the middle mile. DSL with a fiber optic middle mile connection would reduce latency problems.
Symmetric/Asymmetric	DSL - Symmetric ADSL - Asymmetric ADSL+ - Highly Asymmetric ADSL2+ - Highly Asymmetric VDSL - variable and provisioned according to provider VDSL2 - variable and provisioned according to provider G.Fast - variable and provisioned according to provider
Effective Distance Distance in this table is cable distance and subject to the age and quality of the plant. The distances listed are for the bandwidth listed in the first row of this table.	DSL - 12,000' (2.3 miles) ADSL - 9000' (1.7 miles) ADSL2 - 5000' (0.95 miles) ADSL2+ - 2000' (0.38 miles) VDSL - 1600' (0.30 miles) VDSL2 - 1600' (0.30 miles) G.Fast - 328' (0.06 miles)
Services Support	Single Service, Single Provider
Typical per subscriber build cost	$655 - $1100 depending on site utilization

Cable Systems

Cable systems that provide broadband in most U.S. communities use what is called HFC systems, or Hybrid Fiber Coaxial systems. Typically, fiber delivers television and broadband signals to equipment located in or near a neighborhood, and copper coaxial cable is used to connect the subscriber's home or business with the equipment fed by fiber. Cable systems have never been widely deployed outside community boundaries (residential neighborhoods and business districts) because of the high cost of placing equipment near subscribers. In this regard, cable systems have some of the same limitations as DSL, and rural communities are at a disadvantage because of the lower density of customers.

Cable systems also cannot provide the future capacity that will be required by homes and businesses in the near future. Some cable companies have begun to announce pilot projects offering Internet access at speeds "up to 50 megabits." While this is an improvement over current offerings advertised typically at bandwidth "up to 6 megabits," this bandwidth is always shared among all users on a node. It is not unusual to have between 100 and 500 users (typically residential homes) on a single node. The advertised bandwidth (e.g. "up to 6 megabits") is shared among all users on a node, meaning that the usable per household bandwidth during peak use times like early evening is much lower.

Cable modem service typically has asymmetric bandwidth, meaning that the advertised bandwidth ("up to 6 megabits," or "up to 50 megabits") is only available on the downstream side coming into a home. The upstream bandwidth available to users to send data is often 1/10th of the downstream capacity. This makes most cable modem systems unsatisfactory for many kinds of work from home services and applications that require more balanced upstream and downstream bandwidth, like videoconferencing, which works best if the bandwidth is symmetric (the same capacity in both directions). This issue of symmetric bandwidth will become increasingly important as commuting patterns change and more people want to work from home part or full time.

CABLE MODEM SYSTEM CHARACTERISTICS	
Bandwidth	DOCSIS 1 - 42 Mbps/10 Mbps (shared), DOCSIS 2 - 42 Mbps/30 Mbps (shared) DOCSIS 3 - 171 Mbps/122 Mbps (shared, 4 bonded channels)
Line sharing	All subscribers on a given CMTS (Cable Modem Termination System) channel share both upstream and downstream capabilities.
Latency	Latency is not typically an issue with DOCSIS
Symmetric/ Asymmetric	All versions of DOCSIS are highly asymmetric
Effective Distance	The effective distance of DOCSIS can be up to 100 miles from the CMTS to the farthest cable modem.
Services Support	Single Service, Single Provider
Typical per subscriber build cost	$2500 to $3500

Fiber Systems

Fiber is a future proof investment. The upper limit of fiber capacity has not yet been found, and off the shelf hardware can handle thousands of times the needs of an average home or business well into the future. Fiber has a life expectancy of thirty to forty years, and may last much longer than that; every year, the number goes up as fiber systems installed in the 1970s continue to perform adequately. A single fiber can carry all the traffic and services needed by a home or business, including voice telephone service, television programming, live videoconferencing, and HD television.

Fiber's primary drawback is its apparent high cost compared to other systems. Fiber is often unfairly compared to wireless, with the misleading conclusion that wireless is much cheaper. Regrettably, most fiber versus wireless studies compare the start up costs for wireless to the thirty year life cycle costs of fiber infrastructure. During a thirty year period, fiber is installed just once, while wireless systems will have to be replaced entirely several times. Properly costed over a thirty year period, fiber is actually less expensive than wireless, with many times the capacity.

Metro Ethernet is a point-to-point service provided over fiber. Metro Ethernet networks can deliver service as far as 50 miles from network element locations and provide speeds up to 10 Gigabits per second (10GB Metro Ethernet circuits are now commonly available from some providers).

Carrier Ethernet is the term used to describe Active or Metro Ethernet deployed to the premises. Carrier Ethernet is available in 100 Mbps and 1 Gbps utilizing a pair or a single fiber strand and speeds of 10 Gbps over a pair of fiber optic strands. Carrier Ethernet can be deployed at distances of up to 50 miles (80km) from the central office.

A Passive Optical Network, or PON, is a fiber optic network based upon a splitter technology. A single PON port can support up to 64 customers utilizing either daisy chained splitters or a central splitter location. For service providers PON is cost effective as it allows the service providers to create "fiber light" networks and fewer network elements. However, PON has many drawbacks including bandwidth limitations due to the shared nature of the feeder fibers as all customers fed from a splitter share bandwidth over a single fiber (or single pair in some networks). A major drawback of PON, if field splitters are used, is the upgradeability of the network which usually requires additional feeder fiber to be deployed which is costly as it is considered a "forklift upgrade."

CARRIER FIBER (ACTIVE) ETHERNET CHARACTERISTICS	
Bandwidth	1 Gbps standard
Line sharing	Each user has a dedicated 1Gbps between the premises and the core location.
Latency	Not latent
Symmetric/Asymmetric	Symmetric
Effective Distance	up to 50 miles (10km, 20km, 40km, and 80km optics available)
Services Support	Multiple services, multiple providers
Typical per subscriber build cost	$3250 - $3500

PON FIBER (PASSIVE) CHARACTERISTICS	
Bandwidth	2.4 Gbps/1.24 Gbps (shared between users on a port). A few 10Gig PON systems are now being deployed because the older PON systems are running out of bandwidth.
Line sharing	Each port is shared by a power of 2 premises (2, 4, 8, 16, 32, or 64) depending on how the network is configured.
Latency	Minimal latency.
Symmetric/Asymmetric	Asymmetric
Effective Distance	up to 25 miles (40km)
Services Support	Multiple services, multiple providers
Typical per subscriber build cost	$3250

We are now seeing even small and medium-sized businesses asking for fiber connections. Fiber is the only transmission system that will be able to deliver all the services businesses and residents will expect and demand in just a few years. Communities that choose to delay fiber infrastructure investments will be at a severe disadvantage in the next several years when trying to attract and retain businesses and workers.

In business areas of the county, fiber is an absolute requirement to retain existing businesses and to attract new ones. Many of subdivisions could have fiber within the neighborhood and wireless backhaul, and multiple services (e.g. video, Internet, voice, data backup) could be delivered within the neighborhood by fiber. In growth areas, retail and office space would become more valuable with high performance fiber availability.

Fixed Point Access Wireless

Fixed point wireless Internet access via private sector providers is already available in some areas of the county. This service introduces additional competition for Internet access customers, which can lower prices and create incentives to offer better customer service from the providers. Over time, most fixed point Internet users (five to seven years out) will want to migrate to fiber connections which will have the capacity to provide a much wider range of services, including HD TV, telemedicine, and tele-health, among other applications.

Fixed point wireless infrastructure investments (e.g. locations for towers, towers, fiber and duct backhaul connections) can be re-used over time to support mobile wireless services and long term public safety voice and data services.

The goal would be to identify existing tower sites that could be reached affordably with fiber. Fiber access to these towers will lower the cost of backhaul for local wireless broadband providers while simultaneously allowing them to increase bandwidth and overall performance.

Wireless broadband services will be important in rural parts of the county. And wireless is not going away; it will remain as an important component of a well-designed community broadband system--as a mobility solution. As we travel around the community, we want to be able to access the Web, check email, make phone calls, and do other sorts of things. Wireless services enable that, and in rural areas, wireless services are an important step up from dial-up.

WiMax and LTE capacities and distances are widely exaggerated. It is very common to see promises of "up to 80-100 megabits" of capacity and distances of "10 to 20 miles." With respect to bandwidth, that 100 megabits of capacity will be shared among all connected users, so if 100 households are trying to access the network via a single WiMax access point, the usable bandwidth may be more like 2-4 megabits per household or per user. Distances are limited by line of sight.

Both WiFi and WiMax signals will work over many miles, but only with narrow angle antennas and clear line of sight. While WiFi can easily reach ten miles or more with clear line of sight, and WiMax can reach twenty miles with clear line of sight, in practice these optimum distances are rarely achieved; it is more realistic to consider WiFi usable over 2-4 miles and WiMax over 4-8 miles. Tree cover is particularly problematic, and it is often necessary to remove tree limbs, an entire tree, or to relocate the antenna in order to get a good signal.

LTE and television "white space" systems are emerging standards that can provide connectivity at much longer distances (five to ten miles is possible under ideal circumstances) and the radio frequencies used are better able to penetrate at least some foliage. Bandwidth of several megabits are possible, and compare very favorably with copper-based systems like DSL. But even these systems will have a limited ability to handle TV programming, interactive videoconferencing, and other business class services.

FIXED POINT WIRELESS CHARACTERISTICS	
Bandwidth	5Mbps - 10Mbps on average for rural/residential service. Higher speeds available at higher cost.
Line sharing	In most Wireless ISP (WISP) architectures customers share a point to multi-point connection with an access point. Service can be affected when too many customers are on an access point.
Latency	Minimal latency issues
Symmetric/Asymmetric	Symmetric
Effective Distance	The effective range of an access point depends on the frequency chosen.
Services Support	Internet, VoIP, and streaming video can be supported by WISP architectures. A multi-provider environment can be configured on a WISP network, but is less commonly found compared to fiber networks.
Typical per subscriber build cost	$370 to $550, and costs could be much higher if a pole has to be installed ($2000 to $7000). High operating costs should be considered as a factor because of the high failure rate for wireless equipment.

Cellular Data Wireless

Wireless access to the Internet and other mobile services like cellular telephone providers is a long term need that will not be replaced by fiber access. In fact, over the next five to seven years, the most common use for wireless Internet access will be for mobility--casual business, personal, and government access away from the home or office.

Mobile wireless access to voice and data services is already widely available from multiple providers in most of the U.S. Nationwide, Verizon, Sprint, and AT&T have already begun an aggressive expansion and upgrade to LTE (the so-called 4G/5G networks). However, the bandwidth caps and bandwidth overage charges make cellular data services too expensive as a primary residential or small business connection.

Perhaps more alarming, some telephone companies, including Verizon and AT&T, are abandoning their copper line plant in many rural areas of the country, and are only offering cellular-based dial tone for home and small business use.

Cellular data plans, because of the bandwidth caps and overcharges that are included with typical plans, can be a poor solution for rural residents who may be trying to use it for business purposes, for K12 school assignments, and/or personal use. Households with children report that it is very difficult (and/or expensive) to keep within data caps.

CELLULAR DATA SERVICE CHARACTERISTICS	
Bandwidth	2Mbps-12Mbps and up, but actual bandwidth can vary widely.
Line sharing	In a mobile wireless broadband network the access point is in a point to multi-point configuration, meaning access is shared.
Latency	Latency is generally not an issue
Symmetric/Asymmetric	Symmetric
Effective Distance	The effective range of an access point depends on the frequency chosen.
Services Support	Adequate for many common residential and small business uses.
Typical per subscriber build cost	The equipment (satellite dish and receiver) is several hundred dollars, but the companies often offer specials that reduce or eliminate that cost. Equipment is often available at no cost if a multi-year contract is signed.

Satellite Data Service

Satellite service for many years was often characterized as "better than dial-up" and was an expensive alternative to DSL in rural areas, where DSL is often only $20-$30/month and the slow satellite service was often $70-$80/month. Early satellite data service was not only slow, but high latency (the time to send the signal back and forth between the ground and the satellite) made services like voice and video very difficult to use. In Meeker County,satellite data services can provide substantial improvements over DSL or dial up (at a higher cost).

In the past decade, there has been two changes that have made satellite service a better option in rural areas. The first is consolidation in the industry, with now just two companies, HughesNet and Viasat, the primary satellite Internet firms. Viasat has purchased both Exede and Wild Blue. The consolidation has enabled the companies to expand their customer base and improve service. The second change has been that both companies have begun to design and launch their own satellites that are designed specifically to support broadband and Internet services. This has led to reduced latency and much improved data rates. Some anecdotal reports from satellite users in Minnesota indicate that 20 Meg down, 3 Meg up is achieved consistently with some of the service packages priced at about $100/month.

The higher bandwidth rates support much improved Web access and video streaming, and some small businesses that don't need videoconference services like Skype should find this adequate for many of their needs.

SATELLITE DATA SERVICE CHARACTERISTICS	
Bandwidth	2 Mbps-20 Mbps and up, but actual bandwidth can vary widely.
Line sharing	Not a significant factor affecting performance.
Latency	High latency limits the use of these services for real time voice and videoconferencing.
Symmetric/Asymmetric	Highly asymmetric, with upload speeds often 1/10th of download speeds.
Effective Distance	Available anywhere in the U.S.
Services Support	Internet, VoIP, and streaming video can be supported but service may degrade at peak times.
Typical per subscriber build cost	$80 and up, depending on data plan, bandwidth caps and overage charges.

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 early 2018, is still largely marketing hype. The official standard for 5G radio technologies is planned for release later in 2018, although some companies, like Verizon, have begun trials of the equipment with a few customers.

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

- The fact that 5G can deliver much higher bandwidth means that 5G cell sites will require fiber connections. This is going to effectively limit 5G deployments to denser urban environments where both customers and fiber are plentiful.
- There is no free lunch in the physics of radio frequencies. The higher bandwidth of 5G means that cell sites need to be closer together because the 5G frequencies do not travel as far as existing 4G/LTE frequencies currently being used by the cellular industry. Most users will have to be within
- Some experts estimate that more than a million miles of new fiber will have to be deployed just to support the 25 largest metro areas in the U.S. 5G will not appear overnight.
- As many as 60 cell sites per square mile may be needed to make 5G widely available in a given area. In Meeker County's 645 square miles, as many as 25,000 cell sites would be needed to provide ubiquitous coverage, although with careful analysis, that might be reduced to around 10,000 cell sites—all of them needing fiber backhaul.
- For rural areas, the cost of 5G service may be one of the most significant obstacles. The cellular carriers see the increased customer bandwidth use possible on 5G networks as a major revenue opportunity. While they will increase the "standard" bandwidth package for monthly service, bandwidth caps and rate limiting is likely to keep 5G cellular customers bills high.

Technology Options for Meeker County

Options for Service Provision

The service level targets of 100/20 by 2026 and scalable to 100/100 are only going to be achievable in rural areas with fiber (see the discussion on why 5G is not likely to deliver this kind of service in rural areas). But the goal of Gigabit bandwidth to most homes and businesses is easily achievable in seven to eight years if an appropriate and affordable funding strategy is in place. These targets have likely been set with significant input from incumbent telephone and cable providers burdened by outdated and costly copper cable plant. Off the shelf residential fiber network equipment uses Gigabit as the standard, and there is no reason not to set Gigabit fiber service as the 2026 target for the county.

Evaluating Where and How to Invest

If a community-owned project moves forward, investments will be based on just two technologies: fixed point broadband wireless and fiber cable.

The interesting thing about comparing fiber and wireless infrastructure is that there is usually a very misleading comparison between the cost of fiber and the cost of wireless. When comparisons are discussed, the first year cost of wireless is usually compared with the forty year cost of fiber.

When a properly designed fiber network is placed in the ground or on poles, very conservatively, a forty year asset is created. Underground fiber requires virtually no maintenance aside from emergency repairs—when the fiber has been cut by improper digging. Aerial fiber is somewhat more vulnerable to storm and wind damage, but is still a very sold long term investment. Fiber network equipment typically is refreshed on a ten year schedule.

Wireless towers has a long life, the wireless radio equipment, subject to wind, rain, ice, snow, and heat, is typically replaced every five years.

When a fair total life cycle cost of wireless and fiber networks is made, extending over thirty years or more, fiber can be much less expensive.

Estimating the cost of connecting customers via wireless or fiber is complex, because a wide variety of factors affects the build costs, including:

Area served—prices go down as more prospective customers can receive service. In fiber deployments, customers per road mile can have a dramatic effect on per use costs.

Geology—Cost of underground fiber deployment will vary widely based on underground conditions like percentage of rock in the right of way.

Pole access—Aerial fiber can be much less expensive to deploy, but who owns the poles, the pole conditions (how many poles must be replaced), make ready costs (do existing cables on the poles have to be moved?), and annual attachment fees all affect the cost of aerial fiber.

Terrain—deployment of wireless and the number of towers needed can vary widely based on hills and mountains in the service area. Low rolling terrain can be more difficult in some cases than mountainous terrain, because in an area with mountains, towers on mountain tops may be able to provide access to more residents.

Fixed point wireless estimated build cost: $370 to $550 per user

Gigabit fiber estimated build cost: $2700 to $3500 per user

The most important thing to keep in mind is discussed in the first section of the Technology Analysis chapter: both fiber and wireless can work together to lower costs. Network designs should be developed by a firm experienced in developing low cost hybrid designs that make the best use of both technologies to keep the project affordable.

Partnership Options

Because virtually any modern broadband network (and most older telecom networks) use public right of way for a large portion of network distribution, ALL business models are "public/private partnerships." The notion of the public/private partnership is not a distinct business model, but rather exists along a continuum, with minimal public involvement on one end (i.e. only use of public right of way) to full public ownership on the other end.

Private Coop

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

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

Service Providers

In the county, service providers will be part of the solution. No matter what investments the County chooses to make, service providers will have to use the new infrastructure to make the local government investments successful. While in many respects telecom infrastructure investments share many similarities with other public utilities (e.g. roads, water, sewer) there is one fundamental difference. Other public utilities like water and sewer have a captive audience and the utility is able to operate as a monopoly–meaning the customer base can be taken for granted. Early discussions with service providers have been positive, with at least several providers expressing a readiness to offer services if the county makes new infrastructure (like tower access for WISPs) available at fair prices.

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.

Projects that are not successful in attracting service providers will fail. Affordable lease rates for tower space and/or fiber connections will attract service providers. Other open access projects

(Danville, The Wired Road, FastRoads, Utopia) have not had any difficulty getting service providers to use the infrastructure.

Electric Utilities/coops

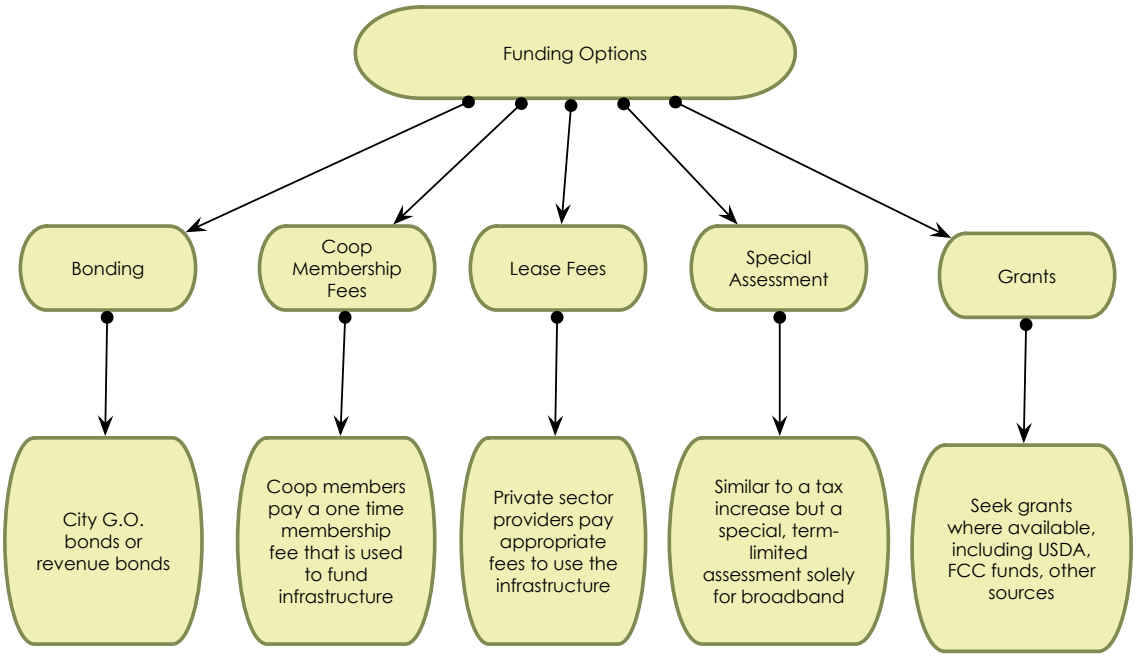
Electric utilities, especially coop electric utilities, are natural partners in any muni/community broadband venture. The fiber infrastructure can easily support both automated meter reading (AMR) and Advanced Metering Infrastructure (AMI). The latter application is becoming more common, and is being used in both industrial and residential settings to control the power use of large appliances and industrial equipment, typically during peak use hours when the utility may have to buy power at higher spot prices. There are other applications that can be valuable to the electric utility. 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.

Public Safety

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.

Financing Options

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



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

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

Somewhat paradoxically, the cost of such a community digital road system is lower when there is a day one commitment to build to any residence or business that requests service. This

maximizes the potential marketplace of buyers and attracts more sellers to offer services because of the larger potential market. This is so because:

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

BONDING

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

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

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

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

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

Coop Membership Fees

Coop members pay a one time membership fee to join the coop. For fiber 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. 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.

Lease Fees

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

Special Assessment/Service District

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

Connection Fees

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

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

One Time Connection Fees – A one time connection fee can be assessed to property owners (e.g. residents and businesses) when the fiber drop from the street to the premise is installed. This is similar to the kinds of connection fees that are typically charged when a property is connected to a municipal water or sewer system. The fee is used to offset the cost of the fiber drop and the Customer Premise Equipment (CPE) needed to provide the operational access to

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

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

Grants

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

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.

Risk Factors, Legal, and Regulatory Issues

Market Size

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

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

Take Rate

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

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

Funding

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

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

Service Providers

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

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

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

Technology

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

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

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

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

Legal and Regulatory Issues

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

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

Broadband Strategies

Meeker County has a variety of options and strategies available to improve broadband availability.

The following pages provide a set of strategies: some can be applied to meet very specific needs in individual areas. Other strategies can be applied more broadly. These include:

Form a Coop— Meeker County residents and businesses could form a broadband coop to pool funds and to take control of the economic future of the county.

Ordinance and Planning Changes — Ordinance and planning changes can make it easier and less expensive for private sector infrastructure investments. Ordinance changes do not commit the County to long term expenditures but can accelerate private investment.

Increased Wood Utility Pole Use — In rural areas of the county, many rural residents may be able to access improved wireless broadband via a properly sited wood utility pole or inexpensive metal tower to "see" a broadband tower with wireless service. Provide incentives for increased use of these utility poles.

Meet-me Box and Fiber Drop Strategy — Meet-me boxes and inexpensive fiber drops to nearby homes or business/retail locations could attract improved wireless services from service providers and/or promote increased competition. Because there are a sizable portion of residents located in rural subdivisions, this could be extremely effective if coupled with a Service District funding strategy.

Demand Aggregation — A simple ongoing Web-based survey managed by the County that collects customer demand information (including location) could be distributed periodically to service providers.

Referendum — It may be useful to have a public vote on allocating funds for broadband improvements in the county.

Nano-cell Cellular Strategy — In some parts of the County where broadband service to the home is adequate but cellular service is poor, wider use of nano-cell equipment can provide improved cellular phone service in homes and rural businesses. If rural subdivisions get fiber to the home broadband service, using the nano-cell boxes could reduce both the complaints about poor cellular service as well as reduce the number of new cell towers needed.

Form a Coop

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

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

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

User-Benefits Principle -- Some purposes of a coop are to help members get services that might otherwise not be available, to get access to markets, or for other "mutually beneficial" reasons.

User-Owner Principle -- The users of the cooperative own it.

User-Control Principle -- The owners of the coop (i.e. members) control the coop through voting (annual meetings, etc), and indirectly by electing a board of directors to manage the enterprise. Large users who make high volume purchases of goods or services may receive additional votes.

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

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

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

government entities that are already trading services like local public safety dispatch, a super local coop may be the most appropriate designation.

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

Cooperatives offer one or more of three kinds of services:

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

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

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

In summary:

- Coops are member (subscriber) owned, meaning they are strongly vested in the community. Any effort by the coop board to dispose of assets or to sell the coop would have to be approved by a majority vote of the members.
- Members play an active long term role in governance by nominating and electing board members. So members have a straightforward way of influencing decision-making by the board.
- Coops generally operate on a cost-plus basis. Income that exceeds some preset level is returned to members periodically as a distribution of funds.

Broadband coop bylaws must be carefully written, especially if there is an interest in several classes of membership. Each class of membership can be charged a different membership fee,

and this can be a valuable source of start up funds, but membership categories are difficult to change later.

Coops are largely immune to challenges by incumbent telecom providers due to the long history of existing coops and because of special legislation passed by Congress.

Coops can tap USDA funds, but the application process can be time-consuming and expensive. But the funds available are substantial and may be worth pursuing.

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.

Recommendation

Rural businesses and residents in the county 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 County and other interested parties and stakeholders could provide an ideal long term solution to broadband in Meeker County.

Ordinance and Planning Changes

A variety of strategies can be implemented at the County government level that do not require significant capital expenditures but can cumulatively have a positive long term impact.

Conduit/fiber overlay plan

Identifying where it is desirable to have telecom infrastructure and maintaining that data in the County GIS systems is an important first step.

Integrate telecom into planning and permitting

New construction, road and sidewalk improvements, and other infrastructure projects should include a review of the fiber overlay plan to assess the value of adding, at a minimum, conduit and handholes. Private developers should be encouraged early in the planning process to add conduit and handholes to both commercial and residential projects.

Map private sector assets

Any private sector fiber cable construction work in the County should be added to the County GIS system using as-built drawings submitted as part of the permitting and construction process.

Open ditch policy

Look for joint trenching opportunities. As noted above, a conduit and fiber overlay plan will help identify where limited capital funds for telecom infrastructure can be put to best use. Occasionally, private sector infrastructure projects will agree to participate in a joint (shared) trench opportunity.

Minimize tower permitting costs

Tower ordinances that require unusually high engineering and radio interference studies can discourage private sector investment. Tower ordinances and permitting fees should find a balance between the need to protect the public and minimizing the cost of erecting new towers.

Increased Wood Utility Pole Use

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).

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

Meet-Me Box and Fiber Drop Strategy

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

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

Ownership and Governance

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

Cost Discussion

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

Funding Options

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

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

Demand Aggregation

A very brief survey that collects address information and bandwidth needs can collect valuable demand data that can be passed on to ISPs and/or help direct infrastructure investments. For wireline services, neighborhoods (often as few as a handful of homes) can aggregate their demand to attract improved service from existing providers and/or provide data on take rates for a fiber initiative—at the neighborhood, sub-division, or community level.

This approach is becoming more common, and has been used by both community fiber projects like Utopia in Utah and commercial fiber to the home projects like Google Fiber. Rather than building fiber throughout a community without regard to where demand is located, demand aggregation first tests and identifies where customer take rates for services meet financial projections.

For the County, this approach reduces financial risk by only making investments in those neighborhoods and rural areas where residents have signed binding agreements to buy service at an acceptable take rate (which would be on the order of 50% to 60% of households at a minimum).

The process would be conducted in two steps:

- Step One: The County announces a demand aggregation study (a very short online survey) that asks residents if the County builds fiber or a wireless tower in an area, would they buy Internet service? No binding commitment is requested at this point, just a yes or no response. The survey has a menu of neighborhoods and residents identify the neighborhood in which they live. Once the study is complete, the County would examine which neighborhoods or rural areas had an acceptable response rate for the non-binding "yes" answer.
- Step Two: In the areas where an acceptable response rate was received (which would on the order of 60% to 70% affirmative, the County would then solicit binding agreements to buy service, with a County commitment to install a tower or fiber to the home in that area if enough binding agreements are collected.

In this manner, the County determines if there will be sufficient revenue to pay for operations and any debt service prior to spending any funds on construction. This approach assumes that a detailed business plan that includes both construction and operations costs has been developed to guide the take rate levels.

Referendum

It may be useful to have a public vote on allocating funds for broadband improvements in the county. Properly presented to the public, it could be an excellent opportunity to educate the public on the cost of trying to balance citizen requests to take action with the cost implementing that action. This approach could have two very different but positive outcomes.

- If the voters were asked to support a tax increase or special assessment to support improved broadband in the County and they voted "no," it could provide elected officials and County staff clear direction on next steps.
- The special assessment could be allocated by creating service districts. By using the demand aggregation strategy to identify areas where homeowners and businesses are willing to pay an extra fee for improved broadband, the assessment would only be levied based on demand.
- If the voters agreed to support a tax increase or special assessment, then the County would have a mandate to fund solutions.

Cost Discussion

Staff time would be needed to develop the cost proposition that would be placed on the ballot. Additional effort would be required to provide an appropriate public awareness campaign to educate the public on the meaning and purpose of the referendum.

Funding Options

No special funding required.

Operation and Management Considerations

None.

Recommendation and Next Steps

Discussion by County staff and Commissioners.

Nano-cell Cellular Strategy

A common complaint in the county is the poor cell service in some areas. In some parts of Meeker, there may be adequate broadband service via DSL or cable modem Internet, but poor cellular phone/data service. This problem can be addressed by promoting the wider use of "nano-cell" devices. These small pieces of equipment are connected to the DSL modem and provide improved cell service in the home or business. The working distance of these devices is limited, and service generally drops off once you leave the house itself (it may work for some short distance in the yard).

These devices work very well and do not require a large amount of bandwidth. They would work with both the DSL and wireless broadband services available in the county.

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

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

Cost Discussion

This strategy does not require any direct funding from the County, but if an coop or nonprofit is formed, that entity could develop play role educating residents and businesses about this option. Prior to formal development of an independent entity, the County could post information on its Web site, 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

This should be developed as a short term strategy whether or not an Coop is formed.

Moving the Effort Forward

A TIMELINE FOR SUCCESS

Next Three Months

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

- Continuing regular meetings with the existing broadband task force.
- If desirable, meet with local media to discuss next steps.
- Meeting with new partners and inviting them to join the effort.
- Discuss and identify funding sources.
- Discuss and choose the desired organizational structure that is regarded as a best fit for Meeker County's needs.
- Moving ahead with formation of the governance entity, which will require legal counsel.

Months Four to Six

With an organizational entity in place or in the formation process, a smaller group of leaders will be needed as the first board of directors. Other tasks and activities include:

- Developing a budget for the chosen "first phase" project and for the organization.
- Identification of early funding sources and solicitation of funds (e.g. writing grant proposals, state funding, soliciting County financial support, private contributions, etc.).
- Identify a source of funds to support the pre-construction Implementation Planning (see more on this later in this section).
- For new wireless towers, identify available County and private properties that fit the desired service areas.
- Solicit input from service providers on use of new towers and/or dark fiber.

Months Seven to Twelve

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

- For new towers, reach agreement with property owners, begin any required permitting process prior to construction.

- For fiber projects, completed pre-construction Implementation Planning, which includes surveying fiber routes, update route designs, and prepare to bid out construction.
- Assuming that funds have been secured, construction of towers and/or fiber may begin as early as month nine or ten.
- If construction has begun, meet with service providers to develop binding agreements to use the new infrastructure to sell services to their customers.
- Maintenance agreements for the repair and maintenance of the dark fiber routes will need to be developed. Tower maintenance will be light, but a small contract(s) may be needed for routine tasks like mowing around the tower site and generator maintenance (periodic tests, fuel replenishment).

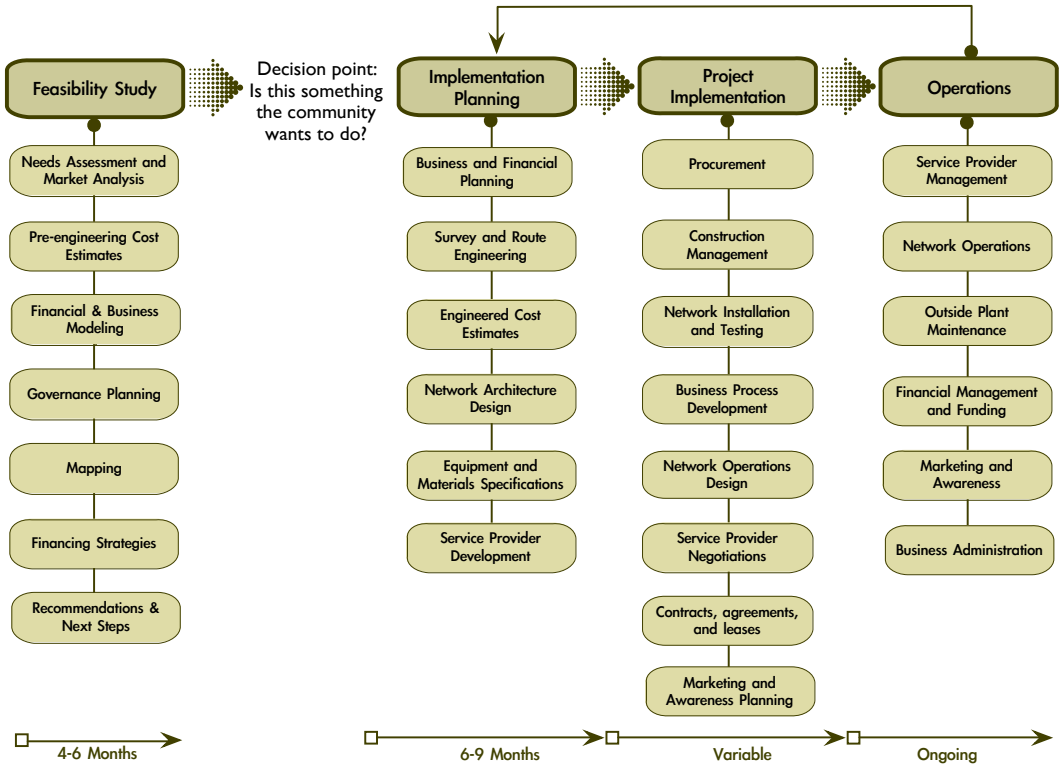
Year Two

In the early part of year two, construction would be completed and service providers would begin installing equipment and offering improved services. Revenue would be collected from providers using the towers and/or the dark fiber. Financial management of revenue and expenses will begin.

Implementation Planning

For the area, the development of a successful community-owned wholesale network will require attention in several areas including the technical (network equipment selection), engineering and construction, and business and financial planning. It is important to note that the business and financial planning are critical elements that will in large part determine the long term success of the effort. This section provides an overview of the key task areas and activities.

The illustration below shows the sequence of key phases and activities in the course of a network project. On the pages following this diagram is more detailed information about the individual tasks and activities that will lead to successful completion of a fully operational network, including the business processes required.



A successful project requires a plan that ensures the right resources are available at the appropriate times during the various phases of development. Some resources must be identified and procured during the planning phase, some during the implementation and construction phases, and some during the operations phase.

- **Financial Planning** – Financial planning includes the development of short term and long term budget estimates and pro-formas. These materials form the basis of developing a funding plan, as well as providing a solid base for ongoing evaluation of the success of the enterprise.
- **Business Model** – The business model selected determines the kind and type of revenue that will be generated by the project, and also affects the kind and type of expenses that are incurred. For community-owned infrastructure, there are two basic model. A "retail" network has business and/or residential customers buying services directly from the local government, which creates direct competition with local private sector providers. The alternative is the "wholesale" model, in which the community-owned infrastructure is leased out to private sector providers on a wholesale basis--the local government sells no retail services and does not compete with the private sector.
- **Legal Counsel** – Whether the retail or wholesale business model is chosen, there is a short term and long term need for legal counsel familiar with telecom and broadband business agreements and contracts. Well written contracts with service providers protect the network and create a fair and equitable "level playing field" for competitive providers.
- **Engineering** – Whether fiber cable is hung on utility poles or placed underground in conduit, prior to construction, the routes must be surveyed and engineered drawings must be

developed to meet DOT (Dept. of Transportation) requirements and to provide contractors with the information needed to construct the network to industry and state technical requirements.

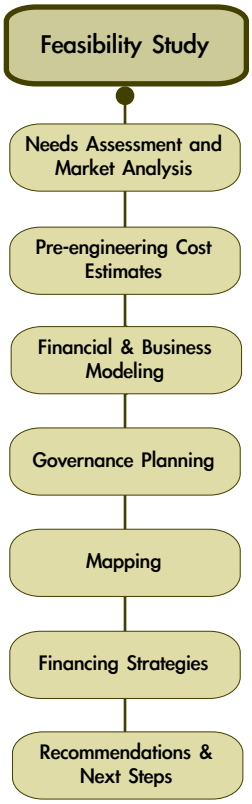
- **Network Design** – The logical design of the network must be matched to the business model, as the architecture of the network may vary according to a retail or wholesale model. The network design must also meet the requirements of large and small businesses, and for large businesses with extensive broadband and data needs, the network must be capable of meeting both current needs and future growth.
- **Equipment** – Once a network design is complete, an evaluation of equipment vendors must take place, ideally via a bidding process to ensure that the selected equipment will meet all of the business and technical requirements of the network, at the best possible price. A Total Cost of Ownership (TCO) evaluation should be completed to ensure that the right initial price is balanced with the longer term costs of extended warranties and technical support. The least expensive purchase price for equipment may be more expensive over time than equipment from a vendor with a higher initial equipment cost but lower support and warranty fees.
- **Build Out** – While fiber construction is generally much less expensive than other typical community projects like water and sewer development, care must be taken to select contractors with the appropriate experience installing fiber in both aerial and underground designs. The cost of construction can vary widely, so the development of very specific bid documents that include the right engineering information as well as a carefully structured proposal response on pricing is needed to ensure the community obtains the right contractor at the right price.

Feasibility/Early Phase Planning

This report represents the activities of the early phase planning. This report represents the early phase planning identified in this section. The work includes:

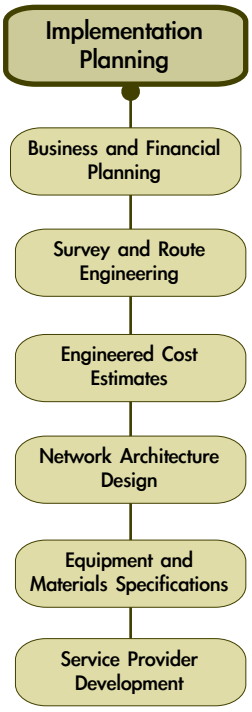
- **Needs Assessment and Market Analysis** – An evaluation of current assets and projections of future needs, based on local business and economic conditions.
- **Pre-engineering Cost Estimates** – Pre-engineering cost estimates of potential network projects provide a baseline for understanding the costs of getting started, provide necessary inputs to the financial pro forma development, and also inform funding strategies. Cost estimates have been included in earlier sections of this report.
- **Financial and Business Modeling** – An understanding of the revenue potential and operational costs is needed to make a decision to move forward.
- **Governance Planning** — Before making a commitment to move to implementation planning, it is necessary to have a basic understanding of the key operations and management tasks related to operating the enterprise.
- **Mapping** – Mapping of current assets, areas and business locations of needs, economic growth areas, and key customers and stakeholders informs the development of the network architecture and the financial planning.

- **Funding Strategies** – Before moving to the next steps, it is vital to understand where the planning, engineering, and initial construction funds will come from. There are many options available.
- **Next Steps** – A list of key activities and milestones needed to move the project ahead.



Implementation Planning Phase

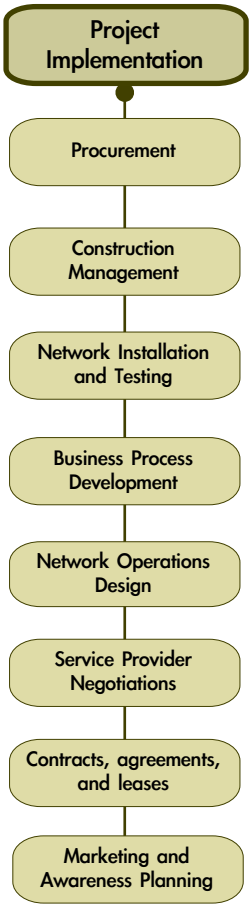
This phase produces the equipment and construction specifications needed to bid out the work of constructing the network. If theTown makes the decision to move forward, many of these activities would become part of the "next steps."



- **Business and Financial Planning** – A more detailed business and financial plan is developed. This includes planning how the business front office and back office will be run.
- **Survey and Route Engineering** – An on the ground survey is needed to complete a final route design. This work is performed by an engineering firm that also has the responsibility to produce the engineered design and obtain required permitting. The field survey confirms that the final route can be built to the necessary standards and regulations.
- **Engineered Cost Estimates** – If the engineering firm will not perform the build, the full drawing set is attached to the construction bid documents and becomes the basis for the awarded construction contract.
- **Network Architecture Design** (Detailed) – Final analysis of vendor equipment is performed and selection is made.
- **Equipment and Materials Specifications** – The Engineering firm also completes a detailed list of all equipment required for the construction.
- **Service Provider Development** – In an open access network, service providers have to be recruited and formally signed to a contract to become a provider on the network. Providers usually need "coaching" because they are typically unfamiliar with open access networks and need help understanding the unique business opportunities they represent for private sector companies.

Construction Phase

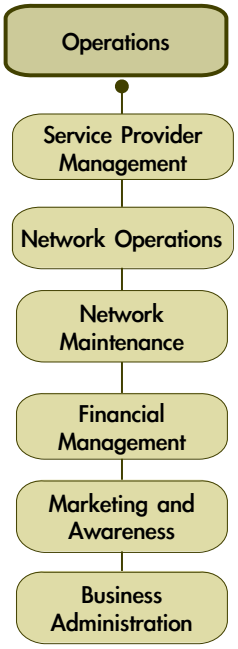
The documents produced in the Implementation Phase are used to bid out the construction work and to procure the network equipment needed to produce an operational network.



- **Procurement** – At the beginning of the construction phase the work will be bid out to qualified contractors.
- **Construction Management** – The construction work is bid out and an award is made to a qualified contractor with the best price. It is common to negotiate the final cost of this work once a firm has been selected.
- **Network Installation** – Network materials are ordered from a vendor that meets the technical specifications. The dark fiber approach does not have any powered equipment other than a generator for the dark fiber cabinet.
- **Business Process Development** – During the construction phase, business and operational decisions must be made to produce a set of business processes that will guide the day to day operations of the network.
- **Service Provider Negotiations** – Negotiations with qualified service providers continues.
- **Contracts, Agreements, and Leases** – The construction phase will generate the need for a variety of legal documents. Some will be related directly to the construction (e.g. an easement agreement to have conduit cross property)
- **Marketing and Public Awareness** – As the network is constructed, a modest but ongoing public awareness and publicity effort is required to ensure that business customers, schools, local government agencies and other potential users of the network are aware of the project and the possibility of reducing costs and obtaining more and better services.

Operations Phase

Once the network is completed, service providers are connected first and then their customers receive connections. At that point, the enterprise becomes operational and a variety of ongoing tasks and activities begin to take place.



- **Service Provider Management** – Service providers sell directly to their own customers. Once they have obtained a new customer that is passed by distribution fiber, they contact the network to get either a physical fiber connection completed (e.g. from the curb to the building) and/or a logical connection across the network to deliver the service requested by the customer (e.g. Internet, phone, data backup, etc.).
- **Network Operations** – In the dark fiber model recommended for the region, network operations will be very limited and there would be limited day to day management responsibilities. Some monitoring of the dark fiber would be required, but this could be outsourced economically, and the main responsibility would be to coordinate emergency repairs if there is a fiber break of some kind (e.g. errant backhoe, etc.).
- **Network Maintenance** – While routine maintenance (e.g. replacement of worn out equipment) may be limited in the first year or two, non-routine/emergency maintenance support must be in place as soon as the network has customers. Fiber is occasionally damaged (e.g. tree limb falling on aerial fiber, backhoe damaging buried fiber), and a qualified firm must be available to back repairs within two to four hours. This service is usually outsourced to a qualified private sector company.
- **Business Administration and Financial Oversight** – An dark fiber network only has a small number of customers, which are the connected service providers. Prudent and careful financial management is needed for accounts receivables and accounts payables, along with other normal bookkeeping activities--chart of accounts maintenance, bank deposits, check writing, and other tasks.
- **Marketing and Awareness** – While service providers will be responsible for their own marketing and sales efforts, an ongoing modest awareness/marketing campaign is required to ensure that customer take rate targets are met.

Appendix A: Glossary

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

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.

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.

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.

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.

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

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.

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.

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

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.

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.

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, which are also called FOSCs, or Fiber Optic 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.

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.

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