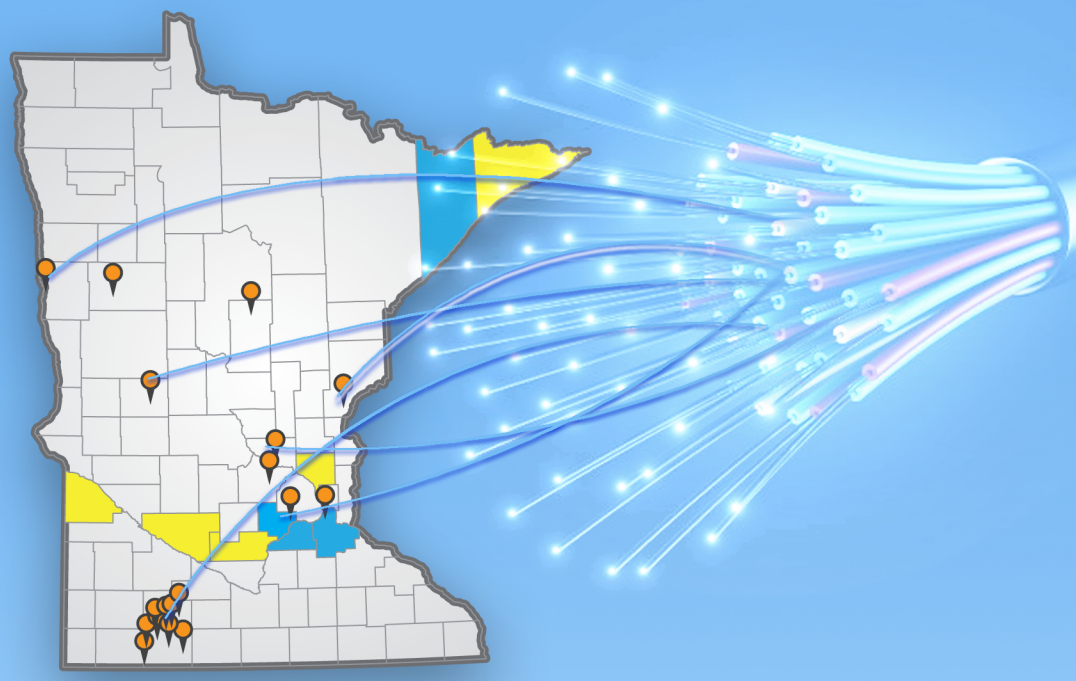

All Hands on Deck

Minnesota Local Government Models for Expanding Fiber Internet Access

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September 2014

40th Anniversary
ILSR

Acknowledgements

This report, as is everything from our Community Broadband Networks initiative, was a team effort from the Institute for Local Self-Reliance. Many thanks to our colleagues, particularly Rebecca Toews, Tom Anderson, John Farrell, Olivia LaVecchia, and David Morris.

This report was created with support from Blandin Foundation, Winthrop Economic Development Authority, Open Society Foundations, Ford Foundation, and the Media Democracy Fund.

Several people went above and beyond to make this report complete. Among them: David Asp, Merton Auger, Kevin Beyer, Joe Buttweiler, Mark Erickson, Pamela Lehmann, Danna Mackenzie, David Milavetz, Kay Roth, and Chris Swanson. Erick Lampland provided specialized research for this project as well.

Thank You

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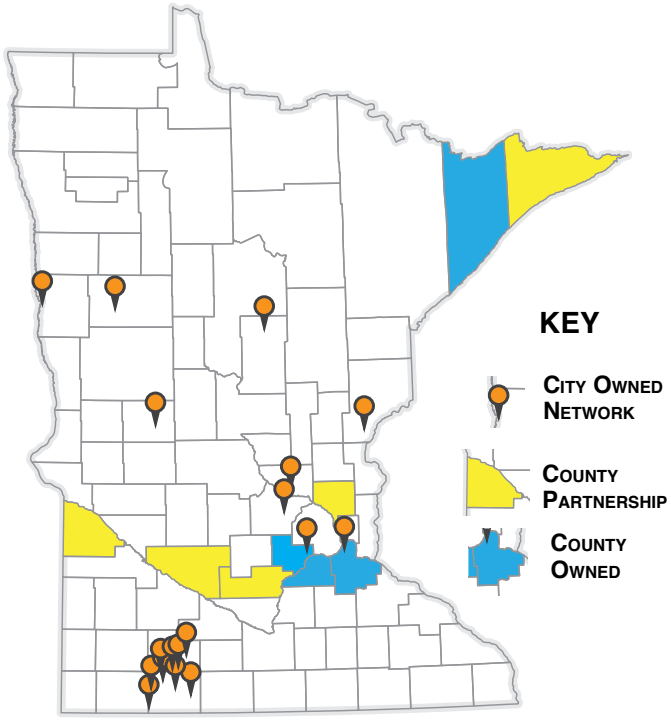
Executive Summary

In 2010 the Minnesota legislature established speed and access goals for broadband. No later than 2015 every residence and business should have access to download speeds of 10-20 Mbps and upload speeds of 5-10 Mbps. Minnesota is not on track to meet those goals. Meanwhile the minimum standards for broadband access in a modern economy have increased considerably. Federal Communications Commission Chairman Tom Wheeler maintains that a 25 Mbps Internet connection is "table stakes in 21st century communications."

Metro areas like Chattanooga, Kansas City, Provo, and dozens of communities with municipal fiber networks already have citywide gigabit (1000 Mbps) Internet access.

Internet access varies significantly across the state. The metro region has the least variation. Most households have access to cable options.

Local Governments Expanding Broadband



Some also have access to DSL connections. These meet the modest state goals but business access to affordable, high capacity fiber networks is quite limited in both urban and rural regions.

Though Comcast has ensured most of the metro region has access to at least average Internet access, Comcast is likely to spin off Minnesota franchises to a Charter Cable managed company if the federal government approves the Comcast - Time Warner Cable merger. Charter has typically offered slower speeds than Comcast. Under the status quo, only a few neighborhoods in the metro region are slated to have access to fiber networks.

Far more variation, and innovation, can be found in Greater Minnesota. Some communities boast networks that provide far greater speeds than are available in the metro area while households a few miles away rely on inferior satellite access or even dialup.

A significant factor explaining this variation is whether local governments have taken an active role. Minnesota local governments have embraced a wide variety of strategies to provide universal fast, affordable, and reliable Internet access.

Some local governments have built their own networks. Others have partnered with private companies or cooperatives. Communities in Sibley and Renville counties are creating a new cooperative as a vehicle for building a new network. Some cities have financed investments by issuing bonds; others have gained federal grants and/or loans. And some have found they can finance a slowly expanding fiber network from the savings generated from switching from leased lines to self-provisioning.

In this paper, we examine some of the prominent examples of local creativity.

• Dakota County has pioneered a model "dig once" approach that has helped it to build an extensive network of publicly-owned conduit and fiber across the region, significantly lowering telecommunications costs for local governments, school districts, colleges and universities, the state, and the County itself. The County has saved some $10 million by using this coordinated approach.

• Scott County, located just West of Dakota County, was one of many counties that learned from Dakota's approach. After building a fiber ring to connect local government facilities, schools, and public safety towers, Scott County used the extra fiber to attract large employers to the region (e.g. Shutterfly and Emerson).

• Carver and Anoka have received broadband stimulus awards to build fiber rings connecting key anchor institutions. Communities within the counties are reporting significant savings and more efficient government operations due to the higher capacity connections. But where Carver decided to retain ownership, Anoka handed the network to its private sector partner. As a result, Carver appears to have more flexibility in attracting jobs and encouraging new providers to connect households.

• Buffalo and Chaska, two communities on the periphery of the metro region, each invested in both fiber optic and wireless solutions to meet different needs. Both began providing access to their local businesses and households before the private sector was prepared to offer broadband. Both have continued to expand their fiber assets at low cost in tandem with other capital projects, but Buffalo is more bullish on expanding the fiber and wireless systems. Schools in both communities have much faster connections at far lower prices than would be available absent the publicly owned networks.

• The small city of Windom was the first in Minnesota with a citywide fiber-to-the-home (FTTH) network. Built and operated by the municipality, the network is extremely popular with most households subscribing to at least one of the telephone, Internet access, or television services. The network has been so successful that eight rural communities that had very poor Internet access sought and received federal stimulus money that has allowed the system to expand out to them. Though building the network has been very challenging, it has delivered many community benefits, including keeping jobs in the community and producing a community savings of at least $400,000 per year in recent years.

• Monticello also invested in a citywide FTTH network but opted to work with local provider HBC to deliver services. Prior to building the network, Internet access was so poor in some areas of the city that businesses would send employees home because they could not be productive in the office. The telephone company TDS filed an ultimately unsuccessful lawsuit that delayed construction for more than a year, resulting in a significantly increased cost and reduced revenue. After having insisted that a fiber network was not needed, TDS took advantage of the delay by building its own, making Monticello the only community in North America with two competing citywide FTTH networks. Meanwhile Charter adopted what many believe is a predatory pricing strategy that imposed additional financial burdens on Monticello's Fibernet. The economic downturn, lawsuit, and aggressive pricing forced Fibernet to borrow from the municipal liquor store funds and bondholders to take a haircut. However, the lower

prices resulting from the injection of competition into Monticello's telecommunication sector has balanced the temporary losses of Fibernet.

• Cook and Lake Counties had both suffered for years because all telecommunications in both counties depended on a single fiber line. Occasional accidents left the counties without access to 9-11 or electronic financial transactions and left public safety officers unable to check licenses or license plate numbers. Despite years of requests for redundancy, the incumbent telephone company refused to invest in a diverse path. One business in Cook County was quoted a $600,000 install fee for a simple 1.5 Mbps connection. Cook County ultimately formed a partnership with electric cooperative Arrowhead, which already served the majority of the county. They used a stimulus award to build a FTTH network throughout the County. Lake County also received a broadband stimulus award to build a FTTH network to everyone in Lake County and some areas of bordering Saint Louis County. Lake County, which owns the network and partnered with nonprofit Lake Communications to operate it, has faced many challenges and come under withering attack from national cable company Mediacom. Nonetheless, it is expanding Internet access and helping local businesses to be more competitive.

These communities represent some of the best strategies local governments can employ to expand Internet access.

• Lac qui Parle combines common themes from both Cook and Lake Counties. As in Cook County, Lac qui Parle partnered with a local telephone cooperative to expand Internet access. Like Lake County, they faced the challenge of whether to build only in areas with no service or to include some areas with existing, but slow and outdated, broadband Internet access. Primarily because of incumbent opposition to competition, they opted to exclude the County seat, Madison, which already had some Internet access. Years ago, the county seat of Madison had broadband while rural areas were left behind; now Madison is stuck with slow DSL and unreliable cable while the rest of the county has very fast fiber optic Internet access from Farmers Mutual Cooperative.

• Sibley County has organized relentlessly for fast, affordable, and reliable Internet access to the entire community, not just the cities. When its initial Joint Powers Agreement proved infeasible, the community quickly organized a cooperative effort. The cities and a majority of the townships are issuing an economic development bond to provide seed funding to RS Fiber, which includes most of Sibley and parts of eastern Renville County.

Of the four cities we profile, three have municipal electric utilities but cities without such utilities are increasingly using incremental approaches to expand fiber. Of the eight counties, five received broadband stimulus funds. All four of the rural countywide projects involve partnerships with a coop or nonprofit to offer services.

Local governments are already responsible for a significant amount of investment in next-generation networks across Minnesota. They are an important tool in expanding Internet access and eventually meeting Minnesota's goals for ubiquitous, high quality Internet access.

However, state policy currently limits local government investment. For example, requiring a 65 percent supermajority vote before a municipality may offer telephone service has dissuaded more than a few local governments from investing in the face of effectively unlimited spending by corporate opposition.

INTRODUCTION

In 2010 the Minnesota legislature set a goal of having universal Internet access across the state with download speeds of 10-20 Mbps and upload speeds of 5-10 Mbps no later than 2015. Another of the legislative goals was to have Minnesota be among the top five states for broadband speeds.

Minnesota is not on track to meet these goals. Meanwhile rapid technological advances have resulted in communities needing higher minimum speeds.

Federal Communications Commission Chairman Tom Wheeler, for example, argues that a 25 Mbps Internet connection is "table stakes in 21st century communications."[1] Metro areas like Chattanooga, Kansas City, Provo, and dozens of communities with municipal fiber networks already have citywide gigabit (1000 Mbps) Internet access.

Most households in the metro region have access to comparatively fast cable options or DSL connections that meet the state goals. However, compared to high profile metro leaders around the country, the mayors and city council members in the core cities of Minneapolis and Saint Paul have been all but absent in encouraging investment in next-generation networks.

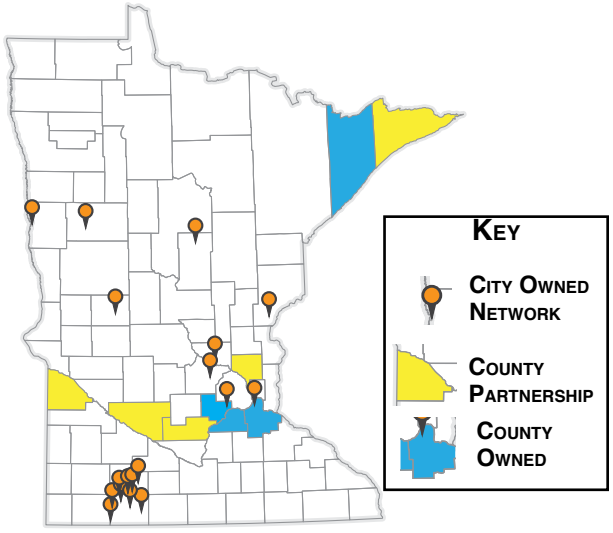
Both Saint Paul and Ramsey County have rejected requests to begin modest fiber and conduit installs based on the Dakota County approach discussed below. In Minneapolis, a local company USI has deployed fiber in some areas, mostly around the Lake Calhoun and Lake Harriet areas. USI also owns and operates the Wi-Fi network that Minneapolis supports with approximately $1 million per year.

It may be that Saint Paul and Minneapolis are holding out hope for a big investment from Google. If so they would do well to heed the words of Google Vice President for Access Services, Milo Medin:

> *"If there is one message I want cities to leave here with, it's that you need to start owning how you plan to improve broadband in your community. Don't wait to have us or someone else do it for you. You can take meaningful action starting today."*[2]

Some suburban communities like St. Louis Park and Eagan have invested in their own fiber networks. St. Louis Park has connected anchor institutions and school buildings while Eagan has made the fiber available to businesses, particularly to service providers it hopes can improve access and reduce rates to businesses in some corridors. However, most elected officials in the metro region seem content with CenturyLink DSL and Comcast cable despite the limitations of both technologies.

Local Governments Expanding Broadband



CenturyLink has published press releases claiming it will be offering gigabit services to some people in a number of its metro territories, including the Twin Cities. However, CenturyLink's capital investment budget does not seem capable of supporting such investment and until the company explains to investors how it plans to fund such an investment, few experts believe it will be available to a significant number of households.[3]

It remains unclear how long Comcast will serve Minnesota. As part of its anticipated merger with Time Warner Cable, Comcast plans to trade territories with Charter Cable, which will then become the second largest national cable company. Charter already has a de facto monopoly in many Minnesota communities, including Rochester and Duluth. If the merger is approved later in 2014, Comcast will no longer operate cable systems in Minnesota. Instead, Comcast and Charter will jointly own a new company, first called "SpinCo" and now formally named "Greatland Communications," that Charter Cable will manage. Given that Comcast's connections in most of its territories feature faster Internet access than Charter offers, this deal has negative implications for those who hope for a near term upgrade in broadband speeds.

Greater Minnesota has little to worry about from the coming cable monopoly swap because the big cable companies care little about smaller, more rural markets.

Rural areas in Minnesota have a tremendous variation in Internet access. Some communities have the most advanced technology available whereas households a few miles away rely on vastly inferior satellite access or dialup. The official maps of Minnesota suggest there are few unserved areas but a steady stream of anecdotes suggests the maps, which were based on voluntary data submitted by the providers themselves, overstate connectivity availability.

Many cities in Greater Minnesota have embraced a self-help approach to expanding Internet access. Though we have profiled multiple approaches using a variety of strategies in this report, we could not cover them all. For example, after being ravaged by a tornado, Saint Peter paid for conduit installation with a utility fee in the rebuilding process that local Internet service provider Eventis (formerly Hickory Tech) uses to offer services. Moorhead has a fiber ring and once operated a Wi- Fi network that followed a similar arc as Chaska, which is described in this report, although Moorhead is actively using its fiber to help other providers offer high capacity services.

Crosslake and Barnesville have long been incumbent providers in the community. Pine City built a fiber backbone and Eagan has built a fiber loop, both to serve businesses. Alexandria's municipal fiber network is available to local businesses.

Albert Lea recognized it could lower its telecommunications costs by getting services from the Freeborn County fiber network. Many school districts operate on publicly owned fiber, whether from the municipality, county, or their own assets. There are many more examples of local government ingenuity to expand access than most realize.

And finally, some communities have excellent Internet access even without public investment or special partnerships. A report on advanced Internet access in Minnesota is incomplete without acknowledging these approaches. They

include telephone cooperatives (like CTC and Paul Bunyan) or electric cooperatives that have been steadily building fiber networks, or fiber and wireless combinations, often with loans from the US Department of Agriculture Rural Utilities Service. There are also a number of local companies building advanced networks in Minnesota communities, including two referenced in the report – Hiawatha Broadband Communications and Jaguar.

In 2014, the Minnesota Legislature launched a small competitive program to provide matching funds to expand Internet access. Senator Matt Schmit and Representative Erik Simonson can share credit with a strong grassroots mobilization led by the Coalition of Greater Minnesota Cities for refusing to give up on the fund in the face of strong industry opposition. That fund will be managed by the state of Minnesota Office of Broadband Development and is available to private companies, cooperatives, local governments, and partnerships that will build networks in unserved areas.

The Institute for Local Self-Reliance has nearly a decade of experience studying and working with local governments to expand Internet access. Local governments can choose from a wide variety of strategies based on their unique mix of assets and challenges.

This report offers some examples of the different strategies adopted by Minnesota cities and counties. The case studies are grouped according to similarity, starting with the metro region counties of Dakota, Scott, Carver, Anoka. The cities of Buffalo, Chaska, Windom, and Monticello make up the next grouping. The last group of case studies focuses on the rural communities in Cook, Lake, Lac qui Parle, Sibley, and Renville counties.

One commonality throughout was an initial network focused on meeting internal local government needs and later expansion. In each case, the local government attempted first to work with the incumbent provider before seeking other partners or investing in a publicly owned solution. The counties have tended toward partners and sought federal grant/loan funding whereas cities have tended to use their bonding authority to raise the necessary capital.

What is Broadband?

Definitions on specific speeds vary but it generally refers to an always-on connection that is faster than dial-up (56kbps). The FCC is currently defining “basic broadband” as 4 megabits down and 1 megabit up, saying that this is the minimum connection needed to use common Internet applications.

Most people in Minnesota connect via DSL or cable. With recent upgrades, cable connections are capable of meeting the Minnesota broadband goals of 10-20 Mbps down and 5-10 up. In the metro, Comcast can deliver those speeds but other cable companies have not upgraded recently. DSL connections are limited by distance, meaning real connection speeds in rural areas are often much lower than advertised rates. Even under optimal conditions, DSL will struggle to meet the Minnesota upload goals.

Modern fiber networks often offer symmetrical connections, meaning a user can send data as rapidly as receiving it. DSL and cable networks are asymmetrical, meaning that uploads are much slower than downloads, making it harder to work from home or send large files to clients.

Tech Basics

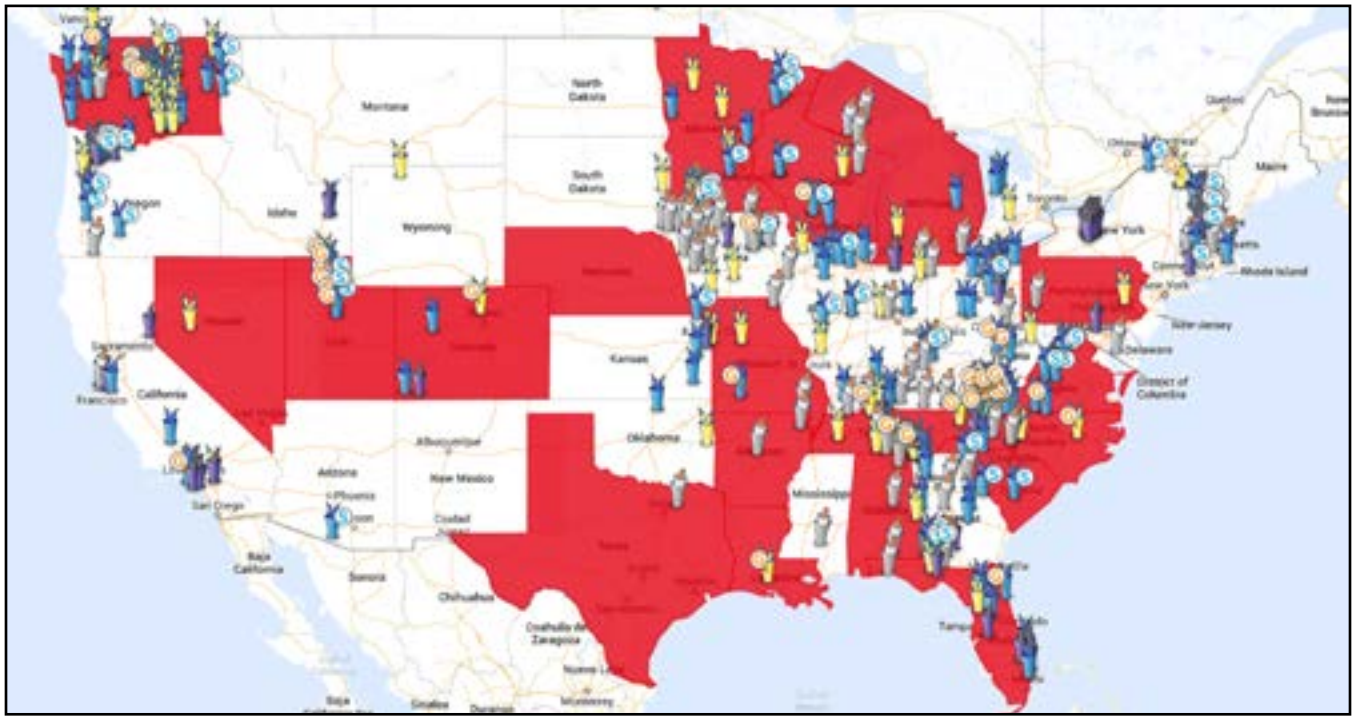
Policy discussions about expanding Internet access require a basic knowledge of some relevant technologies. Understanding the limitations and tradeoffs of different technology is essential in crafting the right policies to ensure all Minnesota has appropriate access to essential infrastructure.

The current Federal Communications Commission definition for broadband is 4 megabits per second (Mbps) downstream and 1 Mbps upstream. Older technologies like DSL and cable are asymmetric, meaning users have much slower upload speeds than download. Modern fiber optic networks may be either symmetric or asymmetric based on various technical and economic factors.

Most of Minnesota has access to DSL, a technology using copper telephone lines. Connections may vary from up to 40 Mbps downstream and often 5 Mbps upstream under ideal conditions to under 1 Mbps in both directions. But for most people in Minnesota, DSL delivers less than 10 Mbps downstream.

Cable networks can offer much faster speeds, but the network is more of a shared environment. That means when many people use the network, it gets congested. DSL and other technologies can also experience congestion, but cable networks have historically had higher rates of congestion even as they deliver much faster connections. Comcast offers download speeds of 105 Mbps in Minnesota and 20 Mbps up. Other cable companies may top out at 40 or 50 Mbps down and only 5 or 10 up.

Municipal Broadband Networks Across United States



The Institute for Local Self-Reliance is tracking more than 400 local governments that provide telecommunications services to local businesses and/or residents in the United States.

Fiber-to-the-home (FTTH) networks are the most advanced networks, though fiber optic technology has been used for many decades in the industry. It is expensive to install, particularly on the labor side as it can require rewiring a whole town.

However, it offers almost limitless capacity and the fiber strands have a useful life measured in decades. Fiber networks have a high capital cost but generally a lower operating cost than cable or DSL networks. The best networks in the world are all fiber optic.

Satellite customers are at the mercy of the weather and exhibit significant latency or lag in sending and receiving information because the signal must travel into space and back. Communicating via Skype or other video application is all but impossible due to latency. In addition, it is often quite expensive. We have never found a person using satellite for Internet access when they had access to DSL, cable, or fiber networks.

Upload speeds from cable, DSL, and satellite are a particular concern for business clients. Businesses that need to share large data files with clients must plan accordingly because slow connections extend upload times or fail before they are completed. In the case of a satellite connection, a business may find a transaction cut off if it exceeds its data cap before completing the file transfer.

Data caps are another important aspect of the modern telecommunications environment. Data caps are monthly allotments of bandwidth usage per subscriber. Users are typically charged for overages or their service may slow or end abruptly. HughesNet, a satellite operator in Lac qui Parle County, caps its basic service at 40 GB per month. HughesNet allows customers to purchase additional blocks of bandwidth at $16 per 2 GB blocks.

The expansion of 4G LTE wireless, which can offer transfer speeds similar to those of cable or DSL, has led some to wonder whether that technology could obviate the need for better wired networks in rural areas. However, mobile wireless plans frequently impose data caps, rendering them unfit for common functions such as telework or even homework.

Fixed wireless networks have long been an option in some rural areas, often operated by local entrepreneurs. Some reliably meet community needs and are expanding to fiber and wireless combined networks. Others have struggled to consistently deliver a high quality connection. This approach has a high “your mileage may vary” factor.

The average American household wired Internet connection used approximately 45 GB per month in 2012. This could cost hundreds of dollars per month on a 4G LTE plan. In an informal survey by GigaOm in 2012, usage for a family of five with two school age children ballooned to 198 GB per month. A couple with no children who occasionally work from home can average as high as 300 GB per month.

POLICY SUGGESTIONS

While researching these case studies, we heard several repeating themes and suggestions. One in particular, the 65 percent referendum was raised many times. Simultaneously, Federal Communications Chairman Tom Wheeler has argued that state laws limiting local authority to build fiber networks unnecessarily limit competition and are counterproductive.

To achieve border-to-border, high speed Internet access, the state should remove barriers to public investment. Both public and private investment are needed to keep Minnesota competitive and maintain a high quality of life.

- A key barrier in Minnesota is the 65 percent referendum requirement to own or operate a telephone exchange. Minnesota should remove this barrier and join the majority of states that do not limit local authority.

- The state has established a one time, $20 million fund to encourage Internet expansion. This fund should be increased in size and made permanent until such a time as Minnesota achieves its broadband goals. Loans should come with conditions similar to that of the stimulus broadband programs, requiring interconnection and basic principles of nondiscrimination.

- The state should not limit broadband grant/loan opportunities solely to areas presently lacking access. New networks should be financially viable without unending subsidization, which may mean mixing in areas of higher density (that already may be served) with areas of lower density to ensure cash flow will support debt and operating expenses.

- The state should not assume that private investment is automatically superior to public investment. Many of the fastest, most affordable networks in the nation are owned by cities. Municipal electric utilities have proven that cities are at least as capable of providing low cost, reliable electricity to the public for over 100 years. There is no reason to believe municipal Internet networks are any different.

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Cities and Counties

1. Dakota County

"Dig Once" Approach serves as model for all communities and has saved the county millions of dollars. Fiber throughout the county will now be used to spur economic development.

Located south of Saint Paul, Dakota County's northern half is part of the Twin Cities metro whereas the southern half tapers into a less dense, more rural area. Dakota County offers an impressive model for expanding fiber and conduit assets on a tight budget while maximizing cooperation – both public and private.

The County's "dig once" approach to quietly expanding fiber and conduit assets has impressed those who have known about it. Many metro counties have copied aspects of it and realized significant savings – see our sections on Scott, Carver, and Anoka counties. Starting in the late 1990's, Dakota County began ensuring it was laying conduit and/or fiber as part of capital projects that tore up streets. By installing conduit or fiber with other projects, the costs can be as much as 90-95 percent less because the most significant cost is tearing up the ground.

Dakota County has dramatically reduced the cost of incredibly high capacity telecommunications connections to schools, public facilities, utilities, and the like. The County is now examining how it could also use its assets to best encourage economic development and increase investment in last mile services to businesses and households.

Dig Once Basics

The Dakota County Information Technology office deserves the lion's share of credit for their approach. They have developed their own award winning software and built strong relationships with key staff in municipalities across the county, the two keys to their success.

The Cedar Avenue rebuild is an example of Dakota County's approach. A major thoroughfare into the metro, Cedar Avenue was widened and rebuilt to accommodate a new Bus Rapid Transit route. To Dakota County IT staff, this was the perfect opportunity to place conduit and fiber under the streets at a fraction of the price for a standalone project.

David Asp, IT Department Network Collaboration Engineer, coordinated with each city along the rebuild path to understand their needs and ensure enough conduit and fiber would be included in the project to meet demand well into the future.

Dakota County has custom built software to facilitate collaboration on any project. Named the "One Stop Roadway Permit Shop," as soon as someone requests a permit to work in the right-of-way or a number of related permits, the software alerts all agencies that may have an interest.[4] Not only has this system streamlined permitting, it saves approximately $4,000 per year for each agency involved. Dakota County even won an award from the National Association of Counties for its development. More importantly, it gives the County more opportunities to place conduit and fiber in the ground at extremely low cost.

In a number of areas, a School District or another public agency in Dakota County may already have conduit and fiber. For instance, some of

the Districts have conduit with 12 fiber strands connecting facilities, built at a time when each strand was considerably more expensive than today. If that conduit is within an area that could help expand the County network, Asp can offer a trade because replacing the 12 strands of fiber in the conduit with 144 strands may only cost a dollar per foot of fiber. Cutting the streets to place new conduit and fiber would cost 10-20 times more.

The network is redundant and reliable but the county is working to make it even more so. They have connections out of the County over three different directions, each at 10 Gbps

It is not unusual for County IT staff to convert 12 strands of fiber in a conduit to 144 strands over the course of a weekend. The School District would own many of those strands but others would be reserved for the County and perhaps other uses as well. If the route came close to state facilities, the State might want to lease a few strands in return for paying the "locate" costs of the network. Locates are performed when someone notifies Gopher State One Call before they dig to allow any entity with fragile assets underground the opportunity to mark their location. These are just a few of the in-kind trades that Dakota County has used to build fiber and conduit throughout the County on a miser's budget.

Benefits

The main benefit of Dakota County's approach has been tremendous cost savings. Replacing the old telephone system saved tens of thousands of dollars per year and unified county facilities that were served by CenturyLink and Frontier. Now they are all on the same system.

According to its website, over 240 nodes have been connected with fiber at a cost of less than $1 million.[5] However, a recent conversation with David Asp put the number of connections now at more than 400.[6] This includes everything from major facilities to water meters, SCADA systems, and traffic signals. As an example, one of these nodes allows the Met Council to monitor video cameras and sensors in a bus shelter along Cedar Avenue to ensure it is secure and operational.

For fifteen years prior to the Cedar Avenue rebuild, slowly corroding copper cable connected devices at intersections with an extremely slow modem to download data and update signal timing. Now, multiple devices need some 12-15 IP addresses per intersection, allowing sensors in the concrete to work their magic and traffic lights to stay green for a few extra seconds to let a bus through. In the event anything goes wrong, traffic engineers can access the intersection from anywhere on the planet. It is impossible to put a dollar figure on these benefits, but they add up across hundreds of intersections, resulting in less pollution, lower tempers, and a generally higher quality of life.

The network is redundant and reliable but the County is working to make it even more so. They have connections out of the County over three different directions, each at 10 Gbps. On one of those routes, the County partnered with provider Hiawatha Broadband Communications (HBC), so a group of government agencies could share 12 strands of fiber and increase their resiliency in the event of a disaster.

Dakota County is prepared for a worst-case IT scenario. To test disaster preparedness, they recently shut off the power in their main Hastings facility. The system immediately re-routed everything to servers in West Saint Paul. Leasing

this level of connectivity from an existing provider would cost considerably more annually than Dakota has invested in its network over the past 10 years. And because the network stretches into other counties, those counties can simply set up server racks in each other's facilities for remote backup purposes - yet another cost savings.

As a final example, the County had been paying $49,200 per year to a private provider for two strands of fiber to a facility. Asp was recently able to structure a deal that required $113,000 in one time construction costs for 48 strands. Some of those are already connecting facilities from School Districts, the University of Minnesota, the Minnesota State Colleges and Universities System, and the State. On that route, they still have plenty of fiber left over for economic development or other uses. The County is currently working with a consultant to develop a policy for the fiber network to encourage development throughout the County and increase investment in rural areas.

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Conclusion

Dakota County's method of intense collaboration to deploy conduit and fiber assets has conservatively saved the County millions of dollars, but the actual total is probably more than $10 million. They developed specialized software to meet their needs and welcome inquiries from other local governments that want to know more.

It is important to note the limitations of their approach. As of yet, no provider uses the infrastructure to expand a gigabit to every household in a Dakota County community. Nevertheless, the collaborative process has likely encouraged local companies like Velocity and HBC to invest more in Dakota County than they otherwise would have. The County is well suited to expand its network further but at this time County Commissioners seem opposed to taking any steps that would verge on competing with existing providers.

The most important lesson is that Dakota County has the freedom to make its own choices. If an industrial park needs access to fiber, Dakota County can make it happen. It has leverage, even if it never chooses to offer services to businesses or households.

2. Scott County

Built a fiber ring to self-provision Internet service to local government facilities. Then used extra fiber to attract businesses to the region, resulting in hundreds of new jobs.

Scott County, located south of the Twin Cities, sits east of Carver County with the Minnesota River as the common boundary. Dakota County is just east of Scott. Ranging from suburban to rural and growing rapidly over the past 25 years, it now has 130,000 residents.

Scott County had long watched as its neighbor, Dakota County, expanded publicly owned fiber and conduit assets to improve access to schools and other community anchor institutions. When Scott mapped publicly owned fiber in the community to determine assets and needs, it discovered that its only publicly owned fiber had been deployed jointly by the County, City of Shakopee, and Shakopee Schools.[7]

Scott County learned from Dakota's approach and its Board of Commissioners approved a $4 million budget for its own 90 mile ring in January, 2007. The budget allocation was part of a larger capital improvement project designed to overhaul public safety communications in the County. Dakota County had been trying to connect its towers with fiber in addition to microwave because of occasional interference problems when the air held too much dust or moisture. Scott County also recognized that fiber would be more reliable as well as create many additional opportunities.[8]

The public savings from the project were estimated to be $500,000 per year because the County could discontinue expensive leased connections from existing carriers.[9] In addition, the new fiber network would offer much higher capacity connections, a much lower cost per bit delivered, and greater reliability. The county bonded for $3.5 million, spreading the cost of building it over many years. However, combining the debt payments and operating expenses, the County saves $35,000 per year compared to the cost of leasing connections.

The county connected all county owned facilities, including public safety towers, libraries, city halls, police departments, school districts, and the state of Minnesota's high capacity backbone. Ultimately, it also interconnected with Dakota and Carver networks as well as providing redundant paths out of the county, one to Mankato and one to the 511 Building in Minneapolis, where hundreds of carriers interconnect networks. Having that connection effectively meant that any carrier in the 511 Building could offer services to Scott County, rather than the county being dependent on the small number of carriers that already built infrastructure in that region.

Access Communications, now owned by Zayo, worked with a local provider to build the network. The partnership resulted in a lower cost to both parties – the County paid the capital costs to install the fiber and Zayo is responsible for ongoing maintenance. The state Office of Enterprise Technology has also agreed to manage portions of the network in return for access to some of the connections, lowering its own costs.

Even this early in the network's useful life, the results have been tremendous. The School District has slashed its expenses, from paying approximately $58 per megabit to under $7 per megabit. And due to the network, the schools

have almost unlimited capacity to upgrade to faster speeds that would be cost prohibitive to lease from a telephone or cable company.

The network is also responsible for job growth in the region. The network was 10% completed in 2010 when County and local municipal leaders began aggressive efforts to spur economic development with the fiber. When Emerson Process Management was engaging in site selection for a 500 job, $70 million investment, the firm narrowed down possible candidates to Shakopee and Chihuahua, Mexico.[10] Scott County could offer it affordable access to the fiber network. Shakopee News reported: "Dependent on projected usage and other assumptions, over a 20-year period, it is estimated this would result in a net present-value savings of between $1.1 million and $1.7 million for Emerson."[11] Emerson picked Scott County.

The more recent decision from Shutterfly to locate in Scott County also was influenced by access to county fiber. Shutterfly planned to bring 329 new positions to the community, paying hourly wages of approximately $19 per hour. The online photo service also planned to employ an additional 200 people on a seasonal basis.[12] Ensuring that businesses will have an affordable – and often more importantly today, reliable – Internet connection is increasingly essential to healthy business environment. The Dakota and Scott County conduit and fiber investments position them perfectly to ensure those connections are available.

Conclusion

Scott County reduced its telecommunications costs by $35,000 annually while dramatically improving Internet access for essential public facilities by replacing leased lines with its own fiber network. Costs for connectivity have contracted sharply for schools from $58 per Mbps to less than $7 per Mbps.

Even this early in the network's useful life, the results have been tremendous. The School District has slashed its expenses, from paying approximately $58 per megabit to under $7 per megabit. And due to the network, the schools have almost unlimited capacity to upgrade to faster speeds that would be cost prohibitive to lease from a telephone or cable company.

In order to reduce the cost of the network, the County partnered with Access Communications (now Zayo) which agreed to handle maintenance. Scott County also collaborated with the state Office of Enterprise Technology, saving both state and county public funds.

Two large-scale employers, Shutterfly and Emerson Process Management, have brought more than 1,000 new jobs into Scott County, citing the network as an enticement. Scott County has more tools at its disposal as it seeks next to spur investment in residential Internet access.

3. Carver County

Used federal broadband stimulus program to build a fiber ring. New network provides higher quality, lower cost access to local government facilities and spurred economic development.

Carver County's 376 square miles lie approximately 30 miles southwest of Minneapolis. There are eleven cities in the County, ten townships, and a small number of unincorporated communities.

The County has experienced high levels of population growth due to the expanding Minneapolis and St. Paul metro. Based on the level of growth, local officials have estimated the population will reach 195,000 by 2030.[13]

Many new residents live in the eastern areas closer to the Twin Cities in order to commute to jobs in the metro. In the more populated areas, such as the County Seat of Chaska, CenturyLink offers DSL and Comcast provides cable connections; Frontier also operates in the County. Chaska owns and operates a fiber network for public facilities and business customers. Chaska also serves a number of small business and residential customers with Chaska.net, its wireless network.

Traditionally, many businesses and residents in the rural western regions of the County were underserved and had to get by with dial-up. Government facilities and other larger entities relied on T1 lines for connectivity. The County's network, a "patchwork" of fiber and T1s leased from private firms, was expensive and slow.

In 2008, the economic downturn coupled with rapid population growth put added stress on government operations. Unemployment was up, tax rolls were down, and the state had significantly scaled back financial allotments in the form of Local Government Aid (LGA). The County received less revenue but served more people than ever before.

As revenue decreased, Carver County's telecommunications budget increased. Prices for T1 lines grew each year; some were as high as $1,000 per connection. The escalating telecom budget burdened the entire County, leading to discussions about a better solution than leasing lines.

Faster Connections, Lower Prices

Recognizing the danger of further reliance on expensive leased connections, County leaders decided to act in 2008. They wanted a solution that would cut costs while still providing fast, reliable connections and ideally jumpstarting economic development. And they were well aware of the Dakota and Scott County approaches of targeted fiber investment.

Carver's first concept for the network was a 60-mile ring to connect County facilities, schools, libraries, police departments, and local government agencies.[14] The plan included 80 – 100 sites, allowing the County to eliminate leased lines for voice and data. Steve Taylor, the Carver County Administrative Services Division Director, predicted the County would save $150,000 - $175,000 per year.

At the time, County administrative offices in Chaska were filled to capacity. The County planned to develop satellite offices but required high-speed connections between facilities. Without its own network, establishing satellites would be expensive and impractical.

Carver worked with Scott County to link government centers located across the Minnesota River from each other. A connection between the two would provide faster access to a range of state

databases and Scott County provided access to the 511 building in Minneapolis, where hundreds of Internet Service Providers interconnect with each other. Direct access to the building means lower prices for Internet connections due to much greater competition.[15]

The County was not alone in needing better access; businesses considering moving to the County also required higher capacity connections than existing providers were providing at affordable levels. When presenting the idea to the County Board of Commissioners in June, Taylor noted that businesses sought locations with access to fiber:

> *"It is almost a requirement now," Taylor told the board Tuesday during a presentation. "There is a demand for this. I've had three companies ask me in the past six months if we have a fiber-optic ring."*[16]

"It is almost a requirement now," Taylor told the board Tuesday during a presentation. "There is a demand for this. I've had three companies ask me in the past six months if we have a fiber-optic ring."

The Board voted to instruct staff to develop and issue a Request for Bids (RFB) for a project developing a fiber network.

On June 6, 2008, the County released a two-part RFB.[17] The first option called for a county-owned network; staff estimated deployment costs of $2.5 – $3 million with $100,000 in annual costs.[18] The second option sought a public-private partnership to fund, deploy, and operate the network.

Three entities bid on the project; costs ranged from $900,000 for a public-private partnership to $2.4 million for a publicly owned network.[19] Jaguar Communications (Jaguar), headquartered in Owatonna, submitted the winning proposal with a 70-mile county-owned network that would connect all County facilities and nine additional community anchor institutions. The bid provided that Jaguar have an Indefeasible Right to Use (IRU) several strands of the network and would not have to pay for access to County rights-of-way in order to offer business services.[20] In exchange, Jaguar offered to pay more than half of the cost of the proposed fiber build.

Over the next few months, the County and Jaguar expanded the project reach to connect more communities. The network would connect all eleven cities in the county, the length was extended to 85 miles, and Jaguar would also have the right to offer triple play services to residents and businesses. The Board authorized the County to spend up to $1.8 million.[21] Planning to break ground the following May, the Board approved the final contract in December 2008.[22]

Jaguar and the County hoped to use a loan from the Rural Utility Service to finance the network but their application had not yet received a response when the federal government announced $7.2 billion program to expand broadband as part of the American Recovery and Reinvestment Act (ARRA). With the unanimous support of the Board, the County applied for ARRA funding in August 2009.[23]

While waiting for the results of the 2009 application, the County developed the Carver County Open Fiber Initiative (CCOFI), a collaboration with community partners to identify community anchor institutions to be connected. The County created a Broadband Infrastructure Task Force that included elected officials and staff from the County, representatives from local schools, and officials from cities and townships.

The County learned in March 2010 that it had not been selected for a stimulus award and quickly decided to apply for an award in the second round with a more ambitious network that would improve government efficiencies across the entire County. They also focused on creating a better economic development impact and the promise of better access for County residents.

Awarded in the Second Round

In August 2010, the County was awarded a $6 million Broadband Technology Opportunities Program (BTOP) grant in the second round of the stimulus program.[24] The County pledged $1.5 million to cover the remaining costs of the project.

County officials first decided to spend $400,000 from its Information Technology budget and finance the rest with a bond issue. At that point, County costs for leased T1 lines had reached more than $230,000 and were expected to increase another $100,000 in 2011 for a total of $330,000 per year. Redirecting the T1 funds to the bond debt would allow them to pay it off in fewer than five years. However, the County later found it could tap into its reserves to fund the project without bonding.[25]

Jaguar agreed to provide maintenance for the ring and be a service provider on the network. Jaguar purchased an IRU for 96 of the total 192 fiber strands; 24 of Jaguar's fiber strands would be managed as open access per one of the stimulus plan requirements. The County would receive a one-time payment of $370,000 from Jaguar for the IRU. Jaguar would also perform splicing, testing, pre-engineering, and project administration during and after installation.[26]

While the network was being built, Carver County and Scott County connected their government centers with a fiber optic cable under the Minnesota River. The connection between the two government centers linked the two counties for public safety purposes.

While the network was being built, Carver County and Scott County connected their government centers with a fiber optic cable under the Minnesota River. The connection between the two government centers linked the two counties for public safety purposes. Scott County planned to transition to the statewide 800 MHz public safety radio system after creating a fiber connection to the tower in Carver County. The primary controller for a subsystem shared by Carver and Scott Counties was located at the Carver County tower.[27]

The connection also created a fiber route to the state's Office of Enterprise Technology (OET) and Minnesota's Network for Enterprise Telecommunications (MNET), linking government offices and schools. Carver County paid $25,000 toward the total cost of the project, which came to approximately $200,000. Access Communications, Scott County, and the state also contributed.[28]

They began construction on CarverLink in early summer 2011 and the County was ready to light its network two years later. On September 4, 2013, federal, state, and local officials met for an official lighting up ceremony at Waconia High School. Superintendent Dr. Nancy Ranjanen emphasized that the new network significantly reduced the District's connectivity costs, allowing investment in other areas.[29] In keeping with the District's technology plan, the robust network permitted more students to access wireless web-based learning software.[30]

The entire network is underground, running along County rights-of-way for approximately 89 miles. Thirty three miles of laterals reach community anchor institutions beyond the main ring. The network connects all 11 cities in the County to the

backbone ring with 8 townships connecting via laterals. Capacity on the ring is 10 Gbps; laterals are 1 Gbps.

CarverLink has connected 55 sites, representing 86 community anchor institutions. Eighteen County sites, 28 public schools, 6 County libraries, and the Carver County Workforce Center were also connected in addition to 2 colleges and a number of community centers.

Network Benefits

The County previously had to duplicate hardware at its Public Works facility in Cologne and at the Government offices in Chaska because CAD files were too large to send between offices through the County's limited network. CarverLink has solved that problem and even allows the County to make better use of its data center in Cologne because bandwidth is no longer a scarce commodity.

After converting to CarverLink and interconnecting facilities with fiber, Waconia reduced its telecommunications budget by 47% or $19,000 per year.

County and municipal public safety entities use the network extensively. Fire stations, police stations, city halls, and several public safety communications towers are all connected. Sheriff deputies now upload squad car video via the network; in the past deputies hand delivered the videos.[31]

Waconia City Administrator Susan Arntz lauded the positive financial effects on Waconia's municipal budget:

> *Our communications costs have reduced by almost half, which has allowed us to add wireless capabilities for the public and our own operations to the Ice Arena, City Hall, and Public Services."*[32]

Waconia schools, located in the center of the County, have found a way to save significantly. The community connected three facilities with T1s and with wireless service from nearby Chaska.net. Reliability was not a significant issue for Waconia, but they were limited in bandwidth and sought a single solution. After converting to CarverLink and interconnecting facilities with fiber, Waconia reduced its telecommunications budget by 47% or $19,000 per year.

Schools in the County often purchase bandwidth via CarverLink. As a way to stretch the federal E-rate subsidy for schools, CarverLink's infrastructure creates a connection between districts that allows districts to purchase bandwidth as a collaborative. The consortium, the Carver County Schools Network (CCSN), is an agreement between the schools that increases their bargaining power and allows them to take advantage of opportunities that may not be available to the districts individually. In addition to obtaining a better price for bandwidth, the CCSN collectively applied for and received E-rate funding.

Beyond the schools, libraries, and county facilities, Crown College, Ridgeview Medical Center, and South West Metro Transit headquarters are on CarverLink. But the most significant impact has come from the eight cities and two townships that obtain services for municipal offices. Randy Lehs, Broadband Fiber Project Manager in Carver County, anticipates more cities and townships will use CarverLink as currently connected communities share their experiences.[33]

Lehs noted that the primary purpose of the network was to increase efficiencies rather than reduce municipal telecommunications budgets. Many of the connected entities still pay what they used to but now receive vastly superior service. CarverLink offers faster speeds that are symmetrical, reliable, and redundant. Being on the same fiber network also makes it easier to cut costs in other departments with more collaboration.

The city of Chanhassen can now take advantage of the County's extensive GIS mapping data. Before CarverLink, Chanhassen did not have GIS at their disposal because it did not have the necessary expertise.

The small town of New Germany (372 residents) has boosted its access four fold compared to its old Frontier service and a new direct connection from City Hall to the Fire Department allows for much faster transfers. Purchasing services from the County allows for more stable budgets because large providers have been known to increase prices with little warning.

Instead of limping along with a collection of "patchwork" connections, Carver is able to efficiently and cost effectively serve the community.

CarverLink offers 20 Mbps connections for a flat rate of $75 to public entities that connect a small number of facilities like New Germany. The option is designed to serve small communities where there are only two or three connections. This option also provides access to what CarverLink describes as a "community ring." In other words, these facilities can communicate directly with any public entity on CarverLink.[34] New Germany now pays $150/month in total for better service: $75 to CarverLink and $75 to Frontier for phone service. (It previously paid $300/month to Frontier alone).

Larger communities pay $150 to connect their first site and $75 to connect each additional site. CarverLink also provides the dark fiber connections between facilities if they choose this option and are comfortable managing their own network. Several communities with technical staff opt for this system and manage their own needs, limited only by the equipment they choose to employ. These communities choose a primary site from which to access the Internet for $9.95 per Mbps; they can then share that Internet access among facilities.

Conclusion

Carver County and its municipalities had hobbled along with outdated, slow, and unreliable connections until community leaders closely examined their options. The primary goals were to increase government efficiency, take control of telecommunications costs, and better serve the people of the County.

Rather than depending on providers headquartered across the country, the County can easily maintain a close relationship with Minnesota-based Jaguar, which has a history of serving community anchor institutions, residents, and businesses.

Instead of limping along with a collection of "patchwork" connections, Carver is able to efficiently and affordably serve the community. By eliminating leased lines, the County is saving $330,000 per year and no longer faces the threat of major unanticipated rate increases.

Local governments also benefitted when they transitioned to more affordable service with better connectivity. Waconia schools reduced their telecommunications budget by 47%, saving over $19,000 per year. New Germany, with less than 400 people, can enjoy the same or better Internet access and voice service available in much larger cities for half of what it used to pay to the incumbent.

4. Anoka County

Used federal broadband stimulus program to partner with private firm to build a fiber network. Local governments and schools see big savings, but economic development potential remains a question.

Anoka County developed a plan to work with a partner to deploy a fiber network connecting community anchor institutions. The County hoped to cut telecommunications costs, encourage economic development, and improve access in rural areas. While the County retains the right to use the network, the infrastructure is owned and controlled by its partner.

Approximately 336,000 people live in Anoka County's 423 square miles located north of the Twin Cities Metro. The County includes densely populated communities in the south with rural areas in the north. The County is home to the largest school district in the state, Anoka-Hennepin, along with 20 cities, one township, and eight other school districts.[35]

Connectivity in Anoka Lacking for Business, Government, & Residents

Despite its size and proximity to the metro, large institutions and businesses were limited to DSL service, cable connections, or T1 connections from the existing providers. T1s, providing speeds of 1.5 Mbps were slow, expensive, and did not provide redundancy. In limited areas, providers offered connections up to 10 Mbps or DS3 connections that supplied 45 Mbps service. Several school districts used fiber for private WAN connectivity, but did not make that fiber available to other entities.[36]

Municipalities were limited by whatever technology was available in their areas; often there were limited connections between facilities. The city of Circle Pines used Comcast lines for data transport but did not have direct connections between police and fire locations; the Lino Lakes Correctional Facility used a T1 but needed more capacity. The city of Ramsey, located on the western edge of the County, paid $1,083 per month for a T1 connection to its fire station.

In rural sections of the County, residents and businesses still depended on dial-up. In some instances, when entities contacted providers to request T1 service, providers told them that it was not available due to the deteriorated condition of copper lines. On the more populated southern edge of the County, a limited number of businesses and anchor institutions had some access to fiber links.

Anchors, businesses, and local governments repeatedly requested fiber connections from incumbents. Qwest (now CenturyLink) and Comcast required the requesting entity to pay prohibitive construction costs to install fiber or simply refused to deploy it. Businesses, residents, and local governments were trapped; they needed better telecommunications options.

In seeking stimulus funding, the County used an example to illustrate its need for more investment.[37] A large medical device company located in the southern part of the County paid Qwest $30,000 per fiber mile to connect facilities in Hennepin County.

When the County issued an RFP for a five-mile gigabit fiber connection between the County Government Center and its primary Sheriff's building, Qwest's bid included a monthly charge

of $9,320 or $111,840 per year. That would be in addition to the construction charges which Qwest did not include in the bid.[38] At these prices, the County had little hope of connecting all the facilities that needed modern Internet connections.

Seeking Partners

In 2009, Anoka County created the "Connect Anoka County" project. The County called 800 residents in a random survey and sent paper surveys to 1,300 local businesses. Residents reported that they would not have moved or built in the County if they had known dial-up was their only choice.[39] Large businesses reported that their bandwidth use had tripled or quadrupled since 2007; they expected usage to rise even higher. Some reported driving files to customers rather than emailing because it was faster. Eighty percent of residential and business survey respondents favored action by the County to improve broadband. To get a more complete picture, the County held meetings with residents, businesses, cities, school districts, and colleges.

Residents reported that they would not have moved or built in the County if they had known dial-up was their only choice.

In 2009, the County also met with Qwest and Comcast to discuss the increasing need and to review solutions. While the incumbents did not offer suggestions or identify specific areas of service within the County, other ISPs expressed interest in participating in a County project.[40]

On November 4, 2009, Anoka County released an RFP to solicit partnerships for broadband development.[41] The County intended to find a private partner willing to apply for Broadband Technology Opportunities Program (BTOP) funding offered through the American Recovery and Reinvestment Act of 2009 (ARRA). Five companies responded to the RFP, two were interviewed, and Zayo Bandwidth LLC (Zayo) won the contract.

Zayo is based in Boulder, Colorado. The company provides a variety of dark fiber and lit services in 45 states and Washington, D.C. The privately owned company also supplies carrier-neutral co-location and interconnection services to government entities and private providers. Zayo had already received a first round ARRA grant for $25 million to develop a fiber network in rural Indiana so it had experience working with the federal stimulus process.

In 2009 and 2010 Anoka County representatives provided information about the proposed project to local elected officials. Their proposal would allow cities to connect municipal facilities to the network for $75 per month per site for 100 Mbps; the price for 1 Gbps connection would be $400 per month per facility.[42] A 2009 survey of county cities indicated municipal government in the County paid approximately $200,000 per year cumulatively to connect their facilities to the Internet and to connect municipal facilities to each other.[43] At the time, County facilities also paid approximately $200,000 per year for similar connections.

County officials explained that cities could connect and receive lit service as soon as Zayo completed the network or choose to only have equipment placed at their facilities. If they chose the latter option, they would not be charged until they established service. Participating cities needed to provide necessary rights-of-way access, a space for equipment on location, and access for maintenance.

Some local leaders were concerned that Zayo had received an unfair advantage over incumbent providers because it received stimulus funds. Though this concern ignored the many ways big incumbents have often received government tax breaks and subsidies, county officials assured them the network would not provide last-mile connectivity and would be available to incumbents to use if they wished. The incumbent providers had refused to apply for stimulus funds for projects in Anoka even though entities in the County had requested infrastructure upgrades for years. Nevertheless, Zayo's network infrastructure would remain open to them.

Over the years, many local leaders around the country have hoped that building open infrastructure would entice incumbents, particularly the big national cable and telephone companies, to invest in better last mile connections. Unfortunately, there are very few examples of that dynamic actually occurring. Regardless, Zayo's core business lies in leasing dark fiber to large entities, not being a service provider to businesses or residents.

County officials stressed to local leaders that the network was a cost-effective long-term strategy:

> *"We think we can repay the bond for what we are paying now and save taxpayers money," [Anoka County Deputy Administrator Dave] Minke said. "We've gotten support [resolutions] from most county cities."*[44]

Anoka County obtained resolutions of support to submit with the BTOP application. In communities with poor service, residents went door to door with petitions encouraging local government action.[45] Some community leaders hesitated, wanting more information before they would support the BTOP application.[46] Eventually, County officials obtained over 80 resolutions and letters of support from local businesses, school districts, libraries, cities, townships, colleges, elected officials, and public safety entities

From Idea to Implementation

Zayo and Anoka County planned a 286-mile fiber network to serve 145 community anchor institutions throughout the County. The list included 56 public safety entities, 11 K-12 Schools, three community college campuses, the Anoka County Sheriff's Office, and city and town halls. The network would significantly reduce connectivity costs to the County because each County facility would pay only $1 per month per facility to connect; each facility receives a minimum of 100 Mbps.

With 61 percent of the fiber deployed in underserved areas, the partners estimated the network could bring better connectivity to over 141,000 homes, assuming that some other entity or incumbent provider would suddenly want to invest in those connections. Anoka and Zayo also predicted private last-mile providers would eventually bring better connections to over 11,000 businesses and 600 additional anchor institutions. This was a more reasonable assumption as businesses and anchor institutions are higher margin customers for service providers than residents.

The partners stated in the BTOP application that they had met with providers interested in delivering residential services via the network but the only provider mentioned by name in the application was Omnicity, a wireless Internet service provider that later filed for Chapter 11 bankruptcy protection.[47] Omnicity had produced a letter of intent to serve County residents with wireless service, but the plan dissolved when another wireless provider acquired Omnicity's assets through the bankruptcy.

Zayo would own the infrastructure while the County would have an indefeasible right of use (IRU) of 12 fibers. The IRU, however, restricted the County to governmental and quasi-governmental uses, limiting its opportunities to generate revenue through commercial relationships.[48] More importantly, if no incumbent provider or other entity decided to connect the 141,000 homes, the County would be in no position to step up and make sure they were connected.

Zayo and the County submitted the BTOP application in March 2010. Four months later, they were awarded $13.4 million for the $19.1 million project. Stimulus funding paid for 70 percent of the project costs. While the original plan was to issue approximately $3 million in bonds, the County was able to tap into its capital reserves instead thus eliminating the need to bond for the project. Zayo contributed the remaining $2.7 million. In September 13, 2011, Zayo and the County officially broke ground on the new network.[49]

Pole attachment fees proved to be higher than expected so Zayo decided to bury fiber in certain areas to keep the project moving forward. The changes required the company to amend environmental assessments for permits to go underground. The permitting process created minor delays but did not significantly slow the project. Attaching to poles and environment assessments challenged many stimulus projects, both public and private alike.

By the end of May 2013, Zayo connected the last community anchor institution - the Coon Rapids Head Start building.[50] Every municipality in the County connected to the network in addition to 145 anchor institutions.

The network consists of 84 aerial and 192 underground miles in three 10 Gbps core redundant rings. The project extends into Ramsey County and also into Isanti County to connect the Isanti Campus of the Anoka Hennepin Community College.

Savings, Efficiencies, & Benefits for Anoka

The County's telecommunications costs are a fraction of what they were when it leased lines from incumbents. As planned, local governments pay nominal user fees to the County based on type of use, capacity, and the number of facilities connected.

The Anoka County Internet Technology Department now backs up large amounts of data in minutes; daily backups had previously required more than 10 hours due to the lack of bandwidth. Even though staff scheduled them for overnight hours, backups would still be processing each morning when employees returned to work. As a result, County staff contended with slow computers every morning; backups now require 30 to 60 minutes.[51]

The Centennial Fire District main office in Lino Lakes also uses the network for data and voice, connecting it to remote stations in Circle Pines and Centerville. The Fire District pays a $187 monthly fee to Anoka County; the old, slower connection was $400.

Fridley's Springbrook Nature Center now offers Wi-Fi for visitors. Staff used to find other tasks to keep them occupied while they waited for search engine results on the old connection. The Center now receives results in seconds via a gigabit connection. The City removed the old electronic storage server at Springbrook because the Nature Center now connects to City Hall's server via the network. Fridley now uses VoIP service via the

network instead of old phone lines, saving $987 per month – almost equal to the City's user fees to Anoka County.

Fridley, Circle Pines, and Centerville are a few of the municipalities in the County who now have fast, affordable, reliable connectivity. The County saves significantly through its partnership with Zayo and enjoys better connectivity than it did when leasing lines from incumbents.

Conclusion

Anoka County expected its countywide fiber optic network to create local government savings, spur economic development, and attract providers willing to offer better residential options. Though the network has clearly created savings for local government it has yet to achieve the other two goals. Local businesses and residents have seen little change due to the network.

The County depends heavily on Zayo to reach out to businesses and work with potential residential providers. The arrangement satisfies the County's desire to shift operation and maintenance of the network to an outside party, but relinquishes much of the County's control over the use of the network.

This is an incredibly important lesson in partnership: Know Thy Partner.

Zayo describes itself as a bandwidth provider that works with most of the largest global telecommunications carriers. It is known for providing middle mile fiber infrastructure and bandwidth to many of the large carriers, not for working directly with businesses that use the infrastructure. In short, the County seems to have developed the wrong expectations of its partner. This is an incredibly important lesson in partnership: know thy partner.

As Internet access has become infrastructure, local governments have to take a stronger role in ensuring residents and businesses have appropriate access. For some, this will mean a partnership but local governments must understand the business model of potential partners. Zayo has a core business focus of providing big pipes to big customers, not ensuring suburban residents and businesses have high quality Internet access. Encouraging investment in small business and residential fiber networks is incredibly difficult; Zayo should not be blamed if Anoka sees little progress in that area.

5. City of Buffalo

Local banks and businesses asked the city to build broadband when private providers wouldn't. Buffalo has a fiber network for businesses as well as wireless services throughout the community.

Buffalo describes itself as "where the old meets the new." Buffalo was a resort town in the mid-19th century for affluent city-dwellers. The town's population would more than double in the summer months with tourists. Today, the community of 15,000 located 40 miles northwest of the Twin Cities Metro is a bedroom community well known for fishing and the many antique, boutique, and specialty shops in its quaint downtown area.

Buffalo is the county seat and operates a utility that provides electricity, water and wastewater services, solid waste services and recycling, and both wired and wireless telecommunications.

CenturyLink and Charter Communications offer voice, cable TV and Internet access but historically have not prioritized the town for investment. Prior to the City's telecommunications venture, Qwest dial-up was the only type of data service in Buffalo.[52]

Businesses, Health Care, Public Facilities Approach the City

In 1996, local businesses also approached the City requesting it take steps to improve Buffalo's connectivity. Dial-up did not allow them to conduct routine business. Many commercial transactions with wholesalers or national headquarters were transitioning to being only online.

In the mid 1990s, the downtown banks similarly approached the City. In addition to better access to the Internet, financial institutions needed fast, secure connections between branches and headquarters. They reasoned that Buffalo was good at providing electric service and that the community would benefit from a municipal network. The financial industry knew it could trust Buffalo's utilities to provide these essential services.

Local health care facilities also became engaged for similar reasons and Wright County saw an opportunity to improve communications between facilities, notably a jail and public safety offices on the edges of town.

Challenges of an Early Adopter

City leaders first went to Charter and Qwest to request better data services for the community. Both companies replied that they were only interested in investing in high-density areas in the metro. Qwest and Charter told the City that "someday" they may be able to bring broadband to the community but not in the near future.

"Someday" was not sufficient for Buffalo. City Administrator Merton Auger and his colleagues considered broadband a necessary economic development tool. In 1996, a group of City and County leaders, local businesses, and educational professionals formed a technology task force.[53]

The utility wanted to take advantage of fiber and wireless infrastructure to establish a supervisory control and data acquisition (SCADA) system. SCADA capabilities would reduce truck rolls during electric outages making the utility more efficient and keeping electricity rates low.

Buffalo had considerable assets that facilitated the development of a fiber network, an impressive feat at a time when the Internet had not yet transitioned from nicety to necessity. Through its electric utility, the City had easy access to its rights-of-way via power poles. Buffalo was in the midst of several street projects so it could take advantage of the excavation to install conduit and fiber underground.

Community leaders wanted to focus on data services only, rather than offering the full triple play of telephone, cable television, and Internet access to the community. The City and the task force decided they wanted to offer carrier class services. Auger and the City aimed for a network that was highly reliable, redundant, and running "to the ten 9s; in other words up and running 99.99999999% of the time."[54] Though this is an impossibly high standard (industry typically aims for "five nines" or 99.999%), it shows the thinking of a utility that prioritizes reliability and quality of service far above profitability.

Deploying the Network

In 1996, the City established a plan to invest approximately $1 million to deploy a small amount of fiber.[55] The School District, which had a history of investing in technology, contributed approximately $100,000 to get the project started. Northwestern National Bank purchased a $1 million tax-exempt bond and the two arranged a five-year municipal lease purchase with the City. Buffalo paid back the lease purchase agreement with revenues derived from the system. At the end of the term, Buffalo bought the system for $1.

The first design was a star topology, lacking redundancy, with the City offices at the center. The City created a new communications and Internet division within the utility and planned a three-phase deployment. Planners intended to connect seven City buildings and utility sites, school district facilities, the county courthouse, the library, and three downtown banks. They planned to next expand deployment north from downtown to Highway 55 to offer connections to more banks, the local hospital, and the middle school.

By the fall of 1997, District facilities used the network for data and telephone connections. Buffalo's educators found new ways to use technology in teaching. In July 1998, several teachers won an award for their WebFolios project.[56]

In 1998, the City began to supply data services to Wright County facilities. The County established a new Human Services building in abandoned retail space where offices needed access to broadband. The existing Wright County Government Center and the Public Works Building north of Buffalo were under renovation, so the County and Buffalo also collaborated to install fiber between those critical facilities. The two entities negotiated a lease wherein Wright County would pay $135 for each line for three years. According to Bill Swing, the County Information Services Director at the time, without Buffalo's network, the County would have had to install its own fiber optic cables.[57]

In 1999, the City Council put up the fiber network for sale in what Auger described as "a moment of cold feet."[58] The City received low offers from Bresnan Cable Company (Bresnan) and a local telephone company.[59] After weighing the pros and cons, the City Council decided to keep the network and develop it for the community.

In 2000, the City began incremental expansion of the fiber network. Over the next several years, the star design was slowly replaced with a redundant ring. The expansion allowed service to later be installed in County buildings on the edge of the City. Buffalo has continued to expand its fiber network incrementally. "We always put money back into the system," said City Administrator Merton Auger.[60]

Buffalo enthusiastically embraced new ideas for technology to make municipal operations more efficient for the growing community. The electric utility was upgrading, including building a new substation with new switching equipment. Police officers used mobile computer terminals in squad cars. Employees at the water plant used laptops to monitor and control pumps, valves, and holding tanks. City staff used GIS and GPS to map out water and sewer infrastructure to replace the City's antiquated paper maps. The City's rapid growth required new approaches. Auger told a reporter in 2001:

> *"We are dealing with growth by using technology to become more efficient without having to add more staff... We are getting quicker. We are getting to the point where we will know more about a problem before we even start to fix it."*[61]

As more residents and businesses used the Internet, Qwest's dial-up service repeatedly struggled under the strain. In 2000, businesses and residents that used Qwest approached the City Council. Telephone calls were blocked; callers received "all circuits are busy" messages. The problem was so widespread that the City Council sent a letter of complaint to Qwest. The company responded with a letter in January 2001 attributing the problem to rapid growth in Buffalo and the increasing popularity of the Internet.[62] Residents and small businesses were increasingly dissatisfied with their limited options in Buffalo.

Expanding Access With An Affordable Wireless Complement

More residents approached the City asking for affordable and reliable connectivity. Buffalo explored the use of fiber to connect users but found fiber network deployment costs prohibitive.

Auger and his colleagues decided to explore the wireless option for widespread residential service. The City released a Request for Proposals to reach potential partners.[63] Buffalo decided on a Waverider 900 Mhz point-to-multipoint system using non-line of sight wireless technology. This means the utility would put up antennas and subscribers would also need an antenna but they would still work even if trees or buildings were between them. The City installed wireless antennas on community water towers because they were already connected to the network for utility purposes.[64] The initial investment in the wireless system was $750,000.

The system was ready for residents and local businesses by November, 2001. Customers within 1.3 miles of an antenna relied on an indoor antenna in their homes. Beyond that distance, homes usually required external antennas. Speeds were up to 1.6 Mbps; modems cost $550 or subscribers could arrange to pay $10 per month on a rent-to-own basis. The service cost $29.99 for residents; businesses paid $49.99 per month with a similar modem arrangement.[65]

The City continued to invest incrementally in fiber whenever roads were opened. By 2004, Buffalo also began offering dark fiber service to local businesses. Dark fiber service cost $149 per month and lit fiber services were $500 per month. They connected approximately 35 commercial customers with fiber; 640 residential and business users subscribed to wireless service. Buffalo upgraded its wireless system in 2008 and named

it Bison QuantumCONNECT. This was the fourth upgrade in order to serve more people with faster wireless speeds.

In 2010, residential rates were $14.99 per month for download speeds up to 512 Kbps. Today, the network also offers download speeds at 5 Mbps for $39.99 per month, 3 Mbps for $29.99 per month, and 1 Mbps for $19.99 per month. Over 200 residential and small business subscribers use the wireless service.

In 2010 the City launched the Buffalo Wireless Internet Group (BWIG), the support center for customers. The BWIG is the antithesis of traditional large scale ISPs that focus primarily on signing up a customer but struggle to provide quality customer service. Customers can call or visit the administrative offices for help configuring equipment, setting up antennas, establishing email accounts, etc. Technicians will also come to a subscriber's home to perform installation or help orient antennas correctly for a nominal charge. The cost to launch the service was approximately $10,000; BWIG realized a return on the total investment within a year.

Economic Development With Fiber

In 2009, a Qwest line was cut, darkening every business subscriber in Wright County that relied on Qwest for service. Since that incident, more business customers have turned to the City to access its redundant network. Two independent providers bring their fiber networks into Buffalo; the City works with both. Automatic switching equipment at the head end ensures that if one line goes down, the other will automatically take over. Today, approximately 60 local businesses connect via dark or lit fiber; many are retail and manufacturing facilities.

PenRad, a software producer that makes products related to mammography, came to Buffalo from a Twin Cities suburb in 2012 because it needed the fiber network.[66] PenRad required greater capacity and especially reliability; because Buffalo could meet its needs, the company brought approximately 60 well-paying jobs to town.

The Centra Sota Cooperative, a customer owned company that provides goods and services to the agricultural market and urban consumers, recently moved to a fiber-ready location in Buffalo. The site is a former car dealership; an ideal location for the cooperative's large farm implement inventory, fertilizer, and gas for farmers. Centra Sota orders products from suppliers that only offer online catalogues. Slow dial-up made browsing and ordering tedious and almost impossible at their previous location.

Dark fiber services for businesses now cost $175 per connection, a modest increase over in ten years. Banks, healthcare clinics, the hospital, and the County Courthouse take advantage of dark fiber. The City also has a 10-year contract with the State of Minnesota to provide connectivity to Wright County facilities through dark fiber connections.

The City connects its eight facilities to the network for voice and data services. Each facility pays $258 per month to the utility. The City also uses the network for a camera system to monitor security at the airport, the electric substation, throughout its park system, and at several traffic intersections.

Today, the School District manages its own network with minor assistance from the City utility. As part of the original investment, the City

provided an IRU to the District for one strand of the original fiber. The District now pays only $129 per facility. In addition to a dark fiber connection between facilities, the City provides an Internet connection, continuous monitoring, and maintenance.

The City keeps expansion costs low with a dig-once policy; whenever Public Works excavate streets, it also installs conduit. The City often installs fiber immediately in addition to conduit. The network has expanded to over 29 miles, with over 80 percent underground.

By 2013, revenues exceeded expenses by approximately $90,000 per year. Auger estimates the City has invested approximately $3 million in the fiber system in total.

Since the beginning, Buffalo has reinvested revenues from fiber and wireless data related services back into the network. By 2013, revenues exceeded expenses by approximately $90,000 per year.[67] Auger estimates the City has invested approximately $3 million in the fiber system in total.

The City's goal is to further expand residential services. The wireless network serves many homes, but Auger and the City Council know that bandwidth requirements will continue to grow. The City is considering a plan to expand the fiber and complement with a fourth generation fixed wireless system, in a hybrid fashion. The plan would improve speed and leverage current assets.

Conclusion

Buffalo began its network with a limited investment but has compounded the benefits by reinvesting network revenues and taking advantage of other capital projects to expand conduit and fiber. The results are impressive, from attracting new employers to town to improving government efficiency. The schools have the capacity they need and can upgrade without breaking their budgets. By making smart investments and retaining control of essential infrastructure, Buffalo can chart its own course in the new economy.

6. City of Chaska

Chaska.net was the first broadband provider in the city, among the first citywide wireless systems in the nation. City fiber provides high capacity, low cost links to schools, city facilities.

Chaska, located approximately thirty minutes southwest of Minneapolis, has experienced steady population growth since the 1950s.

The City provides water and wastewater services in addition to electricity; the Chaska Municipal Electric System has served the community since 1914. In addition to landline telephone service, CenturyLink offers limited commercial fiber services under the Embarq corporate name. While CenturyLink and Comcast bring DSL and cable services to the area today, the community had to seek other options years ago when neither would provide broadband.

Growing Pains in the Schools

In the 1990's, the schools found incumbent providers unable or unwilling to invest in higher capacity school connections than the T1 lines that provided 1.5 Mbps. In 1998, community leaders decided they could wait no longer and took action.

"We were tired of waiting for [cable companies] to provide bandwidth at competitive prices," said City Administrator Matt Podhradsky.[68]

In 1999, KMC Telecom (CenturyLink's predecessor) was installing a fiber optic network along major city corridors. In exchange for free access to the rights-of-way, KMC installed municipal fiber to connect City facilities.

By combining opportunities to deploy fiber in some areas with wireless complements, the City and School District partnered to improve access. With a $100,000 Urban Challenge grant from the 3Com Corporation, the City launched a point-to-multi-point wireless wide-area network to complement the leased T1s as an initial investment in a wireless network.[69]

In 2000, the City and the School District expanded the existing fiber optic network to connect all the existing schools and public facilities. The District agreed to pay construction costs and ongoing maintenance costs and the City would own the lines.[70] The City would also retain a number of strands for its own use. The goal was to interconnect the school facilities and to provide connections for existing public facilities in Chaska.[71]

The network connected City Hall, a community center, the government center, and its municipal facilities. The City created Chaska.net, an independent telecommunications utility, to serve as the ISP for the District.[72] At the time, the District paid $3,000 per month for connectivity through the fiber network.[73]

In 2001, Chaska.net expanded to begin offering high-speed Internet services to local businesses via the city owned fiber installed by KMC. By the end of the year, Chaska.net had connected seven businesses, demonstrating demand for better commercial telecom options. Chaska.net decided to meet the demand with a line of sight point-to-multipoint wireless service.

Chaska.net placed antennas at City Hall, the Community Center, and City water towers to provide line of sight to local businesses; monthly rates ranged from $99 to $450 per month. In an effort to bring connectivity to the surrounding towns, Chaska.net installed additional antennas in Victoria, Waconia, Norwood Young America, and Shakopee. By April of 2004, 71 businesses subscribed to the wireless service, creating $16,400 per month in revenue.

At a cost of $621,000, the City felt it was time to experiment with low cost, self-service Internet access for the entire community.[74] Chaska.net mounted 378 routers on city light poles in order to deploy residential Wi-Fi.

Chaska financed the Wi-Fi network with general obligation equipment certificates, which was ultimately backed by taxpayers. Chaska's certificates were for a four-year term at 4% interest for the entire amount. Chaska.net predicted that it would pay off the certificates through subscriber revenues and still have revenue for investment.

Unfortunately, the initial launch was not very successful in part because they overestimated customer expertise. Chaska.net was overwhelmed by customer calls by new subscribers who did not know how to use their computers. The goal was to offer a self-service, low-cost option for the community, but the community needed more handholding.

City Administrator Matt Podhrasky said:

> *"The service desk calls overwhelmed us... there was a lot of 'We don't know how to use our computer."*[75]

Customer service issues coupled with technical glitches were slowly ironed out and improved the wireless service to improve over the next several years.

Education Benefits

Prior to developing a fiber network with the City, the School District leased six 1.5 Mbps T1 lines at a cost of $280 each; there was no wide area network (WAN). In other words, the District paid $1,120 per Mbps per month for six connections and all internal data went out to the Internet before reaching its destination.

After developing the fiber network with the City and engaging Chaska.net as its ISP, the district connected its facilities. Since 1999, the District has expanded and managed the network incrementally on its own. In 2013, Chaska.net provided 300 Mbps Internet access for $4,500 per month to a total of sixteen facilities, lowering the cost to $15 per Mbps for Internet access.

In addition to Internet speeds 200 times faster, the schools benefitted from the addition of a fiber wide area network at speeds of 4 – 40 Gbps. This means transferring files between schools can happen far faster than downloading or uploading Internet content. Students and staff have expanded their use of distance learning and cloud based applications. The WAN has improved staff efficiency. Sharing large files or participating in videoconferences, a time consuming struggle over the old T1 lines, became routine operations.

Eastern Carver County Schools
Exceptional, personalized learning

The District used capital improvement bonds to finance additions to its initial network deployment. As the student body grew the District included the cost of the fiber optic infrastructure in the construction costs for new facilities. Over time, the District has continued to exchange fiber strands for access to the City's ROW, growing the network to 18 miles.

When Carver County officially lit the CarverLink project, discussed above, the School District was among the first entities to use it – both to increase redundancy for some facilities and prepare for future expansion. In general, Chaska had already developed the expertise and assets to take full advantage of investments like CarverLink.

Chaska.net's Wi-Fi network has been the subject of multiple case studies, celebrated as one of the first municipal Wi-Fi networks to provide affordable service to the entire community. While the service has benefitted a large segment of the population, it would not exist if the City had not first invested in fiber infrastructure for backhaul. On the flip side, Chaska.net has been targeted by opponents of municipal broadband investment, who ignore any social or efficiency benefits of the network. They focus narrowly on its revenues and costs to claim it was an unwise investment.

Conclusion

Though many in Chaska remain confident that the citywide Wi-Fi implementation was a wise decision of its time, it may no longer be a prudent investment moving forward due to the high cost of equipment upgrades.[76] Additionally, Wi-Fi cannot provide the same speeds and level of reliability that many are beginning to demand.

Fortunately, the City's long-term investment in fiber continues to meet its needs and will for the foreseeable future. Chaska.net has expanded the fiber to a total of 26 miles throughout the city, monitored and maintained by Zayo. Chaska also uses the fiber and wireless networks for SCADA to monitor and control water, wastewater, electric, and flood control measures. The municipal electric utility is in the process of installing smart meters to use the network for automatic metering.[77]

In addition to lowering the costs from $1,120 per Mbps to $15 per Mbps, the schools increased their Internet speeds 200 fold.

Chaska's students began benefiting from superior connectivity years before students in peer communities. In addition to lowering the costs from $1,120 per Mbps to $15 per Mbps, the schools increased their Internet speeds 200 fold. The schools were also able to implement a WAN, greatly enhancing staff efficiency.

Chaska's future is its own to chart. With the fiber assets already in place, it could choose to become a citywide gigabit community. Or it can simply enjoy knowing that the telecom bills of its municipal facilities and anchor institutions are far lower than they otherwise would be.

7. City of Windom

The first city in Minnesota with a universal fiber-to-the-home network. It is now expanded to eight nearby small cities. The network has spurred job growth and produces a savings of $400,000 per year for the region.

Windom lies approximately 135 miles west of the Twin Cities Metro and is the county seat of Cottonwood County. The community of 4,600 near the Iowa border is home to several manufacturing plants and many agricultural interests.

Windom Municipal Utilities (WMU) began providing electric services to the community in 1895, a time when private electricity companies regularly claimed that electric networks were too complicated for local governments to manage. The City also provides water and wastewater services. In 1985, WMU also began offering cable television services, as a number of other municipal utilities in small towns had long done throughout Minnesota and Iowa.

By the late 1990's the community was frustrated at the lack of private investment in broadband Internet service and considered upgrading the cable network to begin offering telephone and Internet access in addition to cable. However, Minnesota state law required Windom to pass a supermajority 65 percent referendum in order to "own or operate" a telephone exchange.[78]

After the town placed the measure on the ballot in 1999, the incumbent telephone company, US West (later Qwest and now CenturyLink), campaigned heavily against it, insisting it would upgrade facilities in Windom at some indeterminate point in the future. In an off-year election with poor turnout, only 48 percent of voters supported the measure. Local leaders labeled it dead.

However, after Qwest announced the following July that nearby communities but not Windom, would be upgraded to DSL, an outraged local citizen wrote the paper to call for another referendum. In the ensuing conversation residents reflected on their reasons for demanding a revote. They had been previously confused about the question. They thought the issue would pass easily and hadn't voted. They had initially voted no but with the latest action by Qwest had changed their mind. After several weeks of community discussion and a petition with 800 signatures, local leaders put the question on the 2000 ballot.

Two-thirds of the voters approved the measure, allowing the community to begin examining its options. Just because they had the authority did not necessarily mean the upgrade would be financially feasible.

Local Authority

The US National Broadband plan recognizes the importance of local authority to build networks as necessary. Recommendation 8.19 says, "Congress should make clear that Tribal, state, regional and local governments can build broadband networks."

And a recent opinion from the DC Circuit Court, Verizon v. FCC, specifically noted that the Federal Communications Commission has the power to remove barriers to infrastructure deployment, specifically citing state laws creating barriers to municipal networks.

Local leaders convened a telecom working group in 2001, tasked with educating the community on options for upgrading the cable network and feasibility of adding new services. Over two years, the group considered twelve approaches before settling on building a fiber-to-the-home network offering the "triple play" of television, Internet access, and telephone. Qwest finally began offering DSL in Windom toward the end of 2003.[79]

In 2004 Windom sold $9.5 million in revenue bonds. Of this, $650,000 created the bond reserve account and another $600,000 was earmarked for paying the first two years of capitalized interest. Another $240,000 covered financing costs, leaving approximately $8 million to build the network and pay the startup costs until revenues would support the effort. The bonds were backed by the project's future revenues, not taxpayer dollars.

Demand for WindomNet services turned out to be even higher than expected, with most of the town subscribing to at least one of the three telecommunications options. Rather than installing equipment for 1,500 premises as forecast, they installed 2,000. The entire network was built underground, which has protected the network from accidents. They've never had a fiber cut according to WindomNet General Manager Dan Olsen. Since it costs approximately $2,000 to hook up each household the extra 500 installs demanded an extra $1 million not expected in the original business plan. Windom took out a $1 million line of credit from a local bank in 2005 to cover the difference.

Greater than expected demand came from businesses as well as residents. Fortune Trucking, an important local employer located just outside of town, decided to upgrade its IT systems in 2007 to remain competitive in a field rapidly integrating new technology. Potential customers would place bids online and expect a rapid response. Thus, a little downtime translated into a big "trucking" problem. Fortune first checked with the big telephone company that had thus far met its needs to see if it could upgrade the system. After being assured the telephone company would upgrade, Fortune purchased a $30,000 IT system.[80]

The trucking company quickly found that the telephone company either could not or would not provide the necessary level of service. Frustrated, Fortune began making plans to move the office to a location with better service in a different state. They also called Dan Olsen. In an interview with MPR, Olsen recalled some urgency to the call: "Dan, you need to get your butt out here now."[81]

Thus, a little downtime translated into a big "trucking" problem.

Thirty days later, WindomNet had extended fiber over a mile outside of town, keeping 47 jobs in the community. Now when any company tries to convince Fortune to switch away from WindomNet, they decline, saying: "It's a great relationship. When there is a problem, I call and it's taken care of. It's great to have a local company to deal with."[82]

After expending significantly more capital than expected due to higher than projected demand and the Fortune Trucking expansion, Windom sold $2.365 million in short term general obligation bonds in 2007. Unlike the revenue bonds, these bonds came with the explicit backing of Windom's full faith and credit. The bonds repaid the line of credit from the bank and internal loans to the project from other city funds.

During the economic uncertainty of 2009, Windom chose to refinance its short term bonds again using general obligation bonds. The $2.4 million GO

bond repaid the 2007 debt. Meanwhile, Windom was working with nearby towns on a plan to apply for federal broadband stimulus funds to expand the fiber network throughout the region. That network, the Southwest Minnesota Broadband Service, began connecting households in 2012 and is discussed below.

Key Trade-offs

Windom's business plan did not call for breaking even financially until 2011, a challenge they would ultimately come close to meeting. But rather than be a slave to financial mileposts WindomNet struck a balance by continuing to invest in new capacity.

The largest local employer, a Toro manufacturing plant, upgraded from 100 Mbps service to 1 Gbps in 2010, giving it faster connectivity in Windom than company locations in the Twin Cities.[83] Despite the continuing impact of the recession, Toro added 75 jobs to that plant in 2010.

In the same year, the local hospital became an anchor-tenant on WindomNet after its long contract with the telephone company expired. Expanding connections to the hospital was costly but allowed the hospital to spend less on its 315 phone lines. With the higher capacity connections, the hospital began taking greater advantage of video conferencing and remote reading of diagnostic imagining.

Building fiber paths to Fortune Trucking and the hospital delayed the point at which WindomNet could break even. These are the kinds of trade-offs a community owned network often makes – improving connectivity for indirect community benefits rather than maximizing short term profits. In this case the result for Windom has been more jobs, a stronger economy and more efficient health care.

These are the kinds of trade-offs a community owned network has to make – improving connectivity for indirect community benefits rather than maximizing short term profits.

Over the longer term, these investments can pay dividends far beyond monthly revenue. Windom has more jobs, a stronger economy and more efficient health care due to the network and decisions they made.

WindomNet offers higher speeds at lower rates than CenturyLink. In Windom, as in many peer communities, CenturyLink's DSL peaks at advertised rates of just 7 or 12 Mbps downstream and less than 1 Mbps upstream. However, many people report that their speeds are considerably below advertised rates. CenturyLink's connections are priced from $47 - $52 before the fine print fees are factored in. A 10/2 Mbps (down/up) connection from WindomNet runs $38 and 30/20 is $68. They also offer a 60/40 Mbps connection as well as a full gig for those who need it, whether a manufacturing plant or single entrepreneur.

Small Town Challenges

Given the challenges of its small size and remote location Windom has been extraordinarily successful. Conventional network economics suggest that a triple play network needs at least 4,000 subscribers to pay the substantial fixed and operating costs of a triple-play fiber network. But given its size Windom has just over 2,000 potential subscribers between households and businesses. The small base left Windom with little margin for error even given the fact that most residents took service from the network. Communities considering a triple play municipal network are

well-advised to partner with nearby towns and/or townships rather than attempting to recreate Windom's approach.

Compounding the challenge of its scale was its distance from an affordable Internet connection. Windom needed a high capacity connection to the wider Internet to take full advantage of its fiber system. Rural areas often find the only connections out of town are maintained by the incumbent telephone and cable companies that use their monopoly power to price the circuits high. Until the broadband stimulus projects broke many of these backhaul monopolies in rural America, small towns with fiber networks had to offer far slower Internet connections than their fiber network could handle due to the backhaul bottleneck.

Windom solved its backhaul limitation by partnering with other ISPs and getting a fiber route all the way into Minneapolis. The network now has a co-location facility in its network operations center that allows other ISPs to take advantage of its fast connections as well.

Another challenge Windom faced was the growing competition for video services from the satellite television companies. Windom's total number of cable subscribers began decreasing in 2003 and never fully recovered in town, making it harder for WindomNet to meet its business plan goals. However, Windom has benefitted in recent years by offering its services in neighboring communities. Supported by a federal broadband stimulus award, eight nearby towns joined together to build a fiber network managed by WindomNet.

Municipal Networks & Small Businesses

A recent report from the General Accounting Office looked both at broadband projects funded by the broadband stimulus programs and municipal networks to analyze the impact on small businesses. They found these networks tend to have higher speeds and lower prices.

"According to small businesses GAO met with, the speed and reliability of their broadband service improved after they began using federally funded or municipal networks."

Southwest Minnesota Broadband Services - SMBS

The town of Windom was hardly alone in being left behind by the big, corporate telephone and cable companies. When the federal broadband stimulus programs were unveiled, eight nearby communities recognized an opportunity to finally bring modern telecommunications services to their areas by building their own fiber network that would build on WindomNet's success. They could build a rural fiber network without having to invest in a costly head end, voice switch, or other equipment that WindomNet already maintained.

Jackson, Lakefield, Round Lake, Bingham Lake, Brewster, Wilder, Heron Lake, and Okabena lacked access to broadband in 58 percent of the combined area and another 34 percent only had access up to 1.5 Mbps down.[84] Jackson and Lakefield had previously each built their own cable systems but decided not to upgrade to fiber due to the high costs relative to the small population. After being told by CenturyTel (now

CenturyLink) that the community would "never" get faster than dial-up to due to their size, Round Lake built its own wireless network in 2002 to ensure broadband availability.[85] When commercial providers continued to ignore Brewester, Heron Lake, and Okabena, Round Lake expanded the wireless network to them as well.

The Southwest Minnesota Broadband Services network passes 3,500 residences (including 250 homes outside the towns, mostly farms), 292 businesses, and 50 anchor institutions. Each participating town has a representative on the board of directors and the subscribers from the pre-existing cable and wireless systems were transferred to SMBS.

The SMBS assets are owned by the eight communities via a Joint Powers Agreement. The $12.7 million stimulus award was split evenly into a grant and loan. To raise the rest of the cost of the network, five of the towns contributed an aggregate amount just under $1 million. And Jackson County made an upfront payment of $500,000 in return for $1 million worth of services over the following 20 years.

SMBS began connecting customers in early 2012 and already has well more than half of those passed taking services. Their goal is to serve over 3,600 customers in the first five years and they presently have over 2,600 served. They are even seeing significant demand outside of the territory they presently serve – Dan Olsen noted they could have a full time person just answering calls from people asking them to expand.

In addition to providing the region with Internet access far faster, more reliable, and more affordable than the big carriers would, the network has helped local governments to be more efficient. Having already implemented its own GIS system, Cottonwood County is now able to share the application with these towns and eliminate duplicated systems. Being a high bandwidth application, local governments need cannot use it unless they have high capacity connections.

Private businesses were among the first supporters of SMBS, submitting letters of support to the federal government as part of the broadband stimulus application. The city of Jackson had been seeking a solution for better connectivity to its industrial park for some time because its paltry 1.5 Mbps service was unlikely to attract new businesses. In fact, when employees showed up to work each morning, "there is such a drain on bandwidth that the rest of the community's Internet users suffer."[86] It wasn't only businesses publicly lining up to support the investment, the First Baptist Church and Sanford Jackson Medical Center also endorsed the initiative.

Success or Failure?

Throughout its first decade of operation, WindomNet has been regularly condemned in the state capital by lobbyists for incumbent telephone and cable. Its financial losses in the startup years were offered as "proof" that it was a failure despite the fact that these kinds of networks always run losses in early years – it is built into the business plan. As WindomNet's financial numbers improved, critics claimed taxpayer dollars were supporting the network. Actually, the network has been overwhelmingly built with private investor dollars. More importantly, many of the big cable and telephone companies regularly receive subsidies, including tax incentives, universal service funds, and the benefits many cable companies received for decades from being a sanctioned monopoly. WindomNet likely benefited less from taxpayer subsidies than those who regularly attack it.

Our examination of Windom initially found that the network could potentially have received approximately $1.2 million from local taxpayers

as well as financial backing of lower cost general obligation bonds for part of its history. But on closer examination, we actually found that some of taxpayer funds budgeted for the network were never used or came from net revenues from the cable service in earlier years.[87] We believe Windom has used less than $500,000 of taxpayer dollars to support the network since 2004. But as an indication of present day financial health, network expenses have been roughly in balance with revenues after depreciation in recent years.

Assuming Windom did spend some $500,000 of taxpayers' money, what are the benefits to taxpayers from that expenditure? If we ignored all the other benefits of WindomNet and solely focus on direct economic development benefits, saving 47 Fortune Trucking jobs translates into a cost per job saved of $10,600. This is substantially better than Minnesota's JOBZ Program to spur economic development ($27,000 - $30,000 per job).[88]

Some of the network benefits are cultural. In 2013, with the Windom Robotics team in Anaheim for the VEX Robotics World Championship, residents could cheer their team on television after WindomNet "worked some magic" to put the live feed on a cable channel.

Yet WindomNet has benefited the community in many more ways than keeping Fortune Trucking in town. It connects many key employers, from Toro to the hospital, making them more efficient. And still more businesses currently lacking affordable, reliable, and fast Internet access in Cottonwood County will eventually be connected.

In addition to meeting business needs, the network supplies a 10 Gbps ring connecting both Cottonwood and Jackson counties to the state. The counties also use the network to share IT resources and a phone system, helping to stretch taxpayer dollars.

Some of the network benefits are cultural. In 2013, with the Windom Robotics team in Anaheim for the VEX Robotics World Championship, residents could cheer their team on television after WindomNet "worked some magic" to put the live feed on a cable channel.[89]

WindomNet provides IT services valued at $7,500 per year to the City at no charge. Municipal facilities and the library have access to much faster speeds than they would in WindomNet's absence, yet pay a fraction of what those connections would cost from a private provider. Assuming that difference saved only $20 per month per connection, the savings from all 37 connections would be **almost $9,000 per year.**

The SMBS expansion resulted in calls from one town to another being untolled rather than long distance. With over 2,500 households taking telephone service between Windom and SMBS, if the average household avoids just 30 minutes of tolled calling each month at $.1 per minute, the cumulative **savings are $90,000 per year.**

Windom has over 1,000 subscribers to its Internet access service, which are priced about $10 per month below CenturyLink's advertised rates for the two common lower speed tiers. The savings per household are over $100 per month and in aggregate over **$100,000 per year.** SMBS also has approximately 2,000 subscribers to Internet access, some of whom would have been paying much more for satellite Internet access. This group represents yet another **aggregate savings in excess of $200,000 per year.**

Over 10 years, a $500,000 investment has yielded millions in community savings and benefits. Those savings have rapidly increased since SMBS launched and will likely continue growing.

With this full analysis, a possible $500,000 infusion into WindomNet looks a lot less like a subsidy and a lot more like a wise investment in the future of the community and the region. Given the benefits of expanding the network over more communities, the network's financial position should only improve over time.

The addition of so many additional subscribers from the SMBS expansion suggests that WindomNet will no longer need financial support from the town. Indeed, as WindomNet grows it will begin contributing back to the general fund in PiLOT (payments in lieu of taxes). Windom's municipal owned electricity utility, for example, has long paid $175,000 per year into the general fund.

In 2012, Windom refinanced all the network debt into revenue bonds with a term of 20 years. The $11,205,000 retired the previous debts and is not a general obligation of Windom, which means the investors are again assuming risk from the project, not taxpayers. The total cost of the WindomNet network is in the range of $12 million, the overwhelming majority of which will have been paid by subscribers to the system.

Conclusion

Building and operating a triple play fiber-to-the-home network is a very challenging task, particularly for a small town. Windom shows that it can be worth the effort, but it is never easy.

WindomNet Community Benefits

These are some of the benefits we could attach a dollar value to, each is a per year estimate.

$7,500 – IT Services to Windom

$9,000 – Conservative estimate of savings for municipal department connections

$90,000 – Community savings from lower long-distance charges

$100,000 – Windom's aggregate Internet access savings

$200,000 – SMBS aggregate Internet access savings

TOTAL: $406,500 – Estimate of yearly community benefits from WindomNet

WindomNet is delivering benefits to the community well in excess of $400,000 per year, a significant amount for the region. They have access to higher capacity connections than most metro residents and far better customer service than is found from any of the national companies.

Having established SMBS, WindomNet is now helping the larger region to be a leader in connectivity for the state. Moving forward, the network will almost certainly continue to expand, giving still more rural residents and businesses the opportunity to take advantage of modern technologies.

8. City of Monticello

The city built a fiber-to-the-home network in a partnership with a private ISP. Following a disruptive lawsuit, Fibernet has struggled financially but the community has saved millions by introducing real competition.

Monticello is just off Interstate 94, approximately 40 miles northwest of Minneapolis. The city boasts nearly 13,000 residents. Since 2009, Monticello is the only city in the United States, possibly on the planet, with two citywide fiber-to-the-home projects competing head to head.

Prior to Fibernet, most residents and businesses had a choice between telephone service and slow DSL from TDS Telecom (a Fortune 500 company headquartered in Madison, WI) and moderately faster Internet access and television from Charter, (which will become the nation's second largest cable company if Comcast is allowed to take over Time Warner Cable.)

Back in 2005, local businesses were complaining to elected officials about slow, unreliable Internet access. Bill Tapper, a local business owner, told MPR:

> *"My employees would sometimes take the data home where they had a better Internet connection than we did and do their uploads at night."* [90]

TDS Telecom insisted it was meeting existing demand while Charter cable refused to wire any industry or business park unless businesses paid an upfront connection fee that few felt they could afford.

In May, 2005 the City Council appointed a Task Force to investigate options for the community. A feasibility study was completed in September, 2006. As part of that study, a survey of residents and businesses found very strong demand for lower priced services. Residents were more interested in cable television than Internet access but businesses focused on lowering the cost of Internet access. Judging from survey results, neither group particularly cared whether local government provided the service or not, each was focused on lowering their telecommunications bills.

Unlike the vast majority of municipal fiber networks built in the U.S., Monticello did not operate its own municipal electric company. Instead it developed partnership with HBC, a local telecommunications company. Monticello would own the network and HBC would operate it. To reduce risk to the City and avoid using any taxpayer dollars, Monticello planned to issue unbacked revenue bonds to private investors. If the network failed to generate sufficient revenues, then investors, not taxpayers would bear the losses.

Other Minnesota Examples

Local governments have been much more involved in delivering telecommunications than many realize. Crosslake and Barnesville have long been incumbent providers in the community.

Pine City built a fiber backbone and Eagan has built a fiber loop, both to serve businesses. Many school districts operate on publicly owned fiber, whether from the municipality, county, or their own asset.

In October and November 2006 the city held a series of educational forums to discuss a fiber network that would be available to every resident and business in Monticello. By the end of the year, the Industrial Development Committee passed a resolution recommending the City Council bond for the fiber optic project.

In September, 2007 Monticello held a referendum, per Minnesota law, on whether its citizens wanted to own and operate a telephone exchange. TDS and Minnesota cable companies teamed up to oppose the network, producing glossy flyers and hiring an out-of-state firm to call potential voters with misleading claims that the network would cost taxpayers $26 million, which actually was the full cost of the system to be paid for by issuing bonds. Despite being wildly outspent, those in favor of a municipally owned network won 74 percent of the vote, far in excess of the 65 percent required by the antiquated Minnesota law for a network to provide telephone services.[91]

TDS Sues

After the referendum, Monticello focused on financing the network. They understood that offering unbacked revenue bonds would come with a higher interest rate because investors were taking on more risk than if they pledged the full faith and credit of taxpayers. Just as the City was selling bonds to investors, TDS filed a lawsuit claiming the City was prohibited by Minnesota law from financing the project with revenue bonds. Forced to make a quick decision, Monticello decided to complete the bond sale and fight the lawsuit. They issued $26.5 million in bonds at a 6.75 percent interest rate.

In hindsight, the TDS strategy was devilishly brilliant: Delay construction of the network, giving TDS the time to build its own network, increase the cost of borrowing for Monticello, and tie up city resources. It didn't matter that multiple courts ruled against TDS, it didn't expect to win the case. And by the time the final court had ruled against it lasting damage had been done.

As the case began working its way through the legal system, TDS began rapidly upgrading its old copper network to fiber, despite its previous assertion that its existing system was perfectly adequate. The Monticello Times described it this way:

> *"Meanwhile, TDS announced it will be improving its own fiber optic services to Monticello, a move that is 'obviously in response' to the special election held last fall, according to spokesperson Drew Peterson, who is TDS' director of legislative and public relations."*

Monticello, meanwhile, had to keep the bond proceeds in an escrow account. Recognizing the court case would last longer than the 2008 construction season in Minnesota, the city council decided to build a smaller fiber loop to connect community anchor institutions and businesses in downtown and a business park. Unable to use the bond funds, they paid for the project out of the city's reserves, creating a loan that was repaid once the bond funds were available. Some on the city council apologized to the public, noting that they had promised the network would not use taxpayer dollars but felt they had to move forward with at least a small project in 2008.

As part of that project, the city asked TDS to engage in joint trenching, where they would cooperate in placing conduit in the same corridors at the same time, potentially saving both entities millions of dollars. TDS ignored the first letter and then turned down the offer after a second letter, claiming it would be "anti-competitive" to coordinate

in a standard dig once fashion. Joint trenching is a common industry practice that violates neither the spirit nor letter of antitrust laws.

Without getting lost in the details, the TDS lawsuit against Monticello hinged on whether Internet access could be considered a "utility or other public convenience" and whether bond proceeds could be used to pay for the startup costs of a project. As other projects in Minnesota had used bond proceeds for startup costs and Windom had long operated a triple play network, TDS stood on dubious legal ground.[92]

Judge Jasper dismissed the case with prejudice on October 8, 2008, opening a 30 day window for TDS to appeal the decision. On day 29, TDS filed the paperwork to appeal. After another six months of waiting, the Court of Appeals affirmed Judge Jasper's decision. A few weeks later on Jun 16, 2009, the Supreme Court denied the final petition for review from TDS, and Monticello was free to finally use its funds to build the network.

The end of the case was bittersweet for Monticello. Though it would ultimately recover some of the losses from the year-long delay in a settlement from TDS, it still had to pay interest on the bonds for an additional year without revenues. It was nearly a year behind in subscribers and assets relative to its debt costs – this would prove a significant factor in Monticello's subsequent financial troubles.

Fierce Competition

The other significant factor was the cutthroat competition that commenced when Fibernet Monticello began operating in mid-2010. It had a strong start with some 1,200 subscribers despite the late 2009 commencement of citywide construction. HBC operated the triple-play network, offering television, telephone, and Internet services to residents and businesses at far faster speeds than were previously available, and at prices far lower than were previously available within the community.

Charter Cable and TDS Telecom both dramatically lowered their prices while TDS Telecom had also improved its network to offer triple play services.

In most cases where municipalities have built fiber-to-the-home networks, the cable company remains a strong competitor by cutting rates and sometimes increasing available speeds. The telephone company typically continues offering a slow, low cost DSL product, effectively ceding the high speed competition to cable and fiber providers. But the TDS upgrade to fiber resulted in three high speed competitors. Fibernet Monticello offered packages from 10 Mbps to 50 Mbps, symmetrical (both upstream and downstream). TDS offered up to 50 Mbps down and 20 Mbps up. Charter was stuck at 30 Mbps down and an estimated 5 up (cable companies often hide the upload speed as it is so much slower).

Charter responded to the newly competitive market with one of the most aggressive price cuts ILSR has ever seen. It sent sales people door to door with an offer of every cable channel in the lineup plus its top speeds for a two-year guaranteed rate of $60 per month. Tech news site Ars Technica called Charter and verified the offer was real.[93] That same package cost $145 per month in other Charter cities in Minnesota like Buffalo, Rochester, and Duluth. Either Charter was absorbing significant losses in Monticello or was making astonishing profits in its other cities. Channel contract costs are subject to non-disclosure agreements, but every expert we consulted concluded Charter must have been losing money every month for each household taking that offer. A company with revenues of

over $8 billion in 2013, Charter decided to sell its services at a loss for years in an effort to deny market share to Fibernet.

After Charter took the offer door to door around the community, Fibernet's growth stalled. Asked about the issue in the Monticello Times, City Administrator Jeff O'Neill said,

> *Predatory pricing and competitive pricing are two different things. We didn't expect the third-largest cable TV company in the country to offer services at far less than it costs them to provide it. It's an effort to use the revenues from the Buffalos and Big Lakes to rub out their competition [in Monticello].*[94]

Neither the Federal Communications Commission nor the Federal Trade Commission evinced any interest in investigating these types of potential antitrust violations, a sad reminder of how cities are disadvantaged when competing against national cable and telephone companies.

Neither the Federal Communications Commission nor the Federal Trade Commission evinced any interest in investigating these types of potential antitrust violations, a sad reminder of how cities are disadvantaged when competing against national cable and telephone companies.

In some ways, the initial survey of residents and businesses foreshadowed this possible outcome. The largest concern from respondents was price. Residents wanted to pay less and businesses both wanted to pay less and have better Internet access. Fibernet forced the prices down from all providers but the entrenched incumbents could lower prices below Fibernet's cost by cross-subsidizing from other communities where they did not face real competition. The question was whether enough people would support Fibernet due to better customer service or simply because they recognized that if Fibernet failed, the great deals from its competitors would quickly evaporate. Thus far, the evidence suggests that most of the population prefers to take the temporary deals from TDS and Charter.

Having lost an entire year to the lawsuit and then facing predatory pricing, Fibernet was unable to sign up enough subscribers to meet its revenue projections, forcing local leaders to make a difficult choice. The network was not producing enough revenue to make debt payments. Though they had no legal obligation to contribute to the network to ensure bondholders were repaid on time, they also wanted to make sure the network would continue to ensure residents and businesses benefited from the newly competitive market.

To make up the difference between revenues and what bondholders were owed, Monticello began loaning itself funds from an account consisting of profits from the municipal liquor store. Over time, they would ultimately borrow approximately $5 million from other city funds to make debt service payments before deciding on June 1, 2012, to cease subsidizing the network. But prior to that decision, the City's relationship with HBC fractured.

On May 30, 2012, HBC announced it would step down as the network service provider, leaving Monticello to find a new partner. Though both HBC and the City have been relatively quiet about the reasons for the separation, the biggest factor must have been the incredible stress resulting from the lost year, price war, and resulting inability to pay the full debt service from network revenues.

Monticello went on to hire a new manager, Mark Pultusker. Unhappy with his performance, Pultusker was ultimately replaced in 2014. The network is now managed by Dan Olsen, who built and continues to manage both the WindomNet and SMBS networks. Olsen has finished a series of upgrades initiated by the previous manager that are improving Fibernet's service.

Service Improvements

Fibernet has just announced that without increasing prices, those who subscribed to either the 10 Mbps or 20 Mbps tiers will be upgraded to 50 Mbps and those on higher tiers will be upgraded to 100 Mbps. Additionally, they will be able to offer a gigabit to any subscriber in town. These upgrades should help Fibernet to regain some of the momentum lost from the predatory tactics of the incumbent providers.

It should finally be noted that Fibernet was launched in the trough of the significant economic recession the nation experienced in 2009-2012. Any one of the above factors alone may not have so derailed the business plan but together they were disastrous.

The City is on the cusp of resolving its bond debt. After discussions with bondholders, they agreed to a one-time payout of $5.75 million. As is standard in such an agreement, a judge had to examine the deal and decide whether it met a basic fairness test. A judge made this finding in the middle of September and barring any appeals, Monticello will own the network outright in autumn, 2014.

To raise the $5.75 million for the payout, Monticello will offer a general obligation bond. The City's bond rating took a hit during the uncertainty in 2012, with Moody's downgrading it from aa3 to A2 – from a high grade rating to upper medium. Having resolved the uncertainty around the bond, Monticello's bond rating will likely go back up despite having given bondholders a haircut because investors understood the risks associated with an unbacked revenue bond.

Cost – Benefit Analysis

In total, Monticello will likely have spent some $10-11 million on the network between the bondholder payout and the total amount spent on debt service when revenues were insufficient to pay it prior to mid-2012. This is a significant cost that will continue to grow until Fibernet's revenue can cover its own costs. Note that Monticello taxes have not increased by this amount but that some of the liquor store funds, for example, could have been used to offset taxes to pay for street repairs. (It is worth noting that given Charter's promotional pricing and extra investments in advertising and door to door salespeople, it also is probably spending more than it generates in revenue locally but as noted, makes up any losses from its more profitable and less competitive markets.)

The investors were only repaid 22 cents on each dollar invested and no amount of future Fibernet success will benefit them. They have taken a significant loss, which is regrettable but sometimes happens. For instance, Verizon shareholders lost $1 billion when telephone and DSL company Fairpoint declared bankruptcy in 2009.[95] As noted above, investors should have understood the substantially higher risk in purchasing a tax exempt 6.75 percent unbacked revenue bond than other bonds.

Critics of municipal networks generally claim the taxpayers are taking on too much risk, so it is worth comparing the benefits to Monticello against the costs. A municipally owned enterprise uses a different cost-benefit lens than does a private enterprise. Its financial goal is to cover its costs but cities invest in municipal networks to generate both

direct and indirect benefits from spurring job growth to cutting telecom bills. The easiest cost saving to calculate is the telephone service because TDS charged over $40 per month prior to competition. Charter does not offer a telephone service.

Monticello has approximately 4,800 households. If we use the national average of 65 percent of households having a landline connection approximately 3,100 households have landline service, either from TDS or Fibernet.

TDS prices have dropped to about $25. Fibernet has charged $21 per month since 2009. Because more households had landlines in 2010 than today, a conservative estimate for the total community savings from residential landline cost reduction of $15 per month per household is $550,000 per year. Over the five years, this amounts to $2.5 million in residential savings alone.

Combined with the telephone savings of $2.5 million, the network has kept approximately $10 million more in the pockets of Monticello residents over the previous 5 years.

Charter's best deal lowered the biggest package price from $145 per month to $60 per month, a savings of $85 per month. TDS has regularly run deals for a triple play with 50 Mbps downstream and 20 Mbps upstream for $70 per month in the first year and $90 in the second year with an ongoing price of $110 per month.[96] Fibernet, like most community owned networks, tends not to engage in promotional pricing but rather has a variety of triple play combinations at various price points, many of which are in the neighborhood of $100. The average triple play bill in the United States is $154 per month.[97]

Untangling the cable and Internet costs from the various possible combinations of savings is challenging. However, we have already accounted for savings to telephone subscribers above and Charter does not offer telephone, so we will subtract $15 from the average U.S. triple play bill, creating a baseline estimate of $139 per month for television and Internet access. Given the level of price competition and promotional deals, it seems reasonable to assume at least half of all households are paying less than $100 per month for triple play on average. Compared with the national average, this is a savings of at least $39 per month and likely more. 2,400 households saving $39 per month results in a community-wide savings of $1.1 million per year. If another 25 percent of the population are paying the TDS rate of $110 per year, that represents still another savings of $400,000. Over 5 years, these savings total $7.5 million. Combined with the telephone savings of $2.5 million, the network has kept approximately $10 million more in the pockets of Monticello residents over the previous 5 years.

Residential savings from the telephone and other home telecommunications services are roughly on par with the amount the City has contributed to the network. The network has also reduced costs and dramatically increased both available speeds and options for a reliable connection to businesses. However, we could not develop a way to quantify these savings or put a figure to the benefits. Monticello's businesses have transitioned from a poorly connected community to among the top connected communities in the nation. Building the network has clearly resulted in a much better climate for businesses that increasingly depend on Internet access.

Monticello is also more efficient as a local government due to the network. It has gigabit links between city facilities that better enable it to use

mapping applications like Geographic Information Systems (GIS). Judging from the savings we found in Carver, Scott, and Anoka counties for municipal institutional networks, Monticello is likely saving tens of thousands of dollars per year by self-provisioning a gig rather than leasing from TDS or Charter.

In coming years, the operating losses of the network will be at least an order of magnitude smaller than the savings to residents. Losses are likely to be at most in the low hundreds of thousands while aggregate cost savings each year are in the low millions. And given the upgrades at Fibernet, operating losses are expected to decline and disappear over time.

Monticello may have the most competitive market for broadband in the upper Midwest. We surveyed other cities in Minnesota with TDS connections and found the maximum residential speed advertised was 25 Mbps, half the commonly advertised rates for TDS in Monticello and a fraction of the top end 300 Mbps TDS service. Charter has slashed its prices. And the slowest connection a person can get from Fibernet is 50 Mbps symmetrical, at incredibly competitive rates. This level of community connectedness should result in higher property values over time compared to nearby areas reliant on slower DSL and non-competitive cable.

Ultimately, the benefits of Fibernet seem to outweigh the costs, but not by the kind of margin expected. However, the benefits are trending upward at a far greater rate than costs, suggesting that Fibernet has a much brighter future than past.

Conclusion

Monticello Fibernet is a cautionary tale for cities that want to improve their telecommunications services. They may confront huge corporations that can use profits from less competitive areas to subsidize predatory pricing against a fledgling municipal utility. Incumbents can also use lawsuits to increase the cost and delay the introduction of muni broadband services. Nevertheless, some 150 cities have managed to build sustainable citywide municipal networks nationwide.

Early into the life of this 20+ year infrastructure investment, it appears that despite its financial challenges, Monticello's network has saved its businesses and residents more money than it has cost.

The project has achieved a main goal in dramatically lowering the cost of telecommunications services in the community but is not yet able to pay its own way. Coming years will show whether recent improvements in the network and a change in management can make it entirely self-supporting. Given the economies of scale in telecommunications, expanding the network to nearby communities that have been left behind by existing providers will go a

TDS: Monticello vs. Buffalo

The difference in TDS Internet access between Monticello and nearby Buffalo is striking. Though TDS regularly runs better deals for service in Monticello, paying TDS approximately $45 in Buffalo yields a connection of 15-25 Mbps downstream and up to 10 Mbps upstream. In Monticello, the same monthly payment to TDS will purchase 100 Mbps down and 40 Mbps up. TDS doesn't even list 100 Mbps in Buffalo, let alone its top-of-the-line 300 Mbps service from Monticello. Perhaps if Buffalo expands its wireless and fiber networks into a fiber-to-the-home network, it too will see TDS invest in offering faster connections.

long way to helping its finances. Fibernet's head end can support many more subscribers than even the full population of Monticello.

Oddly enough, one of the lessons from Monticello is that the 65 percent requirement in Minnesota law offers little predictive power as to whether potential subscribers will embrace a municipal network. One of the justifications for the law is that passing the difficult referendum demonstrates the kind of support necessary for a network to succeed financially. But as Monticello shows, there are many variables in whether a network succeeds (and on what timetable). The 65 percent threshold offers no predictive values and is simply an impediment to public investment in some types of fiber optic networks.

9. Cook County

Cook county partnered with rural electric cooperative, Arrowhead, to build a fiber-to-the-home network to the entire county, funded with a broadband stimulus grant and loan.

Known for its rustic charm, Cook County is home to roughly 5,000 people. In the summer, the area draws another 5,000 seasonal visitors that fill cabins, resorts, and lodges.

The economic downturn during the Great Recession took its toll on tourism and the lack of high speed Internet access aggravated the situation for businesses that catered to visitors accustomed to high-speed Internet access while on vacation. The County had the lowest availability of broadband in the state at 37 percent.[98] Qwest provided DSL in some areas and Mediacom offered cable connections within the larger towns via its aged coaxial infrastructure. Satellite was available in some areas, but service was costly, slow, and came with data transfer caps.

Dial-up had come to the area in the late 1990s thanks to the community established nonprofit Boreal Access, which later began providing wireless Internet to rural residents and businesses.

In areas popular with tourists, the only choice for lodges and outfitters was still dial-up as late as 2008. Proprietors could not take reservations online, so customers booked elsewhere, taking tourist revenue with them. Visitors came to the many lakes for fishing, but outfitters could not purchase licenses for their guests online.

Local businesses approached the incumbent providers for help. Lutsen Mountain Inn's provider, Qwest, told the owners that it was not possible to connect with a T1. The Cascade Lodge, located on the main Highway 61, sought a quote for installation of a T1 line to offer 1.5 Mbps download. Qwest quoted $600,000.[99]

Real estate agents reported that the lack of connectivity handicapped their ability to sell homes. In one instance, a physician couple that worked at the Mayo Clinic was ready to purchase a home in the area. When they learned that the only access was satellite, they walked away. Both doctors needed access to reliable broadband to work remotely on occasion and satellite could not meet their needs.[100]

In addition to lack of access, the conversion to digital television created another problem. Regional broadcasters did not plan to upgrade to digital equipment in Cook County. Many residents relied on television for local information because their Internet access was so poor. Television provided information on school closings, forest-fire alerts, and local weather conditions.

Determining Need, Gauging Interest, Deciding to Act

For years, community leaders and activists had worked with elected officials to educate them on the importance of higher quality Internet access and the problems with dial-up and satellite. By 2008, the County took action to determine the extent of the problem, the level of interest, and possible improvement options. A $15,000 grant from the Blandin Foundation and a matching contribution from the County funded a feasibility study to examine the problem and potential solutions. Additionally, local electric provider Arrowhead Electric Cooperative, Inc., and Boreal each pledged $10,000 toward the study.[101]

Joe Buttweiler, acting General Manager of Arrowhead, was Director of Member Services at the time. The coop had been interested in bringing better connectivity to its members for some time but the expense of a fiber network and the expertise needed to run it were the two challenging hurdles. Arrowhead had investigated WiMax wireless technology, but the geography was too rocky and hilly for it to work effectively.[102]

Based on the results of the feasibility study, the Cook County Board of Commissioners took up the idea of developing a fiber network for County residents, businesses, and government. The Board passed an ordinance in December 2009 declaring that a broadband network was in the best interests of the County and created the Fiber Optic Network Commission.[103]

The survey indicated a high need for better access in the County and a strong desire to get broadband service from a local provider. Ninety-one percent of residents surveyed said that they believed the County needed a local broadband provider. Ninety percent said they would subscribe to a local broadband ISP, and an additional eight percent said they might subscribe to such an ISP. In other words, almost every respondent felt they needed broadband and would prefer purchasing it from a local company.

Multiple Plans, Same Goal

The County approached Arrowhead to discuss the possibility of building a fiber network. As its service territory covered most of the households and businesses in Cook County, the cooperative recognized the potential of a partnership. As Buttweiler puts it,

> *"Up here when the County or Arrowhead are spending money, we are spending the same person's money, no matter if its tax dollars or if its Arrowhead funds because our service area 99.9% matches the County boundary. Both entities are looking out for the exact same population."*[104]

The feasibility study estimated a fiber network connecting every residence and business on the grid would cost approximately $50 million. That helped to develop a business plan aiming for take rates of 64 and 65 percent of households and businesses respectively. The proposed service area included over 3,152 homes, 236 businesses and 57 community anchor institutions.

Upon reflection, Arrowhead considered the cost of the project too risky for its members. It told the County that it was not interested in the project, so the County investigated using revenue bonds to fund the deployment.

In order to open as many doors as possible, the County also applied for funding made available through the American Recovery and Reinvestment Act of 2009 (ARRA). They sought $33 million in grants and loans. Local businesses, potential community anchor institutions, and government agencies in the proposed service area wrote letters of support. Schools, clinics, public safety, tribal councils, and even the US Forest Service, declared their need for better Internet access in Cook County.

While they waited for a decision on the stimulus application, the County approached the voters on two questions in order to proceed with the project. In November 2009, community leaders asked voters to pass a referendum to grant the County authority to use the proceeds from a half cent local option sales tax to fund a variety of projects.

The project list included a fiber optic network that would be linked to the community's Boreal project in the 1990s. Years earlier, the voters had approved a similar measure to fund an expansion on the County hospital. The hospital project sales

tax was reaching sunset, and the County asked voters to continue the sales tax, rather than letting it lapse. The measure passed in no small part due to the prospect of improving Internet access; the County estimated the tax would bring in approximately $20 million.

On the same ballot, voters needed to approve the question of whether or not the local government could own or operate a telephone service. A law from 1915 required local communities to pass a 65 percent supermajority referendum in order to grant the authority to local government, the only such supermajority requirement in the nation.[105] In order to offer triple-play of Internet, video, and voice, the County needed to pass the measure. Even though 56 percent of voters approved the ballot question, it did not meet the required threshold.[106]

"Up here when the County or Arrowhead are spending money, we are spending the same person's money, no matter if its tax dollars or if its Arrowhead funds because our service area 99.9% matches the County boundary. Both entities are looking out for the exact same population."

Discouraged but hardly ready to give up, County leaders began developing another plan. In the revised model, the County would again try to partner with Arrowhead to deploy a fiber network.

Meanwhile, a January accident in Duluth cut a fiber line that killed telecommunications in both Cook and Lake counties. E911 calls were impossible, credit card transactions could not go through, and Border Patrol agents had to rely on Canadian officers to transmit messages for them. The event underscored the danger of continuing to depend on the existing providers in the region.[107]

In late February 2010, the County learned that its Round 1 stimulus application was denied. The Northeast Service Cooperative (NESC), a private nonprofit established by the Minnesota Legislature, did receive and award that would improve the situation along the North Shore. NESC received stimulus funds to deploy a middle mile fiber project connecting community anchor institutions along Highway 61. The fiber would run all the way to the border with Canada and provide much needed redundancy to the region.

The Partnership With Arrowhead Electric

Arrowhead became the project leader in the next plan devised by the County. In the plan submitted for round 2 of the broadband stimulus awards, Arrowhead Electric would own the network. The projected costs were lower than those estimated for the Round 1 stimulus proposal, coming between $16 - $20 million.

Buttweiler was not familiar with the details of the original stimulus network architecture and equipment choices because Arrowhead stepped away from the project before the County filed the application. The revised plan included the "bare minimum" needed to serve all properties on the AECI grid.[108]

In September 2010, Arrowhead was awarded $4.8 million in a low interest loan and $11.3 million in a grant through the Broadband Initiatives Program of the Rural Utilities Service under ARRA.

As a cooperative with little experience in providing this level of telecommunications service, Arrowhead sought help from Consolidated Telephone Company (CTC), a cooperative from the Brainerd and Baxter region in Minnesota, served a region with similar demographics,

including a large ratio of seasonal properties and tourist establishments. Arrowhead began to learn from CTC in February, 2011.

Arrowhead also collaborated with the NESC to lower costs and expand the footprint of both networks. The electric cooperative would complete all construction in Cook County and supply fiber space to NESC so its middle mile network could reach community anchor institutions in the County. NESC would connect Arrowhead to Duluth with its fiber line. The cooperatives signed a 22-year agreement, creating a zero-dollar transaction benefitting both entities.[109]

Buttweiler said, "The deal saves Arrowhead millions of dollars by avoiding costly transport of data from our office in Lutsen to Duluth using another provider."[110]

AECI began collecting preregistration forms, leading to 550 prospective residential and business customers. Construction started in late July.

The County Board of Commissioners, excited by the project and recognizing the enthusiasm of local constituents, authorized up to $4 million of the 1% sales tax authorized by the voters. The funds were made available to Arrowhead in the form of a grant. In exchange, the cooperative would provide some services to the County at no charge, including Internet access to a number of County facilities.

Throughout the summer, potential subscribers continued to preregister. The cooperative had distributed over 3,000 preregistration packets; by mid-September, Arrowhead had signed up over 1,100 households and businesses.[111]

While waiting for the paperwork for federal funds to clear, Arrowhead began building the network but ultimately had to pause. Delays from state agencies also contributed to the decision to temporarily halt construction. The Minnesota Public Utilities Commission (PUC) was still in the process of approving the cooperative's ability to provide necessary phone services, such as emergency 911 and long distance calling.

As word spread, it became common to find people parked in Arrowhead's parking lot at all hours with their laptops using the fast, free Wi-Fi.

Despite official delays, interest continued building and ultimately revealed a problem unique to rural communities. A significant number of residents living off grid for the purposes of electricity wanted on to the worldwide web. On those properties, the cooperative had no property rights, rights-of-way, or even funds earmarked for providing access. AECI was considering a possible wireless solution using the fiber network for backhaul. The stimulus award pertained only to properties already on AECI's grid. The cooperative, focused on completing the fiber project, decided to revisit the issue in the future; to date, AECI has not found a solution.

After waiting several months, Arrowhead got the needed approvals from RUS and the PUC. By late July they were building again but winter weather and frozen soil slowed underground construction later that year.

In October 2013, Arrowhead held an open house at its Lutsen office to showcase the network. The cooperative had established a 100 Mbps connection between its office and the CTC office in Brainerd. The cooperative also set up a Wi-Fi hotspot from its office. The event drew over 300 people from all over the County, clogging Highway 61 with cars as people parked along the road to test the new service. As word spread, it became

common to find people parked in Arrowhead's parking lot at all hours with their laptops using the fast, free Wi-Fi.[112]

Arrowhead plans to complete the main fiber routes in the fall of 2014. The next step will be to complete drops to members' homes. Because much of the infrastructure rests on existing utility poles, splicing must be done outdoors; progress in the winter is weather dependent. The goal is to finish construction in 2014.

Approximately 200 members already subscribe to the network. These include residential members, a few small businesses, some larger resorts, and several seasonal properties.

The service, named True North, provides voice and Internet access. Monthly prices for Internet access include packages at $46.99 for 20 Mbps download, $59.99 for 30 Mbps download, and $99.99 for 50 Mbps download. All speeds include 10 Mbps upload speeds and symmetrical service is also available. Local unlimited calling phone service begins at $15.99 per month; there are several long distance options. Additional telephone service features such as caller ID, call waiting, voicemail, and others are available in an a la carte fashion. A small discount applies when customers bundle both services.

Expectations for the network are high. In addition to improving the situation for existing businesses and providing an economic shot of adrenaline, County residents want to create an environment that will keep youth close to home.

> *"We'll get an economic bump from the broadband pipe. We don't know how big or how long it will take, but it will happen," [Jim] Boyd said. "Kids who moved away to get an education can't move back and live on $9 an hour part-time seasonal work, which dominates now. We don't have full-time, benefit-paying, livable wage jobs for them, and that's what I'm hoping broadband will make possible."*[113]

Conclusion

Danna MacKenzie, Executive Director of the Minnesota Office of Broadband Development, was Cook County Director of Information Services from 1999 – 2013. She also served as Administrator of the Cook County Broadband Commission. As one of the Community leaders spearheading the project, she advises other communities to begin educating community leaders as early as possible. It is important, she says, to develop a local culture that broadband access is important for the community.[114]

Partnering with a cooperative offers rural communities like Cook County a proven model to build and maintain modern infrastructure– equivalent or even superior to that in major metro areas. Members who use the service also own the service, establishing a clear path to accountability.

Young entrepreneurs no longer have to leave the area to establish businesses dependent on technology. Home-based businesses can thrive; existing businesses can reach out to people around the world. Though Cook County was once hurt by the refusal of distant corporations to invest in it, businesses and residents now have world class infrastructure that they control, restoring self-determination to the community. They have all the tools they need to thrive.

10. Lake County

Building a fiber-to-the-home network to all of Lake and part of Saint Louis County with broadband stimulus funding and a host of challenges from telephone and cable companies.

Lake County, located in the northeast Arrowhead region of the state, is one of Minnesota's largest by area. The County, with 11,000 people and approximately 2,100 square miles, contains pristine swaths of forest and water. Two Harbors, the county seat, and Silver Bay are the most populated communities with 3,800 and 1,900 residents. Both are located on the shore of Lake Superior. One small city, five townships, and nineteen unincorporated communities also lie within the borders.

Lack of Access in Rural Areas: Multi-Faceted Vulnerability

Frontier Communications and CenturyLink provide dial-up in the rural areas with Frontier also offering DSL in the some of the more populated communities. Mediacom offers cable services in Two Harbors, Silver Bay, Beaver Bay, and the two townships of Aurora and Hoyt Lakes. Another cable operator, Midcontinent Communications, serves the townships of Babbitt and Ely.

In a region known for its tourism, local resorts with only dial-up access have had to contend with visitors hoping for some level of broadband access. Without high speed access, resorts have limited options for booking, which limits their ability to advertise online. Even in areas served by cable providers, the service has been notoriously slow and unreliable, which keeps businesses in Duluth even when entrepreneurs want to relocate up the North Shore. Michael Stiff, owner of Hybridge Imaging of Duluth, described his dilemma:

> *"Without it [broadband] we are handcuffed... We have wanted to move our business to Two Harbors for a number of years, but have been reluctant due to poor Internet service speed and bandwidth."* [115]

Because the incumbents have focused only on higher density areas, more than half of the households in the County did not have access to broadband under the FCC definition of 4 Mbps downstream and 1 Mbps upstream. Even in communities considered served by the incumbents, there were often no redundant connections to the Internet. As a result, network failures have been damaging to the local economy, public safety, and residents. Emergency 911 services have been severed on more than one occasion forcing customs border officials to rely on Canadian officers for communications. Outages have lasted 12 or more hours.[116]

Finding Partners and Establishing Plans

In 2008, the County began to address the region's lack of connectivity, recognizing it as a public safety, economic development, and quality of life issue. The broadband stimulus in the American Recovery and Reinvestment Act on 2009 offered an opportunity to improve Internet access throughout the region. County officials quickly issued an RFP with a rapid turnaround for a partner to develop a FTTH network throughout the county.

The County awarded the project to National Public Broadband (NPB), a firm comprised of Dr. Timothy Nulty and Gary Fields, who had expressed interest in the project when the County initially began searching for vendors.

The County submitted a Round 1 Broadband Initiatives Program (BIP) application. The County requested an $11 million grant and a $22.4 million loan to fund infrastructure to local government entities, 585 businesses, and 7,300 homes.

The Rural Utility Service (RUS) declined the application but encouraged the County to apply for the second round of awards. The County submitted its modified application in March 2010. This time, they included rural areas of neighboring St. Louis County, increasing the geographic area to almost 3,000 square miles. In addition to more than doubling the number of households, the plan included a total of 1,060 businesses and 98 critical community facilities. The County requested a $56.4 million loan and $10 million grant; they still intended to issue $3.5 million in revenue bonds to help fund the project.

In September 2010, RUS announced the County was selected to receive a total of $66.4 million in combined grant and loans, the largest broadband stimulus award in the state. The project was also one of only a few stimulus projects that deployed last-mile fiber connectivity. While most ARRA funded projects created middle mile infrastructure, this project and neighboring Cook County planned to serve every premise on the regional power grid. Construction was scheduled to start the following spring; the County and NPB estimated completion within three years, offering a connection to 37,000 people in 15,000 homes. [117]

Overbuilding Policy

One of the frequent concerns in Internet policy is whether a government program should allow "overbuilding" or building a new network where another already exists. In Lac qui Parle, the new fiber optic network avoided areas already served by much slower cable and DSL, which may result in people and businesses moving just outside town limits to get much better Internet access.

The Lake County fiber project decided to connect the entire county and portions of nearby Saint Louis County, including the towns of Two Harbors and Silver Bay. Mediacom has protested this action at all levels of government, saying it should not have to compete against a subsidized network. However, one could also argue that decades of a monopoly is also a form of subsidy that has historically protected Mediacom from competition.

The larger policy problem is that encouraging networks only in the hardest to reach areas increases the costs significantly. By including the more dense areas of Lake County, the project is much more likely to achieve positive cash flow – areas of higher revenue balance the areas of lower revenue. Without the higher density areas, the network may need ongoing subsidies, which is often decried by the same people demanding that no overbuilding occur.

The best question may be: what is the most fiscally responsible way to ensure we have high quality border-to-border Internet access. The answer will almost certainly involve some level of "overbuilding," though almost always where the existing networks have refused to upgrade to deliver modern services.

Early Difficulties

Within a month, the County first faced one of the many issues that have challenged the project. In October 2010, the Lake County Board of Commissioners decided to establish a Fiber Committee. The Committee would have had spending authority up to $15,000 for the project without the need to seek Board approval. But when the Lake County Attorney pointed out that such authority made the Committee subject to open meeting laws, NPB expressed concern. Fields, the NPB Project Manager considered it ill-advised to risk revealing sensitive information that incumbents could exploit to sabotage the project.

A Lake County News-Chronicle article reported:

> *"Fields said his concern is in revealing project aspects when it is competing with other technology companies. He said he would love to go to a Frontier business meeting to see what they are pricing things at -- he can't do that."*[118]

Rather than create vulnerability before the project commenced, the Board chose to withhold Committee purchasing power, allowing the Committee greater flexibility in keeping business strategies secret.

Publicly owned network projects are generally subject to open meeting laws that do not apply to private projects. This imbalance is a significant advantage to the more secretive cable and telephone companies, which have advance notice of business plan specifics for their public rivals.

Nevertheless, in communities where leaders actively engage citizens, as in Cook, Sibley, and Lac qui Parle Counties, people tend to be much more engaged in the project and ultimately more supportive. Community meetings focused on educating the public about economic development, potential savings in the community, and the many benefits of fiber networks, produce a pride of ownership. Lake County used a top-down strategy focused less on building grassroots support. That approach may have hurt its ability to withstand attacks from incumbent providers seeking to undermine the network and prevent new competition in the market.

Financing in a Troubled Economy

As a condition of the award, the County intended to issue $3.5 million in revenue bonds as a local match. When the project planning was in its infancy, elected officials had publicly assured County residents that funds would come from future network revenue, rather than from County funds. But high interest rates in late 2010 threatened to add almost $2 million to the final cost of the project.[119] County officials chose to tap into County reserves rather than inflate the final cost of the project.

Changing the source of funds gave opponents an opening to challenge the project. The County Commissioners could be accused not only of using local taxpayer dollars, but of having misled the public. And this project had a few very motivated opponents.

Cable provider Mediacom serves Two Harbors and Silver Bay, but the towns needed better connectivity. Mediacom's aging copper infrastructure was slow and unreliable. Additionally, the cable network was not symmetrical; upload speeds were much slower than download speeds. Though Time Warner Cable and Comcast are regularly rated the worst cable companies in unscientific surveys, Consumer Reports puts Mediacom as worse.[120]

Community leaders also knew that future economic development depended on ensuring better connectivity for existing and potential job creators, especially home-based businesses.

As the County project moved forward, both Two Harbors and Silver Bay entered into Joint Powers Agreements (JPA) with the County to solidify their intent to cooperate.

Mediacom accused each community of fraud based on language in an early version of the JPA. It also accused the cities of lying to obtain RUS funding and demanded they rescind the JPAs. In keeping with the long tradition of cable companies abusing public records request acts to punish public rivals, Mediacom demanded copies of all correspondence relating to the project; the Minnesota statewide cable lobbying organization also filed similar requests. The New York-based cable company vowed to appeal to the Office of Inspector General of the United States Department of Agriculture (OIG) to request an investigation.[121]

Russ Conrow, Special Assistant Lake County Attorney, responded by pointing out Mediacom's factual errors and sharing the final JPA language. Conrow finished his response by inviting Mediacom to take advantage of the new network rather than fight it:

"It is a pity that you feel you have to resort to such heavy-handed tactics, rather than choosing to continue to work in partnership with the Cities and join with Lake County to provide services on this new infrastructure."[122]

On February 11, 2011, Mediacom filed a complaint with the OIG.[123] It requested the RUS cease distributing stimulus funds while the OIG perform an official investigation. Mediacom also accused the County of expecting to default on the loan segment of the award, illegally transforming it into an unauthorized grant. However, it produced no evidence to back up its incendiary claim.

Mediacom's main objection was that the County was overbuilding its territory. According to the complaint, Beaver Bay, Silver Bay, Two Harbors, and Hoyt Lakes were considered served under federal guidelines because Mediacom was advertising rates of at least 4 Mbps downstream and 1 Mbps upstream. However, large projects may serve areas that already have basic broadband as long as the overall service territory achieves a specified threshold of unserved premises. In industry parlance, building a new network where one already exists is termed "overbuilding," giving a sense of how welcoming industry is to competition.

Any argument of unfairness regarding the stimulus award must be balanced against the reality that Mediacom had every opportunity to take advantage of the program itself or work with the County on a mutually beneficial arrangement. It chose not to.

Mediacom and others have vilified the concept of overbuilding (competition), but it can be necessary to give rural projects a fighting chance. Serving the denser populated town areas (where the cost to operate is lower per household) creates the revenue needed to balance out the high cost of serving rural areas where broadband is most lacking (and the cost to operate is higher per household).

Disallowing overbuilding may result in unsustainable networks that may require ongoing subsidies like the Universal Service Fund. However, if networks have the appropriate mix of densities, nonprofit business plans may not need ongoing subsidization. Or, if they do require subsidization (as CenturyLink, Frontier, AT&T, and many other firms do in rural areas today), the subsidies will be far less with a better mix of density.

Any argument of unfairness regarding the stimulus award must be balanced against the reality that Mediacom had every opportunity to take advantage of the program itself or work with the County on a mutually beneficial arrangement. It chose not to. Another balancing act is whether County

Commissioners should defer to Mediacom's desires or the thousands of constituents that had no broadband and no realistic hope of getting it from an existing provider.

The OIG looked into Mediacom's allegations and determined that the complaint did not warrant an official investigation. But Mediacom was not the only source of problems as the project progressed. In late 2010 and early 2011, the relationship between the County and NPB deteriorated. Burlington Telecom, a municipal fiber project in Vermont that was run into the ground by a secretive-minded City Hall, came to the attention of County Commissioners. Tim Nulty had created Burlington Telecom in Vermont and left the project in 2007 after a disagreement with the then-new mayor. County Commissioners accused Nulty and Fields of misrepresenting the success of Burlington and ultimately severed the contract.[124]

By the end of February 2011, the Board had chosen Jeff Roiland and Gene South to head up the project. Roiland ran the En-Tel telecommunications network in Willmar, Minnesota. South served as CEO of Lakedale Communications in Annandale, Minnesota for many years, providing service in parts of central Minnesota. Together, they formed Lake Communications and become Lake County's partner.

The Board also took formal steps to authorize $3.5 million in County cash reserves for the project rather than pay high interest bond rates or risk losing federal funding. The County had contracted to work with the public finance firm ORIX for the bond issue as part of the earlier financial plan. The move reduced final costs for the project, but prompted ORIX to file a breach of contract claim against the County. The ORIX lawsuit did not significantly delay the project, but increased the overall cost of the project due to legal fees.[125]

Lake Communications needed to obtain a license to operate as a competitive local exchange carrier before offering a telephone exchange service via the infrastructure. Minnesota Cable Communications Association (MCCA) objected on the grounds that the County would be offering telephone service without a referendum as required by Minn. Statute 237.19. That statute requires a supermajority referendum before a municipality may own or operate a telephone exchange. Similarly, MCCA argued that the state law precluded the County from using cash reserves to construct infrastructure on which it could offer voice services without voter approval.

The Minnesota Public Utilities Commission (PUC) agreed with the County's argument that it would not be the entity owning or operating a telephone exchange; Lake Communications would be the third party provider. The MCCA withdrew its objection at the last minute but vowed to "chip away" at the County's authority to deploy a network.[126] The PUC determined that Lake Communications was in a proper relationship with the County to meet regulatory requirements and granted a conditional license.

Though it sent out glossy mailers to scare citizens away from the project, Mediacom announced in the summer months of 2012 that it would not sue to stop the project. What it did do was use its clout in D.C. to convince a House committee to look into the project. The Energy and Commerce Oversight and Investigations Subcommittee began a review that later led to congressional hearings that were used for partisan purposes more than for any substantial review or oversight.

But back in Lake County, everyone was reminded what the stakes were. In June 2012, residents, businesses, and government endured another loss of telecommunications service for thirteen hours when the only fiber optic connection to

Duluth broke in flash flooding. All landline and cell phone service went out, including 911 service.[127] Regardless of the problems surrounding the Lake County project, the incident drove home the fact that the area needed better connectivity than the incumbents were willing to provide.

Even those who were hesitant to embrace the idea of a publicly owned approach realized the necessity. Dave Johnson, owner of outdoor gear design firm Granite Gear, would work from home two days a week due to poor office Internet access. The Two Harbors company needed high capacity connectivity to transmit content rich catalog and design files. The firm's art director would work nights and evenings to avoid competing for bandwidth with other employees.

That all adds up to lost productivity, said Johnson, who notes that nothing has changed in the 11 years he's lived in Lake County.

> *"Generally I'm in favor of a market-based solution, rather than having a government come in and provide a service," he said. "This is one of those cases where the market hasn't met the need."*[128]

Despite the obstacles created by incumbents, financing, and internal struggles, construction finally began on July 17, 2012, some two years behind schedule. Crews began by stringing fiber in the communities of Two Harbors and Silver Bay. Planners were criticized for commencing construction in an area where Mediacom already offered services.

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They planned to first connect Silver Bay properties, then Two Harbors, and then move south toward Duluth in St. Louis County where the network would connect to the larger pipe and the Internet. Rural areas would be added in a later phase. Such an approach makes the project more financially viable – something critics were deeply concerned about – by ensuring the project begins generating as much revenue as possible as early as possible. However, it is a bitter pill for those who have waited years for broadband to have to wait another year when people in town are getting an additional connection.

Pole Attachment Problem

Once they began deploying, they found still another major challenge. In August 2012, the County and Frontier entered into the pole attachment agreement required for the fiber to be attached to Frontier's poles. The agreements were premised on both parties' understanding that Frontier only owned poles located outside of City limits.

Frontier surprised the County, Lake Connections, and the City of Two Harbors when it claimed ownership of approximately half of the poles within the city limits. For decades, the City had maintained the poles, replaced the poles, and even billed Frontier for use of the poles. Nevertheless, Frontier traced ownership to two predecessors, forcing the City to engage in drawn

out negotiations. The two entities eventually reached a settlement over who owned which poles but negotiation continued until July 2013.[129]

The County and Lake Connections continued construction during negotiations to keep the project moving forward. The partners had not submitted permit applications to Frontier before installing fiber because they assumed the poles were County property. During negotiations, Frontier raised a second issue, stating that Lake County had violated the hierarchy standards accepted in the industry because it had placed its cable on the bottom pole position. After numerous County requests, they met and couldn't resolve their disagreement. They went back and forth, complained to the FCC, and eventually resolved it in June 2014 after much drama. This is par for the course of pole attachment minutiae and just one of the reasons there is little hope for robust broadband competition in the current regulatory-political landscape. Any method to delay a project or increase costs for a competitor is a tool in the toolbox of an incumbent provider.

While construction continued in 2014, approximately 100 of Silver Bay's 836 households began taking service in July in Silver Bay. Beta testers in Two Harbors have helped to identify and resolve problems before service is available to every one. Lake Connections estimates that Phase One, covering Two Harbors and Silver Bay, will be finished in the fall of 2014. Phase Two is scheduled for completion before June 2015.

Conclusion

Lake County's plans include a data center to complement its next-generation network and marketing efforts are already yielding interest from possible users. Granite Gear is testing the service in Two Harbors and Dave Johnson says the new connection is affecting productivity "in big ways." The art director now works during the day with other staff. High-resolution images uploaded to customers' websites used to take several hours and degraded speeds for the entire operation; now

Lake Communications Rates
Residential Rates

Internet Access

Speed	*Price*
30Mbps/10 Mbps	*$59.99*
30Mbps/30 Mbps	*$69.99*
50 Mbps/10 Mbps	*$99.99*
50 Mbps/50 Mbps	*$109.99*
100 Mbps/50 Mbps	*$149.99*
100 Mbps/100 Mbps	*$199.99*

Digital TV

Basic	*$29.99*
Expanded Basic	*$49.99*
Enhanced	*$74.99*

Voice

Unlimited long-distance	*$29.99*

the process takes a few minutes. Johnson says:

> *"…Every employee who uses a computer gains a few seconds several times a day courtesy of the faster internet speeds, and cumulatively, this adds up to a significant improvement in productivity."*[130]

The Lake County project offers important lessons for large-scale rural projects. While the geography creates a challenge in the physical sense, Lake County also teaches other communities to anticipate important stumbling blocks. While rural communities often have the benefit of strong community ties, it is important to self-scrutinize.

Due diligence is important, as in the case of Lake County's pole ownership, because incumbents will not hesitate to use their ample resources to slow down or derail al project to maintain the status quo.

As previously noted, educating the community leads to stronger grassroots support. When projects face adversity from incumbents or other sources, citizen backing can help overcome such issues or breath new life in a troubled project.

Fortunately, Lake County's difficulties are not typical. The timing of the project, combined with the significant federal funding resulted in a top-down approach that is uncommon in these projects. In some ways, it is the opposite of the Renville-Sibley Fiber project, where so much effort was invested in educating and involving the public.

Nonetheless, the project goes on. It has significant loans to repay and faces competitors in some areas willing to invest ample resources to protest the County investment while refusing to substantially invest in upgrading their own networks. But the people and businesses of Lake County will finally have modern access to the Internet. The implications for education, economic development, and health care are incredible.

11. Lac qui Parle County

Stuck on very slow dialup and DSL, the county partnered with a telephone cooperative to build fiber across most of the County.

Lac qui Parle County rests on the border of South Dakota. Approximately 7,200 people live in communities of less than 100. Three thousand reside in equal numbers in Madison and Dawson. In Minnesota, senior citizens comprise 14 percent of the population; in Lac qui Parle County, almost 25 percent of residents are over 65.[131]

In 2010, approximately 52 percent of all Lac qui Parle residential properties and business properties still depended on dial-up or satellite. A total of twelve K-12 schools, libraries, medical clinics, public safety facilities, public housing, colleges, community support organization, and government facilities also depended on dial-up or satellite for Internet access.[132]

Mediacom, headquartered in New York, offers the fastest telecom service in the County in the towns of Madison and Dawson. Mediacom's cable service generally outperformed DSL but during peak times, capacity was reduced due to congestion. Mediacom advertised speeds of "up to" 15 Mbps downstream and 1 Mbps upstream but customers consistently described much slower speeds.

Frontier Communications, headquartered in Connecticut, provides telephone service in the region and offers DSL in cities with denser populations. Frontier offers speeds up to 1.5 Mbps downstream with much slower upstream speeds.

A Partner on the Prairie

When farmers sought telephone and electric service in the early 1900s, they banded together to create cooperative entities owned and operated by community members. Today, telephone and electric cooperatives are delivering the next essential utility.

Farmers Mutual Telephone Company (Farmers) was established in 1904 to serve the farming community in the northwest corner of the County.[133] In 1949, an amendment to the Rural Electrification Act of 1936 allowed local telephone companies to receive federal loans to extend service deeper into rural areas; Farmers applied immediately.[134] In 1950, the company obtained a loan that allowed it to rebuild and upgrade its existing system. The following year, the entity reorganized from a stock mutual to a cooperative.

In 1995, Farmers began offering dial-up Internet access over its copper infrastructure; five years later Farmers shifted to HDSL, one of the earliest forms of DSL technology, to improve services.[135] The slowest HDSL speeds were approximately twice as fast as the fastest dial-up speeds.

Around that time, in nearby Stevens County the Federated Telephone Cooperative began offering cable TV and Internet access to its 2,000 residential and business customers, charging lower rates than the existing provider Mediacom.[136] In 2000 Federated decided to rebuild its entire network as a fiber-to-the-premise system.

In 2002 Federated and Farmers formed a partnership. The two entities maintained separate Boards, but began sharing a General Manager; Kevin Beyer has served both cooperatives.

In 2007 Farmers deployed a fiber ring in Madison and Dawson to provide fiber connections to area hospitals. Dawson, Madison, and Appleton hospitals connected to the ring to take advantage of high bandwidth telehealth applications. Farmers also provided fiber service to the Lac qui Parle Valley Schools and to a small number of local businesses.

In places that lacked fiber, Farmers' copper infrastructure provided slow and inconsistent Internet access. The cooperative could not offer the bandwidth members needed because the long distances between households was ill-suited to DSL technology, which degrades significantly over distances as short as a few miles. When members requested better services, Farmers knew that fiber was the best option and piggybacked on Federated Telephone's fiber deployment experience.

Farmer used the proceeds from a sale of its interest in a regional cellular provider to significantly finance a fiber upgrade. The project began in 2007 and the last of Farmers' 1,000 customers transitioned to fiber in 2010. The entire project cost $5.5 million. Approximately 63 percent of customers who received the fiber upgrade now subscribe to Internet access in addition to phone service.[137]

A New Partnership

In 2007 Farmers attracted the attention of the newly appointed Executive Director of Lac qui Parle County's Economic Development Authority (EDA), Pamela Lehmann. She attended a Blandin Foundation conference and heard a presentation by Beyer. Lehmann was particularly impressed by Farmers' fiber upgrade project.

At the time Lac qui Parle County was essentially separated into three geographies and levels of corresponding service: Madison and Dawson, with 3,000 people who had access to cable or DSL connections; the northern 40% of the County where 1,000 Farmers customers had access to fiber service; and the southern rural areas where approximately 3,200 residents depended on dial-up or satellite.

The EDA quickly established a Broadband Steering Committee to investigate methods to improve connectivity in the community. Lehmann approached Frontier to discuss the possibility of bringing fiber to the underserved rural areas in the southern part of the County. In a meeting with the Frontier regional manager, they proposed applying for a feasibility study grant from the Blandin Foundation. Frontier made no commitment for any type of partnership but the EDA did not abandon the prospect of working with Frontier.

In the spring of 2008, the EDA received a Blandin Foundation grant for 32 hours of technical assistance to investigate ways to improve services in Lac qui Parle County.[138] Blandin representatives, Lehmann, and the EDA convened a meeting of leaders from local government, education, business, and healthcare. Internet service providers also attended.[139]

In late 2008 and early 2009, the EDA approached Frontier again to suggest a joint American Recovery and Reinvestment Act (ARRA) application, but Frontier was not interested. In a National Public Radio article, Lehmann described the situation:

> *"We had two meetings with some of the upper management. They said they didn't have the funds available for a project like this. When they are looking at the big picture, a small County in west-central Minnesota was not their priority at that time."*[140]

In early 2009 Lac qui Parle County and Farmers moved forward. Their agreement encompassed three phases, each based on a 50/50 partnership. The two entities would jointly apply for a grant from the Blandin Foundation for the feasibility study. If the study suggested the need for better connectivity in the County and provided possible alternatives, Farmers and EDA would apply for ARRA funding. Their application would combine grant and loan funding; both entities would repay the loan dollars equally. If the project ultimately required more than the ARRA funding allowed, the partners would split the cost of the overage.[141]

In August 2009, the County sent a formal partnership request to both Frontier and to Farmers. Farmers responded while Frontier remained silent.

Lac qui Parle County did not want the burden of owning and managing a telecommunications network. The EDA wished to stay informed of progress and participate in promoting the network, but wanted Farmers to hold the reins.[142] Farmers would own the physical infrastructure.

Farmers had already applied for ARRA funding in the first round of awards but the application was not selected. The Rural Utility Service (RUS), the agency tasked with administering funds for broadband infrastructure, was required to award stimulus finding to projects that included at least 75 percent rural areas without access to broadband.[143] Farmers' first application included Madison, which was deemed sufficiently served for purposes of stimulus funding and without Madison the proposal did not achieve the 75 percent requirement.[144]

Farmers' had the equipment expertise thanks to the 2007 fiber upgrade. When approached with the idea of expanding, cooperative members expressed uncertainty. Beyer described Farmers' assessment of the County's connectivity in the southern areas:

> *"We knew that the towns of Madison and Dawson had reasonable ability to get a broadband connection – 4 Mbps or 5 Mbps connections – outside of town no one did. So we knew the rural residents were needing some form of broadband connection. They had simply no option."*[145]

In October 2009, EDA commissioned a feasibility study. The study was funded with a $25,000 Blandin Foundation grant and $12,500 each from Farmers and the EDA.[146] The feasibility study's engineering, operational, and market development plans were later used to support the ARRA funding application.

As noted, the stimulus funding criteria did not allow infrastructure deployment in areas considered "served." Including both Madison and Dawson in the project had pushed the project over the "served" threshold. They decided to include Dawson in the project area and omit Madison to remain under the required threshold.

Farmers planned an underground network connecting directly to each property. In 2010, 1,561 residential properties, 165 business properties and 12 community facilities still depended on dial-up or satellite.[147] The project focused on replacing those slow, unreliable, expensive connections with broadband via the fiber network.

The County and Farmers were awarded a $9.6 million ARRA award in August 2010. As originally planned, the funds were equally distributed as grant and loan.[148] The 50 percent grant reduced the risk and encouraged Farmers members to strongly back the plan.

However, they discovered a significant problem after finishing the final financial estimates. In the time since submitting the application, the estimated costs had increased dramatically for two main reasons, leading to a projected budget shortfall up to $3 - 4 million. According to Beyer, two main flaws in the original pricing created an inaccurate estimate: 1) the estimates did not calculate labor costs correctly; and 2) some equipment estimates were based on those obtained by large corporations with strong negotiating power.

For the broadband project, the Federal government established labor costs equivalent to highway construction wages at almost $40 per hour, considerably higher than the typical wages for such a project in western Minnesota.[149] That other stimulus projects faced the same dilemma was hardly comforting.[150]

Fiber optic cable was in short supply because of the high demand created by numerous stimulus projects and an increase in fiber-to-the-cell tower investments for 4G rollouts, driving up the cost. Suppliers would offer lower prices to large projects buying in bulk while relatively smaller projects had to pay more and wait longer.

Farmers considered abandoning the plan because it did not have funds to cover the shortfall. Under the terms of the original agreement, Farmers and the County each agreed to cover 50 percent of any shortage. Because Farmers did not have the ability to contribute an additional $1.5 million, the County agreed to loan the cooperative its portion from County cash reserves.[151]

However, by working diligently to keep project costs down, the fiber network has thus far cost just under $10 million, much closer to the original estimate than expected. (We include these details because it offers a glimpse at what problems can occur and how Lac qui Parle and Farmers were prepared to deal with them.)

Once the project was back on track, Farmers and EDA launched an aggressive outreach plan. Farmers applied a well-considered two-pronged strategy. Before construction could begin, Farmers needed to obtain installation agreements from each property owner. If property owners failed to sign the agreement, they would be responsible for installation costs at a later date, likely costing thousands of dollars. Farmers also emphasized competition,

> *"This will allow you, in the future, to have a choice for telephone, high speed data, Internet, and cable television providers."*[152]

Farmers offered households and businesses the opportunity to sign installation agreements at the County Fair. Radio ads, television ads, and flyers kept residents and businesses informed about the project. They contacted each property owner individually through the mail, over the phone, or with a home visit.

Approximately 95 percent of property owners in the proposed project area signed installation agreements.[153]

Unfortunately, a March 2011 earthquake and tsunami in Japan interrupted fiber-optic cable production in one of only a few manufacturing facilities.[154] Demand from other stimulus projects strained materials supplies, delaying construction by approximately nine months.

When Farmers began construction in late 2011, it already had an extensive network in the northern part of the county and had fiber in the towns of Madison, Dawson, and Appleton to serve the local hospitals. Farmers integrated the new network by using the anchor institutions in Dawson, Madison, and Appleton as hubs. Spokes expanded out to serve new customers in Dawson and Boyd and to

extend outside of Madison to reach areas where the partners could deploy fiber without overbuilding, in accordance with stimulus requirements.

The network was completed in the summer of 2014 as Farmers continued to add subscribers. By the end of August, 320 new residential customers and 50 new business customers received services from the cooperative.

New subscribers are not immediately made members of the cooperative. Instead, both Farmers and Federated have a policy of waiting a number of years before allowing membership. The duration is based on the costs of expansion. During that time, the net income from the new subscribers compensates the prior member-owners for the risk and capital they offered to enable the new connections.

Services

Federated offers cable TV but Farmers does not. Farmers will eventually offer standard triple-play services of telephone, Internet access, and television via the new infrastructure, but currently delivers just telephone and Internet access.

For rural residents, satellite TV is often the best or only option. Instead of offering video over its fiber network in 2012 Farmers and Federated became authorized DISH Network partners under a new program offered by DISH. Customers are billed for the service through Farmers and DISH technicians handle all installation or service calls.

Because of an exclusivity agreement between DISH and Frontier in the Madison, Dawson, and Boyd exchanges, however, customers in those areas do not have access to DISH through Farmers. Farmers can still offer DISH in the northern areas it already served before the Lac qui Parle expansion because there are no Frontier/DISH exclusivity arrangements there.

The situation creates a fractured market and logistical problems for farmers. Being unable to offer a triple play everywhere complicates advertising and hurts its ability to grow marketshare.

In order to provide a television option for subscribers in the Frontier territories, Farmers is negotiating with content providers to offer Internet Protocol television (IPTV)[155] via the new fiber infrastructure. However, the entire video market is structured in ways that reward large corporations and make it difficult for small providers, which is one of the reasons few Americans have robust choices for this service.

Fortunately, offering Internet access is comparatively simple compared to the complications of cable television. Most residential and local businesses subscribe to 20 Mbps symmetrical service for Internet bundled with local and long distance service priced at $68.45. Farmers also provides a bundle that includes similar features[156] with unlimited long distance for $99.45. For Internet only, 10 Mbps symmetrical service costs $69.95.

Resistance from Frontier

After Farmers began offering services, several residents and businesses contacted the EDA to report problems they encountered with Frontier when they tried to switch providers. After long periods on hold (up to an hour reported), Frontier told customers they must pay a $250-$300 per line early termination fee, according to the terms of their contract. When customers questioned the contract, Frontier told them accounts automatically renewed. If a consumer pushed

back and demanded a copy of the contract, Frontier representatives told them the company did not retain the physical contract.

Regardless of whether or not Frontier's behavior is illegal, it appears to have caused a cooling effect for the present. Dawson and Boyd schools still contract with Frontier for data and phone service. Schools have multiple lines so hefty early termination fees are a factor administrators must weigh when considering changing providers.

Residential and small businesses comprise the bulk of Farmers customers on the network. Downtown Madison was not included as part of the project area, so many government facilities in the County seat are still connected with Frontier or Mediacom. In the future, Farmers may decide to use its existing fiber to expand in the town of Madison.

Ironically, the County seat has become a reverse oasis – having access only to slower services rather than the ultra fast fiber connections surrounding it.

Ironically, the County seat has become a reverse oasis – having access only to slower services rather than the ultra fast fiber connections surrounding it. Lehmann lives in Boyd but works in Madison. Her home connection is faster and more reliable than her work connection. According to Beyer, this situation is common in Lac qui Parle. This may eventually cause businesses to abandon Madison for locations served by Farmers fiber, rather than settle for slower cable and DSL.

As anticipated, the network has allowed home commerce to expand. Jean Menden of Boyd uses her fiber connection for her jewelry business. In addition to an improved online store, she now accesses video tutorials to improve her silversmith skills.

" If you had two hours, you could watch a 10-minute video," Menden said as she described the fitful connection that used to be the best available around Boyd, a town of 172 people not far from the Minnesota-South Dakota border.

Unfortunately, I probably spend more time on the Internet than I would like to because when you'd be frustrated before it was easy to shut down and be done with it for the day," she said. "Now there's no reason to shut down."[157]

In addition to home-based businesses, a variety of small businesses in the area have benefited from the network. Madison Bottling Company, a wholesale beer and soda seller, is located near the edge of the Madison. In 2007, the company became one of a handful of businesses connecting to Farmers' fiber installations in the area. Madison Bottling left Frontier DSL and switched to Farmers for data service because DSL did not provide enough speed and capacity to transfer daily sales and inventory reports to suppliers. Kay Roth from Madison Bottling describes the transition as a "win-win" for the company. In addition to better rates and faster connections, she feels Farmers is more accountable to customers.[158]

Even as the network is helping other businesses, Farmers itself is also adding jobs. According to Beyer, Farmers is adding new positions to handle the increase in customers – new jobs created because of the presence and popularity of the new network.[159]

Conclusion

Through a strong public private partnership, Farmers Mutual Telephone Company and Lac qui Parle County brought the opportunity for fiber connectivity to the approximate 1,700 locations that had no real access to modern connections. With the exception of the town of Madison, very high speed Internet access is now available in the entire County. The project worked because when incumbent providers refused to invest, local leaders found a trusted partner. The project exemplifies the growing role of local cooperatives as reliable partners the expansion of broadband in Greater Minnesota.

Federated recently submitted an application for funding from the FCC as part a of experimental program to improve investing in rural regions. Federated is considering expanding in Swift County, located northeast of Lac qui Parle County. Swift County is considering a proposal that would include a $1 million contribution in the form of a loan to Federated in order to bring FTTH to its 9,700 residents.[160]

With the exception of the “donut hole” that is Madison, the region has excellent access to the Internet available. The network provides the opportunity for more home based businesses and telecommuting that will keep more revenue in the local communities. If Frontier is required to stop imposing punitive early termination fees, subscribership may increase faster.

12. Renville-Sibley Fiber Coop

Cities and townships in Sibley and Renville Counties have spent years organizing a fiber-to-the-farm network. They are creating a new coop and using local government bonding to provide seed funding.

Sibley County is located in south central Minnesota; Renville County is just to the north and west of Sibley. Sibley's population has steadily declined as the workforce has shifted away from agriculture. The U.S. Census estimates approximately 15,200 people in a little over 6,100 households. Sibley County is just under 600 square miles.

To expand fast, affordable, and reliable Internet access, most of the cities and townships within Sibley County and some of the cities and towns in eastern Renville are working together to build a fiber-to-the-farm network called RS Fiber Cooperative. Renville County has been very supportive of the approach.

Like many other mostly rural communities across the U.S., large corporate providers have not deployed broadband in the areas outside of Sibley's seven cities or even much within them; many of the smaller local providers are also providing only slow broadband. Mediacom Cable operates in some cities; Frontier Communications and CenturyLink offer DSL in some cities and to select surrounding areas. Some of the farms still rely on dial-up for Internet access but many have some form of wireless access that can be both expensive and slow.

In addition to slow Internet access, farmers often complain about poor Frontier telephone service. Repairs can take weeks. Some farmers must pay long distance fees for every call.

Most of the jobs in the Sibley County are either agriculture or service positions; grain farming contributes 16% of the county's total output. The science of growing crops has advanced to include high tech insect and weed control, genetics, and state-of-the-art irrigation systems, not to mention studying market conditions and opportunities. Farmers in Sibley County increasingly rely on Internet connectivity to do business in a highly competitive industry.

"But the project's leaders remained dedicated to universal access. They wanted to build fiber-to-the-farm, with no one left behind because they reasoned that the fate of both the farms and towns are woven together."

Seeking a Modern Network

Prior to taking a position as City Administrator for the City of Winthrop in 2008, Mark Erickson had spent years working in telecommunications. While he had previously served as City Administrator in the city of Lakefield, Minnesota, he most recently worked for Hiawatha Broadband Communications (HBC). HBC has built and operates fiber networks in southeast Minnesota and has partnered with communities to expand Internet access.

Seeking a stable position in a small town, Erickson took the Winthrop position expecting his biggest challenges to be "barking dogs and unshoveled sidewalks."[161] Erickson recalls that during the interview process, he was never asked about telecommunications.

But at a city council meeting that same year, Mayor Dave Trebelhorn raised the issue of telecommunications. He suggested Winthrop look at the possibility of building its own network to improve Internet access speeds, service, and prices. At the time, Erickson did not take the comment to heart, but when Trebelhorn asked him to follow up, Erickson approached local provider Winthrop Telephone Company (WTC).

For historic reasons, Minnesota and Iowa have an unusually high number of "independent" telephone companies – private companies, often owned by local families, that were never a part of the AT&T "Ma Bell" system. Many of these are owned by people who still live in the community and continue to upgrade as they can. Winthrop Telecom Company's owners, however, now live far from the community and their ties and perceived obligations to the city are weaker.

During the next year, the city discussed a possible FTTH project with WTC. At first the company appeared enthusiastic but eventually pulled out, stating that the project would be too expensive. However, even after Winthrop offered to finance construction of the network, WTC refused to further consider partnering, asserting prohibitive costs for the project though it would pay virtually none of them.

In fact, the following year similar offers to pay for construction of the fiber network were also made to CenturyLink, Frontier and Mediacom. All three rejected the idea, choosing not to cooperate with the project.

Knowing that Winthrop wasn't large enough to build a FTTH network (1,400 pop.) Erickson sought partners elsewhere. Winthrop approached the nearby city of Gaylord, where community members faced similar problems with poor connectivity and service. The two decided to join forces and reached out to other local governments, eventually forming a Joint Powers Board (JPB) that ultimately included all seven cities in Sibley County as well as the city of Fairfax in Renville County.

In May 2010, the Blandin Foundation awarded the group a $40,000 grant toward a broadband feasibility study for Arlington, Fairfax, Gaylord, Green Isle, Henderson, New Auburn, and Winthrop. Tim Dolan, Executive Director of the Sibley County Economic Development Commission, suggested the feasibility study also include rural farms. In order to help fund the expanded study, Sibley County Commissioners approved an additional $40,000 for the grant match.

Because western Sibley shares a school district with eastern Renville County, the study also examined the area around the Fairfax telephone exchange. A few years earlier the Gibbon-Fairfax-Winthrop School District (GFW) approved a first-in-the-nation plan to distribute iPads to each student.[162] Without better connectivity at home, students could not take full advantage of the technology. Renville County and the Fairfax Economic Development Authority chipped in to extend the feasibility study to cover that area.

A statistically valid telephone survey in August 2010 indicated high interest in a local project. More than 60 percent of those interviewed voiced approval of a municipally owned telecommunications network.

To educate the public and seek support, the JPB created a marketing committee that hosted dozens of meetings in summer and fall 2010. The group scheduled multiple meetings in each community – a morning, afternoon, and evening meeting in each to maximize opportunities for public feedback. The JPB marketing committee sought citizen participation throughout the process, one of the hallmarks of the RS Fiber project. Meetings were overwhelmingly filled with locals that supported the project; one rural resident memorably called it a "no-brainer."

Starting in November 2010, the Board presented a feasibility study at a series of public meetings. The study first examined a triple-play fiber network in only the cities, assuming an ambitious 70% penetration for residential video service within three or four years offering a $100 triple play including 20 Mbps Internet access.[163] With those assumptions, the network would break even after five years and create an aggregate community savings of $600,000 per year resulting from households paying less for far higher quality Internet access. In order to build the network, the community would need to borrow $33.7 million.

In order to extend the network out to include all farmers in Sibley County and everyone within the Fairfax exchange with the same assumptions, the group would need to borrow $63 million; the network would be cash positive in its 7th year. Community savings would increase to $900,000 per year. The Board recommended funding with a revenue bond., wherein the local governments issue bonds to private investors and repay them with revenue from the network.

The overwhelming agreement was that the farms and cities depend on each other. If one were weakened, the other would suffer.

The presentation highlighted the challenge: whether to include the farms or stick with the stronger business plan only connecting cities. Alternatively, should farms have to pay more due to the higher build costs? The overwhelming agreement was that the farms and cities depend on each other. If one were weakened, the other would suffer. Therefore, they felt it necessary to stick together in building a network, made available to all households on similar terms.

At a January 15, 2011 meeting in the Arlington Community Center, officials from Sibley County, Renville County, city councils, and rural representatives, gathered to discuss the project's next steps. More than 50 officials agreed to decide by the end of February whether or not to participate in the network project and become part of the JPB.[164]

By mid-February, four cities had unanimously voted to join the JPB. However, Sibley County had to sign on to build a "fiber-to-the-farm" network rather than just fiber-to-the-town-households. Without the County they would not be able to raise the necessary capital to connect all the farms.

On February 21, Renville County voted unanimously to join the project. The same day, Sibley County Board of Commissioners voted 3-2 in favor of joining the JPB. Many local farmers, attended the standing-room only meeting. Minnesota Public Radio reported on the meeting:

> *[Linda] Kramer, whose husband is a corn-, soybean- and wheat-farmer in Moltke Township, says their DSL connection of 1.5 Mbps is too slow.*
>
> *"My husband tries to upload USDA maps," she says. "We stream the occasional movie. It's not nearly enough. We're as frustrated with that as we were with dial-up 10 years ago."*[165]

Kramer noted that often her husband would begin uploading reports to business partners in the evening. When they awoke in the morning, they would find that the reports were still transmitting or the connection had failed in the night.

In March 2011, representatives from Sibley and Renville Counties, Fairfax, Gibbon, Winthrop, Henderson, Gaylord, Arlington, Green Isle, and New Auburn gathered for the first formal meeting of the full JPB. The group also established legal, financial, operations, and marketing committees to move the project forward.

Over the next several months, the marketing committee ramped up its effort to educate the public. In addition to distributing 7,200 fiber "primer"[166] booklets through a mass mailing and at a series of community meetings, the committee mailed out pledge cards to every household in the proposed network area. The cards were not legal commitments, but were intended to confirm the results of the study and provide an accurate picture of the need in the region. At the time, the JPB hoped to obtain a minimum of 2,300 cards from households in the potential service area.

In October 2011, the JPB hired Hiawatha Broadband Communications (HBC) to operate the network they planned to build. HBC, a Winona firm, has a strong reputation as a service provider and had managed the publicly owned network in Monticello for a number of years.

While the public rallied strongly around the network, Frontier, CenturyLink, and others sought to persuade Sibley Commissioners to back out of the project.

An especially contentious meeting on March 27, 2012, resulted in the Commission suspending a vote in support of the project. The JPB had collected 3,500 pledges from potential customers, the amount the Commission had requested before deciding to back the project to the next phase. Rather than vote, the Commission voted to suspend the vote until the JPB could collect an additional 1,000 pledges. They also asked project backers to "poll" the 17 townships in Sibley County. The decision inspired new volunteers to knock on doors, make phone calls, and reach out to others in the community. Within a month, the group obtained over 4,300 pledges representing over 56 percent of customers in the project area. Sixteen of 17 townships voted unanimously in support of the county moving forward with the fiber project. In the rural areas, more than 62% of residents supported the project.

At a late April meeting, the Sibley County Commission Board passed a resolution to back the project in the next phase. The Joint Powers Board hired an engineer and a securities firm to put together financing and schedule a revenue bond sale.

Ultimately, the matter of the debt service reserve fund presented the biggest, and ultimately fatal, obstacle to funding the network. Revenue bonds often have a debt reserve fund, a safety valve in case the project falls behind its business plan. The reserve would give the network a chance to fix problems without having to default on bond payments.

RS Fiber was moving forward on a plan where the local governments would establish the reserve fund and if it were drawn down, they would have to replenish it with tax dollars from their community. Unfortunately, this was at the same time that Monticello and Vadnais Heights were requiring different sets of bondholders to take a haircut, Monticello on revenue bonds issued for its broadband network and Vadnais Heights on revenue bonds issued to build a sports arena. As a result, bond attorneys adopted an extremely risk averse perspective to the issuance of revenue bonds for the RS Fiber project.

In the worst case scenario, if RS Fiber signed up no customers, the debt reserve fund would be exhausted in the fourth year. Replenishing it would require most cities to double their annual tax levies to replenish their share of the debt service

fund. Given the overwhelming amount of interest in the project, the prospect of a dismally low take rate is extremely unlikely but the bond attorneys nonetheless refused to sign off on the project.

From the beginning, incumbent telephone company Frontier expressed its resistance to the project. At a December 14, Board of Commissioners meeting, Frontier General Manager Todd VanEpps claimed their old copper infrastructure could compete with fiber:

> *"We have had copper in the ground for many years and it is paid for already. What we can do is provide the same speed of service as fiber can provide."*[167]

That claim could not withstand close scrutiny. Not only does copper have many technical restrictions, the long distances between households in much of Sibley County makes copper solutions almost totally infeasible.

Frontier warned the Board that "the County could write itself into quite a debt" and questioned the projections and cost analysis from the feasibility study. Frontier also regularly suggested that Windom's fiber network had been a failure, a claim we discuss in this paper in the Windom section (chapter 7).

The Minnesota Telecom Alliance (MTA), an industry group representing telephone companies from national companies like CenturyLink and Frontier to locally rooted independents, also tried to stop the project. In a letter in the New Ulm Journal in October 2012 MTA's President and CEO, Brent J. Christenson accused the JPB of withholding information from the public and criticized consultants working on the project, Christensen wrote that "30 percent of all households do not have a wireline connection and the number is growing."[168] Actually the number of households with wireline Internet access is growing. He was confusing telephone statistics with Internet access statistics.

The uncertainty took a toll on the unity of the JPB. On October 23, 2012, the Sibley Board of Commissioners passed a resolution by a 3–2 vote to withdraw from the JPB. But given the strength of the community support for the project, those heading it recognized they could not just give up in their goal of building the network to as many households as possible.

Immediately after the vote, a group of farmers approached Jeff Nielsen, General Manager of the local United Farmers Cooperative (UFC):

> *"They said, 'We have to do something,'" recalled Nielsen. "I said, 'Let's go back to our roots and tryto form a co-op.' Twenty-four hours later, we had an organizational meeting. We had about 30 people show up. This is really a credit to the grass roots people who have been working their heads off for the last two years to get this done. We were shocked the commissioners voted no."*

> *"Clearly it's much more efficient to go into a city (with fiber)," Nielsen said. "But let's remember who paid the taxes in the county--the farmers and ag producers. Why are we leaving them out of the technology?"*[169]

It was clear that a large segment of the community wanted to move ahead. Local municipalities, businesses, and schools still supported the project but without Sibley County and its contribution to the debt reserve fund, options were limited.

Over the next few months, the JPB worked to come up with a viable solution for the project that would be able to attract the necessary financing. Through the efforts of their financial advisor they

decided the project should become a cooperative with the JPB providing a start-up loan to help them attract financing.

The JPB had already completed most of the financing and engineering and all of the members of the new cooperative had already been involved with the JPB. The cooperative is really just a continuation of the JPB project in most respects but may no longer reach every household in the territory because townships could opt in or out. The residents and businesses within the jurisdictions of the JPB would be able to join the cooperative simply by taking service from it.

The new plan improved financial prospects for the project. Less money was required through the new financing scheme and the new estimate for total project costs was $55 million. With so much fiber expected to be built throughout the county, wireless Internet service providers would be able to expand better access to some of the farms if some townships chose not to participate. Such connections would not offer the speed nor reliability of fiber but would be a substantial improvement over the status quo.

Seventeen of the 21 eligible townships in Renville and Sibley Counties ultimately joined the project as well as the Renville cities of Fairfax and Buffalo Lake. Sibley cities of Gibbon, Winthrop, Gaylord, New Auburn, and Green Isle have also committed. Stewart and Brownton, located in McLeod County, and Lafayette from Nicollet County are also participating. Arlington and Henderson have opted out, to the frustration of a fair amount of voters.

Cities and townships that opted out may have an opportunity to join after the network is built, when it could be under pressure to expand in many different directions to meet the growing needs of the neglected farms and towns and cities of Greater Minnesota.

The cooperative board decided to set higher goals for Internet service. The lowest Internet access will be 50 Mbps both downstream and upstream instead of 20. Subscribers will be able to access speeds as high as 1 Gbps. The network will offer home and farm security systems, broadcast high school events live, and make telemedicine opportunities available to the many elderly people in the community. Because the capital costs have decreased, the cooperative will break even after 45 percent of households and small businesses in the project area sign up for service.

RS Fiber already has pledges from about 62 percent of rural households from the proposed service area; they expect more. If the coop signs up 90 percent of rural households, it will only need half of city households.

Financing the Cooperative

To finance the network, the JPB will issue a General Obligation Tax Abatement Bond (G.O. bond) to provide a $15 million economic development loan to the new cooperative. To do so, those communities must hold a series of public hearings and the relevant city councils must vote to authorize each community's commitment. The loan is guaranteed by local governments' ability to raise taxes if the endeavor cannot make payments on the debt for the cities and townships.[171]

Though cooperatives have been successful at providing these services, especially in the Midwest, establishing a new one has significant challenges. All the more so if that cooperative needs a large amount of capital to engage in a business against entrenched competitors like Frontier, CenturyLink and Mediacom. Investors see a new venture like RS Fiber as very risky. Local governments have well-established means of raising capital for essential infrastructure projects but some are uncomfortable with local government delivering

a service that had historically been the province of private companies. The RS Fiber Cooperative approach is an attempt to use some of the advantages of both approaches.

The Board hopes the economic development loan will help secure loan guarantees from federal programs designed to encourage infrastructure investments, including the U.S. Department of Agriculture (USDA), the Small Business Administration (SBA), and the Department of Housing and Urban Development (HUD).

Phil Keithahn, Chairman and CEO of Gaylord's ProGrowth Bank, took up the role of financial advisor to RS Fiber. Keithahn explored potential sources of financing. The RS Fiber Cooperative does not qualify for RUS funding currently because Winthrop Telephone had previously received an RUS loan that was still being repaid. The agency would not lend funds to entities that compete with each other. Because Winthrop Telephone had received funds to build a comparatively slow broadband system, much of the county has a greater challenge to finance a modern network.

Keithahn has approached a number of banks and possible private lenders. He has had to seek out funds from several institutions because smaller banks have lower lending limits. Federal loan guarantees will strengthen his ability to secure lending from private lenders.

Keithahn has calculated the costs to taxpayers in a worst case scenario. If the network signs only one in three households, and all communities must make the full bond payments, the additional tax burden to each home would be approximately $35 - $36 per month. But services from the new network will be approximately $25 less per month than what households now pay. In other words, if the network does not hit its projections, the net additional financial burden to each property owner taking service would be approximately $10 - $11 per month. They would also have the benefit of fast, reliable fiber connections. Even if a property owner chooses not to connect to the RS Fiber network, competitive pricing and services will improve their rates and their Internet access. Additionally, home values are expected to increase with a fiber connection available.

Because HBC is consulting on the project and will likely manage the network, Keithahn has approached potential funders in the local communities where HBC manages other networks. In addition to understanding the ways a community network can jump-start the local economy, local banks earn credibility with local customers for investing in the community.

The RS Fiber Cooperative is established as a Chapter 308B cooperative. The designation makes it easier for cooperatives to raise equity by allowing non- patron investors - also known as equity members.[172] Equity members invest in the project but do not take services from the cooperative. But everyone who takes service from the cooperative will automatically be a member. A Board is elected each year and every member who attends the annual meeting gets one vote.

One of the principles of cooperatives is to cooperate, something RS Fiber has already experienced with an offer of assistance from Paul Bunyan Communications, a cooperative out of northern Minnesota. The MTA has even suggested that it would back off its opposition if RS Fiber were a cooperative rather than a municipal network. It remains to be seen how much Frontier and CenturyLink will continue attempts to undermine its success.

Another guiding principle of cooperatives is to make a positive difference to its members, maximizing benefit instead of the bottom line.

RS Fiber would like to start construction in Q2 2015. For now, the cooperative is busy pursuing financing, holding public meetings to educate the public, and signing up potential customers. In order to update community members about the new business plan, the coop board's marketing committee distributed a second round of pledge cards describing the plans to pursue a cooperative model.

The cooperative is asking potential customers to commit to one year of service and to eventually take at least two of the three triple play services. Those that sign up by a certain date will have the fiber installed at no charge. Those who wait will have to pay an installation fee. The costs of installing fiber connections is more cost effective when installers don't have to return to an area that already has customers hooked up.

Sibley County provides many important lessons, particularly for rural communities. The most obvious is the importance of engaging and educating residents, businesses, and key stakeholders.

Conclusion

Although still a work in progress, the RS Fiber Cooperative experience provides many important lessons, particularly for rural communities. The most obvious is the importance of engaging and educating residents, businesses, and key stakeholders in the importance of and opportunity for improving Internet access. Sibley has faced daunting challenges and disappointing setbacks, but the community remains determined to find a solution that will provide fast, affordable, and reliable Internet access to all.

Though some cities and townships have elected not to join the effort, their populations will undoubtedly be at the end of the waiting list for access, not completely off of it. Sibley's effort to seed a cooperative with an economic development loan from local government bonds appears a unique and fitting solution for its mix of assets and enthusiasm. The project has risk, something that community leaders have been candid about. However, the risk resulting from doing nothing appears far greater to the community.

Endnotes

Executive Summary & Introduction

1. *See Chairman Wheeler's "1776 Speech" here:* http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db0904/DOC-329161A1.pdf

2. http://www.bbpmag.com/2013mags/may-june/BBC_May13_GigabitFuture.pdf

3. *CenturyLink is hardly alone in this regard. AT&T has also issued many announcements, which are disparagingly labeled "fiber to the press release" because they do not appear to have actually changed their deployment plans and instead are simply highlighting fiber availability in newly built*

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5. http://www.co.dakota.mn.us/Government/IT/Pages/c-net.aspx

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7. *Gary Shelton Presentation, Blandin Broadband Conference, December 4, 2008.*

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14. *"Carver County thinks a ring (of fiber optics) may woo business," Star Tribune, June 19, 2008,* http://www.startribune.com/local/west/20551244.html

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19. http://www.co.carver.mn.us/county_government/docs/ACCEL_MM_Aug_08.pdf

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relationship to Burlington. Building a network is a technical area mixing telecommunications arcana, economics, and questions of policy – it ain't easy and often requires a trusted consultant. When that relationship is broken, it can be hard to proceed, one reason that opponents often attack consultants to discourage community networks. To be clear, ILSR does not engage in consulting.

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135. "HDSL" or "high bit-rate DSL", was one of the first DSL technologies developed in the 1990s, http://www.thehistoryof.net/history-of-dsl.html

136. Email from Donna Eul, Marketing and Customer Service Manager for Farmers Mutual Telephone Company and Federated Telephone, April 7, 2014

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139. http://blandinonbroadband.org/2008/05/09/lac-qui-parle-County-talks-broadband/

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142. Kevin Beyer update to the LqP fiber partners, April 6th, 2012, http://www.lqpeda.com/2012/04/06/kevin-beyer-on-lqp-fiber-progress/

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148. http://projects.propublica.org/recovery/locale/minnesota/lac-qui-parle

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150. Reedsburg, Wisconsin, was another community where the project was delayed due to the discrepancy in labor costs, 2011, http://www.muninetworks.org/content/reedsburg-finally-launches-rural-expansion

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152. Line Installation Permission Agreement, http://www.lqpeda.com/wp-content/uploads/2011/10/Drop-Permission-Form-Stimulus-Grants-Lac-qui-Parle.pdf

153. Conversation with Kevin Beyer, General Manager, January 22, 2014.

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155. IPTV (Internet Protocol television) is the delivery of programming by video stream encoded as a series of IP packets rather than via an encoded signal over coaxial cable as most cable customers receive it.

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160. http://www.swiftcountymonitor.com/articles/2014/04/18/federated-seeks-expand-its-fiber-cable-area

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162. http://www.gfw.k12.mn.us/sites/gibbonfairfaxwinthrop.new.rschooltoday.com/files/mankato_free_press_4.11.10.pdf

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165. "Sibley commissioners take the next broadband step," Jennifer Vogel, Ground Level MPR, February 22, 2011, http://blogs.mprnews.org/ground-level/2011/02/sibley-county-commissioners-vote-to-move-forward-with-broadband-plan/

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168. "Red flags for fiber project," New Ulm Journal, October 10, 2012, http://www.nujournal.com/page/content.detail/id/531642/Red-flags-for-fiber-project.html?nav=5004

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172. Patron members still retain at least 50% of the voting powers in "general matters of the cooperative," Minnesota Cooperative Statute 308B Fact Sheet, Cooperative Network, http://www.cooperativenetwork.coop/wm/legislativeregulatory/minnesota/web/308Bfactsheet.html