

Mille Lacs County, Minnesota

**Ultra-broadband Feasibility Study
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**CCG Consulting
Dain International**

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EXECUTIVE SUMMARY

CCG Consulting and Dain International submit this report of our findings and recommendations concerning the creation of a broadband network in Mille Lacs County.

We have done similar studies many times before. One thing we have learned is that no two places are the same and so there is no solution that will work everywhere. We try to walk in with an open mind and let the local facts and the numbers produced from the financial feasibility studies help us to understand the options.

Probably what is most important to understand about the county is how poor the broadband is in the rural areas. The alternatives in those areas are poor or non-existent. And when there are alternatives, like using satellite data or cell phone data, the broadband is expensive and has very small stingy monthly data caps. Since over half of the residents in the county live in these poor broadband areas this is a major problem for the county and one that is going to put you at an economic disadvantage to your neighboring counties as they find broadband solutions. The county is a textbook example of broadband haves and have-nots. You either live in the cities or near the lake and have broadband or else you don't.

But we found that it would be a financial challenge to build fiber everywhere. It's not impossible, but there are several factors that make a business plan a challenge here. First is the geography. The river in the middle of the County means that a network has to be built on both the east and west side of the County, which costs more than what we would have expected in looking at the square miles of the County.

Second, we found that the people in most of the cities today have broadband with which they are probably happy. Certainly some of them would love to be on a fiber network, but the question is: can you count on enough of them to make the business plan work? The financial analysis shows that you'd need at least a 46% penetration rate in the cities just to make the business plan reach breakeven, and you'd want to do better than that. If you want to consider fiber everywhere you'd have to conduct a thorough canvass to make sure that enough customers would support fiber.

Third. There was a change in the rural broadband picture since the time that we started the study. These areas today have basically no broadband, or else broadband that is expensive and that suffers from low monthly data caps. These areas are ripe for a broadband solution. But in late August, as we were wrapping up this report, both Frontier and CenturyLink accepted federal money from the FCC's Connect America Fund to improve the DSL for the rural parts of the county to 10 Mbps download and 1 Mbps upload. Even by today's standards that is not great broadband and it is going to be obsolete almost before it is built. But it might be just good enough so that some rural households might not elect to change to a new network. You need a 62% penetration in the rural areas to justify fiber and that seems like a high hurdle considering these DSL upgrades.

Finally, some parts of the county either already have fiber or will soon get it. Milaca has already been overbuilt with fiber from Milaca Local Link, and the Benton Cooperative Telephone Company is planning to overbuild Bock and the surrounding area with fiber in a few years. If you take Milaca out of the business plan the needed breakeven penetration rate for fiber for everywhere else gets even higher.

In light of the challenges to build fiber in the rural areas we suggest a solution to build a carrier-class point-to-multipoint wireless network just for the rural areas. The biggest issue with doing a point-to-multipoint wireless network is the heavy tree cover and foliage in the county. But there are ways to work around that. We've recommended using a new spectrum that the FCC is just about to release in the 3.65 MHz range that carries through trees a little better than the other spectrum available today. Plus we've assumed that you would build tall towers and also use telescoping poles at each customer house to enable a direct sight to a tower. This network will deliver speeds up to 30 Mbps download to customers. There is an even better spectrum on the horizon called white space spectrum that the FCC is expected to release that could offer speeds of almost 50 Mbps.

Further, the wireless business plan can spin off significant profits over the years and it looks to us that if it's operated well you could eventually use the profits from the wireless business to then build fiber in the rural parts of the county. It might take 15–20 years to get fiber everywhere, but it's a financially and technically viable plan. Customers could get real broadband today with the goal of eventually upgrading to fiber.

We've recommended that the best business structure for the new business is a cooperative. This form of business has advantages over the alternatives. Probably the biggest advantage is that, since a cooperative is owned by the customers of the business, it can maintain the focus needed to eventually get fiber. Any alternative business structure that is for-profit would expect to pay profits to the owners and operators of the business, and as such would probably never have enough cash to replace wireless with fiber.

We've made numerous other specific recommendations that are also important, but the above are the primary take-aways from this study. We have provided a very specific list of next steps that ought to be taken if you want to go from this feasibility study and work towards a solution.

FINDINGS

We report the following findings:

THE PROBLEM

Lack of Rural Broadband. As the county already knew, there is definitely a glaring lack of broadband in the rural parts of the county today. The homes without access to adequate broadband are more than half of the households in the county, so this is a significant issue.

The cities in the county have adequate broadband, although it is not as fast as what is available today in the Twin Cities. The cable companies operating in the county seem to understand the need for broadband and our expectation is that they will continue to increase data speeds in the cities over time, as they have already done in the past.

But one only has to go a very short distance outside of the cities before the data speeds drop off significantly. Customers within a short distance of the cities can get very slow DSL, the speeds of which drop very quickly with distance. The other alternatives for connectivity in the rural areas are dial-up, satellite data, or cellular data, all of which are inadequate for a variety of reasons.

Lack of good broadband has major economic implications for the county. Lack of broadband causes all kinds of problems for rural homeowners including:

- **Lower Property Values:** Homes without broadband are becoming harder to sell. Homeowners are beginning to require broadband as a necessity at a new home. Without a broadband solution the rural parts of the county are going to become undesirable places to live.
- **Education:** It's incredibly hard to raise kids today in a home without adequate broadband. Broadband alternatives like satellite service and cellular have tiny monthly data caps that make them nearly impossible, or else very expensive to use for supporting education along with the normal household needs for broadband.
- **Working at Home:** More and more jobs today can be done at home, even if only part time, but people living without adequate broadband can't participate in this newly expanding part of the economy.
- **Taking Part in the Modern World:** People with good broadband have access to services that either don't work in the rural areas of the county, or which use too much bandwidth to fit within their data plan caps. Households with adequate broadband routinely do things like watching videos on services like Netflix, talking to friends and family on services like Skype, shopping at sites that use video, playing video games which have largely moved online, taking online courses from numerous colleges, or even just browsing the web that now contains video on a large percentage of web sites.
- **Future Services:** The broadband world isn't standing still and the need for broadband has been growing since the mid-90s at an exponential rate. Residences in the county have doubled the

amount of bandwidth they need about every three years since 1995, and that trend is expected to continue to grow at this pace for the foreseeable future. To put this into perspective, if a home needs 6 Mbps download today to be happy, then nine years from now they are going to want 48 Mbps download speeds. And that's easy to explain. Every year the size and the amount of things we do online get larger and faster. It's been that way since we've gotten online and there is no end in sight for new uses for broadband. Programmers are already starting to invest in 4K video which is 8 times larger than HD video. And it's not just video; everything we do online takes more bandwidth over time.

- **The Growing Broadband Gap:** There is a quickly growing broadband gap between the urban parts of the state and the county. Cities in Mille Lacs County have cable modem speeds of around 30 mbps (which is adequate today for most families) while the speeds in the Twin Cities and other urban areas are growing faster.
 - Comcast is in the process of unilaterally increasing speeds. For example, in the northeast they have raised 25 Mbps customers up to 75 Mbps and 100 Mbps customers up to 150 Mbps. They say they are going to do this everywhere.
 - Comcast and the other large cable companies are now installing DOCSIS 3.1, the newest technology that will let them increase speeds dramatically. Comcast says that within a few years they expect to increase speeds again and that their slowest data speed will be 100 Mbps.
 - CenturyLink has started to build fiber in the Twin Cities and will offer gigabit Internet for \$80/month as part of a bundle.
 - US Internet offers gigabit Internet to parts of Minneapolis for \$45/month and offers an amazing 10 gigabits for \$400/month.

THE PROPOSED SOLUTION

Building Fiber Everywhere: It is feasible that you could build fiber everywhere in the county. We estimate it would require financing about \$52 million to build fiber everywhere.

The problem with the Fiber Everywhere plan is that it requires very high customer penetration rates just to break even. You would need to achieve customer penetration rates of 46% of city residences, 62% of rural residences, 40% of seasonal residences, and 60% of businesses for a new business just to reach breakeven. It would require significantly more customers than that to be safely profitable.

In our experience those are very high thresholds to meet. There are places where community systems have done that well, but plenty of others where they have not. As an example, Bristol, Virginia has achieved a penetration rate of over 65% for residences in their city. Most other municipal systems have not done that well.

An important consideration when thinking about building fiber throughout the County is that the existing cable companies within the county have done a good job of providing decent broadband speeds, and they are likely to continue to increase speeds over time. That will probably make it very difficult to get the needed customers in the cities to make this work.

However, it is not impossible that fiber everywhere could work, and if you want to consider it the most important next step would be to undertake surveys, or a residential canvass, to see if there is enough demand to meet the high minimum thresholds needed for success.

In summary, we think building fiber everywhere is a risky option and think it would be a challenge to guarantee that you would get enough customers in the early years and then maintain them for the many years needed to repay financing.

There are probably ways to lower the risk of the project, but they are not easy. For example, if you could raise a significant amount of equity for the project—funding that would not have to be repaid—then the breakeven penetration rates would be lower. But about the only way to do that in any significant way would be if the county or other government entities in the county were to provide an economic development bond to the project that would not have to be repaid. Such a thing is probably hard to get approved and the risk of legal challenge would need to be better understood.

Wireless Broadband Solution: There is a broadband solution for the rural areas that is feasible. That is to build a point-to-multipoint wireless network to bring wireless broadband. With a wireless solution the cost is far lower than all fiber. You could build a fiber network to towers and support a wireless network for between \$15.5 million and \$16.0 million. The breakeven penetration rates are 45% of rural full-time residences and 20% of rural seasonal residences. These seem like reasonably achievable goals in the rural areas without adequate broadband today.

We recommend that you use a relatively new spectrum just authorized by the FCC called 3.65 GHz. This can provide decent broadband out to five miles from a tower and it is far better than unlicensed spectrum in penetrating trees and foliage. There ought to be even better spectrum available in a few years called white space spectrum that does even better with foliage and that provides even more bandwidth up to 50 mbps download.

With a 60% rural customer penetration this business can spin off significant cash, and in the most optimistic scenario studied generates an excess \$32M over 25 years. Those profits could be rolled back into the business over time to convert customers to fiber. So the wireless plan would bring better broadband to the rural areas immediately, and also could provide the basis to eventually serve the areas with fiber.

There are other ways to improve the business plan. The primary one is to expand wireless coverage outside the county where that is reasonably achievable and to use the extra revenues from those customers to help accumulate cash to pay for fiber.

Fiber to Just the Rural Areas: A business plan to build fiber only to the rural areas is not feasible. It would require \$39 million of financing and never produces a positive cash flow. Over time it loses a huge amount of money. There are not enough customers to support the high cost of building fiber only to rural places. The cost to build fiber in cities is much lower and without averaging in those lower cost customers the business plan does not work.

Business Structure and Ownership: There are several options for how a broadband business might be structured. For instance, this could be a municipal venture with the county owning the network. The

business could operate as a private for-profit business for the benefit of its owners. The business could be structured as a cooperative and owned by its customers. The business could be structured as a non-profit. And there are options in between these. For instance, in what is called a Public/Private Partnership, the county and a commercial business could somehow do this together.

In looking at the options for operating a wireless network, we think the two best alternatives to consider are either to do it as a cooperative or for the county to own it. The county would still have the option of operating this directly or with a commercial partner. To the extent that the county doesn't want to be an ISP, then we think a cooperative would be the easiest way to get the business financed. The choice of the business structure will determine the method of financing that can be used.

INDUSTRY FINDINGS

Connect America Fund: Both Frontier Communications and CenturyLink accepted funding from the FCC to improve rural DSL in the county. This funding comes from the Connect America Fund, which is part of the FCC's Universal Service Fund. Both companies took the funding for most or all of their properties in the state. The companies must spend 40% of the federal funding within two years, 60% by four years, and all of it by the end of six years. These are statewide requirements and there is no telling where Mille Lacs would fit into this timeline.

The companies must improve their DSL to produce speeds of 10 Mbps download and 1 Mbps upload. This is much faster than the rural DSL today, which can be as slow as dial-up.

The importance of this for any business plan is that the rural parts of the county will get some broadband sometime within the next six years. It will still be slow broadband which is already much slower than what the cities in the county have today. Six years from now it will be even slower than the cities which ought to see periodic upgrades and speed increases. This is at best a bandaid approach and within a decade this DSL will feel as slow, compared to other places, as the rural broadband feels today. But this DSL, if put in soon enough, might satisfy many of the customers in the rural areas and make it harder to finance a broadband solution.

You should not assume that these DSL upgrades are going to take care of broadband issues in the county because they will not. The download speeds demanded by households have been doubling every three years since the mid-90s and are expected to continue on that trend. The FCC has already said that the new definition of broadband is 25 Mbps, and this solution is only a fraction of that speed. If you do nothing about rural broadband now, then within a few years after the DSL upgrade you will be back looking at the issue again.

Possible Partnerships: There are a number of different partnerships and/or mutual efforts that you can consider with the business. We find it unlikely that the wireless scenario can attract a full equity commercial partner, and even if it did they would want to take profits, thus lowering the ability of the business to ever replace wireless with fiber, assuming that would be an ultimate goal. So your best option is to operate the business yourself and accumulate profits towards building fiber. But there are other ways to partner that should be considered.

BASIC FACTS ABOUT THE COUNTY

Potential Customers: We looked at several different sources for counting homes and businesses in the county. After considering them all we determined that the property tax records were probably the most accurate and so we used those as the basis for counting homes and businesses passed. The passings we used for the total-county scenario are as follows:

City Full-time Residential	4,335
City Seasonal Residential	228
Rural Full-Time Residential	5,728
Rural Seasonal Residential	1,658
City Business	455
Rural Business	<u>274</u>
Total	12,679

We defined Seasonal residences as locations that have tax-assessed values of greater than \$10,000. In the wireless solution there might be a number of other seasonal customers willing to pay for broadband while they are in the area, and so the number of potential customers for the wireless solution are higher than for building fiber.

Some Existing Fiber: Some of the large entities in the county already have access to fiber. For instance, the county government gets broadband from a fiber network built by the state. This means that the county government cannot be a customer of a new fiber network. Unfortunately, the broadband on this network is not available to anybody else including a municipal or private fiber network.

The schools are also already connected by fiber. However, they could use more bandwidth. The US government is pushing for all schools to get a gigabit of bandwidth and the schools in the county don't yet have that much bandwidth. While the schools already have fiber, they would be allowed to buy bandwidth from a new fiber business.

There are numerous private fiber networks in the county including those owned by the telephone companies, the cable companies, and the electric companies. These networks are generally not available to a community broadband effort.

Some Businesses Pay a Lot for Broadband: One might expect businesses operating in rural counties to pay more for broadband than businesses in the Twin Cities. But there are a few examples of businesses we talked to that are paying exorbitantly high fees to get the bandwidth and related broadband services that they want. Some of these businesses are among the larger employers in the county and having very high broadband costs puts these businesses at risk and makes it very hard for the area to attract new employers.

Incumbent Providers: The county has a number of incumbent broadband providers. First, there are four telephone companies operating in the county. In and around Princeton the incumbent telephone company is CenturyLink. For most of the rest of the county the incumbent provider is Frontier Communications. In

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and around Bock, along with Foreston, is served by the Benton Cooperative Telephone Company. There is also a tiny slice of the county served by Windstream.

There are two incumbent cable companies serving in the county. In the south Midcontinent Communications serves in Princeton and the closely surrounding area. SCI Broadband serves the northern cities and areas around the lake.

There is also a competitive fiber venture that has built fiber in Milaca called Milaca Local Link. This is a joint venture between the Benton Cooperative Telephone Company and East Central Energy.

Finally, East Central Energy is a reseller of satellite service to their customers. Additionally any customer is free to buy data directly from one of the satellite companies.

Lastly, cellular data plans are offered by Verizon and AT&T. Some households use these plans for their home broadband, but these plans are very expensive and have very tiny data caps.

Road Miles: A countywide fiber network would have to traverse a lot of road miles in Mille Lacs County. There are 1,077 miles of roads in the county that are maintained year around. We did not assume you would build fiber on roads that were not plowed and maintained in the winter. Not all of the 1,077 miles would need fiber to get to customers; our engineers estimated that it would take 949 miles of fiber to reach every passing.

Rural Incumbent Providers: In what was probably the least surprising finding, and the reason we were hired to do the feasibility study, most of the rural parts of the county outside of the cities have no broadband.

There are exceptions. The areas directly surrounding the lake have cable TV service and cable modem broadband. And the town of Bock is served by the Benton Cooperative Telephone Company. It has DSL broadband today, but the Cooperative says that within three years that they will build fiber to Bock and the rural areas directly surrounding it.

But the rest of the rural areas have nothing that can be considered broadband. Both Frontier and CenturyLink offer DSL service in the county, but that product is severely distance-limited and within very short distances from the cities the speeds are very slow. While there are people in the rural areas that can purchase DSL, the speeds they get might be incredibly slow, even down to barely faster than dial-up.

There is satellite broadband available in most places, assuming that a receiver at a given home can ‘see’ the satellite. But there are numerous problems with satellite broadband. Some satellite services have fairly good download speeds, but there is huge latency, or delay, in the signal due to being transmitted to and from a satellite. This makes satellite broadband unusable for any real-time applications like talking over the Internet. Satellite Internet is also very expensive compared to other options. Worst of all, the satellite services all have very tiny data caps, meaning that the amount you can download in a month is capped.

Finally, there appear to be a number of households in the county that are using cellular data as their home broadband solution. Cellular data is the most expensive broadband in the US, priced at \$8 - \$12 per

downloaded gigabit. Additionally, the data speeds in the rural county are often quite slow because cellular data speeds decrease significantly with distance from a tower.

Broadband in the Cities: Most of the cities in the county already have broadband service that is not as fast as what is available today in the Twin Cities, but still offers decent speeds. The cities are served by two cable companies—Midcontinent Cable in Princeton and Milaca and SCI Broadband in the other cities. These companies today have upgraded to base speeds in the cities of 30 Mbps and both seem to be aware that customers want faster speeds and are likely to continue to increase download speeds in the future. Milaca also has business and residential broadband provided by Milaca Local Link on fiber.

This does not mean that there are not people in the cities who might rather have fiber, but it does mean that there are probably enough people in the cities satisfied with the speeds they are getting today that it would be a challenge for a new fiber business to attract a high percentage of city customers to a new network. These companies also seem to have good customer service, especially compared with the giant cable companies like Comcast that are notorious for poor customer service.

What this finding means is that you have to approach any business plan that relies on high customer penetration rates in the cities with caution. Before undertaking any such plan you would want to do surveys, household canvasses and hold public meetings to see how much potential demand for fiber might exist in the cities.

Seasonal Residences: The county has a number of seasonal residences and these have to be taken into account when looking at broadband solutions. We've found in other parts of the country that seasonal residents want broadband and they are willing to pay for it, especially if the broadband is available seasonably and they don't have to pay for it all year. Many Americans are now dependent upon broadband as part of their daily life and many of the people who come to your county for recreation would have an enhanced experience if they had reliable broadband.

Around the country we've seen that seasonal residents don't want to pay all year for a service they only use for part of the year. In our studies we assumed that the average seasonal customer would pay for broadband only 4 months per year.

Since most of the seasonal residences are near to the lake, and since the lake area has cable modems available we've counted about 950 potential seasonal residences that live in places without broadband. We counted as seasonal residences only those buildings that have an assessed value greater than \$10,000 for property tax purposes. There may be additional seasonal residences in buildings assessed lower than that and even residences who live in recreational vehicles and other alternatives who still might want to purchase broadband when they are in the area. So the business potential, particularly for the wireless option, might be greater than we have shown in the business plan.

ENGINEERING FINDINGS

Challenging Geography: The county has a challenging geography when it comes to looking at broadband solutions. The county is long north and south and narrow with a river running down the center of the county. This means that a fiber ring in the county—which is the backbone of any broadband network—is

going to be long, about 174 miles, and must run on both sides of the river. If the county was more traditionally square like most other counties the fiber backbone would be shorter and less costly.

Long Rural Drops: In this county people tend to live off the main roads. That is not true everywhere; in many parts of the country most homes are a short distance from the main roads. But in Mille Lacs County that is going to mean longer fiber drops and higher costs than what we see in many other places.

If you were to build a fiber network you would want to consider some sort of metric where you might build a fiber drop of a certain length, say ¼ of a mile for free, but that you would want the homeowner to contribute to the cost of longer drops.

Backbone Fiber Network: Any broadband network needs a core fiber called the backbone. The backbone fiber is built in a ring configuration so that it can have electronics that will keep the network running everywhere in case of a fiber cut. The backbone ring would be 174 miles long and would run north and south up each side of the county on both sides of the river. The route taken for the all-fiber design would probably be different than the route used for the wireless solution since the rings would be connecting places for different purposes. In the all-fiber design the ring would be built to pass through the various node cabinets that begin the distribution fiber network. In the wireless network the ring would be built to connect towers places in ideal locations.

Aerial vs Buried Fiber: In general, in the study we assumed that fiber would be put onto poles where the other utilities are on poles today and buried where the other utilities are buried. The vast majority of utility wires in the county are on poles today and only some parts of a few of the cities are buried.

The Pole Issue. There is an issue with building aerial fiber placed on poles. The poles in the county are owned by a number of different entities. But many of the rural poles are owned by the two biggest electric cooperatives operating in the area. They caution that their existing poles are relatively short (many are 30-foot poles, the smallest pole generally used), and many of the existing poles are very full of existing cables from the electric companies, the telephone companies, the cable companies and others.

By law, pole owners in the US must allow a new provider onto their poles. But if a pole is too full of existing cables then the new party must pay to either replace the pole or to rearrange the existing providers to make room for them. This is referred to in the industry as ‘make-ready’ work and it can be quite expensive.

There are two possible solutions for this problem. First, the fiber can be buried in the places where this is the biggest problem to avoid using the poles. But burying fiber is more expensive. As an example, buried fiber in the cities costs \$70,000 per mile, while putting it on poles (without excess make-ready) costs \$42,000. But in the rural areas it costs \$26,000 to bury fiber and \$19,000 per mile to put it onto poles. This means that anywhere the rural make-ready is more than \$7,000 per mile it would be cheaper to bury the fiber. Just as a reference, the backbone fiber needed to support the wireless network is 174 miles long, and if that was all-rural and buried instead of being put onto poles, the extra cost would be a little over \$1 million than what I have shown in the study. If some of that fiber is routed through the towns then it would be even more expensive.

The other alternative is to somehow partner with the electric cooperatives to place the fiber in the power space. That means that it would be placed near the electric lines on the poles, something that electric companies are allowed to do but which others are not generally allowed to do. This would require developing some kind of partnership with the electric cooperatives.

Not all poles will have this issue and poles along some routes will have more existing cables than others. But this is an issue that will require more study and engineering before choosing a solution.

Internet Connectivity: There are numerous options to connect a new network in the county to the Internet. You could buy connectivity from the cable companies, through the telcos, or through a few carriers that have a presence in Princeton. You will have to pay for transport to Minneapolis to get to the Internet POP, but every carrier in the area has to pay that as well and it wouldn't put you at any disadvantage.

FINANCIAL FINDINGS

Financing: We have assumed that the financing for all of the options was done using municipal bonds. We assumed a term of 25 years and an interest rate of 5.5%. This option was chosen for the models since it is generally the most expensive way to finance infrastructure. If you could instead find private financing then the overall costs of financing will probably be cheaper than what we've shown in the studies.

There are a few features of municipal bonds that make them more expensive than some other forms of financing. For instance, it might be necessary to borrow what is called a Debt Service Relief Fund, which would be an amount equal to a full year of debt payments. This is money that is borrowed and put into escrow and that acts as a form of insurance for the bond holders as a cushion against any defaults in the bond. Bonds also have the feature of requiring you to borrow all of the money up front and then paying interest on all of the funds from day one. Since there is no revenue at the beginning of a fiber project, bond financing would require you to borrow up to three years of expected bond payments using what is called 'Capitalized Interest'. Commercial loans can handle these issues in a different way, and while they would have higher interest rates, they are generally more affordable.

Financing a fiber business can be complicated. It might require some mix of bonds, grants, commercial loans, equity, and federally guaranteed loans, each of which has a different impact on the financing to make this work. The assumption of all bonds at 5.5% is probably not a bad approximation of the actual cost of borrowing, although that borrowing could take a different form.

Sources of Financing: There are a number of good sources of funding available for a broadband project. If the city was to be the ISP then it's likely you would use municipal bonds. But if this is structured as a cooperative or some other way there are numerous options for obtaining financing.

One of the biggest issues a new business would face would be having enough equity to qualify for other forms of financing. Equity can come from grants, but I think it's likely that the county might need to provide some of the financing for the business in the form of an Economic Development Bond. This would be viewed by other lenders as equity, or quasi-equity.

There are some grants that might be gotten for the business, but such amounts are not likely to be large so you should not count on grant funding to pay for any substantial piece of the business.

New Employees: We estimate that the all-fiber scenario will require 11 new employees to operate. The wireless scenario would need 8.5 new employees (one part time).

Timeline: There is no way to estimate how long the first two phases of developing a broadband solution might take. The first two steps are making the decision to move forward, and then funding the new venture. But once you have funding, we think you could implement the all-fiber solution in two years with a first customer on the network in 18 months. You can build the wireless network in one year and have the first customer on the network within 9 to 12 months of financing.

Costs Moving Forward: If you decide to move forward past this feasibility report there are costs that must be incurred to go from this feasibility report to financing. Those costs are going to be at least \$200,000 and so finding funding for that will be one of the first challenges of moving ahead.

Sensitivity Analysis: We undertook a sensitivity analysis and looked at a number of the assumptions in the wireless scenario to see how much affect they had on the business plan results. We found the following:

Economical Build: It's possible to build the network for a lower cost. For instance, you could build the fiber to feed the wireless towers without completing a ring, which cuts 30% from the cost of the fiber. It's also possible to use some of the existing towers in the county. This improved performance by generating \$5.2 million more in cash over 25 years. However, there are consequences of taking short cuts. For example, if you build without a ring and the fiber is cut then all towers and customers past that cut would go out of service until the fiber is repaired. If at all possible you will want to build the full fiber ring. But you also ought to take advantage of using existing towers if that is possible.

Adding Telephone: It is possible to provide telephone service over the point-to-point wireless connection and a number of companies do this today. But such a connection is not 100% reliable and voice could get cut off during a big data download or under heavy data use from multiple users. Still, the product is a good low price alternative for home telephone service, particularly when it includes unlimited long distance. Adding a telephone product improved the scenario and added \$5.8 million in cash over 25 years.

Increasing Passings: A wireless network doesn't recognize political boundaries. But the base case was limited to only those who live in the county. The business plan improves if you will serve customers outside the county but within reach of the towers. In this scenario we assumed that 600 additional passings could be reached from the towers, adding \$8.5 million in cash over 25 years.

Higher Penetration Rate: We looked at the impact of increasing full-time residence customers by 5%. Adding more customers will obviously improve performance, and if full-time resident penetration rates were 65% instead of 60% the performance would improve by adding \$6.1 million in cash over 25 years.

Shorter Term on Debt: Shortening the debt from 20 years to 15 years improved performance and added \$3.0M in cash over 25 years. This savings is due to making higher payments for a shorter period of time which saves on interest expense. However, you can't arbitrarily just lower the life to any term, because if the term is too short then the business won't be able to afford the debt payments.

Higher Interest Rates: We looked at the impact of paying 1% higher interest rates. If interest rates are raised from 5.5% to 6.5% the amount of cash generated over 25 years decreases by \$3.2 million.

Partial Funding with Equity: We looked at the financial impact of finding \$1 million of equity for the business instead of debt. Equity could come from several sources including grants. Adding \$1 million of equity reduces the amount that has to be financed and improves the business plan by \$2.3 million over 25 years.

Changing the Price for the Data Product: We looked at the impact of lowering the price for residential data by \$5. This lowered cash generated over 25 years by \$7.5 million. The impact would be the same magnitude for raising the rate by \$5. This is the most sensitive variable in the study and the business is always going to have to be careful about lowering the rate. You would not want to give too many 'specials' to customers without understanding the impact of doing so on the cash flow.

Waiving the Installation Fee: The base study includes an assumption that wireless customers would pay a \$300 installation fee. This fee could be spread as monthly payments over time. The impact of waiving this fee lowered cash by \$2.7 million over 25 years.

LEGAL AND REGULATORY FINDINGS

Applicability of Legal and Regulatory Requirements. The following factors are among the most important that will be taken into account in the body of the report on legal and regulatory issues:

- existence of authority for telecommunications projects
- the technology that is used,
- the form of the owning entity
- status of network as a competitive services provider
- the services available on the network
- the role of local public bodies—if any—in the project.

Form of Ownership. Private, public, cooperative and nonprofit ownership are all approved forms of ownership of a fiber optic network providing telecommunications and data/Internet services under Minnesota law.

Video Regulations. In regard to video services Minnesota Statute Chapter 238.08 applies to the granting of franchises by local authorities to a new service provider for the provision of video services in a municipality or other local unit of government. Any provider offering video service in a local area (and

possible adjacent service areas) will need to obtain a franchise from the local authority to use the streets and rights of way to construct its network and deliver its service. Minnesota Statute Chapter 238.08 identifies a process that is consistent with federal law regarding franchise grants so any new provider of video services where a franchise is required will need to conform to the process and provisions for obtaining a franchise under current Minnesota state law. A new franchise would be required and a provider whose application conforms to statute requirements must be granted a franchise by local authorities.

Telephone Regulation. In regard to telephone services Minnesota Statute Chapter 237.16 outlines the obligations of a telephone service provider that would be consistent with state and federal requirements. A new provider of voice services will need to apply to the Minnesota Department of Commerce and be approved by the Public Utilities Commission which will issue a notice of certification to provide service. A new provider whose application as a competitive local exchange carrier conforms to regulatory and statutory requirements will be approved.

Further in regard to telephone service, Minnesota Statute Chapter 237.19 poses special requirements when the entity intending to offer telephone services involving the construction of a local exchange is a public or municipal owner. The face of the statute calls for a public referendum with a 65% approval level when a community proposes to construct or buy a telephone exchange when an exchange already exists in that community. The applicability of Chapter 237.19 to a fiber optics based voice service offered by a public or municipal owner where the technology for telephone service is at variance from service that is based on a local exchange is untested.

Internet Regulation. In regard to Internet services, the Minnesota Court of Appeals case Bridgewater Telephone Company Inc. vs. City of Monticello established that municipalities have the legal right to offer Internet services as part of the services to be provided through building and operating a fiber optics network. This finding put the rights of private, cooperative, nonprofit and public providers on the same basis as far as provision of data/Internet services.

County Authority. In regard to County authority, County legal provisions do not appear to present any unexpected requirements relating to the infrastructure work necessary to construct a new fiber optic network in the intended service area. At the same time any new infrastructure activity will need to take into account the existence of tribal lands within the County. Any new infrastructure activity would need to conform to local and state requirements in respect to rights of way, environmental and historical preservation requirements and any other county or state requirements that might become applicable.

RECOMMENDATIONS

Following are our specific recommendations:

1. **Fiber Everywhere:** The business case for building fiber everywhere in the county looks to be very challenging. First, the cost to launch the business is in the range of \$52 million if all funded by bonds. The amount that needs to be borrowed might be lower with other forms of financing. Second, the penetrations required to break even with the plan are high. Breakeven would require 46% of the households in the cities and 62% of rural households to break even. That is not impossible, but achieving those penetration rates would only produce a business that barely breaks even and ideally you would want to get penetration rates far higher than the breakeven levels. One of the primary reasons those penetration rates are a challenge is that the cities already have pretty good broadband. Most cities have 30 Mbps cable from the two cable companies while Milaca additionally has fiber that has been built by Milaca Local Link. Another reason this might be hard to achieve is that CenturyLink and Frontier just got federal funding to increase data speeds in the rural areas to 10 Mbps sometime in the next six years. That might draw off just enough customers to make it hard to get a very high rural penetration rate. The business plan is not impossible to achieve, but it is one of the highest breakeven penetration rates we have seen. You would have to be very certain that you could get and maintain those high penetration rates before you decided to tackle this business opportunity.
2. **Rural Wireless Network:** It looks much more feasible to build a carrier-grade wireless network for the rural parts of the county. The primary issue with doing this is the tree cover around houses, but there are ways to work around that. We would recommend using 3.65 GHz spectrum instead of the other unlicensed spectrum that most rural Wireless ISPs use. In the future an even better spectrum that is going to be available is white space radio. The cost to build the wireless business plan is a much more manageable \$15.5–16.0 million.

The breakeven penetration rate for a rural wireless network that sells only data is 54%. The breakeven can be further lowered by adding a resold voice product to the network as well as selling to people outside the county but within range of towers, which together lower the needed penetration rates to 44% of full-time rural households.

The primary benefit of a wireless network is that it would bring real broadband to the rural areas. With the recommended spectrum, data speeds could be as fast as 30 Mbps, and with white space spectrum could be close to 50 Mbps. Today the rural speeds are far below that, and even with the upgrades to DSL promised by the large telcos, the speeds are going to improve in the rural areas only to 10 Mbps or less.

3. **Eventual Fiber in the Rural Areas:** The rural wireless business plan looks to be profitable enough over the long-term to eventually be able to use profits to replace the wireless network with a fiber network. For example, if the business could achieve a 60% penetration rate among rural homes then over 25 years the business would generate over \$35 million in cash, which is more than is needed to build fiber everywhere. With fiber, the speeds in the rural areas could be improved to gigabit download speeds.

4. **Structure the Business as a Cooperative:** We think the best business alternative is a cooperative, for the following reasons:

- 1) The original RFP suggests the county does not want to become a retail ISP and our conversations during the study reinforce that impression.
- 2) The other potential business structures would include a for-profit aspect that means that profits would be paid to an owner or operator. If the business was either for-profit or some kind of a public private partnership (PPP) it seems likely that the business would not retain the cash needed to eventually build fiber.

However, a cooperative, owned by the customers of the business, could have the staying power to operate the wireless business while saving the cash to eventually upgrade to fiber.

5. **Build Some Fiber:** Even the wireless business needs to have a fiber backbone to bring the fastest bandwidth possible to the wireless towers. The reason that most rural wireless businesses today don't have fast speeds is that their towers are not fed by fiber bandwidth. So the wireless business plan includes a fiber network to all of the towers, configured in a ring to produce redundancy in the network so that a fiber cut doesn't take customers out of service.

We also strongly recommend building fiber to the business park south of Princeton as well as through a few of the towns where there are businesses who would subscribe. Those extra revenues contribute to the profitability of the business. The business should also consider offering broadband to any customers it can reach wirelessly outside the county, and might even consider building a few extra towers for that purpose.

One issue that will need to be resolved for building fiber is that the poles in the rural areas are short and mostly full of existing wires. That might make it very expensive to add another wire. There are several possible solutions for this issue. First, you might find some way to partner with the electric cooperatives so that they can put the fiber in the power space. Another alternative would be to bury the fiber, which looks like it would cost about an additional \$1 million.

6. **Next Steps:** There are concrete steps that can be taken immediately after getting this study that are listed in the Next Steps section of the report immediately following this section. The most important of the next steps is to determine if there is enough citizen demand and interest for moving forward. My guess is that in the rural areas there will be a lot of interest once people understand this effort to bring them broadband. The key will be finding ways to get the word out effectively.
7. **More Funding:** It is going to take additional funding to move this project to the next level. If there seems to be community support, the county ought to help kick-start the project by providing some funding and helping to find grants to pay for the next steps. Our experience is that it will take at least \$200,000 in total funding to move from this feasibility to getting a new business funded. This doesn't have to come entirely from the county, but the county probably has to help jump-start the effort.

It is also likely that the wireless business operated by a cooperative is going to need some funding from the county in the form of an economic development bond. This would be a loan made to the cooperative on which the cooperative would make payments. Our best guess is that such a bond would need to be somewhere between \$3 million and \$4 million.

NEXT STEPS

If you decide to move forward the following tasks are most likely the next things to tackle. A few of these are discussed in more detail at the end of the report. We refer to this next phase as the development phase of the project, which comes after this initial feasibility study.

1. Identify A Champion: If you want to take the next step beyond this report somebody is going to have to take ownership of the process. Every municipal broadband venture that has launched has had a champion who has driven the process forward. This isn't something that can be done casually or part-time. A champion might be a person, a government department, or a committee. But somebody has to have the authority, the responsibility, and the funding to take the next needed steps to implement a broadband solution. Without that champion the process will quickly bog down and this report will end up on a shelf somewhere.
2. Find Funding for the Next Steps: Whoever takes on the next steps is going to need some funding. This feasibility study was paid for with a combination of grant money and funding from the county. More funding is going to be needed for the development phase. If the county wants to see the rural people within the county get broadband, then you will have to fund some of this next development phase to get the process started. The county shouldn't have to fund all of the development costs, but it's probably necessary for the county to kick-start the process.
3. Choose the Best Business Plan: This report recommends two possible paths forward. The first is to build fiber everywhere which looks risky, but not completely impossible. A less risky option is to build a fiber backbone and use it to bring point-to-multipoint wireless to the rural parts of the county. Over time the profits from that venture can be used to build rural fiber. One of these two options has to be chosen by whoever is going to champion this forward.
4. Community Outreach: The first priority for moving forward is to determine if there is interest and demand for the proposed solution. That means organizing an educational process to get word out to the public and to recruit volunteers to help move the project forward.
5. Assess Customer Demand: You will also need to determine right away if there is enough customer demand and interest to support a broadband project. You need to know definitively that you can do better than the breakeven penetration rates I have identified. This means conducting some kind of household canvass to see if residents would buy from a new broadband venture.
6. Choose the Structure of the New Business: Early in the process you will need to choose the structure of the ongoing business. We identified three possible structures for the business: a) owned and operated by the county, b) owned by the county but operated by somebody else, or c) a cooperative that will be owned by the customers. Our recommendation is to do this as a cooperative, but that is not the only option.
7. Undertake More Engineering: Our study has taken a high-level look at the engineering of the business. There is always the cart before the horse issue of doing more engineering than you need before you are fully funded. But you will have to do enough additional engineering so that any funder knows that your network design is sound and accurate. For example, if you were

going to do the wireless business plan you would want to do enough engineering to determine the best places to locate the towers, and to determine if you can use any of the existing towers in the county. But you would want to hold off on the really detailed engineering until after you have funded the project. You would undertake just enough engineering to get the network financed.

8. Update the Business Plan: As you start making decisions on exactly how the business is going to operate you will want to update the financial business plan to reflect any changes in assumptions. It's not unusual to revise it several times before it is final and the business is financed. An updated financial plan is mandatory to get financed.
9. Find the Money: If it looks like there is a consensus to move forward, then the biggest task is to find the money to build the network and fund the new business. This will require outside financial and legal advisors.
10. Get Help Where Needed: We hope that one of the reasons you chose CCG Consulting and Dain International is our experience in helping fiber businesses go from concept to reality. We would be glad to make a proposal to help you with any of the required ongoing tasks. We have experience in all of the next steps that are needed to get the business started.

I. BACKGROUND RESEARCH

In this section of the report we will look at the results of the research done by CCG. Specifically in this section we will cover the interviews with key stakeholders, the products and prices of existing service providers in the market, and a strategy for the pricing of products which was used in our financial modeling.

A. STAKEHOLDER INTERVIEWS

Large Stakeholders

Doug Dawson of CCG talked with various large stakeholders in the county. This included some large businesses, a number of local governments, the Mille Lacs tribe, the electric cooperatives, the two cable companies, the local telephone cooperative, the school systems, various officials at the county, the hospitals and large medical providers, and a number of residents.

The goal of these interviews was to find out how large businesses are getting broadband and any other facts that might be pertinent to finding a broadband solution for the whole county. We wanted to know if the larger stakeholders can get fast and affordable broadband.

Like in most communities, there are a handful of large businesses in the area, but most businesses are small to medium businesses. But the biggest businesses are always of interest because they can be very large anchor institutions for a broadband business.

We found out several things from these conversations:

- The county government already has good broadband. This is delivered to them from a fiber network built by the state to serve governments. However, that network is not available to anybody else, including local businesses, the school systems, or other local governments.
- While it is not within the county, the business park just south of Princeton is a major employer of people living in the county. The business park does not have existing fiber throughout. A few businesses there have paid to have fiber constructed to them at a large expense and then pay high rates for bandwidth. One of the businesses there, even with fiber, cannot get enough bandwidth at an affordable price and augments their business needs by leasing servers in the Twin Cities at a high cost.
- The school systems have fiber connectivity to the schools and they buy bandwidth collectively with other school systems. They feel that the bandwidth they are buying is affordable, but they would like more bandwidth. The federal government last year started an initiative to get gigabit fiber speeds to all schools and the schools in the county, while having a fairly good bandwidth of a few hundred Mbps, are not at the gigabit goal.
- The Mille Lacs Band of Ojibwe have constructed fiber connecting their casino, their main headquarters, and some of their other businesses. They buy bandwidth from the local cable company and are satisfied with the bandwidth they can get. They operate businesses outside of that fiber network for which they cannot get good bandwidth.

- Businesses in the larger cities in the county have several broadband options. For the most part, the businesses in the cities feel like they have broadband options, but a number of them say that the prices they pay seem too high.
 - For instance, in Princeton businesses can buy from Midcontinent Communications, CenturyLink, or from a few CLECs (competitive telephone companies) that sell connections from the CenturyLink network.
 - In Milaca broadband can be obtained from Midcontinent Communications, Frontier, or Milaca Local Link, a new fiber overbuilder.
 - In the northern towns businesses can buy broadband from SCI Broadband or from Frontier.
- The Electric Cooperatives in the county have built fiber to take care of connecting their electric substations. Those require a connection back to the electric hub, and in the telecom industry that is considered bandwidth transport as opposed to bandwidth that goes to the Internet. With the fiber connections the Coops have all of the bandwidth they need.
- The hospitals have entered into long-term arrangements to obtain broadband that included building some fiber to connect their facilities. They might eventually be candidates to buy from a county-sponsored network, but for now they could not purchase from a new broadband business.
- The city governments must buy broadband like any other business and the quality and price of the broadband varies in relation to what is available in each city. The governments in the larger cities have broadband options while in smaller cities like Pease there are few, if any, decent broadband options.
- Businesses that are outside the cities have almost no broadband options. In rural areas broadband is limited to very slow, rural DSL from the telephone companies, satellite broadband, dial-up, or data through a cellular data plan.
- We will discuss the incumbent telephone companies and cable companies in the following section of the report.

We drew several different conclusions from the conversations we had with businesses:

- The fact that some of the larger entities in the county already have access to fiber means that some of them are probably not candidates for being customers of any new county-sponsored broadband business. The county government, the Mille Lacs Band, and the electric cooperatives, for example, have already found a broadband solution. In some communities these large businesses create a reliable core revenue stream for a community broadband network, but here they probably will not.
- While there is some fiber in the business park south of Princeton, the whole park is not covered and the businesses there that have found a broadband solution are paying too much. We recommend that any county network that is constructed ought to include building the business park, even though it is just outside of the county border.
- If the county was to provide a broadband solution this would involve building a fiber backbone that would connect through the cities and that would create a redundant ring through the county. If the county builds such a network we recommend that you run it through the business districts of the various cities to offer lower-price broadband to businesses.

- The school systems are not locked into any long-term arrangement or provided broadband from other parts of the government. They would be able to buy bandwidth from a new fiber business, although they have their own fiber network for connecting schools.
- Rural businesses badly need better broadband. They have the same poor options as the rural residences.

Residents and Small Businesses

While we didn't talk to more than a few residential customers or small business customers, we did gather numerous stories from them. We provided several tools for these stakeholders to get their experiences and stories back to CCG for this report. First, we asked everybody in the county to undertake a speed test to tell us the current speeds they are actually getting. Second, we asked both residents and businesses to tell their stories to CCG so that we could find out the kind of issues they have. Here are some of what we found out in this process:

Speed Tests: We got the results of speed tests from people in both the cities and the rural areas. We had asked people in the rural areas who had no broadband to tell us that, although very few did (hard to tell us that without broadband).

We should probably first explain a little bit about speed tests and how they work. A speed test measures the speed of an Internet connection from a customer to a very specific place that the speed test site has chosen at the other end on the Internet. The other end is generally a connection sitting in a data center that always pumps out a large amount of continuous bandwidth to whoever tries to connect to it.

The upside of these tests is that they are the same for everybody who uses them. But the downside is that they don't measure the true speeds that are really gotten on the open Internet. When you use the web your traffic generally gets routed to many different places. Since every connection you normally make is to a different place, the actual speed you get will differ from the speed test, with the speed determined by all of the factors in the network as well as the other end where the signal originates. If you take speed tests frequently you will be very familiar with this phenomenon.

Doug takes speed tests regularly. He has a 50 Mbps cable modem at his house from Comcast. He will get speed test results that vary between 30 Mbps and 60 Mbps, which is even faster than what he pays for. He sometimes gets significantly different results from speeds tests that are just a few minutes apart. The reason for this is that there are a lot of things that can happen between his desktop and pinging a speed test site in some distant city. First, in his house another family member might be downloading something large or watching video. It's also possible, since cable modem is a shared service, for other people in his neighborhood to be using enough bandwidth to affect his speed. After his neighborhood there are several potential choke points in the Comcast network that could slow down the bandwidth if they get busy. And then there is no predicting the path or the issues that might be encountered between the cable company and the signal he is trying to connect to elsewhere.

A speed test eliminates some of this last issue by always going to the same place and encountering the same signal, but even so, the results from speed tests vary. One speed test does not mean that is the speed you always get, or even what you often get. It's a point-in-time test only.

But what a speed test is good for is to see the relative speeds that are available. The broadband products in the world come in fairly predictable and standard speeds. For example, a cable company generally offers several speeds and it's fairly easy with a speed test to see the different tiers of speeds if you get a large enough sample of people using different products. We know that in rural Minnesota that the speeds on DSL are fairly slow. They are not all the same because the speed in a given town is going to vary according to the exact DSL technology being used, and over the years there have been many.

Here is what we found with the speed tests in the county:

- Those that report that they have cable modems were getting pretty good speeds. There were two obvious bands of speed achieved by the tests, with one band between 20 and 30 Mbps download and the other down in the range of 10 to 15 Mbps download. The cable companies have several tiers of speeds and I am guessing these are sold as 'up to' 30 Mbps download and up to 10 or 12 Mbps download. I would also guess that they might have customers on an even slower speed, but we didn't see any in the speed tests. Cable companies often have older legacy customers who pay low rates and it would not be unusual to still find a speed in the county for something like 6 Mbps download.
- We did not see any DSL connections faster than 6 Mbps download. There may be customers in the cities that subscribe to faster rates, but not that took the speed tests. The DSL speeds we saw varied between 6 Mbps download down to 0.5 Mbps download. This, again, is to be expected and DSL speeds drop very quickly with distance from the DSL hub, called a DSLAM. Generally in cities of the size found in the county there will be only one DSLAM location for the whole town. But it's possible that in some neighborhoods there are field-mounted DSLAMs in cabinets.
- The rural customers that took the speed tests all got speeds of about 3 Mbps or much slower, with many of them at 1 Mbps or less. And as I said earlier, nobody who didn't have any broadband responded to our request. There are a significant number of people in the county with satellite broadband. The satellite services offer speeds of all types with the fastest ones as fast as 15 Mbps download. But the satellite providers have a large amount of latency in their service, meaning delays, and often this goofs up a speed test and doesn't produce reliable results. So it's probable that the faster speeds that were reported from the rural areas are actually faster than the 3 Mbps shown by the speed test.
- In total we got around 80 speed test results. Since we didn't get more readings, and since this wasn't conducted at random, the results can't be used to make any definitive statement about the speeds in the county. The data doesn't allow us to tell you what percentage of the households are on slow or fast connections, as an example. But the speed tests do verify that the speeds in the cities are significantly faster than in the rural areas. And the results are enough to confirm that people buying DSL do not get the 'up to' speed if they live very far from the DSLAM.

The Stories: We circulated both a residential and a small business questionnaire and asked people to tell us their broadband story—is it good or bad, are there things they need that they can't get?

We invited people to complete the questionnaire or to just email us with their story, which many chose to do.

Most of the stories we got were from residential customers. We got a few business questionnaires from businesses in the cities who were largely satisfied with their speeds, but who thought they paid too much for broadband. This is not atypical and both cable companies and telephone companies charge more to businesses. What is most interesting about business prices these days is that there is no standard price list for businesses and the prices are often negotiated and are thus all over the board. Many businesses buy a combination of data, telephone, and other services as a bundle and they often don't understand what they pay for the individual services.

Almost all of the residential stories we got were from people with poor broadband. We didn't get a questionnaire back from anybody who doesn't have any broadband. Here are some of the things we found out:

- We heard from a surprising number of people who are using their cell phone data plans as their home broadband connection. We've seen this a few other places before, but here it seems to be a pretty common way to get broadband. The problem with cellular data is that it is extremely expensive. The various data plans work out to about \$10 per downloaded gigabit, making this by far the most expensive broadband in the country (except for one very old satellite plan that we hope nobody is still using). One resident told us that they have four schoolkids at home and they use their cellular data plan for broadband. They have had months where they received bills over \$200 for data and that using the Internet is a constant controversy in the home. To put that into perspective, about 25% of homes in the US now download 100 gigabits per month or more. If that 100 gigabits was done on a cellular plan the cost would be \$1,000 for the data, and so a home using 20 gigabits is not really a heavy data user.
- We heard from several residents who said that they have to routinely take their children to the library or to a friend's house to do homework since they didn't have enough broadband at home. They said that the schools give out homework from time to time that supposes an Internet connection. The school systems told me that if there was good broadband in the county that they would do much more over the web and that lack of broadband is stopping the school systems from teaching in the way they want.
- Several residents said that they would like to work from home but can't do it without broadband.
- One resident told us that when they moved to their rural home in the county a few years ago that they were shocked when they couldn't get broadband at their new home. This home has two children that are not yet of school age and they said they were worried that they might have to move when their children start school, even if that means losing money on their home. They said they would never have moved to the county had they understood the lack of broadband.
- We got universal complaints that people can't partake of the normal things that other people do on the Internet like watch Netflix, or do gaming, or even just surf the web a lot. They said that lack of broadband really puts most of the good things about the web out of their reach.

The Consequences of Poor Rural Broadband: As the county already knew when you hired us to do the study, there is definitely a glaring lack of broadband in the rural parts of the county today. The homes without access to adequate broadband represent more than half of the households in the county, so this is a significant issue.

The cities in the county have adequate broadband, although it is not as fast as what is available today in the Twin Cities. But the cable companies operating in the county seem to understand the need for broadband speed and our expectations are that they will continue to increase data speeds in the cities over time, as they have already done in the past. But it is also likely that the speeds in the county, even in the cities, is going to lag behind what is available in the Twin Cities. We refer to this phenomenon as the rural broadband gap, and this is true for the vast majority of the US.

One has to go only a very short distance outside of the cities before the data speeds drop off. Customers within a short distance of the cities can get very slow DSL, the speeds of which drop very quickly with distance. The other alternatives for connectivity in the rural areas of the county are dial-up, satellite data, or cellular data, all of which are inadequate for a variety of reasons. We talk about those technologies and the providers in more detail later in the report.

This lack of rural broadband has major economic implications for the county. Lack of broadband causes all kinds of problems for rural homeowners including:

- **Lower Property Values:** There are now numerous studies that have been done that show that homes without broadband are worth less than similarly placed homes with broadband. Since the vast majority of homes in the country now have a broadband connection, this is one of the things that a home buyer expects at a new home. I talked with one of the home builders in the county who told me that lack of broadband is a major impediment for him to build and sell new rural homes. What is even scarier for residents of the rural parts of the county is that homes without broadband are becoming harder to sell. Without a broadband solution the rural parts of the county are going to become undesirable places to live, and this is only going to get worse over time as broadband speeds keep growing in the places that have broadband. When it comes to broadband, there is a huge gulf today between the cities in the county and the rural areas. But compare the rural areas to places that can get gigabit fiber and the gap is almost incomprehensible. And we must note that there are now numerous rural places in the state where rural residents can get fiber-based broadband up to a gigabit in speed. Places like Sibley County, Cook County, and others have taken the steps to build broadband networks. And there are numerous telcos and cooperatives that have built, or that are planning to build, broadband in rural parts of the state. If enough other places get it, then rural Mille Lacs County becomes comparatively undesirable. Over time lack of broadband is going to lower your tax base.
- **Education:** It's incredibly hard to raise kids today in a home without adequate broadband. The issue is not just data speeds, but rather the total amount of data that has to be downloaded. For example, some of the satellite broadband has speeds up to 15 Mbps, but the plans mostly come with very tiny data caps that make it hard for a home with children to use. We got reports of people in the county using cellular data plans at home with kids and having astronomical monthly bills for broadband.

Schools want to be able to use broadband for education outside the school. For example, one common thing done in places with adequate broadband is to have students watch video content at home as homework and then discuss it in the class. That frees valuable classroom time from watching video in class. The whole education process is moving more and more to the web and kids without access to the web are lacking the tools that their peers take for granted.

- Working at Home: More and more jobs today can be done at home, even if only part time, but people living without adequate broadband can't participate in this newly expected part of the economy. Increasingly, companies are willing to hire people who work out of their homes. The beauty of such jobs is that they can be done from anywhere. As an example, Doug's sister is in charge of the phone network for one of the major banks nationwide and she works from her home in West Virginia, thanks to broadband. The bank didn't care where she lives because the phone systems she takes care of are everywhere.

Many of your residents commute to jobs as far away as the Twin Cities and many of those employers would allow commuters to work a few days a week from home if they had a good enough broadband connection. Telecommuting is good for everybody. It saves a lot of money for employees to not have to drive to a distant office. Companies have seen after years of trying this that employees are often more productive from home due to missing the various distractions that are in the work environment. And commuting is green and saves a lot of gasoline and the resulting carbon dioxide.

- Taking Part in the Modern World: People with good broadband have access to services that either don't work in the rural areas of the County, or which use too much bandwidth to fit within their data plan caps. Households with good bandwidth are using broadband routinely for things like watching videos on services like Netflix, talking to friends and family on services like Skype, shopping at sites that have videos, playing video games which have largely moved online, taking online courses from numerous colleges, or even just browsing the web that now contains video on a large percentage of web sites.

Many people's social lives, for better or worse, have moved to the web. A lot of people now have friends all over the country based upon some shared interest instead of based upon geographic proximity.

- Future Services: The broadband world isn't standing still and the need for broadband has been growing at an exponential rate since the mid-90s. Residences in the US have doubled the amount of bandwidth they use about every three years since 1995, and that trend is expected to continue at this pace for the foreseeable future. To put this into perspective, if a home needs 6 Mbps download today to be happy (the typical DSL speed), then nine years from now they are going to want 48 Mbps download speeds.

It's very hard for people to visualize the impact of anything that grows at an exponential rate. But look around us at other things that increase at exponential rates. Computer processing speed has been doubling about every 18 months since the early 60s. This

phenomenon is known as Moore's law, named for the engineer who noticed it. It is this exponential growth that means that the computing power in your smart phone is far faster than the best PC you could buy for your home a decade ago. Because of exponential growth, your smartphone is now far more powerful than the best supercomputer of twenty years ago.

Every industry expert expects the need for broadband to keep growing. Every year the size and the amount of things we do online gets larger and faster. It's been that way since we've gotten online and there is no end in sight for new uses for broadband. Programmers are already starting to invest in making 4K video which is 8 times larger than HD video. And it's not just video that's causing the bandwidth growth. Everything we do online takes more bandwidth over time. Files get larger, web pages get busier, and we use more and more applications at the same time. As an example, when social media sites began embedding video in the last few years the bandwidth needed to be on a service like Facebook grew much larger.

- The Growing Broadband Gap: There is a quickly growing broadband gap between the urban parts of the state and the county. Where your cities have cable modem speeds of 30 Mbps (which is adequate today for most families), the speeds in the Twin Cities and other urban areas is growing rapidly.
 - Comcast is in the process of unilaterally increasing speeds. For example, in the northeast they have raised customers with 25 Mbps to 75 Mbps and 100 Mbps customers to 150 Mbps. They say they are going to do this everywhere.
 - Comcast and the other large cable companies are now installing DOCSIS 3.1, the newest technology that will let them increase speeds dramatically. They say that within a few years they expect to increase speeds again and that their slowest data speed will become 100 Mbps with speeds up to a gigabit.
 - CenturyLink has started to build fiber in the Twin Cities and will offer gigabit Internet for \$80/month as part of a bundle. They also will have a 40 Mbps product for \$30.
 - US Internet offers gigabit Internet in parts of Minneapolis for \$45/month and offers an amazing 10 gigabits for \$400/month.

Possibly the most telling statistic is that about 83% of homes nationwide now have a broadband connection. Some of the homes in that number are rural and have inadequate broadband like what we've found in this county, but the vast majority of such homes are able to obtain faster broadband where they live if they are willing to pay for it. But in Mille Lacs County your rural households have no good options.

B. INCUMBENT PROVIDERS

There are a number of different incumbent cable and data providers today in the county. There are four telephone companies in the county. CenturyLink serves Princeton and the area around Princeton. Frontier Communications serves most of the rest of the county. However, the Foreston and Bock areas are served by Benton Cooperative Telephone Company. There is also a tiny part of the county served by Windstream. There are two cable providers who also provide cable modem

service and who probably have the most broadband customers in the county. Princeton and Milaca are served by Midcontinent Communications. Most of the rest of the cities in the county are served by SCI Broadband. Additionally, DirecTV and Dish Networks offer cable services directly in the area. Customers can also buy data services from several satellite providers as well as use cellular data. Finally, there is one competitive provider—Milaca Local Link—that provides fiber-to-the-premise in Milaca.

Overall this makes for a very confusing picture with customers in different parts of the county having service options from different providers. It strikes us that we rarely see such a wide mixture of service providers in one county.

CenturyLink

Telephone service is provided in Princeton today by CenturyLink. CenturyLink is a telecom company based in Monroe, Louisiana that purchased Qwest several years ago. Qwest, which was formerly Mountain Bell and US West, was part of the Bell Telephone system.

CenturyLink is a publicly traded company and is the third largest telco in the US. CenturyLink has projected annual revenues of around \$18 billion for 2014. At the end of 2014 the company had around 12 million telephone access lines, 6 million high-speed Internet customers, and 242,000 cable TV customers.

As the incumbent provider, CenturyLink is considered the “provider of last resort.” This means that CenturyLink is required to serve all residential and business customers for basic local services, and it must provide facilities to all customers. The rules that govern the way that CenturyLink serves customers in the county are embodied in their “General Customer Services Tariff,” which is approved by the Minnesota Public Utilities Commission. This tariff contains all of the regulated products and prices, along with the terms and conditions under which CenturyLink will sell them to customers. The tariff sets forth rules for such customer service procedure such as the manner and amount of customer deposits, the rules by which they will disconnect service for nonpayment, and the rules by which they will reconnect service. We’d note that a recent trend is to get states to deregulate many services as competitive and take them out of the tariff; the Minnesota tariff has had many products removed in recent years.

As a telco, CenturyLink sells the full range of residential and business voice services. CenturyLink also sells data products. They sell traditional TDM voice services based upon multiples of T1s. They also sell high-speed DSL service. In recent years CenturyLink has invested significant capital in improving data speeds in metropolitan areas. In rural cities, for the last decade CenturyLink has provided DSL speeds of between 1 and 3 Mbps. CenturyLink has been upping those speeds in some markets by installing new DSL equipment. For instance, in some parts of the Twin Cities CenturyLink now supports DSL products with speeds up to 25 Mbps. DSL speeds are advertised in terms of ‘up to’ speeds and customers can get slower speeds than the speeds advertised. Some of the factors contributing to slower speeds include the distance the customer is from the CenturyLink central office, and the age and size of the copper wiring in a neighborhood. CenturyLink also builds fiber to some business customers and can sell a large range of very fast data products to fiber customers.

CenturyLink has recently gotten into the cable TV business. Under the Prism trademark they are delivering cable over bonded pairs of copper using DSL and IPTV technology. But CenturyLink is also starting to build FTTP (Fiber to the Premise) systems and they have opened up construction projects in their major markets like Seattle, Denver, Phoenix, and surrounding suburbs. They are also testing a technology called G.Fast in Salt Lake City that can deliver 100 Mbps over two pairs of copper for a short distance using a technology called fiber to the curb. However, at this point there has been no news reports or industry expectations that the company will extend this business to smaller communities. That certainly has been the experience with Verizon where the company built FTTP to the major urban and suburban markets but not to smaller towns and rural markets.

In most of the US CenturyLink partners with DirecTV for cable. The CenturyLink technicians install the satellite service and CenturyLink bills for the DirecTV on the telco bill. They also give a bundling discount, making it cheaper to buy cable through CenturyLink than buying it direct.

CenturyLink just accepted money from the Connect America Fund to enhance the DSL in the county (and in all of their rural properties in the state). This will be covered in more detail elsewhere in the report.

Frontier Communications

Frontier Communications serves most of the county outside of Princeton. Frontier will be the fifth largest telephone company in the US after the completion of a current proposed purchase of Verizon customers. The company changed their name from Citizens Communications Company in 2008. The company has grown through acquisitions and continues to buy customers. For instance, this year they are buying 2.2 million customers from Verizon in Florida, Texas, and California. The company spent \$8.5 billion to buy a huge pile of customers from Verizon in 2009 and then in 2013 bought the Connecticut operations of Verizon.

Like Century Link, Frontier is considered an incumbent provider and is a provider of last resort. At the end of 2014 Frontier had 3.5 million total customers that included 2.4 million broadband customers. The company reported that as of the end of 2014, 83% of their broadband customers had access to speeds of 6 Mbps download, 74% had access to speeds of 12 Mbps, and 55% had access to speeds of 20 mbps. In 2014 the company had revenues of \$5.0 billion.

The company is highly leveraged and at the end of 2014 had a total of \$16.7 billion of debt and will take on more for the latest Verizon acquisition. That is not unusual for a company that is growing by acquisition, but it means there is probably not a large amount of money available for capital improvements.

Much of Frontier's service area is rural like in Mille Lacs County. Frontier is working to maintain and offer services over aging copper cables in the county and elsewhere. Frontier provides service in rural areas using DSL, and like in Mille Lacs County, much of the DSL is of older types that can offer speeds of up to 12 Mbps download, but much of it with speeds only up to 6 Mbps.

Frontier recently accepted money from the Connect America Fund to enhance DSL speeds in the county as well as in other parts of Minnesota. This will be discussed in greater detail elsewhere in this report.

Benton Cooperative Telephone Company

Benton Cooperative Telephone Company is a provider headquartered in Rice, Minnesota. In Rice they offer the full triple play. In Mille Lacs County the cooperative services Bock, Foreston, and the areas surrounding those towns with voice service and data using DSL.

As a cooperative, the business is owned by the customers of the business and profits are rolled back over time to improve the business or used as patronage dividends to customers. The cooperative today has built fiber-to-the-premise in Rice and says they will be building it in Bock within three years. That will bring fiber data as well as competitive cable TV to the town and surrounding area. One would think they might eventually do the same in Foreston.

The Coop today also offers fiber services to businesses and residents in Milaca in a joint venture with East Central Energy and marketed under the name of Milaca Local Link.

Midcontinent Communications

Midcontinent Communications is a regional cable company that offers the triple play over traditional cable network technology. The company is a joint venture between Comcast and Midcontinent Media. The company is headquartered in Sioux Falls, South Dakota and has most of their customers in North and South Dakota, but with some in Minnesota and Wisconsin. The company has approximately 1.2 million customers and provides service in over 200 communities.

Midcontinent Communications was formed in 1999 when the customers from Midcontinent Media and AT&T (then called TCI for the cable business) merged their operations in North and South Dakota. The company then grew more by acquisition and purchased customers from the bankrupt Adelphia, from Charter Communications, and from US Cable.

The company operates a regional sports network that carries college sports from North and South Dakota.

Midcontinent Communications serves both Princeton and Milaca today.

SCI Broadband

SCI Broadband is a small, privately held cable company that services 30 rural communities in east central and northern Minnesota. The company was founded in 1984 as Savage Communications in Hinckley, Minnesota.

The company uses a traditional hybrid fiber coaxial system (HFC) to deliver the triple play to customers. The company offers a full range of digital products and is in the process of upgrading cable modem speeds throughout the service area.

DirecTV

DirecTV is one of the largest cable providers in the US with about 20 million customers. DirecTV just merged with AT&T in a move that still has many industry analysts scratching their heads. But combining the DirecTV and AT&T cable customers makes AT&T the largest cable provider in the country in terms of total video customers.

In Mille Lacs County DirecTV is part of a service bundle with CenturyLink in the southern part of the county, but customers are free to subscribe directly to the service. One would imagine that outside the city limits that most homes have satellite cable.

Dish Networks

Dish Networks is the other satellite provider who has customers in Mille Lacs County. The company has around 14 million customers nationwide and annual revenues of over \$14 billion. The company has average customer revenues of over \$80 per month. Dish Networks is sold in the county as part of a bundle from Frontier.

Milaca Local Link

Milaca Local Link is a joint venture between the Benton Cooperative Telephone Company and East Central Energy. The company has built FTTP within the city limits of Milaca, available to both residents and businesses. The day-to-day operations are handled by the Benton Cooperative.

This is the only residential fiber within the county today, although the Benton Cooperative will be bringing broadband to Bock.

The company offers a full triple play, all provided on fiber.

Satellite Data

There are a number of satellite providers available in the county. In each case the availability depends upon the ability to have a clear path from a satellite dish to see the satellites. The top four providers in the country are Exede (which also markets under the name of Wildblue), HughesNet, DishNet, and StarBand. In general, there are several issues with using satellite broadband. First is latency, which means delay in the signal. When an Internet connection must travel to and from a satellite there is a noticeable delay and that makes it hard or impossible to do real-time transactions on the web. So any website or service that requires you to maintain a constant connection will perform poorly, if at all, with a satellite connection. The second biggest issue is the small data caps which limit the amount of data you can download in a given month. All of the services require contracts of up to 2 years. Finally, the service can be expensive. Here is a short summary of the four providers:

Exede (Wildblue): Exede uses the newest satellite and uses technology that has meant a significant increase in download speeds. Exede touts speeds up to 17 Mbps download

although customer reviews say the average speed is more like 12 Mbps. But that makes it the fastest satellite service. They also tout an upload speed of almost 5 Mbps.

Monthly plans range from \$49.99 to \$129.99 per month and vary by the size of the monthly data cap. There is also a \$9.99 monthly fee for the modem as well as a \$149.99 installation fee. The basic package comes with a monthly allowance of 10 gigabits of total download (same as the largest cellular plans). The premium service has a cap of 25 gigabits. This puts the price per gigabit at \$5.50, about half the price of cellular data. Exede does allow unlimited download at nighttime.

HughesNet: HughesNet is the oldest satellite provider. They have recently upgraded their satellites and now offer speeds advertised as 8 Mbps download and 0.4 Mbps upload. Their prices range from \$49.99 to \$129.99. The smallest package has a 10 gigabit download limit per month and the largest one is 20 gigabits. When including the \$9.99 cost for the modem the premium package equates to \$7 per downloaded gigabit.

DishNet: DishNet is associated with Dish networks and can be bundled with their cable product. DishNet prices range from \$49.99 to \$79.99. They also charge \$10 monthly for the modem. They have download speeds of 7 Mbps and upload at 0.8 Mbps. The monthly caps range from 10 gigabits per month on the smallest plan to 50 gigabits on the larger plan. For the largest plan this works out to \$1.80 per downloaded gigabit, making them the most affordable satellite provider.

StarBand: StarBand is a legacy satellite provider that works on older satellites. Their prices range from \$59.99 to \$119.99 with a \$14.99 monthly charge for the modem. Their data caps range from 1 gigabit for the smallest plan up to 5 gigabits on the largest plan. That works out to a cost of \$27 per downloaded gigabit for the largest plan, making them probably the most expensive broadband per gigabit in the country.

Cellular Data

There are four primary cellular companies in the country—AT&T, Verizon, T-Mobile, and Sprint. Typically only Verizon and AT&T have wide coverage in rural counties like Mille Lacs, although there are exceptions.

A number of households in the county use their cellphone data plans as their household broadband. There are several problems with this. First, the speeds you can get vary by distance from the cellphone tower. Speeds for cellular data generally are not fast. There are two different cellular data standards in use: 3G and 4G. 3G data speeds are capped by the technology at 3.1 Mbps download and 0.5 Mbps upload. 4G can operate at about 12 Mbps download and the upload varies by service provider. There are slightly faster 4G networks which have speeds up to about 25 Mbps download, which you might think of as 4.5G, but those are available today only in urban areas. For both of these standards, actual speeds in the field will vary by distance from the tower as well as by how busy a tower is, meaning actual speeds in rural areas tend to be fairly slow for most customers.

The biggest problem in using cellular data for home broadband use is that most of the plans have very small data caps. For example, with AT&T you can buy 10 gigabits in monthly download for \$79.99 and then pay \$10 per additional gigabit downloaded.

While cellular data avoids the latency issue of satellite data, it is more expensive per downloaded gigabit than satellite data and for most customers will be slower.

Business Competitors

In Princeton and the business park just south of Princeton there are several competitors offering advanced data services. In talking to some of the businesses in town we heard that there are businesses that have some service today from companies like Level3 and Zayo. These companies do not own fiber of their own that reaches into the south of the county. Instead, they likely have transport agreements with Midcontinent or with CenturyLink that provides them access to the area. However, both of those companies will build some local fiber in the right circumstances for a large business customer.

What Kind of Competition Should You Expect?

A question that must always be asked when considering the creation of a broadband solution is: what kind of competition will you encounter?

This county has such a mixture of different providers that it's not an easy question to answer. So perhaps answering it by parts of the county is the best way to tackle the question.

In Princeton the primary competition is from Midcontinent Communications. They have a cable network that offers base speeds of 30 Mbps download today and with premium products that are faster. Starting in 2016 the technology will be available to upgrade cable networks to gigabit speeds. While a company like Midcontinent Communications won't be the first to do this (Comcast has already announced they will do it everywhere by 2017), one can expect that they would make that upgrade for any area where they were going to get significant new competition. They already have most of the data customers in that market and they would fight to keep them. CenturyLink sells DSL in the city and generally has a product that is attractive to those that are looking for low prices instead of speeds.

The businesses in Princeton and the business park south of Princeton have more choices and there is a presence there today of Midcontinent Communications, CenturyLink, Level3, Zayo, and possibly others who have a transport arrangement with CenturyLink.

Milaca has both Midcontinent Communications as well as Milaca Local Link which has built fiber in town. Frontier also offers low price DSL for cost-conscious customers. In a town that size it would make no sense for anybody to build a third network.

In the northern cities and around the lake the primary service is from SCI Broadband. While they are a small local company, I heard a number of reports that they have great customer service. Their

HFC network is also capable of, over time, being upgraded to gigabit speeds. These towns also can get Frontier DSL.

The towns of Bock and Foreston are served by the Benton Cooperative Telephone Company today with DSL and telephone service. The Coop says they will be bringing fiber to Bock within a few years and one has to imagine they will eventually also bring it to Foreston.

The challenging places in the county are the rural areas. In the south is a large area around Princeton that is served today for telephone service by CenturyLink. As we were writing this report CenturyLink accepted over \$500 million per year in support from the Connect America Fund which they are going to use to improve data speeds to 10 Mbps download and 1 Mbps upload in the rural areas of thirty states. The area around Princeton is included in this area. While they have up to six years to upgrade everybody in the many states, they have to upgrade 40% of them by the end of 2017 and 60% by the end of 2019. Until they announce it locally, we'll probably not know where the Princeton areas falls within that timeline.

The rural parts of the rest of the county are served by Frontier. They also accepted the Connect America funding for Mille Lacs County and will be upgrading the rural DSL.

It is not easy to put together a solution to meet these many needs. There are areas that have no broadband and are unlikely to get it, primarily the rural areas in the north of the county, and other areas that have or will soon have better broadband.

C. CURRENT BROADBAND AND OTHER PRICES

In this section we will review broadband prices available to customers today in the county. It used to be very easy to analyze the prices that people pay for services. Just a few years ago you could go to the web and find the prices charged by any telco or cable provider, and except for the rare special, most customers in a given town paid about the same thing for service. But this is no longer true. Most telco providers have removed their 'standard' prices from the web and so there is no baseline cost you can compare. Further, companies have developed strategies to freely charge different rates to different customers.

In preparing this study we asked for copies of customer bills, and looking at those bills confirmed our belief that we would find prices all over the place in the county. The way the carriers price products is almost anti-intuitive. The customers who have been with them the longest and are loyal tend to pay the highest prices because they have gotten rate increases over the years and no special deals. Brand new customers pay the lowest amount and the larger telcos and cable companies all have specials that are good for one or two years as an introductory price for first-time customers. These special prices are what you find on the websites for these companies and these low prices do not reflect what most customers pay. In between the low specials and the highest rates will be rates for customers who have somehow negotiated special prices. This is a fairly routine occurrence. For example, when a new customer's contract expires and they get charged a much higher price, a call to customer service may result in a price that is somewhere in between the original special price and the higher price paid by older customers.

Pricing is further complicated due to bundling discounts. CenturyLink, Frontier, and Midcontinent all have bundling discounts that apply when customers buy multiple services. And bundle discounts vary as much as the regular pricing and the discount varies according to when a customer connected and the deal they negotiated at the time.

This means that prices vary widely in the county, even among the customers of any one provider. There are neighbors in the cities that pay very different rates for the same product package. This means that any actual pricing that people get might vary from what I report below and that there will be customers who are paying both higher and lower prices than what we report. The bottom line of all of this is that there are no ‘standard’ prices in the market any more. But if you want to compete against these companies you must understand the range of prices.

Of course, the prices we are reporting only hold for those areas that can even get the products described. In the rural areas where cable modems aren’t available customers are paying much higher prices for poorer broadband than people in the county who live in the cities.

CenturyLink

CenturyLink is the incumbent telephone company in Princeton and the surrounding south part of the county. Historically the telephone rates they charged were filed under a tariff on file at the Minnesota Public Utilities Commission. A few years ago every one of their telephone customers in the county would have been billed exactly the same rate for the class of service they were using (residential and business rates are different). We would have been able to look at bills for Qwest at the time and would have seen the same rates for every resident. But CenturyLink now has bundling discounts and they also run specials, and so you will be able to find different telephone rates in town. Because telephone is so competitive, the tariffed rates are now generally viewed as the highest rate that CenturyLink can charge and there will be customers paying less than the tariff rate.

CenturyLink sells DSL for broadband and these rates have never been regulated. So the company has always been free to charge different rates to different customers for the same services.

CenturyLink does not directly offer cable TV, but they bundle DirecTV with their other products on the same bill.

Telephone Rates

Their basic rates were in the following range when they were last tariffed. This does not mean that these are the rates any longer and with a de-tariffed rate CenturyLink is allowed to charge whatever they want, within reason. The following rates were the last listing of the flat rate option, meaning a telephone line using these rates can make unlimited local calls. There used to be options available for customers who wanted to be able to make and pay for fewer local calls.

	<u>Monthly</u>
Flat Rate Residential Phone Line	\$18 - \$22
Flat Rate Business Telephone Line	\$42 - \$45

Business PBX Trunk Lines \$45 - \$51

These rates do not include the Subscriber Line Charge which is currently \$6.50 for both a business and a residential line and would be added to the above rates. The rates also do not include the Access Recovery Fee (ARC) which is a new FCC fee that is currently capped at \$1 per month by the FCC, and CenturyLink could be charging any amount up to and including the \$1 rate.

CenturyLink telephone line prices don't include any features. These features were either sold a la carte or sold in bundles and packages. Some of the most commonly purchased features are call waiting, 3-way calling, voice mail, and caller ID. CenturyLink offers dozens of features and they range in price from \$2.95 to \$8.50 per feature for residential service. These products are also now de-tariffed and CenturyLink can charge whatever it likes for these products.

CenturyLink DSL

CenturyLink sells high speed Internet using DSL technology. They sell both a bundled DSL product, meaning that you purchase it along with a telephone line, and also a 'Pure' product, meaning a customer can buy just DSL. As discussed above, CenturyLink has a lot of specials, and so there are special rates available on the web today for a new subscriber as well as older rates for those not on a special plan. Following are some of the rates charged for residential DSL. We say some of the rates because there are certainly going to be customers in the market on older specials that have different rates than these. Note that the quoted speeds offered by CenturyLink DSL are "best effort" speeds, meaning they are not guaranteed. In fact, rural customers will usually get speeds significantly slower than the best effort speeds.

Residential DSL

CenturyLink currently advertises three special DSL products on their website. These are bundled prices that assume that the customer also buys a telephone line at the full regular price.

Bundled Pricing (bundled with either telephone service or DirecTV)

Fast	From 786k to 3 Mbps Download	\$14.95 to \$24.95 for a 1-year contract \$39.95 Regular Pricing
Faster	From 7 Mbps to 12 Mbps	\$29.95 for 1-year contract \$39.95 Regular Pricing
Fastest	Over 12 Mbps	\$29.95 for 1-year contract \$39.95 Regular Pricing

As you can see, all of the DSL has a regular price of \$39.95 and the speed a customer can get is related to the specific DSL technology that is deployed in their area. In addition to the base price, CenturyLink charges \$6.99 per month for a DSL modem. Customers can obtain their own compatible modem to avoid the fee, but the web is full of cautionary tales of customers who were unable to get 'compatible' modems to work for them.

Pure DSL

Pure DSL is CenturyLink’s name for a DSL line that is not bundled with telephone or DirecTV. The CenturyLink website shows the following current prices for Pure DSL. A customer must sign a two-year contract to get the discounts. There is one price for the first year, a higher price for the second year, and after that the customer pays the list price:

	First Year	2 nd Year	List
1.5 Mbps download, 896 Kbps upload	\$30.00	\$40.00	\$42.00
7 Mbps download, 896 Kbps upload	\$35.00	\$45.00	\$47.00
12 Mbps download, 896 Kbps upload	\$40.00	\$50.00	\$52.00
20 Mbps download, 896 Kbps upload	\$50.00	\$60.00	\$62.00
40 Mbps download, 896 Kbps upload	\$60.00	\$70.00	\$72.00

Pure DSL also comes with the \$6.99 CenturyLink DSL modem.

From our research it appears that there are no DSL products in the county faster than 12 Mbps. On the speed tests we didn’t see any DSL faster than 6 Mbps, although we’ve been told that faster DSL exists. We note that CenturyLink serves a lot of large markets like the Twin Cities, Seattle, Denver, and Portland and other markets where the faster products are available.

CenturyLink Business DSL

CenturyLink no longer publishes business DSL prices. There are no prices on the website and no prices listed in any of their sales literature or tariffs. Basically, CenturyLink will negotiate a price with a business customer based upon how many other products they purchase and also depending upon how long they are willing to sign a contract.

When CenturyLink last published rates their slowest business DSL ranged from \$40.00 per month for a 3-year contract up to \$62.50 for a month-to-month product and no contract commitment. But today each customer will negotiate with a salesperson and rates charged in the market are all over the board for the same product.

CenturyLink T1 Products

For decades before DSL the standard data product was a T1 and there are still going to be businesses in Princeton that are using a T1. A T1 is a 2-way symmetrical circuit, meaning it has the same speed for both upload and download. A T1 delivers 1.544 Mbps both in the upstream direction and in the downstream direction. A T1 typically can be installed anywhere and is not limited by distance from the central office, like DSL.

T1s are very expensive when used for Internet access. In order to buy a T1 a customer must pay for the local T1 circuit (often called the loop) plus an additional charge for the Internet Access. CenturyLink has de-tariffed T1s, meaning they can quote different prices to

different customers. In Minnesota I've seen T1 bills with a local loop in the range of \$300 per month and Internet T1s costing between \$500 and \$600 per month.

Frontier Prices

Frontier Communications is the incumbent telephone provider that serves most of the county north of Princeton. Frontier rates are no longer tariffed, meaning that they can offer special prices or put products into bundles.

Frontier offers cable TV with bundles through Dish Networks.

Telephone Rates

Frontier offers a base price of a basic residential telephone line for \$27.99. They also have a line with features and unlimited long distance for \$40.99. Both of those lines also have an extra charge of \$6.50 for a Subscriber Line Charge and up to \$1 for an Access Recovery Charge (ARC).

Frontier does not list business telephone rates and we didn't get any bills that included them. But they do currently list three bundles for business DSL plus a business phone line with unlimited long distance as follows, with a 2-year contract:

With DSL up to 7 Mbps	\$49.98
With DSL up to 15 Mbps	\$69.98
With DSL up to 20 Mbps	\$99.98

We suspect that only that lowest speed product would be available in Mille Lacs County. Since business telephone lines always cost more than residential lines, these bundles are highly discounted, and after a special the prices would go much higher.

Frontier DSL

Frontier only advertises residential DSL nationwide at speeds of 6 Mbps download and 768 kbps upload.

Residential DSL is available from the Frontier website as follows:

- Add DSL to an existing phone line for \$19.99 per month.
- Standalone DSL with no phone line is \$34.99 per month
- Bundled DSL with a phone line with voice mail, caller ID, and call waiting is \$47.98.

DSL customers can also add a 100-channel line-up including local channels from Dish Networks for \$19.99.

Again, there are many customers paying different prices than these. There are customers who might be paying lower rates due to past specials and customers paying more than the current specials.

The bad news for rural customers is that the DSL costs the same everywhere, but in some places near the end of the DSL range customers might be getting speeds that are not much faster than dial-up.

Benton Cooperative Telephone Prices

We did not get any bill samples for Benton Cooperative and their prices are not listed on their website. They serve Bock and Foreston.

Midcontinent Prices

Midcontinent Communications is the incumbent cable provider in Princeton and Milaca. They are very typical of a cable company and they have prices all over the board for the same products. They offer specials often to lure new customers and so they have customers priced at different specials. They also will negotiate with customers at the end of a special.

Midcontinent also has a very wide range of products across their system because they operate cable systems of widely differing capabilities. They have some systems that have cable modem speeds as fast as 100 Mbps and they have other systems with speeds of only a few Mbps, all according to the technical capability of the system.

It's worth noting that they have a philosophy with data products to increase speeds without a price increase as they upgrade their systems. There are a number of websites of reviews from Midcontinent customers who talk about getting several speed upgrades over the last few years.

There are three factors which determine the fastest Internet that a cable company can offer, and Midcontinent did not want to disclose exactly where the system for Mille Lacs County lies along the spectrum of possibilities. But we talked to them and they told us that they have future upgrades in mind for the system, so speeds are likely to keep improving and will get faster in the future. The factors that determine the fastest speed:

- Overall bandwidth of the network. Cable network speeds are expressed in terms of megahertz, because within the coaxial cable the systems actually act like a radio broadcast. There are very tiny rural systems of only 250 MHz up to 450 MHz that are too small and of an older technology that will support only very slow broadband. There are a few Midcontinent systems in North Dakota that only have 1 Mbps cable modems.
- The technology level of the cable modem systems. Cable systems use a transmission standard called DOCSIS (data over cable service interface specification) that has been developed by CableLabs. There are four major releases of the DOCSIS standard that allow for different data speeds. The oldest is DOCSIS 1.0 which allowed for modem speeds up to about 7 Mbps. DOCSIS 2.0 has allowed for speeds up to about 12 Mbps. DOCSIS 3.0 offers speeds up to as much as 300 Mbps, although most systems don't offer speeds much faster than 100 Mbps. The newest DOCSIS 3.1 will allow speeds up to multiple gigabits although it probably won't be used for a while to offer anything faster than 1 gigabit.
- The number of cable channels on the system and how much they have been compressed. Data is provided on a cable system in bandwidth that has been freed from transmitting TV

channels. There are various digital technologies that let cable providers cram more TV channels into one channel slot on a network that frees up empty channels to be used for data service.

With all of that said, it was widely reported to us that customers in Princeton could buy cable modem speeds of 30 Mbps. We did not see any customer bills with faster service, but we would expect that faster speeds are available in the market. We also expect that Midcontinent will continue to improve the network like they are doing in their primary markets in North and South Dakota. The larger cities in those markets can get speeds up to 100 Mbps download and 15 Mbps upload which is advertised at \$105 per month.

The company seems to have prices in three ranges, which can best be described as slow, medium, and fastest. In each market these prices are applied to whatever is available on the network. As networks are upgraded, people keep the prices they pay but increase in speeds. The low prices are around \$35 to \$40. The medium speeds are around \$55 to \$60, while there are fast speeds of 100 Mbps they seem to cost around \$100.

Speeds vary by market. In the following example of speeds, the first number is the download speed and the second number is the upload speed. For example, one of their typical markets in North Dakota has speeds of 15/1, 25/2, and 50/5. But there are other markets where the faster speeds are instead 30/2 and 60/6.

The good news for Princeton and Milaca is that over time they ought to see their speeds increased. Somebody with a 30/2 Mbps cable modem will wake up one day and find it upgraded to something like 50/5 or 60/6.

This is the same philosophy being shared by the largest cable companies like Comcast. Comcast has announced that within three years their base speed in urban areas will be 100 Mbps with speeds up to 1 Gbps. We would not expect Midcontinent to be that aggressive, but they will follow behind those kinds of upgrades over time.

Finally, Midcontinent bundles prices like larger cable companies. They have a huge range of bundling specials. For example, we saw a bill that had a 30 Mbps cable modem, a phone line, and expanded basic cable television for \$99 per month. We are sure that was a special price that will probably revert to something higher over time, because it is certain that each product costs much more than that when purchased individually. We saw another bill that has a 30/2 cable modem, expanded basic cable TV, and a DVR recorder for \$114 per month. Another variation was a 30/2 Mbps cable modem, expanded basic cable TV, and HBO for \$107. The company literally has hundreds of different combinations of products available.

SCI Broadband Prices

SCI Broadband provides cable service in the north end of the county and around the lake. They offer the triple play. They offer specials for new customers and also bundles to lower costs to customers.

On their web they currently are advertising the following specials:

- Internet service for speeds up to 12 Mbps at \$19.95 for six months.
- A voice line with unlimited long distance and a lot of features at \$19.95 for six months.
- A bundle of cable, broadband, and telephone for \$79.95 for 6 months.

For each of these specials there would be additional charges for equipment like the broadband modem or for cable settop boxes.

We talked to SCI Broadband and they are currently upgrading the network and expect very soon that the basic speed will be 30 Mbps download. They said they will increase customer speeds at the existing prices. This will be an upgrade to DOCSIS 3.0.

We did not get any sample bills from customers of SCI Broadband, and so we don't know what the prices revert to at the end of the specials. We expect that they look a lot like the prices from Midcontinent as cable companies in the US don't generally vary a whole lot on prices. But SCI is a much smaller company than Midcontinent and they are not going to have the wide range of speeds and prices in their system and all markets are roughly priced the same.

Cellular Data

We've talked about this elsewhere in the report. Cellular data is some of the most expensive broadband in the US. Most data plans charge about \$10 per downloaded gigabit of data. To put that into perspective, about 25% of US households now routinely download over 100 gigabits of data per month, mostly video. At cellular data prices that would cost over \$1,000 per month (and there have been reports from people living in rural areas who have gotten gigantic bills from the cellular providers).

Satellite Data

We have also talked about this elsewhere in the report. Satellite data is very expensive, but not quite as costly as cellular data. The best broadband prices for downloading 1 gigabit of data from the four major satellite providers are: Exede at \$5.50 per gigabit, HughesNet at \$7.00, DishNet at \$1.80, and StarBand at an incredible \$27.

D. THE CONNECT AMERICA FUND

As this report was being written both Frontier Communications and CenturyLink accepted funding from the FCC to improve rural DSL in the county. This funding comes from the Connect America Fund, which is part of the FCC's Universal Service Fund.

The Universal Service Fund today is funded primarily from surcharges on telephony revenues. Originally the USF was funded by surcharges only on landline telephones and special access circuits, but eventually a surcharge was also placed on cellphones. Following are the uses of Universal Service Fund for 2013:

Mille Lacs County Ultra-Broadband Feasibility Study

High Cost Fund	\$4.17 B
Lifeline	\$1.80 B
Rural Healthcare	\$0.16 B
Schools and Libraries	<u>\$2.20 B</u>
Total	\$8.33 B

The Connect America Fund has been carved out of the High Cost Fund. The FCC has currently set aside \$1.7 billion per year for the next seven years to build or upgrade rural broadband. The FCC has made these funds available to Census blocks that have little or no broadband today.

The funding was available to the largest telcos automatically. Both CenturyLink and Frontier elected to take this funding for Mille Lacs County. The FCC has identified 1,168 customers in the CenturyLink footprint that don't have broadband and 3,033 in the Frontier footprint. Those numbers are based upon reporting by those two telcos and the figures look smaller than the places that we think don't have broadband today. The areas covered by the Connect America Fund are shown on the map on the following map. This map comes from the FCC and the areas shown in green represent the rural areas of the Frontier and CenturyLink service areas that should get faster DSL sometime during the next six years.

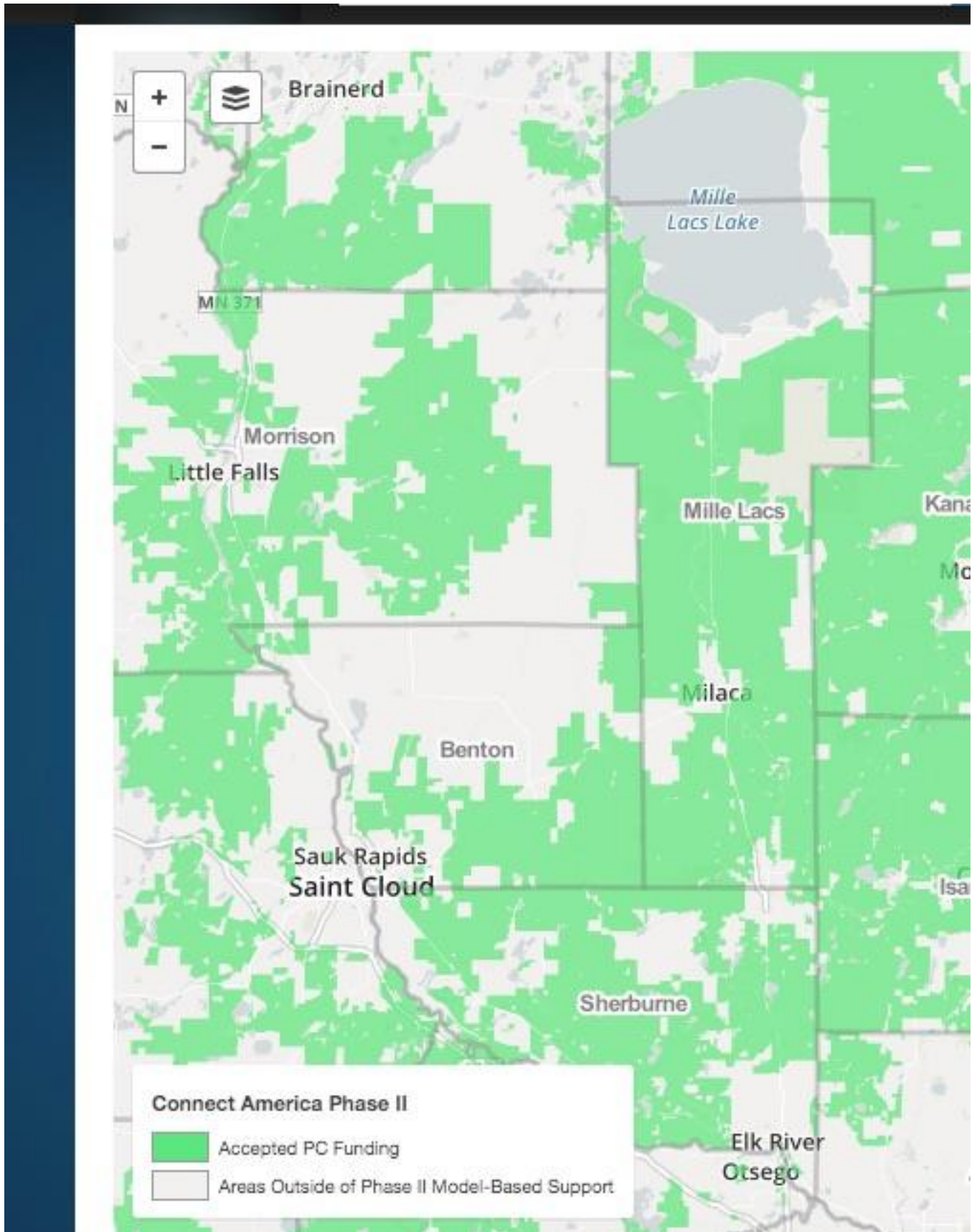
If the telcos had not accepted these funds they would have been available to anybody else (like the county or a new cooperative) who wanted to use the funds to bring better broadband to the rural areas.

Now that these two companies have accepted the funds they must use the money to increase rural data speeds. All of the customers in those rural areas must be upgraded to data speeds of at least 10 Mbps download and 1 Mbps upload. Note that those speeds are far slower than the FCC's own definition of broadband which is 25 Mbps download and 3 Mbps upload.

The companies can use the money to implement any broadband technology that will achieve the desired speeds. They have both said that they will use the money to help to improve DSL in the rural parts of the county and the rest of Minnesota.

Even though the FCC's mandate is that any upgrades must improve speeds to at least 10 Mbps download to everybody, we suspect that is not going to happen. As discussed in the next section of this report, DSL speeds drop drastically with distance and a DSL circuit can lose a lot of speed just going down a long rural driveway. There will be customers in the green areas shown on the map that will not get the 10 Mbps speed.

In order to improve DSL the telcos are going to have to extend fiber deeper into the rural areas to support the DSLAMs (DSL transmitters).



The fact that the telcos accepted this money creates a dilemma for the county in how to use this report:

- First, the telcos have up to six years to do the upgrades. That six year limit is a statewide goal and Mille Lacs County could be at the beginning or the end of the upgrade cycle. The telcos have to have 40% of the upgrades done in two years, 60% within four years, and all done at the end of six years—all also statewide goals.
- This upgrade is going to bring 10 Mbps broadband to the rural areas of the county. That is already a slower speed than what can be purchased from the cable companies today in the county and far slower than what is available in the Twin Cities. We think this is the last upgrade these areas are likely to ever get from the telcos. The copper wiring in the rural areas is already old, and this upgrade is probably going to get all of the rural speeds out of these systems that can reliably be delivered to everybody.
- These upgrades are going to feel great to people who have been living on dial-up, satellite data, or cellular data. For the first time they will have an unlimited download data product with no monthly caps, and one that is fast enough to watch streaming video.
- The dilemma is that 10 Mbps is going to quickly become antiquated and inadequate as a broadband speed. The speeds and the amount of downloads needed by households has been doubling roughly every three years. This is true back to the times in the 90s when everybody had dial-up. And there is no expectation that the need for broadband is going to stop growing rapidly. Already today households with families find 10 Mbps to be inadequate. It can support at best a few video download streams simultaneously. But in the future the video streams are going to get larger. We already see many video systems promoting 4K video streams which are roughly 8 times larger than the streams from Netflix today. There is also a growing demand for bandwidth from things like online gaming, which is expected to need far more bandwidth as we move into virtual reality headsets and other new technologies. And just surfing the web takes more and more bandwidth over time as websites embed multiple video streams.
- Following is a comparison of what the upgraded rural DSL will be able to do compared to other parts of the county and state:

Upgraded DSL	10 Mbps
Cable modems in the county today	30 Mbps (3 times faster)
Cable modems in the Twin Cities	Up to 200 Mbps (20 times faster)
CenturyLink fiber in Twin Cities	1 Gbps (100 times faster)
US Internet in the Twin Cities	10 Gbps (1,000 times faster)

This comparison is just for today. Over the next six years we think you will see increases in cable modem speeds in the county and in the Twin cities. Anybody getting the enhanced DSL is going to start off far behind the rest of the state, and over time the gulf between the 10 Mbps speeds and what everybody else has will be just as large as the gulf is today between rural broadband speeds and what the rest of the county has. The Connect America Fund upgrades are nothing more than a temporary bandaid and will not solve the rural broadband shortage in the county.

- The main problem with the DSL upgrades are that the enhanced 10 Mbps speeds might feel good enough to many rural households that they might stop clamoring for a broadband solution. But in just a few years the cry for rural broadband will return and

you will find yourself right where we are today. As you can see by the comparison to the rest of the county and the state, these rural areas will be behind everybody else from the start, and as those other areas get faster broadband over time the rural customers in the rural areas will not. They will fall further and further behind and a decade from now a home with a 10 Mbps connection is going to feel as slow as one today that has a 1 Mbps connection on old DSL. Within a decade or so it will be as if the area doesn't have any broadband and you will be back looking for a broadband solution.

- If the DSL gets upgraded in these areas, then it is going to make it harder to make any business plan work. There will be some customers who will be satisfied today with the upgraded DSL and that will make it harder for any solution to be brought that requires a lot of customers to reach breakeven.

In conclusion, the Connect America Fund is both a boon and a curse. It will bring faster DSL to the rural parts of the county and to customers who have no broadband today. But the broadband that will be delivered will be slow even by today's standards and will feel really slow within a decade. We think bandaids is the right way to describe what the FCC is doing. It has industry experts all shaking their heads, because the FCC is throwing a lot of money at what is a very temporary fix, at best, and that doesn't solve the problem of having inferior broadband in rural America.

II. PRELIMINARY ENGINEERING

In this section we will look at the various technologies in use in the county today and also at what might be made available through this study. We also examine the cost estimate made for the network, the electronics, and other assets. We looked at several different network configurations and different technologies and will describe each result. In making this estimate, Derrel Duplechin and Doug Dawson of CCG made trips to the county to look at local conditions that would affect network costs.

A. A TECHNOLOGY REVIEW

1. Active and Passive Fiber Networks

One of the first decisions to be made when looking at a fiber network is determining if it is better to use active or passive fiber electronics. This is a key decision because it impacts the way the fiber network is constructed. This is important in this project because there are scenarios we considered where each choice would be the preferred way to serve customers.

The Active Optical Network (AON) dedicates a fiber for each user between the customer location and the electronics hub. This means each customer has a dedicated path to the electronics and does not share bandwidth directly with another customer in the neighborhood. An AON network has many more field lasers than a passive network since there are two lasers for each customer at the two ends of the network.

In an AON network, everything is encoded as data between the electronics and the customer. This means all services must be digitized and delivered as an IP data stream to the user. The AON uses only 2 wavelengths on each fiber—one for transmission of data to the users and one for transmission of data from the users.

Since everything on an AON is data, the only possible video product is IPTV. IPTV delivers one channel at a time to each TV in the house as customers request it. This is a different model than normal broadcast TV and minimizes the number of channels that are being broadcast on the network. With traditional cable TV the system sends all of the channels all of the time to everybody. With IPTV, a customer must have a settop box for each TV that wants to receive its own channels.

The current vendors making Active Optical Network equipment includes Enablece, Calix, and PacketFront. Since PON equipment has won a much greater market share than AON equipment this part of the industry has been in a decline for a few years.

The other choice is to build a Passive Optical Network (PON) which uses passive hardware to "split" the signals so that a single high-powered laser can be shared by up to 64 customers (more typically by 32 customers). This technology requires less fiber than an AON since many customers in an area share the same single fiber over which the information carried on the fiber is 'split' into 32 individual fiber drop paths for delivery to homes or businesses. In construction, one feeder fiber "feeds" a passive splitter that takes the information that is transmitted onto the feeder fiber and distributes it across 32 or 64 individual fiber drops similar to the way water in a single pipe can be

sent to 32 individual locations by placing a 1-to-multiple pipe junction on a single feeder water pipe.

PON technology uses bandwidth on the fiber differently than the AON. The PON electronics divides up the optical wavelengths on the fiber to allow 1 wavelength to transmit data and voice to the users, another wavelength to receive data and voice from the users and a third optional wavelength to transmit RF video (like traditional broadcast Cable TV video on a cable network) to the users over one fiber strand. In this manner, the PON network can transport both analog signals and digital signals into the home.

A PON network has the ability to transmit video at the RF level and have it split into multiple fibers drops. This means that a PON does not need to require a settop box to deliver analog cable TV. A PON also uses existing wiring more easily since the video signal is delivered in the same way as the existing Cable TV video is delivered by the cable company. This gives easier access to existing telephone and cable wiring.

The current vendors for PON equipment include Alcatel-Lucent, Adtran, Zhone, Huawei, Calix, and Enablence.

Today passive optical networks use the GPON (Gigabit Passive Optical Network) technology. This technology uses Ethernet signaling for the customer delivery path. In a GPON system there is still the capability for three separate data streams—one for cable TV and two more for downstream and upstream data. The currently available GPON technology can deliver 2.4 Gbps of downstream data and 1.2 Gbps of upstream.

A new GPON standard called 10-GPON will enable 10 Gbps downstream and 2.5 Gbps upstream to be shared among 32 customers. This technology is being designed to coexist with current GPON technology which holds great potential for future upgrades in network capacity. While writing this paper we saw an announcement that Verizon is doing field trials of these units.

There is now also a variation of GPON called WDM PON which uses a different color or laser light to each of the customers. This brings some of the best characteristics of an active network into the PON network since this makes it possible to deliver different amounts, and even dedicated amounts, of bandwidth to each customer.

FTTP technology is expected to continue to grow in available bandwidth as volume sales of the technology decrease laser costs. The limiting factor is the development of these cheaper lasers. Already in the lab are systems that will deliver a terabyte of download speed and such technology upgrades will be introduced as laser prices drop.

Active Optical Network

Advantages

- Can serve customers up to 36 miles from last active field device.
- Does not require as much complex pre-planning and engineering. With AON there is a separate fiber to each customer, making it easier to engineer as you go.

- A single point of failure will often affect fewer customers
- Can easily support multiple service providers. This allows for an open access system with multiple CATV or data providers. A wholesale provider is given access to customers one fiber at a time. Wholesale can also work with a PON network, but it's more cumbersome.

Disadvantages

- Active Ethernet uses more fiber. Since there is a home run fiber to each customer, there is much more fiber in the network. This also means fiber bundles are much larger in the field since they contain multiple fibers. This means a lot more splicing during construction or during repairs.
- Cannot support RF video broadcast TV (only IPTV). An AON system requires every customer to get a settop box (a settop box for every separate TV, in fact), thus increasing capital costs.
- Shares data and CATV bandwidth in the same data stream. Today an AON system can cost-effectively deliver 1 Gigabit of data to each home. This is not a shared pipe with neighbors and each customer can get a dedicated 1 gigabit pipe. However, this one data stream must support CATV, data, and voice together. Thus, if a customer is watching multiple HDTV sets, the amount of bandwidth left for data will be something less than a gigabit.
- Usually requires additional home wiring. Since the AON provides only one bandwidth (the data stream), the video service (IPTV) always requires a high bandwidth data wire, such as category 5 or 6 wire to each TV location.
- Active field devices require backup power throughout the network. This means there are many more locations in the network that may need battery or generator backup to engineer for power failures.
- The CATV head-end is more expensive. An AON system must use IPTV and therefore sends every signal out in digital format in an IP packet, meaning there are no analog channels.
- It's harder to serve T1s and traditional telephony products. Some telephone customers will still want to purchase traditional T1s to support existing telephone systems. T1s are harder (but not impossible) to serve on AON compared to PON. However, T1s are a dying product in most markets.
- More physical space is required for electronics because there are more fiber terminations onto the electronics. If the electronics are located in the field, the cabinets housing the electronics and fiber terminations could become relatively large. This means most cabinets need to be on private land and not on public rights-of-way.

Passive Optical Network

Advantages

- Uses less fiber than an AON since multiple customers in a neighborhood use the same fiber back to the electronics.
- Can support both RF Broadcast TV and digital IPTV.
- Can deliver analog TV without a settop box.
- Has a separate bandwidth stream for CATV and data services.

- Much more efficient use of bandwidth at the customer premise. A GPON network delivers 2.4 Gbps of data to a small cluster of houses and an individual customer will normally have access to much of this bandwidth for data transmission, thus giving the customer a faster bandwidth experience at his home. By contrast, a typical Cable TV system shares 150 Mbps with up to 500 homes and an AON shares bandwidth farther into the core network.
- For the most part you can use existing home wiring. The PON network is designed to tie into existing telephone and cable wiring as long as they are conveniently located and in good working order.
- Requires no field electronic devices. The key word about a PON network is that it is Passive. This means that no power is needed except in those locations, generally at major hubs, where the provider places electronics.
- Can easily provide traditional T-1s for larger business customers using business ONTs.

Disadvantages

- Customer must be within 12 miles of hub when using 1 X 32 splitter. This means with very large installations that multiple hubs are required. For the normal town this is not a limitation.
- Is not as easy to use in an open access manner, but it can be made to work. Because multiple customers share the same electronics and same fiber, it is more of a challenge to allow multiple service providers to share the system. It can be done through establishing VPNs or other network methods, but these make the network a little less efficient.
- More customers potentially are affected by a fiber failure in the field.

In our engineering for this project we chose to use both technologies together as follows:

- We chose a GPON network for serving residential customers and small businesses, for the following reasons:
 - More bandwidth: This delivers more bandwidth to each customer, bringing a better customer experience.
 - Easier and less expensive construction: There are literally 32 times fewer fibers going to each neighborhood network with PON, vastly reducing the complexity of construction and future repairs.
 - A PON network can use most existing home wiring.
- We recommend an Active Ethernet Network for serving the Princeton business park and for other larger customers for the following reasons:
 - AOC allows a dedicated data path to larger customers to provide them the highest level of security.
 - This would be used in a small enough number of places that the extra fibers won't materially change the build-out cost. In fact, the easiest way to accomplish this network would be to provide a few extra fibers in all parts of the network, allowing you to add AON customers as needed alongside PON customers.

- AON networks can more easily be scaled in the future to larger bandwidth. It would be possible today to provide 10 gigabit service to a large customer if that was desired.

2. Hybrid Fiber Coaxial Network

Another technology we considered was hybrid fiber coaxial. This is the technology used by traditional cable companies today and it would be the natural network to build if you ended up with one or both of the existing cable companies as your partner.

The traditional wisdom in the industry is that only fiber networks can deliver gigabit connections, but today the capacity is available to deliver gigabit end-user customer speeds with an HFC network.

If you build an HFC network you would probably also string fiber deep into the neighborhoods to allow you to serve larger customers with an AOC Ethernet connection.

An HFC network is called a hybrid network because it uses both a fiber network as well as a copper network to deliver service. Generally in an HFC system there is one central hub called a headend. The headend would be the location that generates video programming, high speed data connections, and voice services.

Fiber is constructed from the headend to reach neighborhood nodes. At each node is a broadband optical receiver that accepts the fiber signal from the headend and converts into a signal that is sent over coaxial cable to reach homes and businesses.

An HFC system handles delivery of customer services differently than an all-fiber network. All television service is broadcast and every channel reaches every customer. When customers buy packages or programming that are something less than all available channels, the channels that have not been purchased are blocked by filters or else by a smart settop box.

All of the customers in a node share the data that is available for the node. As such it become important how many customers share a node. Before cable systems offered data services they might have had over 1,000 customers on a node. But today the sizes of the nodes have been ‘split’ by building fibers deeper into neighborhoods so that fewer homes share the data pie for the node. It is this sharing that has always given a cable network the reputation that data speeds will slow down during peak usage times, like evenings. But if nodes are made small enough then this does not necessarily have to occur. Telephone service is delivered as an IP service and is carried over the same data path that delivers broadband.

The amount of data that is available at a given node is a function of how many ‘channels’ of data the cable company has dedicated to data services. Historically a cable network was used only for television service, but in order to provide data services the cable company had to create free channels on the system that were to be dedicated to data only.

The technology that allows data to be delivered over an HFC system follows a standard called DOCSIS that was created by CableLabs. Most of the cable companies in the country are currently using DOCSIS 2.0 or 3.0 which allows bonding together enough channels to create data products as fast as about 250 Mbps download. However, there is now a new standard, DOCSIS 3.1 that theoretically allows all of the channels on the network to be used for data and which could produce speeds as fast as 8 Gbps.

But most cable companies are not going to offer tremendously fast speeds because they have a lot of demand to provide a large number of video channels. A cable company needs to free up around 24 empty channels to offer a gigabit data product, and many systems don't have that much empty space. But over time expect that the new DOCSIS standard is going to let cable networks deliver faster and faster products that will be of the same sorts of fast speeds offered by fiber providers.

The one big data limitation of a DOCSIS network is that the standard does not anticipate symmetrical data speeds, and so the download speeds are generally much slower than the upload speeds. This is not an issue for most customers, but it does give a fiber network a marketing advantage and there are customers who care about the upload speeds. If an HFC wanted to offer gigabit upload speeds they would need to dedicate an additional 24 empty channels, something none of them are ever likely to do.

HFC cable networks have generally been built to serve towns and not rural areas, and this has been done first for cost purposes. Most cable companies won't build a network unless there is some set number of potential customers per street mile, generally a number like 15 or 20. That kind of density generally ends pretty quickly outside most town boundaries. This can be seen in Mille Lacs County where the cable networks are built in most of the towns. There is also some service outside town in Princeton, and also a cable network built in the north end of the county around the lake front, since there are enough homes there to meet the economic goals of the cable companies.

There is also a distance limitation on coaxial cable, but since these networks are not often built in rural areas this rarely comes into play. But today, unamplified signals are not generally transmitted more than about 2.5 miles over a coaxial network. This limitation is based mainly on the number of amplifiers needed on a single coax distribution route. Amplifiers are always needed for coax distribution over a couple of thousand feet. Modern CATV companies try to limit the number of cascaded amplifiers on a coax route to 5 or less. In rural systems, this limit is due to the desire to provide quality broadband service and to minimize the number of "active" units in the network. Generally, in an all-digital service offering, all distance limitations are limited to the distance on the coax and not the fiber.

3. Wireless Technologies

When one talks about wireless technologies, you have to first make sure which technology you are talking about, because there is a wide range of spectrum that can be used to deliver wireless data and there are very different characteristics for the various blocks of spectrum as well as very different regulatory rules and technologies used. In this report we will talk about the following wireless technologies:

Cellular Data: This is the data delivered today by the cellular companies. All of the spectrum they use today is licensed, meaning that whatever company owns the license for a specific swath of spectrum in a given area is the one who controls it, and usually is the only one that uses it. In this country there are four primary cellular companies: AT&T, Verizon, Sprint and T-Mobile. There are still a few smaller, regional cellular carriers, but none of them operate in Mille Lacs County.

Point-to-Point Wireless: This is the technology used to provide wireless backhaul or else to supply wireless data to a large customer. This can be done with a wide variety of spectrum including the WiFi spectrums. However, the best spectrums for larger bandwidth are various higher spectrums that the FCC has set aside for this purpose and which are generally referred to as microwave.

Point-to-Multipoint Unlicensed Spectrum: This is technology that uses portions of spectrum that have been set aside by the FCC for anybody to use. This is the same spectrum that is used for WiFi, but in this case we are referring to a system where a beamed signal is sent from a tower to a dish antenna on the side of a home or business.

WiFi Hotspots: WiFi hotspots use the same frequencies as point-to-point unlicensed systems, but just broadcast the spectrum from one location to receivers in the immediate area.

Other spectrums of interest: There are two other portions of spectrum worth considering. The most immediately useful is the 3.65 GHz band of spectrum that ought to be widely available by sometime next year. The other spectrum is what is referred to as white space spectrum. Both of these will operate in a Point-to-Multipoint arrangement.

Wireless versus Fiber: In general, wireless technologies are not as good as fiber for delivering data, particularly in rural areas. There are two basic types of wireless networks: broadcast/point-to-multipoint and point-to-point. A broadcast network beams out a signal and anybody within range with the right receiver can use the spectrum—this is how cellular data works. The other kind of wireless network is point-to-point, meaning that a narrow beam is transmitted between a tower and a customer. This kind of network requires a customer location to have some sort of small dish to receive the signal, much like you can receive cable TV from a satellite. However, point-to-point requires 2 dedicated antennas for each endpoint provided service.

You will often hear people claim that wireless is the future and that it is a waste of time to build fiber. We believe that this is a myth that has largely been promoted by foes of municipal broadband to try to convince the public not to invest in municipal fiber. For example, this argument was recently raised in the Minnesota House. In the last legislative session when considering a new round of broadband grants for communities, the chairman of the House Job Growth and Energy Affordability Committee in Minnesota tried to kill the state grants. House Budget. Rep. Pat Garofalo, R-Farmington said that wired broadband is too costly in sparsely populated areas and believes that wireless and satellite technologies are more financially effective.

Most of the time people making these claims are talking about broadcast networks like cellular systems. They believe that 4G and future cellular technologies are going to deliver large amounts of broadband and that fiber is not really needed. But there are a lot of reasons why that is not true; consider the following:

- Even without considering the cost of spectrum, it costs far more to build a wireless network when comparing construction cost per megabit that can be delivered to end users. Modern fiber networks rarely cost more than \$10 per Mbps capacity created, and often far less than that, while it costs several hundred dollars per effective megabit to construct a wireless network using any of the common technologies like 4G LTE.
- From a physics perspective, the amount of frequency available through US allocated spectrum is not large enough to deliver symmetrical bandwidth, which is the goal of the National Broadband Plan. This limitation is a matter of physics and not of technology. That limitation is still going to be there with 5G or later wireless technology unless the FCC massively reworks the way it allows frequency to be used.
- At least in today's world, the prices charged to customers are drastically different for wireless and wireline data. Already today, 25% of residences are using more than 100 gigabits per month in total download. That can be affordable on wireline, but almost every current wireless provider has monthly data caps that range upward from just a few gigabits per month. A customer on one of these plans that used 100 gigabits in a month would face an astronomical monthly bill.
- Wireless technology is changing so fast now that the shelf-life for wireless equipment and networks is relatively short, in the range of seven years, while fiber networks can have an incredibly long economic life.
- Landline data in general performs better in terms of bandwidth delivery when considering things like the amount of bandwidth, latency times, and high reliability, all of which tilt in favor of landline networks.

To expand a bit more on the physics of broadcast wireless:

- In the US the FCC has chopped almost all of our spectrum into tiny channels. This was done years ago before there was any concept of needed fast data, but these channels make it a challenge to cobble together a fast data product over wireless. To make a fast connection means tying together a number of channels at the same time from different frequencies. This can be done, but what it means in real life practice is that from any one cell site only a few users can be using big wireless data at the same time.
- Wireless data capabilities drop off significantly with distance. The physics of wireless spectrum dictates that the higher the frequency, the shorter the distance that data can be sent.
- The best frequencies for sending data a long way are the somewhat longer frequencies like 700 and 900 MHz. But these frequencies have small channels and can only deliver a few megabits of data. These are some of the primary frequencies used in 3G and can send out the smaller data pipes for 10 miles or more.
- The higher the frequency, the less the distance. For instance, the primary WiFi frequency is 2.4 GHz. It can send out a pretty strong signal, perhaps 100 Mbps, but this is only good for about 150 feet from a hotspot.

- The other free frequency is 5 MHz. It can do up to about 200 Mbps, but this is only good within a room. It won't travel more than about 60 feet from a hotspot.
- What these data limitations mean is that in order to have robust broadcast wireless data you have to have cell sites that are very close together. And that means having fiber everywhere. This will probably be done in downtown urban areas and there will be cell sites everywhere, perhaps multiple sites per block. But this is never going to happen in rural areas. Nobody is going to build the fiber or the cell phone towers because it's not cost justified.

On the other hand, fiber has almost limitless data capacity. Today, consumer networks can be built to deliver gigabit speeds. That is fifty times faster than the best rural wireless solution available today. And there are already tests being done at 10 gigabits, which is 500 times faster than the best wireless solution.

The wireless solutions are not going to get better because they are limited by physics and not by technology. But fiber can always be improved by using faster and cheaper lasers. The difference between the two technologies is so gigantic that there is no real comparison.

When people talk about gigabit wireless, they are talking about having a wireless technology that will deliver that much speed within a room. This has only been done in a lab, but those kinds of speeds will eventually be available within your living room. But we have already reached the capacity of physics for outdoor rural wireless networks. They are not going to get better, or if they do it will be by a few percentage points as there are minor improvements in things like compression technologies and the use of overheads.

Point-to-Multipoint Data. The second kind of wireless network is a point-to-point data network that is transmitted from one central transmitter to many individual points. These networks often use the same spectrum as a broadcast wireless network, but they use it in a very different way. For example, 2.4 GHz is one of the pieces of spectrum we call WiFi. If you set up a WiFi router in your house the signal can travel decently about 150 feet, or less if it has to pass through impediments. This is a fairly low power application and most WiFi systems broadcast at no more than 1 watt of power.

But you can take that same spectrum and broadcast it at a much higher power level, shape it into a narrow beam, and send it over pretty far distances. All around the country there are wireless ISPs using this technology. Depending upon the geography, trees and leaf cover, and the general humidity in an area, this spectrum can send about 20 Mbps data out for 3–4 miles—a very different result than what you get out of a hotspot.

There are three current pieces of spectrum that can be used for this purpose and two more that will be coming on the market in the next few years:

- 900 MHz: This is a spectrum that has been around for public use for many years. This is the spectrum that was used back in the 70s and 80s to provide the bandwidth for garage door openers and cordless phones. This spectrum got very full and in urban areas there

were tons of stories about people opening their neighbor's garage doors when they made a phone call.

This spectrum can still be used today in a point-to-multipoint radio system. The good characteristic of this spectrum is that it travels well through impediments like trees and it can go for a long distance—over ten miles. But the down side is that, since it has a low frequency, the channels aren't very big and it can only deliver a few megabits per second of data speed. But there are systems out there who use this spectrum to augment other point-to-multipoint spectrum.

- WiFi: WiFi is short for *wireless fidelity* and is meant to be used generically when referring of any type of 802.11 network. The FCC has currently set aside two swaths of frequency for WiFi: 2.4GHz and 5.7 GHz. In a point-to-multipoint network, these two frequencies are often used together. This can be used multiple ways and the most common way is to use the higher 5.7 GHz to reach the closest customers and save the lower frequency for customers who are farther away.

In practical use, in wide open conditions these frequencies can be used to serve customers up to about 3–4 miles from a transmitter. They have a theoretical cap on the bandwidth that can be delivered at 28 Mbps, and in ideal conditions they can achieve that much speed. But the signals are disrupted by trees and leaves and can be degraded by rain, snow, or just heavy humidity. So the ideal condition is in the flat open southwest desert and everywhere else performs somewhat less than the ideal.

- 3.65 GHz: The FCC authorized the 3.65GHz–3.70GHz frequency for trials of public use in 2006, and this year started developing the final rules for using the frequency. It's expected to be available to everybody starting in 2017.

This spectrum has good promise, because in the existing trials it has shown that it can penetrate trees much better than the 2.4 GHz WiFi. This could make this ideal for Mille Lacs County.

There are a few limitations of the spectrum. The spectrum cannot be used close to existing government installations or satellite earth stations that use the spectrum. But that is mostly near to a few submarine bases and should not be an issue in Minnesota.

The spectrum will be licensed and the license fee is only going to be \$280. However, the license is not exclusive and every holder of the spectrum is expected to coordinate with other users. This is not like a normal FCC license and it is not first come first serve. Everyone using the spectrum in a given area is expected to work with others to minimize interference. The FCC will act as the arbiter if parties can't work this out together.

There are different rules for using the spectrum depending upon how you deploy it. The rules promote radios that use other spectrum in addition to 3.65 GHz. For radios that only use this spectrum the usage is limited to the 25 MHz band between 3.65 and 3.675 GHz.

But radios that allow for a shift to use other frequencies when there is contention can use the full 50 MHz channel within this frequency.

The frequency can support bandwidth on one channel up to 37 Mbps download. It's possible to bond channels within the frequency band or with other unlicensed spectrum to get even faster throughput. It's theoretically possible with bonding to get speeds of 100 Mbps. But in practical use that will be hard, because for every customer that is bonded in this manner there will be fewer customers who can be served from that transmitter. So there is a tradeoff between the number of customers at a site and the amount of bandwidth per customer.

Radios for this frequency are readily available from most of the major point-to-multipoint radio manufacturers. The price of the base stations and customer CPE are slightly higher than the cost of radios in the unlicensed bands.

In practical application this is going to be able to deliver 20 Mbps at five miles from the transmitter, and more bandwidth for those that are closer than that. It can theoretically transmit to the horizon, but at greatly diminished speeds.

- White Space Spectrum: The FCC has been doing trials in what is called white space spectrum. This is spectrum that is the same range as TV channels 2 through 51, in four bands of frequencies in the VHF and UHF regions of 54–72 MHz, 76–88 MHz, 174–216 MHz, and 470–698 MHz. Whitespace radio devices that will work in the spectrum are referred to in the FCC order as TVBD devices.

The FCC is preparing next year to auction a lot of this frequency to the cellular companies in what is being called the incentive auction, because TV stations that give up their spectrum will share in the sale of the spectrum. But the FCC also plans to make some of this spectrum available for rural broadband. The rules are not yet worked out, but it will probably be done something like WiFi today and be available to anybody.

The downside of the spectrum is that it won't be available everywhere. In some places the TV stations will keep their spectrum. In other cases there is already something else occupying part of the spectrum.

There are two possible good uses for the spectrum. On a broadcast basis this can be used to make better hotspots. A 2.4 GHz WiFi signal can deliver just under 100 Mbps out to about 100 meters (300 feet). But it dies quickly after that and there may 30 Mbps left at 200 meters and nothing much after that. But whitespace spectrum can deliver just under 50 Mbps out to 600 feet and 25 Mbps out to 1,200 feet.

But the rural potential for the spectrum is to extend point-to-multipoint radio systems. With white space you can deliver about 45 Mbps up to about 6 miles from the transmitter. That's easily twice as far as what can be delivered today using unlicensed spectrum, and a 12-mile circle around a transmitter can make for viable economic returns on an investment. Physics limits this to about 45 Mbps of total bandwidth meaning that a

product of 40 Mbps download and 5 Mbps upload is possible. That is certainly not fiber speeds, but it would be a great rural product.

But we are going to have to wait until after the incentive auction next spring for the FCC to take action on this spectrum and so it is probably at least a few years before this can be practically used.

Cellular Data

In doing research for this report we discovered that there are a lot of households in Mille Lacs County that are using cellular data for their home bandwidth. There are several reasons why this is a major problem and concern.

First, cellular data is the most expensive bandwidth in the US. The cell phone companies are selling it between \$8 and \$15 per downloaded gigabit of data. To put that into perspective, over 25% of households today already download over 100 gigabits of data per month. Somebody using that much bandwidth with cellular data would be spending \$1,000 a month. Of course, the telcos could change the pricing in rural areas if they so choose. We know that AT&T wants to decommission millions of rural copper lines, and perhaps when they do so they could price cellular data differently at homes than they do for cellphones.

The cellphone companies have told the FCC for many years that cellphone data is priced high and has low data caps because they must limit usage to avoid network congestion. They have argued that big users tie up networks and make it hard for others to get good service. But two years ago, Michael Powell, ex FCC Chief and head of the NCTA admitted that data caps are not about congestion but are about ‘pricing fairness,’ which means they are not about fairness at all, but about charging large data users more.

There is a little validity in the cellular companies’ claims in that cellphone networks were not originally designed to deliver data. The cell towers were spaced to maximize voice coverage. But data travels for a shorter distance than voice and so the data coverage from any given cell tower is not as good as the voice coverage.

Further, cell towers can only handle some set number of customers, or serve some set amount of bandwidth at a time. This is why you can’t get coverage when you’re in a sports stadium or convention center with a lot of other people.

Another issue with cellular data is that the speeds in rural areas are not as fast as those in urban areas. Cell phone companies have made a lot of upgrades over the last decade or so, upgrading first to 3G data and then to 4G data with a few intermediate steps in between. While most urban areas now have 4G data, the vast majority of rural cell towers are still at 3G or maybe even slower analog data speeds.

And, like all wireless bandwidth, the speeds you can achieve are directly in proportion to how far you are away from the cellular tower. The data speeds on 3G and 4G diminish quickly with distance, and so people who are not close to a cell tower are going to get relatively slow speeds.

Data speeds on cellular networks are a lot slower than what people expect. 3G networks are engineered to deliver speeds between 1.4 Mbps and 3.1 Mbps. 4G LTE has theoretical speeds of between 4 Mbps and 12 Mbps. There are a number of firms that track average 4G speeds for large numbers of connections and they usually report average speeds in the range of 8 or 9 Mbps. And of course, that average is mostly an urban average and rural customers are either not going to get 4G or else may get slower speeds due to distance from the tower.

4. DSL and Copper Technology

The study did not consider new DSL and copper technology for delivering broadband, but since there is already a lot of DSL in the county it is worth discussing briefly.

DSL (Digital Subscriber Line) works by using the higher frequencies that are not used for voice service that are available on a piece of copper wire. The telephone companies in the county all deploy DSL. The two primary telcos in the county are Frontier, which serves the northern 2/3 of the county, and CenturyLink that serves the southern parts of the county. There is also an independent telephone cooperative—Benton Cooperative Telephone Company—that serves in and around Bock. There is also a tiny sliver of the county served by Windstream.

DSL is used to provide an Ethernet data path over the copper that can be used to deliver customer broadband service. There are different kinds of DSL standards, each of which have a different characteristic in terms of how much bandwidth they deliver and how far the signal will travel. But probably the most important characteristic of DSL is that the data speed that can be delivered to customers drops with the distance the signal travels.

In the county, DSL is generally served out of the telephone exchange buildings that house the central office equipment of each telephone company. There are eight central offices in the county:

Princeton	CenturyLink
Milaca	Frontier
Onamia	Frontier
Isle	Frontier
Wahkon	Frontier
Pease	Frontier
Foreston	Benton Cooperative Telephone Company
Bock	Benton Cooperative Telephone Company

The Benton Coop is in the process of converting all of their networks to all-fiber, and so they will no longer provide any traditional copper services at some point soon. But the other telephone company networks are mostly copper between the central offices and the customers.

The general rule of thumb is that DSL can deliver a decent amount of bandwidth for about 2 to 2.5 miles over copper. And so you would generally expect that places within that distance from a central office can get DSL bandwidth.

The newest kinds of DSL can deliver up to about 25 Mbps over good copper wiring for up to about 9,000 feet from the central office. But it appears that the DSL in the county are older versions of DSL that deliver speeds of 12 Mbps or less.

DSL service will be readily available from the telcos in the towns within the two mile circle. A DSL signal will travel much further than 2 miles, but the further it goes the slower the signal. We have seen telcos that sell very rural DSL where the speeds are as slow as 124 kbps, or just barely faster than dial-up.

DSL signal strength is also affected by the quality of the copper. The newer the copper and the larger the gauge of the copper wires, the better the signal and the greater the bandwidth. The copper networks in the county appear to be quite old and many of them are probably 50 years or more old.

B. PRE-ENGINEERING AND NETWORK DESIGN

We considered several different network designs:

- We looked at providing Fiber-to-the-Premise (FTTP) for the whole county. Within that option we looked at doing this with all-buried fiber and with a mix of buried and aerial fiber.
- We looked at providing FTTP to just the rural areas that don't have broadband today.
- We also looked at extending a Hybrid Fiber Coaxial network into the parts of the county that don't have broadband today.
- Finally, we looked at several options for serving the rural parts of the county with point-to-multipoint wireless networks.

General Assumptions

Before looking at the specific network designs we gathered information about the county that was used in all of the scenarios. Following is a description of the most important of the generic data we used:

Passings: In the telecom industry we use the term passing to mean any home or business that is near enough to the network to be a potential customer. Counting passings in Mille Lacs County is a little more challenging than other places due to the significant number of part-time and recreational properties in the county.

We looked at several different sources of housing units and finally decided to use property tax records to count passings. In our studies we used the following passings:

- Residential passings in the cities. The cities consisted of Isle, Milaca, Onamia, Wahkon, Pease, Princeton, and Foreston. We did not include the homes in Bock since that area is served by the Benton Cooperative Telephone Company and either has, or will soon have, fiber built to homes. We counted homes that had an assessed value greater than \$20,000 as a passing. This resulted in 3,094 passings for single homes and 1,227 passings of residential units that are in multiple dwelling units (or MDUs). An MDU is any residential location

that has more than one living unit and could be a duplex or a large apartment complex. We counted the actual living units within each MDU as defined by the tax records.

- Recreational passings in cities: We counted as a seasonal or recreational passing any living unit that was appraised for more than \$10,000. In those same towns this was 228 passings.
- Rural residential passings: Using the same threshold of \$20,000 and above, we counted 5,487 single family homes outside of the cities and 242 living units in MDUs.
- Rural recreational units: Using the same threshold of \$10,000 and greater, we counted 1,658 part-time seasonal homes in the rural areas.
- Businesses in the cities: According to the tax records there are 455 businesses in the cities and 274 businesses outside the cities.

We know that tax records are never a precise way to count potential customers. There might be homes or farms that have multiple tenants that are not listed in the property tax records as MDUs. There might be some business locations that have more than one business that might be a separate data connection. And in a county like Mille Lacs there might be quite a few more part-time and recreational homes that might want to pay for broadband. As an example, we have clients who sell broadband to RVs parked in RV parks. But we think that this count is a good enough way to assess the financial viability of bringing broadband.

Road Miles: The cities each provided us the road miles within their city. We found a database that listed all of the roads outside the cities that are maintained for 8 months of the year by the townships (meaning they don't plow the snow). Those are the rural miles we included in the studies since we didn't expect that you would build fiber on roads that are not plowed or maintained in the winter.

There are 106 miles of roads within the cities that include federal, state, and county roads.

There are 438 miles of township roads that are maintained all year.

There are 533 miles of federal, state, county, and reservation roads. Our engineer estimated that only 76% of these roads would need fiber construction. For instance, some of these roads don't have houses and go through park or other land. And some of the homes that are on these remote roads can also be reached from the township roads. So in our studies we used 76% of these miles, or 405 miles.

That means in an all-fiber construction you will need to build fiber to 949 miles which consists of 106 miles in cities, 438 miles in townships and the rest on other rural roads.

The Pole Issue

The poles are owned by different entities in the county. In the cities the poles might be owned by a municipal electric utility or by either the telephone company or the electric company. Most of the rural poles are owned by the several electric cooperatives that operate in the county.

By law everybody has to give a new fiber provider access to their poles. This right has been guaranteed by the FCC. But there are also FCC rules that govern how poles are used. The space on a pole is divided up into zones for the different utilities. Generally the electric wires are at the

top, the telephone wireless come next, and where there is a cable company wire they are at the bottom.

A new fiber network would need to be built somewhere into the same telecommunication space that is used by the telephone company. But there are additional FCC rules that govern how far apart different wires must be from each other and also that define how low the lowest wire on a pole must be from the street surface below.

When you want to build a new network on poles, problems can arise when there are a lot of existing wires on the poles already or if the poles are short and don't have a lot of leftover space. A lot of the poles owned by the electric cooperatives are short, at thirty feet. They believe that if you build on their poles that there is not enough existing space in the telecommunications space to accept a new provider (you).

The FCC rules take this circumstance into consideration and when there is not enough room on an existing pole then the party that wants to place the new wires must pay to either rearrange the existing wires on the pole, which in the industry is called make-ready. Or if the pole is too short and just can't accommodate the new provider, then the pole has to be replaced with a taller pole. All of the costs of make-ready and replacement must be paid for by the party that is adding new wires to the poles.

There are always some make-ready and replacements needed in every aerial fiber project. There will be poles where the existing providers may have built too close to allow the fiber provider to fit within the FCC specifications. We have included a 'normal' amount of make-ready work into our cost estimates.

But if the poles in Mille Lacs County require extensive make-ready work then the aerial construction could cost millions more than what we have estimated. This is an issue that would need further study before you undertook borrowing the money to build a network.

There are other solutions instead of make-ready. For example, it would be possible to place the new fibers in the power space where the electric wires are today. Fiber does not contain any metal and so the wires are not disturbed by interference from the electric wires like what would happen with a copper cable. But building in the power space would require reaching agreements with the electric cooperatives to do so. Other networks have reached such agreements. They might include such things as the new network providing free fibers for use by the electric cooperatives. Another arrangement might be to actually partner with the electric cooperatives so that they are part owners of the network.

If the cable was put into the power space it might actually cost less than the estimates that we used in the study.

This represents one of the major findings in this study and is an issue that would need to be resolved before commencing to build a network.

FTTP Electronics

We priced the FTTH electronics in this study based upon recent prices we got from Calix. Calix is one of several FTTP vendors and we feel safe in using their prices because the equipment from all of the vendors has a similar cost. CCG is vendor neutral and we are not suggesting that you use Calix. Rather, our experience is that the cost of the FTTP electronics is similar between vendors and thus using a recent quote from any of the vendors is sufficient for predicting the cost of the network electronics. Calix just happened to be the most recent bid we had in hand.

The ONT (Optic Network Terminal) at the premise is the device that converts light back into the signals needed to provide the triple-play services. There are several different options for including ONTs in the study. First, ONTs can be external, meaning placed outside on the side of the building, or internal and placed inside like is done with cable modems. If the ONT is external, it has an optional battery that can keep the ONT running during a power failure. In the study we have modeled mostly internal ONTs. The upside is that internal ONTs are less expensive. They also can be plugged directly into an outlet for power, whereas outside a tap is needed into an external power wire. Outside ONTs are more accessible to technicians, but outside ONTs also have to deal with the warm summers and cold Minnesota winters. Most of the maintenance needed on an ONT can be done remotely through an electronic connection at the headend.

Many FTTP networks have been designed with battery back-up for the ONT. However, many of our clients have stopped providing batteries. The batteries were historically installed to operate phones in the case of a power outage at the home. However, there are fewer and fewer phones in existence that are powered from the phone line and most phones must be plugged into an outlet. So when such a phone loses power it can't be powered by the battery. We have not included a battery in our design, but you might offer it as an option for a customer who really wanted it.

Residential costs: The model assumes a total installed cost of a residential ONT at \$453. We further estimate the cost of a drop in a city at \$583 for an aerial drop or \$658 for a buried drop. This means the cost to add a customer to the network is around \$1,000, not counting any cost for settop boxes for cable TV. It would be possible to build the network for less than these estimated costs. For example, if most of the customers on the network were pre-sold before construction, then you could probably build for less by having the installations done concurrently with the construction.

Rural drops are estimated to cost \$780, meaning the cost to add rural customers is higher than for city customers. Further, that is an average cost and there are some customers who are fairly far from the road and for whom the costs are even higher.

Business Costs: Small businesses can use the same ONT as residences and have the identical costs. However, many businesses have parking lots in front of their premise rather than a lawn and it costs more to bury the drops. We have assumed that business drops in a city cost about \$200 more than a residential drop. There will be a few larger businesses that will require a larger than normal ONT. These large business ONTs, which support many telephone lines plus a larger data connection, cost \$1,175 installed instead of \$453.

In our model we have assumed the use of HPNA for distributing bandwidth within the home. HPNA is a technology that uses the existing coaxial cable to deliver cable TV and broadband. There are other technologies available. For example, we could have used MOCA which would also use the existing coaxial cable in the house to deliver broadband.

The ONTs we used in this model are designed to deliver only voice and data. This means any Cable TV offering over the network must be digital and delivered over the data path. This requires the use of IPTV where video is 100% digital and delivered in an IP Data format to the settop box. IPTV is becoming the video delivery method of choice in the industry, so we used this technology in the model.

Cable TV

We have assumed that if you offer cable TV service that you would not build a cable TV headend, but would instead buy the signal from some existing headend. The headend is the place where there is equipment that pulls TV signal from satellites and places it onto landline networks. These locations generally have large satellite dishes to communicate with the satellites as well as electronic equipment that prepares the TV signal for use by customers.

There are at least three companies in the county who might agree to sell use of their headend for a monthly fee. Should you not be able to work out such an arrangement then you would have to build a headend which would cost around \$1.7M.

The study does assume that you will provide to customers the settop boxes needed to watch TV. We have assumed that video customers will average two settop boxes per household. Some could have more or less than this. You would offer two kinds of boxes—a simple one that just puts the signal onto TVs and a more advanced one that would include a recorder to allow people to record shows to watch later.

There are cheaper headend alternatives available should you have to build one. For example, you could save money by offering fewer channels. There is also a cooperative of companies that have gone together to provide cheap headends called Skitter TV that we would explore if you can't find local content.

Telephone Service

We have assumed that you will provide telephone service for customers and will buy this as a wholesale service. We have a number of clients who buy wholesale voice and it is a mature product that works well. We cover the details of this in the expense assumptions.

The alternative to this would be to buy a voice switch and establish an interconnection network, which might together cost you \$700,000 or more to establish.

Building

If you needed to construct a cable TV headend and also owned a voice switch then you would need a large air-conditioned space in a room with very specific specifications like a talk ceiling, raised floors with wiring underneath, etc. But if you outsource those services you need a much smaller space. If you were to build a building to house all of this plus a business office it could easily cost more than \$800,000.

However, without the need for those components you can get by with something far smaller. We have included \$250,000 in the business plan, and likely this would be used to retrofit some space in an existing building somewhere in the county. The interesting thing about a fiber network is that the electronics hub can be almost anywhere on the core network.

Data Routers

The business plan budgets for the data routers needed to provide customer ISP services. This would include providing email, security, IP addresses, web storage, and other functions normally provided by an ISP. It's possible that you wouldn't even need these if you were to outsource your ISP functions.

Other Assets

The business plan also includes the other assets needed to operate a triple play business. This would include a few vehicles for outside technicians. Since part of the network is aerial these need to be at least one or two bucket trucks. The business plan includes a computer for every employee and furniture and office equipment. The business plan includes \$400,000 of inventory which would consist of spare fiber, settop boxes, ONTs, and spare cards for all the electronics.

Specific Scenarios

Fiber for the Whole County

In designing a PON network there are several different network architectures in use in various systems around the world. The first design issue to consider is whether to centralize or distribute the electronics in the network. The second design issue looks at using a star versus a ring topology. A third issue in the design is to determine whether to use distributed splitter locations or local convergence points for splitter locations.

Large communities need to use distributed PON huts where PON electronics are housed. In a larger community, a design will place huts in several locations about town that will contain PON electronics which will light the fibers that will be split and assigned to each home. However, in a small community, it's possible to have the PON electronics all placed in the headend building with no requirement for remote huts. Centralized PON electronics are the preferred design, where possible, because this design allows a technician access to the electronics without needing to make a trip.

In terms of a network topology, a PON network with distributed PON huts can be built using a star design, where the fibers all go from the headend directly to each electronics hut, or using a ring

design, where there is some sort of a circular fiber path throughout the community from which the fiber goes to each electronics hut.

When the community is large enough, a ring design is used because a ring adds an additional layer of security to the network in that a fiber cut anywhere on the ring would not disrupt service on the ring. Rings are self-healing, meaning that transport on the ring can travel both clockwise or counterclockwise, thus bypassing a fiber cut.

When considering splitter location design, there are two options: a) distributed splitter locations where PON fiber is split at several locations and thus splitters are distributed along the PON fiber and b) local convergence point splitter locations where all PON splitters feeding a certain geographic area are located at the same cabinet. A distributed splitter design works best when an FTTP provider is not in a competitive environment and will supply service to all homes and businesses in the service area. In this situation, the provider knows that he will utilize every fiber to every home and thus utilize the PON fibers to their maximum capacity. A local convergence point design is used in a competitive environment where the FTTH operator does not know who will take his service. In this case the local convergence point allows the operator to utilize his PON fibers (and subsequently his PON electronics) more efficiently by allowing the operator to fill up each PON fiber (and PON splitter) as customers are added to the network. Thus, the local convergence point design allows a competitive FTTH operator the same benefits as that of a non-competitive FTTH operator, by adding splitter cabinets in each neighborhood and dedicating individual fibers from each home to this cabinet. Splitters are added to the inside of the cabinet only as subscribers grow.

In the preliminary design for Mille Lacs County we used for this study, we chose a distributed PON electronics design, meaning the PON electronics would be located in huts distributed at points around the county. Hut placement was determined mainly by the transmission limit associated with a PON system. The fiber from the PON electronics to the subscriber can extend no more than 12 miles. We placed a hut in each city as well as huts in various rural locations to maintain the 12 mile limit. We also used a ring topology to connect all of the hut locations. The distributed design is a good choice because of the way the county is divided by the river.

We also chose a local convergence point design for the splitters. This is a design that will include having major fiber cables, called feeder fibers that would extend from a PON hut to the local convergence/splitter point in each neighborhood where the local fibers are split to get to homes and businesses. Because of the rural nature of much of the county, there is not always a 'neighborhood' where rural homes are found. In these rural areas, we will find that the local convergence splitter location will be quite small serving only a few houses or there will be dedicated fibers from more standard sized convergence splitter locations. Both of these designs can be facilitated as the need arises within the county, but the more standard sized convergence cabinets make the most sense in order to use the PON electronics most efficiently.

We designed the fiber network in three parts: core ring, distribution fiber, and feeder fiber.

- The core ring is fiber that connects all of the huts. We designed this to be a ring, which provides security and redundancy should there be a fiber cut. In a ring configuration the signal from the headend to any hut can travel around the ring in both directions and so cutting the fiber in just one place will not isolate or take any huts out of service. The core

ring is 175 miles of fiber. This fiber cable contains the fibers that are used to connect all of the huts as well as additional fibers that are used to serve customers that live close to the core ring.

- Feeder fiber is fiber that goes from the PON Hut to the converged splitter cabinets.
- Distribution fiber is fiber that goes from the converged splitter cabinets to customer locations. In a PON network each feeder fiber can serve up to 32 customers and the distribution fiber is a dedicated fiber from the splitter to the customer.

In general, the deeper you go into the network the smaller the size of the fibers required. You would expect a lot of fiber pairs on the core ring since it carries all three types of fiber, while the distribution fiber in smaller neighborhoods will need fewer pairs of fiber. All fibers are built with sufficient spare fiber pairs to accommodate future growth or to compensate for fibers that go bad for some reason.

We assumed that all of the network outside the towns is aerial, meaning that the electric and telephone cables today are strung on poles. We assumed that 90% of the cities is aerial and 10% of existing cables in the cities is buried underground.

Our study assumes the use of pre-connectorized fiber drops. This a relatively new technique that consists of installing connectors into the distribution fiber and then using drops that are pre-manufactured to plug into the fiber. These drops speed up installation and repairs since no aerial splicing is needed to install a drop. Splicing requires an experienced fiber technician and bulky equipment while any tech can plug in a pre-connectorized drop. The pre-connectorized drops are not only more efficient but will cost less. In the rural areas we will also use pre-connectorized drops where it makes sense, where a home or business is relatively close to the road. But for buildings further off the road we would instead construct the drop using traditional splicing.

Drops are the wires that connect directly to a home or business and are connected to the distribution fibers. We estimated that the average length of a residential drop in the cities is about 300 feet. We estimated that business drops in the cities are 1,320 feet, reflecting that some businesses are offset from the road due to parking lots. We estimated the rural drops to average 450 feet. We have assumed that all of the drops will be aerial or buried to match the way that the fiber is built in a given part of the network. These distances were estimated by looking at a sample of homes on Google Earth.

In pricing out the network we have assumed that the cost for serving an MDU customer is the same as serving a single family home. Sometimes the cost of serving MDUs can be lower. For example, MDUs can often use fewer fiber pairs and can benefit by using larger ONTs. However, this savings can be offset by MDUs requiring more extensive wiring to make FTTH work. Our experience in other communities is that the cost of MDUs ends up being nearly as high as the cost of serving single family homes. With very old and very large MDUs the cost of serving them can be higher than average due to the cost of providing the fiber wiring to the units. But we didn't see a lot of these kinds of buildings in the area and it's the large urban apartment buildings that tend to have this issue.

We have assumed the construction of new huts in each town and in many rural areas of the network. It would be possible to save money over our estimate in two ways. First, if the network was built today we would almost certainly purchase used huts. There happens to be a glut on the market of those today due to the cellular companies de-commissioning a large number of cell sites around the country. But it would also be possible to save money if the electronics that are inside the huts were instead placed inside of existing buildings. For example, we would need fewer huts if some of the electronics could be put into city halls or similar locations.

We have based the cost of fiber construction on other recent fiber builds in Minnesota. But fiber doesn't cost the same everywhere, so we also took local conditions into consideration. As an example, we recently worked with Sibley County that elected to bury most of their fiber network. They were able to do this because their roads have wide rights-of-way and also they have very deep and soft top soil. So burying fiber there is at a much lower cost than it would be in Mille Lacs County or most of the rest of the US. The same can be true for aerial cable costs and I will address this more directly below.

We estimated construction costs for the various types of fiber as follows:

Buried Fiber – City	\$70,000 per mile
Buried Fiber – Rural	\$26,000 per mile
Aerial Fiber – City	\$42,000 per mile
Aerial Fiber – Rural	\$19,000 per mile
HFC – City	\$35,000 per mile
HFC – Rural	\$26,000 per mile

Rural FTTP Scenario

We also considered the scenario of building fiber only to the rural parts of the county that don't have broadband today. We designed the rural network to go to the places that do not have a land-based cable company today. Some of these places may have DSL available from the telephone company, but most of the people in the rural areas have no decent broadband alternative.

There is a landline cable company in all of the towns except Bock and Pease. However, in Bock there is DSL service and cable TV provided by the Benton Cooperative Telephone Company. The Benton Telephone Coop has also stated that they plan on deploying FTTH within the Bock exchange, which includes the city of Bock as well as a large portion of the township of Borgholm. For this reason, we didn't consider building to the city of Bock and about half of the Borgholm Township.

There is some cable service outside of the towns, predominantly around the edge of the lake. This includes parts of the townships of East Side, Isle Harbor, Kathio, and South Harbor.

After accounting for the areas around the lake, and also removing Bock we came up with 776 miles of rural roads that would need fiber. In the rural scenario we also added five miles of fiber to reach the business park south of Princeton.

Again, after subtracting out the homes around the lake, the rural study covered only 6,318 living units and businesses in the rural non-CATV served areas and in Bock. All other rural areas were the same as was included in the whole-county scenario.

Rural HFC Scenario

The rural HFC scenario (building coaxial cable and fiber in the same manner as the cable companies) includes the same assumption of areas covered and miles of cable required as the rural FTTP scenario. The HFC network has higher wire costs but lower electronics costs.

There are a few assumptions that are different in this scenario than in building with fiber:

- Coaxial cable is more expensive to build than fiber and the costs range between \$5,000 and \$6,000 more per mile.
- But HFC networks do not require electronics at the home in the same manner as a fiber network and there is nothing in a cable network that is akin to the fiber ONT.

Rural Wireless Build

We also explored the alternative option of providing wireless broadband in the rural areas instead of fiber. Following are the assumptions used to make the estimates of the wireless cost.

We assumed that the best wireless spectrum to use is 3.65 GHz. This spectrum should be available for use by 2016 and is going to be inexpensive to license and use.

This spectrum will provide significant bandwidth on a point-to-multipoint basis up to the horizon. However, the bandwidth drops with distance from the transmitting tower, and so there is a practical limitation on how far a customer ought to be from a tower.

Our design looked at constructing 13 towers to broadcast the signal. These towers were set to 190 feet to be under the limit where you must worry about aircraft and other similar issues. The network consists of point-to-multipoint radio systems. That means that the transmitters at the tower can talk to multiple customers. There is actually more than one transmitter at each tower site. Each transmitter is designed to transmit in a 60 to 120 degree path, called a sector, and thus it takes at least three transmitters to serve the full circle around one base station. We have designed the system using 6 sectors that overlap with each other, allowing a tower to serve more customers. Each of the sectors can support up to 50 customers.

We still constructed the core fiber network to connect all of the towers and to also create a ring to help make sure that towers don't drop out of service if there is a fiber cut. It would be possible instead to use wireless microwave backhaul to get bandwidth to the towers. However, when building this many towers the amount of bandwidth delivered to the towers at the end of the network would be a lot less than if those towers were fed with fiber.

With this spectrum customers within five miles of a tower would get speeds as fast as 28 Mbps close to the tower down to about 10 Mbps at 5 miles. We didn't assume there would be any customers past five miles. However, at 9 miles away from the tower this network can still deliver

around 3 Mbps, which is still good bandwidth for a rural person who only can get dial-up today. This opens up the possibility of using spare capacity on the towers to serve customers outside the county.

In a point-to-multipoint radio system each customer would require a small antenna a bit larger than a dinner plate. It would be necessary for the customer antenna to be able to ‘see’ the base-station transmitter. This is going to be a big issue in Mille Lacs County because of the trees and leaf cover. Luckily the 3.65 GHz goes through leaves better than the WiFi frequencies, but you still want a pretty clear shot. We have engineered this so that each home can have a telescoping pole to extend upward to be able to see the tower. Not all customers will need this, but we’ve been conservative and assumed they all need one.

Wireless systems don’t care about political boundaries, and so it is likely that even within the five mile circles that there will be customers in adjoining counties who might take service. We didn’t increase the take rates or the passings, but we would fully expect you to pick up at least a few hundred customers that are not included in the study.

In a wireless system you can serve more than the recommended fifty customers. However, when you do so, the speeds for all the customers get diminished at busy times of the day, like in the evenings.

It is possible to go into the wireless business with a smaller investment than we’ve estimated. Some of the things you could do to save costs include:

- Not building fiber to every tower and bringing bandwidth to a few of them using microwave radios.
- Not making a fiber ring which cuts out about 30% of the cost of the fiber. Such a system would have towers go out of service if there was a fiber cut.
- Use at least some of the existing cellular towers in the county. You might or might not be able to get onto the existing towers, and even if you do they are not located in the ideal places for your wireless deployment. However, there is a substantial savings if you could get by with building a few less new towers.
- We’ve built a business plan for this lower-cost option that will be described in the results section.

C. BACKHAUL OPTIONS

One of the things we looked at is if a county-sponsored broadband network could reasonably get connectivity to the Internet. In the industry this is referred to as Internet backhaul. In Minnesota, the major Internet POP is at located at a carrier hotel (where many carriers meet) at 511 11th Avenue South in Minneapolis. Anybody that you buy connectivity from will be ultimately connecting through fiber to that data center.

Interestingly, the county already has a lot of existing fiber. I found the following fiber networks:

- Both of the cable companies have a fiber network that connects their towns and pockets of customers.

- The telephone company exchanges in the county are all connected with fiber, meaning CenturyLink has fiber in the south of the county and Frontier has fiber in the north of the county.
- There is a State of Minnesota fiber that comes to Milaca to connect to the county government complex.
- The schools are connected to a fiber network that is jointly owned by the school districts along with a number of other neighboring school systems.
- Each of the rural electric cooperatives has built some fiber to connect their electric substations together.
- Milaca Local Link has fiber that connects from Milaca back to the headquarters of the Benton Cooperative Telephone Company.
- Benton Telephone Cooperative has fiber to both Foreston and Bock and within a few years promises to extend fiber to all of the homes and businesses in Bock.
- The Mille Lacs Band of Ojibwe has built a fiber connecting its casino and headquarters back to SCI Broadband.
- There has been some private fiber constructed to connect the hospital networks to the Internet as well as to provide transport between locations.
- There are a handful of customers connected to fiber in the business park south of Princeton.

To some degree you could say the county is fiber rich with so many different fiber networks. The bad news, though, is that very little, if any, of this fiber would be available to the county to use to bring broadband to customers.

It is very common for private or government-owned networks to be off-limits to a new fiber venture. Government fiber networks like the state-owned one are off limits because the state has declared that the networks they build cannot be used for commercial purposes. We can understand restrictions against commercial uses, even if we don't like them, particularly when customers in the area of these networks lack broadband. When government and commercial entities work together the fear that it creates a chance for corruption is always present. But this kind of fear should not be a reason to automatically write-off the opportunity for public-private partnerships.

And there are no rules that require privately built and owned networks to provide bandwidth or dark fiber to others. It may turn out that a few of these fiber networks might let the county share some pairs on the existing fiber routes, but we normally don't find this to be the case.

However, there are a number of entities today that are connected to the Internet and who could sell connectivity to a county network. All of the telcos—CenturyLink, Frontier or Benton Cooperative Telephone Company—can sell connectivity to the Internet. Both cable companies also could provide this connectivity. But perhaps the best pricing might be found through the large fiber providers like Zayo who have connections in Princeton. These companies are likely using either the CenturyLink or Midcontinent fiber networks, but they are in the business of selling connectivity and might have lower prices than buying directly from the telcos or cable companies. But there are enough options that I think the county would have no problem finding an Internet backhaul connection.

III. FINANCIAL BUSINESS PLAN ANALYSIS

In this section we look at several different business plan scenarios, as requested by the RFP. For each business plan option we will examine the ability for each option to be profitable and to pay for itself.

We looked at the following specific scenarios:

- **Fiber Everywhere:** In this scenario we construct FTTP to all residents and small businesses and active Ethernet to the business park and a few larger businesses.
- **Fiber for the Rural Areas:** This builds FTTP to rural residents that don't have a landline cable TV provider as well as active Ethernet to the business park and a few larger businesses.
- **HFC to the Rural Areas:** This builds Hybrid Fiber Coax to rural residents that don't have a landline cable TV provider as well as active Ethernet to the business park and a few larger businesses.
- **Wireless for the Rural Areas.** Builds a fiber backbone to support a wireless network for rural customers that don't have a landline cable provider as well as builds an active Ethernet network to the business park and through the downtowns of most cities.

For some of these scenarios we have created more than one option. In each case our goal was to find a breakeven scenario. That is a business plan where you have enough customers to pay for all costs of operating the business. The breakeven number of customers needed is probably the most important fact that you can get out of these studies. For example, if the studies show that you only need a very low percentage of customers to be successful, say 30%, then you could feel pretty assured that you can create a successful business. As the needed percentage gets higher it becomes more of a challenge and more of a risk to undertake a business plan. And there comes some point where the needed breakeven customer penetration is greater than what you can reasonably expect.

In the cases where we could find a reasonable breakeven scenario we also created a second 'expected case' scenario that shows how the business might fare if you get more than the needed breakeven penetration.

To the extent possible we also looked to see if there is an opportunity to create a public private partnership. Like most government entities, the county indicated that it does not want to become a retail ISP, and so we look at ways to get these businesses achieved in some other manner.

We've also looked at a few permutations. For example, there are several ways to build wireless networks that can affect the cost.

A. BUSINESS PLAN KEY ASSUMPTIONS

There are some assumptions that were used in all or most of the scenarios, so we want to talk about these first to avoid repeating them for every option. In the various descriptions of scenarios we will only focus on those assumptions that are unique for that scenario.

In order to explore the economics of the various scenarios, we undertook a business plan study that contemplated all aspects of operations. The business plan assumptions used in the forecast include our best estimate of the operating characteristics for such a business. As a firm, we consult to over 400 other communications entities that operate triple play businesses. We not only work with clients to develop original business plans, but we work with them to help maximize profits with existing businesses. This has given us a lot of insight into how triple play businesses work and we are experienced in how businesses really operate under all sorts of conditions. We believe that the financial results shown in these models are characteristic of similar operations elsewhere and we believe our assumptions are realistic.

Our primary goal with these business plans was to determine the breakeven scenario. We asked the question: what is the worst the new business could do in terms of residential penetration rates and still be successful? Breakeven in this case is defined by having positive operating cash throughout the life of the business. Breakeven for a municipal or non-profit venture is defined as the ability to generate enough revenues to cover operating expenses, debt payments, and routine annual capital expenses. A model that is just barely able to maintain positive cash flow would be at breakeven using that definition.

If you launch a retail business the actual penetration is going to be influenced by two main factors—how well you execute on the business plan, and the reactions of the incumbent providers. One thing to keep in mind is that when you cut rates the incumbents almost always match your rate cuts. There is a natural tendency to cut rates significantly with the assumption that it will buy your market share. But we have found out that it does not, and in fact can spur a price war that results in both you and the incumbents having a hard time making money in the market. So we recommend modest discounts at most, with the real benefit being much faster data speeds and enhancements on every product. And we assume that as a small, local company that you are going to offer better customer service than the large incumbents.

Revenue Assumptions

In the all-fiber scenarios we assumed that an FTTP network in the county would offer the normal triple play of video, voice, and high-speed data services. But I have also assumed that you are likely to keep your products as simple as possible. As an example, the incumbent telephone companies in the county offer a wide range of different kinds of telephone products. We assumed that you would be like most of our small clients and offer only a few options. For instance, for residential service we have assumed you would offer only a plain telephone line and a telephone line with unlimited long distance. The telephone companies sell dozens of features on an a la carte basis and I've assumed instead that you would include many of these features in the basic lines. Complexity comes with a cost and as a new provider I strongly recommend a simple product line. Even large competitive companies do this. For instance Google, in places like Kansas City and Austin, TX only has a few products.

In general we don't recommend offering much discount on product prices from today's market. That is a bit difficult to achieve in the county because you have three different telephone companies, two landline cable companies, and the two satellite cable companies. This means that

there is already a wide range of prices in the county and it's impossible to set a price that will work for every customer. Further, the two cable companies bundle their prices today and in general that means that customers don't know exactly what they pay for the component products, just the amount they pay for the whole bundle.

Telephone Rates

Telephone service is probably the one product that we have priced under market on a standalone basis. There are two primary telephone companies in the county—CenturyLink in the south and Frontier for the rest of the county. The Benton Cooperative Telephone Company serves Bock and the area surrounding it.

On a standalone basis the incumbent telephone companies charge a lot for a telephone line plus features like voice mail, caller ID, etc. The fees for the various components of a standalone telephone line in the county are something like the following:

Basic Line	\$15 - \$20
Subscriber Line Charge	\$5 - \$7
Voice Mail	\$5 - \$7
Caller ID	\$4 - \$6
Other Features	\$1 each

The Subscriber Line Charge is a regulatory fee defined by the FCC that the telephone companies bill and keep as revenue, although they often try to make it look like a tax on the customer bill. So a basic line, without features, costs between \$20 and \$27. With features it's not hard to pay \$30 or more for a home phone in Minnesota, even without long distance and taxes.

Our study used the following very simplified pricing for residential phone service:

Basic Local Line	\$15
Line with Unlimited Long Distance	\$25

Both lines include a full package of features like voice mail, caller ID, etc.

The basic line would only be able to make local calls and calls to 911. A customer with a basic line would need to use a calling card or some other method to pay for long distance calls if they wanted to make them. We suggest that you not sell long distance by the minute. To do so adds a lot of cost to the company, far in excess of the revenue generated. A basic line would be good to use for a fax machine, for a burglar alarm line, or as a phone to keep around to provide 911 capabilities.

It will be a challenge to get local phones that would exactly match the local calling scopes of each city in the county. But every basic line would have some places that could be called for free. Today the local calling scopes in the county vary widely by area, as follows:

<u>Exchange</u>	<u>Telco</u>	<u>Can Call for Free</u>
Princeton	CenturyLink	The Twin Cities (big area)
Milaca	Frontier	Bock, Foreston, Pease
Onamia	Frontier	Isle, Wahkon
Isle	Frontier	Malmo, Onamia, Wahkon
Wahkon	Frontier	Isle, Onamia
Pease	Frontier	Bock, Foreston, Milaca
Foreston	Benton Coop	Foley, Gilman, Milaca, Pease
Bock	Benton Coop	Milaca, Pease

As you can see, outside of Princeton, which has a gigantic calling scope, the rest of the county today has a very limited free calling area, meaning that most calls placed from those exchanges are long distance today.

We suggest a \$25 price for lines that include unlimited long distance nationwide. Anybody that wants to use the home phone to make many calls is likely to want this option. Like a cell phone, the plan would let you call anywhere in the country for the fixed monthly price, but unlike some cellphone plans the calling would be unlimited.

Unlike with the telephone companies, your price would not have any add-ons other than the required taxes. There would be no separate Subscriber Line Charge or any other hidden fees. There would be the typical taxes which normally range between \$1.50 and \$3.00, but those would not be revenues for the business but would be remitted to the proper tax authorities.

Business telephone rates would vary more by customer. To a large extent telephone companies have detariffed business telephone rates. That means that they don't have a fixed price to charge them but rather can bill different rates to every customer should they so choose. There are also a number of different kinds of business telephone lines. Businesses can buy bare lines with no features to use for fax machines, lines with features in the same way that a residence can buy them, and lines where the telephone company provides business features like call transfer, call hold, and those functions that you associate with a telephone at a business. These features are generically referred to as Centrex.

Your business would be able to support most of these kinds of lines. There are a few kinds of lines that you are not going to be able to support. Companies that have their own in-house phone system, usually referred to as a PBX or Key System, require a special kind of line called a trunk. This can be delivered using several kinds of lines such as a PRI (analog) or SIP trunk (digital). These kinds of services require that your business own a telephone switch and our recommendation is that you not own a switch, but rather buy telephone lines wholesale. Thus, there will be a few businesses that you could not serve, although the vast majority of businesses are going to want to buy fairly normal lines that will be available to you wholesale.

You would also be able to sell the newest kinds of phones, IP Centrex, which are business lines that have smart phones that roughly match all of the calling features of a cellphone. You will be able to sell the IP Centrex sets and the services should you wish to do so.

In our business plan we have estimated that the average business in the county has about 2.5 telephone lines, an average that we see often in towns of your size. This number would exclude the very large businesses in towns like the county government or the hospitals, but would represent the small businesses. We have estimated that you will charge an average of \$80 per business customer, which would be a mix of the various kinds of lines that are available to you.

We are not recommending that you sell long distance by the call. This is something you could buy, but that would require you to buy a much more expensive billing package since the process of converting raw calling records and then matching them up with customer's bills is complex. We think you should sell lines that either include no long distance or else unlimited long distance.

One of the business plans we considered is wireless. It's possible to deliver telephone calls over a wireless network, but it may not always work for every customer. Because of this many wireless providers elect not to sell voice. In our models we have looked at this business line with and without voice.

Cable TV Products

The cable TV product presents some real dilemmas for a new provider like you. Today people in the towns have a choice of either a cable TV company or else satellite TV. In the rural areas everybody that wants cable TV gets it from satellite. So your first dilemma is that you will have a lot of competition.

Second, you are not really going to be able to compete on price for cable TV. In fact, your prices are likely to be higher than satellite prices. For a small company the cost of programming alone is extremely high and makes it hard for you to be competitive. And so the cable prices in my model are based more upon the cost of programming (the channels you must buy) than they are on the competitors' prices.

You are also going to have to raise cable rates every year since the cost of programming goes up every year. For the last decade, programming costs have risen over 7% per year, and to cover that kind of cost you are going to have to raise rates about 5.5% every year. But lately programming has been rising even faster and we have some small clients that have seen 15% increases in programming over the last two years. One doesn't have to look too many years into the future when your rates (and all of your competitors' rates) are going to be higher than what most homes can afford.

The whole industry expects that something drastic is going to change with cable some time during the coming decade. There is getting to be a lot of programming available on the Internet and perhaps that is going to capture most of the market. Or alternatively, small

providers like you might be allowed at some point to offer smaller packages of the things that people want to watch, rather than selling them hundreds of channels—most which never get watched.

We have assumed that you will be able to provide state-of-the-art products. This would include an interactive program guide, video on demand, pay-per-view sports, music channels, and any new bells and whistles that come along in the industry. The system would strive to carry a large number of high definition (HD) channels.

One of the most exciting advantages of a local cable system is the ability to offer local programming. Many other systems have made this a priority and they carry such things as high school sports, little league games, parades, plays and pageants, church services, community meetings, government meetings, and other local programming. These programs can be carried on a local channel, but they can also be placed on the video on demand system so that the shows could be watched at any time. It is actually possible today to give a separate channel to every high school, church, local government body, and any other entity that is interested in creating local programming.

The model starts with the following products. These products would be the same for residents and businesses.

Basic Cable: \$20. This is the line-up of network channels like ABC, NBC, CBS, FOX, and PBS plus a few other local channels.

Expanded Basic: \$69. This will include about 75 channels. It will include the basic lineup and add the most popular cable networks like ESPN, Disney, the Comedy Channel, etc.

Digital: \$81. This would include over 200 channels and will basically match the top tier offering by the satellite or local cable companies.

Movie Channels: These are extra and can be added to the other packages. We suggest that you sell these just a little over cost (because the cost is very high). Today the most expensive of these cost you almost \$15 per month, so these will not be cheap for customers nor will they make you any profit.

Pay-per-View: Most small companies no longer carry pay-per-view movies and people now watch movies on services like Netflix. But they do carry pay-per-view events like wrestling and also some pay-per-view sports like major league baseball.

DVR Service: You will charge a monthly fee for DVR service, or the ability for a customer to record shows. This would be equivalent to the fee charged by a company like TIVO.

Settop Box Fees: We've assumed that you will charge for the cable settop boxes to recover those costs. The cable companies now charge as much as \$8 per box, but we've assumed a monthly fee of \$5.

Data Products

With a fiber network you have a lot of costs, so you will not be competing against the lowest-priced data products in the towns. There may be very low-speed DSL lines at rates like \$30 per month, and you don't want to compete with them. Instead, your competitive advantage is data speeds, and so we would recommend that you charge full market price for data products but that you offer far faster speeds than are available today.

Fiber Network Data Products

On a fiber network in the county I would recommend the following speeds and prices:

Residential

100 Mbps download	\$54
1 Gbps download	\$99

Business

100 Mbps download	\$ 79
250 Mbps download	\$129
1 Gbps download	\$299

While many networks make these products symmetrical, we don't think that is a great idea for products this fast. Having extremely fast upload speeds provides more benefits to spammers and other people with bad intent than it does to your customers. However, you do want to provide upload speeds in the range of 30 Mbps to 50 Mbps that are sufficient for people to work at home or do on-line gaming. But it is very hard today to justify a 100 Mbps or a 1 Gbps upload speed. You could make faster upload speeds an option for the small handful of customers that value upload speeds.

These are shared data products, meaning that the overall bandwidth to provide them is shared among numerous customers. This is not to say that the data path to a given customer is not secure, because the transmission to any specific customer is encoded for privacy purposes. But there will be some business customers that will want a dedicated data product that is not shared with anyone else. The network can accommodate this by providing such customers with an active Ethernet connection. Prices for these services cost quite a bit more than shared data services and will depend upon a variety of factors to determine the price. But your prices for dedicated bandwidth ought to be considerably lower than the prices charged by the current providers in the area.

Wireless Network Data Products

If you build a wireless network we would recommend the following speeds and prices:

Residential

Up to 15 Mbps download	\$ 49
30 Mbps download	\$ 99

Business

Up to 15 Mbps download	\$ 79
30 Mbps download	\$129

These speeds are obviously far slower than those on a fiber network. But these are also being sold in areas that have no broadband alternative. If you were able to bring a faster network to these customers later, either by upgrading to white space spectrum or by slowly expanding your fiber network, then we would recommend you keep the same prices and just increase the speeds.

The people in these rural areas either have no broadband today or else are paying very high prices for the alternatives that are there such as satellite data plans or cellular data. These plans would have no data caps and would allow unlimited downloads during a month.

We know that these prices seem high, but part of the reason for that is to insure profitability so that the business can eventually migrate everybody to fiber. There are several wireless providers in the state today charging the above prices.

Expense Assumptions

Employees: Labor is generally either the largest or second largest expense of operating a broadband network (programming is the other large expense). In the various options we have studied we have assumed that you will have to employ a local staff to run the business. The specific number of people required for each option will be covered as we discuss each scenario. We have assumed salaries at market rates with an annual increase for all positions at 3% inflation. We've assumed that the benefit loading is 35% of basic annual salary. That would cover payroll taxes, other taxes like workman's compensation, as well as employee benefits.

The employees needed are a mix of different job responsibilities. The business will require a very rounded and experienced general manager. The business will need a finance manager/accountant. All of the business plans also require a technical staff to connect customers and maintain the networks. The business plans also include customer service representatives to take customer orders, answer questions, and collect cash. Each plan also has a full or part-time salesperson.

In some of the plans when customers are being added to the network we have projected the use of temporary contractors to help cover the temporary workload of connecting customers for the first time.

Start-up Costs: There are considerable start-up costs included in each model. There are a large number of expenses associated with launching a new business and rather than list them all specifically we have included them as start-up costs.

Marketing Expenses: Each business plan contains either a part-time or full-time salesperson. This function is going to sell to business customers. In addition, there is a budget for marketing in each

plan to advertise and otherwise get the word out in the community that the new business is open and ready to serve customers. It might be possible to save on these costs if instead there is a pre-launch sales campaign where customers pledge to sign-up before you build the network. In that case you would not have to market to those customers again resulting in lower marketing costs than have been shown in the study.

Cable TV Programming: Almost all small cable operators purchase cable signal from the National Cable Television Cooperative (NCTC), a cooperative of small cable providers. NCTC currently provides programming to nearly 20 million subscribers, meaning they get some of the best prices for programming in the industry. In our business plan we have shown the current trend of having annual large increases in programming rates. For the past 6–8 years rates have risen steadily by around 7% per year. This is one of the main causes of the annual rate increases done by cable companies. In the model we have tried to keep the margins fairly steady throughout the model, which means that while cable TV rates will increase (and in the outer years of the model will climb to ridiculous numbers) the margins are not much different than in the beginning. In fact, we have margins decreasing a little. We point this out because the model looks like cable revenues are increasing while customers are shrinking, and this is due entirely to the increase in rates and programming costs. We have assumed that the business will raise rates each year by 5.5% to offset the 7% annual programming increase. If we were to freeze both rates and costs at the starting levels the bottom line projections would actually improve, so we have been conservative.

There are ways to control programming costs by carrying the least amount of channels that you can. Though programmers are very good at forcing you to carry many stations that you might not want, it's still a good goal to strive towards. The temptation is to carry every channel available, but if you do so your rates will have to be too high. This is not to say that you can't have an extremely robust and competitive channel line-up, but there are an incredible number of channels available and you can't afford to carry them all.

Internet Backbone: The business will need to buy a large data pipe to the Internet to provide connectivity from the network to the open Web. This is referred to in the industry as Internet backbone connection. The amount of bandwidth purchased for the backbone is a big factor in the quality of the Internet connection sold to customers. The quality of a backbone is measured in the industry by use of an oversubscription factor. Oversubscription is the sharing of bandwidth between customers. For example, if you had one customer on your system, then the network would not be oversubscribed and we would have an oversubscription ratio of 1:1. However, since customers don't all use the Internet all the time to download or upload, you are able to share a data pipe among multiple customers. The cable and the telephone companies are believed to use an oversubscription ratio of 200:1 or higher, meaning that at least 200 customers share a data pipe to a neighborhood. We have calculated the price of bandwidth in this model at an oversubscription rate of 100:1. This is a reasonably high quality oversubscription ratio and most customers will get the bandwidth they want almost all of the time.

Another issue to consider with Internet backbone is the price per raw megabit. Our model shows internet expenses in two parts: transport and bandwidth. The model predicts that transport costs will grow at the rate of inflation but that the costs of the Internet port connections and bandwidth will drop over time. This has been the trend for a number of years and is expected to continue. We

think our prediction is conservatively high and that costs will probably drop faster than we have predicted, including the chance that transport might get cheaper.

Cost of Goods Sold: In addition to the cost of programming the business plan contains estimated costs for two other external services: use of a remote headend and the purchase of wholesale voice.

Billing: A company has two choices for billing services. The company can subscribe to an external billing service or the company can buy software and do the billing internally. In the long run, internal billing is more cost effective and these models assume the purchase of a billing system as part of a larger suite of software known as OSS/BSS. This software is used to take customer orders, to coordinate installations, and to keep track of inventory as well as to bill customers. In the software costs built into the model we also have included the cost of auto-provisioning software, meaning that orders can be transmitted directly from a customer order to activate the voice switch, the cable TV services, and the data services. With this software, a customer can call and ask for a new service and have it active while they are still on the telephone.

Other General & Administrative (G&A) Expenses: The models include the cost of other overheads such as utilities, insurance, human resources, legal, accounting, etc.

Taxes: The model assumes that the business will pay property taxes on buildings. We've been told that there is no property tax in Mille Lacs County on the network. We have assumed no income taxes unless we contemplated an option that would be taxable such as a public private partnership or a cooperative.

This business would expect to pay any communications taxes like any other communications company. For example, this business would be expected to pay cable TV franchise taxes. Communications taxes are normally added to the customer bill, and thus customers directly pay these taxes. We have not shown such pass-through taxes in the model since customers pay them and the taxes are sent as collected to the tax authorities. They are not a revenue or an expense to the business, but rather are just a pass-through.

Capital Assumptions in the Study

Capital is the industry term for the assets required to operate the business. The capital expenditures predicted in these models reflect the results of the engineering studies referenced in the section above. The launch of a broadband network requires a significant investment in fiber network and electronics and this is by far the biggest cost of getting into the business.

We have described the specific capital needed for each business plan below when we discuss that plan. The amount of investment required is going to vary by the type of technology used as well as by the number of customers covered by a given business plan.

Generically capital includes several broad categories of equipment including fiber cable, electronics for FTTP, wireless towers and electronics, and cable settop boxes. In addition to capital needed for the network, there are expenditures predicted for assets like furniture, buildings, computers, vehicles, tools, inventory, and capitalized software.

We have tried to be realistic in our estimates so that constructing a project will cost a little less than what we are estimating. In addition to being a little conservative in our estimates we also include a construction contingency to cover potential cost overruns. CCG has made numerous estimates for the cost of building networks and we don't think there has ever been a case where actual construction costs came in higher than our estimates.

However, it is important to remember that our estimates are very high level. Generally the type of estimate we made, which is our best guess at the total cost of each asset, is good enough to see if it makes sense to move forward and consider a fiber project. However, before raising the money to build this large of a project, many businesses get a second estimate of the construction costs as a hedge against being short with the financing funds raised.

We have assumed that there is capitalized labor in several of the asset cost estimates. Capitalized labor is when a company uses its own employees to build an asset and then adds the cost of those employees into the cost of the asset. This is something that is required by GAAP accounting. It is important to predict this in a forecast because generally bond money can be used to pay for assets but not operating expenses, so it is important to calculate the expected cost of the final assets as installed. I have assumed that there would be employees and/or temporary installers involved in installing both the fiber drops and the ONTs on the side of each home. So this estimated labor has been added into the cost of those assets below. If this work was instead done by outside vendors, say a construction company, then there would be no need to hire the temporary installers and the cost would still be very close to what I have estimated below. We normally recommend hiring temporary installers because it gives the business more control over the quality of the installation.

B. SPECIFIC BUSINESS PLAN ASSUMPTIONS

In the following section we look at the results of specific business plans. Note that all business plans exclude the town of Bock and the area immediately surrounding it. That area is served by Benton Cooperative Telephone Company and they have plans to serve that area with fiber within three years.

Fiber Everywhere: In this scenario we construct FTTP to all residents and small businesses and active Ethernet to the business park and a few larger businesses.

Passings. The passings for this scenario are as follows:

City Full-time Residential	4,335
City Seasonal Residential	228
Rural Full-Time Residential	5,728
Rural Seasonal Residential	1,658
City Business	455
Rural Business	<u>274</u>
Total	12,679

Again, as described earlier, we limited seasonal passings to those that were occupied and that had a tax assessment greater than \$10,000. There could be seasonal homes with a lower assessment that might want broadband part of the year, but we needed to set some threshold to eliminate most of the unlikely candidates for broadband.

Employees. By year two this scenario requires 11 employees as follows:

General Manager	1
Accountant	1
Marketing Analyst	1
Salesperson	1
Inside Technicians	2
Installers	2
Customer Service	3

In future years the business adds two additional outside technicians.

To some degree both the accounting and the marketing function could be outsourced rather than require a full-time employee. However, the cost would be similar even if that was done instead by a contractor.

Customer Penetration Rates

In general we take a two-step process in looking at penetration rates. First, we create a business plan with what we call ‘expected penetration rates.’ These are the ideal target rates you might hope for in the business plan. Think of these as the best case penetration rates. These rates are important because they establish a cap on the capital costs.

We then lower the penetration rates until we find the ‘breakeven’ penetration rates. These represent the level at which the business would just be able to pay for itself using the original financing with no additional cash infusion or subsidy required.

In this business case we arbitrarily set the best-case expected penetration rates at the following (for the data product):

	<u>Expected</u>
City Full-time Residential	50%
City Seasonal Residential	40%
Rural Full-Time Residential	65%
Rural Seasonal Residential	40%
City Business	60% (Year 6)
Rural Business	60% (Year 6)

Our reasoning for these penetration rates are as follows:

- City Full-time Residential: The cities already have good cable modem service and so many of them are happy enough with the existing cable companies to prefer those vendors over fiber. If anything, the 50% penetration could be high.
- City Seasonal Residential: Fewer seasonal households in general are willing to pay for broadband.
- Rural Full-Time Residential: These are the customers that largely have no alternatives today. You would expect at least 65% of them to be willing to pay for broadband and it could be higher.
- Rural Seasonal Residential: Fewer seasonal households in general are willing to pay for broadband.
- City Business: In general businesses generally prefer fiber, although it takes longer to achieve the penetration rates.
- Rural Business: In general businesses generally prefer fiber, although it takes longer to achieve the penetration rates.

As it turns out, the expected penetration rates produce a business plan that is not very much above breakeven. We calculated a breakeven scenario as follows:

	<u>Breakeven</u>
City Full-time Residential	46%
City Seasonal Residential	40%
Rural Full-Time Residential	62%
Rural Seasonal Residential	40%
City Business	60% (Year 6)
Rural Business	60% (Year 6)

This makes this scenario quite risky because you must achieve fairly high penetration rates to break even with little margin for error. With just a handful of fewer customers than the expected case the business plan enters what is called a death spiral and it loses money year after year until it finally collapses.

Specific Assets

Following are the assets that are in service by the end of the third year for the two scenarios. These are the assets that are funded by debt. There will always be a capital budget in future years to add additional customers or to replace or upgrade network components, but the following is the capital that is capital for which you must find financing:

	Expected	Breakeven
Vehicles	\$ 141,050	\$ 141,050
Tools	\$ 150,000	\$ 150,000
Buildings	\$ 780,000	\$ 780,000
Furniture	\$ 37,497	\$ 37,497
Computers	\$ 44,840	\$ 44,840
Data Routers	\$ 242,500	\$ 242,500

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Settop Boxes	\$ 1,929,703	\$ 1,829,817
FTTP Equipment	\$ 4,477,852	\$ 4,314,572
Fiber Drops	\$ 5,078,652	\$ 4,831,949
Fiber Network	\$23,683,330	\$23,683,330
Inventory	\$ 400,000	\$ 400,000
Capitalized Software	<u>\$ 240,000</u>	<u>\$ 240,000</u>
Total	\$37,205,224	\$36,695,556

Fiber for Only the Rural Areas: This builds FTTP to rural residents that don't have a landline cable TV provider as well as active Ethernet to the business park and a few larger businesses.

Passings. The passings for this scenario are as follows:

Rural Full-Time Residential	5,728
Rural Seasonal Residential	1,658
City Business	100
Rural Business	<u>274</u>
Total	7,760

The network does pass through the business districts of several cities, so we show some of those businesses as passings (and as customers).

Employees. By year two this scenario requires 8.5 employees as follows:

General Manager	1
Accountant	1
Salesperson	Part-time
Inside Technicians	2
Installers	2
Customer Service	2

In future years the business adds one additional outside technician.

Customer Penetration Rates

In this business case we arbitrarily set the best-case expected penetration rates at the following (for the data product):

	<u>Expected</u>
Rural Full-Time Residential	65%
Rural Seasonal Residential	40%
City Business	60% (Year 6)
Rural Business	60% (Year 6)

Mille Lacs County Ultra-Broadband Feasibility Study

As it turns out, this business plan does not cash flow at the expected penetration rates. In fact, the plan loses over \$21 million of cash during the study period. Because of this, there is no realistic penetration rate that will break even and this particular scenario cannot work.

Specific Assets

Following are the assets that are in service by the end of the third year for the expected scenario. These are the assets that are funded by debt. There will always be a capital budget in future years to add additional customers or to replace or upgrade network components, but the following is the capital that is capital for which you must find financing:

	Expected
Vehicles	\$ 141,050
Tools	\$ 150,000
Buildings	\$ 780,000
Furniture	\$ 37,499
Computers	\$ 34,540
Data Routers	\$ 242,500
Settop Boxes	\$ 1,252,772
FTTP Equipment	\$ 3,050,164
Fiber Drops	\$ 3,354,502
Fiber Network	\$18,177,830
Inventory	\$ 400,000
Capitalized Software	<u>\$ 240,000</u>
Total	<u>\$27,860,857</u>

HFC to the Rural Areas: This builds Hybrid Fiber Coax to rural residents that don't have a landline cable TV provider as well as active Ethernet to the business park and a few larger businesses.

Passings. The passings for this scenario are as follows:

Rural Full-Time Residential	5,728
Rural Seasonal Residential	1,658
City Business	100
Rural Business	<u>274</u>
Total	7,760

The network does pass through the business districts of several cities, so we show some of those businesses as passings (and as customers).

Employees. By year two this scenario requires 8.5 employees as follows:

General Manager	1
Accountant	1

Mille Lacs County Ultra-Broadband Feasibility Study

Salesperson	Part-time
Inside Technicians	2
Installers	2
Customer Service	2

In future years the business adds one additional outside technician.

Customer Penetration Rates

In this business case we arbitrarily set the best-case expected penetration rates at the following (for the data product):

	<u>Expected</u>
Rural Full-Time Residential	65%
Rural Seasonal Residential	40%
City Business	60% (Year 6)
Rural Business	60% (Year 6)

As it turns out, this business plan does not cash flow at the expected penetration rates. This plan performs better than the all-fiber rural plan, but still loses over \$14 million of cash during the study period. Because of this, there is no realistic penetration rate that will break even and this particular scenario cannot work.

Specific Assets

Following are the assets that are in service by the end of the third year for the expected scenario. These are the assets that are funded by debt. There will always be a capital budget in future years to add additional customers or to replace or upgrade network components, but the following is the capital that is capital for which you must find financing:

	Expected
Vehicles	\$ 141,050
Tools	\$ 150,000
Buildings	\$ 575,000
Furniture	\$ 37,499
Computers	\$ 34,540
Data Routers	\$ 242,500
Settop Boxes	\$ 1,698,975
Coaxial Drops	\$ 2,014,226
Fiber Network	\$23,207,800
Inventory	\$ 400,000
Capitalized Software	\$ 240,000
Total	\$28,741,590

Wireless for the Rural Areas: Builds a fiber backbone to support a wireless network for rural customers that don't have a landline cable provider as well as builds an active Ethernet network to the business park south of Princeton and through the downtowns of most cities.

Passings. The passings for this scenario are as follows:

Rural Full-Time Residential	5,169
Rural Seasonal Residential	950
City Business	100
Rural Business	<u>274</u>
Total	6,493

As can be seen, this is fewer residential passings than with the fiber model. Because of the tree cover in the county, there will be some homes that cannot get good radio reception. We have engineered around this to some degree by assuming that every rural home will need to use a telescoping pole in order to see one of the towers. But realistically there will still be some homes that are in wireless shadows, meaning that there will be something between them and a tower, or which will just have too much foliage to serve.

Note also that since the fiber runs through some of the cities that we have assumed that you pass some city businesses and that you would eventually try to serve them. It would be a pure business decision, but you could also add residential customers in the cities if they were close enough to the fiber and if they would sign a long-term contract for service. But we have not included any city residences in the study or the assets associated with them.

Employees. By year two this scenario requires 8.5 employees as follows:

General Manager	1
Accountant	1
Salesperson	Part-time
Inside Technicians	1
Installers	2
Customer Service	2

In future years the business adds one additional outside technician.

Customer Penetration Rates

In this business case we arbitrarily set the best-case expected penetration rates at the following (for the data product):

	<u>Expected</u>
Rural Full-Time Residential	60%
Rural Seasonal Residential	50%
City Business	60% (Year 6)
Rural Business	60% (Year 6)

Our reasoning for these penetration rates are as follows:

- Rural Full-Time Residential: These are the customers that largely have no alternatives today. You would expect at least 60% of them to be willing to pay for broadband and it could be higher. This is not quite as good as the expected fiber penetration rate and wireless will be a harder sell. But it is still far better bandwidth than is available in the rural areas today.
- Rural Seasonal Residential: Fewer seasonal households in general are willing to pay for broadband.
- City Business: In general businesses generally prefer fiber, although it takes longer to achieve the penetration rates.
- Rural Business: In general businesses generally prefer fiber, although it takes longer to achieve the penetration rates.

The breakeven penetration rates for this scenario are somewhat lower than the expected rates as follows:

	<u>Breakeven</u>
Rural Full-Time Residential	54%
Rural Seasonal Residential	39%
City Business	60% (Year 6)
Rural Business	60% (Year 6)

This business plan is not as risky as the fiber plan above. Of course, one would want to take steps to make sure that you can get the number of customers predicted by this study, such as canvassing rural customers before you borrow the money. But the 54% penetration rate feels achievable in those area that have basically no broadband today. However, if and when CenturyLink improves the broadband around Princeton these penetration rates would be harder to achieve.

Specific Assets

Following are the assets that are in service by the end of the third year for the two scenarios. These are the assets that are funded by debt. There will always be a capital budget in future years to add additional customers or to replace or upgrade network components, but the following is the capital that is capital for which you must find financing:

	<u>Expected</u>	<u>Breakeven</u>
Land	\$ 195,000	\$ 195,000
Vehicles	\$ 106,050	\$ 106,050
Tools	\$ 100,000	\$ 100,000
Towers/Huts	\$ 2,915,000	\$ 2,915,000
Furniture	\$ 37,499	\$ 38,999
Computers	\$ 30,540	\$ 30,540
Data Routers	\$ 242,500	\$ 242,500
Wireless Electronics	\$ 1,262,519	\$ 1,261,319

Wireless CPE	\$ 2,423,680	\$ 2,154,880
Fiber Drops	\$ 120,097	\$ 105,277
Fiber Network	\$ 4,722,960	\$ 4,722,960
Inventory	\$ 300,000	\$ 300,000
Capitalized Software	<u>\$ 60,000</u>	<u>\$ 60,000</u>
Total	\$12,515,845	\$12,231,025

Why These Scenarios are Conservative

At CCG we always try to make our business plans conservative. We do this because we want to make sure you can succeed if you enter one of these businesses based upon our recommendation. Following are some of the conservative assumptions used in the business plan:

- In the all-fiber scenarios the revenue stream over 25 years mostly assumes the sale of the triple play. It is clearly understood in the industry that both voice and cable revenues are on a decline in terms of customer penetration. The models assume customer decreases in both products. It is also widely understood that network owners will have to find new revenue sources during the next few decades to replace those revenues. The models show modest new revenues coming in from unspecified future products, but we have kept the vast majority of revenues coming from the triple play. Already today we know of system operators who are offering burglar alarm and other security services. We have several clients that are offering home energy management systems. We have other clients who are helping customers implement home automation. It’s also possible today to resell cellular services with a decent mark-up. Certainly over 25 years there will be new revenue opportunities that we can’t even imagine today. We see big potential in things like cloud services, medical monitoring, and a host of other new products.
- We have been very conservative in terms of ‘home run’ revenues. By that we are referring to the large bundles of services that might be sold to a few large customers. We are certain that the business would gain from a few such opportunities because every similar business does. There is also a chance to sell transport on your network to places like cell sites and other wholesale opportunities like creating rings for the current cable providers and other companies. There certainly is the opportunity to sell gigabit bandwidth to the schools who get less bandwidth than that today. However, to be conservative, we have included a modest amount of such revenues, but we think the opportunity is greater than our estimates.
- In the model we show a drop in data costs over time. However, industry costs for raw data will probably drop even faster than we are predicting.
- Our model shows a major electronics upgrade every eight years. It is possible that upgrades will be needed less often than we have shown. Further, our assumption is that the cost of equipment at the time of each upgrade would cost as much as the equipment that was being retired. The experience of the electronics industry is that electronics get cheaper and more efficient over time, so the cost of upgrades is probably going to be less than is shown in the model.

- The model is conservative in terms of predicting when businesses will join the network. The model assumes that businesses lag the residential market by several years and it is certainly possible to do better than predicted.
- If the community was to undertake a pre-construction sign-up campaign to identify customers before the start of construction, then capital expenditures could be lower since the customer drop and electronics could be installed during the initial construction at a lower cost than installing customers individually later.

C. BUSINESS PLAN RESULTS

It is never easy to summarize the results of complicated business plans to make them understandable to the non-financial layperson. In the following analysis we will show some key results of each study scenario we considered along with some facts that hopefully will allow you to compare the various options.

For any business plan there are always a few key assumptions that have a significant impact on the results. So using a process called sensitivity analysis I will show the impact of the most important assumptions on the wireless business plan. This same sort of sensitivity analysis could be done for any of the financial models, but there is not a lot of reason to look at these variables for a plan that looks hard or difficult to achieve.

One of the most important assumptions affecting all of the business plans is the way that they are financed. The two key variables in financing are the term—how long of a time that money can be borrowed—and the interest rate.

In the first draft of each plan we assume that these plans would need to be 100% financed with debt. However, in general a business plan can be improved by somehow attracting equity or grants so to reduce the amount that is borrowed. But rather than make assumptions about low cost or free money, we would just say that you should keep in mind that such money always makes it easier for a plan to be successful.

Fiber Everywhere, the Expected Case: In this scenario we construct FTTP to all residents and small businesses and active Ethernet to the business park and a few larger businesses.

Basic Assumptions

Amount borrowed	\$51.9 M
Interest Rate	4.75%
Debt Term	25 Years
Positive EBITDA	Year 3
Positive Net Income	Year 6
Debt Breakeven	Year 23
Cash after 25 years	\$9.2 M

Let us define the above terms:

- Positive EBITDA: EBITDA is earnings before interest, taxes, depreciation, and amortization. When a business has a positive EBITDA it means that revenues are large enough to pay for the operating expenses of running the company. That is one of the important milestones for a new business. But a positive EBITDA is not itself a sign of financial success because not included in the EBITDA are payments on debt and income taxes, if applicable. A business will achieve cash breakeven when it can cover operating expenses, annual capital expenditures, debt payments, and income taxes.
- Positive Net Income is when the books of the business show a positive profit. This is really a taxation and public reporting issue because profit measured in this way includes depreciation and amortization, which are not cash expenses. The net income also does not consider repayment of debt principle and annual operating capital. But still, this is an important milestone for a new business, because this is when the business is profitable for accounting purposes. Just note, though, that you could have a positive net income and still have enough cash to operate the business.
- Debt Breakeven is when the business has generated enough excess cash that you could retire the remaining debt. In this case that breakeven event doesn't occur until about year 23, just two years before the debt is scheduled to be retired—so the business is not generating a lot of excess cash.

The way that you measure profitability in a new business is going to differ according to the structure of the business. A municipal business, for example, basically measures success by having enough cash to operate the business without any external subsidy. But a for-profit business would generally use something like Net Income to measure profits, which is close to the IRS definition of profitability.

It is important that a business always have cash in the bank to meet its obligations. In this particular business the ideal situation would be to always have at least \$1M in the bank to have a cushion against non-linear expenditures. For instance, not all expenditures are done evenly throughout the year and so you need to have a cash cushion to allow for those times of the year when the expenses are higher than normal or the revenues are lower than normal.

This particular scenario generates a little positive cash each year until about year 19 when it starts losing cash every year. That is so far into the future that small tweaks in rates or other key variables would be able to fix this long before it occurs.

Our overall assessment of this business plan is that it is very risky. It requires significant customer penetration rates to basically float a little above breakeven. Should anything go wrong in this business it does not have the reserves or the resiliency to easily respond. Ideally you would want a business plan to be able to hit breakeven with a penetration rate far lower than the expected rate. Then, even should the market change over time, the plan probably can find ways to keep positive. But this business plan has very little room for error, and for that reason it's too risky.

Fiber Everywhere, the Breakeven Case: In this scenario we construct FTTP to all residents and small businesses and active Ethernet to the business park and a few larger businesses. The business plan is able to just maintain positive cash in the bank. The breakeven penetration rates are 46% of city residences and 62% of rural residences. This is not very much below the expected penetration rates of 50% and 65%,

Basic Assumptions

Amount borrowed	\$51.9 M
Interest Rate	4.75%
Debt Term	25 Years
Positive EBITDA	Year 3
Positive Net Income	Year 7
Debt Breakeven	Year 25
Cash after 25 years	\$1.8 M

With just slightly lower customer penetration rates than the expected scenario the plan just barely maintains cash throughout the 25th year. It doesn't cover the debt until the final year of annual payments. I would note that any of these business plans will fare better once the debt has been paid off. In this scenario the annual debt payments are \$3.7M, and once the debt has been retired in 25 years the business would generate that much extra cash each year. But that is a long time into the future and we generally don't look out that far when operating a business.

Fiber for the Rural Areas: This builds FTTP to rural residents that don't have a landline cable TV provider as well as active Ethernet to the business park and a few larger businesses.

Basic Assumptions

Amount borrowed	\$39.0 M
Interest Rate	4.75%
Debt Term	25 Years
Positive EBITDA	Year 3
Positive Net Income	Never sustainable
Debt Breakeven	Cannot cover the debt
Cash after 25 years	(\$21.0 M)

As noted earlier, this scenario does not work. It runs out of cash by year 4, and if somehow it was kept operating it would lose cash each year thereafter. Basically, there are not enough customers or revenue to be able to cover debt payments of \$2.8M per year. This is not surprising for an all-rural network. Except for tiny towns like Pease this business plan basically is all very rural customers.

This business plan has a network that costs \$3,600 for every customer passed. Contrast this to the whole county model that had a cost of \$2,900. But even the whole county model barely can pay for itself and ideally you would want to have a cost per passing under \$2,500.

HFC to the Rural Areas: This builds Hybrid Fiber Coax to rural residents that don't have a landline cable TV provider as well as active Ethernet to the business park and a few larger businesses.

Basic Assumptions

Amount borrowed	\$40.2 M
Interest Rate	4.75%
Debt Term	25 Years
Positive EBITDA	Year 3
Positive Net Income	Year 17
Debt Breakeven	Cannot cover the debt
Cash after 25 years	(\$13.9 M)

This plan using Hybrid Fiber Coax does better than using fiber. Even though this scenario has slightly higher initial capital costs, the maintenance expensed and ongoing capital on an HFC network are lower over time than with fiber. But the plan still cannot achieve breakeven and is not a feasible option.

Wireless for the Rural Areas, the Expected Case: Builds a fiber backbone to support a wireless network for rural customers that don't have a landline cable provider as well as builds an active Ethernet network to the business park and through the downtowns of most cities.

Basic Assumptions

Amount borrowed	\$15.5 M
Interest Rate	5.5%
Debt Term	20 Years
Positive EBITDA	Year 2
Positive Net Income	Year 7
Debt Breakeven	Year 17
Cash after 25 years	\$20.8 M

This is the best performing business plan of the ones studied. It is able to pay for itself with a reasonable customer penetration rate. It also generates significant excess cash over time which could be used for a number of purposes. The most interesting use of the profits would be to roll them back into the business to slowly build fiber to the rural areas. We will discuss this more below.

Wireless for the Rural Areas, the Breakeven Case: Builds a fiber backbone to support a wireless network for rural customers that don't have a landline cable provider as well as builds an active Ethernet network to the business park and through the downtowns of most cities.

Basic Assumptions

Amount borrowed	\$15.5 M
Interest Rate	5.5%
Debt Term	20 Years
Positive EBITDA	Year 2
Positive Net Income	Year 9
Debt Breakeven	Year 19
Cash after 25 years	\$13.5 M

The breakeven penetration rates are 54% for rural full-time residences and 39% for rural part-time residences. This is comfortably under the expected case of 60% and 50%. This looks like a business plan that can be made to work and we will look at this case in much more detail below.

D. SENSITIVITY ANALYSIS

It is important to understand that the above scenarios each represent one set of assumptions, but that many of those assumptions could vary from the ones we have chosen in the studies. So, using the expected case of the rural wireless scenario, we looked at how changing a number of the key assumptions will change the results. This sort of analysis is generically referred to as sensitivity analysis, because it tests the importance of the key variables in the study and quantifies how much changing one of those assumptions would change the result.

We specifically looked at changing the following assumptions.

- Assets: we looked at an 'economical build' which cut out as many of the assets as possible to still produce a working network.
- We added a telephone product.
- We assumed that because the network is wireless that it would 'pass' more potential customers than is shown in the study.
- We looked at the impact of achieving a higher customer penetration rate.
- We looked at adding telephone and considering more customers.
- We looked at shortening the life of the financing from 20 years to 15 years.
- We looked at the impact of having to pay a higher interest rate.
- We looked at the impact of finding \$1 million in equity to help finance the project, meaning that less would have to be financed.
- We looked at lowering customer data prices by \$5 per customer per month.
- We looked at the impact of waiving the \$300 installation fee.

Following is the results of each of these scenarios, compared back to the base expected case. This comparison lets you see the bottom line impact of each change. To some degree these changes are additive and if you did several of these changes together the results would change in the direction

predicted by the sensitivity analysis. However, to the degree that changing different assumptions have a dual impact, the changes might not be additive, but they would go in the direction indicated in changing the bottom line. Another way to say this is that if you made all of these changes you would not get the same result as adding up the bottom line effect of each change.

Economical Build

In this scenario we asked the question, “Is there any less costly network design that would still produce a working network?” The answer is that there are a few changes that could be made to produce a network that would still be functional. We considered the following:

- Existing Towers: You could save money by using some of the existing towers in the county instead of building new towers. Our preliminary look suggests that most of the existing towers are not at the ideal places you would want a network for supplying rural data. This is not surprising since the existing towers were built to provide cellular coverage to the cities as well as some roaming along major highways. However, our engineers believe that there are four existing towers that might be useful. However, using them would create a few gaps in the wireless data coverage and two additional towers would need to still be built if we used the four existing ones. However, this still reduces the cost to build by a net of two towers, which is a significant savings. You also save by not having to build huts at the existing towers. But there would be two additional sets of electronics needed compared to the base study.
- Fiber Ring: Our design for the wireless network provides a fiber ring to bring bandwidth to each of the towers. With a ring configuration none of the towers would go out of service with a single fiber cut anywhere along the network. However, it would be possible to build, instead of a ring, two long fibers, one up each side of the river, but not closed off as a ring. This cuts out about 30% of the fiber needed. The downside is that any cut in the fiber would take any towers past the cut out of service.
- No Fiber at All: We considered not building any fiber but instead delivering the bandwidth to the towers with point-to-point microwave radios. This is often how wireless ISPs build wireless networks. The big downside to this configuration is that without fiber bandwidth the bandwidth would have to be delivered to the towers using microwave radio. The problem with using microwave radios instead of fiber is that the bandwidth that you can deliver to the first tower then must be shared with all of the other towers in the chain of towers. For instance, if you fed a wireless gigabit to the first tower and it then had to feed bandwidth to four more towers, then each tower would only be able to get 200 Mbps of bandwidth. Contrast this to a fiber network where each tower could be fed directly with a gigabit. For a network with a large number of towers like this one a microwave backhaul will produce greatly reduced system bandwidth and an inferior customer product.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$12.5M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years

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Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 5
Debt Breakeven	Year 17	Year 14
Cash after 25 years	\$20.8 M	\$26.0M

This change would lower the amount needed to get the business started by \$3 million. And over the 25-year study period it would generate \$5.2 million in extra cash.

If at all possible we don't recommend this scenario because it leaves you vulnerable to network outages. That is perhaps one of the most important ways that customers judge a broadband provider because outages are majorly disruptive for customers. But if you find that you can only raise \$12.5 million and not \$15.5 million, then this would get the business started. You could always use excess cash later to close the fiber ring, although that would take 5 or 6 years to do that out of profits.

Adding Telephone

This scenario looks at adding a telephone product over the wireless connections. While telephone service will work over this network, the quality is not going to be as good as the quality of voice over fiber. The primary reason is that in a fiber network you can take advantage of something called quality of service. This is an engineering term that means that the bits used to deliver telephone service on a fiber network can be given a priority to always get delivered first compared to bits for anything else like downloading files or streaming video. We can approximate quality of service on a wireless network, but it is not as foolproof as on a fiber network and there might times when a customer might disconnect their voice call if they have a lot of other downloads happening simultaneously. A telephone call only uses a very tiny slice of bandwidth, but it is also a real-time service, meaning that call quality can suffer if bits are not delivered exactly on time. For most customers most of the time the voice product over the wireless network is going to be of very good quality. But there will be customers who have quality issues with voice, and so it would probably not get as high of a customer penetration rate as you might get on fiber.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.7M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 5
Debt Breakeven	Year 17	Year 15
Cash after 25 years	\$20.8 M	\$26.6M

Adding voice over the wireless is a very positive change. For a tiny extra amount more of upfront debt the cash generated increases significantly. This is a change that ought to be implemented.

Passing More Customers

Wireless networks don't follow geographic or political boundaries and so the towers would be able to see customers in the adjoining counties. Also, while the network is engineered to deliver 10 Mbps download at 5 miles from a tower, it is possible to still deliver some decent amount of bandwidth further away. This expands the opportunity from every tower since there will be some customers at 6, 7, and 8 miles from a tower who will wish service, even if it is not as fast as what the base customers can get. For somebody with no broadband, a 5 Mbps connection would still seem like a huge improvement.

For this analysis we've assumed that the towers will be able to 'see' 600 additional residential passings. It will take a detailed engineering study to determine the exact number, but considering that there are 13 towers this does not feel like an aggressive estimate.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.8M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 5
Debt Breakeven	Year 17	Year 14
Cash after 25 years	\$20.8 M	\$29.3M

Again, like adding telephone, with a minor increase in debt the business can generate a lot more cash. This tells us that you need to offer data services to those outside the county but within reach of your towers. In fact, this opportunity is so good that you might even want to consider building a few towers primarily for the opportunity to attract more customers. The profits from the extra customers can help to pay for the upgrade to fiber sooner.

Adding Telephone and Passing More Customers

Since the two above scenarios were so positive, we then looked at doing them both together—adding a telephone product and also considering the extra customers that can be reached outside of the county.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$16.0M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years

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Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 4
Debt Breakeven	Year 17	Year 13
Cash after 25 years	\$20.8 M	\$35.6M

This adds \$500,000 to the debt but produces almost \$15 million more in cash over 25 years. This is such a major improvement that we think that this should be considered as the base study and that the wireless business plan should add voice and should also consider the customers that can be reached outside the county. That much extra cash can be rolled back into building significant fiber during the 25 year period and many of the customers can be converted over time from wireless to fiber.

The best news is that this scenario greatly reduces the breakeven penetration rate. It only requires 44% of rural full-time residents and 20% of rural part-time residents to make this plan pay for itself.

Increasing the Penetration Rate

This scenario looks at the bottom line impact of doing better than expected. What happens if the business gets a 65% penetration rate rather than a 60% penetration rate?

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.7M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 6
Debt Breakeven	Year 17	Year 15
Cash after 25 years	\$20.8 M	\$26.9M

As this shows, if the business gets more customers it performs better financially. This does raise the issue of what we call borrowing for success. Often in financing these businesses it's not easy to raise additional funds once they get started. So it's fairly common to borrow a little more than you expect to need to account for the situation where you do better than expected. In this case, borrowing \$200,000 extra would pay for the equipment needed for the business to get extra customers, and if at all possible you should borrow a little extra as a cushion.

Shortening the Financing Term

This scenario looks at the impact of shortening the length of the loan from 20 years to 15 years. This might actually be necessary since it might be hard to get a longer term note for a wireless network.

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Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.5M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	15 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 7
Debt Breakeven	Year 17	Doesn't
Cash after 25 years	\$20.8 M	\$23.8M

This shows that the business is very sensitive to the term of the loan. This is a crucial issue because it might not be possible to get a 20-year loan unless financing through bonds. In this scenario the business runs out of cash in year 6 and remains negative until the debt is paid back. Basically, the business would not work without some additional infusions of cash through borrowing or equity. The business probably requires about \$1M extra in this case. But that would be hard to borrow on the basis of the assets being built and so the extra money would probably need to be raised as equity of some sort. If the term was even shorter, say 12 years, the cash problem would be even worse.

Paying a Higher Interest Rate

This looks at the impact of raising the interest rate by 100 basis points (one full percent).

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.9M
Interest Rate	5.5%	6.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 9
Debt Breakeven	Year 17	Year 18
Cash after 25 years	\$20.8 M	\$17.6M

As would be expected, a higher interest rate means lower generated profits and cash. This model is very sensitive to a change in interest rates. Just a 1% increase in interest means borrowing \$400,000 more money to cover the higher debt payments in the early years plus a \$3.2 million reduction in cash generated over the 25 years.

Partial Funding with Equity

In this scenario we quantify the impact of funding the business partially with equity and look specifically at the impact of using \$1 million of equity. Equity in this case is defined as money put into the business that does not earn a return, such as grant money.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$14.3M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 7
Debt Breakeven	Year 17	Year 15
Cash after 25 years	\$20.8 M	\$23.1M

Adding equity upfront has a very positive effect on the business plan by reducing the amount borrowed and the annual payments on the debt. The most common way to get this kind of equity would be through grants or through raising it from members in a cooperative. We've assumed that the business gets some equity from charging customers a fee to connect (which could be considered as a fee to join the cooperative).

Lowering Customer Prices

In this scenario we dropped data prices by \$5 per month for both residents and businesses.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.5M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 2
Positive Net Income	Year 7	Year 9
Debt Breakeven	Year 17	Year 19
Cash after 25 years	\$20.8 M	\$13.3M

As this shows, probably the most sensitive variable in the model is price. In this case, dropping the price of the data product by \$5 lowers the cash by \$7.5 million over the study period. This provides a cautionary tale should you ever move forward with the business plan. One of the first thing a new business will often do when getting started is to lower the prices in an attempt to get more customers. The impact of lowering the prices temporarily for new customers, such as through an introductory special, would be minor. But lowering the prices permanently can devastate the

business plan. This also demonstrates the danger of getting into a price war with your competition. You lose a lot in a price war, as probably does your competitor.

Waiving the Installation Fee

This looks at the impact of eliminating the \$300 installation fee. This fee is included in the wireless plan, but there is no fee in the fiber plan.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.5M
Interest Rate	5.5%	5.5%
Debt Term	20 Years	20 Years
Positive EBITDA	Year 2	Year 3
Positive Net Income	Year 7	Year 7
Debt Breakeven	Year 17	Year 19
Cash after 25 years	\$20.8 M	\$18.1M

This change actually breaks the business plan, meaning that the business runs out of cash for a few years. The business plan does not have enough cash to operate in years 3–6. In some ways the customer installation fee acts like equity, and if the business was organized as a cooperative it probably would be counted as an equity contribution rather than as a revenue. It’s not necessary to charge the \$300 all at once and this could be spread across multiple payments to make it easier on new customers, but charging this makes the business plan easier to finance. It’s always hard in financing a project to borrow for what is called operating cash, which means funding the losses until the business turns positive. Most lenders want to lend for the assets that are going to be built and they expect the lender to somehow finance the operating losses. In this case, a lot of those losses were funded by the installation fees.

Combining Multiple Changes

We then looked to see the impact of layering changes. So we created a model that does the following:

- Adds residential telephone.
- Considers customers from neighboring counties.
- Assumes you will raise \$1M of equity through grants or some other process.
- Lowers the financing term to 15 years.
- Pays 1% more in interest rates.

This includes changes that were both positive and negative and we wanted to see if they would all work together.

Effect of this Change

	<u>Base Case</u>	<u>Revised Study</u>
Amount borrowed	\$15.5 M	\$15.2M
Interest Rate	5.5%	6.5%
Debt Term	20 Years	15 Years
Positive EBITDA	Year 2	Year 3
Positive Net Income	Year 7	Year 4
Debt Breakeven	Year 17	Year 13
Cash after 25 years	\$20.8 M	\$27.9M

This is a very interesting scenario because it demonstrates the kind of changes that are often necessary to get a business plan financed. In this specific example, increasing the interest rate and lowering the term both have a negative impact on the business. But adding the voice product, looking further away from the towers for customers, and raising \$1 million in equity more than offset those negative effects and makes for a plan that is better than the base plan.

It’s not unusual for clients to want a simplistic answer from us such as “How much do I have to raise to make this work?” The answer is that it depends. It’s possible to predict a range of what needs to be borrowed, but until you can start pinning down things like the interest rate and the term of the loans you can’t know that answer. And this gets complicated in a real financing situation because there often is more than one form of financing used to make a plan work. This will be discussed below in the financing section, but a project as small as this might require two to four different loans to get financed.

E. FINANCING OPTIONS

Following is a discussion of some of the primary ways this project could get financed. We will look at the options for financing it as a municipal venture and also as a private venture.

Public Financing Options

The two primary mechanisms used for public financing are revenue bonds and general obligation bonds.

There are some major benefits of using bond financing. First, the term of the bond can match the expected life of the assets and it’s not unusual to find bonds for fiber projects to stretch out for 25 to 30 years.

Second, you can finance a project completely with bonds, meaning that no cash or equity needs to be put into the business.

Revenue Bonds

The primary historic source of money to finance this sort of telecommunications system is through the issuance of municipal tax-exempt bonds. Most of the municipal fiber networks that have been built have been financed through revenue bonds. Revenue bonds are backed by the revenues and the assets of the fiber network and the associated business. With a pure revenue bond the county would not be directly responsible for repaying a revenue bond should the project go into default. With that said, having a default would be a financial black-eye that might make it hard to finance future projects. So to some degree the county would be on the hook for the success of revenue bonds, at least tangentially.

However, it is getting harder to finance a project with revenue bonds due to some failures of other municipal networks. Among these are Monticello, MN, Crawfordsville, IN, and Alameda, CA. These kinds of failures have made investors leery about buying bonds that are only backed by the business. And this reluctance has made financing with revenue bonds more expensive.

The cost of a bond issue cannot be judged only by the interest paid. In fact, the other financing costs of bonds can outweigh the interest rate in the effect on the bottom line cost of repaying a bond issue. Because of market reluctance to buy revenue bonds, they often have higher interest rates than general obligation bonds, but they also can incur the following costs:

Debt Service Reserve Fund (DSRF): Many revenue bonds expect the borrower to borrow additional funds to be kept in escrow as a hedge against missing future payments. The DSRF is often set to equal a year's worth of principle and interest payments. This money is put into escrow and is not available to operate the business.

Capitalized Interest: Bonds begin accruing interest from the day the money is borrowed. Since fiber businesses take a number of years to generate enough cash to make bond payments, the bondholders require capitalized interest that is used to make the interest payments for up to the first five years of the project. Basically, the project must borrow the amounts needed to make debt payments which can add a significant amount to the size of the bond issue.

Bond Insurance: Bond Insurance is an up-front fee paid to an insurance company who will then pay one year of bond payments to bond holders in case of a default. We've seen bonds issued that have required both a debt service reserve fund and bond insurance.

These costs greatly increase the cost of issuing revenue bonds. As an example of how expensive this can be, with a revenue bond you might have to borrow \$70 million to construct a network that costs \$50 million. The extra \$20 million in this example would be due to the above sort of fees that are added into the bond cost.

As an example of how this works, following is a summary of the \$52 million needed to finance the all-fiber network:

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Assets	\$37.2 M
Bond Fees	\$ 0.9 M
Working Cash	\$ 2.6 M
Capitalized Interest	\$ 7.4 M
Debt Service Reserve Fund	<u>\$ 3.8 M</u>
Total	\$51.9 M

As you can see, the assets of \$37.2 million are only 71% of the total amount borrowed. The working cash is needed because this is the cash that covers the early operating losses. But the other fees totaling \$12.1 million are associated with the cost of financing with bonds. To be fair, some of these costs are also associated with other forms of financing, but these fees and the method of financing add a lot of costs to bonds.

And this means that the effective rate of a revenue bond might be far higher than the published interest rate. For example, a revenue bond with a 5% interest rate, but with the above fees added, might have an effective interest rate in double digits.

One of the problems with revenue bonds is that the interest rate can be considerably higher than general obligation bonds. The difference between these two rates is referred to in the industry as the 'spread.' In the last few years the spread between the two types of bonds has not been too large, with general obligation bonds between 4% and 5% and revenue bonds between 6% and 7%. But the spread changes all of the time and there have been historic times when the spread gets too large and it becomes nearly impossible to issue revenue bonds.

General Obligation Bonds

If you can't use revenue bonds, then the next typical alternative is general obligation bonds. General obligation bonds are backed by the tax revenues of the entity issuing the bonds. This backing can be in the form of various government revenues such as sales taxes, property taxes, or the general coffers of a government doing the borrowing.

In Minnesota many kinds of general obligation bonds requires a referendum approval by voters. There are some kinds of economic development bonds and other types of GO bonds that don't require a referendum, although many cities do referendums for such bonds anyway to make sure the public supports the initiative being financed.

There are other financing mechanisms that have been used by other municipalities to fund revenue-generating projects. These include:

A Combination Construction Loan and Bond

Because fiber projects take a few years to construct and then take a few more years to grow to full revenues, the interest that can be incurred in the early years can be significant. This is due to the fact that with bonds all of the cash is borrowed on day one at bond closing and begins to accrue interest.

There have been times where this is not too costly because the interest income that can be earned on the idle cash has been somewhat close to the interest being paid on the bonds. But for the last decade the interest rates on invested cash have been extremely low, under 1%. This has made it very expensive to sit on unused bond funds.

One way around this problem is to construct the network with some other kind of financing. The ideal kind of financing is referred to as a draw-down loan or a construction loan, where money is only borrowed by the project each month as needed. If a fiber project is able to arrange construction financing they can save significant amounts of money. Typically the first six months of a fiber project are spent doing engineering, which is relatively inexpensive. To give an example, if you can use a construction loan to finance a \$50 million fiber construction, the savings on interest by using a construction loan might be between \$2 million and \$4 million.

Construction loans have typically been given by banks. So under this scenario a bank would finance the construction, with a bond scheduled to then take out and repay the bank loan. This structure also makes it easier to sell the bonds because the bondholders are buying into a completed network. This removes the risk of going over budget on construction and speeds up the revenues in the project since the bondholders avoid the build-out phase.

In practice the only way to get something like this done is to work with a lender who will handle both parts of the transaction. You would want somebody who could issue the bank loan and who could then make the conversion to bonds at the appropriate time. There are only a few large banks, like the Bank of America, who have done these kinds of financing.

The biggest risk to this kind of project is that the interest rates on the bond might be very different when it's time to convert the construction loan into a bond. But the savings achieved through construction financing are probably still beneficial unless there was a catastrophic interest rate increase.

Variable Rate Demand Obligations (VRDOs)

VRDOs are a bond where the principal is paid in a lump sum at maturity. However, the borrower has the right to repay the bonds in whole or in part at any time (upon an agreed upon notice). VRDOs are very effective in circumstances when the borrower wants to match the repayment of the bonds to a revenue stream that varies year to year or a revenue stream that can vary from initial estimates and changes over time. In the case of the new telecommunications system, this type of financing provides the flexibility to make bond payments that match the actual revenues received. If revenues are slower than anticipated, principal payments do not need to be made. If revenues come in faster than anticipated, repayment of the bonds can be accelerated without penalty.

VRDOs are most commonly structured as 7-day floating rate bonds. Interest rates are reset each week and this adds a lot of risk to this type of financing. Unlike fixed-rate bonds, the borrower does not know what the interest rate will be on the VRDOs over the life of the issue. Interest rates on VRDOs are on the short end of the yield curve and have therefore historically been lower than interest rates on fixed-rate bonds even with the additional ongoing costs for a

liquidity provider and a remarketing agent. There is typically a maximum rate stated which the VRDOs cannot exceed. But in a market where there is a significant increase in overall interest rates this kind of financing could be a lot more expensive.

Capital Appreciation (zero coupon) Bonds (CABs).

CABs are bonds that are issued at a deep discount and which do not bear any stated interest rate. Like a Series E savings bond, CABs are bought at a price that implies a stated return calculated on a basis of the bond being payable at par at maturity. With no stated interest rate there is no interest paid until maturity, at which time all of the compounded accreted interest is paid. With no interest payments required in the beginning years of the bonds, this would enhance the cash flow in the beginning years of the business.

CABs do, however, have several drawbacks over other types of available financing. First, the interest rates on CABs are typically higher than both the fixed-rate and VRDOs. Second, investors prefer not to have a prepayment option on CABs, which limits the flexibility of the government to call the bonds early if revenue collections are better than anticipated or if a restructuring of the debt is needed.

Private Financing Options

If the business is launched as a cooperative, a non-profit business, a commercial entity, or some kind of public private partnership, then 100% financing through bonds will not be an option. The traditional way for commercial ventures to get financed is through bank loans. But the interest rates on such loans are generally a lot higher than bonds. Still, there are some ways to mitigate the financing costs so that a project doesn't have to rely on only bank loans.

Here are some thoughts on financing the fiber business if it is a non-municipal venture:

Equity

Most forms of private financing require some equity. Equity means that the borrowing entity brings some sort of cash or cash equivalent to the business as part of the financing package. The amount of equity required will vary according to the perceived risk of the venture by the lender. The higher the risk, the more equity required.

Equity can take a number of different forms:

- Cash: Cash is probably the preferred kind of equity and lenders like to see cash infused into a new business that can't be taken back out or that doesn't earn an interest rate.
- Preferred Equity: For a stock organization (like an LLC or other type of corporation) the business can issue some form of preferred stock that then acts as equity. Preferred equity usually gets some sort of interest rate return, but the payments are not usually guaranteed like they are for bank loans. If the business gets into a cash crunch they must pay bank loans and other forms of debt before they pay preferred equity interest.
- Assets: It's possible to contribute assets as equity. For example, a new fiber venture might be seeded by having one of the partners contribute an existing fiber route or other

valuable asset to the business. In such a case the contributed asset generally has to be assigned a market value by an independent appraiser.

- Non-recourse Cash: Non-recourse cash would be taking cash in an obligation that is not guaranteed to be paid back. To give an example, in Sibley and Renville counties, a fiber business was recently launched in the form of a cooperative. The local government provided an economic development bond to the business as a non-recourse loan. This means that the new fiber business will make their best effort to make the bond payments, but if they are short of cash then the government entities who issued the bonds would have to make bond payments. The other sources of financing for that project looked upon these bonds as a form of equity.

Bank Loans

While there are around 150 municipal fiber ventures in the country that mostly got financed through bonds, the vast majority of other fiber projects in the country have been financed with commercial lending sources. Most fiber projects have been built by either for-profit communications companies or by cooperatives.

The banking industry as a whole does not like to finance long-term infrastructure projects. This is the primary reason why the country has such an infrastructure deficit. Historically banks would fund things like power plants, electric and water networks, and other long-term revenue-generating assets. But various changes in banking laws which have required banks to maintain larger cash positions along with a general desire to go after higher interest rate short-term projects mean that banks have largely stopped doing this kind of lending. It's not impossible to finance an infrastructure project at a traditional bank, but the general parameters of bank loans make it a challenge.

Most banks prefer to not make loans with a term much longer than 12 years, and very few telecom projects can generate enough cash in that time period to pay for the original investment. Bank loan rates are generally a few percentages higher than bond rates, which also makes it harder to prove feasible.

And bankers generally expect a significant amount of equity from the borrower. The banking industry has gotten a lot more conservative over the last decade and they now might require 40% equity where a decade ago for a similar project they might have required 20% equity. Since fiber projects are relatively expensive, it's very difficult to raise the kind of equity needed to make a project work.

There are exceptions. A few of the large banks like Wells Fargo and Bank of America have divisions that will make bank loans to municipal ventures that look a lot like bonds. These loans will have long payment terms of 20 years or more and reasonable interest rates. However, most of these loans go for things like power generation plants and other projects that have a really strong guaranteed revenue stream. These banks have done a tiny handful of telecom projects, but they view most of them to be too risky. These banks also like very large projects, at \$100 million or even a lot larger. Banks are also particularly adverse to start-ups and prefer to make these kinds of loans to existing businesses that already have a proven revenue stream.

There is one unique banking resource available to companies who want to build fiber projects. This is CoBank, a boutique bank. This bank has financed hundreds of telecom projects, mostly for independent telephone companies. But CoBank is a relatively small bank and has very strict requirements for financing a project. They are leery of start-ups and we can't think of a start-up they have financed. They also expect significant equity to be infused into a new venture. They tend to have somewhat high interest rates and somewhat short loan terms of 10-12 years.

The final source of bank financing is local banks. Historically local banks were the source in many communities for car and home loans. But over the last few decades those loan portfolios have migrated to other lenders and local banks have been struggling for a decade to find worthwhile projects in their regions. We know of many commercial projects for small telcos that have been financed by local banks.

One of the issues of borrowing from a local bank is that they are going to have a relatively small lending limit. Most local banks won't make an individual loan for more than one or two million dollars. And that obviously doesn't go very far in a fiber project. But local banks have become very adept at working in consortiums of multiple banks to make larger loans. This spreads the risk of any one loan across many banks. And banks who do this usually take part in consortium loans for a number of projects. These smaller banks see this as a way to make loans to quality projects and quality customers that they could not loan to on their own.

To make this work you generally must start with a bank that is local to the project and let them help you put together the consortium. They essentially become the sponsor of the deal. This approach takes some extra work to put together, but there are many examples of this working for financing good projects.

Loan Guarantees

One way to make banks more amenable to loaning money to fiber projects is through federal or state loan guarantee programs. A loan guarantee is just what it sounds like. Some state or federal agency will provide a loan guarantee, which is very much like getting a co-signer on a personal loan. These programs guarantee to make the payments in the case of a default and thus greatly lower the risk for a lending bank. In return for the lower risk the banks offer lower interest rates.

These guarantees are not free. One has to apply for them in much the same manner that one would apply for a bank loan or a grant, meaning lots of paperwork. And then the agency generally wants a fee equal to several interest 'points' up front. To some extent this process works like insurance and the agency keeps these fees to cover some of the cost of defaults. If they issue enough loan guarantees, then the up-front fees can cover eventual losses if the default rates are low. These points are a payment to the agency for issuing the guarantee and are not refundable.

There are several state and federal agencies that might be willing to make loan guarantees for telecom projects. The following agencies are worth considering:

HUD 108 Program: The Department of Housing and Urban Development has a loan and loan guarantee program that is allotted for economic development. There is both federal money under this program as well as money from this program given to the state to administer. While these loans and loan guarantees generally are housing related, the agency has made loan guarantees for other economic development projects that can be shown to benefit low or moderate income households. If enough of a fiber project can be said to benefit low income residents, then these loans can theoretically be used for a fiber project.

Small Business Administration 504 Loan Program: This program by the SBA provides loans or loan guarantees to small start-up businesses. These loans or loan guarantees must be made in conjunction with a bank, with the bank providing some loan funds direct and with the SBA loaning or guaranteeing up to 50% of the total loan.

USDA Business and Industry Guaranteed Loans (B&I): The Department of Agriculture provides loan guarantees through the B&I program to assist rural communities with projects that spur economic development. Such a project must, among other things, provide employment and improve the economic or environmental climate in a rural area. These loan guarantees are available to start-up businesses. The program can guarantee up to 60% of a loan over \$10 million or greater percentages of smaller loans.

Rural Utility Service (RUS): This is a part of the Department of Agriculture. We cover their loan program in detail a little bit below in this report. But they also can provide loan guarantees. These come with the same sorts of issues associated with the loans. These loans and loan guarantees can only be used in communities of 20,000 population or less, which would not be an issue in Mille Lacs County.

Economic Development Bond

Even if the business is created as a commercial entity, the project could still benefit by a municipal bond. The county is allowed to issue a general obligation bond for economic developments reasons, and this money could be loaned to the commercial network business. This kind of economic development bond does not require a referendum in Minnesota.

The primary issue involved with doing this is that the primary lender to the new business is going to have priority over the economic development bond in terms of who gets paid if there is any kind of default of debt. So this bond would probably take a second position behind other bank financing.

Rural Utility Service (RUS) Loans

The Rural Broadband Access Loan and Loan Guarantee Program (Broadband Program) furnishes loans and loan guarantees to provide funds for the costs of construction, improvement, or acquisition of facilities and equipment needed to provide broadband in eligible rural areas. These loans can't be used for any town with a population over 20,000 in population.

RUS makes broadband loans and loan guarantees to:

- Finance the construction, improvement, and acquisition of facilities required to provide broadband including facilities required for providing other services over the same facilities;
- Finance the cost of leasing facilities that are required to provide broadband if the lease qualifies as a capital lease under Generally Acceptable Accounting Procedures (GAAP). The financing of such a lease will be limited to the first three years of the loan amortization period;
- Finance the acquisition of facilities, portions of an existing system and/or another company by an eligible entity, where acquisition is used in the applicant's business plan for furnishing or improving broadband. The acquisition costs cannot exceed 50 percent of the broadband loan amount, and the purchase must provide the applicant with a controlling majority interest in the equity acquired;
- Finance pre-loan expenses, i.e. any expenses associated with the preparation of a loan application, such as obtaining market surveys, accountant/consultant costs for preparing the application, and supporting information. The pre-loan expenses cannot exceed 5 percent of the broadband loan excluding any amount requested to refinance outstanding telecommunication loans. Pre-loan expenses may be reimbursed only if they are incurred prior to the date on which notification of a complete application is issued.

RUS is legally allowed to make loans to a wide range of entities. Borrowers can be either a nonprofit or for-profit and can be one of the following: corporation; limited liability company (LLC); cooperative or mutual organization; Indian tribe or tribal organization as defined in 25 U.S.C. 450b; or state or local government, including any agency, subdivision, or instrumentality thereof. Individuals or partnerships are not eligible entities.

To be eligible to receive a loan under this program, the entity must:

- Submit a loan application. We note that the loan application requires a lot of work including such things as pre-engineering, surveys, mapping, financial business plan models, environmental impact studies, and other things which make the application expensive to get prepared externally;
- Agree to complete the build-out of the broadband system described in the loan application within three years from the date the borrower is notified that loan funds are available;
- Demonstrate an ability to furnish, improve, or extend broadband in rural areas;
- Demonstrate an equity position equal to at least 10 percent of the amount of the loan requested in the application; and
- Provide additional security if it is necessary to ensure financial feasibility as determined by the Administrator.

In practical terms here is how the RUS loans have been administered over the past few decades:

- The rules say that a project needs at least 10% equity, but in reality this is generally expanded to be anywhere from 20% to 40% at the discretion of the RUS. In effect, the RUS acts as a bank and they will require enough equity that the project can adequately cover debt payments. In comparing the RUS to other banks I would classify them as conservative.
- The loan terms are generally in the range of 12 years, sometimes up to 15 years for fiber projects. This is much shorter than the terms available on bond financing, meaning the annual payment would be higher under an RUS loan than with a bond.
- It is exceedingly hard to get a project funded for a start-up business. When one takes an RUS loan they essentially want the whole company as collateral. Thus, the bigger and the more successful the existing company, the easier to meet their loan requirements.
- Their collateral requirements are overreaching in other ways that make them hard to work with for municipal projects. For example, if your project was going to share fiber with some existing network, such as one built by a school system, they would want that asset as collateral. This is generally not possible.

This makes the RUS a very unlikely funding source for a municipal venture or for any start-up venture. To the best of our knowledge, they have never successfully funded a municipal venture and they rarely approve a project for a start-up business unless it is extremely well funded by a demonstrably successful company.

The other big drawback of these loans is that they take a long time to process. They often have a backlog of loan applications at the RUS of 12–18 months, meaning you have to wait a long time after application to find out if they will fund your project. Very few existing companies are willing to wait that long unless they are certain they will be funded. And if you are coordinating these loans with other forms of financing this wait is not practical.

The loans are granted by using a very detailed checklist and rating system. This system gives a big preference to making new loans to existing RUS borrowers.

However, the loan fund is really big and is currently at nearly \$1 billion. Congress generally has been adding additional funds to the RUS pot each year. The RUS also has some discretion and they have it within their power to make a grant as part of the loan. This is something that can't be counted on, but we know of projects where the borrower only had to pay back 80% of what they borrowed. The interest rates can be lower than market in some cases, but for the last several years, with low interest rates everywhere, the RUS loan rates were not much cheaper than commercial loans.

These loans also require a significant paperwork process to drawdown funds along with significant annual reporting requirements.

There is a low likelihood that RUS would be a funding source for a project in the county.

New Market Tax Credits

The New Markets Tax Credit (NMTC) Program was established in 2000 as part of the Community Tax Relief Act of 2000. The goal of the program is to spur revitalization efforts of low-income and impoverished communities across the United States and Territories. Eligibility of the county to use these funds would depend upon meeting the earnings test. But much of rural America meets this test if you earmark the funds for the rural parts of a project.

The NMTC Program works by giving big tax credits to investors that are willing to invest in infrastructure projects in qualifying communities. The tax credits are so lucrative that often the other terms for accepting the funding are modest. The tax credit equals 39% of the investment paid out—5% in each of the first three years, then 6% in the final four years, for a total of 39%.

The Community Development Financial Institutions (SDFI) Fund and the Department of the Treasury administer the program. The process of how the Treasury allots credits is a complicated one and we won't cover it, but in the end there are entities who end up each year with some amounts of New Market Tax credits that they must invest to gain the tax credits. The credits are often purchased by the large national banks or other firms that invest in infrastructure.

Generally in practice, these funds act like a mix of loans and credits to the recipient. For instance, a community that received these funds might have to pay some modest amount of interest during the seven years of the tax credit, and at the end would have a balloon for the principal. However, often some or even all of the principal will be excused, making this also look like a grant.

Because the entities that get the credits change each year, and because you apply with the entities that hold the credits, and not with the federal government, the processes for applying for this money is somewhat fluid. However, there are entities and consultants who help find New Market Tax Credits and who can help you through the maze of requirements.

These funds are not likely to fund a whole, or even a large percentage, of a fiber project, but they might be used to find 5% to 10% of the needed funds of a project and can be a very affordable piece of a funding package. In some cases the terms for getting these credits are so good that other pieces of the financing might look at the tax credit money as equity.

Creative Sources of Loans

We've seen entities get very creative in finding sources of financing. Take the example of the RS Fiber Cooperative formed in Sibley and Renville counties. Their financing includes two unique revenue sources we have not seen used before:

- **Loans from Individuals:** The Cooperative borrowed money directly from people and businesses in the counties. These loans had loan contracts and covenants like any other loans. The money borrowed in this manner reduces the amounts that have to be borrowed from the larger external sources, and generally these loans avoid the large fees associated with external financing.
- **Loans from Other Cooperatives:** Since RS Fiber is a cooperative they found that they were able to borrow from other cooperatives at very low interest rates. Cooperatives are a unique

type of business that is required by law to either invest their profits back into the business or else return it as dividends to members. Because the amount of dividends are limited by law, cooperatives often find themselves with large cash reserves. They are allowed to loan out these cash reserves, but only to other cooperatives.

We show these examples as a way to remind you that it is often necessary to get creative to find all of the financing needed for a project. The RS Fiber project probably has more than a half dozen forms of financing that were needed to complete the financing and outside of traditional bond financing, this kind of complicated financing from multiple sources is often the only way to get projects financed.

Possible Minnesota Sources of Funding

There are existing programs that can provide some assistance to fiber projects. Following are several specific loan and grant programs that could provide some support for a fiber project. None of these grants are large enough that they are going to make a difference in whether the full project gets funded, but any money you can raise this way will lower the overall cost of debt financing.

Each of these projects has a catch or two that makes them available under very specific circumstances.

Deed Grants

For a second year in a row the Minnesota legislature has provided grant money for rural broadband that is administered through DEED (Department of Employment and Economic Development). In 2014 the amount of grants was \$20 million and for 2015 will be \$10 million.

These grants can go to projects that are expected to be built within two years of receiving the funds. That means you can't really apply for these grants until you have created an operating entity and have arranged for other sources of financing.

There is a lot of competition for these grants and also, apparently, a lot of politics involved in choosing the winners. In the 2014 grant cycle almost all of the money went to existing commercial telephone companies which promised to use the money to build in rural areas. The only non-telco grant went to the new cooperative in Sibley and Renville counties. So it might be a challenge for a municipal venture to get a DEED grant, but a cooperative might fare better.

Because there are so many applicants the amounts you might get from this program are likely to be relatively small, unless in some future year the program is made larger. But as the earlier analysis showed, any amount of equity is valued.

Minnesota Angel Loan Fund

This is an economic development fund in Minnesota that is used to spur new start-up businesses. The funds come from the Minnesota Department of Employment and Economic Development.

This is a loan fund and the program can make 0% interest loans for up to a seven year term. The loans can be for as much as 10% of the amount of equity received by the start-up after approval in the program. That must be noted, in that the start-up business needs to register with this fund before raising equity and not after.

At least one of the equity investors must be certified by the Minnesota Angel Tax Credit program and also must be qualified as an accredited investor per the US Security and Exchange Commission under Rule 501 of Section D. In a nutshell, that means that this must be a professional investor and might be something like an insurance company, a pension fund, an investment bank, or some other entity that invests in businesses as a normal course of business. This would not include small private investors like the sort of investors that buy municipal bonds for personal investment purposes.

The amount of the loan must be at least \$20,000 but is capped at \$250,000. The loan payment is a balloon payment for the full amount due at the end of the seventh year. If the business is sold before the end of seven years the fund will charge a 30% premium on top of the principal due.

This loan only covers 10% above the amount of qualified equity the new business raises, but the zero percent interest rate still makes it attractive. However, fiber projects are generally of such a magnitude that even a loan of \$250,000 will probably not make a huge difference in affecting the overall interest rate or in making it easier to raise the rest of the funding.

Greater Minnesota Public Infrastructure Program

This is a grant program that is part of the Small Cities Development Program. The purpose of this grant is to help stimulate economic development and jobs through investments in public infrastructure. Applicants must be home-rule cities that are outside of the 7-county metropolitan area. The money is available for any publically owned infrastructure project and includes projects like water and waste water, economic development projects, utilities, and streets. It seems by the description that municipally owned fiber projects should qualify.

The grants can be up to 1 million and a community can't receive more than \$1 million in total over any two year period. I cannot tell by the rules of the program if a project that involves multiple municipalities could get multiple grants for the same project.

The big catch of this program is that the municipality must make a cash contribution to the project. The Community must put in equity equal to at least half of the amount of the grant. This matching can be either cash or in-kind. Fiber projects are often 100% debt funded, but perhaps a Community that is willing to contribute land, building or other in-kind assets to a fiber project should consider pursue this grant as a way to stretch their contribution.

Minnesota Community Development Funding.

This is a grant program that is aimed at municipalities of fewer than 50,000 people or counties with fewer than 200,000 residents. The grants are available for three different categories or projects

– Housing, Water Projects and Comprehensive Grants. Any project that is funded must meet certain tests, and one of these is that it provides benefits to people of low and moderate income.

The Comprehensive Grants are the ones that might be granted to fiber projects. A comprehensive grant can be up to \$1.4 million. There is some expected matching by the Community taking the grant, but this is not a specific formula like with the Greater Minnesota Public Infrastructure Program. Rather, the amount of matching is determined and negotiated as part of the grant process. However, the general rule of thumb is that the greater the matching the more likely a grant.

Comprehensive grants can be provided for economic development projects. This fund has never made a grant for a telecom project, but it appears that such programs could be eligible if they can demonstrate the benefit for low and moderate income households. A strategy might be to have at least part of the broadband project aimed at low income households.

F. OPTIONS FOR BUSINESS STRUCTURE

A natural follow-up to a discussion on financing is a discussion about different types of business entities. The type of entity often dictates the way that the business can be financed. For example, a municipally-owned business would probably use bond financing, although governments are not legally limited to only bonds. But it's the traditional way that governments finance infrastructure.

So, what kind of legal entity makes the most sense for Mille Lacs County? In the business plan we showed that there are probably only two options for a broadband business. Either you build fiber everywhere, which seems like a big challenge, or else you start with a wireless network in the rural areas that could eventually build fiber using profits.

There are a number of existing telecom companies in Minnesota with different business structures. These include entities that are fully privately owned, entities that are fully publicly owned, and entities that are formed as cooperatives. There are also some public private partnerships and other kinds of joint ventures. While we don't know of any in the state, the other kind of structure that is possible would be to form as a non-profit entity.

Following is a description of each of these kinds of entities along with a more specific discussion of what might work best in Mille Lacs County.

1. Cooperatives

How It Works

Cooperatives are governed and protected under both federal (Capper Volstead Act) and state law (Minnesota Statutes Chapter 308A Minnesota Cooperative Law and Chapter 308B Minnesota Cooperative Associations Law.) A cooperative is a legal entity owned and controlled by its members and members often have a close association with the enterprise as producers or consumers of its products or services. Cooperatives are typically based on the cooperative values of self-help, self-responsibility, community concern, and caring for others. Cooperatives generally aim to provide their goods or services at close to cost while

any excess earnings tend to be reinvested in the enterprise or returned to individual patrons based on patronage of the cooperative.

In Minnesota most cooperatives historically were formed under Chapter 308A and often had agricultural purposes. The passage of Chapter 308B in 2003 enlarged the options and altered the permissible equity structure of a cooperative by allowing investor members to hold as much as 99.99% of the equity of a cooperative and receive up to 85% of the profits from the cooperative. The basic result of 308B is to allow an entity to be formed under Minnesota law that can elect to be taxed (and governed) much as a limited liability company and still operate under cooperative law. The implications of that flexibility would need to be fully understood if in fact the option to create a cooperative were chosen.

Cooperative governance is structured into patron members and non-patron members operating under a Board of Directors elected at an annual meeting according to statutory guidelines and founding bylaws. A 308B cooperative has a corporate shield comparable to a corporation which applies to the actions of the Board of Directors. All who would purchase services from the business would become patron members when they sign up for services.

Advantages

- A cooperative is owned by the customers. Minnesota has a deep history of cooperatives for various purposes and generally people like to be members of cooperatives. They like the fact that they can have some say in what the business does and they really like patron dividends once those start being paid. Cooperatives generally have very little churn, meaning that once somebody becomes a patron they are not likely to leave the cooperative in response to a competitive offer from some other telecom provider. It is interesting to note that for-profit telecommunications companies are at the bottom of national customer satisfaction lists with the exception of cooperative and public or municipal entities.
- A cooperative is a community asset. This means that the revenues of the business are spent locally and the profits from the business are kept locally. A telecom cooperative would add value to the community just through being local. Local ownership is historically more responsive to community needs and offers the promise of better services to customers through local accountability.
- Becoming a cooperative avoids a lot of the problems associated with launching the business as some form of municipal entity. There are significant advantages in building a new fiber optics broadband network and providing services as a private company because it is less likely to be the target of legal challenge such as might arise with a public ownership option in regard to telephone service (this is discussed under the legal section of the report).

Disadvantages

- Because the business is owned by customers, there is no way for the founders of the business to dictate the direction of the business or to direct the use of excess funds eventually created by the business. Once the business is given to customers it can never be taken back. There might be some exception to this under the newer 308B rules, but that would need further investigation.
- If the cooperative option is chosen it will be important to make a sound judgment about community members' readiness to engage to ensure the success of the cooperative. There would need to be a number of citizens willing to step forward and take on roles as the cooperative board to set direction and launch the business.
- A cooperative is a taxable entity and must pay income taxes on its profits (unlike a municipal entity that is generally non-taxable).

2. Municipal Entity

How It Works

Public ownership of an information and telecommunications utility is not uncommon when looking across the US and very common beyond the US. In Minnesota there are municipally owned communications businesses in Windom and Monticello with other communities considering this option.

When municipalities start a telecommunications business they generally have three choices on how to structure such a business. They can create a standalone utility, which means a separate business entity. Second, they can make it a new department within the local government. And third, they can combine the new business with an existing business or utility.

This is not happenstance. Communities that have built or are building publicly owned fiber optic networks to provide services have sometimes been divided about the appropriateness of public enterprises and such differences need to be resolved. Communities are also likely to face determined opposition from existing providers. The opposition activities includes negative opinion formation, legal suits, and pursuit of a legislative agenda that would retain legal provisions in state statute that inhibit municipalities from building networks that include telephone service or to increase obstacles to local units of government trying to build fiber optic networks. These facts on the ground affect the willingness of communities to take up the public ownership option even if they might prefer to do so.

Advantages

- Communities that choose the public ownership option generally have goals and values similar to those of communities which choose the cooperative form. These goals and values include community betterment, community investment, local accountability and

local ownership enabling retention of excess earnings at home. Communities that have good experience with electric utilities often choose public ownership. Additionally it is the case that an already established municipal public utility in a community can provide experience and financing assistance to launch an information and telecommunications utility which leads to public ownership.

- Public ownership is also valued because it allows a management philosophy that expects sound business practice which at the same time takes into account larger and longer term community needs and invests over a different timeline. A remarkable example of this approach is the success story of Chattanooga, Tennessee where a fiber optics network was built under the leadership of the municipal utility. It faced several court battles with Comcast and other providers before it was launched and it is having a transformative effect in the economy and broader community.
- It is the demonstrable case that some of the best fiber networks, with the best customer service at the best prices can be found in communities where fiber optic networks are publicly owned. Looked at from that point of view a public network could be a beneficial choice and a very valuable long-term asset. Citizens generally have a very good opinion of local governments that often carry over to a municipal fiber network.

Disadvantages

- One issue with municipal ownership is the critical question of financing. Generally municipal fiber networks would be constructed using all bond financing, which is expensive money. Since fiber networks are costly, financing a fiber project might have a negative impact on the overall borrowing capacity of the county and would tie up funds that might be used for other municipal projects. The bonds for a fiber project often extend for 25 to 30 years and thus tie up credit for a long time.
- There is always the danger that politics can find their way into the governing of a fiber system. That almost never works out well and a form of governance ought to be found that isolates the business from the pressure of politics. A fiber business needs to be operated as a competitive business if it is to survive.
- A third challenge relates to broader public support which calls for community leadership ready to undertake the hard work of education and organization to provide stability for a public enterprise despite changes in office holders. It is very important up-front to understand if the community supports a fiber system before you build it.
- Minnesota is known as having a strong anti-municipal environment and some legal uncertainties about the terms on which a municipal system might offer phone service could lead to legal challenges—challenges which are better avoided if a good alternative exists. It's well known that Monticello got sued to keep them out of the business. Nuisance lawsuits have been used in other parts of the country to obstruct municipal fiber projects. Although Monticello and other cities have won such lawsuits, such suits are a

delaying tactic by the incumbents which successfully impose delay and cost onto a municipal project.

- There is also another legal requirement detailed earlier in the report that requires you to hold a referendum if a network owned by a municipality is going to create a ‘telephone exchange.’ And that referendum needs a 65% yes vote, which is a high threshold to meet. There also might be a referendum required for financing the project through certain types of bonds.

3. Nonprofit Corporation

How It Works

Nonprofit organizations in the United States are, like for-profit corporations, mostly organized and operated under the law of a state, rather than the federal government. A nonprofit corporation is a legal entity which has been incorporated under the law of its jurisdiction for purposes other than making profits for its owners or shareholders.

In Minnesota a nonprofit corporation may exist for a purpose not involving monetary gain and paying no dividends to its members. It may form for any lawful purpose, including commercial activities. If a nonprofit corporation were to be formed to fund, build, and operate an information and telecommunications network it could be launched with funds or assets from an individual, corporation, government, foundation, or other charity (Minnesota Chapter 317A).

The purpose of the nonprofit corporation would be to confer a general public benefit from which anyone in the community might benefit. In the case of an information and telecommunications nonprofit the general benefit would be open to any subscriber to its services within the service area. As a matter of information, the nonprofit entity would need to comply with already established rules under federal and state law that require any service provider to participate in certain public benefit funding such as devices to assist hearing impaired users or subsidy to low income users for telephone service.

It is the case that a nonprofit corporation may not be formed for the purpose of pecuniary gain to its members in general, but an exception exists in that certain kinds of members may have pecuniary remuneration, directly or indirectly, including dividends. These exceptions include members that are nonprofit organizations or subdivisions, or units, or agencies of the United States or a state or local government (Chapter 317A Subd. 6). Nonprofit corporation formation gives latitude in that as few as three may serve as the Board and whether to have other members or what number of members is at the discretion of the Board.

Advantages

- The advantages to the nonprofit form are significant if there is enough capital to launch the enterprise. The nonprofit corporation form would allow lines of connection between it and other key institutions in the community to be close if desired or more arms’ length if

that seems a more beneficial arrangement. It is also the case that the nonprofit corporation form offers flexibility in working with other key entities in the community. It is authorized to participate in transactions or undertakings that share or delegate control and that the nonprofit corporation can participate in another corporation, or partnership, or joint venture, or other associations to do what it would have the power to do by itself. In addition, the nonprofit corporation is able to make donations for religious, scientific, educational, or charitable purposes and for other purposes consistent with law that furthers the corporate interest.

- Generally the ‘profits’ from a nonprofit entity must be reinvested in the community and not just in the business itself. As the business plans show, it takes a number of years for a new telecom venture to become profitable, but once it does there could be community benefits to having such an entity in the community.

Disadvantages

- As noted elsewhere in the report, most fiber optics broadband projects have pursued either public ownership or the cooperative as forms of ownership. Most projects are limited to the more traditional forms due to the unfamiliarity of the capital market with the nonprofit entity structure. It would probably be very difficult to obtain financing for a nonprofit telecom company, and that might be the primary reason we don’t see any of them in the world today.
- It is a bit difficult to assess the impact of the unusualness of a nonprofit corporation approach. It is not apparent on the face of it that the novelty would invite nuisance law suits, but the possibility cannot be ruled out. Funding community projects with familiar forms of ownership have not always avoided lawsuits. The form of ownership that runs the least risk of nuisance law suits and other forms of obstruction is the cooperative. The form of ownership that runs the largest risk of nuisance law suits and obstructive action is public ownership. The nonprofit corporation lies somewhere between but closer to the comfort zone of the cooperative than the exposed zone of public ownership.

4. For-Profit Corporation

How It Works

The telecom world is full of for-profit companies and that is the most typical structure for telecom companies. For-profit businesses have a number of options on the type of corporation they choose, but today the vast majority of corporations are either C-Corporations or LLCs, which are a type of S-Corporations. A C-Corporation is a taxable entity and they pay income tax on their earnings directly. An LLC distributes the profits each year to the owners who are then responsible for paying the taxes.

The primary reason that companies elect C-Corporation is if they want to accumulate cash for some reason. In an LLC it’s less convenient to accumulate cash because the owners get taxed on it even if you don’t distribute it to them. Why would a company hold cash? One

reason might be due to the terms of any borrowing. For example, for a start-up company the holders of the debt might say that there can be no dividends paid to the owners until the debt has been repaid. Under that kind of scenarios if the business was an LLC the owners might have a tax liability every year without any cash distribution to cover their taxes.

LLCs are very flexible. It's possible to have a different distribution for various things. For example, there might be one structure for voting as an owner, another structure for distributing cash, and a third structure for distributing tax liabilities. Basically almost anything the owners can agree upon in those areas can be achieved.

Advantages

- Probably the primary advantage is that it gives control (and profits) directly to whoever owns the business. And almost anybody other than a municipality can own a for-profit business. For example, Hiawatha Broadband in Winona is owned by the Fastenol Trust. Corporations issue shares of ownership and so there can be a mix of as many different owners as are needed.

Disadvantages

- The primary disadvantage is being taxable. In a state where there is both a state and federal income tax, the tax burden can be substantial. It is important to note that in a fiber business that even when the business is cash positive there is rarely a tax liability for the first decade due to depreciation expense. But once the original network is mostly depreciated the tax burden can be greater than the cash generated. And this points out that tax liability is often very different than cash availability. It is possible to owe taxes even when the business might not be generating positive cash.

5. Public Private Partnerships

How It Works

A public private partnership (PPP) is a business structure that partners between a government entity and some other commercial entity. In this case it would mean a community-formed entity would look for a partnership with some for-profit business that is already in the telecom business. One goal in partnering with an existing service provider may be to bring their technical and operational expertise into the business. Another goal in partnering may be to bring some financial investment into the public private partnership.

It is useful to note that almost all community projects aiming to build fiber optic networks begin with the hope that some sort of partnership might be formed with the telecom businesses already in the community or the service area. Communities look toward the long term benefits of investment in fiber optics and would like to bring their investment capacity to a partnership with an existing telecoms business. Another motivation is that communities often would like experienced help to operate this kind of business. But for the most part, existing telecom businesses have, on the whole, shown almost no interest in such

partnerships for different reasons including unwillingness for their business decisions to become entangled in community or public process, different expectations about needed community investment, different obligations and expectations about return on investments, and the view that communities should not be in the business altogether. In Minnesota, at least one successful existing provider has worked with community projects and new potential partners could be explored.

There are a large number of ways for a PPP to be put together, making it very difficult, if not impossible, to model in detail until you have established the type and purposes of the community entity and until you are in talks with an actual potential private partner. Nevertheless, the advantages and disadvantages of two types of public private partnerships will be examined in broad outline.

There are two basic models for creating a PPP. First is to hire external management, for pay, to operate the business. Second is to bring in a true equity partner that would be part-owner of the business. You can't model the first alternative until you have a proposal from a real partner who tells you what they might charge you to operate the business. And it's even harder to guess the nature of the second alternative, because if a private firm makes an investment in the business, either in cash or in kind, they are going to want some sort of return for their investment. Returns can be as simple as dividends or as complex as a structured future buy-out. There is no standard way to structure this kind of deal and it's going to boil down to what the commercial partner wants from their investment.

External Management with Payments for Contracted Services:

Advantages:

- Communities that find an appropriate management partner retain control over the combined enterprise while still hopefully gaining an experienced management partner for day-to-day operation of the business.
- You can contract for as little or much as you like. For example, a management contract could just provide for general management and specified technical services. Or a contract could go so far as to require that the manager hire the employees of the business.
- Communities that adopt an external management approach will find that it will not be much affected by the form of business entity that it chooses for the business.
- Communities have often used the external management approach for municipal electric businesses and there is a bit of precedent for this in the telecoms area in Minnesota. As an example, the new RS Fiber Cooperative has hired Hiawatha Broadband to launch and manage their fiber network. Monticello also used Hiawatha Broadband to manage the business, although the city took back the business after a few years.

Disadvantages:

- The external management option adds to the costs of operation beyond what would otherwise be the case if the management were assembled and run as a core part of the business.
- There are not many options for finding willing partners, and those partners that can be found are going to be small businesses. This arrangement will have the running risk that the management company will give priority to its needs over those of the contract services. There is also the risk that a small management company could decide to end the relationship, and it's not easy to replace such a relationship, particularly if the management team also brought key business services.
- The community will have less control over the fate of its enterprise under an external management option than if operated independently. If the community operates the business directly then it can implement changes to the business quickly. However, an external management firm might not react as quickly or in the same manner as desired by the community.

Equity Partner

Advantages

- Communities seeking equity partners for a public private partnership fiber optics project will have fewer choices for the structure of the business since the external partner will probably demand a for-profit business structure as a likely pre-condition for investment.
- The extent to which the private partner funds the business reduces the needed investment from the public partner.
- A private equity partner can bring cash to the business that might be hard to raise elsewhere.

Disadvantages

- Communities seeking equity money to create the business will find that it is generally the most expensive money. In the telecom industry the general rule of thumb is that an equity cash investor will expect at least 30% overall return. The comparative costs of other forms of financing were discussed earlier in the report.
- The high expected overall return expected for equity investment is difficult to achieve with dividend return so that leads to the likelihood the equity partner will want to include a future sale or structured buy-out as part of the structure of the original investment. This may be difficult to combine with the long-term purposes of a community-based fiber optics project.

- In general, the timeline on expected rate of return for private equity is shorter than the timeline on rate of return for a community-based fiber optics project. This difference may not be reconcilable.
- Overall, having a commercial equity partner is generally more expensive than borrowing the money and obviously much more than community-based equity contributions. To the extent that the partner wants normal equity returns, that is the most expensive part of the financing and costs more than all of the scenarios that have been modeled.
- One of the primary reasons why there are not a lot of public private partnerships is that it's often difficult to reconcile the differing goals of the two sides. The commercial partner is generally going to be very focused on the bottom line and returns while the community part of the business often has goals like community betterment and lower rates. It's often very difficult to put together a structure that can satisfy most of these needs. And even when PPPs were formed there are numerous examples of partnerships that broke up after a few years when the two sides were unable to reconcile their differing goals.

G. CHOOSING THE BEST OPTION

There is no one option that is automatically the best structure for the business plans described in this report. The best corporate structure is often going to be determined by how and who finances the business.

In this report we have discussed two business plans that might make financial sense. We will discuss the best structure for these two options separately.

Fiber Everywhere

The amount needed to finance this option is \$51.9 million.

The business plan needs a penetration rate of 46% of the residents in the cities and 62% of the rural residences for this plan to break even.

The only business structure that works for this plan would be the municipal structure. The needed penetration rates are so high that the business won't have a lot of profits generated. But the biggest issue of using any other structure is the financing terms. The municipal structure works because with bonds you could get a bond for a 25 or even 30 year term, and the business plan is so tight that it needs the lower payments that come with the longer term.

Any commercial loans would probably have loans that would be due somewhere between 15 and 20 years, and more likely closer to the 15. The business plan cannot be self-sustaining with a loan term that short.

Wireless in the Rural Areas Eventually Upgraded to Fiber

The amount needed to finance this option is \$15.5 million to \$16.0 million.

In the business plan option that adds telephone service the business plan needs a penetration rate of only 44% of full-time rural residences and 20% for part-time rural residences for this plan to break even. Considering that the rural areas have poor broadband, those penetration rates seem very reasonably achievable.

This could certainly work as a municipal entity using all bond money. But that would require the county to issue a bond for the needed funds less any small amount you might raise from grants. We got the impression that the county was not interested in taking out any sizable bond issues, so this is probably not a reasonable option. But it certainly can work.

One of the key goals of this business would be to take the profits from the business and use them over time to replace wireless with fiber. There are probably only two business structures that can meet that need—municipal or cooperative. Both of these entities could be structured in such a way that would require future managers to plow the profits back into the business. That would be much harder to do if this was established as a pure for-profit entity.

A public private partnership for this plan is possible, but the private entity is going to want to take profits and/or management fees each year, and in doing so would make it very difficult to save up the profits to build fiber. Our guess is that if this business had a private equity partner that it would remain as a wireless company forever and never be able to build fiber.

Since a cooperative structure will work to meet all of the goals, and assuming the county doesn't want to finance and own the business, then a cooperative is probably the best structure.

The Issues of Financing with a Cooperative

If this was to be done as a cooperative, the biggest hurdle is probably the first one of getting the company off the ground. That is probably going to require at least several hundred thousand dollars and possibly a little more. That early money would be used for such thing as:

- Creating the legal entity.
- Getting more detailed engineering.
- Canvassing all of the rural people to make sure that there will be enough customers of the business to make this work. Even if this done with volunteers it's going to need some money.
- Keeping the business plan up to date as assumptions change so that you have a plan that is ready for bankers.
- Legal advice.
- Strategic advice.

So assuming that some citizens would volunteer to tackle setting up a cooperative, somebody is going to have to step forward with the needed funds. Some of these sources might be:

- A grant. There is talk at the Blandin Foundation of creating this sort of grant. They are starting to recognize that there are a lot of costs needed to take the next steps after a feasibility study.
- The county. The county could contribute to this effort. The money you give to the entity could be a grant, or a loan, but one that you would be prepared to not get repaid for a long time even if the business launches, and never if they never get it up and running.
- Large businesses and other entities. Even with the wireless business plan we have assumed that fiber would be built to places like the business park south of Princeton. So there might be some larger entities in the county willing to kick-in to get something like this started.
- Potential cooperative members. As the new cooperative asks people to pledge if they would join they could ask for something like a \$50 or \$100 fee to ‘join’ the prospective coop. We’ve worked with a few new coops over the years who raised seed money in this manner. This money would go into each member’s capital account and eventually would be repaid to them as the business gets profitable. This kind of pledge drive doesn’t raise a very big percentage of the amount needed to fund the business, but if 2,000 households contributed \$100 then the first \$200,000 needed for early expenses would be in hand without external help.
- It might take some of all of these to make it work. In Sibley County the new cooperative got early funding from one of the agricultural cooperatives already in the county. But there may or may not be an entity in the area willing to fund this effort.

After raising enough money to get started, and after having taken the steps listed above, the cooperative would be ready to seek long-term financing. The primary issue with that is that the cooperative is going to need somewhere between 20% and 30% equity to be able to get the rest of the financing. So the financing structure is going to look something like the following:

- There are only a few sources of equity:
 - Any money raised in the step above would count as equity.
 - Grants count as equity and there might be a few state or federal grants that could be obtained.
 - New market tax credits can probably act as pseudo equity if the project would be eligible for them.
 - Economic Development Bond from the county. In order to have enough equity to raise the rest of the loans, the new coop is almost certainly going to need some money from the county. In Sibley and Renville counties the governments joined together to give a bond that equaled roughly 25% of the money needed to build the project. The full expectation is that the business would make the bond payments, but if the business defaults the government entities are on the hook for the bond payments. In this case, 25% of the project would be between \$3.5 million and \$4.0 million.

With the equity raised the business would be able to borrow the rest, with the following as the most likely sources:

- Local banks or a consortium of banks making loans that are backed-up by a federal loan guarantee. This could be from the RUS, the SBA, or other sources discussed earlier in the paper.
- Loans from other cooperatives.
- Loans from people and companies in the community.
- Again, it might take all of these together to make the project work.

H. EXAMPLE OF A POSITIVE SCENARIO.

We think it might be beneficial to talk about the long-term potential for the wireless business. The ideal business plan might go something like the following:

A cooperative is formed and finds a way to raise the money for the wireless buildout. The company is able to get more customers than is needed to breakeven and will generate excess cash over time.

Probably within five years after the business is launched it's likely that white space radios will become widely available. These radios probably offer twice the download speeds of the 3.65 GHz spectrum we are recommending. Not only that, but the white space radios will care less about foliage. So you will probably invest a few million dollars and overlay the white space radios over the top of your existing network.

The business doesn't begin accumulating significant cash until near the time that the original loans are paid off. After that the business can start building fiber to members. You could do this a little bit each year. As you built a pocket for wireless, it might make sense to think about expanding the wireless network further out to pick up even more rural customers in surrounding counties to help generate more cash.

Alternatively, you wait until you have enough cash to enable you to borrow the rest of the money needed to build fiber to your customers within the county. Since you will already have a revenue stream and already are generating excess cash, the new debt payment ought to be affordable. Again, you would then consider moving the wireless network further out to pick up additional customers and revenues.

This is not something that would happen quickly and it might be twenty years before everybody gets fiber. But as long as the company holds that vision and works for it you ought to be able to retain customers. Your wireless network will be the fastest alternative in the rural areas and so you should win the speed game until you have fiber.

IV. OTHER ISSUES

A. STAKEHOLDER ANALYSIS/PARTNERSHIP OPPORTUNITIES

If the all-fiber option looked feasible we would be discussing potential partnerships with parties like the cable companies or the Benton Cooperative Telephone Company. Such a partnership might have consisted of the county paying for the network but one of those entities (or somebody from outside the county) operating the business. This could have been structured either as operating partner or as a full equity partnership.

But the wireless option is more limiting. First, wireless is not a primary expertise of any of these companies and none of them may be interested in operating this business. Second, the number of employees needed to operate the business is small. We've estimated 8 employees and it might be possible to do it with 6 or 7 if you find the right people. With such a small staff it might be easier, and certainly would be more economically prudent, to hire the employees directly rather than pay another company a management fee to operate the business. But the biggest limiting factor on having a full public private partnership is the goal of keeping the cash inside the business. If you were to either hire a full operating partner or go even further and have an equity partner, then a lot of the cash that could be used to build fiber would instead go to your partner.

But that is not to say that there are not more limited types of partnerships possible. Following are the ones we can think of, and once the plan was known locally there might be other possibilities.

Tower Partner: There are companies who will build towers for you and then charge you a rental rate to use the tower. This can save up-front capital and loans. In the business plan we have up to 13 towers being constructed and it's likely that only a few of them would be of interest to these companies. They only build towers when they know there is interest from the cellular companies to use them. So these builders will only build towers that are profitable for them.

Of course, if they can make a profit on these towers, so could you. Assuming that you can find enough money to fund the business, then you would be better off financially to rent these towers directly to the cellular companies so that you get the profits. There are only four major cellular companies and it's not hard to find out if they are interested in leasing new towers.

So we would recommend that you only consider this option if it somehow makes it a lot easier to finance the business. A tower partner might save you half a million dollars, but that might turn out to be necessary to get the project started.

Pole Partner: The rural poles are mostly owned by the electric cooperatives. They warn that their poles are already full of existing wires and that it might be very expensive to use their poles.

There is a way to still use their poles, which is to construct your fiber in the electric space with the power lines. And the only way to do that is to somehow partner with the electric coops in some way. There might be things you can offer them that would make this attractive to them such as:

- You would always hire their technicians to hang fiber drops or to make any connections to the fibers. This would be a new revenue stream for them.

- You might offer them free use of some of the fiber pairs.

If you can't make an arrangement with them then it's likely that the fiber is going to cost more than what is in the business plan. We have \$3.7 million of fiber in this business plan and it would cost more to build the fiber if a lot of the poles require rework. Alternately, you could bury the fiber which costs an additional \$1 million. This is one of the things that would have to be determined with more engineering. You will need to select the best location for the towers, and from there determine the best roads to use for the fiber network, and finally look at those poles to see how bad the pole issue might be.

Fiber Partner: Any time you build fiber it's worth seeing if that fiber would benefit anybody else. For instance, one of the cable companies, the electric cooperatives, or some other large entity like the school systems or the hospitals might find it useful to share the cost of building fiber with you for at least some of the routes you might build. In such a case the two parties would work out an arrangement where each pays for a part of the construction and where one party takes over the maintenance of the fibers for a fee.

Again, until the actual routes you are going to use are determined we can't get specific with potential partners. But once that is known it wouldn't be hard to talk to all of the potential partners to see if there is any interest in fiber sharing.

The Mille Lacs Band of Ojibwe could be a partner in several ways:

- They have a desire to see all of their members get broadband, many of whom live in places without broadband. It's possible that the Tribe might consider ideas like contributing equity or paying connection fees on behalf of their members. The Tribe might even be a possible source of some of the upfront seed funding to get going. This project brings a lot of benefits to tribal members.
- The Tribe has access to some types of financing that the cooperative could not get. It might be possible for the Tribe to help get a loan for the cooperative that otherwise you might not qualify for. For example, some of the loan guarantees discussed in this paper would be easier to do with help from the Tribe rather than directly as a cooperative.
- They own some fiber today and it might be possible to use some of that fiber for part of the needed fiber route. There are many ways to structure this sort of sharing that would be in the benefit of both parties.

The Cable Companies or Telcos: It would still be possible to partner with either the cable companies or the Benton Cooperative in some manner. With this business plan it doesn't make sense to consider them as full operating partners or equity partners such as might have made sense if you built fiber everywhere.

But it might make sense to partner with them for things like telephone service. For instance, you could buy local voice from them to power your telephone product rather than trying to buy it from a national provider. You also might partner with them to act as your ISP backoffice and to actually operate that part of the business for a fee. That might be cheaper for you than having a full-time technician to do the function and a revenue source for them. We have clients who partner

operationally with their neighbors in all sorts of creative ways and that possibility exists in this business plan.

B. LEGAL AND REGULATORY ISSUES

This report discusses legal, regulatory, and policy issues that could affect a decision to provide information and telecommunications services including voice, video, and data/Internet on a new network in Mille Lacs County or in parts of Mille Lacs County. The county has expressed interest in the provision of a fiber optic network and that will be the form of network referred to in this discussion.

The legal and regulatory provisions that need to be taken into account and that could apply may in some instances arise under the power of local public bodies and in some circumstances the relevant legal and regulatory provisions may arise under state and/or federal power. It can also be the case that relevant legal and regulatory provisions arise at all three levels—local, state, and federal authority. For example, authority over provision of cable based video services is an instance where legal and regulatory provisions do arise at all three levels of authority—local, state, and federal authority.

Applicability of legal and regulatory provisions may vary depending on a number of factors. The following factors are among the most important.

- Existence of authority for telecommunications projects.
- The technology that is used.
- The form of the owning entity.
- Status of network as a competitive services provider.
- The services available on the network.
- The role of local public bodies—if any—in the project.

Discussion of Key Regulatory and Legal Issues

1. Private, public, cooperative, and nonprofit ownership are all approved forms of ownership of a fiber optic network providing telecommunications and data/Internet services under Minnesota law.

In general, private ownership which includes cooperative ownership and nonprofit ownership do not now, nor have they in the past, faced legal obstacles to entering the information and telecommunications business. However, the legal right of public municipalities to own and operate public telecommunications and information systems as a public utility was not legislatively or judicially established in Minnesota until 2009 even though notable examples of public telecommunications systems such as WindomNet Telecommunications were operating.

In 2009 the legal right of public municipalities to own and fund a telecommunications utility was clearly established by the Minnesota Appeals Court in Bridgewater Telephone Company, Inc. vs. City of Monticello. The Minnesota Appeals Court held and the Minnesota Supreme

Court upheld that under Minn. Stat. §475.52, subd.1., any statutory city may raise and spend money for any utility or other public convenience and that a fiber optics network is within the law as a public convenience. Therefore it is now clear that public ownership of a fiber optic network is an approved form of ownership for any municipal project along with private, cooperative, or nonprofit forms.

It is important to note that there is a divided opinion whether the finding in Bridgewater Telephone Company, Inc. vs. City of Monticello (2009) applies to the authority of counties to raise and spend money for a fiber optics network project. Under some statutory provisions in Minnesota, counties are explicitly treated to the same regulation or requirement as municipalities which would argue that the finding in Bridgewater should apply to counties as well as municipalities. However, this question has not been presented to a court. Because it has not been tested, this argues for the possibility that if a conflict were presented to the court the result could find that counties do not have the requisite authority. It should be noted that in practice, Lake County in northern Minnesota has in the last three years established a fiber optic network project which began offering services in 2014 with no legal challenge to its authority to do so. A number of counties in other locations in Minnesota are also exploring the launch of a county fiber optic network for telecommunications services. That reinforces the presumption that county ownership of a fiber optic network telecommunications project would be found to be valid if it were to be contested in the future.

2. Minnesota Statute Chapter 238.08 applies to the granting of franchises by local authorities to a new service provider for the provision of video services in a municipality. Any provider offering video service in a municipal area (and adjacent service areas) will need to obtain a franchise from local authority to use the streets and rights of way to construct its network and deliver its service. Minnesota Statute Chapter 238 identifies a process that is consistent with federal law regarding franchise grants. A new franchise would be required and a provider whose application conforms to statute requirements will be granted a franchise.

Video service is among the services that could be delivered over the fiber optics network. These services are subject to some regulation at federal, state, and local levels.

The most important initial requirement is that the new entity owning a fiber optics network will need to obtain a franchise from the local authority wherever it delivers service within a municipality, county, or township. Federal law requires that local authorities grant competitive franchises to qualified applicants (47 C. F. R. β 76.41).

Federal statute prohibits states from passing state legislation that contradicts federal regulations or guidelines for video service. However, states may establish specific regulations for the process by which franchises for video service are granted. Minnesota has chosen to establish such regulations. Minnesota Statute 238.08 lays down the requirements for obtaining a franchise including that any video system providing service within the municipality (or other local authority) must obtain a franchise.

A key provision of Minnesota's state video franchising law is section 238.08 (b) identified as the "level playing field" requirement. It requires that "no municipality shall grant an additional

franchise for cable service for an area included in an existing franchise on terms and conditions more favorable or less burdensome than those in the existing franchise pertaining to: (1) the area served; (2) public, educational, or governmental access requirements; or (3) franchise fees. Nothing in this paragraph prevents a municipality from imposing additional terms and conditions on any additional franchises.” The application of this provision means that the new fiber optics network will assume essentially similar obligations as found in the franchise that will be in place at the time the new applicant will apply for a franchise.

Federal law has imposed a specific limitation on the amount a franchise authority can require for payment of franchise fees under 47 U. S. Code §542. The obligation of the new applicant for payment of franchise fees will be limited by federal law to no more than five percent of the gross revenues on an annual basis.

Minnesota Statute 238.08 provides a carefully sequenced franchise application process and specifies the content of the application materials. If a newly established entity which owns and operates a fiber optic network satisfies the state franchising process and content requirements in pursuit of a franchise then that new entity must be granted a franchise.

In addition, Minnesota Statute Section 238.08 explicitly authorizes municipal ownership and operation of a video system and numerous municipalities operate such systems. A county fiber optic network owned by the county which offered video services would apply to the municipalities within which it planned to offer services and to the other local authorities within which service would be proposed. The possible role of the county to act as the franchising authority for townships within the service territory proposed by the new entity could be explored.

It is also important that county authorities be informed that the operation of a video system involves a significant commitment to continuous regulatory management of video content service agreement contracts with video content providers. Smaller size entities typically contract for these ongoing services.

3. Minnesota Statute Chapter 237.16 outlines the obligations of a telephone service provider that would be consistent with state and federal requirements. A new provider of voice services will need to apply to the Minnesota Department of Commerce and be approved by the Public Utilities Commission which will issue a notice of certification to provide service. A new provider whose application as a competitive local exchange carrier conforms to regulatory and statutory requirements will be approved.

Among the three services a new fiber optic network might provide, telephone service has had a long history of both state and federal regulation and remains today the most regulated among the three main services of voice, video, and broadband (Internet) services. Two state agencies in Minnesota regulate voice service providers. The Minnesota Department of Commerce (DOC) reviews the application of a new applicant provider, investigates the company, and makes a recommendation to the Public Utilities Commission (PUC). The PUC evaluates the application, considers recommendations, and decides whether to grant or deny authority. Once

a new company is in business, the DOC monitors the company's services and enforces the rules of operation, as defined by PUC Rules and Minnesota Statute 237.

Obtaining authority to engage in telephone service is the initial critical step. All telecommunications carriers, telephone companies, and service resellers must file an application with the Public Utilities Commission for a "certificate of authority" to do business in Minnesota. The new applicant wishing to offer telephone service over its fiber optic network would submit its application to become a competitive local exchange carrier (CLEC). The PUC is required to respond to a bona fide application within 120 days though in actuality it may be less. Initial applications must be accompanied by a \$570 filing fee. All regulated telecommunications service providers pay an annual assessment based on gross state revenues once in business. No services may be provided until a proper certification has been issued.

The major legal consequence arising from offering telephone service is that at the outset there is a considerable need for attention to regulatory requirements which will become less frequent once service is established but which will always need to be tended. Rules and requirements at the state level that will apply to the telephone service side of the new business include tariff filings, agreements with other carriers for interconnections, customer service requirements, and other matters relating to both intrastate and interstate services. There will also be some rules and requirements at the federal level reflecting federal law such as access to numbering blocks, privacy of customer information, and other matters.

4. Minnesota Statute Chapter 237.19 imposes special requirements about offering voice services when a municipal owner is the new provider. The face of the statute calls for a public referendum within the municipality with a 65% approval level when a community proposes to construct or buy a telephone exchange when an exchange already exists in that community. The applicability of Chapter 237.19 to a fiber optics based voice service is untested.

The applicability of Chapter 237.19 to any fiber optics based voice service project is untested. It is arguable that under conditions of new fiber optics based technology for voice service Chapter 237.19 is not relevant. New forms of technology enable telephone service that is arguably different from that referenced in the statute.

Second, Chapter 237.19 in any case is relevant if a new fiber optic system is owned by municipal owner but its relevance is doubtful if a new fiber optic network project owned by a county, or by Mille Lacs County, specifically offered voice services. Third, if Mille Lacs County should pursue a project that included voice service it is likely that the specific contour of the service area and the owning entity would need to be taken into account in assessing whether this statute would be of further concern.

5. The Minnesota Court of Appeals case Bridgewater Telephone Company Inc. vs. City of Monticello provided the finding that all forms of entity such as private, cooperative, nonprofit, and public providers have the same rights to provide data/Internet services.

Data/Internet services have historically been an unregulated area of service with open entry. As the demand for Internet services increased over time, a number of Minnesota cities or city

owned public utilities began to offer Internet service when private providers were not offering any or inadequate service.

However, a Minnesota court case attempted to limit the right of one type of public entity—namely municipalities—to offer Internet services as part of funding and building a fiber optic network. This issue arose in the *Bridgewater Telephone Company, Inc. vs. City of Monticello* case (2009) in which Bridgewater argued that Internet services were not a proper public purpose within the meaning of the statute authorizing public utilities for serving the convenience of the public. Since broadband data/Internet service is now a key service running over a fiber optics network the loss of that right would have definitively blocked the path for local communities who wanted to provide a fiber optic network for their residents.

The Minnesota Appeals Court held that under Minn. Stat. §475.52, the statutory authority was clear that the definition of a public convenience included broadband Internet services among other services.

6. Relevant Mille Lacs City Ordinances have been reviewed and do not appear to present any unexpected requirements relating to the infrastructure work to construct a new fiber optic network in the intended service area. Network construction would expect to conform to ordinances in respect to rights of way and other construction needs typical of network infrastructure.

Two areas which sometimes present legal issues arising from construction activities include (a) rights of way access and conformity and (2) pole access and fees. These issues should be revisited when the specific contours of a possible project become known.

C. OPERATIONAL WORK PLAN/TIMELINE

Perhaps the best way to discuss the timeline and operational plan is to walk through the major steps needed to launch the business plan that we are recommending—a wireless company that eventually builds fiber. So following is one way that such a business might work; there are obviously many other variations that could also be considered, but a lot of these steps are basic:

Getting Started

As discussed earlier in the report, the first big hurdle to cross is to go from this report to the point of launching the effort to form a cooperative and get funded. That might include the following types of tasks:

- **Public Meetings:** The county holds a number of public meetings discussing this report to see if there is any public interest in the solution proposed. Specifically, the call would go out for people interested in working to get the coop started.
- **Public Education:** In addition to public meetings you probably want to start a broadband website and take other steps to get the word out that there is a potential broadband solution if there is public interest.

- **Form a formal group:** Somehow the volunteers need to be brought forward into some sort of formal group that could accept funding to get the process started. Perhaps they could be formed as an official committee of the county or some other structure that would allow them to accept and use funding.
- **Funding for Next Steps:** The county probably will need to take the lead to get the early funding for the ongoing effort. This could be a combination of external grants from somebody like Blandin or from direct grants from the county. At some point the coop will want to seek the other kinds of early funding discussed elsewhere in this report, such as getting a small contribution from each interested household.
- **Canvass Potential Customers:** It's vital to find out early if there is enough interest in this to make it work. The business plan shows that as long as you offer telephone service along with data that you only need a 44% penetration rate from full-time residences and only 20% from seasonal residences. While those penetration rates seem achievable in an area without broadband today, you need to take steps to make sure that you have at least that much support. This can be done in many ways, but all of them involve somehow asking people to formally declare that they would buy from the cooperative if it brings them broadband. Getting to everybody in the rural areas is time consuming and this is going to require some significant volunteer time. But you probably should not create the cooperative unless you know the support is there for it.
- **Determine Entity Structure:** We've recommended a cooperative, but you need to determine if that is the right structure for all involved.
- **Create the Business:** Get business license, tax IDs, etc. If a cooperative form is chosen there are specific requirements to be followed.

Seeking Funding

The next steps once the coop has been formed is to take all of the steps needed to get full funding:

- **More Detailed Engineering:** Our feasibility report is done at a high level. You would want, at a minimum, to get a wireless engineering company to come and determine the best locations and specific quantity for the needed towers. They can also find out if any of the existing towers in the county could be used. We try to be conservative in our business plans and hopefully this will work with a few less towers than we have estimated. Of particular concern in your business plan is understanding the pole issue better since the Electric Cooperatives say the poles are largely already full of other wires.
- **Update the Business Plan:** As you get better engineering and get a better idea of how many customers the business might have, you need to update the business plan to make it ready to seek financing.

- **More Community Education:** The coop board will want to meet with people at every opportunity to keep the word on the street that this is underway and to build a level of excitement. That means having volunteers to make presentations at every kind of public group and forum that will let you speak.
- **Figure out the Sources of Funding:** The group will want to get more specific with establishing the financing. Probably the best way to do this would be to hire a financial advisor to help you start pinning down the financing. Your biggest challenge is that most of the sources of funding will have to be timed and scheduled to happen at the same time. It is likely that each of them will be contingent on you getting full financing in place which means most of them have to close within a day or so of each other. You will then be going after each source of financing that might include:
 - Applying for Grants.
 - County Economic Development Bond.
 - Membership Capital Drive (\$50–100 per member).
 - Local Equity Drive.
 - Local Loan drive.
 - Find interested local bank to act as the loan coordinator.
 - Get one or more federal loan guarantees to lower the interest rates.
 - Look into Investment Tax Credits.
 - See if there is any way for the Tribe to help with financing.
 - See if there are loans available from other cooperatives.
 - Other creative financing ideas.

Operational Readiness

Once it starts looking like the business can be financed you will want to get ready to operate the business. Our recommendation is that a cooperative should hire a staff and operate this directly in order to maximize control and profits.

- **Hire a General Manager.** Ideally this could be done as much as six months ahead of funding, or as soon as you know for sure that you will be funded. If the GM is on board early they can do a lot of the work needed to get the business started, which means the business gets built faster once the funding is in place.
- **Establish a Bank Account.**
- **Establish a set of books and begin the accounting process.**
- **Develop and implement a marketing plan.** Make a list of customers who want your service.
- **Determine benefits, policies, etc.** You will need to determine how you will operate the business for things like benefits, sick leave, and all of those other things you have to put in place when you have a staff. Coops benefit from having employees stay a long time, so you will want benefits and policies that are attractive for your area.

- Interview other employees. You will have hopefully identified at least a few key employees before funding so that they can be hired soon thereafter.
- Determine final products and pricing. We've recommended a very simple product line, but that needs to be finalized.
- Regulatory readiness: You need to be prepared to get any regulatory approvals you might need.
- Contractual readiness: At a minimum you are going to need pole attachment agreements with the Electric Cooperatives and any other pole owner along the fiber routes. But there might be other kinds of permits needed such as building permits to construct towers and that sort of thing. While you may not file such permits until after you are funded, you will want to make sure ahead of time that you have everything needed to make the filings when they are needed.
- Choose a construction company(ies). You will want to have chosen the company that is going to build the towers and the ones that are going to build the fiber. These may require two vendors since those are generally very different expertise in the industry. You will want to negotiate a contract with these companies with the help of your engineer.
- Choose a wireless electronics vendor. There are several brands of wireless equipment and you will want to pick a vendor.
- Find tower sites. Even if you don't have the cash to buy them, you will want to have found and negotiated for the tower sites so that they can be purchased after financing.
- Find office space. You are going to want a small store front and office space.

Post Financing

The real work starts when the funding is available. You will want to have done as many of the above tasks as possible before that (and within the constraints of your budget). This will greatly speed up launching the business. But here is what happens with financing:

- Close all the Financing. If you think there is a lot of paperwork with a home mortgage you will be in for a surprise when you see the mountain of paperwork needed to close the various types of financing. But you will have a financial advisor and attorneys to help make this happen.
- Create a working budget for all expenditures.
- If forming a cooperative, determine cooperative rules for Board membership, elections, distribution of patronage dividends, etc.

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- Hire the employees. Not everybody starts immediately, but you will hire people throughout the first year.
- Street specific engineering if needed. You may need a little bit more detailed engineering to get very specific about the fiber and tower construction.
- Order needed materials for construction. As soon as the engineering is complete you will place orders for all of the materials needed to construct the network. That would be all of the things needed for the fiber routes, the towers, and the electronics huts that go with them.
- Buy the tower sites and begin constructing towers.
- Construct the fiber backbone to connect the towers.
- Build and install huts at towers.
- Install dishes on towers.
- Order customer radios.
- Develop Customer Policies. What the policies are for things like late payments, partial payments, credit card payments, credit checks and deposits, etc.
- Enable software needed to take orders, create billing.
- Develop processes for monitoring the network and dealing with outages.
- Track expenses and reporting needed for various lenders.
- More specific marketing and begin taking customer orders.
- Establish a help desk to take customer technical questions.
- Create the ISP functionality. Be prepared to block SPAM, fix viruses, connect to the Internet, and similar functions.
- Connect to the Internet Backbone.
- Develop sales commission structure.
- Start selling to larger customers who will be directly on the fiber network.
- Determine the customer installation process.

Operations

- Test the network and all of the operating systems. Set up a few test customers to make sure everything works.
- Take customer orders.
- Connect the first live customer.
- Generate first set of bills.
- Sell, sell, sell.
- Never look back.

Time Line

We am always asked how long it will take to go from a feasibility report like this to having better broadband. Our response is that it is impossible to know because there are three major stages in the process, and the first few steps can go quickly or take a long time, as follows:

Decision to Move Forward: The first thing that has to happen in a community is that a decision has to be made somehow that the community ought to tackle finding a broadband solution. No two communities that have formed a community broadband solution have gone about this in the same way. Here are a few of the different ways this can happen:

- Process Driven by Elected Officials: There are examples of community broadband networks where the driving force behind it came from elected officials. For example, in Lafayette, Louisiana, the Mayor was the early driving force. He got help from the municipal utility, but he had bipartisan support from other local officials to pursue a fiber network.
- Process Driven by Staff: Sometimes this process is driven by government staff workers. For example, in Anoka County and Cook County this was largely done by county staff who were given the time and budget to find a broadband solution.
- Process Driven by a Broadband Committee: We've seen officially designated broadband committees drive the broadband solution. For instance, this was the case in Monticello, MN. The committee had been formed as a sub-committee that reported to the City Council. It was made up mostly of volunteer citizens who were given a budget but who did most of the work to move things along.
- Driven by an Individual or Group of Individuals: We've seen fiber projects driven by a single person or small group of people who keep pushing everybody else along. We've always called these champions, and they think broadband is so vital for their community that they are willing to devote a lot of effort to educate and move people forward. This is how the project in Sibley and Renville counties, MN, got started.

This process can go quickly, particularly in smaller communities where the general public agrees there is a need for a broadband solution. But this is also a place where many projects die. It requires

a lot of effort at this early stage and generally what is needed is to educate and stir up the general public for the need for broadband. Then the elected officials, utility staff, or government staff needed to make it happen must also be convinced and come on board into the process. You are not going to get community buy-in from having a few public meetings. It generally requires some volunteers who are willing to devote the time needed to get the word out that there is a solution for the broadband problems of the community.

We would say on average that this process usually lasts at least a year, but could be longer. However, some communities know they want this even before we do the feasibility study.

Raising the Money: We listed many of the next steps above that must be done once you decide to move forward. This includes things like getting direct proof of community buy-in through some sort of sign-up campaign, doing enough engineering to pin down the amount needed to borrow, and then doing all of the hard work needed to raise the money. This phase of the process requires real funding, generally at least several hundred thousand dollars, and sometimes more. And it generally takes a lot of volunteers to help hold down costs.

We've seen this done as quickly as six months, when city officials and utility staff were behind the process. But we've also seen this take a long time. Again, talking about Sibley County, it took four years from the time that there was consensus to go until they finally got funding. There are some communities such as Annandale, MN that are still seeking funding after many years of trying.

Building the Network and the Business: Building the network is much easier to put onto a timeline. If you choose to build fiber everywhere that probably would take two years to construct and would probably have the first customer on the fiber about 18 months after you got the money.

If you go for the wireless option, all of the construction can be done in one year, and the first customer can probably be brought on board somewhere between 9 and 12 months after funding.

Every construction process and the process of launching a new business will develop what is called a critical path. These are tasks which will delay the whole project if they are not done on time. The critical path items will vary by project and sometimes they are construction related, sometimes they rely on other assets, such as building a headend building, and sometimes they are related to things you might not expect. For example, in Lafayette, Louisiana, the biggest critical path item turned out to be getting all of the cable TV channels from the programmers.

But assuming that nothing unexpected arises, then this ought to easily all be done inside of a year. You probably would not have all of the customers connected until sometime into the second year.

D. NEXT STEPS

There is a summary of the most important next steps near the beginning of this report. Following we are going to talk about a few of them in more detail, mostly those that haven't already been discussed elsewhere in the report.

Getting Comfortable with Customer Demand

The financial models were used to calculate the minimum number of customers you need to make the various options work. It's vital that you know that customers are interested before you spend much money on a broadband effort. All bankers are going to be keenly interested in the results of this effort. It is unlikely that you are going to be able to get the business financed without concrete proof that you will get customers. There are several ways that communities have gone about this process:

- Pre-Sign-up List: A number of communities have asked residents to sign up on a formal list saying that they will take service when the network is completed. For example, the City of Bristol, Virginia had customers sign-up for service starting about a year before the launch. During that period the fiber network was always in the local news, perhaps due to the efforts by the incumbents to stop the project. In any event, the constant publicity resulted in Bristol having nearly 40% of the potential customers in town on their pre-sign-up list. This list did not in any way obligate customers to buy service when it was available. However, Bristol found that all but a handful of customers did take service once it was available. The one issue with using a pre-sign-up list is that it may create customer expectations that they are soon going to get service. This means that you must be very careful to explain how the sign-up list will be used and must stay in contact with prospective customers to keep them informed and happy.
- Customer Canvass: A canvass is an effort to talk to every potential customer. It would mean contacting them in whatever manner is needed to ask them if they will pledge to the project. This is the process that was used in Sibley County. They first contacted people with a mailer and asked them to sign a pledge card. They also had an on-line place for customers to commit to the project. Finally, as financing drew nearer, volunteers went out and knocked on the doors of everybody who had not sent in a signed pledge card. This process in Sibley got well over 50% of the customers pledging to the project, and Sibley made a return guarantee that the people on the list would be the first customers installed in any neighborhood and that people who didn't pledge would have to wait.

These pledge drives are generally limited to residential customers. We know from experience that businesses will buy from you if you can demonstrate a reliable and safe network. Most businesses are not willing to pledge early and most businesses value a safe network more than they do price.

Paying for the Next Phase: We've said it a few times in this report but we can't repeat it often enough. It is going to cost up-front money if you want to move from this report towards a broadband solution. It's not unusual for the next phase of work to cost at least \$200,000, even if a lot of the next steps are done with volunteers.

This can get to be somewhat tricky depending on the nature of who takes the next steps. If government staff takes the next steps then funding them can be done in the same way you funded this study. But governments sometimes have a harder time providing funds for volunteer committees or even for more formal situations like having somebody actually form a

cooperative. The county doesn't have to fund the next steps, but it will be a lot easier and a broadband solution will come a lot sooner if you do.