

Sharon Township Options for a Broadband Network

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I. Scope of Work

This report is the result of an informal RFP issued by Sharon Township looking for a consultant to help them look at broadband issues. That RFP asked for the following deliverable products:

- **Design narrative.** Discussion regarding the recommended approach to be used for access to rights of way, pole structure, outside plant fiber layout, impact of active versus passive networks, central hub equipment location, and other pertinent decision points.
- **Detailed project costs.** Analysis of all costs for design, implementation, and maintenance of fiber optic cable infrastructure build from a head end to each improved property in Sharon Township.
- **Route map.** A summary map depicting proposed routes and fiber sizes. (This was delivered separately from this report).
- **Bandwidth analysis.** Investigate local bandwidth providers and obtain quotes for appropriate levels of service.
- **Assumptions.** Enumerate assumptions and known unknowns including justifications for assumptions.
- **Financial model.** A model that takes into account project costs and projected take rates to determine overall project feasibility.

This report represents the results of the study done by CCG Consulting to meet the stated goals. This report contains the following:

- A description of the engineering analysis done and the results obtained. CCG considered several different design options to try to find the most affordable network alternative for the design.
- A description of the financial analysis done in looking for the most affordable way to pay for a fiber network. CCG considered numerous options including:
 - Different network designs.
 - Different business plans, notably open access (meaning partnering with one or more commercial ISPs) versus doing this through a cooperative effort with other townships. We also looked at the option of the township forming a small ISP.
 - The effect of key variables like the number of customers (penetration rate), interest rates, and the term of the bond.
- A look at a few key industry issues that are most relevant to this effort. This includes:
 - Issues associated with having an open access network.
 - Various threats or external issues to consider.
- An analysis of the study results. We looked to see what options make the most sense for the citizens in the township. We highlight the findings that we think are the most important results of our analysis.
- Specific recommendations and next steps. The report makes specific recommendations of what should come next after this analysis.

II. Executive Summary

Sharon Township hired CCG Consulting to look at options for funding and bringing broadband to the township. While we've done hundreds of similar studies over the years this is one of the smallest communities we've ever studied. We knew it was going to take some creative solutions to make this work.

Before hiring us the township had already come to understand that it was going to require some increases in property taxes in the township to make this possibility financially feasible. Thus, one option we studied was to finance a bond with property tax increases and then to allow one or more ISPs inexpensive access to your network. Such a plan can finance fiber. And one would expect ISPs to offer low broadband rates if they don't have to pay for a network. However, we spotted a few downsides to this concept. First, the ISPs are likely to make considerable profits working on your network for free – and yet none of those profits would flow back to help defray the costs of the bonds. Second, the ISPs are going to serve households that buy products from them, but ideally since everybody in the township is paying for the network then every household ought to get connected and get some benefit from it.

One thing the analysis gave us is a set of numbers to understand the cost of the network. In the open access scenario just mentioned you would need a bond issue of \$4.6 million, which would mean an average property tax increase of \$43.26 per month for twenty years. That number could be lower if you could get an interest rate on the bonds lower than the 5% assumed in the analysis.

We also looked to see if there were other ideas that might work. One idea was to look at a more traditional open access network where the township charged some fee to ISPs to get access to customers. Those revenues could be used to lower the property tax payments. There are a few problems with this idea. First, the ISPs are likely to pass all fees charged to them on to customers, making broadband more expensive. We know from experience that as broadband costs rise that ISPs engage more in what we call cherry picking – meaning they tend to only pursue customers with the largest profit margins. We would expect that if you charge more to the ISPs that fewer homes would buy broadband. We've seen that open access networks that charge \$30, for example, don't seem to get more than 50% of the customers on the network. From a financial perspective this looks to be the worst option.

We then went in another direction and asked if there was a way for the township to start their own ISP. Frankly, we expected this to look terrible, and were surprised when it didn't. The township is small with only 700 homes, but an ISP using a fiber network would not require a huge amount of effort. It's possible today to outsource the most technical aspects of being an ISP, making it possible to take care of a network and customers with only two part-time local employees. We looked at several options for this scenario. The good news of this option is that you could charge a low broadband fee of \$35 and still make a profit as an ISP. Those profits could then be used to offset some of the annual bond costs, or to pay the bonds off early. This scenario has the added advantage in that you could give free broadband to every home at some minimal speed to allow them to save money on cellphone data or to use modern services like the Amazon Echo or smart home technologies.

Finally, we look at a scenario where the township partnered with other townships to create a larger ISP. If you only partnered with a few townships then the results are similar to having your own standalone ISP. But there are economies of scale if you can gather a larger number of townships into a partnership. For example, if you could put together a consortium with nine times the homes in Sharon, then an ISP selling at the same \$35 rate would generate enough cash to cover about one-fourth of the bond issue.

While the financial numbers are important, there are other issues to consider. The report looks at a variety of other issues that you should take into consideration before choosing the option that best suits the township. This would require feedback from homeowners, feedback from other townships about the potential for partnering, and some legal analysis looking at the best corporate structure and asking if a cooperative is the best structure for a joint government enterprise.

Below I have also made specific recommendations for the logical next steps that ought to be taken after you digest this report.

If I was asked to rank the alternatives from a financial perspective, the option I most favor is partnering with multiple townships to create a large ISP. This would provide a big enough company to attract and keep the needed technical talent and it would allow you to meet social goals like providing some level of broadband to every home, even those not willing or able to pay for faster broadband. This option can also provide significant cash to help offset bond costs.

My next choice would be to operate your own small ISP. This might seem intimidating, but it would be a tiny business with only a few part-time employees. It would allow you to retain the profits from the ISP business to defray the cost of the bonds. And you would be able to dictate that there be quality customer service.

My last choice is the one that we started with, which is to pay for the network entirely out of property taxes and to allow commercial ISPs to operate on the network (open access). This option is the most expensive for homeowners overall since the profits of the business all goes to ISPs and not back to the network.

But before you choose any option you will need to do more research into legal restrictions of operating in the various scenarios. But I think there is a wide enough number of viable options that I feel certain there is one that will work for the Township.

III. Next Steps

Here I address the steps that I think come next after the township digests this report.

Some Legal Research Needed.

The financial analysis shows that there are several options that can work – and for two of those options you need to make certain that you can meet all of the legal requirements.

One of the ideas that looks financially feasible is for the Township to become your own ISP. Michigan has legal roadblock against municipal broadband as follows:

Michigan permits public entities to provide telecommunications services only if they have first requested bids for the services at issue, have received less than three qualified bids from private entities to provide such services, and have subjected themselves to the same terms and conditions as those specified in their request for proposals. (Mich. Comp. Laws Ann. § 484.2252)

I recommend that you get legal advice from a regulatory lawyer to fully understand what this means. On the surface this doesn't look like a terrible hurdle to overcome since it seems likely that nobody would respond to an RFP to bring broadband to the township. But you should find out if any other communities have tried this before and if they encountered issues or were unable to overcome this barrier for some reason.

The other viable idea is to band together with other townships to form a larger ISP. That primary benefit of that option is that the ISP can make profits that could be returned to the township to offset bond costs. And so you want a legal structure for such a jointly owned ISP that is able to return profits to you as earned. There are probably a number of ways this could be done but the two primary ideas that come to mind are to join with the other townships as part of an Authority. In that case you would face the same legal roadblock discussed above.

The other way to structure a jointly-owned ISP is through the Cooperative that already has been formed for this basis. But there are a number of issues that must be understood before you adopt the cooperative model:

- First, cooperatives are generally owned by the customers that buy services from the coop. If that means that the end-user customers own the coop then this would not meet your financial goals. That would mean that profits of the coop would accrue to customers and could not be returned to the townships to help pay for the bonds. The ideal structure would be a coop with the members being each township. I don't know if such a thing is possible, and if not, then the cooperative model is not the right structure for this venture.
- Even if the townships can own the cooperative, would cooperative law in Michigan allow the coop to pay out most of its profits each year back to the owners? I know that in some states there are limits on how much earned profits can be paid out each year. If it turns out that cash would accumulate in the coop and would not be available to the townships, then that also means that a cooperative is probably not the right business structure.

If there are problems with doing this as either a coop or as a government entity through an Authority, then you will have to explore other alternatives. But many of them will also face restrictions. For example, this could be structured as an LLC or other kind of corporation, but many states have restrictions against government entities owning corporations.

It might also be possible to structure this as a non-profit corporation. But the major issue with that structure is that profits are supposed to be used for social good and you might not be able to use any profits to repay debt.

There are more esoteric structures that have been used in other communities. For example, there is a group of communities in Minnesota that created a cooperative called RS Fiber. That cooperative is owned by the end-user customers. The government entities supplied the funding for part of the cost of the network through economic development bonds that are backed by property taxes. Those bond proceeds were 'loaned' to the cooperative and the cooperative is expected to make the payments on the bonds. The bonds provided enough cash to allow the cooperative to borrow the rest of the funding from traditional banking sources. However, that structure does not look easily feasible here. You really couldn't launch this until all of the member townships were ready to fund the cooperative. But the bigger issue is that it doesn't look like a cooperative in the townships can make enough money to fully cover the cost of debt – and that means they would be unable to borrow the money needed to finish the network from banks.

I see this structure issue to be the first thing that needs to be resolved. There doesn't appear to be any automatically easy business structure that works. But research might show one or more of these alternatives to be viable.

Bond Research.

With this study in hand you should now be able to have a conversation with bond sellers about the term (number of years) and the interest rates you might be able to get from the bond assumed in here. To the extent that result is different than the assumptions I've made I would be glad to provide a new set of numbers that incorporates the best estimates. My hope is that you can get a lower interest rate than I've assumed at 5%.

Socialize This with Other Townships.

Since one of the best financial options is to create an ISP between multiple townships, the process of spreading that word and looking for other interested townships needs to be undertaken.

I have always found that having these discussions is far easier when there is a concrete proposal to suggest. I know there has been a lot of discussion with other townships generically on the issue. But I think you can use this study to demonstrate that working together is a superior solution for your homeowners than building an open access network.

And obviously, if not enough other townships are interested, or if there are a few but they are geographically scattered, then this idea can't work.

Get Feedback from Citizens.

This study allows you to talk concrete numbers with homeowners. You now have an estimate of the size of the bond and how much that will cost homeowners each month in terms of bond payments.

Investigate what it Means to be An ISP

You are probably intimidated by the concept of operating your own ISP. This is something that CCG has done many time and we would be glad to help you understand your options.

Choose the Best Option.

After all the above research and feedback you can start to choose one of these options as the one you want to pursue. Again, remember that you want to consider both financial and social issues. For example, the idea of giving everybody free broadband if you do this with your own ISP is an idea that might gather a lot of public support.

Pledge Drive.

At any point where you want to get serious about pursuing a specific option you need to undertake a pledge drive. This would involve getting every homeowner in the township to tell you if they would be willing to pledge to buy broadband on the network. That pledge is needed so that you can understand the expected financial performance of the business. You would want to undertake this pledge drive even if the City is going to be the ISP. It's vital to understand the revenue stream that will be generated by the business.

IV. Engineering Analysis

In this section we will look at the engineering analysis performed as part of this study. The purpose of our engineering estimate was to determine the best network configuration to bring fiber to everybody in the township. We also explored network design options that resulted in the most affordable network. Derrel Duplechin of CCG made a trip to the township to look at local conditions that affect network costs.

A. Primary Engineering Assumptions

Following are the primary assumptions made in designing and determining the price of the fiber network.

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. The township provided a count of passings and showed us that there are 711 buildings in the township that might be customers of a fiber network.

Aerial versus Buried Fiber

In many places in the country a fiber network would follow the existing utilities, and most existing utilities follow existing roads.

But we found Sharon Township to be nonstandard. The existing electric network often does not follow roads. It's frequently built across lots or parallels a road at some distance from the road. In terms of our industry, this means that the existing electric pole network is built partly on private rights-of-way rather than on public rights-of-way. The government automatically assumes they own a public right-of-way along any named and maintained road. Such right-of-way was probably acquired when the road was first built or else taken by eminent domain.

But the same is not true for the power poles that don't follow the roads. At some point in time when those poles were built the electric company obtained the right-of-way from the landowners at the time.

In our design we considered both a buried fiber network and one placed on the existing poles. It looks to us that it would be exceedingly expensive to place fiber onto some of the existing poles. Many cut through wooded areas or take paths that would not allow easy vehicle access. Aerial fiber construction is done by trucks that contain large reels of fiber and it's mandatory that these large trucks have easy access to poles (which almost always means they must be on a road surface).

We also saw that some of the poles in the township would require additional work before the township could place fiber on them. This extra work is called 'make-ready' in the telecom industry. FCC rules say that it is the financial responsibility of a new attacher to a pole to pay for any work needed to move or rearrange the existing wires on a pole. We noted poles that were short and that in some cases didn't have enough clearance to add fiber and stay within dictated safety parameters. This means that the township would have to pay to 'move' existing electric wires that might not meet FCC safety or clearance standards. The township would also have to pay for any cost of tree trimming needed to enable construction. We note that AT&T largely has buried their telephone network and we are sure that they came to the same conclusion as us many years ago when they built their network.

After looking at the number of places where construction on the poles would be a problem, we determined that burying the network will be the lowest cost option. That's a bit unusual since it's generally less costly to string fiber on poles – but in Sharon using poles would be a costly issue.

Further, burying the fiber means considerably lower costs to maintain the network over time along with fewer outages. We understand that there are often power outages in the area due to limbs falling onto electric wires. Such problems would be avoided with a buried fiber network. This is

not to say that there can't be problems with underground fiber networks. For instance, somebody with a backhoe can dig up and cut fiber. But such outages are generally far less frequent for underground networks.

We used electronic mapping records provided by the county that show there are 69.64 miles of 'named' roads in the township. Many of these roads are considered as 'private' roads in the township. We included all roads needed to reach all of the existing homes the township. It might be possible with a detailed construction design to builder fewer miles of roads to avoid any long stretches of roads that contain no potential customers.

In terms of relative density, this means that there are 8.5 homes in the township per mile of fiber. That is less dense than small towns which generally have 15 or more homes per mile, but the township is still more densely populated than true rural areas with farms that can be anywhere under 5 homes per mile.

B. Fiber Network Design Parameters

We looked at a fiber network design in two ways. First, we looked at what we call a carrier class design. This is the design that a regulated telephone company might use when building a network. Such a network would utilize building techniques that would add a large amount of future potential capacity to a network. But building to the carrier class standard is expensive, and telcos are often accused of building 'gold-plated' networks to the detriment of their rate payers. So we also designed a leaner and more cost-effective network that we still think meets all of the requirements today, and will continue to meet those requirements into the future of the township.

Here are the characteristics of the carrier class fiber network that affect design cost:

- A carrier class network 'right-sizes' the fiber and will put a fiber on each route that anticipates all of the needs of that fiber both today and into the future.
- A carrier class network would put all of the buried fiber into conduit. This requires that first an empty conduit is buried into the ground. In the kind of soil around Sharon Township that will involve a significant amount of backhoe work to get the conduit deep enough.

Once the conduit is in place fiber is then pulled or pushed through the conduit. In the ideal carrier class network two conduits are placed into the ground at the same time, with one being a spare in case something ever happens to the first one. Generally there is room inside of a conduit to pull multiple strands of fiber.

- A carrier class network would use boring to cross roads. Boring is the process of digging a deep hole on both sides of a road and then using a machine to bore a hole across the road for inserting a conduit. Fiber is then passed through the conduit. Fiber networks require many road crossings. For example, a fiber built on the east side of a road would require a crossing to get to every home on the west side of the road.
- A carrier class network will place devices or access points along the fiber to have access to every existing home, but will also place access points where there might be future homes. A good analogy for this is when you see fire hydrants sitting in an unbuilt part of a new subdivision. It's cheaper up front to add the fiber access points while constructing the fiber than it is to add them later.

We estimated the cost of a network built to these carrier class standards, which will be summarized below. But then we also looked at a more affordable network that considered the following different design parameters.

- We designed the network using only two sizes of fibers. We used a 72-count fiber for the main backbone of the network that connects across the township. Everywhere else is designed with a 48-count fiber. It may seem counterintuitive, but it’s cheaper to design a network with the same count of fiber almost everywhere than it is to exactly right-size the fiber on each street. And that is due to the fiber construction process. First, the contractor needs to procure and bring different sizes of cable to the township. When constructing with different sizes of fibers the contractor then needs to swap out cable reels during the construction process to get the right sized fiber for each street. It’s more efficient to use the same size everywhere which simplifies the construction process and also the ordering process. While larger strands of fiber cost a little more than smaller ones, the vast majority of cost in building fiber is labor, and so anything that reduces labor can save overall cost.
- In the lower cost design the network in neighborhoods is not placed in conduits. With the 10-acre lot minimum in the township it’s easy upfront to know the potential long-term demand for fiber in any portion of the network. Building with all 48-count fibers basically assures a lot of space capacity everywhere in the neighborhood networks, thus eliminating the need for conduits. Many commercial overbuilders would also directly bury fiber in these kinds of neighborhoods; this is not a unique design parameter. Our design would still place a single conduit along Highway 52.
- Whenever possible, we assumed that road crossings would be trenched and not bored. Many of the roads deep in the neighborhoods are dirt or gravel and it would be extravagant on such roads to go through the extra cost of boring to reach customers on both sides of the road. Instead, a narrow trench would be dug across the road and the dirt and gravel replaced once the fiber was placed.
- Our design does assume placing multiple handholes or other types of access in locations where there might be future homes or businesses.

The cost of the two kinds of construction are as follows for the fiber:

	Lower Cost	Carrier Class
Fiber Construction	\$2.77 M	\$3.19 M
Engineering	\$0.13 M	\$0.15 M
Construction Management	\$0.15 M	\$0.17 M
Permitting	\$0.04 M	\$0.04 M
Total	\$3.09 M	\$3.55 M

The township is free to choose between the two designs, but we strongly favor the less expensive build – not only because it costs less, but because it still satisfies all of the needs of the township. In your semirural area there is no way to justify spending nearly a half million extra for things like burying two conduits on dirt roads that are serving only a few customers.

We also note that the study includes an option for building 4.8 miles of fiber to Chelsea to get access to Internet bandwidth. A quote for wholesale bandwidth was obtained if the connection could be made at or near to the Chelsea Library where you could meet a carrier with fiber to the internet. This construction is shown as optional because if one of the townships around you also builds fiber then this construction would not be needed. You can very inexpensively connect two fiber networks at the edge where the two networks are close to each other.

Active versus Passive Electronics

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.

An 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.

The vendors currently making Active Optical Network equipment include Enablence, Calix, and PacketFront.

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 for 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 divide 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.

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 PON 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. This technology is just now becoming available in the market.

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.

In this study we have calculated the cost of the network using passive electronics. But on a scale as small as the township the cost difference between the two technologies is negligible; you could choose either technology

Normally you would have to choose one of the electronics technologies to match the fiber design since active fiber requires more pairs of fibers in the field. However, in your case, since we have designed the network using the same-sized fiber throughout, there are sufficient fiber pairs in the design to accommodate active fiber, or you could choose passive fiber.

One of the recommendations elsewhere in this study is that you work together with other townships to achieve economy of scale savings, and in doing so it would make sense for any townships involved to use the same type and brand of electronics. The network design we have given you provides the flexibility to handle any electronics alternative chosen.

PON Network Design

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 like the township all of the PON electronics can be placed at the core with no requirement for remote huts. We have assumed that these electronics would be placed at the Township building. But they could optionally be placed into a small hut.

In a PON network, even when the electronics are in the core, there is a need to have small field cabinets where the fibers are split. These are where one feeder fiber is connected to the fiber to serve up to 32 homes. There are two possible designs for splitter location design: 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.

Our design uses a “local convergence point” splitter architecture. This type of architecture ensures that the splitters that serve a general geographic area are all located within the same splitter cabinet. This design also makes it easier to make sure that a given splitter cabinet isn’t overloaded. This is important if there is ever a need to upgrade the core electronics. The local convergence point also ensures that the FTTH common electronics are most efficiently utilized—thus saving money on optics and electronics.

In our model design, we estimated the placement of 5 splitter locations using a 288-count splitter cabinet for PON distribution. This would provide 5 X 288, or 1,440 potential customer locations within the township, making the design ready to handle significant future growth. The most heavily-loaded cabinet covers only 152 passings, meaning it uses 53% of capacity. This design can serve twice as many homes than are in the township today.

Customer Assets

There are several assets needed to connect a customer to the network. This includes fiber electronics, a fiber drop, and any equipment to be placed inside of customer homes.

Customer electronics in the industry are referred to as an ONT (Optic Network Terminal). This device converts light from the fiber network into the signals needed to provide the triple-play services. There are several different options for ONTs. 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.

Since there is a possibility that the network will partner with one or more ISPs to provide service, we elected to use external ONTs in the study. The two types of ONTs cost very nearly the same. But in the long run it’s smarter to put the ONT inside to keep it out of weather. The decision to place ONTs inside or outside can’t really be determined until you decide who will be serving customers.

ONTs come with an option for battery back-up. However, most 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 electric outlet. So when

such a phone loses power it can't be powered by the battery. These are small UPS units and also are unable to power laptops or any other electronics for more than a short time. We have not included a battery in our design, but you might offer it as an option for a customer who really wanted it.

Fiber drops are the wires that connect directly to a home or business from the outside fiber network. We estimated the cost of drops in your network using an average length of 350 feet. This distance was obtained by looking at the homes in the townships using google Earth. We note that this is one of the highest average drop lengths we have seen. We have assumed that all of the drops will be buried. But there may be some homes where it would be easier to string them on an existing power pole, so there is that potential to save some money. Drops are not buried as deeply as the fiber alongside roads and can generally be plowed into the ground using a specialty hand-guided plow that looks something like a snowblower.

Today most, but not all, ISPs provide a WiFi router for their customers. They have found that when customers have service complaints that it's more often about the quality and performance of the WiFi router and not about the fiber network. Providing a high quality WiFi router can eliminate a lot of the problems that come with cheap routers that customers might purchase on their own. Our study assumes that routers will be supplied, but it's not mandatory.

Other Assets

There are other assets required to support an operating fiber network. Following is a list of such assets. Most of these assets would be provided by the ISP. In most of the scenarios we considered that somebody other than the township would provide these assets – but if you were the ISP you would have to provide these assets.

- Building. We don't think that the township needs to construct a building. We have assumed that you will house the needed electronics in Township Hall. The electronics require two racks that need only a few square feet of floor space in a locked room or closet. If you wanted a building there are many used ones available today due to the cellular companies centralizing electrics at cellphone towers. You could have one of these in place for somewhere between \$10,000 and \$25,000.
- Data Routers. The ISP must provide various servers and routers to handle the ISP functions. This would include providing email, security, IP addresses, web storage, and other functions normally provided by an ISP. We've assumed that this equipment will be provided for at the core site of the ISP and not inside the township.
- Telephone Service. The operating ISP might also want to provide telephone service. While not everybody wants it, about 50% of homes nationwide still have a home phone. Again, the equipment needed to provide voice service would be at the ISP location.
- Cable TV. If the ISP you are partnered with already offers cable TV they could deliver this over the fiber network. However, this would require them to buy an additional gigabit data connection back to their headend. Any ISP not already providing cable TV is not likely to

consider it since the product has a low margin today and households are starting to abandon the product. We have not assumed a cable TV product in the analysis. It would also possibly be possible to bring cable TV eventually if

- Other Assets. The business plan also includes the other assets needed to operate an ISP. This would include a vehicle for an outside technician. The business plan assumes the need for computers, furniture, and office equipment.

C. Network Costs

Our estimated costs for the required assets were estimated as follows:

Fiber. We based the estimated cost of fiber based upon conversations we had with several fiber construction companies that have recently built fiber in Michigan and in terrain similar to the township. Fiber costs vary significantly nationwide due to factors such as labor costs, terrain, and local construction methods.

There are two different ways that municipalities build fiber. One is called design/build where the same construction company designs and then builds the network. This practice is not allowed by law in many states because there are too many examples where a design/build allowed a contractor to cut corners to the detriment of the municipality. Commercial ISPs often use design/build because they have the expertise to keep an eye on the contractor to make sure they are delivering what was promised, at the price promised.

The more normal construction method for municipalities is to hire an engineering firm to both design the network and to also then inspect the build to ensure that it is being built correctly. We have chosen this method in our pricing since most municipal networks are built this way. It would be possible to save as much as \$100k to \$150k if you were allowed to use design/build and could find a contractor you trusted.

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

Buried Fiber in Conduit	\$42,000 per mile
Buried Fiber Without Conduit	\$37,980 per mile

These prices include \$12,500 per mile for fiber and other materials with the rest of the cost being labor.

However, these prices reflect the cost of building fiber straight down one side of the road and not stopping for customers. However, in a FTTP deployment the fiber has to serve customers on both sides of the road and the fiber needs to be spliced to numerous handholes. These are small devices buried in the ground that give technicians access to the fiber that goes to each home. There are several different ways to design the network to cover both sides of the road. The most expensive is to build one side of the road and then bore under the road at each home on the other side. A slightly less expensive method, particularly where there are some dirt and gravel roads, is to cross the fiber as needed from one side of the road to the other, trenching where possible and boring

when not possible. We chose this second method and it adds an additional 20% to the cost of the fiber routes to cover the trenching, boring, handholes, and splicing.

These costs do not include engineering, construction inspection, or permitting. We've estimated that the engineering and inspection will cost 10% of the cost of the construction, a price range we see often. The permitting fees would be paid to the township and this is something you might waive in order to hold down the price of the network. We've estimated such fees at \$35,000. Note that if you waived them for your own fiber construction then you might have to forego such fees for anybody else that wants to build in the township.

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.

There are two major components of fiber electronics. First is the core. The core 'lights' the fiber and transmits the signal to customers. Calix calls this component an Optical Line Terminal (OLT). The other major component, mentioned earlier, are the ONTS that sit at each home and that are used to receive the light signal and translate it back into an electronic signal for inside the home or business.

We've assumed that the core electronics cost around \$73,000. We have assumed that each ONT at the customer premises costs \$450, which includes the cost of installation.

There are more expensive ONTs that can be used for larger customers. There are no businesses in the township today that would need the more expensive electronics. Even if one was built, the cost for the electronics for a large business is, at most, a few thousand dollars more expensive than a standard customer connection.

As noted above, the overall price of using active electronics is similar, and so our business plan provides a reasonable estimate for either type of network.

Fiber Drops. Drops are estimated to cost \$423 including materials and labor. We assume an average drop length of 350 feet.

Connecting All Customers. The models all assume that you would provide drops and ONTs to all of the potential customers in the township. While there may be a few homes that don't want to be connected, our thoughts are that if citizens are paying for the network from property taxes then everybody should be offered the chance to connect to the network. It's cheaper to connect everybody during the construction process than it would be to come back later and connect them one-by-one as they take service.

Other Costs. We've assumed a cost of \$30,000 to upgrade and install the needed racks and power equipment in Township Hall. We've assumed an inexpensive router costing \$10,000 that would be used to connect the network to one or more ISPs.

Construction Contingency. A contingency is essentially a fudge factor. When borrowing money to build a fiber network it is routine to borrow a little extra to protect against price overruns. A contingency is not needed if you have first done a detailed network design before hiring a contractor. We've included a 5% contingency to the cost of fiber. This could be set higher if you wanted more safety. We don't normally add a contingency to electronics since it's easier to make a good estimate of those costs.

Summary of Network Costs

Following are the low and high cost estimates of expected network costs. These costs are for network assets only and don't include assets like vehicles that are probably going to be owned by the ISP(s) that operate on your network.

	Lower Cost	Carrier Class
Upgrade to Township Hall	\$ 30,000	\$ 30,000
ISP Router	\$ 10,000	\$ 45,000
Splitters	\$ 49,750	\$ 49,750
Electronic Core	\$ 72,910	\$ 72,910
Fiber Core	\$ 58,032	\$ 58,032
Fiber	\$2,765,920	\$3,190,320
Engineering	\$ 134,371	\$ 154,318
Construction Management	\$ 151,524	\$ 174,018
Permitting	\$ 35,000	\$ 35,000
Drops	\$ 300,398	\$ 300,950
ONTs	\$ 319,950	\$ 319,950
Subtotal	\$3,927,855	\$4,430,247
Optional Route to Chelsea	\$ 221,760	\$ 221,760
Total	\$4,149,615	\$4,652,007

Note that the drop and ONT prices assume that a connection is built to every customer. This will be discussed more when discussing possible business models.

V. Business Structure

This section will first look at the possible business structures that the township can consider. It will then look at a few key segments of the fiber industry today that have the most bearing on the choices the township is considering.

A. Business Structure

There are several possible operating models for the township to consider. Each option has significantly different results and consequences. The two options are:

Open Access. In this option the township would build the model and then would allow one or more ISPs to offer service on the network.

Township as the ISP. In this option the township would form and operate your own ISP.

Partnering with Other Townships. In this option multiple townships would come together to operate the fiber businesses.

There is a more detailed discussion of this issue in the Next Steps section above. Determining the structure of the business is the first step to take and the ideal structure will be one that allows the profits made from the ISP business to help offset the cost of the bonds.

B. The Open Access Market

Let's first look at how the existing open access market operates today. It is an interesting and fairly limited marketplace. The most common open access structure is that ISPs buy access from network owners to get access to customers. That structure is identical whether there is one or multiple ISPs providing service. There are many more open access networks that provide wholesale access on a more limited basis, mostly to serve business customers.

The Full Open Access Market

Most open access networks operate in states where this business structure has been mandated by legislation or regulation.

- The PUDs (Public Utility Districts – rural electric companies) in Washington are restricted to being wholesale providers due to legislation passed a number of years ago. There are numerous different open access models being tried at various PUDs, with the largest being Chelan PUD, Grant PUD and Douglas PUD.
- Utah has a similar law that applies to municipalities. This led to the creation of an open access fiber business in Provo and another in a collective of small towns operating as Utopia. Provo subsequently sold their network to Google Fiber. Utopia is still operating a wholesale business.
 - Utopia doesn't charge ISPs to get onto the network. Instead, when a household joins Utopia, a customer accept a lien on their home, and have the option to pay \$300 down and \$30 per month for 10 years, nothing down and \$25 per month for 20 years, or a flat payment of \$2,750. This allows ISPs to offer services like 250 Mbps fiber for \$35 per month.
- A similar law was passed in Virginia after Bristol Virginia Utilities (BVU) built a retail fiber network. The legislation grandfathered BVU as a retail provider but only allows other

cities to operate open access networks. So far the wholesale model has been adopted by a small number of cities, the largest being Roanoke on a limited basis.

There are a few other municipal entities that have elected a wholesale business structure, even though it was not mandated by law. This includes the following situations:

- Tacoma, Washington chose a wholesale model where the city is the retail provider of cable TV, but connections to the network for telephone and broadband are sold wholesale to ISPs. The city recently announced that it is considering changing to a full retail model for all services.
- Ashland, Oregon operates an open access network, but the city also operates as a retail ISP on the network and competes against a few local ISPs that sell on the network.
- There is a network in Urbana and Champaign Illinois that purports to be open access operating under the name UC2B. The backbone network for this project was built from the Broadband Stimulus Grants that were awarded a few years back. The network is owned jointly by the two cities plus the University of Illinois. UC2B has not yet built a citywide fiber network, but works with various ISPs to add fiber one neighborhood at a time to the network. So rather than being open access, it's more like negotiated deals with different ISPs to operate in different parts of the city.
- There are a number of municipal networks that have built fiber rings and which are promoting "open access" to carriers. But these networks have largely not built to reach residential customers. I would put these networks into the open access wannabes, and with financing and the right partners they might eventually become open access networks. An example of this is AXcess Ontario in Ontario County, NY.
- Other communities have tried to build open access networks but then were unable to find any ISP partners. For example, Longmont, Colorado sought funding as an open access network, but since they were unable to find ISP partners they now offer full retail services directly to residents.
- Ammon, Idaho is just now starting an open access network. This is an interesting model in that the network is being financed through liens placed upon customers' homes plus a monthly 'utility fee' charged to homeowners. The plan is for these fees to pay for the network so that the ISPs will not be charged for using the network.
- There are other cities that are considering open access networks. The largest of these is San Francisco, which would pay for the plan through a 'utility fee' charged by the city to every electric customer in the city.

Overall, it is a very tiny universe of US networks that operating with open access and that include residential customers.

Problems with Full Open Access Networks

There are several problems faced by all full open access networks in the US:

- Quality of ISPs. Europe has seen some large success with open access networks because a significant number of the large ISPs there are willing to operate on a network operated by somebody else. This came about due to the formation of the European Union. All of the

state-owned telecoms and ISPs found themselves in competition with each other, and as a whole they embraced open access. There are huge open access networks in places like Amsterdam and Paris as well as hundreds scattered in smaller towns and cities. The big networks have over a hundred ISPs competing for customers—many of the ISPs with niche businesses going after a very specific tiny slice of the market.

But that hasn't happened in the US. There is not one example in this country of a large telco or cable company agreeing to operate to any significant extent on somebody else's network. These large ISPs will lease the occasional connection to serve a large business customer outside their footprint, but they won't buy large-scale connections.

This means that open access networks in the US have to rely on small ISPs. These small ISPs are generally local and mostly undercapitalized. They are often family businesses. The small ISPs have all of the problems inherent with small businesses. They often don't have the money or expertise to market well. They often have cash flow issues that put restraints on their growth. And many of them don't last a long time, which is typical of small businesses in general. This can be seen in a few of the open access networks in the US. In Chelan County, one ISP has almost 98% of the residential customers. There were originally almost a dozen ISPs, but over the years they either folded or were purchased by the remaining ISP. The danger faced by Chelan PUD is that they would have no provider if the one ISP fails or goes out of business. These kinds of businesses, for example, often don't survive the death of the owner-operator.

In Provo, before the network was sold, there were only two ISPs on the network. They originally had eight ISPs on the network. It's hard to make an argument that a network with so few choices is really open access—because the whole purpose behind open access is to provide customer choice.

- Cherry Picking. The wholesale model tends to lead to cherry picking. That is the phenomenon where the ISPs only want to sell to the most lucrative customers in the market—those with the highest monthly bills. This cherry picking is driven to a large degree by the wholesale arrangement between a network owner and ISP. Most existing wholesale networks sell connection to ISPs at some fixed price. This price varies between \$25 and \$33 per customer on the various networks mentioned above.

This kind of pricing makes it impossible for the ISPs to develop profitable products to sell to smaller users or low-income homes. An ISP can't pay \$30 for a connection and then create a \$25 to \$40 data product—the math just doesn't work. And this is unfortunate because every one of these open access networks had an original goal to bring broadband to as many customers as possible.

The open access networks generally have customer penetration rates far lower than similar municipal networks that are directly operated by the municipality as the ISP. I don't think any of the networks mentioned above have customer penetration rates greater than 50%. This means the networks benefit less than half of the customers in the market. That is

perceived as a disaster for a municipal provider since everybody in the municipality is paying for the network.

- Making the Numbers Work. Almost by definition, an open access network owner has a big challenge in making the numbers work. Consider the difference between a network owner that is in the retail business and one that operates an open access network. A retail provider today that offers the triple play of cable TV, broadband, and telephone probably has an average customer bill higher than \$120 per month. Compare that to an open access network provider that might charge between \$25 and \$30 per month for the wholesale connections. The biggest expense to recover in any network is the cost of the physical network, and the networks for the two business plans are nearly identical. The retail provider might have extra network costs for assets like a cable TV headend, cable settop boxes, or cable modems—but the big cost of building fiber to reach each customer is the same for both businesses cases.

Since the margins are so thin for open access, the business often requires a high customer take rate just to break even (meaning to cover operating costs). It can be difficult, or even impossible, to create an open access business plan that will cover operating expenses as well as pay for the network.

- Stranded Investments. One problem that plagues all fiber networks is that the cost to connect the customer to the network is high compared to competing technologies. Both telcos and cable companies can bring a fairly inexpensive drop wire to a customer home without needing any electronics. But fiber networks require a significant investment, an average of around \$1,000, to connect a customer—and if that customer leaves the network before spending enough to recover the installation cost, then that investment is “stranded,” meaning it is not generating any revenue. Over time it’s not unusual for a fiber network to accumulate a significant number of these stranded customer connections.

What This Means for Sharon Township

Sharon Township can’t consider the “normal” open access network structure because you would never be able to repay the cost of building the network. This is easy to demonstrate. As is shown elsewhere in this report, the cost of the network and the costs to finance it, when spread across all customers, equates to a required revenue stream of roughly \$43 per month, depending upon different variables like the exact network design and the interest rate on debt. If Sharon tried to charge \$43 monthly to ISPs for each customer on the network the ISPs would have to charge a high rate for broadband, perhaps \$80 per month for a basic connection. With that rate probably less than half of the homes would buy broadband. And that would mean that the shortfall would have to be spread to just the households that buy a wholesale connection. This leads into what is called a death spiral in economics because it’s a problem with no solution. There is no price that customers are willing to pay that will generate enough revenue to pay off the cost of building the network. And so far, none of the cities that have built wholesale networks has been able to recover that initial cost. All of these other cities have electric utilities and those utilities covered the costs of the fiber network (and basically passed it on in higher electric rates). That’s not a viable option for Sharon Township.

The township already understood the basic dilemma of pure open access, and so you have anticipated that you will cover the cost of the network through some other mechanism. In my analysis I have assumed that the cost of the network will be covered with property taxes. In the township that is the only viable option. But other cities have considered other sources like sales tax. For example, Cook County Minnesota funded about half of the cost of their network through a sales tax—something that was viable there because they are a resort area on Lake Superior.

So the network option in Sharon Township is to pledge an increase in property taxes to pay for the network. When the network is built you will invite one or more ISPs to operate on the network. In my business plans I have assumed that you will still charge the ISPs a small fee per customer per month—I've assumed \$5. The township will own the network and you need to maintain a rainy day fund to cover the cost of network repairs or of adding additional new homes to the network. But the township business plan is simple. Your only revenues are from the property taxes and from whatever small fee you charge to the ISP(s). For that fee your role is to pay for the original network plus whatever other additional future costs are negotiated between the parties.

Issues with Working with ISPs

Even though the township is paying for the original network there are still concerns with working with ISPs in an open access environment. You still run some of the same risks that are mentioned above. I particularly would be concerned about:

- The Viability of the ISPs on the Network. The township is small and so it is unlikely that you are going to attract multiple ISPs unless a number of other townships also build open access fiber networks.

Large networks like Chelan County (over 25,000 customers) and Provo (over 20,000 customers) had a very difficult time finding and keeping viable ISPs on their network. Small ISPs are not generally strong companies and they also tend to be sole proprietorships that fold when the owner can't sustain financial viability or else just decides to do something different.

It's a real possibility that you build a fiber network and get only one ISP serving. And then sometime in the future that ISP folds shop and your customers are stranded with no viable ISP option. As mentioned, that is the fear today in Chelan County where they have 25,000 customers and one ISP.

- You Have Little Negotiating Power. At the end of the day the tiny number of potential customers is not going to be enough customers to give you any leverage to get concessions out of an ISP. It's likely that you beg somebody to serve on your network as opposed to being able to influence how they operate in terms of prices, service, etc.

This means that even if you charge very little to the ISP they might still charge high prices. There is really nothing you can do to stop them from doing that. In your case your citizens will be paying the equivalent of over \$40 per month more in property taxes. And for that

contribution they are going to want significantly lower retail rates for the broadband and other products.

But the ISP(s) on your network either might be so tiny as to have no economy of sale, or they might just be greedy and want to charge high prices. Or, as mentioned earlier, they could just decide to cherry pick and only serve those households willing to pay a high price for broadband. It's been my experience that you will have little or no power to influence their behavior.

- ISP Profits. The ISP can make a significant amount of profits over time. There is nothing wrong with that, but the ISP profits are due in a large part to the fact that you are providing them with a free (or very cheap) network. They could never do as well financially in your market if they had to build a network or had to pay you what it's worth to use it.

In effect you have subsidized the ISP(s) and any profits they make come out of the pockets of your citizens who are also paying over \$40 per month in tax revenues for the network.

Is There Another Alternative?

The other alternative is to form your own ISP, either just for the township or in partnership with multiple townships. If you limit the product line on the fiber network to basic broadband, and perhaps to resell telephone service, it's not a complicated business to operate. It is possible to create a functional ISP at this small scale.

There are a number of upsides to this concept:

- First, you could now serve every home. Since everybody is paying for the network then you could put a minimal data product—say 5 Mbps download—for free into every residence. Even people that don't use computer would benefit by having WiFi to save money on their cellular data plans. All but a tiny few homes would not benefit from ubiquitous service.
- Any profits can be rolled back to benefit your citizens. This could either be structured as direct reductions in the retail prices of the products sold on the network, or else profits could be used to make some of the bond payments, thus reducing the property tax millage you would need to charge. The second idea is probably the fairest answer since it saves money for all taxpayers equally.
- You eliminate the risk of having a poorly performing ISP or one that disappears and strands your customers.
- You can control the customer service experience. We know from working with many municipal businesses that they provide superior customer service compared to almost all commercial providers. This is just in the general nature of what municipalities do and is why citizens tend to love municipal electric and water companies compared to commercial ones.
- Doing business as a cooperative or some other form of commercial entity might bypass state restrictions on municipalities offering broadband.

I've created financial models for this scenario that will be covered below. I've created models with a Sharon-only ISP and one also working in a cooperative that shows financial viability. I've always felt that numbers tell the best story, so in the next section of the report I look at the results of the financial analysis and the story that those numbers tell us.

VI. Results of the Financial Analysis

One of the tasks undertaken in this study was to examine various business plan alternatives to see which business structure and financing ideas work for the township. Following is a discussion of the major assumptions used in creating the studies and the results of the analysis.

All studies looked out over a 20-year future period. While that is a long time over which to make financial projections, the goal was to match the study period with the anticipated financing period of 20 years.

A. Studies Considered

I considered a number of different business plans as follows.

Standalone ISP. I looked at the financial impact of the township directly operating and acting as the ISP. In this case the township would use revenues from the ISP business to try to pay the bond and then would use property taxes to make up the difference. I looked at several different options:

ISP at Market \$35 Basic Broadband Rate. This scenario set the price of the primary broadband product at \$35. In my study I have assumed this would be for 100 Mbps with a higher price for gigabit service. I chose the \$35 price since when it's added to the increase in property taxes the average cost per broadband subscriber would be just under \$80 per month. But note that there is nothing magic about the \$35 number and you could set a price higher or lower than that depending on the goals you are trying to achieve. Depending upon the number of customers on the network, this scenario generates some positive cash flow that could be used to help offset bond costs.

ISP with Market Rates. I also looked at a scenario where the basic rate was increased to \$55, which is a representative rate in larger communities in the state for basic broadband. The major purpose of this look was to see how much extra cash this would generate, which could be used to offset the cost of the bonds.

Open Access Models. Following are the open access models considered. The models are the same from a financial perspective if there is one or multiple ISPs operating on the network.

Base Model. I always create one 'base' model which is then used to compare the effect of changes in other assumptions. In this case the base open access model assumes the following:

- The township pays for building the fiber network. This includes the cost of fiber drops and ONTs to connect to customer locations. The township would also be responsible for future capital such as connecting to new homes built in the township, or needed repairs to the network (such as when somebody cuts the fiber network).
- The townships pays for the network by using a bond funded by an increase in the millage on property taxes.
- The ISPs take care of any capital costs inside of homes, like WiFi modems. The ISPs then operate the business. They bill and collect revenues from customers and these revenues belong to the ISP. The ISPs cover all operating expenses like employees, software, vehicles, customer service, marketing, etc.
- I've assumed the township would charge a small fee to the ISPs for using the network—assumed in the model at \$8 per customer per month. This is to establish the 'rainy day fund' that would be used to pay for future capital and repair needs. The rate is set low so that the ISPs can profitably set low rates for customers.
- The base model assumes that 70% of the customers in the township buy services from the fiber network. At this early stage we can't know how many homes will want broadband. But in working around the country, we are seeing relatively high customer take rates of broadband in rural areas – generally between 70% to 85%. This tells me that using 70% as the starting base penetration does not feel out of line as a moderate penetration goal.
- From a network cost perspective the base model assumes that the township will have to build fiber to Chelsea to get access to affordable bandwidth. It is assumed that the fiber construction will follow our “low-cost” construction ideas.

Base Model at a 60% Penetration. Same as the base study except that only 60% of residents buy broadband from the fiber network.

Base Model at an 80% Penetration. Same as the base study except that 80% of residents buy broadband from the fiber network.

Traditional Open Access Model. Same as the base model except that the township charges \$25 each month to ISPs for each customer on the network.

Effect of Interest Rate Increase. Same as the base model but with interest rates on the bond set 1% higher.

Lowest Possible Capital Costs. Same as the base model but excludes the fiber route to Chelsea (assumes some township nearby meets you at a border).

High Capital Costs. Same as the base model but uses “carrier class” construction methods to design the network.

Higher Capital Contingency Costs. Same as the base model but assumes a higher contingency reserve to protect against construction cost overruns.

Partner with Other Townships. The other concept explored was partnering with other townships. This means that the townships would join together to fund an ISP as a cooperative (or as some other business structure) to operate the network.

This model works basically the same as the open access network, but with several exceptions:

- The townships would have to fund the startup costs to launch the jointly run ISP.
- We've assumed that the township would pay for all initial capital, including the cost of the electronics inside the home (WiFi router).
- The jointly operated business needs to have the ability to return profits to the township. The major reason to consider this option is to see if there is economy of scale from acting as a group – and to then take advantage of any profits to offset bond costs.
- Because the business is operated by the townships, through the cooperative, I've assumed that you would provide a free data connection at some minimal speeds like 5 Mbps to every home. Even those that don't use a computer would be able to save money through WiFi on their cellular data plans. There is no incentive for an ISP to offer this kind of service in an open access environment. You just have to be careful that so many people don't opt for the 'free' option that the ISP does not cash flow. This is why I am strongly recommending holding a pledge drive before funding or building the network to find out the products customers are willing to pay for.

I looked at two scenarios:

Partnering with 3 Other Townships. In this scenario three other townships roughly the same size as Sharon go together and form an ISP as a co-op to provide services.

Partnering with 9 Other Townships. This scenario looked at economy of scale and considered a customer base that is 9 times larger than Sharon. This could be 9 small townships or a smaller number of larger townships.

In all of these studies I create two separate set of financial statements—one for the township and one for the ISP. That lets me look in detail at how the ISP might perform—which is essential in understanding

B. Business Plan Assumptions

Customer Revenue Assumptions

In an open access or cooperative environment the goal is to generate enough cash for the Township to maintain a rainy day fund, but to otherwise hold down charges for using the network so that the ISPs can offer the lowest rates possible. My models assume a charge to the ISP(s) of \$8 per customer per month.

Even though you won't charge much to get onto the network we still have to recognize that the Township is a small market for broadband. The ISP will have incremental costs to serve it and will still want to make a profit. In my models I estimate those costs and look at setting prices that will derive the margins that I think ISPs will look for.

In my model I've assumed two sets of products—broadband and telephone using VoIP. Most ISPs serving on fiber networks offer the two products. Even if the ISP does not own a voice switch, there are numerous options for them to buy wholesale voice to resell to your citizens.

But there is nothing stopping ISPs from offering additional products. For instance, if they provide cable TV elsewhere they might also want to provide it in the township. The issue for them will be if the cost of getting the cable signal to the township (requires about a gigabit of data speed) is too costly to support the product. ISPs are also offering other products around the country like smart home services (smart thermostats, door locks, security systems, watering systems, etc).

But for purposes of this modeling I've kept the product line simple. Unless noted, the models assume the following products and prices for the ISPs:

100 Mbps broadband	\$35
1 Gbps broadband	\$60
Basic phone line	\$20
Phone line with unlimited long distance	\$30

We've assumed no hook-up fees for customers

Note that in an open access environment that an ISP might charge more than the above rates. The Township probably does not have any market power to force ISPs to a preferred set of rates. This is one of the primary reasons to consider your own ISP if that can be made to work – because then you control the pricing. All of the profits in an open access environment go to the ISPs and so they could charge more than the suggested \$35 and pocket the profits. Unfortunately their rates don't benefit you, but if their rates get too high there will be fewer customers buying broadband.

Township Revenue Assumptions

The township has two revenue sources. The first is the property tax revenues that are set to be adequate to make the annual payment on the bonds.

Second, I show the township charging \$8 per month for each customer to the ISPs (or to the co-op). The purpose of this revenue is to fund a 'rainy day fund' to enable the township to fund adding new homes to the network or to make the occasional repairs to the network.

Expense Assumptions

It's important to note that this analysis looks at "incremental" expenses—those are new expenses that are incurred as a result of launching the township fiber business. This analysis does not include some allocated share of existing expenses.

Let me give an example of what that means. An ISP will already have an owner/manager who operates the business and collects a salary. I have not accounted for any of that salary in the analysis because the ISP is already paying that salary today.

Without knowing the specific ISPs that might be involved we also can't know the specific incremental costs of the ISP for taking on provision of service in the township. And so I have made my best estimate based upon the experience of working with hundreds of small ISPs. But they don't do everything the same. For example, one ISP might do the 'help desk' function with staff while another might outsource it to an external vendor. The help desk function is the technical support function at the ISP that answers questions about broadband and that troubleshoots and fixes technical issues.

ISP Expenses

Following are the various major expense assumptions used in the models.

Inflation. I assumed that expenses will increase 2.5% per year for inflation.

Employees: Labor is always one of the major expenses for offering broadband services. We estimate the following labor costs needed to support broadband in the township.

- **Field Technicians.** A field technician is somebody in a truck that does maintenance on the network and that fixes problems in the field. The standard industry metric for small ISPs is that one field technician can take care of an area covering 1,600 customers. In the case of the township that would add about 1/3 of a new technician in workload to an existing ISP.
- **Customer Service.** The ISP will also need additional resources for customer service. These are the employees that take orders, receive and process bill payments and answer customer questions. The metric is similar to that for field technicians and a small ISP generally has one customer service representative for every 1,500 customers. That also equates to roughly 1/3 of a representative assignable to the township business.
- **Benefits and Taxes.** We assume that the ISP's benefits and taxes add 30% to the cost of the base salary.

Internet Help Desk. These are the people in an ISP that handle technical support. This means that they take technical questions from customers, fix any problems that can be done remotely through the electronics, and maintain 24-hour monitoring of the network. While some small ISPs do this function in-house, the more common method is to hire an external company to handle this function. This function today costs roughly \$4.00 per customer per month.

Bandwidth. The ISP must buy wholesale bandwidth to the Internet. In the forecasts we used a price of \$1,800 per month for a gigabit of Internet bandwidth. That should be adequate for the number of homes in the market today. But that price was quoted for getting access to bandwidth in Chelsea, if the ISP has connections in larger towns they probably will be able to get a better price than this.

Other ISP Operating Costs. There are a number of other incremental costs for the ISP to serve new customers, as follows:

- **Wholesale voice and long distance.** If an ISP does not own their own voice switch then they must buy wholesale telephone lines. We've assumed the purchase of wholesale lines, which cost a little more generally than providing this in-house.
- **General asset-based expenses.** This would include things like the gas and insurance for the vehicle used to serve the township. It would include computer expenses for the employees that work in the township. It would include the electric bill for powering the fiber electronics.
- **Advertising.** There will be some advertising costs at the beginning of the business to sign up new customers.
- **Billing.** There are costs to create, mail, and collect payments for billing. Some customers are going to want paper bills. Others will want to pay by credit cards.
- **Software.** Most ISPs maintain software that they pay for by the number of customers they have. This might include mapping software and OSS/BSS software (the recordkeeping, customer service, and billing software).

Not Included. Again, my study looks at incremental costs—which means new costs that the ISP must take on in order to serve the township. This means that there is no assignment of costs for such things as accounting or the salary of the owner of the ISP. I've assumed that those costs would be covered by the “profits” generated by the business in the township.

Township Expenses

Fiber Maintenance. Since the township owns the fiber network I have assumed that you will be responsible for the cost of fixing the network when something breaks. This could be a cut fiber or a customer card that goes bad. The actual maintenance work may be handled by the ISP, but I've assumed that as the network owner these costs would be borne by the township.

Rights-of-Way Expenses. In Michigan there is a proscribed fee that must be paid each year for access to public rights-of-way. This is covered in the METRO Act as follows:

Section 8 (4) Except as otherwise provided under subsection (6), for each year after the initial period provided for under subsection (3), a provider shall pay the authority an annual maintenance fee of 5 cents per each linear foot of public right-of-way occupied by the provider's facilities within a metropolitan area.

To be conservative I've estimated that this would apply to all state, county and township roads. It would not apply to private roads. There are approximately 56 miles of roads that might incur this fee which results in an annual expense of about \$15,000. It's possible that the Township could waive the fees on Township-owned roads or else perhaps use any such revenue to offset the cost of the bonds. But that is going to require legal research.

Start-up Costs. There are one-time costs for getting into this business. These include things like this study, legal fees, and other similar costs.

Capital Assumptions in the Study

Above I talked about the cost of the fiber network. But there are other assets needed to operate the business. My assumptions for this additional capital are as follows:

Township Capital. I've assumed that the township would cover the capital cost in the future of adding new customers to the network as homes are built. I've assumed the township would pay for replacement of electronics or for fixing fiber if it's damaged.

ISP Capital. I've assumed the ISP would take care of the following capital costs:

- **Equipment Inside Customer Premise.** The most common such equipment would be a WiFi router. But if the ISP provides cable TV service this also would include settop boxes.
- **Operational Assets.** The ISP would also be required for any assets needed to operate their side of the business. This could include things like vehicles, computers, furniture, tools, and anything else they need to be a functional ISP. The ISP would also own any of the electronics needed to provide broadband, telephone, or cable TV products.

Financing Costs.

One of the biggest costs for the township is the debt payments on the bond. I have assumed that the bonds would be for twenty years with steady payments throughout. Like all loans there is both a principal and an interest component of each debt payment. The study assumed that property taxes will be increased by enough to cover the cost of the debt.

C. Summary of Financial Findings

The financial studies I have created are complex and produce sets of financial projections for the township as well as for the partner ISPs or for the partner cooperative. I've found it's overwhelming to copy all of the detailed results of these studies into a written report.

So instead, I will focus on the summary results of the studies. There are a few key facts about each study that I think are the most important:

- How much the township has to borrow in a bond, and how much that bond costs each taxpayer per month during the bonding period.
- How much cash is generated by the township.
- How much cash is generated by the ISP partners or the cooperative partners.
- The net impact on the taxpayers in the township for all of these items.

Township Acting as the ISP

I looked at six different alternatives for this scenario. I looked at setting rates starting at \$35 and I also considered using 'market rates' starting at \$55. I then looked at the two alternatives at a 60%, 70% and 80% customer penetration rate. The financial results are as follows:

60% - \$35 Rate	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,925,000	\$46.32 / Month
Township Cash after 20 Years	\$1,450,726	(\$ 8.50) / Month
Higher Customer Prices		\$ 0.00 / Month
Net Impact on Township Households		\$37.82 / Month
60% - Market Rate	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,925,000	\$46.32 / Month
Township Cash after 20 Years	\$3,837,589	(\$22.49) / Month
Higher Customer Prices		\$20.00 / Month
Net Impact on Township Households		\$43.83 / Month
70% - \$35 Rate	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,925,000	\$46.32 / Month
Township Cash after 20 Years	\$2,086,368	(\$12.23) / Month
Higher Customer Prices		\$ 0.00 / Month
Net Impact on Township Households		\$34.09 / Month
70% - Market Rate	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,925,000	\$46.32 / Month
Township Cash after 20 Years	\$4,880,018	(\$28.60) / Month
Higher Customer Prices		\$20.00 / Month
Net Impact on Township Households		\$37.72 / Month
80% - \$35 Rate	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,925,000	\$46.32 / Month
Township Cash after 20 Years	\$2,660,445	(\$15.59) / Month
Higher Customer Prices		\$ 0.00 / Month
Net Impact on Township Households		\$30.73 / Month
80% - Market Rate	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,925,000	\$46.32 / Month
Township Cash after 20 Years	\$5,819,076	(\$34.10) / Month
Higher Customer Prices		\$20.00 / Month
Net Impact on Township Households		\$32.22 / Month

Here is what these results tell me:

- First, there is ‘profit’ to be made by being your own ISP. While you can’t make enough profit as an ISP to fully cover the costs of the bond, you can generate excess cash that could be used to either make some of the bond payments each year (and reducing the millage rate that year), or else you could pay off the bonds early. One of the big upsides of this idea is that after the bond payments are finished this would return a positive new cash flow to the Township that could be used for other things.
- It’s obvious that the number of customers that buy ISP services makes a significant difference. This makes it vital that you undertake a pledge drive before seeking financing

or launching your own ISP so that you can have a good idea of what the finances will look like.

- The version where I look at ‘market rates’ was done to see the impact of raising customer rates and then using the profits to somehow cover bond expenses. You have a philosophical issue to answer when choosing rates. These results show that excess profits can result in lower overall costs to everybody in the market, even those that don’t buy broadband. So you could increase rates so as to lower the cost for everybody (and by charging more to those that want broadband). There is no right or wrong answer when setting rates and the two rates I’ve suggested aren’t the only options. But these results show that the more you charge, the more cash is generated by your own ISP that can be used to cover bond costs.
- All of these versions are superior to an open access scenario where all of the profits accrue to an external ISP rather than to the Township.

Open Access Scenarios

In this scenario the Township pays for the network through property taxes. You would only charge \$8 per month to the ISPs to use your network – that fee to maintain a rainy day fund to pay for repairs. In this scenario all of the profits accrue to the ISPs. The results of this scenario are the same in you have one or multiple ISPs.

60% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,600,000	\$43.26 / Month
Township Cash after 20 Years	\$ 241,283	
Equity Needed by ISP	\$ 188,923	
ISP Cash after 20 Years	\$1,495,617	\$ 8.76 / Month

Net Impact on Township Households \$43.26 / Month

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,600,000	\$43.26 / Month
Township Cash after 20 Years	\$ 352,211	
Equity Needed by ISP	\$ 199,955	
ISP Cash after 20 Years	\$1,914,832	\$11.22 / Month

Net Impact on Township Households \$43.26 / Month

80% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,600,000	\$43.26 / Month
Township Cash after 20 Years	\$ 479,427	
Equity Needed by ISP	\$ 210,959	
ISP Cash after 20 Years	\$2,396,510	\$14.04 / Month

Net Impact on Township Households \$43.26 / Month

These results tell me:

- In this scenario your citizens always pay the full cost of the bond issue through property tax. There are no profits generated to offset those costs or to pay the bonds off early. The expected property tax assessment is an average of \$43.26 per month per household for 20 years.
- The number of customers on the network doesn't make a big difference to the township. However, you want the ISPs to do well so that they continue to serve on the network.
- The primary downside of this scenario is that ISPs are free to charge whatever they want. The above figures assume a \$35 rate, but they could charge more than that to increase their profits.
- The big risk of this scenario is that you might someday not have an ISP willing to serve your customers. The best example I have of this, which is described elsewhere in this report is in Chelan County Washington where they have been reduced to having one ISP who is serving over 20,000 customers. And there is no guarantee that ISP will always be there to serve.

Effect of Interest Rate Increase

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,600,000	\$47.01 / Month
Township Cash after 20 Years	\$ 649,751	
Equity Needed by ISP	\$ 199,955	
ISP Cash after 20 Years	\$1,914,832	\$11.22 / Month
Net Impact on Township Households		\$47.01 / Month

An increase (or decrease) in interest rates only really affects the homeowners since they must cover the bond payments with property taxes. This shows that a full 1% higher interest rate changes the impact to a household by \$3.74 per month for the 20 years. While interest rates are in a state of flux right now, a full 1% swing in interest rates would be extraordinary. But none of us has a crystal ball to predict the future.

Effect of 15-Year Bond Term (shorter)

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,600,000	\$51.94 / Month
Township Cash after 20 Years	\$ 382,290	
Equity Needed by ISP	\$ 199,955	
ISP Cash after 20 Years	\$1,914,832	\$11.22 / Month
Net Impact on Township Households		\$51.94 / Month

It's clearly going to be an easier sell to homeowners if the property tax increase is smaller. Shortening the bond term to 15 years raises the monthly increase in property taxes to \$51.94. This actually is a savings for homeowners and it costs less to make these larger payments for 15 years than the smaller payments for 20 years. But this feels like an increase that many homeowners

might object to. The term of bonds generally follows the life of the assets being financed. I generally see fiber bonds with lives between 20 and 25 years.

Lowest Possible Capital Costs

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,350,000	\$40.91 / Month
Township Cash after 20 Years	\$ 362,515	
Equity Needed by ISP	\$ 199,955	
ISP Cash after 20 Years	\$1,914,832	\$11.22 / Month
 Net Impact on Township Households		 \$40.91 / Month

This shows that changes in the capital costs to build the network flow through straight to homeowners. This means it's important to choose construction options that provide for a great network without overbuilding them.

High Capital Costs

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$5,100,000	\$47.96 / Month
Township Cash after 20 Years	\$ 280,111	
Equity Needed by ISP	\$ 199,955	
ISP Cash after 20 Years	\$1,914,832	\$11.22 / Month
 Net Impact on Township Households		 \$47.96 / Month

This shows that higher capital costs hurt the homeowners in the same manner that low ones benefit them.

Higher Capital Contingency Costs

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,775,000	\$44.91 / Month
Equity Needed by ISP	\$ 199,955	
Township Cash after 20 Years	\$ 362,603	
ISP Cash after 20 Years	\$1,914,832	\$11.22 / Month
 Net Impact on Township Households		 \$44.91 / Month

The contingency represents borrowing extra money to cover any cost overruns in constructing the network. This shows that it would be wise to seek fixed price bids to build the network before you get funded, which would pin down the construction costs and would eliminate the need for extra contingency.

Traditional Open Access Model

50% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,600,000	\$43.26 / Month
Township Cash after 20 Years	\$1,398,624	
Township Reduced Property Taxes	(\$1,200,000)	(\$ 7.03) / Month
ISP Cash after 20 Years	\$1,248,800	\$ 7.32 / Month
Customer Price Increase		\$20.00 / Month
Net Impact on Township Households		
For those buying broadband		\$56.23 / Month
For those not buying broadband		\$36.23 / Month

This scenario has the township charging \$25 per month per customer to use the network. This is likely to mean fewer customers on the network since the ISPs will pass along your fees in higher rates. For this example I've assumed that the scenario reduces the penetration rate to 50%.

The results of this scenario have a different impact on customers that buy or don't buy broadband on the network. I've assumed that the township would use a lot of the cash it generates in this scenario to cover bond payments.

This scenario doesn't make much sense for the township. It forces rates to be higher, meaning that there are fewer customers who will use the network. The customers that use the network have already paid for bonds in their property taxes and will also pay high rates for broadband in this scenario.

Partnering with 3 Other Townships – 70% Penetration

In this scenario the township would partner with two other townships and create a broadband cooperative to operate the business and act as the ISP. The big difference between this and the open access scenario is that any profits from the cooperative could be used to benefit customers. This will be discussed in more detail below. This benefit could come either through reductions in retail prices or by lowering the cost of bond payments.

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,875,000	\$45.85 / Month
Township Cash after 20 Years	\$ 311,340	
Coop Profits after 20 Years	\$ 520,098	(\$ 3.05) / Month
Net Impact on Township Households		
		\$42.80 / Month
80% Penetration		
	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,875,000	\$45.85 / Month
Township Cash after 20 Years	\$ 442,591	
Coop Profits after 20 Years	\$ 993,215	(\$ 5.82) / Month

Net Impact on Township Households

\$40.03 / Month

There is one additional benefit to this concept which is that it would allow you to provide a minimal free broadband connection to every home, even if they don't buy traditional broadband. They could use the WiFi, for example, to reduce the data costs for their cellular plans or to use Internet of Things devices like Amazon Echo, smart thermostats, or IP burglar alarms.

This shows that there is a modest savings available to customers from creating a cooperative between a few townships.

These bonds are a little larger than in the open access model since I've assumed that the township would kick in a share of the cost to launch the ISP. But there are issues with using bond money for anything other than capital, so a way needs to be found to fund the money needed to start the ISP. For example, it might be possible for the ISP to obtain bank loans to start the business. But the easiest path would be for each township to kick in a share of funding to jumpstart the new ISP.

Partnering with 9 Other Townships – 70% Penetration

70% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,775,000	\$44.91 / Month
Township Cash after 20 Years	\$ 319,156	
Coop Profits after 20 Years	\$ 1,422,647	(\$ 8.34) / Month
Net Impact on Township Households		\$36.57 / Month
80% Penetration	<u>Total</u>	<u>Per Customer</u>
Bond Needed	\$4,775,000	\$44.91 / Month
Township Cash after 20 Years	\$ 450,250	
Coop Profits after 20 Years	\$1,895,700	(\$11.11) / Month
Net Impact on Township Households		\$33.80 / Month

This shows that there is a big benefit to making the cooperative larger. There is an economy of scale at the jointly-created ISP from having more customers. And with more townships the cost for each one to fund the new ISP become smaller. Finally, this demonstrates that even with a larger cooperative there is great incentive to get as many customers on the cooperative networks as possible.

A Few Other Revenues to Consider

The business plan I have created is a little conservative on the revenue projections. There are other potential revenues that could help to pay for the network:

- Business Revenues. I've included no business revenues. Some ISPs (not all) charge a premium price to business customers for broadband. There are only a few businesses in the township today, so recognizing these extra revenues won't make much different to the business plan analysis. But there is the potential for some extra revenue.

- Home Run Revenues. There are a few opportunities for what I call home run revenues – meaning significant revenues from a single customer. For example, there are a few cell towers within the township and it is possible over time that you could provide bandwidth to these towers. But I’ve not included this revenue in the forecasts because it’s not an easy revenue to get – cellular companies prefer to buy connections in bulk from wholesale providers and it could be difficult to displace whoever is serving these towers today.
- Future Products. It’s likely that ISPs will find future revenues that are not reflected in these projections. We are already seeing the large cable companies offer products like home security, energy management, home automation, etc. It’s possible over time that even small ISPs will be able to make some positive margins by reselling these products.

D. What These Results Tell Us

The township has some interesting options to consider. There are viable scenarios that work under three different business models:

- The township acts as the ISP. If enough households would subscribe the excess cash generated can be used to help offset bond costs.
- The township finances the entire network through property taxes. You then make it available for one or more ISPs to bring services. It turns out this is the financially least attractive option because it requires the township to pay for the network and you don’t gain any benefits from the profits made from operating on the network. This comes with the risk that the ISPs might charge higher rates than you would with your own ISP. And there is a huge risk that someday you might have no ISP who wants to operate on the network.
- The township can partner with other townships to create an ISP that would operate on the network. If you can gain economy of scale by getting enough townships to work together, this can return significant cash profits to each township to help offset bond costs.

Following considers the pros and cons of each of these ideas. This is important because the decision should not be made entirely based upon finances.

Township Operating Your Own ISP

Note that this would have to be a very simple and stripped down ISP. I would envision perhaps two part-time employees to operate the ISP. So this would mean “small-town service,” but it would also be local service and these employees should be able to satisfy everybody. But most of the services needed by an ISP can be purchased from vendors—meaning that the local employees would take care of local maintenance issues, bill customers, and answer customer questions.

Pros

- Any revenues generated above operating costs can be used to offset the bond payments. As long as the business is run efficiently it can generate positive margins.
- This can work really well if households agree to pay broadband rates higher than market. In nearby towns like Ann Arbor a household can get a decent broadband connection for \$55. If your households would agree to pay something higher than my suggested \$35, then that extra cash can cover a significant amount of the bonds. It’s worth noting that a lot of rural broadband cooperatives charge rates between \$70 and \$100.

- Because the township owns and operates the ISP, you could also provide a free or low-cost broadband connection to every household. Such a connection might be set at a low speed like 5 Mbps—but this would be sufficient to allow home usage of data for cellphones and for Internet of Things devices (Amazon Echo, burglar alarms, smart thermostats, etc.). The big danger here, though, is that too many people elect the free option.
- One of the biggest benefits goes to homes that don't use broadband. The revenues from customers paying for broadband pay more towards the debt than homes that don't. But it looks like there will always be some property tax assessment each year to pay for the network.

Cons

- The township is taking all of the risk of operating the ISP. If you operate inefficiently and let costs get out of control, then this could cost more to households than a straight-up property tax financing.
- There is an administrative state barrier that makes it harder for a municipality to serve broadband than other kinds of business entities. The specific language of this restriction is included in the Next Steps section of the report. It doesn't appear to be a hurdle you can't overcome, but you need to get legal advice on the issue.

Open Access Network

In this scenario the township would secure financing directly with a property tax increase. The network would then be opened to one or more ISPs to provide service.

Pros:

- Customers should hopefully get lower prices since the ISPs are paying almost nothing to use the network (I am recommending you charge them \$8 per customer per month). This might mean that customers can get a 100 Mbps connection for something like \$35. But there is no guarantee that the ISPs will price it that low and the township is going to have almost no control over what ISPs choose to sell on the network and what they charge for products.
- The township does not have to be in the ISP business. You build the network and then open your doors to ISPs. This is the simplest option for the township in that you set the property tax surcharge each year and make bond payments and have to do very little else.
- It's possible that if you get multiple ISPs that you might get some competition for broadband. However, there is no guarantee of this and in other open access markets we've seen the ISPs all charge basically the same rates.

Cons:

- Households will pay the full cost of financing the network from property taxes. I've estimated that to be in the range of \$43 per household per month for 20 years. This fee is charged to everybody—homes that want broadband and those that don't. If this is charged on assessment values, then more expensive homes will pay even more for the broadband surcharge.
- None of the profits from selling broadband is used to help pay for the network. The ISPs will make a profit while homeowners always pay the bond payments.

- My analysis shows that traditional open access is the most costly option for citizens. If you want to charge any substantial fees to the ISPs, they will both pass those fees on to customers and they will also cherry-pick, meaning they will seek to only serve homes willing to commit to a high monthly bill. My analysis shows that if the township charges \$25 per month for each customer connection that the overall impact to customers is the worst of any scenario. This is because customers will pay high prices, and there will also likely be fewer households on the network.
- You always run the risk that at some time in the future there might be no ISP willing to operate on the network. We've seen an example in both Chelan County WA and Provo UT where an open access network started with multiple ISPs and then dwindled to one. And there is no guarantee that even one ISP will want to serve you. In such a circumstance your network would go dark but you'd still have to make the bond payments.

Partnering With Other Townships

In this scenario you would partner with other townships to create an ISP to operate on all of your networks. The goal is to take advantage of economy of scale such that the more townships that band together, the better the financial result for everybody.

Such an ISP probably would have to be more complex than the simple stripped-down one you could operate by yourself.

Pros:

- This has the potential to being the best financial scenario for homeowners.
- The biggest benefit from this scenario is that all profits from operating the network would flow back to help reduce the burden on customers. This could be done either by reducing broadband rates (benefitting just broadband customers) or by flowing profits back to the townships to help cover bond payments (benefitting all homeowners).
- The analysis shows there is a major economy of scale. The bigger this joint effort becomes, the bigger the benefit to every member township and their citizens. There is not much benefit from doing this for just a few townships (unless you run the ISP as stripped-down as the one I've recommended if you do this yourself). But there are significant profits to be made as the township-ISP gets larger.

Cons:

- You won't get competition from multiple ISPs on the networks. But this perhaps ought to be listed as a benefit, because if the ISP is owned and operated by the townships it is likely to provide great customer service and low prices.
- There is a lot of work needed to put together this kind of coalition and to make it work. You need firm buy-in from township partners before the first township can feel safe to launch. There is a bit of a chicken and egg phenomenon—townships might want to see this work before joining, but without enough of them joining it's difficult to get started. The township could launch first with your own ISP and add other townships into the business over time.
- It's not necessarily a negative, but there is research needed to understand the best legal structure for such a joint business. The primary issue is to find a structure that would let

the profits from the business flow back to the townships. For now you've created a cooperative, but it may turn out that is not the best structure. For instance, can governments be owners of a cooperative? This might also work as something an Authority arrangement between government entities. But then there are the legal risks associated with operating directly as a government entity—meaning any restrictions on municipal broadband providers could kick in.

E. Conclusions/Recommendations

In my first conversation with the township broadband committee I heard that concept that was most in favor is to use property taxes to pay for the network and then open up the network to open access.

But I've always said that numbers ought to tell the story. It turns out that an open access network is the most expensive option for the township homeowners. If a way can be found to somehow form a government-run ISP, then the profits from that business can help to offset some of the bond fees and can provide the lowest overall cost to homeowners.

Another big upside to have the township, or a group of townships, operate the network is that you could provide broadband to every home, even for those that don't have computers or want traditional broadband. Such households could be given a free low-speed connection that could be used to supply data to cellphones or to operate devices that need WiFi such as smart appliances, burglar alarms, etc. It seems like this will be an easier sell to the public if everybody gets something for their property tax increase.

The numbers tell me that capturing some of the profits from operating the ISP is the best idea. This can be done by the township operating a minimalist and stripped-down ISP or it could be done by partnering with other townships to operate a more robust ISP.

One thing to keep in mind in looking at all of these options is that households will be paying a lot for broadband—either directly or through property taxes. For example, in the open access scenario households will be paying \$43 for property taxes and probably at least \$35 per month for broadband. That means a total increase to households of \$78 per month for twenty years—although they do get great fiber broadband for that price.

With all of that said, here are my specific findings and recommendations:

Forming an ISP is the Best Financial Option

This is the opposite of what I expected to find, which is why I let the numbers tell the story. The number cut through issues and paint the bottom-line picture of what various options cost your homeowners.

There are two possible ways of doing this, and there are pros and cons of each.

- The township could create a small and simple ISP to serve your homes.

- You can partner with other townships to create an ISP. This could be a little more robust of an ISP than doing it yourself, and could, for example, afford to hire an experienced general manager. There is significant economy of scale with such a business and the more townships that come together, the bigger the benefit to customers.

Consider More Than Only Dollars

There are generally reasons other than a pure dollar comparison when making these kind of choices. I call these social considerations.

Free Broadband For Everybody. One of the most intriguing possibilities is that if you somehow operate this with your own ISP that you can then provide free, or very cheap, broadband to every home. That is something that is not likely to work in an open access environment as an ISP is not going to want to service customers who aren't paying for broadband. But you could provide every home with a small amount of broadband to use for cellphone data or for the many new uses for broadband such as using an Amazon Echo, having an IP security system, or operating smart home devices (something that is going to be in big demand within a few years).

Rate Fairness. There are some negative social issues to paying for the network from property taxes. First, homes with a higher assessed property value will pay more than others. But more importantly, homes that don't want to have broadband are going to be paying for those that do. Some of the options I am recommending recover a significant amount of the money needed to make bond payments from broadband customers. Generally municipal businesses adhere to a principal that cost causers ought to pay for service. That's why homes that use more water or more electricity pay more than those who use less. A structure that generates some of the bond payments from broadband customers is fairer than one that only uses property taxes.

Quality of Customer Service. There is always the possibility in an open access environment that the ISPs on your network won't do a good job. A small ISP might maximize profits by being slow to answer customer calls or to make repairs. They might be bad at billing customers. The problem with a low-quality ISP on an open access network is that you will have almost no ability to replace them or offer an alternative. The township can control customer service better if you control the ISP, either through direct ownership or through partnering with other townships.

How Hard Is it to Be an ISP? If you want to consider one of the options other than open access, you will have to wrestle with the question of how comfortable you are with operating an ISP. My opinion is that this is probably a lot easier than you think and it is certainly a lot easier than it was a few years ago. There are numerous small ISPs around the country that would be of a similar size of yours at 500 – 600 customers. Here are the primary functions the ISP would have to handle:

- Providing the Data Product. This used to be quite technical, but today this entire function can be outsourced to high-quality vendors for a reasonable monthly cost per customer. The outside vendor will route Internet traffic, check for viruses,

protect the network against malicious software attacks, etc. This vendor would also answer customers' technical questions and would also have the ability to effectuate simple repairs for you remotely.

- Maintain the Network. For a fiber network this small there is a not going to be a lot of maintenance required. You can hire a part-time technician to make any needed repairs and to maintain the fiber and electronics. You can contract with other carriers to come in and handle major repairs (such as when somebody cuts a fiber).
- Backoffice Functions. This involves things like taking orders, preparing bills, and collecting payments. For a company this small this can easily be a part time position that perhaps works only in mornings, or else a few days per week.

This gets a little more complicated if you were to operate a larger ISP across multiple townships. In that case I would recommend that the ISP be staffed with a general manager who would oversee all of the above functions. But otherwise, even a larger ISP only has to cover the basic functions. One thing we've learned is that the one product that requires a lot of staff effort is cable television, and as long as you don't offer that, then an ISP can be a pretty simple business. Obviously you will want to have a technician who is competent, but this kind of talent seems to be reasonably available almost anywhere.

Consider Risk

There are a few risks to consider for each of the options that should also be part of the decision-making process of choosing the best operating model. The following are the biggest risks I foresee:

What if no ISP Wants to Serve? One of the dangers of the open access model is that you might eventually end up with a situation where no ISP is willing to serve on your network. The kinds of companies that will operate on an open access network are small, undercapitalized, and are generally sole-proprietorships or family businesses. You are looking at probably financing the network from 15 to 20 years, and that is a long time to count on somebody to be willing to operate on the network. If you end up with only one ISP (and this has happened to other open access networks), then you will live in fear of that ISP folding or the company owner/operator dying. It is not inconceivable that your network could go dark if there is no ISP available or willing to serve.

Broadband Alternatives. There are two possible competitors to any broadband network you build that must be considered.

- CAF II Broadband. The FCC has provided subsidies to AT&T and Frontier, both of whom serve part of the township, to upgrade their rural broadband. This is likely to result in faster cellular broadband from AT&T and faster DSL from Frontier. The FCC requirement is that these upgrades deliver at least 10 Mbps download – speeds that are faster than what is available in the township today. The risk is slight from this competition, but there will be households that find these upgrades to be adequate and who would rather stay with these providers than pay for a fiber network.
- Elon Musk Satellite Broadband. Elon Musk, the owner of other innovative businesses like Telsa Motors and SpaceX, is trying to raise \$10 billion which he says will enable him to blanket the globe with faster satellite broadband. He's

talking about putting up over 4,000 satellites at low altitudes and might be able to offer broadband of 100 Mbps or faster. Of course, this is still just an idea on the drawing board, but he has been able to make his other wild-sounding plans come to fruition. If this network is built it could provide a significant competitor to your own network (and every other rural broadband network). The risk is building your own network and then his satellite network is built and can do what he promises and undercuts demand for your network versus him never making this work. This is a really hard risk to judge.

Build Only to Success

If you end up being the ISP, then I strongly recommend that you only build to success. By that, I mean that you should have some sort of pledge drive and sign-up all of the customers in the township before getting the network financed. If you adopt one of the business options that counts on customer revenues to help pay for the network, then getting customer buy-in before you start is essential.

F. FINANCING OPTIONS

The township has already found the most likely financing option for a project this small. A lot of 'normal' financing options are not going to be easily available to you. But let me highlight a few that could be. Following is a discussion of some of the primary ways this project could be financed. We will look at the options for financing it both as a municipal venture and 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 is not unusual to find bonds for fiber projects that 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 up front.

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 still 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 on the part 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. 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 require borrowing 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 that 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.

The difference between bond interest rates and commercial interest rates both change over time; that difference is referred to in the industry as the 'spread.' Sometimes the spread favors bonds and at other times it favors commercial borrowing. In the scenarios used in the study the commercial loans produce better results. But in some of the scenarios studied above the business had a hard time covering the debt payments on the commercial loans in the early years, and in those cases municipal financing would be safer.

Interest rates are not the same for all kinds of bonds. For instance, the interest rate for revenue bonds can be considerably higher than general obligation bonds due to the perceived higher risk. In the last few years the difference between the two types of bonds has not been too great, with general obligation bonds between 4% and 5% and revenue bonds between 6% and 7%. But this changes over time and there have been historic times when one of the two types of bonds would be a better option.

The revenues from this project are not going to be strong enough to support a pure revenue bond. However, that does not mean that the revenues from the business can't be used to help pay for other kinds of financing.

General Obligation Bonds (GO Bonds): If revenue bonds aren't an option 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 the case of the Township, this is the most likely financing option, and one you have already realized. In your case you can issue revenue bonds backed by property tax revenues. But again, this does not mean that only property taxes can be used to repay the bonds and it looks like the best option includes using some of the revenues generated by the business to help cover some of the bond costs.

Private Financing Options

One of the problems of launching the business through a cooperative is that you might not be able to use bond proceeds to start the cooperative ISP. This might mean looking for a small secondary source of funding. The traditional way for commercial ventures to get financed is through bank loans. 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 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.

In your case, the only likely form of equity would be a cash payment, up front by each home owner. There is no reasonable way to require homeowners to do this, which creates its own set of issues. But a bank loan is likely to require equity.

Bank Loans: While there are around 150 municipal fiber ventures in the country that largely have been 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 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 reserves along with a general desire to go after higher interest rate 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 not to make loans with a term much longer than 12–15 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 percentage points higher than bond rates, which also makes it harder to prove feasible.

Also, bankers generally expect a significant amount of equity from the borrower. The banking industry has gotten much 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 difficult to raise the kind of equity needed to make a project work.

There are exceptions. A few of the large banks like Key Bank 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. Banks are also somewhat 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. CoBank is a relatively small bank and has strict requirements for financing a project. They are leery of start-ups and we can't think of a start-up they have financed recently. 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. That obviously doesn't go far in a fiber project. However, local banks have become adept at working in consortiums of multiple banks to make larger loans. This spreads the risk of any one loan across many banks. 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. There is an application process to get a loan guarantee in much the same manner as applying for a bank loan or a grant, meaning lots of paperwork. And then the agency making the guarantee will generally want 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 directly 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. 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 that do not include cities of 20,000 population or greater, which would not be an issue in Nobles County.

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.

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 allowed to make loans to a wide range of entities. Borrowers can be either 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 often 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, we 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 yet 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 large 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 Markets Tax Credit: 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. However, 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 Markets 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 are 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:

- Loans from Individuals: We've seen small fiber businesses gain equity through non-recourse loans from people and businesses in the area. 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: If you borrow through the cooperative, it's possible to get low or even zero-interest loans from other cooperatives in the area. 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.

While it's possible to pursue non-bond financing, the process to so can be expensive. And there is no guarantees of getting funding from traditional lending sources like banks or the federal government.

G. OPTIONS FOR BUSINESS STRUCTURE

This report is recommending that you find a business structure that can somehow funnel some of the profits of the business back into paying for financing costs. However, this is not a straightforward process. There are several business structures that might work for this, and there are issues with each:

- **Direct Ownership of the Business by the Township**. The problem with this idea is that you would be operating a tiny ISP. This is possible and I know successful ISPs that are as small as this. But there is a lot more safety in finding a way to instead partner with other townships in order to form a larger ISP. On the plus side, the township would control everything. The revenues from the ISP could be used to directly offset some of the bond costs.

- Township Ownership, Operation by the Cooperative. This alternative is more attractive in that several townships could go together to form an ISP. That gains economy of scale and would allow an ISP that can offer better service. But the downside of this is that it might be challenging for Cooperative to flow money back to the township to help pay for financing costs. Cooperatives have rigid rules that dictate how much they can pay out of profits and when. There are two alternative ways to structure ownership by the Cooperative to be considered.
 - First, all of the customers could be owners of the Cooperative. In that case, the Cooperative would not be contributing to bond payments. But it might be able to pass money back to customers in the form of rate reductions. However, there might even be limits on that.
 - It might be possible for the Cooperative to be owned directly by the Townships with the townships as the only members. However, that is a nuance of coop law that will have to be explored. In that option the coop could make payments back to each township to help defray bond costs. But even then there might be legal restrictions on how much and how fast the Cooperative could make such payments.
- Township Ownership, Operated by some other business structure. It may turn out that a cooperative is not the best structure for multiple townships to own an ISP. Perhaps this would best be done as some sort of joint powers agency owned by the various participating townships. It might even be possible to form this as an LLC or as a direct non-profit corporation – depending on what is legal for townships to do in Michigan. The big upside to this kind of structure is that profits could probably be flowed immediately each year to help pay for bond costs.
- Township Ownership, Open Access to ISPs. This is the least attractive option from a financial perspective because all of the profits of the business go to the ISPs, meaning that homeowners pay the full cost of the bond financing.

In my recommendations I suggest that the Township take a hard look at these options. A lot of the choice is going to boil down to what is allowable to Townships under Michigan law. For example, you might not be able to be an owner of a cooperative or for-profit corporation.

I know you have already formed a cooperative, but that is not necessarily the right or the best structure to make this work to everybody's best interest. The ideal arrangement looks to be where the Township owns the network, services are provided by an ISP owned by one or more townships, and profits from the business used to defray some of the bond costs. Any structure that does not allow for all of that is not the best one.

VII. Other Issues

A. Connect America Fund

In the fall of 2015, both Frontier Communications and AT&T accepted funding from the FCC to improve rural broadband in Washtenaw County. There is a map attached as an addendum that shows the areas that are covered. Sharon Township is included in these upgrade areas.

This funding comes from the Connect America Fund, which is part of the FCC's Universal Service Fund. This particular program is referred to as CAF II, meaning that it was the second round of such funding awards, with the first round being much smaller.

The Universal Service Fund today is funded primarily from surcharges on telephony revenues. Originally, the USF was funded by surcharges on landline telephones and special access circuits only, but eventually a surcharge was also placed on cellphones. The fund has the purpose of promoting broadband around the country and has four primary components:

- High Cost Fund. These are payments made to rural providers for building networks. This was historically given to support rural telephony but is being shifted to support rural broadband.
- Lifeline. This program provides a \$9.25 monthly subsidy for either a telephone line or a data connection for qualifying low-income households.
- Rural Healthcare. This provides for data connections to rural hospitals and clinics.
- Schools and Libraries. This subsidizes fast broadband connections to schools and libraries, where the national goal is to bring gigabit speeds to these facilities.

The Connect America Fund (CAF) is a component of the High Cost Fund. The FCC set aside \$1.7 billion per year for the six years starting with 2016 to build or upgrade rural broadband. These funds were mostly made available to Census blocks that have little or no broadband today.

The funding was available to the largest telcos automatically. Both AT&T and Frontier elected to take this funding for Washtenaw County. The CAF II awards for the County are as follows:

- AT&T accepted \$435,687 per year to bring service to 1,617 rural customers.
- Frontier accepted \$119,570 per year to bring service to 441 rural customers.
- Together the two companies are getting \$3.3 million to improve rural broadband in the county.

The amount of the awards are based upon nationwide cost models that have been developed to estimate the cost of upgrading rural areas to broadband.

The township is mostly served by AT&T, although there are a few customers in the township served by Frontier.

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. The companies have six years to make the needed

upgrades, with 2016 being the first year. Note that those speeds are far slower than the FCC's own definition of broadband—25 Mbps download and 3 Mbps upload.

The companies can use the money to implement any broadband technology that will achieve the desired speeds. Frontier has said that they will use the money to upgrade or add DSL. In order to implement the DSL, they will have to extend fiber deeper into the rural areas to support the DSLAMs (DSL transmitters).

But AT&T is likely to use the money in a very different way. I have not yet seen any announcements made for Michigan, but in other states AT&T says they will use the money to expand 4G cellular wireless coverage and will use that to satisfy the FCC requirement. We also know that AT&T badly wants to get rid of their copper networks and they have started the process in many states of tearing down their copper. I expect them to do this everywhere that gets the CAF II upgrades to cellular service.

This means that AT&T is likely to be offering a faster cellular data service than they do today. But note that the fastest speeds available on 4G are about 14 Mbps—and to get that speed you need to be right next to a cell tower. It's likely that data speeds in the township today for cellular data are slower than the goal of at least 10 Mbps. We think it's likely that AT&T will offer a "fixed" cellular data product at homes where they will put a small dish on the outside of the home and will deliver data to a WiFi modem like other ISPs. It's also worth noting that the CAF II build-out allows ISPs to impose stingy data caps. The FCC suggests that data caps can be as small as 100 Gigabytes per month in total download. For a household that watches video over broadband that is a tiny data caps these days. As an example, my household doesn't have traditional TV and we watch all video over the Internet. With three family members (and a home-based business) we generally use about 700 Gigabytes per month.

These upgrades are something for Sharon Township to consider. While the 10/1 Mbps broadband is not very fast, even by today's standards, it might be welcomed by some of your citizens who only have the option today of dial-up or satellite broadband. Some of your citizens might be happy with this small broadband and not want to participate in fiber.

B. Faster Satellite Data

Late last year Elon Musk announced that his SpaceX company is moving forward with attempting to launch low earth orbit (LEO) satellites to bring better satellite broadband to the world. His proposal to the FCC would put 4,425 satellites around the globe at altitudes between 715 and 823 miles. This contrasts significantly with the current HughesNet satellite network that is 22,000 feet above the earth. Each satellite would be roughly the size of a refrigerator and would be powered by a solar array.

This idea has been around a long time and I remember a proposal to do something similar twenty years ago. But like many technologies, this really hasn't been commercially feasible in the past and it took improvements to the underlying technologies to make this possible. Twenty years ago they could not have packed enough processing power into a satellite to do what Musk is proposing. But Moore's Law suggests that the chips and routers today are at least 500 times

faster than two decades ago. And these satellites will also be power hungry and providing them enough energy wasn't possible until modern solar power cells were created. This kind of network also requires the ability to make huge numbers of rocket launches—something that was impractical and incredibly expensive twenty years ago. But if this venture works it would provide lucrative revenue for SpaceX, and Elon Musk seems to be good at finding synergies between his companies.

Musk's proposal has some major benefits over existing satellite broadband. By being significantly closer to the earth the data transmitted from satellites would have a latency of between 25 and 35 milliseconds. This is much better than the 600 microsecond delays achieved by current satellites and would match the latency achieved by many ISPs. Current satellite broadband has too much latency to support VoIP, video streaming, or any other live Internet connections like Skype or distance learning.

The satellites would use frequencies between 10GHz and 30GHz, in the Ku and Ka bands. Musk says that SpaceX is designing every component from the satellites to earth gateways and customer receivers. The large number of satellites would provide broadband capability to a large number of customers, while also blanketing the globe and bringing broadband to many places that don't have it today. The specifications say that each satellite will have an aggregate capacity of between 17 and 23 Gbps, meaning each satellite could theoretically process that much data at the same time.

The specifications say that the network could produce gigabit links to customers, although that would require making simultaneous connections from several satellites to one single customer. And while each satellite has a lot of capacity, using them to provide gigabit links would chew up the available bandwidth in a hurry and would mean serving far fewer customers. It's more likely that the network will be used to provide speeds such as 50 Mbps to 100 Mbps.

But those speeds could be revolutionary for rural America. The FCC and their CAF II program is currently spending \$9 billion to bring faster DSL or cellular service to rural America with speeds that must be at least 10/1 Mbps. Musk says this whole venture will cost about \$10 billion and could bring faster Internet not only to the US, but to the world.

It's an intriguing idea, and if it was offered by anybody else other than Elon Musk it might sound more like a pipe dream than a serious idea. But Musk has shown the ability to launch cutting-edge ventures before. There is always a way to go between concept and reality and like any new technology there will be bugs in the first version of the technology. But assuming that Musk can raise the money, and assuming that the technology really works as promised, this could change broadband around the world.

C. Recommendations

Following are my recommendations. Some of these are explained in more detail in the executive summary and the next steps at the beginning of the report.

Form Your Own ISP

The numbers say that it makes more financial sense to form your own ISP, either alone or with other townships. This is preferable to open access since it allows you to use any generated profits to offset the cost of financing. This also allows you to set prices and to make sure that you get good customer service.

Some Legal Research Needed.

There are a few areas that require more legal research.

First is to understand the existing Michigan rules for a municipality to offer broadband. At first glance this looks like a roadblock that can be overcome. But you need advice on how this has worked with other cities and if there are issues that are not apparent in the code language.

There are also issues to investigate before you use a cooperative to form an ISP. The primary one is to find a structure that allows you to flow excess cash back to help offset bond costs. That might be a real challenge with a cooperative.

Bond Research.

With this study in hand you should now be able to have a conversation with bond sellers about the term (number of years) and the interest rates you might be able to get from the bond assumed in here. To the extent that result is different than the assumptions I've made I would be glad to provide a new set of numbers that incorporates the best estimates. My hope is that you can get a lower interest rate than I've assumed at 5%. You also need to understand things like the ability to pay a bond off early. Finally, there is the issue of being able to use bond money to start an ISP – particular an ISP that would be operated by an external cooperative.

Socialize This with Other Townships.

Since one of the best financial options is to create an ISP between multiple townships, the process of spreading that word and looking for other interested townships needs to be undertaken.

I have always found that having these discussions is far easier when there is a concrete proposal to suggest. I know there has been a lot of discussion with other townships generically on the issue. But I think you can use this study to demonstrate that working together is a superior solution for your homeowners than building an open access network.

And obviously, if not enough other townships are interested, or if there are a few but they are geographically scattered, then this idea can't work.

Get Feedback from Citizens.

This study allows you to talk concrete numbers with homeowners. You now have an estimate of the size of the bond and how much that will cost homeowners each month in terms of bond payments.

Investigate what it Means to be An ISP

You are probably intimidated by the concept of operating your own ISP. This is something that CCG has done many time and we would be glad to help you understand your options.

Choose the Best Option.

After all the above research and feedback you can start to choose one of these options as the one you want to pursue. Again, remember that you want to consider both financial and social issues. For example, the idea of giving everybody free broadband if you do this with your own ISP is an idea that might gather a lot of public support.

Pledge Drive.

At any point where you want to get serious about pursuing a specific option you need to undertake a pledge drive. This would involve getting every homeowner in the township to tell you if they would be willing to pledge to buy broadband on the network. That pledge is needed so that you can understand the expected financial performance of the business. You would want to undertake this pledge drive even if the City is going to be the ISP. It's vital to understand the revenue stream that will be generated by the business.

VIII.Appendix: Map of Washtenaw County

Connect America Fund Phase II

Accepted Areas Map

