

Gainesville, Florida

Community Broadband Study May XX, 2019

DRAFT



Doug Dawson
President
CCG Consulting

Table of Contents

Executive Summary	3
The Study	5
Findings / Next Steps	7
I. Market Research	22
A. Current Market Rates	22
B. Residential Survey	28
C. Speed Tests / Customer Bill Analysis.....	36
D. Predicting Market Demand.....	45
II. Engineering Design and Cost.....	53
A. Design Parameters	53
B. The Technology	58
C. Electronics Design	65
D. Competing Technologies	67
E. Smart Grid and Smart City	72
III. Financial Business Plan Findings	78
IV. Other Considerations.....	84
A. Competitive Responses from Incumbents	84
B. Funding Options.....	86
C. Legal and Regulatory Analysis.....	99
D. SWOT Analysis	107
E. Implementation Timeline.....	115
F. The Opportunity to Create a Public / Private Partnership.....	119
G. The Connect America Fund.....	122
Appendix I: Business Plan Assumptions	179
Appendix II: Business Plan Results	179
Appendix III: Summary of Financial Results	179
Appendix IV: Results of the Residential Survey	184
Appendix V: Map of Gainesville City Limits.....	189
Appendix VI: Map of GRU Service Territory	190
Appendix VII: Map of Urban Expansion Area.....	191
Appendix VIII: Map Adding Small Cities.....	192
Appendix IX: Map of Incumbent Telephone Companies	193
Appendix X: Map of Alachua County Opportunity Zone	194

DRAFT

Executive Summary

CCG Consulting (CCG) submits this report of our findings and recommendations from the feasibility study conducted to understand the potential for bringing fiber broadband to Gainesville. Our study considered the most important aspects needed to consider creating a retail fiber business including market research to define interest in broadband, engineering estimates of the cost of building a fiber network, business plan projections to understand the financial feasibility of a fiber business, an analysis of the legal hurdles for municipal broadband in Florida, and an analysis of numerous ancillary issues that will need to be part of the decision process to consider a fiber network.

The city presented us with an interesting challenge when we were asked if there is an opportunity to build a retail fiber network that can have the lowest broadband prices in the country. We were even asked to quantify the ramifications of giving free broadband to everybody. This report discusses the steps we took to answer those questions and describes the results we found.

What we found was interesting. There are scenarios where the city could provide low-price broadband while operating a fiber business that would be self-sustaining and profitable and that wouldn't need any subsidies from GRU or the city. However, creating such a business is no slam dunk.

First, there are some considerable hurdles to overcome. One is finding a way to finance the network with our estimates of the needed bond financing, ranging from \$113 million to build fiber in the city limits of Gainesville up to \$213 million to build fiber to reach all of the populated parts of the county, including the small cities.

Another hurdle will be the reactions of the incumbent providers. We would expect them to vigorously attempt to delay or derail any plans to launch a retail fiber business. They would be helped in this effort by existing Florida statutes that create a series of hoops for a city to jump through before launching a retail fiber business. One of the provisions of those statutes is particularly troubling – the suggestion in the law that revenue bonds be used to finance the project. We don't think there is a current market in the country for selling pure revenue bonds for a fiber network and that any financing would likely require the use of some form of general obligation bonds.

Another hurdle is the likelihood that you'll decide to hold a referendum. There is a provisions in Florida law that require a referendum if the city borrows for revenue bonds for broadband for more than a 15-year term. This project is going to require bonds with a term longer than 15 years. It's not clear if that restriction applies to other kinds of bonds. The issue is further muddied since the city has built the current broadband business using non-revenue bonds with terms greater than 15 years. The city faces the difficult decision of holding a referendum to be safe or risk being sued over the issue.

The final set of hurdles are the operational challenges of creating the internal processes needed to execute on the business plan. The nature of bond financing for this kind of project is that you'd

have to sell and install customers quickly and in large numbers in order to be able to make the needed payments in bonds. While GRUCom is already a telecom provider, it's a tall task to gear up for the operation needed to make this work in the time frame that's needed.

We also looked at the possibility for providing free broadband for residents. That looks to be possible if the city could find some other tax revenue that would cover a cost of over \$27 per month per household in the city (more than \$330 per household per years). That sounds like a huge challenge.

We also looked at alternatives to the city being the ISP. We conclude that public private partnerships are probably not possible because the profit motive of a commercial partner conflicts with the city's goal to have low-priced broadband. There are ideas that might benefit financing for the business plan. For example, if you build outside the city limits you might seek financial help from the county and the small cities in the county. There is also the intriguing possibility of somehow getting some low-cost debt financing as a result of the Economic Opportunity Zone laws that were recently enacted at the federal level. It's even worth discussing the possibility of buying out Cox rather than competing with them as a shortcut to bring lower-cost broadband.

Below is a summary of our primary findings of fact, followed by the conclusions we've reached concerning the opportunity to build fiber. Finally, we provide a list of what we think are the most important next steps needed if the city decides to pursue the fiber idea past this feasibility report.

The Study

Project Description. CCG Consulting was hired to conduct a Community Broadband Study. The project was initiated by an Invitation to Negotiate (ITN) issued on March 27, 2018. We were eventually selected as the consultant to provide the analysis.

The ITN defined three geographic study areas, but during the negotiation we added a fourth study area being the city limits of Gainesville. The ITN also required us to consider: 1) GRU Service Area, meaning where GRU provides utility service; 2) Urban Reserve, only looking at neighborhoods with reasonable housing density; and 3) adding on the municipal areas within the county where GRUCom has fiber infrastructure - Newberry, Hawthorne, Archer, High Springs, Waldo, and Alachua.

The ITN listed some specific goals for the study:

Primary Goals:

Lower prices and increased speeds for residents
Lower prices and increased speeds for businesses
Everyone has access to municipal network in designated areas

Secondary Goals:

Lowest priced gigabit internet for residential service in the United States
Lowest priced internet for businesses in the United States
Universal free service to all residents served

The ITN specified specific deliverables in order to complete the project

- Feasibility engineering cost estimate of each option
 - Infrastructure assessment (Gap analysis from current to implementation)
 - Best available technology for the application
 - Leverage AMI and Smart City plans
 - Implementation Timeline
- Financial feasibility models and forecasting models
 - Should study each alternative and provide sensitivity analysis of key variables
 - Goals are free and/or lowest priced gig for residential and commercial customers, however, each scenario would need to be compared to a market rate
 - Recognize change to GRU/GRUCom's business model and determine impact on current business
 - Analysis of available funding options and mechanisms for community investment, including potential grants to close funding gaps
- Various market-based levels of service
 - Broadband only
 - Content package included
 - Phone or other services
 - Triple play combination
- Market analysis

- Description of methods
- Residential and commercial surveys
- Legal and regulatory assessment
- SWOT Analysis
- Competitive analysis (current and outlook)
- Likely and required adoption rates and schedules
- Report of findings. At a minimum should include:
 - Description of the work done
 - Description of the findings
 - Recommendations for moving forward
 - Executive summary

This study assesses how the city might meet the stated goals. It also provides all of the needed analysis and work product required by the RFP, with that work product described in this report.

Findings

Market Rates and Competition. The incumbent providers in the city today are AT&T and Cox Communications. We looked at the prices currently charged by both companies and conclude that the city has some of the overall highest rates we've seen for the triple play in the country.

We looked at how these two providers have reacted to competition in the past and conclude that there is a high likelihood of significant reaction by these companies. At the extreme that might include lawsuits to block the city from building a network. AT&T could react by building fiber to parts of the city to make it harder to compete with them. At a minimum you should expect price competition from both companies and improved customer service in the city as a result of a new fiber network.

Residential Survey. We conducted a random survey of potential residential customers of a fiber network. The survey produced some interesting results:

- 92% of survey respondents had some form of landline broadband. 64% of those with broadband subscribe to Cox, 29% subscribe to AT&T, and the remainder subscribe to Windstream or another provider.
- 91% of respondents still subscribe to traditional cable TV service.
- 59% of respondents still have a landline telephone.
- 38% of respondents support the idea of the city building a fiber network with another 35% saying they need more information to understand the issue. This suggests the need for a public education campaign before holding a referendum asking the public to support the network.
- The public was more enthusiastic about the city's goals for fiber. 84% liked the goal of having the lowest broadband prices in the country, 62% liked the goal for bringing more competition and choice to the city.
- 49% of respondents said they would definitely or probably buy faster broadband from a city network at market rates. That improved to 56% when asked if they would buy gigabit broadband for \$50.
- 43% said they would definitely or probably buy cable TV from a city fiber network.
- 31% said they would definitely or probably buy landline telephone service from a city fiber network.
- 47% of respondents said they would definitely or probably support the idea of having part of their broadband rates support making sure all school students have broadband in their homes.

Speed Tests and Customer Bill Analysis.

The speed tests showed that many customers are getting the download speeds they subscribe to, and even a little more. However, nearly half of customers that took the speed tests were receiving speeds that are slower than what they are paying for. We can only speculate about the reasons for slow speeds, but our past experience makes us suspect that there are issues with at least some parts of the Cox and AT&T networks.

Customer bills show that the incumbent providers freely negotiate prices with customers. There are some customers paying near to list prices and other customers with substantial discounts. The bills also showed some products include what the industry calls ‘hidden fees’, including the “FCC fees” on telephone service and the Cox fees for access to Broadcast and Sports fees. Our general observation is that Cox has higher ‘list’ prices for cable TV and for bundles than what we’ve seen in looking at other large cable companies. While some customers negotiate deep discounts, we also saw bills from customers paying the higher prices.

Fiber Network Design. One important component of the feasibility study was estimating the cost of building a fiber network into each of the four geographic study areas. We considered the following in determining the design and cost of a fiber network.

Source of Data. We utilized the county’s extensive GIS mapping data that shows the locations or streets, buildings, and numerous other factors that affect the design of a fiber network. We did not have GIS data for a few of the smaller cities in the county and made a visual inspection of those cities. We also relied on US Census data, customer records from the GRU utility, and other sources of data from various departments in the city.

Passings. In the telecom industry, we use the term “passings” to mean a count of every potential customer that can be served by a network. The passings for the three scenarios are as follows:

	City	GRU	Urban	Plus
<u>Passings</u>	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Small Cities</u>
Single Family	23,021	17,515	3,731	8,241
Buildings with 2 - 4 Units	<u>11,897</u>	<u>1,344</u>	<u>1,179</u>	<u>1,498</u>
Total Residential	34,918	18,859	4,910	9,739
Businesses	<u>7,811</u>	<u>955</u>	<u>232</u>	<u>772</u>
Total Passings	42,729	19,814	5,142	10,511
Cumulative	42,729	62,543	67,685	78,196

Miles of Fiber Construction. The network design considered and incorporated some fiber already owned by GRUCom. We determined that the following miles of new fiber are needed for each scenario:

	City	GRU	Urban	Plus
<u>Miles of Fiber Construction</u>	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Small Cities</u>
Aerial Miles	358.65	244.55	60.79	128.94
Buried Miles	<u>293.45</u>	<u>200.08</u>	<u>49.73</u>	<u>60.57</u>
Total	652.10	444.63	110.52	189.51
Cumulative	652.10	1,096.73	1,207.25	1,396.76

Network Design. The following parameters were used in estimating the cost of building and operating a fiber network through each of the four study areas:

- The study excludes large apartment and condominium complexes and buildings. Residences included in the study include single family homes, duplexes, townhouses, and small apartment buildings of four units or less. The study considered small and medium businesses that are not served by the existing GRUCom fiber network.
- The network was designed to pass every home and business in the service areas and to provide the opportunity for every home and business to connect to the network. The network design also includes spare capacity to accommodate future growth.
- The study assumed that fiber would be placed on poles where they exist today and would be buried underground in places where other utilities are buried today.
- The network design uses passive optical technology (PON) to serve residents and small businesses. The technology reduces the number of fibers required in the field by allowing up to 32 customers in a neighborhood utilize the same fiber. The PON technology is robust and can provide a gigabit of broadband speed to every customer.
- Since the geographic area of the fiber footprint was so large, we decided to use a distributed electronics network that would place huts in neighborhoods throughout the various study area to house electronics for the surrounding neighborhoods. To the extent possible we assumed that huts would be located with electric substations.
- We utilized the existing GRUCom fiber network to provide a backbone connection to the huts and to provide a connection to the small cities included in the study. In some cases, like the fiber recently extended to the small cities is not configured in self-healing rings. The newly constructed fiber would allow for the completion of rings so that the huts would not lose service from a single fiber cut on the backbone network.
- The network cost estimate includes the cost of connecting customers to the fiber network including a fiber drop wire for each customer, electronics at each customer that communicates with the fiber network, and any electronics needed to provide the services sold to customers, such as WiFi routers and cable TV settop boxes. We only assume these assets are required for customers that buy service.
- The network cost estimate also includes the ancillary assets needed to be in the fiber business such as the huts, vehicles, computers, furniture, spares, and other assets.
- The feasibility also assumed that many assets like electronics would routinely be replaced during the 25-year study period.
- We believe the engineering cost estimates are conservatively high. As an example, we added a 6% construction contingency to the cost of building a fiber network.

Asset Costs. We estimated the cost of the required assets for each of the four scenarios as follows. For purposes of estimating costs, each of the following scenarios assumes a 48% customer penetration rate. The study only provides a fiber drop and customer electronics for subscribers to the network.

	<u>City</u> <u>Limits</u>	<u>GRU</u> <u>Area</u>	<u>Urban</u> <u>Reserve</u>	<u>Plus</u> <u>Small</u> <u>Cities</u>
Vehicles	499,429	629,759	669,734	801,115
Tools & Work Equipment	75,000	100,000	100,000	100,000
Buildings	1,165,000	1,631,000	1,924,000	2,803,000
Furniture	48,000	58,500	61,500	69,000
Computers	102,041	125,483	131,857	148,444
CATV Electronics	2,316,826	3,459,362	3,748,528	4,337,716
Fiber Electronics	10,648,100	15,589,960	16,755,268	19,102,828
WiFi Modems	2,298,030	3,368,295	3,648,225	4,212,075
Fiber Drops	13,184,822	19,075,731	20,614,893	23,742,842
Fiber	66,046,030	111,088,345	123,297,358	138,852,162
Software	1,375,592	1,996,382	2,159,514	2,487,124
Spares	200,000	200,000	200,000	200,000
Total	97,958,870	157,322,818	173,310,877	196,856,306

Competing Technologies. The study discusses technologies that compete with a fiber network. This includes the hybrid-fiber coaxial technology used by Cox, upcoming 5G wireless technology and, upcoming satellite broadband. While none of these technologies is as robust as a fiber connection to each home and business, each technology could garner market share in the broadband market.

Financial Business Plan Assumptions

The above research culminated in the creation of financial feasibility models that predict the performance of a city-owned fiber business built throughout the study areas. The assumptions used in creating the various business plans are discussed in Section III.C. Following are some of the basic assumptions that are common to all of the financial business plans:

- We assumed that a new fiber business would be operated by GRUCom and would be incorporated into the current GRUCom operations rather than being created as a new entity within GRU.
- We arbitrarily chose a 48% market penetration (the percentage of customers using the network) for all base studies based upon the way that we interpreted the residential survey. There is no guarantee that the city would achieve this penetration rate. It would also be possible for the city to exceed this target penetration rate. We needed to choose a base penetration rate in order to be able to compare between various options and scenarios.
- All financial models cover a 25-year period, which matches the longest expected period for financing the network bonds.
- The financial studies estimate every aspect of operating a fiber business and include projected revenues, projected operating costs, projected financing costs and the projected cost of building the network as discussed above. One of our primary goals was to see if there are scenarios where the revenues of the fiber business will cover all of the operating costs such that the resulting business would never need an external subsidy.

- Telephone and cable TV products are priced at, or modestly below market prices.
- The key assumption in the studies is that the city would provide a low-price gigabit broadband product to every customer. Since the goals of this feasibility was to determine if low-price gigabit is possible, our base studies start with the assumption of a \$50 gigabit product – which would be the lowest-priced product in the US.
- The operating expenses used in the projections represent our best estimate of the actual cost of operating the fiber business and are not conservative. Most operating expenses are adjusted for inflation at 2.5% per year.
- One of the most expensive costs of expanding the fiber business is labor and we used projected salaries that fit within the GRUCom pay scale.

	<u>City</u> <u>Limits</u>	<u>GRU</u> <u>Territory</u>	<u>Urban</u> <u>Reserve</u>	<u>Plus</u> <u>Small</u> <u>Cities</u>
Employees in 5 Years	31	39	41	46
Employees in 25 Years	36	43	48	52

- We performed what we call sensitivity analysis where we calculated the impact of changing the key variable such as market penetration, interest rates on bonds, prices for broadband service, etc.
- We also considered options with different product offerings include the triple play, Internet plus telephone service, and standalone Internet only
- We looked at a series of scenarios that we call digital divide scenarios which look to see if it would be possible to offer low-price broadband for low-income homes. We began this analysis by considering a \$20 digital divide broadband product and looked at numerous other options.

SWOT Analysis

We looked at the existing strengths, weaknesses, opportunities, and threats associated with starting a retail fiber business in the city.

Strengths. The biggest strength for tackling a retail fiber business is that GRUCom already operates an extensive fiber network and has the technical knowledge and skills needed to tackle the deployment of a retail fiber network. GRU as a utility also already has the experience and systems designed to support a large residential and small business base of customers.

Weaknesses. One of the biggest concerns is that the city currently doesn't operate any competitive businesses at the retail level. One must always ask the question of a city can be nimble enough to be a competitor in the telecom business.

There are also inherent aspects of being a government entity that add challenges to undertaking such a large undertaking. For example, financing a fiber network with bonds can add significantly higher interest costs due to having to borrow the full cost of the network upfront and due to having to borrow the funds needed to make interest expense payments during the first several years of the project. Municipal purchasing practices can also add to the cost of the constructing a network compared to a commercial builder that is freer to negotiate prices.

The surveys indicate that there is a sizable segment of households that dislike the city as a provider of services, meaning that a city-owned fiber business might have to overcome built-in bias against trusting the city. We think this bias is baked into the survey responses and is reflected in the projected penetration rates, which are lower than what we've seen in some other cities.

Opportunities. The analysis shows that it is possible to successfully operate a profitable fiber business in the city while also offering low prices. Such an opportunity is not a slam dunk and there are numerous hurdles to overcome to operate a retail fiber business successfully – but the numbers show it can work if all of the projected conditions and assumptions are met

We know from experience that having a municipal fiber network lowers prices for everybody in the market.

The city also has the opportunity to be one of the first ones to tackle the digital divide. Almost every city that builds fiber has solving the digital divide high on the list of reasons to build a network, but we're not aware of any city that has been able to provide affordable broadband to homes that can't afford current market prices.

There are a huge number of benefits to the community from better broadband. One of the biggest is the economic development and economic stimulus that we think would result from providing gigabit service to everybody. There is also the immediate benefit of lower rates – broadband rates should drop for everybody in the City.

Threats. Past experience tells us that you are likely to see a significant response from both Cox and AT&T if you undertake building a citywide gigabit fiber network. Those companies may try to thwart the effort with legislation or lawsuits. Both would likely beef up their network and AT&T might even build fiber to selected neighborhoods to make it harder for the city to succeed.

The current legislative restrictions in Florida present a number of hurdles for the city to overcome. The incumbents will be watching closely to make sure that the city fully complies with those laws.

It's likely to be a challenge to raise the needed funds. We estimate bond issues of between \$113 and \$213 million to fund the various scenarios.

The city might need to pass a referendum to approve the bonds to build fiber. There is a provision in Florida law that require a referendum if the city borrows for revenue bonds for broadband for more than a 15-year term. This project is going to require bonds with a term longer than 15 years. It's not clear if that restriction applies to other kinds of bonds. The issue is further muddied since the city has built the current broadband business using non-revenue bonds with terms greater than 15 years. The city faces the difficult decision of holding a referendum to be safe or risk being sued over the issue.

It's worth noting that the proposed fiber would only directly benefit single family homes and those living in townhouses, duplexes, and small apartments with fewer than 4 units. While the current GRUCom fiber network is bringing big bandwidth to many apartment buildings, the actual method and cost of providing broadband in apartments is generally decided by the property owner. The

city does not have the authority to build fiber to apartment units without the permission of the property owner. It's hard to imagine a scenario where the city can offer low-cost digital divide products in apartment buildings.

There are also performance risks for anybody undertaking a new business of this magnitude. There have been notable failures by both municipal and commercial fiber overbuilders and there is no guarantee of success. The sensitivity analysis conducted as part of this study show that changes in key variables can have a big impact on the financial performance of the business – so it's essential to fully understand and try to control those variables before launching a new broadband business.

One of the biggest challenges for a new business will be gearing up to be able to install significant numbers of customers. We estimate that the number of customers that must be installed monthly varies from 550 in the Gainesville-only scenario to 850 if the city tackles the full footprint including the small cities.

We also know from experience that there is risk if a municipal fiber business is not shielded from politics. If future politicians can influence or change rates for the business, then it's always at risk for underperformance or negative performance.

There is a risk from other technologies. While no technologies will be as good as fiber there are likely to be future technologies such as 5G broadband that might lure some percentage of the broadband market.

Conclusions

Following are the primary conclusions as a result of our analysis.

Market Demand

We believe that the residential survey demonstrates sufficient market demand to support some of positive financial business cases used in our analysis. We interpret the survey results to mean that around 48% of homes ought to be interested in buying broadband from the city – assuming you build a good network and do the needed marketing. The survey also suggests there would be even more demand for lower-priced broadband, such as the \$50 gigabit product used in our base studies.

Our research shows that Gainesville has some of the higher prices for the triple-play bundle that we've seen in our work across the country. With that said, the incumbents offer a wide range of prices to customers and there are some customers in the market that enjoy low prices while others pay exceedingly high prices.

There is a significant amount of marketing and sales effort needed to acquire customers and we predict nearly \$1 million per year in marketing costs for the first five years of a fiber build.

Network Design

GRUCom already operates an active Ethernet network to support the exiting wholesale and retail network. We think the existing network can provide the needed backbone fibers to support the new fiber network that would be used to pass every home and business in the study areas.

We recommend GPON technology as the most appropriate technology for the last mile network to serve residents and small businesses. The network design we are recommending is robust enough to provide a gigabit broadband connection to every customer on the network.

We also think a fiber network is robust enough to compete successfully against the technologies used by the incumbent providers and against any likely competitive technologies that might come along during the next several decades.

Hurdles

There are a number of significant hurdles to overcome to create a successful fiber business in Gainesville:

- **Competitive Response.** We expect a significant reaction by the incumbent providers when they are faced with competing in a market of this size. For instance, these same two providers sued to keep the city of Lafayette, Louisiana from entering the fiber business. It's possible that AT&T would build some residential fiber, making it harder to compete. Both incumbents will likely offer stiff price competition.
- **Florida State Law.** There are a number of hurdles created by the Florida state laws that govern how municipalities can enter the retail fiber business.
- **Large Bond Issue.** The size of the borrowings needed to finance a fiber business is likely to be a challenge. The needed borrowing ranges from around \$113 million to build fiber within the city limits of Gainesville to \$213 to build fiber to all of the populated areas of the county.
- **Excludes Apartments.** This study, and any resulting fiber business would only serve single family homes and other small building units like duplexes and small apartments with 4 or fewer units. This is because apartment owners don't have to let the city provide broadband on their properties.

Because of the wide range of ways that property owners treat broadband it's likely to be difficult or impossible for the city to bring low-cost broadband to most apartments in the same way you might everywhere else in the city. That creates a host of issues. For example, it's likely that many of the low-income households will live in apartments and not be reachable by the city's broadband efforts. It also likely means asking apartment dwellers to approve a bond issue that might not benefit them.

- **Low Prices.** The business plans grows more challenging as the price for broadband is reduced. It is much easier to be successful with broadband rates that are modestly less than market rates.
- **Operational Hurdles.** It's a challenge to create a municipal ISP and gear up to meet the targeted sales and installations needed to meet these projected business plans.

Key Financial Study Results

The results of the financial analysis are included in Appendix II. A summary of the financial results of the analysis is included in Appendix III. Some of our key findings of the analysis include:

- **There Are Key Variables that Have a Major Impact on Financial Performance.** Following are the impacts from changing the key variables in the study. It's worth noting that these impacts are somewhat additive, meaning that you can roughly add the impacts together if you were to change two variables.
 - Penetration rate. Changing the market penetration rate upward or downward by 1% (for example, from 48% penetration to 49% penetration) changes the cash over 25 years by \$8.2 million.
 - Broadband Prices. Changing broadband prices by \$1 per month upward or downward changes the cash generated over 25 years by \$5.88 million.
 - Interest Rate. Changing the interest rate on bonds upward or downward by 10 basis points (for example, changing from 3.5% interest to 3.6% interest) changes the cash generated over 25 years by \$2.6 million.
 - Bond Term. Changing the bond term from 25 years to 20 years increases cash over 25 years by \$6.75 million. It doesn't look feasible to use a 15-year term.
 - Capital Spending. Changing the cost of the network upward or downward by \$1 million changes the cash flow over 25 years by \$2.17 million.
 - Eliminating Cable TV. Getting rid of the cable product dropped cash over 25 years by \$1.35 million.
 - Eliminating Telephone. This essentially breaks the model and reduces cash flow over 25 years by almost \$90 million.
- **There is Economy of Scale.** The larger the broadband business, the more efficient. For example, the threshold for being profitable is lowered by serving all of the populated areas in the county rather than just serving the city limits of Gainesville.
- **You Must Offer Products other than Broadband.** The analysis shows that it would be difficult to offer only broadband as a product. While the expected customer penetration rates for telephone and cable TV will be significantly lower than for broadband, those products are needed to achieve the needed penetration rates and the needed margins. Telephone has a high margin that is needed to meet financial goals. Cable TV has a low margin, but the percentage of households with traditional cable TV is still high in the market and it's likely to be difficult to lure them to the new network without a cable product.
- **It's Possible to Offer Low-Price Gigabit Broadband.** Assuming that the city can find a way to get over the hurdles, there looks to be scenarios that offer low-price gigabit broadband. For example, the breakeven penetration rate for the city of Gainesville, and with a \$50 gigabit product is around 44%, assuming the business meets all of the major assumptions in our studies. That would be the lowest-priced gigabit broadband in the country, and 44% seems like a reasonably achievable market penetration.
- **There Are Interesting Digital Divide Scenarios.** It looks feasible to offer subsidized low broadband prices to low-income homes if other rates are higher. For example, it looks feasible to offer a \$20 digital divide broadband connection if other residential broadband is priced at \$70 – the market price set by Google Fiber.
- **It Would be Possible to Have “Free” Gigabit Broadband.** It's possible to provide free gigabit broadband to homes if some other source of revenue can be found to cover the operating losses of the business. For example, in looking forward to 2025, after the network

has added all customers. an external revenue source of \$11.6 million, or \$27.21 per residential household per month, would cover the operating losses of the business. This could be covered by tax revenues such as a utility fee per home, or an increase in other taxes like sales or property taxes.

- **There is a Substantial Amount of Risk in any of the Business Plans.** The analysis shows that there are variables that have a big impact on the long-term performance of a fiber business. For example, the low prices cited above would have to be higher if interest rates were significantly higher. It is essential to understand these variables and take steps to better define them before deciding to move forward. This report makes specific recommendations on next steps that ought to be taken to better define the variables in order to reduce the risk of moving forward.

Competitive Response from Incumbents

We predict a significant response from AT&T and Cox if the city decides to build a retail fiber network. Those companies might pursue legislative and legal ways to stop such a project. They will campaign vigorously against any referendum vote. Your referendum rules don't allow the city to promote broadband during the period leading up to a referendum and you'll need to energize citizen groups to offset negative advertising by the incumbents. The incumbents will likely intervene continuously and loudly in the process of approving and funding a network. They will also continue to monitor and create bad press after launching the network for perceived shortfalls or problems you encounter.

Funding Options

The most likely source of revenue for building fiber is municipal bonds. Florida statues suggest that the project should be funding with revenue bonds, and we don't think there is a market today for selling pure revenue bonds. There is enough uncertainty in the Florida statutes that using something other than a revenue bond might be a point of attack by the incumbents.

The size of the needed borrowing is likely to be a hurdle. The size of the bond funding, using general obligation bonds ranges from \$113 million to build fiber in the Gainesville city limits to over \$213 million to build fiber to all populated parts of the county including the small cities. The city has two options for bonds – finance bonds with GRU utility revenues as the backstop for bond shortfalls or finance bonds that use tax revenues as a backstop.

We don't think there is any realistic possibility of creating a public / private partnership. We find it unlikely that a partner will be interested in a business where the primary goal is to provide low-price broadband. Commercial ISP partners would instead be seeking high profits.

There are a few other ways you might offset part of the cost of the project. For example, if you build outside the city limits you might want to seek some financing assistance from the county and the other smaller cities in the county.

It might also be possible to find some way to obtain cheaper financing through the Opportunity Zone financing that was created by the federal tax changes in 2017. That would require somehow

mixing bond financing and funding from a private source, but the hope would be to find lower-cost financing.

Timeline

The nature of bond funding makes it mandatory to build and add customers to a new network as quickly as reasonably possible. Since bonds borrow the full cost of the project up front, it's necessary to add enough customers expeditiously in order to be able to make the bond payments by the end of the use of bond proceeds. The need to move quickly is going to be a significant challenge. It's possible to speed up the timeline by undertaking some of the selection of vendors and some of the engineering effort before bond funding. It ought to be possible to add the first customers to a new network within 9 – 10 months after funding, although significant customer additions wouldn't occur until the second year.

Recommended Next Steps

Immediate Next Steps

If the city thinks that the results of this study are promising, then there are a number of next steps that are needed in order to make decision to move forward. This report discusses dozens of issues that need further investigation and debate before deciding to move forward. Below are two lists: one is immediate next steps, the second are other issues you'd want to investigate if you are happy with the results of the first list.

Where to Build? This study considers four different operating footprints that range from the city limits of Gainesville to a footprint that includes populated parts of the county plus the small cities. It will be easier moving forward with the decision process if that list can be whittled to one, or perhaps two options.

Financing Plan. The size of the borrowing needed to support the retail fiber business varies from \$113 million for the city limits of Gainesville to \$213 million for the largest footprint. Now that the amount of funding has been quantified the city should be able to determine if there is a reasonable way to fund projects of that magnitude with bond funding.

There are also other options to consider. For example, it might be possible to partner with the other cities and the county and have them contribute some funding toward a fiber network. There may be other alternative, non-bond funding options like using sales taxes or property taxes to pay for some portion of the network. There are also more esoteric funding opportunities that might be possible such as financing part of the project from newly-formed Opportunity Zone funds, or funding through private activity bonds. We recommend an investigation into the funding alternative to find out what is feasible. Our analysis shows that interest rates have a big impact on the long-term results, so the city should explore any option that will lower the interest rate.

Digital Design Pricing and Policies. This feasibility study shows that there are a number of ways for the city to meet its goal of having low prices and for getting broadband into

more homes in the city. For example, one concept is to have a low-price gigabit product available to everybody, such as the \$50 product used in our base analysis. There are also intriguing possibilities of offering a low-price product in the range of \$20 that could be made available to low-income households that qualify.

The city should undertake the discussion to choose among these options. If you decide to consider a digital divide product, then the next step would be to define how households would qualify for low-income broadband and then quantifying the number of homes that might qualify.

More Market Research? The residential survey done as part of this project was somewhat generic in the questions that were asked. If the city can better define which options you are considering, such as a pricing structure, we'd recommend another survey to dig deeper into specific proposals.

A Plan for Dealing with Florida Laws. The current Florida statutes create some challenges for getting into the retail fiber business. We find it likely that the incumbents will use those laws as a cudgel to try to slow or stop the city from getting into the broadband business. We recommend starting internal discussion to specifically determine a plan for meeting the Florida laws and for dealing with the expected reactions of the incumbent providers.

Longer-Term Next Steps

If the city should decide to keep moving forward with a fiber project, there are specific operational tasks needed to get ready to undertake building and operating a fiber network.

Public Education. If you decide to move forward, the public needs to be brought into the process. Cities have taken a wide array of approaches for doing this. This is especially important if there is to be a public referendum on building and financing fiber. This might include taking steps like holding public hearings and workshops, creating an informational web site, assigning, and funding expanded effort by the fiber task force, etc.

More in-Depth Engineering Estimates. Probably the key estimate made in this study is the estimated cost of building the fiber network and the associated electronics. We've made estimates that we are hope are a little higher than actual costs. However, before tackling funding you'll want to go another layer deeper and refine the engineering estimates.

Operational Analysis and Readiness. It will be a big challenge for the GRUCom staff to tackle building and launching a retail fiber network. If you decide to move forward you'd want to authorize GRUCom to take steps to be ready to execute a plan long before the date of bond financing. There are a number of different areas of readiness to be considered, and one of the first tasks would be to define all of the readiness steps that ought to be done before financing. A readiness plan might consider the following issues:

- Sales and Marketing Plan. Perhaps the biggest challenge of launching a retail business would be in marketing and selling retail products. We recommend creating a detailed marketing and sales plan, with the associated budget.
- Staffing Plan. A retail fiber business will require hiring a lot of new employees. There should be a staffing plan to identify the positions needed and to determine any changes to the GRUCom organizational structure due to integrating a retail business.
- Product Readiness. There is more research needed to provide the needed products. The biggest area of investigation is where to find an external source for a cable TV product.
- Vendor Identification. The launch of the fiber business would be significantly accelerated if all of the primary vendors are already identified and selected before funding, including firm prices for services.
- Products and Prices. As mentioned earlier, it would be essential before bond financing to determine products and prices.
- Processes and Procedures. Possibly the second biggest challenge to launching a retail fiber business is gearing up to be able to install large numbers of customers monthly. All of the processes and procedure to do this should be in place before, or immediately after the sale of bonds. These processes would be specific roadmaps and work flows that define exactly who at GRUCom is responsible for each step in the process of selling and installing customers.
- Software Readiness. A lot of the processes just mentioned are embedded in operational software. While GRUCom already owns much of the needed software, there are many parts of the software they don't use today in the same manner required by a retail business. We'd recommend a full analysis of software, including plans to purchase anything needed to close any gaps, along with training so that GRUCom staff is ready for a launch.
- Regulatory Readiness. GRUCom already complies with many of the needed regulatory requirements needed to provide retail products. However, there are additional steps to take to be fully compliant with all regulations.
- Pre-Launch Action Plan. The above steps are complicated, and we strongly recommend using some sort of formal planning process to make sure the company is ready to launch a fiber business. We are big believers in the Gantt chart process that develops detailed work plans and that makes sure that every task has been assigned for completion.

More Detailed Budget. Before bond funding you'll want to create a revised business-plan forecast that matches the way that GRUCom is going to launch and operate the business. We've made hundreds of assumptions in our forecasts, many based upon input from GRU and GruCom. You'll want to refine every assumption used in the forecast before bond funding, particularly the assumptions on how overheads would apply to a retail business.

In-Depth Review of City Practices that Affect Fiber. Most cities have processes that directly impact any entity that is going to build fiber. This would include such things as permitting, traffic control, construction inspection, utility location, etc. Before building fiber on every street in the city you should review all of these processes to see if any should

be improved. It's worth noting that any changes you make in processes would also apply to anybody else that wants to build fiber in the city.

I. Market Research

Following is a discussion of some of the general research undertaken in preparing this report.

A. Current Market Rates

As part of the analysis we looked at the existing rates charged by the incumbent providers – AT&T and Cox Communications in the city and Windstream for other parts of the county.

AT&T is the world’s largest telecommunication company. Headquartered in Dallas, the company is the second largest provider of cellular telephone service and the largest provider of landline telephone services in the United States. Since the recent merger in 2018 with WarnerMedia, the company is also the world’s largest media and entertainment company in terms of revenue. The company currently ranks #9 on the Fortune 500 rankings of US corporations, based upon revenues.

AT&T was once the monopoly telephone and data provider for most of the country. The company was broken in pieces with a divestiture in 1982 as a result of an antitrust lawsuit. At the time the company was broken into seven regional telephone companies plus a long-distance company – since then the company has merged three of those companies back into the parent.

AT&T is the incumbent landline telephone provider in Gainesville, Archer, Newberry, and Hawthorne. While AT&T still sells traditional telephone service and older legacy DSL under the AT&T brand name, customers with faster DSL or with fiber are marketed under AT&T’s U-verse brand.

The majority of households in the city are still served by telephone copper facilities. However, it’s likely that there are at least a few residences and probably a number of businesses in the city served by fiber.

AT&T recently purchased DirecTV. AT&T is in the middle of a transition and now bills some customers under the DirecTV brand and others under the U-verse brand—even for landline customers. It appears that the company plans to phase out the U-verse brand.

Broadband. AT&T supposedly offers the following broadband products for all of Florida. However, some of these products are likely grandfathered for older customers and not available for new customers.

DSL Broadband Products. AT&T offers the following DSL products. Each product also requires a \$7 monthly Internet Equipment Fee for a modem that is not optional – customers can’t supply their own modem.

Download Mbps	Upload Mbps	Price	Data Cap Gigabits
3	0.384	\$56	150 GB
5	1	\$60	1 TB
6	0.512	\$61	150 GB

10	1.5	\$70	1 TB
18	5	\$70	1 TB
25	10	\$70	1 TB
50	10	\$70	1 TB
75	20	\$70	1 TB
100	20	\$70	1 TB

As can be seen, every product over 10 Mbps is priced at \$70. AT&T clearly indicates in all of their advertising that these are “up to” speeds, meaning that customers can receive speeds slower than advertised. We’ve never heard of a DSL customer ever receiving actual speeds faster than 50 Mbps.

Fiber Broadband Products. AT&T also sells broadband over fiber, both to residences and businesses. Where they offer residential fiber products the prices are as follows. Each product also requires a mandatory \$7 monthly Internet Equipment Fee – customers can’t supply their own modem. There might be some residences in the city with the fiber products. Rather than offer fiber everywhere, AT&T has a strategy to offer fiber products in the immediate vicinity where they already have built fiber for some other purpose. There might be homes within a block of a school or business served by AT&T fiber that might get the offer to convert to the fiber network. This is done quietly and AT&T sells by knocking on doors in such neighborhoods. AT&T recently announced that they now have fiber passing 10 million premises – many of them would fall into this category of hyper-local to an existing AT&T fiber POP. The majority of the passings that AT&T is counting are in MDUs.

Download Mbps	Upload Mbps	Price	Data Cap Gigabits
5	5	\$60	1 TB
25	25	\$70	1 TB
50	50	\$70	1 TB
100	100	\$70	1 TB
300	300	\$90	1 TB
1,000	1,000	\$100	Unlimited

It’s worth noting that the gigabit price seems to be flexible, priced as inexpensively as \$80 in a competitive market like Atlanta and as much as \$115 in non-competitive markets.

AT&T also has a data cap on products smaller than gigabit speeds, set at 1 Terabyte (1,000 gigabytes). Any customer exceeding that monthly cap must pay \$10 for every additional 50 GB of broadband used in a month. The only AT&T product with unlimited bandwidth is the 1 gigabit product.

AT&T also has an unusual feature on the 1 gigabit product, for an extra \$30 per month AT&T will promise not to record or use any data from a customer – which reminds customers that the company otherwise routinely records, uses, and sells customer data.

Discounts. Many AT&T customers get a discount from the above prices. New customers can get a discount by buying at a special promotional price, with the lower price usually in effect for a year or two. The price then reverts to the above prices unless a customer is willing to continually renegotiate pricing.

Customers can also get a discount by bundling with AT&T's telephone landline product or with DirecTV. Customers also report getting discounts by negotiation, particularly if they are considering moving to the cable TV provider.

Telephone Service. AT&T sells residential telephone service in Florida for \$24.25 per month plus a fee they label as federal subscriber line charge of \$5.72 per month. This is not a tax or a fee paid to others; AT&T keeps this as part of the telephone service.

The company still sells features individual ranging from \$1 to \$10 per feature per month. The basic telephone line also comes with no long distance – something a customer has to buy from AT&T or others.

A basic business telephone line in Florida is \$62 plus the same \$5.72 fee. However, the company is not required to charge this rate and they routinely make deals with businesses at a wide range or rate – typically only the smallest businesses pay the full rate.

Cable TV. AT&T has stopped offering landline cable TV to new customers. They instead offer satellite TV through DirecTV or more commonly push customers to buy TV through the Internet from DirecTV Now.

Cox Communications is an incumbent cable company that is a subsidiary of the privately-owned Cox Enterprises, headquartered in the Atlanta suburb of Sandy Springs, GA. As a private company, Cox doesn't release its financial reports. At the end of the third quarter of 2018 the company was the fourth largest provider of cable TV service with 4,035,000 customers. Cox is the sixth largest ISP with 5,040,000 broadband customers at that same date. Cox is also the seventh largest telephone company in the country.

Broadband Products

In the residential survey we did not talk to any customer who was buying standalone broadband. We did get copies of a few bills from customers buying standalone broadband. Some customers told us that customers must buy a bundle in order to get broadband. We guess that bundling was a requirement at some time in the past, but is not today. There is clearly some misunderstanding in the general public that they can buy standalone broadband.

The most recent standalone broadband prices are as follows:

Cox Internet Starter 10	10/1 Mbps	\$ 55.98
Cox Internet Essential 30	30/3 Mbps	\$ 76.98
Cox Internet Preferred 100	100/10 Mbps	\$ 94.98
Cox Internet Ultimate	300/30 Mbps	\$115.98

Cox also has been selectively marketing a gigabit product since 2014 that they market as “Gigablast” This product is not listed on the web page, and perhaps this is because it’s not available in all markets. The product supposedly has speeds of 1,000/100 Mbps. It’s reported on consumer sites that the list price is \$99.99 with specials as low as \$69.99 in markets where competitors offer fiber. There were a few customers that took the speed test that that reported to be buying the product. We also saw bills from several customers who are being billed for the product.

All broadband products as sold as “up to” speeds meaning that a customer might receive something slower.

Customers can lease a WiFi capable modem for \$10.99 per month or buy the modem for \$179.

Cox has a data cap on all broadband products, set at 1 terabyte (1,024 gigabytes). Customers that exceed the cap are charged \$10 for each 50 GB of broadband over that cap. Customers can also pay \$50 per month extra for unlimited broadband (no cap).

All new customers pay a \$20 installation fee, even those who self-install.

Cable TV

Cox has only 1 standalone TV product called Cox Contour. This offers 220 channels for \$84.99. Contour includes TV anywhere, meaning that a customer can watch on any broadband device within the home, or selected channels over the Internet when traveling.

While not available as a standalone product, Cox now offers what the industry calls a “skinny bundle.” This is a small package of 75 channels, that includes local channels that is intended to help keep customers on the Cox network rather than change to an online provider like Sling TV or DirecTV Now. This is priced at \$25 per month. The package does not include ESPN (which is the most expensive station for Cox to purchase).

There are also two different levels of DVR service available with any cable product and that allow customers to record TV programming. The prices are \$12.99 or \$19.99 per month.

All cable products require at least one cable settop box for a monthly rental was recently increased to \$10.

Telephone Service

Cox does not offer standalone telephone service. They offer an upgrade to existing customers to add a voice product with unlimited long distance for \$29.99. They do not advertise the price of more basic telephone service, but basic service is available as part of the many Cox bundles.

Home Automation / Security

Cox offers a suite of services that offer smart home automation plus security.

Cox Homelife. The basic package is \$29.99 per month. This includes home lighting control, door and window sensors for security, several video cameras that customers can view from a smartphone. This package does not alert police in case of an intrusion.

Cox Homelife Automation and Security. This larger package adds motion sensors and also alarm monitoring that notifies law enforcement if there is an intrusion. This is priced at \$54.99 per month.

Cox offers specials that include the security monitors. However, there are online reviews of customers who have been charged over \$1,000 for hardware and installation services.

Cox Bundles

Cox offers a confusing array of bundles and it’s possible to bundle together the different cable channel line-ups, the various broadband speeds, basic or premium voice and the Homelife security products. That means that dozens of combinations are possible.

Like many ISPs, Cox offers special low pricing for first-time customers. These specials generally are good for a year, and then the customer reverts to the list price. However, it seems that customers are able to negotiate pricing and there are customers paying a wide range of prices for the various bundles.

Following are just a few of the bundles. The pricing at the end is first list price followed by the current advertised special price as of the time of writing this report. CCG Consulting works nationwide and sees the pricing from cable companies and telcos of all sizes. We observe that Cox’s regular prices seem to be the most expensive prices compared to the other large cable companies. In the bill analysis we found some customers receiving specials that had affordable prices.

<u>Broadband and Cable TV Bundles</u>	<u>List</u>	<u>Web Special</u>
75 channels / 10 Mbps	\$ 72.98	\$ 55.98
75 channels / 30 Mbps	\$101.98	\$ 65.98
75 channels / 100 Mbps	\$110.98	\$ 85.98
140 channels / 100 Mbps	\$162.48	\$ 89.99
170 channels / 300 Mbps	\$251.44	\$109.99
250 channels / 300 Mbps	\$267.48	\$129.95
<u>TV and Telephone</u>		
Contour TV + voice with unlimited LD	\$117.49	\$ 74.99
<u>Triple Play including Telephone with Unlimited Calling</u>		
75 channels / 10 Mbps	\$102.97	\$ 65.98
75 channels / 30 Mbps	\$120.98	\$ 64.99
75 channels / 100 Mbps	\$129.98	\$ 84.99
140 channels / 100 Mbps	\$192.47	\$ 89.99

170 channels / 300 Mbps	\$281.43	\$109.99
250 channels / 300 Mbps	\$297.47	\$129.99

Quad Play Including Homelife Security and Telephone with Unlimited Calling

140 channels / 100 Mbps	\$222.46	\$109.99
170 channels / 300 Mbps	\$311.42	\$129.99
250 channels / 300 Mbps	\$327.46	\$149.99

Final note, all customers can buy a plan called the Cox Care Plan for \$10 / month that covers the cost of any technician visits for any reason that is customer related. Cox fees for a technician visit start at \$60.

Windstream Corporation serves many of the customers outside of Gainesville. A map showing the Windstream service area is shown in Appendix IX. Windstream is a publicly traded telephone company created in 2006 with the merger of Alltel and Valor Telecom. The company is headquartered in Little Rock, Arkansas. The company offers telephone service plus broadband service provided by DSL. The company also offers a bundle that includes cable TV provided by Dish Networks.

The company operates in 16 states and had \$3.3 billion in revenues for 2017. At the end of the third quarter of 2018 the company had just over 1 million broadband customers.

As the incumbent provider, Windstream is considered the “provider of last resort” in its service areas. This means the company is required to serve all residential and business customers for basic telephone service, and it must provide facilities to all customers. The rules that govern the way that Windstream serves customers in the county are embodied in their “General Customer Services Tariff,” which is approved by the Florida Public Service Commission. This tariff contains all of the regulated products and prices, along with the terms and conditions under which the company will sell them to customers. The tariff sets forth rules for such customer service procedures as the manner and amount of customer deposits, the rules by which they will disconnect service for nonpayment, and the rules by which they will reconnect service.

Windstream accepted money from the Connect America Fund (CAF II) to enhance the DSL in some parts of the county. The grants are to be used to increase the speeds on DSL to at least 10 Mbps. The company accepted \$2.5 million to upgrade broadband to 1,572 households in the County. The company has until the end of 2020 to implement these upgrades.

Windstream has gotten poor reviews from several firms that rank ISPs. The JD Power poll gives Windstream a ranking of 2 out of 5 and said they were the lowest rated telephone company in the South.

As of the time of this report, Windstream filed for Chapter 11 bankruptcy protection. While this often is done by companies in economic distress, the filing was instead due to Windstream’s loss of a lawsuit for \$310 million brought by the hedge fund Aurelius Capital Management. Several years ago, Windstream had spun off its physical network into the equivalent of a REIT, which is usually used to bundle real estate assets. While Windstream has \$5.6 billion in debt and has been

losing residential and business customers steadily for years, the main impact on the bankruptcy will be to restructure the debt and equity of the company and will likely not have any direct impact on customers.

Windstream Pricing

Windstream offers 3 DSL speeds as follows:

6/1 Mbps	\$57.99
10/1 – 25/1 Mbps	\$67.99
50/1 Mbps	\$77.99
Modem for first two products	\$ 9.99
Modem for 50/1 Mbps	\$11.99
Installation	\$35.00
Service Activation	\$50.00
Inside Wire Insurance	\$ 8.00

There are no data caps on the broadband products

Windstream does not advertise their telephone prices online. The only telephone product pricing I could identify is telephone with unlimited long distance for \$44.99. All telephone products are loaded with a number of fees that total to at least \$7.50.

Summary. Interestingly, customers that have been with the incumbents the longest pay the highest rates. Both Cox and AT&T offer specials and promotions for new customers or to existing customers who are willing to fight their way through the customer service process. This makes it a challenge for a new competitor because there is no one “price” for the existing products in the market. Prices vary due to promotional discounts, negotiated customer rates, and differing levels of bundling discounts.

B. Residential Survey

As part of the broadband feasibility study, the city authorized a residential survey to assess the interest of the public for using a new fiber network for broadband. A full list of the survey questions and the responses received is included in Appendix IV.

Survey Methodology

The survey covers the largest study area contemplated by the feasibility study – the GRU service area, plus the populated portions of the urban reserve, plus the small cities in the county.

One important aspect of the feasibility study is that it excludes large MDUs (multi-dwelling units), meaning large apartment and condominium complexes. Residents living in apartment buildings were excluded from the survey.

The survey was conducted by CCG Consulting by telephone. The city wanted this survey to represent households across the socioeconomic and age range, and the easiest way to get that broader mix was to include cell phones in the survey. We obtained a list of telephone numbers to call from GRU which provided us with a list of customer telephone numbers included in the database used for billing for electric, water, and sewer. GRU believes there is a good mix of landline and cellular telephone numbers in these records. GRU was able to remove addresses from large apartment and condominium complexes.

This calling list didn't disclose any personal information to CCG other than the phone number and the zip code for each GRU customer on the list. The impersonal nature of the number list eliminated any chance for CCG callers to somehow be biased in our calling.

It is important that the survey is conducted randomly, meaning that the calling shouldn't be clustered around any one particular portion of the study universe. For example, the survey would not be considered to be valid if all of the calls were placed only to one portion of the city.

Since we had phone numbers by zip code, we used a technique called directed calling where we made certain to call some people in every zip code. This is the same technique that would have been used had the city decided to conduct the survey by going door-to-door. This is a well-accepted survey practice that is considered to be valid as long as the choice of directed locations doesn't include bias. Because the list of phone numbers included no personal detail, we felt we were able to use it without introducing any bias – our callers know nothing about the demographics of various parts of the city.

It's also essential for a survey to be conducted randomly. This is an issue that is at the heart of political surveys because the decision on which states to call in a nationwide survey can automatically skew the results. In our case, the CCG callers know nothing about Gainesville – we don't know the relative demographics of various parts of the city. We felt we could call any numbers from the number list provided by the city because those numbers were already anonymous and randomized.

Most business and political surveys strive to achieve an accuracy of about 95% with results that are plus or minus 5%. In layman's terms, this means that the results of such a survey are reliably accurate (the 95% number) and you would expect to get the same results (within 5%) if you could ask the questions to everybody in the survey universe.

At CCG we use an online survey tool that is provided by Creative Research Systems and is found online at <https://www.surveysystem.com/sscalc.htm>. We've used this tool for many years and have manually done the mathematical calculations that demonstrate that the tool is accurate.

We were able to complete 370 surveys for this project. With approximately 78,176 passings in the survey study area the online tool shows the accuracy of this survey to be 95% accurate plus or minus 5.08%.

Survey Results

The survey produced some interesting results. A full copy of the survey questions and the responses are included as Appendix IV. Here are highlights of the survey results:

Counting Customers

Before we describe the various results of the survey in terms of the number of customers using various services, there is one fact that skews the results in Gainesville compared to other markets. Until recently, Cox did not provide standalone Internet service. Customers have been forced to buy telephone service, cable TV service or both in order to get Cox broadband. When we compare the results of the survey to other markets, we see a higher penetration of cable TV and telephone customers in Gainesville than what we see in markets where Cox is not the cable incumbent. A great example of this impact is that every Cox customer who took the survey reported buying a bundle of services – not one Cox customer was buying standalone Internet service.

In fact, every customer that purchased Cox broadband also purchased Cox cable TV. 65% of Cox broadband customers also bought Cox landline telephones. This practice almost certainly is a major reason why there is a higher penetration rate in the city for both cable TV and landline telephones than what we normally see. This also might be one of the reasons why the telcos in the area still have a higher penetration rate than what we see elsewhere – customers that don't want to buy bundles from Cox might be sticking with DSL.

Broadband Customers

92% of survey respondents have some form of landline broadband. The FCC reports that almost 86% of homes nationwide now have a broadband connection. However, the FCC nationwide numbers are skewed due to the fact that there are roughly 14 million rural homes in the country that have no option to buy broadband. If the FCC nationwide statistics are adjusted for those homes, then the nationwide average broadband penetration everywhere except those rural areas is 93% - right in line with the results of this survey. (This is a good reason to always be careful when using a nationwide statistic – unless you know how it's calculated).

It's also worth noting again that this survey excluded large apartment buildings. We have no way to know if the apartment buildings in the city have a higher or lower broadband penetration rate than single-family homes, duplexes, and townhouses.

We have seen that in college towns that apartment complexes that cater to college students almost always provide broadband to 100% of residents, and we've done surveys of apartments in college towns where the broadband penetration rate was higher in apartments than elsewhere.

4% of the respondents said their only source of broadband is cellular. One respondent reported only using WiFi hotspots, which could mean libraries, coffee shops or other places with free broadband.

59% of respondents use Cox for broadband while 33% use the various telcos (mostly AT&T, but a few on Windstream and CenturyLink). One household reported being served by fiber provided by Windstream.

One thing we noticed is that Cox has a lower overall market penetration rate than what we've seen from cable TV companies in other markets. In Gainesville, the ratio between providers is 64% Cox / 36% telco. In most of the surveys we've done in the last year we've seen the cable incumbent have at least 70% of the joint market. We can only speculate why Cox hasn't done as well in Gainesville as other big cable companies are doing elsewhere. For example, the fact that Cox has historically required customers to buy a bundle of service might drive customers that only want to buy broadband to choose to stay with telco DSL. But there may be other reasons and we see the mix between the cable company and telco vary by market – just never skewed this low before for the cable company.

CCG Consulting has been tracking the nationwide telecom markets for years and we know that customers nationwide are abandoning telco DSL in favor of the faster cable modem broadband. In 2018 we saw the big cable companies collectively gain over 2 million new customers per quarter while the various telcos either lost customers or barely held on to their customer base. In the case of the two primary ISPs in Gainesville, Cox nationwide added 3.7% to their customer base for the year ending September 2018 while AT&T nationwide grew by 0.2%. We don't know how this dynamic is changing in Gainesville.

We also know that Cox is not growing broadband customers as quickly as the biggest cable companies, and Comcast increased broadband customers by 5.3% and Charter by 5.6% over the same time period of a year ending September 2018.

Cable TV Penetration

In another surprising result, 91% of homes report the purchase of traditional cable TV. That is extraordinarily high compared to the nationwide average reported earlier late last year by the FCC to be at 69% and dropping by about 2% market share per year.

Of that 91%, 62% use Cox, 16% use satellite TV (DirecTV or Dish Networks) and 13% use the telcos. Again, part of this phenomenon might be due to the forced bundle from Cox – but that doesn't account for the 91% overall cable penetration rate.

We've done surveys in other cities with similarly high cable penetration rates. We've also done surveys in cities that have cable penetration rates significantly below the nationwide average. Our conclusion from the wide range of results we see from surveys in different cities is that the percentage of people who are electing to keep traditional cable TV is very much a local phenomenon. We see market after market that have broadband penetration rates close to the nationwide average – but cable penetration rates vary widely.

There are 6% of households in the city who are cord cutters and who only watch video online. Nationwide the number of cord cutters seems to be growing by about 2% total market share per year. If that statistic held true in Gainesville, we'd see the 6% of cord cutters grow to 8% of the market by next year (but there is no way to know the growth rate in Gainesville).

There is one statistic affecting cable TV that is hard to understand or quantify. Households that cut the cord say that the primary reason they do so is due to the high cost of cable TV. We know there is a phenomenon called cord shaving where customers downgrade to smaller cable packages to save money – often supplementing the smaller cable packages with online programming like Netflix or Amazon Prime. The big cable companies like Cox don't report on cord shaving, but it's likely to exist in Gainesville, like everywhere else – where people downgrade to save money rather than cancel cable service.

Telephone Penetration

In another surprising finding, 59% of homes still claim to have a landline telephone. Nationwide there are still about 45% of homes with a landline phone.

This is the one statistic on the survey that we can't fully trust. GRU provided us a list of the phone numbers on record for their various customers. Our callers have no idea when they called a given number from the list if they are calling a landline or a cellular number. From a statistical basis, the very act of choosing who to call might have influenced the response to this question – there is no way to know if we had this selection bias. This is the only question in the survey that has this potential bias.

However, there is also a chance that this is a correct finding. As discussed earlier, the forced bundle from Cox could be forcing households to keep landlines in order to keep broadband. It's worth noting that 65% of Cox customers still have landlines.

Customer Bills

The survey asked customers what they pay each month for the triple-play services. We've found that this question always has to be taken with a grain of salt because what people say they pay is often quite different than what they actually pay. For example, a household might cite a \$60 special price they are paying for broadband without realizing that they actually pay more due to additives like the cost of a router and other fees. It's especially easy these days for customers that pay automatically with credit cards or bank debits to not know the amount they actually pay.

With that said, here is what customers say they are paying:

Customers buying a bundle of service	318	86%
Customers buying only broadband	20	5%
Customers buying only cable TV	15	4%
Customers buying other standalone combos	10	3%
Customers buying nothing	7	2%

This is an interesting result. In the numerous surveys that CCG Consulting has done, we've generally seen that 70% to 75% of households buy a bundle of services. This survey reports that 86% of households in the city buy a bundle. As described at the beginning of this discussion, the easy explanation for this higher result is the forced bundles from Cox – every Cox customer in the survey is buying a bundle.

Bundles are not cheap and only 32% of customers report paying \$100 or less for a bundle of services. However, only 12% report paying more than \$150.

Internet Speeds

66% of those with Internet access don't know the speed they are supposed to be getting at their home. 72% don't know the actual speed they are getting. Of the respondents that knew their broadband speed, it looks like many are getting less speed than they are subscribed to. This issue is covered in more detail in the discussion on the speed test.

Only 27% of homes say they are extremely dissatisfied or somewhat dissatisfied with their Internet speeds. That's one of the lowest levels of dissatisfaction that we've ever seen in a survey. However, only 12% of households are extremely satisfied with their broadband speeds, implying that everybody else has some issues with their broadband connection.

Only a slightly higher 29% of households say they are extremely dissatisfied or somewhat dissatisfied with the value they get from their ISP compared to the price they pay. That's also one of the lowest levels of dissatisfaction we've ever seen. This question is more of a test of how people feel about price and we often see many more households unhappy with the value even when they like the service. With that said, only 7% of households are extremely happy with the value they receive.

Comparing Service Providers

We asked respondents to rank Cox and AT&T on a scale of 1 to 5. We also asked them to rank the city. While the city isn't an ISP, these questions measure overall sentiment about how people feel about each provider. The results are interesting:

	<u>Satisfied</u>	<u>Dissatisfied</u>
Cox	31%	34%
AT&T	26%	19%
The City	17%	43%

Cox had a higher level of satisfaction than AT&T as well as a higher level of dissatisfaction – seems people either like or hate the cable company.

The findings concerning the city surprised us. We've almost always seen cities have a higher satisfaction level than ISPs. This tells us that if the city decides to become a retail ISP that you have some work to do to create a trusted brand name for broadband. We believe this bias against the city is baked into the responses to other survey questions. For example, the percentage of residence who say they would buy broadband from the city is lower than what we've seen in other markets – and this might partly be due to this bias. The primary worry this issue raises is that customers won't buy broadband from the city due to dissatisfaction they have that arises from some other issue.

Existing Fiber Network

70% of respondents were not aware that GRUCom already operates an extensive fiber network.

That's not necessarily bad because we've found that when people find that there is a fiber network near to them, they are unhappy when they can't buy service on the network. While GRUCom operates an extensive fiber network, this network was not designed to serve residential customers along the fiber routes. The existing fiber network is largely a middle-mile network that is extended to reach specific businesses or pockets of businesses. It would have been significantly more expensive to build the fiber network to provide the needed access points along the fiber to serve every customer.

Support for a Fiber Network

We asked if households support the idea of the city building a fiber network to reach everyone. 38% of households support the concept of a city-owned fiber network. Another 35% said they might support the network but need more information. However, 27% of households said they do not support a city-owned fiber network.

We asked for the reasons why some households didn't support a city-owned fiber network. The majority of the respondents said they were happy with their current provider. A much smaller number said they worry about an increase in taxes or don't believe that a government should compete with private business.

We then asked how households feel about the city's goals for operating a fiber network. Respondents were allowed to choose more than one reason. An overwhelming 84% of households were in favor of the goal of having the lowest broadband prices in the country. A majority 62% of respondents support the idea of bringing more competition and choice. There was not nearly as much support for the goals of bringing gigabit speeds (30%) or of providing better customer service (28%).

We then asked the factors that might lead a household to choose to move service to a new network. An overwhelming 78% said that lower prices would make them consider a change. A much smaller 26% said that faster speeds would make a difference. Almost nobody thought that better customer service would be a lure.

In probably the most important question of the survey, we asked households if they would buy broadband service from a city-owned fiber network. Only 16% said they would definitely buy from the city. 33% said they would probably buy service and 29% said they would consider buying service. Only 22% said they would not buy service.

We next asked how important it is to people that a new network provides cable TV service. 43% said that cable TV was important to them and another 37% said that a cable TV option would be nice, but not mandatory. However, when then asked if they would buy cable TV from the city, only 12% said definitely yes and another 31% said probably.

When asked if they would buy a landline telephone, only 12% of the respondents said yes with another 16% saying probably. 49% said they were unlikely to buy a landline. This comports with what we've seen elsewhere, and customers often choose to drop landline service when they are changing to a new provider.

When asked if households support the idea of getting broadband to every home with school children, 47% supported the idea and 18% opposed the idea.

Finally, the survey asked again if households would subscribe to a city-owned fiber network if they could buy a gigabit of broadband for \$50 per month. 23% said they definitely would buy and 33% said they probably would buy. Only 18% of homes said they would not consider it.

It's always a challenge to interpret these kinds of results. It's easy to interpret these responses in a community that has poor broadband, and we have done surveys where 80% to 90% of citizens support a city-owned fiber network. It's much more of a challenge to understand what these responses are telling us in a city like Gainesville. Proponents of fiber will see plenty of support in these responses, but opponents of fiber can probably say the same thing. Following are my observations of what these responses tell us:

- Probably the key responses in this string of questions is the one where 35% of respondents said they need more information in order to know if they support the idea of a city-owned network. That response then colors the responses to many other questions since many respondents don't have an opinion either for or against the idea of a fiber network.
- A few things came through strongly in the various responses. Lower broadband pricing is the predominant issue of interest in the community. 84% of respondents support the goal of the city having the lowest prices in the country. 78% said the number one factor that would influence them to change providers would be lower prices.
- Customer service is clearly not of major concern in the community. We often hear nationwide that ISPs do a dreadful job of customer service, but this does not appear to be the case in Gainesville. Only 28% of households supported the idea of bringing better customer service to the city. Only 3% said that better customer service would influence them to change providers.
- Cable TV is a more important issue in Gainesville than what we see in most communities. First, the penetration rate for cable is high, but that is inflated due to the forced Cox bundle. But 43% of homes said that they would want a new provider to offer cable TV with another 37% thinking that would be a positive thing.
- The key questions of the survey are the ones that ask if customers will buy the triple-play services. It's important to understand two things about these responses. First, most survey respondents are answering the survey with no facts about what it might mean to buy service from a new service provider. These responses are likely to change if there was a public education campaign or a direct marketing campaign – people are being asked if they buy something when they don't know the products, the prices, the bundles, or anything about the new network.

It's also important to recognize that these responses tell us more about the opportunities for a new market entrant in the first few years of operating a new business and not about the long-term opportunity. CCG has been involved in some of the bigger municipal ISPs

from the beginning. Cities like Lafayette, Louisiana and Chattanooga, Tennessee have more broadband customers on their networks today than was predicted by their pre-launch surveys. That's because after any ISP has been in business for a number of years the public gets to know them, and people can then make an informed decision about which ISP they prefer. These surveys are always somewhat conservative in their forecasts to reflect that respondents are naturally cautious about saying they support an idea that they don't fully understand.

C. Speed Tests / Customer Bill Analysis

Speed Tests

As part of the analysis we asked broadband users in the city to take a speed test. We elected to use a speed test provided by Ookla at speedtest.net, which is the most commonly used speed test in the world. However, there are numerous other tests available such as dslreports.com, speed.io, the BandWidthPlace, and TestMySpeed. Many ISPs also make a speed test available to their customers.

A speed test is one of many ways to measure a broadband connection. Speeds tests in general measure the speed between a user and a remote test site router. Speed tests are generally routed regionally, and we would expect that almost everybody participating in your speed test would have measured their speeds to the same regional hub.

If you've ever closely watched the download speeds for a large file you know that Internet download speeds vary second by second. Every speed test uses a different algorithm to account for this variability. For example, the algorithm used by Ookla discards the fastest 10% and the slowest 30% of the results obtained. By discarding the slowest results, the test might be masking exactly what led somebody to take the speed test, such as not being able to hold a connection for a VoIP call. Ookla also multithreads, meaning that they open multiple paths between a user and the test site and then average the results together. This could mask a congestion problem a user might be having with the local network.

Another issue to remember with any speed test is that it measures the connection between a customer's device and the speed test site. This means that the customer portion of the network, like the home WiFi network, are included in the results. A lot of ISPs claim that poor in-home WiFi accounts for the majority of the speed problems reported by customers. A slow speed test doesn't always mean that the ISP has a slow connection.

Speed tests also can be confounded due to what the industry calls burst speeds. We know that ISPs often give customers a burst of faster data for the first minute or two of a broadband connection and then revert to slower download speeds. Since many web transactions are short in nature, this practice makes the customer experience feel faster. However, the practice also makes speed tests look faster than the sustained speeds a customer can achieve. This is important for a customer if they are having trouble maintaining simultaneous data streams – the speed test, aided by the ISP bursting practice, will mask the true, and slower speed of the broadband connection.

With all of this said, a speed test is a good way to compare the performance of customers using different ISPs in the same market. Everybody taking the test is trying to make the identical Internet connection and we generally can spot performance trends for download speeds, upload speeds, and latency between different ISPs.

It's important to note that the results from our test are not a random sample, and as such it makes no sense to tabulate the results or try to somehow quantify the results. This means we can't make any definitive statements like "the average speed of Cox is X."

We generally expect to see slower upload speeds than download speeds. The technologies in use in the city offer a fixed amount of bandwidth to a customer connection and both AT&T DSL and Cox cable modem provide faster download speeds by limiting upload speeds. However, there are customers that now care about upload speeds. There are some applications that need a reliable upload link including gaming, security cameras, and online video chatting. There are numerous companies working on applications that will require significantly faster upload speeds. For example, there is a lot of research being done to create telepresence, which is the ability to create a hologram of somebody in a remote location in order to facilitate business meetings or visits with family members. This technology will use some version of enhanced reality technology and will require a larger upload link than is available to a lot of households today.

The speed tests also measure latency, which is the measure of the time it takes for a data packet to travel from its point of origin to the point of destination. Latency is measured using milliseconds (ms) which are one thousandth of a second. Speed tests measure latency because it tells a user about the quality of their connection. The lower the latency the better the connection. There are many real-time web applications that need relatively low latency in order to maintain the connection between a user and the online service. This includes applications like VoIP, gaming, live connections for online training, connections to corporate WANs when working at home, etc.

There are a lot of underlying causes for delays that increase latency—the following are primary kinds of delays. Total latency is the combination of all of these delays.

- Transmission Delay. This is the time required to push packets out the door at the originating end of a transmission. This is mostly a function of the kind of router and software used at the originating server. This can also be influenced by packet length, and it generally takes longer to create long packets than it does to create multiple short ones. These delays are caused by the originator of an Internet transmission.
- Processing Delay. This is the time required to process a packet header, check for bit-level errors, and figure out where the packet is to be sent. These delays are caused by the ISP of the originating party. There are additional processing delays along the way every time a transmission has to "hop" between ISPs or networks.
- Propagation Delay. This is the delay due to the distance between the user and the web server they are connected to. It takes a lot longer for a signal to travel from Tokyo to Baltimore than it takes to travel from Washington DC to Baltimore. This is why speed tests look for a nearby router to ping so that they can eliminate latency due to distance. These delays are mostly a function of physics and the speed at which signals can be carried through cables.

- Queueing Delay. This measures the amount of time that a packet waits at the terminating end to be processed. This is a function of both the terminating ISP and also of the customer's computer and software.

The technology of the last mile is generally the largest factor influencing latency. A few years ago, the FCC did a study of the various last mile technologies and measured the following ranges of performance of last-mile latency, measured in milliseconds: fiber (10 - 20 ms), coaxial cable (15 - 40 ms), and DSL (30 - 65 ms). These are measures of latency between a home and the first node in the ISP network. This is slightly different than what is measured in a speed test, which measures the latency the whole way to the speed test router.

Differences in latency is the primary reason that some technologies “feel” faster than others. A 25 Mbps connection on fiber feels faster to a customer than a 25 Mbps on DSL due to the lower latency. Latency is part of the reason that cellular data connections feel slower since 4G latency can be as high as 100 ms. In the same FCC test that produced the latencies shown above, satellite was almost off the chart with latencies measured as high as 650 ms. We've seen speed tests for satellite connections that showed latencies as high as 1,000 ms.

A lot of complaints about Internet performance are actually due to latency issues. It's something that's hard to diagnose since latency issues can appear and reappear as Internet traffic between two points uses different routing. The one thing that is clear is that the lower the latency the better the connection.

In the speed test we got results from both AT&T and Cox broadband customers.

Cox. As a reminder, Cox advertises the following speeds: 10/1 Mbps, 30/3 Mbps, 100/10 Mbps and 300/30 Mbps.

The latency reported on Cox varied from 15 ms to 59 ms, with the majority of latencies between 25ms – 30 ms. In general, the speeds for Cox were slightly better than what we've seen for the typical HFC cable network, which indicates to us that the network has good electronics and the coaxial cable in is in good condition. There were a few customers with latencies over 40 ms, and there is a likelihood that there is a problem in the Cox drop wire or the wiring inside the home.

We asked customers what speeds they were paying for and got a range of answers that were different than the current products listed above. For example, there were customers reporting that they are purchasing 25 Mbps, 50 Mbps, 80 Mbps and 150 Mbps. Since there were multiple customers reporting these speeds, we suspect that these are the speeds that they originally purchased, but that somewhere in the past Cox upgraded them to a faster speed.

There were customers claiming that they were sold speeds that were considerable faster than what they are experiencing. For example, the four customers that claimed there were purchasing 150 Mbps broadband was puzzling since none of them have speeds faster than

100 Mbps. But perhaps the 150 Mbps was part of some past marketing effort that sold “up-to” speeds at that level.

There were also three customers that claimed to be buying “GB blast” service. That’s close in name to the Cox marketing name “Gigablast” that is supposed to deliver 1 Gbps service. It’s clear that these three customers had something different than other customers because all three had upload speeds of 37 Mbps – faster than any other customers. But their download speeds were not at the 1 Gbps level, with the three speed test results showing download speeds of 36 Mbps, 107 Mbps and 466 Mbps.

There was also one outlier customer with a speed test result of symmetrical 31.5 Mbps upload and download speeds. That product would be more indicative of fiber and perhaps this customer lives in an apartment building that Cox serves with fiber rather than with their regular network.

However, there were a few customers that seem to have older products. For example, there were a few customers that reported having 60 Mbps products who were receiving download and upload speeds consistent with that product. We guess that these customers are grandfathered into an older product, perhaps part of a special promotion that gave them this speed for a several year period. It’s not unusual for big ISPs to keep customers on older products. We often find customers who are left with the older grandfathered speeds for years after everybody else was upgraded to faster speeds.

There were no customers buying the Cox 300 Mbps product who took the speed test. This is a relatively new product and there may not be a lot of customers with this speed.

Download speeds for Cox were mixed. About 30% of customers are getting speeds that are faster than what they are paying for. The fastest was for several customers getting speeds of 120 Mbps on a 100 Mbps product. Another 20% of customers reported speeds on the that were within 10% of the speed they are paying for.

But nearly half of Cox customers were getting speeds that were slower than what they paid for. Many of the speeds are significantly slower. For example, there were dozens of customers who say they are buying the 100 Mbps product and who had upload speeds consistent with that product, and yet were getting download speeds between 25 Mbps and 50 Mbps.

We can’t know why so many customers seem to be getting speeds less than what they are paying for. There are a number of possible reasons. First, there might be an issue where the modem and WiFi unit supplied by Cox are older and not able to deliver the speeds that are being sold today. Since Cox unilaterally increased speeds they may not have swapped out the associated old gear that won’t handle the new speeds. There is a heavily publicized example of this in upstate New York where Charter, and their predecessor Time Warner Cable didn’t upgrade cable modems for years after introducing faster products into the market.

It's also possible that customers are supplying their own WiFi modems which are not capable of the faster speeds. However, since almost half of the Cox customers have seemingly slow speeds these seems like an unlikely cause since most older WiFi modems are capable of speeds up to 100 Mbps.

Finally, there could be network issues. Perhaps some parts of town have outdated or inadequate outdoor coaxial wiring. Perhaps there are a lot of bad coaxial drops to customer homes. It's a bit of a mystery since there are a lot of customers getting decent speeds.

Like we see in every market, there were a handful of customers that have a problem that should be leading to a service call. For example, there were a few Cox customers with speeds under 5 Mbps who clearly have an issue that probably could be resolved.

The likelihood is that slower speeds are probably due to a combination of issues. However, the fact that half of customers in the speed test seem to be underperforming in speeds points to some sort of problem in the market.

Upload speeds on Cox seem to be a lot more consistent and largely match the products that people say they are buying.

AT&T. We didn't get enough responses from AT&T customers to make any sweeping generalizations about their performance. There were a few DSL customers getting more than their subscribed speed and a few getting far less than what they were paying for. This is typical of what we find with DSL since the product performance varies depending upon the distance from the AT&T central office and also upon the size and quality of the copper wiring.

There was one AT&T customer who was clearly served by fiber, with a download speed of 125 Mbps and a latency of 11 ms. We have always found some AT&T fiber customers scattered around every market, consistent with the way that AT&T provides fiber only around existing fiber nodes.

Customer Bill Analysis

As part of the analysis we asked for customer bills for from existing telecom providers, and we received bills from customers of Cox, AT&T and one bill for Windstream. We reviewed bills for several reasons. First, we wanted to understand the prices charged for broadband and other products in the city today. We were also interested in the transparency of the service providers in what they are reporting to customers.

Cox Communication. As the incumbent cable provider Cox sells the full triple play of cable TV, broadband and telephone service. They are also selling a home security product. We saw the following when looking at Cox bills:

Broadband

- We were surprised when we didn't talk to one Cox customer in the survey that wasn't buying a bundle of services from Cox – nobody was buying standalone broadband. We did receive several bills for standalone broadband. Our surveyors reported that some customers in the survey said they were required to buy the bundle rather than standalone broadband. We speculate that this might have been a Cox requirement in the past (we've seen that from other cable companies and also found reviews on the web discussing the issue). It's also possible that new customers are only offered standalone broadband on request. This was a significant finding for us because the survey indicates a higher-than-average penetration rate for cable TV.
- Most Cox bills list the download speeds of the broadband products being sold. We saw bills that listed speeds of 15 Mbps, 30 Mbps, 50 Mbps, 100 Mbps and 300 Mbps. We saw one bill for "Premier" internet service, which is a marketing name not listed on the current Cox web site.
- For comparison purposes, the speeds marketed on the current web site are 10 Mbps, 30 Mbps, 100 Mbps and 300 Mbps. We assume customers being billed for different speeds are probably "grandfathered" into older products.
- Roughly 2/3 of the bills we saw included a charge for a WiFi modem. There doesn't appear to be any fee for those using the normal DOCSIS modem that doesn't include WiFi. Customers are allowed to provide their own WiFi modems.
- The charges for a WiFi modem vary from \$8.99 to a high of \$10.99.
- There are no taxes charged for broadband service, but there is a 1% county sales tax and a 6% state sales tax billed for the modem rental fees.

Cable TV

- We didn't see any bills with cable TV that didn't also include a bundle of other products. As described earlier, Cox has a huge array of bundles and will bundle any combinations of products together.
- We saw bills with cable TV packages labeled as Starter, Contour, Contour Preferred and Advanced TV. Other than "Contour" the marketing names for the other channel line-ups are not listed on the Cox web site. Starter TV is the equivalent of what the FCC calls basic TV, which would include the local network channels like ABC, CBS, FOX, NBC, and PBS plus some other channels of Cox's choice.

We know from the website that contour TV includes 200 channels. We don't know what's included in contour preferred and advanced TV. The difference is likely to be different numbers of channels of programming included and perhaps the inclusion of movie channels.

- We didn't see any two customers paying the same rate for Contour TV. One customer was getting it for free. We saw other prices of \$20, \$84.99, \$87.49, and \$91.98. We have to assume that the different prices represent different special promotions, different bundle deals, or different negotiated rates. We also saw prices of \$15 and \$25 for Starter TV.
- The normal charge for a settop box is \$10. We saw a few customers with other rates such as \$8.50. Cox also provides what the industry calls a digital converter, which is a digital tuner without the other functions of a settop box. Cox calls this a mini-box and charges from \$2.99 to \$5.98 for the digital converters.

- Cox also sells DVR service, which includes a settop box that can record and store programming. The normal fee for this service is \$12.99 per month, which is typically added in addition to the \$10 settop box fee. We saw one bill for a \$19.99 DVR service that allows for recording to up to 6 shows simultaneously.
- Most cable customers are billed \$10.00 per month for a “Broadcast Surcharge.” This is a charge that is pretty common in the industry and represents fees that Cox pays for access to the local network channels like ABC, CBS, NBC, FOX, and PBS. A few customers are not being charged this fee and we assume it’s waived as part of a bundle or a special promotion. In the industry this is considered as a ‘hidden fee’ because customers often don’t realize that it’s a basic part of the cable TV fee since it’s shown separately on the bill.
- Most customers are also charged a “Sports Surcharge” for \$7 which covers some of the more recent cost increases for sports programming. This is also a ‘hidden fee’.
- Both of these fees are part of the cost of buying cable, and by labeling these as “surcharges” Cox is able to advertise cable TV at a lower price than it actually costs. For example, somebody who is paying \$84.99 for Contour TV is really going to pay \$101.99 including these two fees.
- We saw a “franchise fee” billed to only one customer.

Telephone

- We saw basic telephone service billed at \$10.67. However, telephone service also comes with two other fees – an FCC Access Fee of \$6 and a Regulatory Cost Recovery Fee of \$1.60. This makes the actual cost of a telephone line to be \$18.27. Cox lists these fees in the section of the bill that includes actual taxes, we assume to lead customers believe that these are also taxes.

These fees come from decisions at the FCC many years ago where the FCC shifted part of the cost recovery of the telephone drop wire at homes to customers instead of to long distance carriers. The FCC mandated back in the 1980s that regulated telephone companies like AT&T show these as separate line items on the bill. Some telephone companies refer to this fee as the Subscriber Line Charge, which is the FCC’s designation of the FCC.

Cox is a competitive telephone provider and they were never directed to bill these fees by the FCC. Competitive phone providers like Cox have decided to mimic the way that AT&T bills to make their bills more comparable. However, at the end of the day Cox has no regulatory authority to bill this fee, and it is clearly a deceptive billing practice for them to summarize these fees with the taxes rather than list them immediately under the fees for the telephone line.

Numerous consumer groups have complained about these fees. The FCC ordered a few competitive telephone providers to not attribute this fee to the FCC. However, Cox and many other competitive telephone providers continue to bill in a way that make a customer believe they are FCC taxes.

- Cox also sell a telephone line that includes unlimited long distance for \$29.99. They also add these fees to that product, meaning the actual cost is \$37.59.

- There are numerous taxes on the telephone bills, which is typical of the industry. The list is long but looks like the normally expected taxes for things like 911, hard-of-hearing service, contributions to the Universal Service Fund, etc. Telephone providers collect these taxes and remit them to the appropriate tax authorities.

Discounts

- Cox obviously applies discounts in bills in a number of ways. For the most part Cox does not list a specific discount on the bill, but instead lowers the prices of some of the products on the bills. This is likely the explanation for the wide range of prices charged for products like Contour TV.
- There were a few bills that instead listed a specific discount. There were a few customers with a “promotion discount.” There was one customer with a “loyalty discount.”

Home Life

- There were a few customers buying the Home Life security package. There are no details of what is included on the bill, but there appears to be two packages, one at \$54.99 and another at \$99.99. Some customers pay extra for a touchscreen wall pad to control the system.

AT&T. We didn’t receive enough bills from AT&T to make many specific comments. However, we have recently collected AT&T bills from other markets, and we’ve noticed that the company seems to have the same billing practices across markets. This makes sense because AT&T has developed centralized systems that serve the whole company, while cable companies like Cox seem to provide more regional autonomy to area managers.

Our observation of the bills is as follows:

DSL Broadband

- The only broadband bills we saw for Gainesville were for the 18 Mbps product. The price for that product varied from \$40, with no charge for a modem to \$65 with a \$7 additional charge for a modem.
- We know from other markets that AT&T makes “deals” with customers either through promotion rates for new customers or from customers calling and negotiating rates. AT&T understand that it is competing against Cox cable modems with a slower broadband product and will provide price discounts to keep customers. For example, the list price for 18 Mbps DSL is \$70, so the customers mentioned above are getting a substantial discount. The discount is not shown on the bills.
- There are sales taxes on the modem rental, but not on DSL.

Telephone Service

- The telephone rates for AT&T residential service are still regulated. They charge around \$24.25 per month for a residential line – but this varies slightly for each city in the county according to how many places they can call for free.
- The company bills a fee they call a “Federal Access Charge” of \$5.72 per month per telephone line. In the industry this is called the Subscriber Line Charge. It’s a fee from

decades ago that transferred access charges from long distance companies to customers. AT&T this fee as revenue and it is not a tax. The company also bills a fee called “Access Recovery Fee” of \$1.60 per month. These fees raise the price of a basic residential phone line to \$31.60. Unlike Cox, AT&T has full regulatory authority to bill these fees.

- AT&T also bills for numerous taxes on the telephone bills, which is typical of the industry. Telephone companies collect these taxes and remit them to the appropriate tax authorities.

Cable TV

- We know from the survey that AT&T has some cable TV customers in the market. However, we didn’t receive any customer bills that include cable TV.
- AT&T offers cable TV three ways. First, it’s available to U-verse customers, being those that buy the fastest DSL product of 50 Mbps. This is traditional cable TV, delivered over the DSL connection. However, the TV signal uses a lot of bandwidth and AT&T has announced that they are in the process of phasing out this product and are trying to entice customers to convert to DirecTV Now offered online.

AT&T also owns the DirecTV satellite business and they sometimes bundle satellite TV with DSL and telephone. This means that it’s possible that at least some of the respondents to the survey who say they have AT&T TV actually are using DirecTV through the satellite dish. AT&T has also started a campaign to migrate homes from the satellite to DirecTV Now, but they have a long way to go since there are currently over 19 million subscribers on the satellite service.

Finally, AT&T has the online service DirecTV Now. This competes with other online services like Sling TV, PlayStation, Vue, and others. Initially this product carried around 75 of the most popular cable channels for \$35 per month and was intended as a surrogate for having a landline cable subscription.

AT&T recently got realistic with the product. They have collapsed from four options down to two options now priced at \$50 and \$70 per month. The company got ready for this shift by eliminating special promotional prices in the fourth quarter of last year. They had roughly half a million customers who were paying even less than their published low prices. When AT&T raised the rates they immediately lost over half of those promotional customers.

Along with the price increases the company has significantly trimmed the channel counts. The new \$50 package will have only about 40 channels while the \$70 package will have 50 channels. It’s worth noting that both packages now include HBO, which is the flagship AT&T product. HBO is by far the most expensive programming in the industry and AT&T has now reconfigured DirecTV Now to be HBO plus other premium channels.

Customer Discounts

- AT&T doesn't show the discount on the customer bill. They just list the price of the product being sold.

Summary. For both companies we see prices varying significantly, even for customers buying the identical services. Discounts also vary widely, with some customers getting no discounts and others getting significant ones. Because of the varying prices and discounts, it's hard to say that there are "market prices" for the triple-play services in the market. It appears that customers can negotiate lower prices if they are willing to put in the effort with both AT&T and Cox.

D. Predicting Market Demand

One of the first questions we are always asked when helping a client look at a new market opportunity is how many customers a new venture might get over time. We've learned that customer penetration rate is the most significant variable in the performance of a fiber business.

One thing we've seen is that the likely customer penetration rate varies widely by market. In the residential market there are several factors that seem to have an impact on the overall customer interest in changing to a new broadband network.

Market Pricing / Affordability. We've found that the most important variable is the pricing of current broadband products in a market along with the sentiment of a community about whether the rates are reasonable and affordable.

Broadband rates vary widely across the country and even vary for the big ISPs by region. We've always figured that there must be some local authority among regional managers of the big ISPs in terms of the policy for offering discounts and special pricing.

The broadband pricing in Gainesville is interesting and somewhat unique in our experience. The primary driving force behind pricing is the fact that Cox Communications has, until very recently, had a policy that broadband is only available as part of a bundle of other services. In the residential survey we did not encounter one Cox customer with broadband who was not also buying cable TV as part of the bundle, with many customers also buying telephone service.

Additionally, since we work across the country, we see the prices and the policies of the various cable companies and we believe that Cox is the most expensive of the large ISPs. Almost across the board their list prices for products are higher than other cable companies. For example, the pricing for Charter, the second biggest cable company is \$65.99 for standalone Internet that varies between 135 Mbps and 200 Mbps download depending upon the market. The Cox prices for the same range of speeds starts at \$55.98 for 10/1 Mbps and ranges to \$94.98 for 100 Mbps.

Cox also has the highest list prices for cable TV compared to the other big cable companies. However, the other big cable companies have started to break out parts of the cost of cable service into separate fees. For instance, both Comcast and Charter also have separate fees for local programming and for sports programming. For those companies you'd have to

add together the charges for cable TV along with these extra fees to get the true price of cable. It's difficult to compare cable companies because of the different channel line-ups, and it's possible that after accounting for the separate fees charged by other companies that Cox is not more expensive.

However, since almost every Cox customer buys a bundle, all that really matters is their bundle prices.

A more recent pricing issue is also becoming a growing issue in Gainesville. Both AT&T and Cox have a data cap on products of 1 terabyte per month (1,024 gigabytes). Any household that uses more data than this per month (combination of downloaded and uploaded data) pays an extra fee. Both companies charge \$10 for every extra 50 gigabytes of data used. Both companies cap the extra fees at \$50 per month, and Cox allows customers to pay the \$50 automatically for unlimited data.

When the data caps were established a few years ago very few customers used that much broadband in a month. The company OpenVault sells software used at the major internet POPs and they measure data usage for many millions of customers. They report that 4.12% of homes used a terabyte of data per month in 2018, almost double from the 2.11% in 2017. We know that the average amount of data used by households is doubling about every 3 years, and so the number households that hit these data caps should continue to grow annually. Households hitting the data caps pay as much as \$50 extra per month.

Satisfaction with Broadband Speeds. Cox is the only major cable company where customers can still buy lower broadband speeds, with the first two Cox products at 10/1 Mbps and 30/3 Mbps. All of the other major cable companies have adopted a philosophy to only offer speeds that are significantly faster than the DSL offered by the telephone incumbent. For instance, the minimum speed for Comcast is 200 Mbps and for Charter varies between 135 Mbps and 200 Mbps.

The other big cable companies have unilaterally increased speeds for customers several times in the past. For example, in my home town of Asheville, North Carolina, Charter unilaterally increased speeds last fall from 60 Mbps to 135 Mbps, with no change in price. Both Comcast and Charter have done this at least three times in the past. The telcos that offer fiber like Verizon have done the same thing.

Overall Satisfaction with the Existing ISPs. It's well known that Americans regularly rate the big ISPs (both big telcos and big cable companies) as having the worst customer service in the country, compared to all industries (and even compared to the IRS). The annual ratings from the American Consumer Satisfaction Index have shown that the consumer dislike of the big ISPs have been increasing in recent years.

The consumer ratings for both AT&T and Cox are equally dismal and so customers can't change providers to find a better experience. Windstream is rated at the bottom of the large telco ratings.

What has become obvious is that customers much prefer the customer service of smaller regional ISPs when given a choice. Whether that is a municipal ISP or a fiber overbuilder operating in a market, customers tend to like the more personalized customer service at smaller ISPs. The municipal ISP at the city of Chattanooga, Tennessee has been the highest rated ISP nationally for the last several years.

Demographics. For many years there was conventional wisdom in the industry that demographics made a huge difference in broadband. For instance, the industry observed that older households purchased broadband at a far smaller percentage than other demographics, with each succeeding younger generation valuing broadband more than the generation before it.

However, since most homes now have broadband this is no longer as true. While broadband penetration still lags in homes from the greatest generation, that gap has closed considerably. In some markets the penetration between baby boomers and generation X is nearly identical. One interesting new phenomenon is that there is a growing percentage of new millennials and generation Z new households that don't buy landline broadband and rely on cellular broadband and publicly available broadband. We still don't know enough to know if this is more a function of the lower earnings of new households and if these households will buy landline data as they get older.

Residential Market Demand Forecast.

The residential survey looked at some of these issues and I won't repeat what was described in the section just above. One of the primary goals of undertaking a residential customer survey is to understand the interest in the community for buying broadband from a new fiber network owned by the city.

CCG has done hundreds of residential surveys, and we have often seen how the results of the surveys translate into real-life penetration rates. Based upon our experience, we've seen the following. Note that these predictions assume that the new ISP will mount a quality marketing and sales campaign to get customers – without that no new ISP fares well in the beginning. We also assume that the network is built to operate properly, and customers quickly abandon a network with major outages.

The following customer penetration rates predict the market opportunity over the first 3 – 5 years. After that time, if the new ISP and new network performs well, they can surpass these initial market targets.

- The customers that say they will definitely buy broadband from the city probably will. This group is likely comprised of two groups – early adapters and those who don't like the incumbents. The early adapters are those who already understand the benefits of fiber and who are willing to pay to get it without a sales pitch. The first customers for any new overbuilt network are also the core of consumers who don't like the incumbent providers. We've found these consumers are among the first to give a new network a try.

- We've always found that around 2/3rds of those that say they will probably change will do so. You don't get all of these because some can't overcome the ennui and make the effort to change providers. Other will be lured by low-priced packages aimed to keep them on the current provider. But overall these consumers have heard that fiber is better and are interested enough that a good sales effort should find them.
- The portion of the market that is a "maybe" are just that. These are many of the same households that said in the survey that they need to learn more before they have an opinion of a fiber network. We've always seen that a perhaps a third of these customers can be gained as customers with a good sales and marketing plan.

How does that assessment and prediction translate into projected customer penetration rates? We would summarize this discussion by quantifying the results of this survey as follows:

- Broadband: When asked if households would buy faster broadband that is priced similar to current rates, the survey predicted the following 3-5-year target goal of around 48%. That is comprised of the following from the survey:

	Survey	% Predicted	Target Market Share
Definitely yes	16%	100%	16%
Probably	33%	67%	22%
Maybe	29%	33%	<u>10%</u>
Total			48%

It's worth noting that when asked if households would subscribe to a gigabit of broadband for \$50 that the projected penetration targets increased to a likely 3-5-year target penetration of 56% calculated as follows.

	Survey	% Predicted	Target Market Share
Definitely yes	23%	100%	23%
Probably	33%	67%	22%
Maybe	32%	33%	<u>11%</u>
Total			56%

- Cable TV: According to the survey, a realistic goal for a 3-5-year plan is around 43%, calculated as follows:

	Survey	% Predicted	Target Market Share
Definitely yes	12%	100%	12%
Probably	31%	67%	20%
Maybe	31%	33%	<u>11%</u>
Total			43%

However, this assessment does not account for several issues. First is cord-cutting where the overall market for cable TV currently is dropping by a full 2% per year. Over 10 years that's a drop of 10% of the total market and about a 14% drop in cable customers. Applying that market trend to cable penetration rates would lower the 5-year target to 37%.

Further, there is likely going to be some impact from households that are freed from the forced bundle from Cox that makes them buy cable television. There is no way to quantify this, but I would predict that when Cox customers are offered the opportunity to drop cable than many of them will do so. The survey would have already captured some of that sentiment, but my guess is that Cox customers would bail on cable faster than other customers. I'm not comfortable in a forecast to put the cable TV penetration rate on a new network any higher than 30% looking out 5 years.

- Landline Telephone: According to the survey a realistic goal for a 3-5 goal for telephone penetration is 33%., calculated as follows:

	Survey	% Predicted	Target Market Share
Definitely yes	15%	100%	15%
Probably	16%	67%	11%
Maybe	20%	33%	7%
Total			33%

However, there are similar market factors affecting cable TV as well. The overall market penetration rate for telephone service continues to fall. Because telephone service is not mandatory in the Cox bundle there probably is no adjustment due to that. I'm not comfortable in a forecast to put the cable TV penetration rate on a new network any higher than 25% looking out 5 years.

Business Market Demand Forecast.

Business market demand is more difficult to predict. The original ITN for the project asked for a business survey. However, our proposal did not include on because at CCG we've learned that business surveys are not effective in predicting the eventual market penetration rate for broadband sales to business.

This is for a number of reasons:

- The number one concern of any business when considering a change of broadband providers is reliability of the connection. Businesses generally only consider a new network after they heard from others that the new network is reliable. Because of this, business sales generally lag residential sales.
- A survey given to anybody other than the decision maker for buying broadband has no validity. The broadband decision maker could be anybody inside of a given business, not necessarily the CEO. In many cases this is a decision made by committee.
- The decision to change broadband providers is generally step-by-step and a deliberate and careful process. It's impossible for a business to provide a snap answer on a survey for something that they are likely to deliberate about only when presented with the actual opportunity and the actual facts.

With that said, we know that most fiber owners do well in the small business market. In Gainesville that's the only business market we are considering in this study since the larger businesses in town

can already buy from ISPs using the GRUCom fiber network. There are several fairly predictable things to understand about the small business market:

- While reliability is generally more important than price, the incumbent providers often charge high prices to small businesses in a non-competitive environment.
- The small business market is largely ignored by the incumbent providers. It's not unusual to find small businesses that have never seen a representative of the incumbent ISP. Even when they can get the attention of the providers, small businesses are generally offered a narrow range of service options.
- We've also learned that small businesses want one provider for their broadband and telephone services. Otherwise, they fear finger pointing between two different service providers when there are problems.

Because small businesses are often both neglected and overcharged, we've seen that the consultative sales process generally fares well in this market. That is a step-by-step sales process that evaluates each business and provides broadband options specifically tailored to meet the needs of the business. A consultative sales process generally involves several visits to a business.

- The first business is to strictly ask about the business. What are the broadband needs of the business? How do they use their phones? Are there limitations placed on them by their current products? Generally, a salesperson also gets a copy of the current bill.
- The salesperson will then analyze what they found and develop a specific technical solution. At this point they look at pricing. The goal is not to automatically beat the current pricing, but to instead offer the business a suite of the products they really need, which might be more than they have today.
- Salesperson visits the business and explains the recommendation. There may be another meeting if changes are needed to the proposal. Only at this point does the salesperson discuss contracts and business issues.

We've seen that fiber overbuilders that follow this process can achieve a market penetration rate within 5 years of 50% or more. The "or more" depends upon the technology the fiber network is competing against. The success rate is higher for customers still using DSL and a little lower for those on a quality cable modem connection.

MDU Demand.

The feasibility study excluded apartment buildings with greater than 4 living units. This was done for several reasons.

- First, property owners make the decision on how broadband is brought to their buildings. They don't have to allow access to a new fiber network.
- Probably more importantly, many property owners have a financial incentive to not bring a new fiber connection to their apartments. They may already be buying a broadband pipe and be acting as the ISP and including broadband in the rent. They might instead be getting a 'commission' from an ISP that pays them a share of any revenues earned inside their buildings.
- There is also a robust market for selling large-bandwidth data connection to apartments.
- It's often expensive to wire older apartments due to plaster walls, concrete floors and other physical impediments that make it costly to add fiber.

- There are often aesthetic requirements that are hard to meet. For example, a property owner might allow fiber, but only if tenants can't see the wiring.
- It's harder to sell to apartment tenants. There is often a lot of churn or tenants coming and going. Many apartments don't allow door-to-door sales within the complex.
- Finally, there can be many other kinds of physical restriction such as not enough space for fiber electronics, inadequate access to metered power, access to make repairs on weekends and evenings, etc.

Even with these many issues, there are likely some property owners that would want the city to bring fiber to their tenants. Some of these property owners might want the city as the only provider if you're bringing fiber. Others might prefer an open access environment where tenants can choose between multiple ISPs. It's difficult to make an estimate of the likely demand, and even harder to predict the cost of serving apartment buildings.

The cost to getting into apartment buildings can vary by several multiples of the cost of serving single family homes. Most ISPs deal with this issue by determining some maximum investment they are willing to make, on a per customer basis to get into an MDU. That limits them to only serving buildings where the cost to add fiber is reasonable. Those limitations also reduce the number of MDUs an ISP might serve – making it challenging to estimate the size of the potential market.

Predicting MDU revenues is additionally a challenge since there are at least three major ways that a relationship with a property owner might be structured. GRUCom today is already engaged in the model where they sell a large broadband connection to a property owner that then distributes it to tenants. There are two other revenue models:

Direct Sales. This means selling products directly to tenants. It's possible for this to be an exclusive arrangement, but it's more likely that a new ISP will be competing against the incumbent ISPs in the market inside the building. This can add numerous complications such as determining if the new ISP can use existing wiring.

Bulk Sales. Bulk sales means selling individual products to property owners that either mark-up the products and sell to tenants or else include products in the rent. In a bulk sale agreement, the landlord generally buys a product for every unit, even the empty ones – but at a significant discount from single-family rates.

ISPs also have to take into consideration that it generally costs more to serve MDUs. It's harder to sell inside of MDUs. It's often hard to gain the needed access to make repairs.

While these models completely exclude larger MDUs, the chances are that if the city was to become a residential ISP that you'd end up serving some portion of this market.

Summary of Section 1

Current Market Rates

- AT&T has residential broadband products up to 1 gigabit per second served on fiber. However, most AT&T customers are served with DSL technology with speeds as fast as 50 Mbps. AT&T offers discounts to some customers in the market.
- Cox advertises speeds as fast as 300 Mbps download on their website. However, we found customers who buy 1 gigabit from Cox in both the bill analysis and on the speed test. Cox's list prices for cable TV are the most expensive we've seen from a big cable company. Until recently Cox required a customer to buy cable TV in order to buy broadband. Cox offers a wide range of bundling discounts along with special rates due to marketing promotions. Most customers likely pay less than the published rates. It's hard to generalize about all Cox customers, but our impression is that the overall billed rates in Gainesville are among the highest we've ever seen.

Residential Survey

- 92% of survey respondents had some form of landline broadband. 64% of those with broadband subscribe to Cox, 29% subscribe to AT&T and the remainder subscribe to Windstream or another provider.
- 91% of respondents still subscribe to traditional cable TV service.
- 59% of respondents still have a landline telephone.
- 38% of respondents support the idea of the city building a fiber network with another 35% saying they need more information to understand the issue. This suggests the need for a public education campaign before holding a referendum asking the public to support the network.
- The public was more enthusiastic about the city's goals for fiber. 84% liked the goal of having the lowest broadband prices in the country; 62% liked the goal for bringing more competition and choice to the city.
- 49% of respondents said they would definitely or probably buy faster broadband from a city network at market rates. That improved to 56% when asked if they would buy gigabit broadband for \$50.
- 43% said they would definitely or probably buy cable TV from a city fiber network.
- 31% said they would definitely or probably buy landline telephone service from a city fiber network.
- 47% of respondents said they would definitely or probably support the idea of having a portion of their broadband rates support making sure all school students have broadband in their homes.

Speed Test Results

The speed tests showed that many customers are getting the download speeds they subscribe to, and even a little more. However, nearly half of customers that took the speed tests were receiving speeds that are slower than what they are paying for. We can only speculate about the reasons for slow speeds, but our past experience makes us suspect that there are issues with at least some parts of the Cox and AT&T networks.

Customer Bill Analysis

Customer bills show that both incumbent providers freely negotiate prices with customers. There are customers paying near to list prices and other customers with substantial discounts. The bills also showed some billing practices that we think are deceptive, including the 'FCC fees' on

telephone service and the Cox fees for access to Broadcast and Sports fees. Overall the list prices for Gainesville are some of the highest we've seen, although some percentage of customers are negotiating lower rates.

II. Engineering Design and Cost

This section of the report describes the network design we used in the feasibility study, discusses the technology used and also looks at other competing technologies.

A. Design Parameters

The first step in any network design is to collect the raw facts about the community to be served in terms of number of potential customers, miles of fiber that must be built, existing assets, etc.

We estimated network costs for four different study areas:

- Gainesville City Limits. This covers everything inside the city limits but excludes the University of Florida. The University already provides broadband within the campus boundaries.
- GRU Service Area. This covers the city limits plus all areas where GRU currently provides utility services.
- Urban Reserve. This includes the GRU Service area plus areas in the county with significant housing density to consider for fiber construction. This area was defined for us by GRU. We did not include undeveloped rural areas.
- Adding Small Towns. Finally, the largest study area adds on the developed areas of the cities of Newberry, Hawthorne, Archer, High Springs, Wald, and Alachua. In all cases GRUCom already has a fiber presence in these cities.

One of the key parameters of all of these studies is that the ITN that defined the project excluded large MDUs (Multi-dwelling units) that consists of either large apartment or condominium buildings and complexes. These were excluded for several reasons:

- First, a fiber builder doesn't have automatic access to MDUs. Property owners don't have to allow access to MDUs or allow fiber construction on private property.
- Many of the large MDUs are already served by fiber. Some of this fiber is provided by the GRUCom fiber network. There are also MDUs served by AT&T, Cox and possibly a few other carriers.
- It's not always easy to bring fiber into MDUs. Older buildings often have structural impediments such as plaster walls, concrete floors and other types of construction that make it expensive to bring fiber inside a building. Other MDUs are challenging because of esthetic restrictions required by property owners who might want fiber, but only if the wiring and electronics are not visible to tenants.
- There are additional challenges if the city wanted to provide low-price gigabit service into MDUs. For example, property owners are used to a market where Cox, AT&T and others pay them to get access to tenants. This can be in the form of a lease for facilities, or more typically an arrangement where profits are somehow shared with the property owner, or

the property owner is provided with low-price wholesale connections that they mark-up to tenants. Most cities find it difficult or impractical to offer profit-sharing with property owners because it can look a lot like a kick-back. Also, the whole concept of offering low prices is not compatible with the idea of the property owner sharing in profits or marketing up rates. It would be a huge challenge to somehow bring large apartment into the business plan that wants to offer low-price gigabit service.

Existing GIS Data

Alachua County maintains an extensive and detailed GIS mapping system. This system contains a wealth of information such as maps of streets, address points, structure information (i.e., residential, commercial, government), and more. We also had access to data from GRU that showed the location of existing aerial and buried utilities. We utilized this data extensively to determine potential fiber routes, crossing locations for major roads and railroads, locations for huts and other items that impact the cost of building a fiber network.

We were able to use this data to categorize different sections of the study area according to the likely costs of construction. For example, we identified the streets in the city that we categorized as heavy urban versus light urban, with heavy urban having a greater density of passings or covering business districts or other areas where fiber construction would be more expensive. We were then able to estimate costs for fiber construction each area such as light and heavy residential, commercial, etc. This is a process that we routinely use in making high-level feasibility estimates. We have found through past experience that we are able to make a reasonable estimate of the cost of fiber construction without actually designing the entire city, street by street – such an effort would be expensive and can't be justified when the goal is only to estimate the cost of fiber.

We did not have the same GIS data for the smaller cities. In those cities we had enough data to estimate miles of streets. We relied on Census data to get a count of passings. We made a visual inspection of each smaller city in order to estimate the current mix between aerial and buried utilities, and also to enable us to see the conditions of the current aerial poles.

Passings

The telecom industry uses the term passing to mean any home or business that is near enough to a network to be considered as a potential customer.

We used several sources of information to estimate passings. The GIS data supplied us with the total number of structures in the city. We also had access to city data that allowed us to classify residential buildings by the number of residential units. We eliminated all residential buildings that have more than four living units. The fiber technology we chose for the study can be used easily in residential buildings with four or few units. The technology can also easily serve townhouses as long as each has its own utility connection.

We also considered the number of existing electric and water meters. We know from experience that the number of electrical meters can be significantly greater than the total number of potential locations that might require fiber. Examples of meter locations which would not subscribe to a

retail broadband connection might be garages, standalone shops, wellheads, etc. Finally, we considered US Census data, which has been updated to estimates through 2017.

It's always more of a challenge to count potential business customers in a city. There are many business locations that contain multiple potential business customers for broadband. That includes places like malls, strip malls, small business complexes, etc. Even when businesses are in a standalone building there might be a second business tenant in some portion of the building that would buy broadband separately from the main building owner.

We elected to use the business counts supplied by the US Census. Again, those estimates were updated to 2017. We know from past experience in working in other cities that the Census estimates are always a little high. This comes from the Census counting multiple businesses that share the same address. For example, a business in the city might also be listed as the official address of a non-profit corporation, which is a separate but real second business at the location.

Counting potential business passings in the city are further complicated by the fact that GRUCom currently provides fiber access to many businesses in the community. GRUCom sells fiber to carriers, ISPs and other telecom providers which then sell services to the business.

We decided to reduce the Census business counts by 20% as an estimate of the duplicate businesses located in the Census as well as those businesses that already have access to GRUCom fiber.

The passings used in the studies are as follows:

	City	GRU	Urban	Plus
<u>Passings</u>	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Small</u>
				<u>Cities</u>
Single Family	23,021	17,515	3,731	8,241
Buildings with 2 - 4 Units	11,897	1,344	1,179	1,498
Total Residential	34,918	18,859	4,910	9,739
Businesses	7,811	955	232	772
Total Passings	42,729	19,814	5,142	10,511
Cumulative	42,729	62,543	67,685	78,196

Miles of Fiber Construction

GRUCom has already constructed a 550-mile fiber network that reaches throughout the city, the county and even outside of the county. We utilized this network to the extent possible in our design. However, there are many cases where the existing fiber is not adequate for a FTTP network design. Our use (or non-use) of existing fiber is as follows:

- The existing fiber can be utilized to create what we call a fiber backbone. The FTTP design requires that neighborhood huts be spaced around the service area and the existing network is adequate to reach these huts. We've assumed that the design would place the needed huts at electric substations wherever practical. Even where not practical, such as in the smaller

cities where there is no GRU electric service, the existing fiber network already reaches each small city. The GRUCom fiber extends today to a lot of places that could be adequate for fiber neighborhood hubs such as the electric substations, schools, other government buildings, water pump stations, apartment complexes, and large businesses.

- For the most part the existing network is built in a home-run configuration. That means that there is usually an uninterrupted run from the beginning and end of each fiber run. For example, if fiber is built into a residential neighborhood to reach a school, the fiber has been designed to have fiber splice connection points at the school and back where this particular fiber originates in the network.

FTTP requires a different configuration. When fiber is designed to serve every home or business passed there is a fiber access point built into the fiber after every couple of homes or businesses. These access points are located relatively close together to limit the length of the fiber drop required to go from the street to the home or business. On a buried fiber route these access points are usually in the form of handholes, which are small fiber enclosures that are buried near to the street and that are spliced into the primary fiber. There might be a buried access point for every two or three homes, including access points on both sides of the street. If underground fiber was built to a school, then it was not constructed with these buried access points. In most cases it would cost more to try to excavate to an existing buried fiber to add the needed access points than it is to bury a new fiber.

- The other issue with the existing fibers is that most of the existing network is built with relatively small fibers in terms of the number of fibers in each cable. In most cases, even if access points could be added, the existing fiber doesn't contain enough fibers to accommodate fiber to every home and business along a route.

The lowest-cost construction methodology is to install distribution fiber in the power space – that means installing fiber close to the power lines. There is a big potential cost savings from using the power space since there rarely will be any need to move or modify existing wires. When fiber is constructed below the power space there are often poles where there is not enough room to safely install a new cable. In those situations the wireless have to be rearranged to make room for the new provider, and in the worse case some poles might need to be replaced. That effort of making room for a new attacher is called make-ready, and the cost would be borne entirely by the new fiber project.

Somewhat offsetting the savings from building in the power space is a requirement that only technicians that are licensed to work around high voltage can work on fiber located in the power space. Those technicians generally make a higher salary, and technicians certified in power work generally don't like doing fiber work.

Another downside to installing distribution in the power space is having the fiber drops from customers originating in the power space. Those extra wires can add safety concerns and complications when technicians are working to repair storm damage.

Today we see electric companies that resolve these issues by installing the distribution fiber in the power space, but then installing a drop wire so that the fiber drops can originate from

a lower space on the pole. This solution saves money by being able to build fiber with little or no make-ready work. There is also a long-term savings due to allowing technicians that are not certified for high voltage work to make and change connections to customers.

Our study uses this hybrid design – distribution in the power space with drop wires that originate from lower on the pole.

- The summary of this discussion in two-fold. The existing underground fiber doesn't have enough access points to be useful for FTTH. The existing aerial fiber generally doesn't have enough fibers to serve all of the passings along a street.

Our conclusion is that the existing fiber network is useful to create the backbone to reach neighborhood huts. The existing fiber makes it affordable to consider building fiber in the smaller cities since the backbone to those towns is already in place. There may be some cases where existing aerial fiber might be useful to reach some customers, but it's likely that you need a new fiber network in the majority of the city to reach FTTP customers.

- Our of the most important assumptions we've made in estimating the cost of the network was that we didn't assume that all buried fiber is placed into conduit. We understood the goal for the study was to find the most reasonably-priced and reliable network that could support low bandwidth prices. We assumed that 40% of the buried fiber would be directly buried in the ground and not put into conduit. This is a construction technique used by commercial fiber providers who are trying to control network costs. We assumed that any street where there are multiple fibers sheaths or where there are large-count fibers would be put into conduit. The advantage with conduit is that you can pull a bad fiber out of the conduit and replace it should something go horribly wrong.

However, realistically fiber overbuilders rarely remove and replace fibers. They sometimes augment fiber routes by pulling an additional fiber through conduit to increase capacity. That ability is why we assumed placing conduit along major routes where there might someday be a need to add additional fibers.

But this is not a likely need when deep into residential neighborhoods where it's extremely unlikely that additional fibers will ever be required. In this "last-mile" part of the network the need for additional future fiber can be accommodated by installing a larger fiber initially with extra fibers to accommodate future growth or fibers that go bad for some reason. In most neighborhoods in Gainesville there are very few new houses built annually and the need for additional fibers would rarely arise. There is a significant saving on construction costs to direct bury fiber in these situations. This kind of fiber has a tough sheath and is as hard to cut as a fiber in a conduit. This assumption eliminated a huge amount of cost from the network design. In the city of Gainesville alone it reduced fiber construction costs by \$13 million dollars. Our best guess is that the 40% direct buried fiber estimate is probably low and there is probably the opportunity for more savings.

We estimate that the following miles of fiber construction are needed for each of the four different options.

Plus

<u>Miles of Fiber</u>	<u>City Limits</u>	<u>GRU Territory</u>	<u>Urban Reserve</u>	<u>Small Cities</u>
Aerial Miles	358.65	244.55	60.79	128.94
Buried Miles	<u>293.45</u>	<u>200.08</u>	<u>49.73</u>	<u>60.57</u>
Total	652.10	444.63	110.52	189.51
Cumulative Aerial	358.65	603.20	663.99	792.93
Cumulative Buried	<u>293.45</u>	<u>493.53</u>	<u>543.26</u>	<u>603.83</u>
Cumulative Total	652.10	1,096.73	1,207.25	1,396.76

B. The Technology

Before discussion the network design, we want to first discuss the different technologies that can be used in bringing fiber to customers. There are two primary technologies to consider - active ethernet and Passive Optical Network (PON). These are both mature technologies that are widely used and well understood industry-wide.

Active Ethernet (Active E)

This is the technology already in use in the existing GRUCom fiber network. An Active E network is essentially a fiber “home run” from the electronics core directly to the customer. Active E network dedicates a fiber path for each user between the customer location and the electronics equipment in a hub. This means each customer has a dedicated path to the electronics and does not share fiber or bandwidth directly with another customer in the neighborhood. An Active E network has many more field lasers than a passive network since there are lasers at both end of the fiber connection for each customer.

An Active E network is 100% digital and all services must be digitized and delivered as an IP data stream to the user. The Active E technology uses only 2 wavelengths on each fiber—one for transmission of data to the user and one for transmission of data from the user.

The primary vendors in the Active E equipment market are Cisco, Calix, Adtran, and Nokia-Alcatel-Lucent. Since PON equipment has won a much greater market share than Active E equipment, this part of the industry has been in a bit of a decline for a few years. Active E is easier to engineer and expand and is useful for customizing solutions for small volume specialized applications.

Advantages:

- Can serve customers up to 36 miles from last active field device.
- Requires less pre-planning and engineering.
- A single point of failure will often affect fewer customers
- Offers true non-blocking 1 Gbps and beyond speeds.
- Easily upgradeable to 10 Gbps by upgrading lasers.

Disadvantages:

- Any field electronics must be placed into air-conditioned huts or enclosures and all field locations need CD power.
- More physical space is required for electronics because there are more fiber terminations onto the electronics (due to one fiber per user). If the electronics are located in the field, the cabinets housing the electronics and fiber terminations can become relatively large. This makes it more complicated to manage the fiber bundles into and out of huts and other field hubs. This also means most cabinets need to be on private land and not on public rights-of-way.
- Fewer customers are served per electronic chassis. Since only one customer can be served per laser then there are fewer customers that can be served from a single card.
- Using the technology for a lot of customers means constructing larger fiber cables in neighborhoods, greatly increasing fiber construction costs. The use of larger fiber cable in an aerial application may significantly increase make-ready costs.

Passive Optical Network (PON)

The more common technology used for FTTH is PON (Passive Optical Network) which uses passive hardware to "split" the light signals so that a single high-powered laser can be shared by up to 128 customers (more typically 32 customers). This technology requires less fiber than an Active E since many customers in an area share the same single neighborhood fiber. 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 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 Active E. The PON electronics divide up the optical wavelengths on the fiber to allow one 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 cable signals into the home.

A PON network has the ability to transmit video at the RF level and have it split into multiple fiber drops. This means that a PON that is delivering analog TV would not require a settop box. A PON also uses existing wiring more easily since the video signal is delivered in the same way as the existing cable TV video is delivered by the cable company. This gives easier access to existing telephone and cable wiring. It's worth noting, though, that most new PON installations are foregoing the analog data path and are only using the digital path – it saves money on the electronics at the home, plus there are fewer analog cable headends left in operation.

The current vendors for PON equipment include Alcatel-Lucent, Adtran, Zhone, Nokia, and Calix. Today passive optical networks use the gigabit passive optical network (GPON) technology primarily, even though more advanced versions do exist and are discussed below. 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, which is shared by the number of customers on a splitter. As an example, a 1x32 splitter would mean that 32 customers would share a single 2.4 Gbps downstream and 1.2 Gbps upstream connection.

Advantages:

- Lower Cost (typically 10-20% less than Active E for the core fiber electronics).
- Much more efficient use of bandwidth at the customer premise. A GPON network delivers 2.4 Gbps of data to a small cluster of houses and an individual customer will normally have access to much of this bandwidth for data transmission, thus giving the customer a faster bandwidth experience at the home. By contrast, a typical cable TV system shares 150 Mbps with up to 500 homes and an Active E shares bandwidth farther into the core network.
- For the most part it can use existing home wiring. The PON network is designed to tie into existing telephone and cable wiring as long as they are conveniently located and in good working order.
- Requires no field electronic devices. The key word about a PON network is that it is passive. This means that no power is needed except in those locations, generally at central offices and major hubs or huts, where the provider places electronics.

Disadvantages:

- Customer must be within 12 miles of hub when using 1x32 splitter. This means with very large installations that multiple hubs are required.
- More customers potentially are affected by a fiber failure in the field.

Why Not Next Generation PON Technology?

There are newer PON technologies now on the market. There is a lot of debate within the industry about the direction of the next generation of last-mile fiber technology. There are two possible PON technologies that might be adopted as the preferred next generation of electronics—NG-PON2 or XGS-PON. These technologies are capable of delivering a 10-gigabit data stream to customers.

The current widely deployed GPON will eventually hit a technology wall. The technology delivers 2.4 Gbps downstream and 1 Gbps upstream for up to 32 customers, although many networks are configured to serve 16 customers at most. This is still an adequate amount of bandwidth today for residential customers. However, many ISPs already use something different for larger business customers that demand more bandwidth than a PON can deliver.

The GPON technology is over a decade old, which generally is a signal to the industry to look for the next generation replacement. This pressure usually starts with vendors who want to make money pushing the latest and greatest new technology—and this time it's no different. After taking all of the vendor hype out of the equation it's always been the case that any new technology is only going to be accepted once that new technology achieves an industry-wide economy of scale. That almost always means being accepted by at least one large ISP.

The most talked about technology is NG-PON2 (next generation passive optical network). This technology works by having tunable lasers that can function at several different light frequencies. This would allow more than one PON to be transmitted simultaneously over the same fiber, but at different wavelengths. That makes this a complex technology with multiple lasers and the key question is if this can ever be manufactured at price points that can match other alternatives.

The only major proponent of NG-PON2 today is Verizon, which recently did a field trial to test the interoperability of several different vendors including Adtran, Calix, Broadcom, Cortina Access, and Ericsson. Verizon seems to be touting the technology, but there is some doubt if they alone can drag the rest of the industry along. Verizon seems enamored with the idea of using the technology to provide bandwidth 10 Gbps connections for the small cell sites needed for a 5G network. However, the company is not building much new residential fiber.

The market question is if Verizon will buy enough equipment to create enough economy of scale to get prices down for NG-PON2. The whole industry agrees that NG-PON2 is the best technical solution because it can deliver 40 Gbps to a PON while also allowing for great flexibility in assigning different customers to different wavelengths. Still, the best technological solution is not always the winning solution and cost is the greatest concern for most of the industry. Today the early NG-PON2 electronics are being priced at 3–4 times the cost of GPON, due in part to the complexity of the technology, but also due to the lack of economy of scale without any major purchaser of the technology.

Some of the other big fiber ISPs like AT&T and Vodafone have been evaluating XGS-PON. This technology can deliver 10 Gbps downstream and 2.5 Gbps upstream—a big step up in bandwidth over GPON. The major advantage of the technology is that it uses a fixed laser which is far less complex and costly. In addition, these two companies are building a lot more FTTH networks than Verizon.

It may be a number of years until this is resolved because most ISPs building FTTH networks are still happily buying and installing GPON. One ISP client told us that they are not worried about GPON becoming obsolete because they could double the capacity of their network at any time by simply cutting the number of customers on a neighborhood PON in half. That would mean installing more cards in the core without having to upgrade customer electronics.

The bottom line of this discussion in terms of the study is that we chose not to consider NG-PON2 for the primary technology to deliver FTTH services. The technology is still too expensive and since it has not yet been accepted widely in the industry it might never get long-term support by vendors.

However, the design we've used allows for an eventual migration to XGS-PON or NG-PON2 through what we call an overlay. That means you could selectively introduce the new technology while maintaining the current network. This would allow for an orderly transition over time while bringing faster 10-gigabit connection to customers that need it immediately. The fiber network design should accommodate these future technologies if you ever decide to make such an upgrade.

Should GRUCom Consider Wireless Technologies?

The ITN for the project asked that we consider alternative technologies, and for broadband today that means wireless technology. After we came to understand the study area, we couldn't find any places where wireless technologies would provide a better solution than fiber. We considered the following:

Point-to-Point Broadband

There are wireless radios today that can provide high-speed connection of up to a few gigabytes of speed over relatively short distances. This technology uses extremely high spectrum of 20 GHz or higher – referred to as millimeter wave spectrum. The US is the first country to authorize specific use of the spectrum in millimeter wave band

The technology can be deployed in two ways. First is as a hot spot. One of the specifications of 5G will be to use this spectrum to provide gigabit bandwidth inside of a room with a millimeter wave hot spot. As a hot spot these frequencies don't travel very far, and so using them within one room is a reasonable goal. The higher up on the frequency scale the shorter the effective distance as a hot spot, and at the upper end of these spectrums at 60 GHz the signal dissipates at 50 feet from the hot spot. These frequencies won't go through walls, making this a room-by-room application as an alternative to WiFi. Millimeter wave hot spots are not going to be a competitive threat to GRUCom, but rather might be a new offering for you to provide to broadband customers.

This technology can also be deployed in the form of a highly focused beam. This can be configured in two ways. First is the more traditional point-to-point transmission between two transmitter/receivers. There have been radios using the millimeter wave frequencies for several years that can deliver up to a 2 Gbps connection for 1 mile or a 1 Gbps connection for 2 miles. This configuration is mostly useful as a fiber replacement. It's a good way, for example, to beam a signal from a roof top to provide service to another building. It's a good way to connect buildings together in a campus environment without having to build fiber. It's an interesting way to be able to provide temporary service to a large business customer until fiber can be built.

This technology is available to anybody and the FCC licenses are easy and inexpensive. The largest company using this technology today is Webpass, a subsidiary of Google Fiber. Webpass deploys the technology in downtown high-rise districts to bring gigabit broadband to whole buildings. They start with a building where they have a fiber connection and bring that connection to the roof. From there they beam to other downtown buildings. This is far cheaper than constructing fiber in downtown areas. Radios today are affordable and a pair of transmitters / receivers costs around \$5,000. The technology is of limited use though, in that two radios are needed for every connection, and this can quickly clog up valuable rooftop space. Verizon, AT&T, and CenturyLink have been experimenting with the technology to bring fiber speeds to apartment buildings and other big broadband customers without having to build additional fiber. This is mostly a downtown urban technology. The beams need pure line-of-sight and there can be no impediments in the signal path.

One limitation of the technology is the amount of bandwidth. One or two gigabit speeds might sound large, but even in today's environment that's often not enough bandwidth to serve a whole

building. Most companies deploying the technology view it as a temporary solution that will eventually be replaced by fiber.

We don't foresee GRUCom using this technology, except perhaps as a way to connect buildings in a campus environment if the building owners don't want fiber construction. If you're going to build fiber along all streets this technology would have limited applications.

Point-to-Multipoint Broadband

It's likely today that there are wireless ISPs (WISPs) operating in the rural parts of the county. Today there are wireless technologies that can deliver up to 100 Mbps broadband connection up to 4 airline miles from a tower to a handful of customers, or slower speeds to a greater number of customers. This technology places transmitters on tall towers and beams the signal to a small dish placed on customer homes and businesses. The speeds available to customers decrease with distance from the tower.

There are several different frequencies of radios that can be used for wireless deployment by providers like the city:

- The primary frequency used for this technology today is WiFi. This is the same WiFi frequency used to deliver broadband inside homes. WiFi is really two frequencies – one at 2.4 GHz and another band at 5 GHz. Probably the biggest advantage of WiFi in this use is to use each frequency to serve different customers – matching each customer to the one that gives them the best signal.
- New radios also often include the 3.65 GHz frequency that was recently approved for rural broadband by the FCC. There are several advantages of this frequency over WiFi. First, the channels in this frequency naturally allow for greater bandwidth delivery. The 3.65 GHz frequency handles trees much better than WiFi. But no frequency is perfect with foliage and some customers, particularly those farther away from the tower, might need to take some steps like cutting down trees to improve reception.
- Radios used for this purpose today are largely software tunable and we envision networks that will use both 3.65 GHz and WiFi, and which might be able to accommodate other future frequencies allowed by the FCC.
- The industry is hoping that the FCC will make “white space” spectrum available for rural broadband. This uses the same frequencies that are deployed by UHF television channels (TV channels above channel 13). The FCC recently finished an auction where TV stations offered their frequencies, which were then sold in an auction to bidders. The frequencies were bought by wireless carriers like T-Mobile and AT&T. Dish Networks also bought spectrum. The surprise buyer was Comcast, which is now entering the wireless business and has announced partnering with Charter to do so.

The number one limitation on these technologies is bandwidth. While 100 Mbps is possible, a more typical configuration is to provide 50 Mbps service at best. While 50 Mbps service feels like a lot of bandwidth, this technology is not likely to get faster in the future, and we are not many years away from a time when most customers will want a connection faster than 50 Mbps.

This wireless technology is not a good fit for the city service area. The wireless path between a tower and a customer must be wide open without impediments and needs “line-of-sight.” The wireless signals are disrupted or critically attenuated by foliage, trees, terrain, and manufactured structures, which makes service inconsistent across the service area. These limitations mean that there are customers that can’t be reached from a given tower. Further, this technology does not provide the level of signal security that many businesses require.

There is also a limit on how many customers can be served from one tower. Most of the technologies can transmit within a defined number of degrees of delivery area, referred to as sectors. For instance, a tower might use four 90-degree sectors for coverage. Each sector has a natural limit of perhaps 200 customers, meaning that a lot of towers would be needed to serve any significant number of customers. That’s the primary reason this is best used as a rural technology.

Our study focused on the parts of the county that have significant housing density (meaning houses are close together). Should GRUCom want to consider serving the rural customers that are outside of the urban expansion area or around the smaller cities, then this technology is probably the best option.

Because of the slow speeds, this wireless technology is probably the most susceptible to technology bypass. For example, it’s impossible to imagine a wireless technology that can outperform fiber, but low-orbit satellites might well out perform this technology.

Wireless Local Loops

The most recent use of wireless technology is to provide point-to-multipoint configuration in an urban or suburban setting. This is the technology that Verizon launched as a trial in Sacramento and a few other markets in late 2018 – and which they claimed is 5G (which it’s not). This technology doesn’t have the same bandwidth throughput as the point-to-point transmitters. The easiest analogy to understand the capability of this configuration is that each customer connection shares characteristics of both a hot spot and a point-to-point link. Verizon says in early trials that they can deliver speeds of 300 Mbps – 600 Mbps for about 1,000 feet. The short distances are the limiting factor of the technology.

Verizon is deploying the technology at street level by placing small transmitters on utility poles. At the street level the two limiting factors for delivery from a pole are the transmission distance limitation and the need for line-of-sight. The millimeter wave frequencies are going to be largely blocked by foliage and other impediments found at the street level. The technology will work best in a place like Phoenix, with no trees, but will less useful in areas with lots of trees. The envisioned network design is a transmitter on a pole that might serve up to a half a dozen homes.

This technology, when perfected, will create what the industry has always called wireless local loops. The concept has been around for decades with the vision being that a transmitter would be placed on a power or light pole to deliver broadband to the nearby houses without having to build wires from the poles to the customers.

There are other hurdles to be overcome for this to become a viable business plan. Delivering gigabit broadband from a transmitter on a pole require big bandwidth at each transmitter. This implies needing a fiber network built on residential streets. This gets even more complicated in neighborhoods where the utilities are buried and there are no utility poles. This would require hanging the devices on light poles and somehow getting the fiber bandwidth from the ground to the top of a light pole.

The need for fiber is the big financial limitation of this technology. The technology seems to roughly require the same investment as building fiber-to-the-home. There are very few companies tackling residential fiber overbuilds today, and it seems unlikely that there will be many willing to spend the same huge dollars for wireless local loops. It's hard to picture a wireless company willing to build fiber into the residential neighborhoods in Gainesville.

AT&T recently said that the technology is not of immediate interest. The only company tackling this is Verizon, and they are only doing this in places where they own fiber or can reasonably and affordably string fiber. As I was writing this paper and Wall Street analyst opined that they could not make a case for this technology at the current cost of the electronics. A lot has to happen for this to become a viable technology.

There is huge controversy on this issue since the FCC said late last year that cities must provide pole access to wireless carriers. There have been numerous lawsuits filed to appeal that ruling. There are a number of issues and concerns raised by communities, including:

- Safety issues (making it harder to work on other wires during a storm).
- Pricing issues (what's the right price to charge for a wireless device connection).
- Aesthetics (does the community really want these devices all over the place?)
- Reducing pole real estate (taking up room on poles that will make it harder to connect the next new wire).

For now, this is not a viable technology. However, if GRUCom was to build a fiber network, there could come a time when using wireless loops is less expensive than building fiber loops. At that point you'd likely overlay this technology on your network and over many years might migrate to wireless.

C. Electronics Design

In designing a passive fiber network there are several possible network configurations and options that can be considered. 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 to connect the electronics. A third issue in the design is to determine whether to use distributed splitter locations or local convergence points for splitter locations.

In large communities like Gainesville it would be unwieldy to try to place all of the electronics in one central location. This would require bringing all customer fibers to one point in the city, which would increase the miles of fiber needed to reach customers. Instead we made the assumption to create neighborhood fiber huts that would serve as the local focus and termination point for fiber.

The current GRUCom network is mostly a star configuration where fiber is built from central locations to reach customers. An ideal network configuration would be to connect the needed huts by one or more fiber rings. The benefit of a fiber rings is that it provides for a redundant electronics path, meaning that if the fiber in the ring is cut, the whole ring will continue functioning. A single fiber cut will not knock any of point on the ring. Rings can be made self-healing, meaning that the electronics can immediately react to a fiber cut since traffic on the ring travels continuously in both a clockwise and counterclockwise direction, thus bypassing a single fiber cut.

There are numerous opportunities in your current network to create fiber rings. In any cases where there needs to be a new fiber path to create a ring, the new fiber being built to reach customers could be used to close any gaps.

There are standard components in a distributed fiber network, as follows:

Connection to the Internet. GRUCom already has a core hub location where your network connects to the Internet and other peering locations. These would also be the core site for the FTTP network.

Optical Line Terminal. The piece of electronics used to light the fibers to customers is called an optical line terminal (OLT). OLTs are located in the neighborhood huts, which are provided with the -48 Vdc power supplies, rectifiers, and battery backup in case of a power outage. These huts are air-conditioned and heated to maintain an indoor working temperature.

An OLT provides customer interfaces through the use of line cards; each GPON card can serve between 128 and 256 customers. A typical shelf-mounted OLT has 20 card slots for customer interfaces.

PON Splitters. A PON splitter is a device that can “split” the light from one fiber in order to connect up to 32 customers. Splitters can be housed inside the same hut as the OLT, but ore typically most splitters are located in the field, in small cabinet, closer to customer homes. Only a small fiber is needed from the OLT hut to the splitter cabinets, and a design with field splitters reduces the size of fiber construction and splices. This is the place in the network where significant fiber can be saved since one fiber coming into the splitter can serve up to 32 customers.

The splitters do not require power, which is why they are referred to as “passive,” a highly desirable operational feature. The splitters can be located anywhere in the network where fiber splits are needed to reach customers. They can be in small huts on the ground or mounted on poles.

PON Cabinet. There are several ways to manage the fibers coming into a slitter cabinet. If there aren't a lot of fibers, a typical configuration is to splice the fibers in a large handhole. If there are a greater number of fibers, then many networks deploy a PON cabinet, which is used for the purpose of arranging and splicing the fibers. The typical PON cabinets can contain up to 864 fiber connections, although larger varieties are possible.

Fiber Drops. Earlier we talked about needed access points in neighborhood fibers. These are small devices that are made to connect the fiber along the street to the fiber drop that reaches to the home or business. Our fiber design anticipates designing enough access points so that every potential customer in the city could be connected to the fiber.

To connect a customer to the fiber network, a fiber drop is built from the street to connect to the outside of a customer's building. We've designed for a 4-fiber drop. Our design assumes that aerial drops will be used where the fiber on the street is on poles and buried drops will be used when the street fiber is underground.

There are two ways to connect drops to the access point. One method is to fusion splice the fiber, using a tool that heats and then merges the ends of the two fibers. A more common technique used today is to buy pre-made drops that plug into the access points. These drops come in different lengths and are plugged into the access point much like the category 5 or 6 plugs that go into computers.

At the Customer Location. The electronics at the customer is referred to in the industry as an Optical Network Terminal (ONT). This is an electronic device that contains the electronics that interface with the light from the outside fiber and converts it as needed to electronic signals.

ONTs can be located on the outside or inside of the premises, and both types of ONTs have about the same cost. There is a debate in the industry about which kind of ONT is best. ONTs located outside provide 24/7 access but are exposed to the elements. Indoor ONTs make it easy to connect or interact with gateways and WiFi equipment.

ONTs are available in multiple sizes and configurations, distinguished often by the number and types of customer interfaces which are available. Typically, it is common to have one to four Ethernet ports which are sufficient for small businesses and residential applications – particularly when used in conjunction with a variety of customer owned equipment to expand their Local Area Network (LAN).

While FTTH networks are designed for ONTs with battery backup, the battery backup creates more clutter at installation and becomes an operational nightmare when the battery life expires. We do not recommend using the batter backup. Per the FCC, voice services providers must offer an optional battery backup – ISPs only have to make these available (and may charge full cost for the units).

Regardless of the type of ONT (indoor or outdoor), it will be necessary to drill through the side of the home to bring wiring. ISPs have widely differing ideas on the best way to do this – but most ISPs look for the installation method that requires the least amount of work inside of the customer premises. Much of the wiring needed inside a premise is driven by trying to get wires to a cable TV set top box.

D. Competing Technologies

While there are clear benefits from building a fiber network in the city, there are also risks. One major kind of risk is competition from other technologies that will compete with fiber. The following list is not aimed at dissuading the city from considering fiber, but rather is to provide you with a list of issues to consider when making the decision to take the next step past this study.

While fiber is considered as the ultimate technology, meaning there is no realistic cap on the amount of bandwidth that can be delivered over fiber, there are other technologies that will compete with fiber in the market place today and in the future. While many of these technologies may not be as fast as the capabilities of fiber, to the extent that they satisfy the broadband needs of segments of the market they will make it harder for a fiber network provider to generate revenues.

DOCSIS 3.1—Gigabit Cable Network

Cox uses a technology called DOCSIS (Data Over Cable Service Interface Specification) to insert broadband onto its coaxial copper network. The technology was developed by CableLabs, which is a research and standards organization that the cable companies have created for research and development purposes. DOCSIS 1.0 was first issued in 1997 as a standard and created the basis for cable modems. Since then the technology has undergone several major upgrades that were named DOCSIS 2.1 and DOCSIS 3.0.

Cox says they have recently completed an upgrade to DOCSIS 3.1, the latest version of the technology. This new technology allows for unlimited bonding of empty channels that can be used to provide broadband. DOCSIS 3.1 allows Cox to offer gigabit data speeds to customers. Theoretically they could provide speeds as fast as 6 Gbps, but that would mean not carrying any cable TV on their network.

The upgrade to DOCSIS 3.1 doesn't always result in blazing fast speeds for everybody. While a large part of the upgrade involves replacing the electronics in the Cox network, there are also physical limitations in the network that can be caused by older types of coaxial cable or by the network technologies used to deliver power through the network. If the network in the city has these issues, then Cox might not achieve the fastest speeds everywhere in the city.

One big limitation of Cox is that they can't deliver gigabit broadband to everybody. Their network is composed of large neighborhood nodes, typically up to 250 customers. In larger nodes, if some customers are provided with a fast service with priority access then the speeds delivered to everybody else is degraded. The only way for Cox to get gigabit speeds to everybody would be to reduce the size of the nodes to be similar to the FTTH nodes.

For now, Cox is not advertising speeds greater than 300 Mbps. However, we saw a few customers on the speed test that claimed to be buying the "Gigablast" product, although they weren't getting gigabit speeds. We also collected a few customer bills from customers who have this product. What we know from past experience is that if the city builds fiber that Cox would likely beef up the network to offer faster speeds. Even if you don't build fiber one can expect the Cox network to continue to improve over time.

5G Wireless

The industry news is full of talk about how 5G is going to revolutionize wireless technology and perhaps make it a direct competitor for fiber. How much of that is true versus hype?

5G is a new wireless standard that was finalized in late 2017. The standard defines various technological improvements that provide a roadmap for providing improved wireless products. The 5G standard can be applied to a wide range of spectrum – and the use case for these spectrums vary according to the physical characteristics of each spectrum. The consequence of this is that there are three different 5G applications being discussed in the market today that are all being labeled as 5G – yet the applications are widely disparate. This has led to a lot of market confusion because the first question that must be asked when somebody talks about 5G is which technology is being discussed. The press has widely confused the different technologies, which has led to articles talking about things like gigabit cellphones – something that is not remotely part of the 5G capabilities.

The three different current 5G applications are:

- 5G cellular service;
- 5G point-to-point links;
- 5G last-mile loop.

The last two technologies were discussed earlier when we considered if GRUCom should consider using wireless technology. The other 5G technology is improved cellular service that will eventually replace the current 4G LTE. The new 5G standards propose an improved cellular experience for customers. There are 13 new technical improvements required to fully implement 5G. The most important of these are:

- The primary stated goal of the 5G standard is to be able to handle upwards of 100,000 simultaneous connections from a single cell site. We're all familiar with being unable to get a cell signal in a busy environment like an airport or stadium. This will fix that issue, but the real hope for the cellular companies is to be able to use cellular technology to be able to communicate with Internet of Things devices. IoT is a term that refers to the many devices that we communicate with wireless, such as the many devices in a home today that are connected to WiFi. Today the IoT works almost entirely with WiFi and the cellular companies envision capturing much of that market – but they have a huge uphill battle to wrest the market away from WiFi.
- The standards set a speed goal to eventually achieve widespread cellular speeds of 100 Mbps download and 20 Mbps upload. Contrary to the cellular company press releases, the standards goal of 5G is not to create blazingly fast gigabit cellular service. The cellular companies can likely eventually achieve gigabit speeds from pole-mounted wireless loops, but's not delivered to a cellphone, but to a small dish at a home or business.
- The last important improvement is to achieve latency at near-fiber levels. Latency measures a delay in a signal, and today cellular signals have higher latency than fiber connections. This is the primary reason why it often feels sluggish to download a web page on a cellphone.

These improvements won't all be introduced at once. The cellular equipment manufacturers typically introduce each new improvement as they are perfected, and it's likely to take another decade for all 5G improvements to be implemented. The same thing happened with the transition from 3G and 4G and the first true 4G cell site that fully meets the 4G specifications was just activated late last year – even though the cellular carriers have been selling what they call 4G service for a decade. This gradual introduction of the 5G improvements will mean a gradual improvement over 4G technology. In industry lingo, in 5 years we might see enough of the 5G standards implemented that from a technical perspective we'll be at 4.5G. Until then, from a technical perspective, the industry will grow through 4.1G, 4.2 G, etc. Even though this will take a decade to be fully implemented, the cellular marketing folks are already making claims about having 5G cellular by the end of 2019.

There are numerous articles on the web that talk about gigabit cellphone speeds. This is mostly due to nontechnical writers confusing the three different 5G technologies. But this speculation has also been fueled by a few announcements of trials done by Verizon and Sprint. Sprint got great press by saying they had achieved a connection to a cellphone at 600 Mbps. This was a highly controlled test. It involved a cellphone that used an immense antenna array that could receive and combine signals from ten different millimeter wave transmitters at the same time. To achieve that same performance in real the real world would require ten small cell sites within close proximity to a cellular customer – meaning a world where there are cellular transmitters literally everywhere. A phone using this antenna array would have a likely battery life of 30 minutes.

The test shows that fast speeds are theoretically possible – in a controlled lab setting. Fast speeds will not be possible in the real world unless the parameters of this same test are met – multiple cell sites nearby, a cellphone with a massive antenna array, the use of ubiquitous millimeter wave spectrum (will be explained more later), and zero interference. It's worth knowing that the body of the cellphone user would block the signal to a phone in the “shadow” of the user. These signals are blocked by almost anything, and a person walking between a cell sites and the receiving phone would block the signal. Because of numerous limitations of physics, we may never see that kind of performance in the real world.

The goal of achieving 100 Mbps cellular speeds is due to a major change in the way that the cellular network functions. Today's network is based upon the idea of roaming. For both voice and broadband purposes today's cellphone makes only one connection at a time to the cell tower that provides the strongest signal (and which has an open slot). 5G introduces a radical change and would allow for a handset to connect to multiple cell sites and draw broadband from each of them. This is done using MIMO (multi-input multi-output) antennas that can make and sustain multiple connections. This is the most difficult 5G challenge to implement in the real world. First, in most places there are only one or two existing cell sites. Faster speeds will only be available in places where enough new small cell sites are added to increase the available transmitters. In practical terms this means that in most places cellular data speeds will remain at 4G levels, even after 5G implementation – any place where a customer can see only one cell site will not get faster broadband speeds.

Faster cellular service could be a competitor to fiber, at least for customers who aren't big bandwidth users and prefer mobility. But even if those speeds can be achieved, they are likely to

only work in urban areas where cell sites are close together. It's unlikely for the cellular companies to invest in the number of cell sites that would be required to achieve those speeds in residential neighborhoods. Most wireless experts are still predicting that we'll still be heavily using the 4G cellular networks a decade from now.

Satellite Broadband

In 2017 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. He's proposed to the FCC to launch 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 miles above the earth. Each satellite would be roughly the size of a refrigerator and would be powered by a solar array. SpaceX launched two test satellites in 2018.

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—about the same experienced in a cable TV broadband network. This is much better than the 100+ millisecond delays achieved by current satellites. This means that Musk's proposed network could support VoIP, video streaming, or any other live Internet connections like Skype or distance learning.

The satellites would use frequencies between 10 GHz and 30 GHz, in the Ku and Ka bands. The FCC filing is technical, but an interesting read: <https://cdn.arstechnica.net/wp-content/uploads/2016/11/spacex-Technical-Attachment.pdf>

The specifications say that each satellite would have an aggregate capacity of between 17 and 23 Gbps, meaning each satellite could theoretically process that much data at the same time, although realistically they would probably max out at 80% of that capacity (as do all broadband transmission methods).

The specifications say that the network could produce gigabit links to customers, although achieving that much speed would require making simultaneous connections from multiple satellites to one single customer. Moreover, 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 to a lot of rural customers.

There are almost a dozen other satellite companies with similar ideas, although most are considering far fewer satellites than Musk. Many of these other satellite companies are not interested in rural broadband, but want to provide bandwidth for the military, large corporations, cellular sites and even a network between other satellites.

One alternative to SpaceX is OneWeb. They launched six test satellites earlier this year. OneWeb was started by Greg Wyler of Virginia in 2012, originally under the name of WorldVu. Since then the company has picked up heavy-hitter investors like Virgin, Airbus, SoftBank and Qualcomm. The company's plan is to launch an initial constellation of 650 satellites that will blanket the earth,

with ultimate deployment of 1,980 satellites. The plans are to deploy thirty 65- pound satellites with each launch. That means twenty-two successful launches are needed to deploy the first round.

OneWeb is already behind schedule. The company had originally promised coverage across Alaska by the end of 2019. They are now talking about having customers demos sometime in 2020 with live broadband service in 2021. The timeline matter for a satellite company because the bandwidth license from the FCC requires that they launch 50% of their satellites within 6 years and all of them within 9 years. Right now, OneWeb and also Elon Musk's SpaceX have both fallen seriously behind the needed deployment timeline.

As this paper was being completed there was also an announcement that Amazon will be entering the satellite broadband business. It came to light that Amazon has taken the first public steps and had the FCC file paperwork with the International Telecommunications Union to make notice of Amazon's intent to launch satellites.

Amazon has big plans and the ITU filing said the company wants to launch a constellation of 3,236 satellites in low earth orbit. That's 784 satellites in orbit at 367 miles above the earth, 1,296 in orbit at 379 miles, and 1,156 in orbit at 391 miles. Added to the other companies that are talking about getting into the business that's now more than 10,000 planned satellites.

It's an interesting business model. The upfront cost of manufacturing and launching the satellites is high. It's likely that a few launches will go awry and destroy satellites. But other than replacing satellites that go bad over time, the maintenance costs are low. The real issue will be the bandwidth that can be delivered. Speeds of 50 - 100 Mbps will be welcomed in the rural US for those with no better option. But like with all low-bandwidth technologies – adequate broadband that feels okay today will feel a lot slower in a decade as household bandwidth demand continues to grow. The best long-term market for the satellite providers will be those places on the planet that are not likely to have a landline alternative – which is why they first targeted rural Alaska.

E. Smart Grid and Smart City

We were asked to consider how build a ubiquitous fiber network might affect future plans for smart grid and smart city applications.

Smart Grid

Smart grid has been defined by the Department of Energy as, “an automated, widely distributed energy delivery network, the Smart Grid will be characterized by a two-way flow of electricity and information and will be capable of monitoring everything from power plants to customer preferences to individual appliances. It incorporates into the grid the benefits of distributed computing and communications to deliver real-time information and enable the near-instantaneous balance of supply and demand at the device level.”

Since a smart grid system performs a wide array of different functions, there are discrete function of smart grid that can benefit better with a fiber connection versus wireless. Consider the following applications:

More Efficient Energy Transmission. This means providing fiber between electric substations to provide smarter connectivity between the major components of the local electric grid. GRU built this fiber a number of years ago and this was the fiber that eventually led GRUCom to offer fiber products and connections to others in the city. The smart functions for controlling the local grid are improving over time, but the core connectivity to support this function are already in place.

Smart Meter / AMI. Smart meters allow for automated meter reading as well as allowing the utility to directly interface with meters to curtail electric usage during times of peak power demand. The industry has almost entirely moved to wireless meters for this function and it would be hard to find fiber-wired meters that can duplicate the same functionality.

The wireless hubs throughout the community that feed the smart meter wireless grid are connected too fiber and there is already sufficient GRUCom fiber to accommodate this need.

Another related function is smart thermostats, which can be provided by GRU or by customers. These devices allow customers to monitor and control their power usage. These devices largely work on customer-provided WiFi connections, although devices that will instead connect to the cellular network are starting to be made available. This is largely a customer function rather than a GRU function.

Restoration of Outages. One of the goals of a smart network is to restore electric outages more quickly. This largely involves detecting outages automatically and also having software in place that can sometime repair problems without a truck roll.

This is one function that definitely benefits by a fiber-to-the-home network. A city ISP would constantly monitor ONT electronics and any city-controlled WiFi devices at a customer residence. Cities that already have FTTH report that they can instantly identify neighborhood electric outages by noticing multiple customer devices losing power. When these outages are tied into the electric grid records the electric utility can almost always pinpoint an electrical problem in almost real-time. Some electric companies are now referring to this ability as “SCADA to the home” meaning they can now monitor the electric grid at homes, rather than just at major neighborhood electric grid devices.

Electric utilities that also have FTTH networks report that it’s not necessary to connect every home to fiber to be able quickly pinpoint problems with the electric grid. Having as few as 30% household penetration provides sufficient coverage to detect even small local electric outages.

In “*Power Distribution, Planning Reference Book*”¹ the author H. Lee Willis estimates the cost to customers of power outages. Mr. Willis estimates cost per kilowatt hour for an outage by class of customer.

¹ “Power Distribution Planning Reference Book, Second Edition”, by H. Lee Willis; 2004, Marcel Dekker, Inc.

A few years ago I worked with the electric engineers in Provo, Utah – a city that operated an electric utility and a citywide fiber network. The Provo engineers, using Mr. Willis’s formulas estimated the cost of a 1-hour outage to be \$90 per customer (higher for businesses and lower for residences). Any benefit from improved outage repair times accrue directly to customers. The Provo engineers were also able to estimate the average improvement time due to having fiber deeper into the neighborhood and were able to estimate a total community benefit from having fiber. A similar calculation could be made for Gainesville.

Integration with Customer-generated Power. Electric utilities are integrating today with significant numbers of home and business-based solar power or wind generation units. Integration of these power sources is a challenge because the flow of power from home generators varies by time of day and by cloud cover and can cause issues with the grid if not accounted for. Having fiber connections to customer-generated power sites can provide direct feedback to the utility of all of the issues in the field. The software to monitor and control this function is still evolving but is becoming an important component of the smart grid as the use of solar power continues to grow.

Increased Security. Security of the components of the electric grid has been a growing concern in a time of increased terrorist activity and of foreign hacking of electric grids. The most secure form of internal communications is encrypted data over a fiber connection, and this is another reason to move as much of the grid communications as possible to fiber.

Summary. Many of the connections in a smart grid, such as the connection to each home and business meter is going to be accomplished with wireless technology. However, there are definite benefits to the grid to have greater amounts of fiber available for in-system communications. Possibly the best benefit of fiber is rapid identification and increased response times to power outages.

Smart City

The city doesn’t yet have a formal smart city plan, although one is under development. Staff working on this concept provided us with the following list of smart city ideas that currently under consideration:

Smart LED Street Lights. This is the most immediate smart city concept. The city is currently considering areas in the city to test the concept. This would replace traditional lights with lower-power LED lights that can be remotely controlled. This would allow each light to be separately controlled. For instance, lights in quiet traffic areas might only activate and light when sensing traffic or a pedestrian. Other lights might stay on all of the time where security is an issue. Light timing could be changed as needed to support one-time events like street festivals, fires and accidents or any other reason where it would be desirable to change the lighting pattern.

The current plans are to control the street lights through a wireless mesh network. Such a network would likely be instituted by neighborhoods with at least one wireless radio connected back to a central hub though fiber or other kind of broadband connection. From that core neighborhood hub,

a wireless mesh network would originate to connect to other street lights. A mesh network is self-healing and would bypass any streetlight that was not functioning in order to maintain connection to other streetlights.

This same mesh network could then be used to communicate with other city devices. Some of the areas under investigation include:

- Providing WiFi Internet access to public safety and city employees, and possibly to the public.
- Gunshot detectors and reporting system.
- Other Internet of Things (IoT) sensors. This could be almost anything that would be outdoors and could include things like weather sensors, air quality sensors, flood sensors, etc.

Smart Park. The city wants to implement some form of smart park technology within 3 to 5 years. This would include:

- Smart irrigation systems that only water when it's needed instead of automatically.
- Smart trash cans that signal when they are full.
- Smart parking sensors that notify the public when there are parking spaces inside garages, in parking lots and in city spaces on streets near parks.
- Information kiosks that could offer a host of functions such as providing directions within the park, notifying the public of upcoming events, information on local attractions / plants and animals within the park, etc.
- Provide public WiFi connectivity within the park.

Security / Access. Implement smart systems for functions like locking and unlocking community centers for authorized users. Could include more digital cameras and other devices like motion sensors to monitor and provide safety at community centers. Provide enhanced monitoring and security around all city buildings and structures.

Smart Traffic. Provide pedestrian detection at intersections and coordinate with traffic lights to reduce pedestrian accidents. Eventually provide smart traffic signals that react to traffic to speed-up traffic flow and eliminate time sitting at red lights.

Interface with Fiber Network. The smart city industry is developing most smart city applications using wireless networks, primarily because so many cities don't have a fiber network.

Smart city applications require two kinds of connections. One is low-bandwidth. Devices like air quality monitors or smart trash cans don't need a large broadband pipe since they only occasionally burst a small amount of data into the city's network. Such applications are probably most affordably done wirelessly, particularly since these kinds of devices come with wireless access. There is a lot of debate in cities about whether these connections will ultimately be done with WiFi (as the city is currently contemplating) or if this can be done better using cellular connections, which will be enhanced for this purpose after the introduction of 5G cellular service.

But there are also large bandwidth applications. This includes applications like WiFi access points to provide Internet access, security cameras that continuously stream a high-definition picture,

multi-purpose kiosks, and the hub WiFi units in a mesh network. A citywide fiber network will make it much easier to accommodate these larger bandwidth applications.

Wireless network will function much better if each primary wireless hub in a mesh network is connected to fiber. With fiber available on every street it will be easy to design the perfect wireless network since there is always going to be a fiber connection to tie into the wireless network.

It would also be possible to directly connect big bandwidth applications to fiber. For example, the WiFi connections in a park can be significantly faster and stronger if the WiFi routers are connected directly to fiber rather than meshed throughout the park using only a single fiber connection.

Having fiber everywhere will allow Gainesville to have a far more robust smart city network than cities that must go 100% wireless.

Summary of Section II

Passings. In the telecom industry, the term “passing” is used to denote a potential customer that can be served by a network. The passings for the scenarios are as follows:

	City	GRU	Urban	Plus
<u>Passings</u>	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Small</u>
				<u>Cities</u>
Single Family	23,021	17,515	3,731	8,241
Buildings with 2 - 4 Units	11,897	1,344	1,179	1,498
Total Residential	34,918	18,859	4,910	9,739
Businesses	7,811	955	232	772
Total Passings	42,729	19,814	5,142	10,511
Cumulative	42,729	62,543	67,685	78,196

Miles of Fiber Construction. The network design considered and incorporated some fiber already owned by GRUCom. We determined that the following miles of new fiber are needed for each scenario:

	City	GRU	Urban	Plus
<u>Miles of Fiber Construction</u>	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Small</u>
				<u>Cities</u>
Aerial Miles	358.65	244.55	60.79	128.94
Buried Miles	293.45	200.08	49.73	60.57
Total	652.10	444.63	110.52	189.51
Cumulative	652.10	1,096.73	1,207.25	1,396.76

Network Design. The following parameters were used in estimating the cost of building and operating a fiber network through each of the four study areas:

- The study excludes large apartment and condominium complexes and buildings. Residences included in the study include single family homes, duplexes, townhouses and small apartment buildings of four units or less. The study considered small and medium businesses that are not served by the existing GRUCom fiber network.
- The network was designed to pass every home and business in the service areas and to provide the opportunity for every home and business to connect to the network. The network design also includes spare capacity to accommodate future growth.
- The study assumed that fiber would be placed on poles where they exist today and would be buried underground in places where other utilities are buried today.
- The network design uses passive optical technology (PON) to serve residents and small businesses. The technology reduces the number of fibers required in the field by allowing up to 32 customers in a neighborhood utilize the same fiber. The PON technology is robust and can provide a gigabit of broadband speed to every customer.
- Since the geographic area of the fiber footprint was so large, we decided to use a distributed electronics network that would place huts in neighborhoods throughout the various study area to house electronics for the surrounding neighborhoods. To the extent possible we assumed that huts would be located with electric substations.
- We utilized the existing GRUCom fiber network to provide a backbone connection to the huts and to provide a connection to the small cities included in the study. In many cases the current fiber is not configured in self-healing rings. The newly constructed fiber would allow for the completion of rings so that the huts would not lose service from a single fiber cut on the backbone network.
- The network cost estimate includes the cost of connecting customers to the fiber network including a fiber drop wire for each customer, electronics at each customer that communicates with the fiber network, and any needed electronics needed to provide the services sold to customers such as WiFi routers and cable TV settop boxes. We only assume these assets are required for customers that buy service.
- The network cost estimate also includes the ancillary assets needed to be in the fiber business such as the huts, vehicles, computers, furniture, spares, and other assets.
- The feasibility also assumed that many assets like electronics would routinely be replaced during the 25-year study period.
- We believe the engineering cost estimates are conservatively high. As an example, we added a 6% construction contingency to the cost of building a fiber network.

Competing Technologies. The study discusses technologies that compete with a fiber network. This includes the hybrid-fiber coaxial technology used by Cox, upcoming 5G wireless technology and upcoming satellite broadband. While none of these technologies is as robust as a fiber connection to each home and business, each technology could garner market share in the broadband market.

III. Financial Business Plan Findings

This section of the report summarizes the findings derived from the financial analysis of bringing a residential retail fiber business to Gainesville. The detailed assumptions used in the financial analysis are included in Appendix I. The detailed results of the financial analysis are included in Appendix II. There is a summary table showing a short summary of each scenario we studied in Appendix III.

This section summarizes our interpretation of the results of the financial analysis – what do the numbers tell you?

Financial models are important and can tell us some key things about a potential business. The results show the big picture and show the relative amount of money needed to build and operate a fiber network in the city. The various options explored also show which variables are the most important and how changes in those assumptions impact the amount that needs to be funded and the eventual cash generated.

What feasibility studies don't do it to provide an exact answer about the potential of the new business. That kind of surety can only come after undertaking the hard work of specifically defining the key variables. For example, you can't accurately predict the financing costs until you know the specific interest rates and terms of the borrowing – and that's something that is generally not known until a short period of time before the date of selling bonds.

It's also mandatory to digest the degree to which changes in the key variables can change the results of a projection. It's always tempting for somebody to see the results of the financial analysis and conclude something like, "the study says we can make money with a \$50 gigabit product as our only broadband product". In this study there is a scenario that shows that, but the results of that analysis are only good if all of the key variables are realized as assumed in that study – the penetration rate, the interest rate and term on debt, the number of employees, the cost of building the network, etc. Changing some of those variables in a negative direction can turn a positive forecast into a losing one.

Each of the many study scenarios that are summarized in Appendix III are snapshots showing the results of one set of assumptions. To fully understand a given scenario, such as the feasibility of providing a broadband solution for the Gainesville city limits, it's mandatory to understand the results of all the variations studied to understand that the expected results can best be predicted by a range of results. As you move forward to implementing a network solution that range of results will narrow as the various assumptions are refined. But even there is no way to know how the business will launch. Will the company get the needed sales to meet the desired penetration results and will they do so in a timely manner?

This all means that the only way to interpret the results of this feasibility is to understand that positive results can be achieved if the city was to meet the expected criteria. But it also means that the results could be significantly different than shown in Appendix III.

Adding Together Scenarios

It's also important to recognize that the effect of changing more than one variable are somewhat additive. For instance, the financial performance will be worse than shown in Appendix III if the construction cost for the network is higher than predicted. Those results would also be worse if the business didn't get as many customers as predicted.

Clients often want us to present a "best-case" scenario, which would indicate how well they might do if things go well. We've always been hesitant to do that for several reasons. First, we don't have a crystal ball to know which of the variables the city might be able to meet and which ones you might fail to meet. We could grab the most favorable variables such as a low interest rate, higher prices, etc. to paint a rosy picture of the potential for the business. Unfortunately, we know from hard experience that politicians and the public will often latch onto a best-case example and use it as a justification to build a network.

A final warning is that there is danger in quoting the numbers derived from the business plans, such as "it's going to take us X million dollars to get this done." As can be seen with the sensitivity analysis, changing a few major variables can greatly change the projected costs and results. That means that a city would need to do a lot more research before launching a fiber business to better understand things like the likely customer penetration rates. The better that the sensitive variables can be defined, the lower the risk of the project.

It's probably worth discussing how commercial ISPs view opportunities like the one we've studied. Commercial ISPs evaluate the risk of a venture. They understand that there are variables under their control, like making sure they stay within a defined expense budget, and also variables out of their control such as interest rates on debt or the appearance of another network competitor.

Assuming that a commercial ISPs is already operating a similar market, they are able to make a more accurate estimate of the cost of operating in a new market. They already know a lot of things like the likely number of employees that will be needed and their salaries and benefits. They know the cost of buying everything from network components to the cost of envelopes needed to mail bills. Their innate knowledge of how they already operate gives them the ability to pin down the costs that they understand and control. That frees them up to assess the risk of those things out of their control. Once the work has been done to create a budget, almost all of the discussion about launching or not launching a new market centers around those risks.

In your case, the majority of the feasibility assumptions require making guesses. This makes it even more important for the city to understand that you need to do more work to fine tune the estimates made in this analysis before deciding to proceed. With research you can better tie down the variables. For example, with more engineering analysis you can fine-tune the cost estimate of the network. After consulting with your bond advisors you can probably make a better-educated guess of the likely interest rate and terms for debt.

Most Important Results of the Financial Analysis

With that long cautionary warning, here are some of the things that the financial analysis shows us:

Lowering Rates Decreases Potential Profits. As would be expected, lowering broadband rates decreases the long-term cash generated (which can be thought of as profit). In the scenario that considered the Gainesville city limits, the cash return over 25 years with market broadband rates would be \$75.23 million. Changing to the assumption of offering only a \$50 gigabit product lowers that cash to \$35.23 million (with the assumption of getting the same number of customers).

There is one important consequence for the city in pursuing low rates – it probably eliminates any possibility of a public/private partnership (PPP). There are numerous examples around the country of municipalities and commercial ISPs working together. These partnerships have one thing in common – the commercial partner undertakes the partnership with the goal of earning decent profits. Municipalities have different goals, but generally at the top of their list is wanting to bring the benefits of fiber to their community while also being fully compensated for any investment they make in fiber or other assets.

Since one of the city’s primary goals is to have the lowest-priced broadband in the country, you are far less attractive to a commercial ISP partner. We would go so far as to say that the goal of having low prices and solving the digital divide almost eliminates any chance of having a commercial partner.

It is possible to have low rates and still be solvent. There are several scenarios we studied that assume a \$50 gigabit broadband product that show positive cash during the whole 25-year study period. That demonstrates that it is possible to set rates that low – rates that could be described as the lowest in the country. As discussed earlier, those results depend on meeting all of the other assumptions. The bottom line is that you can have low rates and be solvent as long as you can meet the needed assumptions.

The key number needed to assess the possibility of lowering rates is the breakeven penetration rate. We calculated the breakeven penetration rate with a \$50 gigabit broadband product to be around a 44% customer penetration.

That breakeven penetration rates would move upward or downward according to changes in the other key variables. For example, the breakeven penetration rate gets higher with higher interest rates. The breakeven gets lower if the network was to cost less than projected. We always advise looking at our results within a range, and not with precise numbers. It’s a lot more accurate to say that the breakeven penetration rate with a \$50 gigabit product is likely to be in the mid-40% range rather than to say that it’s 44%.

The City must Consider Risk. Only the city can judge the risk you face in trying to implement one of the scenarios suggested by this study. Our financial analysis quantifies the relatively risk if the market stays somewhat unchanged after you launched a fiber network. We have no way to put a number value on big changes in the market. For example, how well might AT&T do if they were to build fiber everywhere as a reaction to the city building a broadband network? That is an example of a complex question that is never easy to answer – but it’s the kind of risk that a commercial ISPs considers when thinking of

building in a new market. This is a perfect example of how complex of a decision it is to move forward. This report includes a section labeled as Next Steps that recommends steps to take that can help to better pin down the various major assumptions.

There Are a Few Key Variables. There are a few key variables that have a big effect on the outcome of the business. Looking at the scenario for serving the city limits of Gainesville, the key variables are:

- Penetration rate. Changing the market penetration rate upward or downward by 1% (for example, from 48% penetration to 49% penetration) changes the cash over 25 years by \$8.2 million.
- Broadband Prices. Changing broadband prices by \$1 per month upward or downward changes the cash generated over 25 years by \$5.88 million.
- Interest Rate. Changing the interest rate on bonds upward or downward by 10 basis points (for example, changing from 3.5% interest to 3.6% interest) changes the cash generated over 25 years by \$2.6 million.
- Bond Term. Changing the bond term from 25 years to 20 years increases cash over 25 years by \$6.75 million. It doesn't look feasible to use a 15-year term.
- Capital Spending. Changing the cost of the network upward or downward by \$1 million changes the cash flow over 25 years by \$2.17 million.
- Eliminating Cable TV. Getting rid of the cable product dropped cash over 25 years by \$1.35 million.
- Eliminating Telephone. This essentially breaks the model and reduces cash flow over 25 years by almost \$90 million.

There are Interesting Digital Divide Scenarios. Again, focusing on the Gainesville city limits scenario, we looked at some interesting digital divide scenarios. These are scenarios where low-income homes get low-price broadband. The assumption is that the city would establish some sort of test that would qualify homes, such as eligibility for WIC or some other test or tests.

Some of the digital divide scenarios considered include:

- Lowering the Price to Everybody. The breakeven broadband rate was calculated to be \$44.50. This means that as long as the business got a 48% penetration (and met the other key variables) that the gigabit price could be even lower than \$50.
- \$60 / \$21.25 Pricing. Another interesting breakeven was the combination of a normal gigabit product with a digital divide product set at \$21.25. Even at \$60 the city would have one of the lowest gigabit products in the country – and the \$21.25 product would go a long way towards solving the digital divide.
- \$70 / \$6.25. Yet another interesting breakeven would be to set the normal gigabit product at \$70 with the digital divide product set at \$6.25. \$70 is the same price charged by Google Fiber. They don't report their penetration rates, but many in the industry believe they have achieved at least a 20% market penetration with the \$70 product, perhaps as high as 30%. A more realistic scenario might be a combination of a \$70 gigabit and a \$20 digital divide product, which would generate \$35 million over 25 years.

- Low Price to Serve Everybody. If the goal was to get the cheapest gigabit product to everybody, the analysis shows that prices could be as low as \$32 for a gigabit if 90% of households subscribed. It's worth noting, though, that this scenario added around \$20 million to the cost of the network, needed to connect the additional homes.

Note that in all cases that it would be difficult to get the project funded if prices were set at breakeven. All of these results need to be considered as the lower bounds of pricing, but that bondholders would likely require a business plan that didn't skirt insolvency.

There is Economy of Scale. We considered four scenarios where each successive footprint was larger than the previous one. This provided a great example of the economy of scale. What we saw was that all of the various study results reported in the above example for the city of Gainesville got a little better with each successive scenario. This was due almost entirely to economy-of-scale which is a way of saying that the broadband business gets more efficient as customers are added.

There are several hurdles to cross to serve a larger footprint. One is the increased difficulty of raising a larger amount of money. There would also be added operational pressure of achieving sales goals across a larger footprint. There are always other considerations as well, such as city-backed bonds to build outside of the city limits and outside of the GRU service area.

A better approach to building to a large footprint might be to tackle parts of the county over time in a series of bond issues. The long-term financial performance from spreading the project over time should about the same as the results achieved in these projections – but spreading the construction out over a longer period, say 10 years would reduce hurdles for raising the money and would also reduce the stress of trying to add too many customers in a short period of time.

There is one other interesting scenario to consider. While it doesn't look feasible to offer low-price broadband and have a commercial ISP partner, it would make sense to partner with the smaller cities. The risk of the overall business would decrease if the small cities helped to fund part of the network while GRUCom gained the economy of scale from serving a larger service footprint.

There is some Impact from Housing Density. A smaller, but noticeable impact of expanding the study area past Gainesville is that the cost of fiber became more expensive, on a per customer basis as the service area included areas where the housing was less dense than in Gainesville. Consider the cost of fiber per passing in the four service areas:

Gainesville city limits	\$2,293 per passing
GRU Service area	\$2,996 per passing
Urban Expansion area	\$3,109 per passing
Small cities	\$2,240 per passing

It's worth noting that the housing density in the small cities is slightly higher than in Gainesville, but that includes lower fiber construction costs since these cities have a higher percentage of aerial fiber, which is less expensive to build per mile.

It's Theoretically Possible to Have "Free" Gigabit Broadband. The analysis shows that broadband could be provided for free if the city found some other source of revenue to make up the cash shortfalls. For example, for the city limits of Gainesville, in 2025 the city would need to find \$11.6 million to cover the net operating losses of the business, which equates to \$27.21 per month per residential passing. If the city could cover that shortfall through some other mechanism – such as a utility fee, higher sales taxes, or higher sales taxes, then broadband could be provided free to everybody (remembering that this study doesn't include apartments).

Why Our Financial Projections are Conservative

We always try to be conservative in creating financial forecasts. Our goal is to make projections that are conservative so that it is likely that the business could perform better than we've estimated. However, this is one of the more challenging studies we have ever undertaken and it's not as easy to say for sure that the study results are conservative. Consider some of the things that add complications to this study:

- GRUCom is already an ISP and fiber provider and has already captured a significant portion of the market for large businesses, carriers, the university, and other big entities in the city like the schools. If we were studying a similarly-sized city that didn't have an existing fiber business, then all of the revenues and profits made by GRUCom today would be part of the projections made in the feasibility study, and those revenues could help to offset the cost of providing residential service. In this study all of those big-customer revenues are already off the table. This makes it harder to craft a solution for the remaining customers. To put this into perspective, had those large customer revenues been considered, then the breakeven with the \$50 gigabit product could have been a lot lower. For city of this size, I would have expected the breakeven penetration rates to be in the mid-30% range.
- We included a construction contingency on fiber and core electronics of 6%. This is a little smaller than the contingency we sometimes consider. That's due to two factors. First, since GRUCom has already built 550 miles of fiber, we were able to learn a lot about their practical experience of building fiber. Maybe more importantly, one of the biggest variables in estimating the cost of building a fiber network is the cost of the make-ready work on poles. In this case, since we assumed that fiber goes into the power space, we were able to ignore make-ready costs.
- Another assumption that we made that might be conservative was to assume that 40% of fiber could be directly buried rather than placed into conduits. We understood the goal for the study to find the most reasonably-priced and reliable network that could support low bandwidth prices. Directly burying fiber is a construction technique used by commercial fiber providers who are trying to balance costs with profits. We assumed that fiber would be put into conduit only for any street where there are multiple fibers or where there are large-count fibers.

It's rare to have to add a fiber to a residential street. In this "last-mile" part of the network the need for additional future fiber can be accommodated by initially installing a larger cable with extra fibers. In most neighborhoods in Gainesville there are very few new houses built annually and the need for many additional fibers rarely arises. Direct-buried fiber has a tough sheath and is as hard to cut as a fiber in a conduit. In the Gainesville city limits the assumption to direct bury fiber reduces construction costs by \$13 million. We think the 40% assumption for direct-buried fiber is low and there probably is an opportunity for a further reduction in fiber construction costs.

- We also think that the estimate for the cost of customer electronics is high. At a minimum, a lower-cost ONT could be used for customers who buy only broadband.
- Some of our clients have found ways to build fiber drops for less than what we've estimated.
- We have been conservative on future rate increases. We've raised broadband rates by 5% every fifth year, or a rate of increase of less than 1% a year. Raising broadband rates is the only real tool that for ISPs are going to have in the future for keeping up with inflation, and our projected increases are far smaller than the inflation rate of 2.5% that was assumed for expenses. This means that \$50 broadband doesn't stay at \$50 forever. Over 25 years the rate increases result in a rate of \$67 in 2044.
- We have a modest overall market growth rate of 0.4% per year for new housing. There are parts of the county that are growing faster than that, but there is always a danger in these kinds of projections from making the future look better just through the growth assumptions.
- We've tried to be as realistic as possible with our estimates of operating expenses. However, GRUCom is already a complex business and we almost certainly estimated some costs to be either higher or lower than what would be experienced if you launched the business. Our hope is that overall we are in the right range. The biggest incremental new expense is labor, and we would guess that the business will probably function well with a few less new employees than we have forecast.
- There is a potential upside to the model if the city was to be able to serve some of the larger apartment complexes. Assuming that the city would only pursue apartments where the costs to serve aren't too high, then there could be a greater number of passings and sales.

IV. Other Considerations

A. Competitive Responses from Incumbents

This section of the report looks at the expected competitive response from AT&T and Charter, the two large incumbent providers in the market.

AT&T as a Competitor

AT&T is an interesting competitor. The company hasn't upgraded DSL for many years, but they are still making the effort to sell DSL-based broadband. They still have DSL service in Gainesville and probably will for many years. However, that technology is becoming obsolete with maximum download speeds even on ideal copper at only about 50 Mbps. The cable companies have been steadily taking AT&T's residential customers for many years.

AT&T is selectively building fiber to some residents in most markets – with the construction closely nearby to existing locations where AT&T already has fiber. There may be some homes in Gainesville that are near to a school, apartment complex, large business, or cell site where AT&T will have extended fiber for a short distance to sell to nearby customers. The company has made a concentrated effort to only build fiber to those places where they can make their desired margins. As part of the agreement to buy DirecTV, AT&T committed to the FCC to build fiber past at least 12 million potential customers. At the end of 2018 they announced that they were passing 10 million potential customers. Most of these passings represent key pockets of customers—large MDUs, business districts, and new residential subdivisions – but there also are some single-family homes. In those places where AT&T builds fiber they are a fierce competitor – but they won't extend fiber to any customer that doesn't meet their financial parameters.

AT&T has elected, for now, not to pursue fixed 5G point-to-point radio technology. Verizon is deploying this technology in some of its markets, but AT&T says they don't see a business case for the technology.

AT&T is also counting on faster cellular speeds through 5G, knowing that some small portion of residents will be happy to only use cellphone broadband. It's probably at least a decade away, but eventually 5G cellular speeds could climb to as much as 100 Mbps.

We know that AT&T is aggressively pursuing the MDU (apartment complex) market. That is a significant portion of their 10 million passings. It's likely that AT&T already serves some of the apartment complexes in the city with fiber.

AT&T also is aggressively building fiber in some markets to business parks that contain large businesses. However, absent any competition, their prices for large business broadband is often extravagantly expensive. But in competitive markets AT&T will match the rates offered to businesses by others.

If the city builds fiber AT&T will sell door-to-door in the city in front of any fiber construction. They'll try to lock customers into two or 3-year contracts to delay customers from moving to the new fiber provider.

It's even conceivable that AT&T could build their own FTTP network in the city, at least in what they consider to be key neighborhoods. We've seen them build residential fiber networks in places like Austin, Texas, in the Research Triangle area of North Carolina, and in Atlanta in response to fiber being constructed by Google Fiber. There is no way to judge if they would have the same response in Gainesville – but they might. AT&T would be a formidable competitor if they built a competing fiber network. They might build in neighborhoods where they think they can get a high customer penetration, but that might be enough to make it hard for the city to achieve overall market penetration goals.

Both AT&T and Cox Communications serve the city of Lafayette, Louisiana where the city built a fiber network about a decade ago. At the end of this section below I discuss how Cox and AT&T together reacted to the city's plans to build fiber.

Cox Communications as a Competitor

We are only aware of one other sizeable Cox market that was overbuilt with a competitive fiber network. That's Lafayette, Louisiana where the city leveraged their municipal electric business to build a citywide FTTP network. We discuss in more detail below some of the specific ways that AT&T and Cox together tried to thwart the municipal bond issues in Lafayette.

Interestingly, Cox offers a gigabit product, but only quietly and doesn't discuss it on their web site. There were several customers who took the speed test and claimed to have gigabit service, but none were receiving gigabit speeds. The fastest product advertised on their website is 300/30 Mbps.

If the city built a fiber network Cox would likely counter by pushing their gigabit product. They have one problem, though, in that it's challenging for a cable network to offer a gigabit to a lot of customers in a given neighborhood node without degrading the speeds for everybody else. They would not be able to match the city if your only broadband product is a gigabit. I think it's also hard to know if they would drop prices far enough to really compete with a low-cost gigabit. It's more likely that they would offer a slower broadband product for less cost than your gigabit price in hopes of luring customers away from the city.

Cox would likely beef up customer service in the city in response to a city fiber network. It's likely that they would shuttle customers from Gainesville to the front of the customer queue when calling customer service. It's likely that they would add more technicians in the city to improve response times for installations and making repairs.

It's also highly likely that they would have a major marketing blitz in the year while you are building fiber to try to tie customers down to long-term contracts – to keep people off your network. Such tactics only work for a few years until the contracts expire, but such a tactic can hurt your early marketing success.

The Lafayette, Louisiana Story

Both AT&T and Cox serve Lafayette, Louisiana. Both companies reacted strongly when the City of Lafayette announced they were going to build a municipal fiber network. Following are a few of the ways that the two companies worked to stop the fiber network. It's worth noting that the Lafayette fiber project started in 2004, making them one of the first cities in the country that wanted to build a municipal fiber network. There is no way to know if the companies would react as strongly today. Some of the tactics used to slow down the Lafayette fiber project include:

- Like Gainesville, Lafayette already had a financially successful fiber business that sold to the same kinds of customers that are on the GRUCom network today.
- The two incumbents introduced and passed legislation that created hurdles for the city. The legislation was labeled as the "Local Government Fair Competition Act," and as can be imagined it was anything but fair. The new law was not as draconian as the existing Florida

legislation, but it imposed a long list of extra obligations on the city that don't apply to private providers.

- AT&T and Cox jointly filed a lawsuit against the city challenging their ability to build a fiber network. After a lot of pushback by local and state politicians the lawsuit was eventually retracted and never went to trial.
- The city held a referendum on the fiber project. One of the provisions of the Fair Competition Act was that the city needed a 60% positive vote to approve fiber. Both Cox and AT&T advertised and lobbied heavily against the referendum. At one point one of them sponsored a push-poll that ask a long string of questions that put the fiber project in a bad light. For example, one of the questions was, "Did you know that the city would not be allowed to offer cable TV service on Sunday?" Many of the questions were equally misleading. See this footnote to hear a recording of the push-poll.² The referendum passed with a 62% positive vote.
- Both incumbents sent hordes of employees to every City Council meeting where fiber was on the agenda. The Fair Competition Act required the city to hold a number of public meetings on the fiber issue and the companies provided a list of loaded questions to employees to pose to the city during the meetings. Some of those meetings lasted past midnight.
- A second lawsuit was filed against the city challenging the legality of the bond issue that was to be used to fund the fiber. The lawsuit was ostensibly being filed by two private citizens, but it was clear to everybody involved that the plaintiffs, who never showed up in court, were just faces for a lawsuit that was backed by AT&T, Cox or perhaps both companies. The city won the lawsuit in state court. The ruling was appealed, and the city won the appeal at the Louisiana Supreme Court. The lawsuit cost the city over \$2 million dollars and delayed the project by 2 years.
- The city finally closed on bond issues in early 2008, 4 years after they publicly announced the project.
- Cox has continued to monitor the city closely. To this day they still send voluminous public records request to get any document that is related to the fiber project. Cox has complained numerous times about Lafayette to the Louisiana Public Service Commission. Most of these complaints were frivolous, but the city spends a lot of time answering enquiries from regulatory staff.

B. Funding Options

One of the most significant costs of building a broadband network is the financing cost needed to raise the money to pay for the network. This section of the report looks at ways that other communities have been able to fund a broadband network.

² <https://muninetworks.org/content/audio-dirty-trick-push-poll-lafayette-2005>

At this end of this report is a summary discussion looking at the financing needed for the broadband scenarios covered by this report.

There are a number of different financing options to consider. Below we will look at the following:

- Public Financing (bonds)
- Private Financing (loans)
- Grants and Federal Programs
- Tax/Customer Financing
- Public-Private Partnerships
- Opportunity Zones

Public Financing

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, bonds can be used to 100% finance a project, meaning that no cash or equity needs to be put into the business up front. One major downside for many communities is that many kinds of bonds require voter approval.

The rates charged for issuing municipal bonds is highly dependent upon the perceived creditworthiness of the borrowing city. Most cities have gotten bond ratings, which is a judgement made by a bond rating firm about the general financial health of a city. Cities with high bond ratings can generally pay lower interest rates and can negotiate other favorable financing terms.

For at least the last decade the interest rates charged for municipal bonds have been lower than the interest rate on commercial loans. However, that has not always been the case. The difference between bond interest rates and commercial interest rates are referred to in the industry as the “spread.” Sometimes the spread favors bonds and at other times it favors commercial borrowing. 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.

General Obligation Bonds. The majority of municipal bonds are general obligation (GO) bonds. GO bonds are supported by the normal tax revenues collected by the city. Sometime GO bonds will rely on some specific revenue source for that will be used to pay the bonds, such as toll fees on a bridge, school tax levies to pay for schools, a portion of sales tax to pay for a new courthouse. However, at the end of the day the municipality is forced to dig into other tax revenues should the proposed revenues not be sufficient.

For example, if general obligation bonds were used to finance a fiber project, then the revenues from customers could be used to pay the bond issue. But if for some reason those revenues aren’t sufficient, then the city is obligated to still pay the bonds and make up any shortfall from tax revenues of some sort.

Today it’s likely that a municipal bond issue for a fiber business that is labeled as a revenue bond is like still a modified form of a general obligation bond. The mechanism used to

accomplish this is a debt service reserve fund (DSRF). When the bonds are first issued, they will include an extra amount of borrowing to fund the DSRF. This money sits in escrow during the life of the bond and can be used any time the revenues are insufficient to cover bond payments. However, any time funds are taken from the DSRF, the municipality must replace those revenues – and that is normally done from tax revenues. Ultimately, a revenue bond that includes a DSRF is really still a general obligation bond since the city is required to continually replace any funds drawn from the DSRF.

In this study we look at both standard general obligation bonds and at a “revenue” bond that includes a debt service reserve fund that is guaranteed by the city.

Revenue Bonds. A revenue bond is one that would be solely backed by the revenues and the assets of the fiber network and the associated business. With a pure revenue bond, a city would not be responsible for covering any shortfall should the project underperform and the revenues are insufficient to make bond payments.

With that said, having a default on a revenue bond would still be a financial black eye that makes it hard for a city to raise future bond funding of any kind. We are aware of a few cases where a city defaulted on a revenue bond but then still made bond payments from tax revenues rather than suffer the consequences of being able to borrow any other funds.

It is probably not possible to finance a fiber project today with pure revenue bonds. There were several failures of fiber systems financed this way in communities like Monticello, MN, Crawfordsville, IN, and Alameda, CA. These failures have made the investor community leery about buying bonds that are only backed by a broadband business.

The only scenario that we could picture for pure revenue bonds would be by issuing them with a high interest rate – perhaps 7% or higher in today’s market - which would put them into the same category as corporate “junk” bonds. A high interest rate on bonds denote a high risk of default, but there are investors willing to take a chance.

Bonds Are Expensive Financing. Bond financing for a fiber project is relatively expensive debt. The general perception of the public is that bond financing is cheaper because of the lower interest rates. However, there are costs of bond financing that can make it effectively more expensive than commercial bank financing:

Capitalized Interest. Bonds begin accruing interest from the day the money is borrowed, and the buyers of bonds (coupon pinchers) want to start collecting interest payments immediately in the first year that bonds are issued. Since a new fiber business takes a number of years to generate enough cash to make bond payments, bonds for fiber must borrow the money up-front to cover the required interest payments for up to the first 5 years of the project, with 2 or 3 years being more typical. This extra borrowing is called capitalized interest and it adds a significant cost to the size of the bond offering.

Debt Service Reserve Fund (DSRF). As discussed above, a DSRF also adds to the size of the bond issue. A typical DSRF might be equal to a full year's debt payments that are borrowed up front.

Bond Insurance. Bond insurance is an up-front fee paid to an insurance company that will then pay 1 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.

Issuance Costs. There are significant costs associated with issuing bonds. First, the transactions are complicated and must comply with state and federal as well as to various tax codes. This means a significant legal cost. There is also a significant fee to sell the bonds. There are financial institutions that specialize in selling government bonds, and they charge a significant fee for finding buyers for a bond issue.

Tax Free Bonds. Municipal bonds are general sold tax free, meaning that the buyer of the bond doesn't have to pay income tax on the bonds. Tax free bonds benefit cities because they can be sold at a lower interest rate. But tax-free status also creates some issues. For example, by federal law a tax-free bond issue can't borrow more than 5% of the cost of the bond to cover operating expenses of the new business. That can present a challenge since the start-up costs for a business the size of the one in Gainesville could be greater than 5%.

Variable Rate Demand Obligations (VRDOs). The only other kind of bond we have seen used to finance a municipal communications network is a VRDO. These are bonds where the principal is paid in a lump sum at maturity. This is sometimes referred to as a balloon payment. However, the borrower has the right to repay the bonds in whole or in part at any time (upon an agreed upon notice). VRDOs are effective in circumstances when the borrower wants to match the repayment of the bonds to a revenue stream that varies year to year or a revenue stream that can vary from initial estimates and changes over time. In the case of the new telecommunications system, this type of financing provides the flexibility to make bond payments that match the actual revenues received. If revenues are slower than anticipated, principal payments do not need to be made. If revenues come in faster than anticipated, repayment of the bonds can often be accelerated without penalty. The only example we know for VRDO financing was in the city of Alameda, California. This was also a revenue bond and the city defaulted on the balloon payment.

Private Financing

The traditional way for commercial fiber ventures to get financed is through bank loans. The interest rates on bank loans have recently been only a little higher than for municipal bonds. Cities are allowed to borrow money from banks, and until the 1960s cities regularly borrowed from banks. Over time there were changes in the banking industry including the rise of the municipal bond markets that made bonds more attractive to most cities than loans.

While there are perhaps 150 municipal fiber ventures in the country that have been financed through bonds, most of the other fiber networks in the country have been financed from commercial lending sources. Most fiber projects have been built by for-profit communications companies or by cooperatives. If a city is going to contemplate having a commercial partner, that partner is likely going to be financed with loans – so it’s important for cities to understand the basics of how commercial financing works.

Following are a few of the issues associated with borrowing from banks.

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 and the perceived strength of the borrower. The higher the perceived risk, the more equity required.

Bankers generally expect a significant amount of equity from a borrower. The banking industry has gotten much more conservative over the last decade and they now might require as much as 30% to 40% equity where a decade ago for a similar project they might have required 10% to 20% equity. Since fiber projects are relatively expensive, it’s difficult to raise the kind of equity needed to make a project work.

Lack of the needed equity is the primary issue that constrains commercial ISPs from borrowing money. A common question asked by the public is why ISPs aren’t building fiber in their community. They see reports like this one that show it to be financially feasible and wonder why no commercial company will tackle building fiber in their community. The answer often is equity:

- Consider the first option we studied looking at bringing fiber to the city limits of Gainesville. The cost to a commercial provider is probably around \$105 million, and if the ISP needed 20% equity they would need to bring \$21 million in free cash to find the needed financing. The public overestimates how much money companies have, but other than the big telcos and big cable companies there are no other ISPs that have that much equity. This is why the only other ISP to tackle larger cities is Google, which has the needed cash to build.
- Even if an ISP had the cash, the returns of the fiber business are slow to materialize. Commercial companies strive to get the highest possible return on their equity and most companies want to see at least a 20% return on equity, or perhaps even 30%. A new fiber network can generate significant cash over a long horizon like 20 years, but the return on equity is generally a little under 10%, at best. Commercial ISPs that have equity instead are likely to choose building high-return opportunities, such as building fiber only to business districts or building only to cellular towers.

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 and that doesn’t earn interest.
- 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.
- Nonrecourse Cash. Nonrecourse 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 in Minnesota, a fiber business was recently launched in the form of a cooperative. The local governments provided an economic development bond to the business as a nonrecourse 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.

Loan Terms. Most banks prefer not to make loans with a term much longer than 12–15 years, and many fiber projects don't generate enough cash to support loans that short-term. This is perhaps the primary reason why the country has such an infrastructure deficit. Prior to 50 years ago, banks would fund things like power plants, electric and water systems, and other long-term revenue-generating assets. However, 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 lending to long-term infrastructure projects.

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 might 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 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 averse to start-ups and prefer to make these kinds of loans to existing businesses that already have a proven revenue stream.

Comparing Bond and Bank Financing

Benefits of Bond Financing. There are several major benefits for using bond financing.

- 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. It's difficult to finance a commercial loan longer than 15 years. The longer the length of the loan, the lower the annual bond payments.
- Bonds can be used to 100% finance a project, meaning there is no need for cash or equity to fund the new business. Lack of cash equity is generally the requirement that creates a challenge for traditional commercial financing.

- Bonds often, but not always, have lower interest rates. The interest rate is dependent upon several factors including the credit-worthiness (bond rating) of the borrower as well as the perceived risk of the project.
- It's generally easier to sell bonds than to raise commercial money from banks. Sometimes bonds require a referendum, but once bonds are approved there is generally a ready market for buying the bonds and raising the needed funds.

Benefits of Commercial Financing. There are also a few benefits for commercial financing.

- Generally, the loans in a commercial fiber project will be significantly smaller compared to financing the same project with bonds. This is due to several issues associated with bond financing. Bond financing often contains the following extra costs that are not included with commercial loans.
 - Surety. Bonds often require a pledge of surety to protect against default of the bonds. The two most common kinds of surety are the use of a debt service reserve fund and bond insurance. A debt service reserve fund (DSRF) borrows some amount of money, perhaps the equivalent of 1 year of bond payments, and puts it into escrow for the term of the bond. The money just sits there to be used to help make bond payments should the project have trouble making the payments. Bond insurance works the same way and a borrower will prepay an insurance policy at the beginning of the bond that will cover some defined amount of payments in case of a default.
 - Capitalized Interest. Bonds typically borrow the interest payments to cover bond payments for some period of time, up to 5 years.
- Construction Loans. Another reason that commercial financing usually results in smaller debt is through the use of construction loans. A commercial loan will advance the cash needed each month as construction is done, and interest is not paid on funds until those funds have been used. However, bonds borrow all of the money on day one and begin accruing interest expense on the full amount borrowed on day one. Construction loans also mean that a borrower will only draw funds they need, while bond financing is often padded with a construction contingency in case the project costs more than expected.
- Deferred Payment. Commercial financing often will be structured so that there are no payments due for the first year or two. This contrasts with bonds that borrow the money required to make these payments. Fiber projects, by definition, require several years to generate revenue and deferring payments significantly reduces the size of the borrowing.

Grants / Federal Programs

We don't know of any specific grant programs that might benefit building a fiber network in Gainesville. Almost all broadband grants at both the state and local level are aimed at bringing broadband to rural areas that have little or no existing broadband. We've not seen grants made to build fiber in cities for many years.

We have seen cities find grant money to build chunks of fiber. For example, we've seen a number of grants from highway programs to help fund traffic light systems. We've seen grants from homeland security or other federal programs that can be used to beef-up communications between key safety infrastructure like 911 centers, police stations, etc. We've seen an occasional grant used

to provide bandwidth to low-cost housing and senior housing. If the city was going to build fiber, you'd want to scour the available grant programs and perhaps help to pay for some small portion of the network – but every dollar not financed is a plus.

Federal Loan Guarantee Programs

One way to help finance broadband projects is through federal loan guarantees. A loan guarantee is just what it sounds like. Some federal agencies 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 significantly 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. 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 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 part of a fiber project. We've never seen HUD 108 money used for this purpose, but we know cities who considered this option and thought it was reasonably achievable.

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. These would not be available in Gainesville since the city is considered to be part of a major metropolitan area. But there might be some money available to support the parts of the network that benefit the rural households in the county.

The only one of these programs that most might benefit Gainesville is the HUD 108 program. It could help to pay for the portion of a fiber network that is being used to provide service in low-income areas of the city.

Tax Financing

When all else fails, an idea that we have seen work in other communities is to use tax revenues of some sort to directly fund some or all of a broadband project. There are several examples of places where this has been done in the country.

Property (or Other Kind of Tax) Revenues. It is possible to obtain some or all of the cost of a broadband network through a pledge of future tax revenues. That pledge can then support a bond. This is different than most bonds for a broadband network where the network would be secured by revenues of the broadband venture. However, a pledge of some other kind of tax revenue is one of the easiest ways to get a bond. There are some real examples of this kind of financing.

- Leverett, Massachusetts. In Leverett the citizens all voted to raise property taxes to fund and build a municipal fiber project. This is a relatively small town of about 2,000 people, but there was enough demand for broadband that a ballot initiative passed easily to use property revenues to pay for the fiber.
- UTOPIA, Utah. UTOPIA is a consortium of a number of small towns in Utah that banded together to get fiber. They also have pledged property tax revenues to fund part of the cost of the network.
- Cook County, Minnesota. Cook County funded about half of their fiber network using a federal grant awarded from the Stimulus funding program in 2008. The county held a referendum and used a sales tax increase to fund part of the matching funds needed to build the network.
- Electric Rates. There are a number of municipal electric companies that financed part of a fiber network through an explicit increase in electric rates. They generally argue that some portion of the project brings benefits to the electric utility and then cover part of the debt with electric rates. There are a handful of communities that have funded 100% of the cost of a fiber network through electric rates.

Direct Customer Contributions. It's also possible to pay for some of a broadband project through direct contribution from possible customers. This has never been done on a large scale because it would be exceedingly difficult to get a lot of residents to agree to write a check to fund a network. However, there are some examples to consider:

- Contribution to Aid in Construction. Most utilities have a program where they will agree to extend their network to customers if those customers agree to pay the cost of the connection. We are aware in the broadband area of numerous cases where small pockets of rural homes raised the needed money to get connected to a nearby broadband network.
- Ammon, Idaho. This is the only municipal attempt at funding a network in this way. The City of Ammon will connect customers to a fiber network if they will contribute \$3,500 up-front to cover the cost of construction. This program is just getting started and it reportedly has a few hundred homes interested. However, it's an unusual combination of a city prompting citizens to pay for the needed network themselves.

- San Francisco. The city floated the idea of charging every home and business a “utility fee.” This fee would be used to generate bonds to pay for the construction of a fiber network. The city would then open up the new network to all ISPs in an open-access environment. The ISPs would get free (or very inexpensive) access to the network, allowing them to offer broadband at extremely low rates. The city was hoping for gigabit rates at \$25.

If the goal in the city is to significantly lower rates and get broadband to everyone, then you should probably look hard at these alternate funding ideas. For example, one of the easiest ways to lower broadband prices would be to finance the fiber network from a revenue stream that didn’t have to be repaid from fiber revenues. If sales taxes, property taxes, or any of the other many forms of tax revenue could pay for some portion of the fiber network, then the business would be stronger and would be able to offer even deeper discounts on rates. Using the example above for San/Francisco, the goal was to pay for the network using a utility fee so that gigabit broadband could be priced at \$25.

Economic Development Funding

The FTTB network to serve only businesses is small enough that the city might want to pursue some sort of economic development funding to pay for all or some part of the fiber network. This is attractive because it would eliminate the burden of making debt payments in the investment if the fiber is funded with traditional municipal bonds.

Cities generally have all sorts of pots of money that can be used for economic development – often gathered from various sources like tax revenues and federal and state grant programs. A strong argument can be made that a fiber network built to serve the largest businesses in the city is a good use of economic development money. In your case these large businesses are the major employers in the city. We often see economic development money being used to extend fiber to a new business that is relocating to a city, but it’s just as important to invest if that helps to keep the current large employers from leaving the city.

Public-Private Partnerships - Combining Public and Private Financing

There are benefits to combining the two kinds of financing, such in the case of a public-private partnership.

- In terms of the amount borrowed, the two methods work well together if commercial construction loans are used to cover the construction and bond financing is used for the longer-term financing costs.
- Combining the two methods works to produce a payment term that is longer than a traditional commercial loan.
- Combining the two methods also usually means lower debt payment during the first few critical years while the network is being built.
- Both municipalities and commercial telcos have a natural borrowing limit, meaning that there is always some upward limit on the amount of money they can borrow. Combining both kinds of financing can mean that neither partner has to hit their debt ceiling. Just as an aside, the debt ceiling is often the main impediment to funding a project 100% with

bonds. Fiber projects are generally large projects and the required funds can easily exceed the ability of a government to fund it 100%.

There is a significant challenge to bring low broadband prices to the market and also finding a commercial partner – those two goals are in opposition since the lure to a partnership for a commercial ISP is potential profits. This issue will be discussed in more detail below in Section IV.F.

One interesting funding idea is to finance the network with a financial partner. Under this arrangement the normal public/private network arrangement is reversed, and the financing partner would finance and own the network while the city would operate it. This kind of financing is referred to as private activity bonds. This might be an interesting way to bypass the requirements that the city must finance with revenue bonds – because in this case the city wouldn't be financing the network at all.

Opportunity Zones

Congress created a new tax opportunity as part of the 2017 Tax Cuts and Jobs Act. The Act created Opportunity Zones in which investors can get special capital gains treatment and other tax breaks for investing in qualified infrastructure within an opportunity zone.

Each state governor then designated specific opportunity zones and there is one that covers the downtown of Gainesville. The zone matches a census tract that is inside the area bounded by 1) the intersection of W. Walnut and Greenway Corridor, 2) the intersection of W. Walnut and S State Street, 3) N. State street and the Conrail railroad tracks, and 4) Richmond Street and the Conrail railroad tracks. A map of the opportunity zone is included in Appendix X.

Qualified investments made inside that area can get special tax treatment. The first benefit is that taxes can be deferred from past investments if the gains are invested inside of an opportunity zone. For example, if an investor had a capital gain from the sale of a property, they could invest those gains and not pay taxes on the gains now, but have those gains deferred until as long as 2047. Investors have until 2026 to make such investments.

An investor also gets tax forgiveness on new investments made inside the opportunity zones if that investment is held for at least 10 years.

Most of the opportunity zones include sizable areas of low-income residents and a qualified investment must meet a test of benefitting that community in some significant way. A fiber optic network that will bring broadband to all of the homes in an opportunity zone should meet that test – there are lot of demonstrable benefits of fiber.

Section IV.F of the report talks about the challenges of working with a commercial partner. If you can find a reasonable way to bring a partner into the Gainesville fiber business, then opportunity zones could enhance the financial benefits for the partner. If the partner is making capital investments for fiber in an opportunity zone, they get huge tax benefits on the eventual capital gains to be made on the project. These tax benefits can be so significant that the partner ought to

be able to provide some benefits to the city. For instance, the partner might loan money to the city to build other parts of the network at an interest rate far below market rates. Opportunity zone credits create no advantages for the city directly.

Like with any tax-scheme, there are hurdles that add challenges to using opportunity-zone tax credits. For example, in order for the eventual benefit of the opportunity zone to materialize there would have to be a liquidity event – meaning the partner would have to sell some portion of their business in approximately 10 years. The partner could sell parts of the project to a different partner that would then take their place in the partnership. They might sell their portion of the network to the city. Or perhaps their investment could be included in one of the many opportunity zone investment funds being created. That fund would somehow sell the partner's share as part of liquidating the fund. In any event, it would be a challenge to work with a partner who is going to disappear in 10 years, and who will stress building value for the business rather than the goals the city might think are more important.

This adds a complication to the funding process. However, there have been similar tax benefits in the past. For example, we've worked with a number of projects that have used Investment Tax Credits. These credits were similar to the opportunity zone credits, and banks found a way to incorporate them into funding packages.

Partnering with the County and Other Cities

If you decide to build outside the city limits of Gainesville you should consider seeking a funding partnership with the county and the other smaller cities in the county. Those parts of the county possibly benefit more from fiber even than Gainesville because they don't have the same situation where AT&T and Cox are competing in all locations. There are also parts of the county where the broadband technology is not as good as what's found in the city.

There are numerous ways to partner with other municipalities on this. We've seen some of the following ideas used around the country for fiber networks that benefit multiple jurisdictions:

- Joint Board. The most formal relationship would be to form a joint board or intergovernmental agency as a partnership between Gainesville and the other municipal partners in the arrangement. While GRUCom would still be the likely operator, the policies, pricing and other policies for operating the business would come from this joint government agency. While this cedes some control over the broadband business, it's also an interesting way to shield the fiber business from the politics in any given city.
- Operating Agreement. At the other extreme would be a situation where the other governments would finance their own portions of the fiber network and hire GRUCom to operate the business. This would look a lot like a public / private partnership.
- Bond Assistance. One of the more beneficial ways that the other jurisdictions could help would be by participating in the financial backstop to bonds. Under this scenario the city would fund and operate the network, but in the bond funding process the other cities and the county would agree to take on a portion of the obligation to fund any shortfall in revenues needed to make bond payments.

Higher Rates Outside the City Limits

While this isn't really a financing idea, another way to reduce the financial risk of the business would be to charge higher rates outside the city. For example, while the city's goal is to have a low-price product like a \$50 gigabit broadband, there is no reason that the prices outside the city couldn't be something higher, like \$60 gigabit. That is still an attractive rate. All of the business plan scenarios contemplated the same rates everywhere.

There is some justification for higher rates outside the city. First, the network is less dense outside the city, meaning a higher cost per customer to build the network. More importantly, if you don't somehow partner with the other cities and the county, then the citizens of Gainesville would be absorbing the full risk of covering revenue shortfalls of the system.

Slightly less than half of all passings lie outside the city limits, so there is no doubt that charging higher rates outside of the city would significantly lower the risk of the project.

Buy Cox?

This almost sounds like a facetious suggestion, but any time that a commercial provider looks at building a network in a new market they almost always consider the idea of buying an existing provider as an alternative.

From a business plan perspective there are huge benefits to buying Cox rather than building a new network and competing with them – assuming the network could be bought for a reasonable price. With such a purchase the existing revenues are realized on day one, greatly reducing the risk of not performing financially. The city would also have purchased a valuable asset and it would always be possible to sell the business again at a later date to get all or most of your money back.

It's likely that the lender that is financing a buy-out would consider this as lower risk than overbuilding with fiber and competing for customers, so there might be easier financial terms available.

From a technical perspective the Cox network is not fiber and it could not be used to offer ubiquitous gigabit broadband. However, it probably would take much improvement to offer some reasonable fast speed to everybody, perhaps 200 Mbps or 300 Mbps. Over time the network could be upgraded to add faster broadband. It would ultimately be possible to offer near-fiber speeds by reducing the size of neighborhood nodes on a coaxial network. If the node sizes were reduced to the 25 or so customers that will probably exist on each fiber PON node, then gigabit speeds are likely possible.

Buying the network would also provide the opportunity to meet some of the city's social goals. The city should be able to drop rates across-the-board since your goal is not to make high profits. It also would be possible to have an aggressive program for using the network to provide a digital divide product for low income homes. Cox and other cable companies have offered such plans, but they never vigorously push the plans and rarely serve many customers under reduced-price plans.

Throwing this idea into the mix doesn't imply that Cox would be interested in selling, but if they believed the city was serious about building fiber everywhere the possibility of selling to you might be attractive to them.

It's my understand that the local Cox network that serves Gainesville and Ocala is somewhat isolated from the larger Cox markets. It's likely that for Cox to give a sale any consideration that you (and partners) would have to buy the whole local system.

Funding Summary

If you decide to pay for the full cost to build fiber everywhere in the city, it's likely that most of the network is going to have to be funded with traditional municipal bonds. For fiber networks, we've seen that be either straight general obligation bonds, or a bond that is a variation on revenue bonds where the city still must pledge to refill a debt service reserve fund in case of a cash shortfall.

It's possible that the city might be able to find lower-cost financing through some mechanism other than bonds. For example, you might be able to finance part of the system with bank loans that have subsidized interest rates through the HUD 108 program. There might be an opportunity to get low interest rates through the newly formed Qualified Opportunity Zone tax credits where you'd borrow money from a fund established for that purpose.

It's also worth at least exploring the idea of using alternative sources of funding such as sales tax, a utility fee or some kind of income stream paid by the public that would offset part of the cost of the network. The benefit to the public from these ideas is that while they are paying for the funding mechanism such as sales taxes, they also benefit from significantly reduced-price broadband.

It's also worth exploring the idea of partnering in some manner with the county and the other cities in the county to help spread the risk of building a fiber network.

While it's not a funding idea, it's also worth considering a financial model that would charge higher broadband rates outside the city. You could still offer attractive rates in the county, but not as low as the \$50 gigabit assumed in our financial analysis.

Finally, in the most out-there idea, you always should consider the option of trying to buy the Cox network as an alternative to building yourself. It would be an extreme long-shot, but it's not entirely outside the realm of possibility.

C. Legal and Regulatory Analysis

GRUCom has been providing retail telecommunications services since 1995. These services include data transport and Internet services to businesses, multi-tenant and student housing communities, government agencies, other telecommunications carriers, and to other Internet service providers.

GRUCom has stated its intent to provide telecommunications services to persons in addition to its service provision to business and institutional entities in the Gainesville area. This opinion

considers how that intent is or may be affected by the legal and regulatory environment in which GRUCom operates. This section provides an opinion regarding the legal and regulatory obstacles and risks for GRUCom to enlarge its fiber business so as to provision telecommunication services to persons as well as businesses and other entities.

The Legal Framework in Florida Statutes

Over the last several decades private telecommunications companies have registered their opposition to government entities providing services to the general public. Twenty-six states have statutes that place obstacles or ban municipally owned fiber networks which are more commonly referred to as broadband networks. In Florida two types of legal obstacles are usually cited as hindering government entities from providing communications services to the public: (1) obstacles to formation, financing and operation of public networks (2) excessive taxes on municipal broadband services. We will consider first the legal obstacles relating to formation financing and operation of public networks.

The main legal road map for governmental entities wishing to offer communications services in Florida is set out in Florida Statutes; Title XXVII; Chapter 350; Section 81: Communications Services Offered by Governmental Entities. The rules for governmental entities to provide retail services to persons are fairly detailed and specific including several dozen requirements for any government entity intending to provide communications services to the public. However, due to historical circumstances GRUCom is in a favored position regarding its current plan to expand its telecommunications services.

The most important legal provision affecting GRUCom and its intent to expand services is a waiver provision in Section 4 (Chapter 350; Section 81) which provides a waiver from numerous Section 81 provisions for government entities that were in business as of April 1, 2005, already providing advanced services, cable services or telecommunications services.

GRUCom Grandfathered for Some Legal Requirements

GRUCOM operates its current services under the waiver provisions contained in Section 4, since they were providing both “advanced services” and “telecommunications services” prior to April 1, 2005. The waiver provision provides relief from many of the most onerous obstacles contained in Section 81 which affect start up projects. However, some Section 81 requirements do apply though not all that apply require further discussion. GRUCom has governed itself since 2005 according to the waiver provisions in Section 4. For convenience GRUCom has provided a marked-up copy of the relevant Section showing the provisions that are and are not applicable to GRUCom.

The Section 4 waivers exempt GRUCom from the following requirements that would likely be hurdles for other municipalities.

- A government entity that wants to provide a communications service (includes broadband), must hold at least two public hearings. At these hearings they must consider:

- Whether the service that is proposed to be provided is currently being offered in the community and, if so, whether the service is generally available throughout the community.
- Whether a similar service is currently being offered in the community and, if so, whether the service is generally available throughout the community.
- If the same or similar service is not currently offered, whether any other service provider proposes to offer the same or a similar service and, if so, what assurances that service provider is willing or able to offer regarding the same or similar service.
- The capital investment required by the government entity to provide the communications service, the estimated realistic cost of operation and maintenance and, using a full cost-accounting method, the estimated realistic revenues, and expenses of providing the service and the proposed method of financing.
- The private and public costs and benefits of providing the service by a private entity or a governmental entity, including the effect on existing and future jobs, actual economic development prospects, tax-base growth, education, and public health.
- The government entity must also provide a written business plan that contains, at a minimum:
 - The projected number of subscribers to be served by the venture.
 - The geographic area to be served by the venture.
 - The types of communications services to be provided.
 - A plan to ensure that revenues exceed operating expenses and payment of principal and interest on debt within 4 years.
 - Estimated capital and operational costs and revenues for the first 4 years.
 - Projected network modernization and technological upgrade plans, including estimated costs.
- After making specific findings on the issue listed above, the governmental entity may authorize providing a communications service by a majority recorded vote and by resolution, ordinance, or other formal means of adoption.
- Products offered on the network cannot be priced below the total long-run incremental cost of the service.

Relevant Requirements of Section 81

Bonding and Referendum Issues

By statute the governing body of a governmental entity is authorized to issue one or more bonds to finance the capital costs for communication facilities under certain conditions (Section 2(e)). It is notable that the section does not implicitly or explicitly allow or disallow the use of any particular types of bonds for financing the provision of a communications service.

The conditions for bond issuance include that the bond/s may only be used to finance a communications service within the county in which the governmental entity is located. The current understanding is that the project planned by GRUCOM lies within Alachua county. It also allows that if communications services are provided by a governmental entity outside its home county it may do so under an electric service territorial agreement approved by the Public Service

Commission before the effective date of Section 81 of Florida Statute Chapter 350, a condition that should be noted if it becomes relevant in the future.

A second set of guidelines found in Section 2(a)(1) pertains to bond financing. They discuss the use of revenue bonds to finance a communications service and provide that bonds maturing within 15 years may be issued on the authority of the government entity but that bonds maturing in more than 15 years require a public referendum to approve those bonds prior to bond issuance. Such a referendum must be conducted as specified in Florida Chapter 100.

It is notable that the section does not implicitly or explicitly disallow the use of other types of bonds for financing the provision of a communications service. If types of bonds for financing other than revenue bonds are used for financing, then arguably no referendum is required. If, however, revenue bonds are the financing vehicle and they mature in more than 15 years then a referendum is required.

In the event a referendum path is followed a discussion of the relevant issues follows.

- The decision rule specified in Chapter 100 is that approval is determined by the majority of votes cast by those eligible to vote. The relevant provision follows: “Referendum required before issuing bonds. Whenever any county, district, or municipality is by law given power to issue bonds which are required to be approved by referendum, such bonds shall be issued only when the same have been approved by the majority of votes cast by those persons eligible to vote in such referendum. The election costs of such referendum shall be paid in whole or in part, as the case may be by the county, district or municipal treasury.”
- The size and make-up of the voting area for a GRUCom referendum are also important factors in its likely success. If the voting district for the GRUCom referendum would be the City of Gainesville area. GRU and GRUCom are known providers of services and presumably trusted which counts favorably toward success. If the voting district for the referendum should be larger than the City of Gainesville area the challenges to obtaining a successful referendum outcome increase.
- Challenges to a referendum could be mounted. Experience with other referenda in other parts of the country shows that if a competitor decides to bring a referendum challenge it is likely to use deep pockets. Among the issues related to holding a referendum is the extent of support already existing in the community for the services GRUCOM would be able to provide from its new facilities. Understanding the extent to which public support and activity in favor of the referendum can be anticipated from the public will be important to the eventual success of it.

Provision in Section 81 Without Explicit Exemption

There is a provision under Section 2.1 (l) which does not provide explicit exemption but nevertheless on the face of the language would not appear to apply to the GRUCom project. The language requires certain actions by a government entity “4 years following the initiation of the provision of communications services by a governmental entity”. Just how this provision would possibly affect GRUCom project is unclear. Even if there is no explicit exemption from Section

2(l) GRUCom will not be “initiating the provision of communications services” and has been in the communications business since 1995.

It is important to note that even if this Section were to be construed as applicable to the GRUCom project one of the actions open to the government entity at the end of 4 years is to “approve the continuing provision of communications services by a majority vote of the governing body of the governing authority.” That would occasion a public conversation about the continuing community commitment to the project and whether approval should be given. The alternative actions include ceasing operations, disposal of the system or merging with a willing private entity.

Taxes on Government Communications Facilities

Florida is one of the few states that levies fairly high ad valorem taxes on municipal communications providers. One of the issues to be considered is the role of ad valorem taxes in relation to any new property, facilities and equipment GRUCom would acquire for the proposed project. There is some concern as well in regard to current arrangements on existing properties.

GRUCom now has an exemption from ad valorem taxes which was established by consent decree which applies to its fiber related property and equipment, but it pays property taxes on cell towers. This report is raising the need for GRUCom to consider the possibility that the existing exemption would be challenged by the acquisition of new property, facility or equipment in two ways. GRUCom might face a challenge to a request for the current exemption to be extended to any new property, facilities or equipment. GRUCom might also face the possibility that a new challenge might bleed out over the current exemption. The least good outcome is that all GRUCom properties become subject to ad valorem taxes. There is an obvious need to discuss financial scenarios as to the scope of possible financial impact on current and future new operations. This impact is not included in the projected financial models.

City Code Issues

Rights of way issues and pole attachment issues are frequently in play when communications build out projects are proposed. In light of the existing facilities already in place there is no pole attachment issue and the rights of way concerns are less acute than in many projects.

However, there is a potential rights of way issue on the horizon which needs to be highlighted in this report. The county of Alachua has had some discussion about moving utilities out of the rights of way. This was reported as related to land use development changes and potential use of the rights of way for other purposes. This would affect GRUCom in the roads in unincorporated areas of the county and in the county roads that are in the City. It raises the need to consider the potential financial impact for purchase of easements if in fact utilities including GRUCom were to be displaced from county rights of way.

Should it be necessary to acquire new easements the legal aspects of acquisition of easements will overall probably be less difficult than the financial aspects where new market prices would need to be established.

Video Services

One of the options for the GRUCom project includes provisioning of cable services. Florida is one of the more than two dozen states which have established a state authority to grant cable franchise certificates as it is termed in Florida or franchises as sometimes still termed elsewhere.

The Florida Department of State is designated to accept applications for state franchise certificates and issues those certificates. It posts franchise certificate application forms and other relevant information on its website.

The fee to obtain a state franchise certificate is \$10,000 which must be accompanied by a \$35 fee. Once issued it remains valid for five years. Every five years a \$1,000 fee must be paid to process application updates. All fees go to the Department of State. Local governments no longer receive revenue under local franchise agreements.

Several state agencies now share limited oversight responsibilities for cable and video services in Florida—the Department of State, Department of Agriculture and Consumer Services, Department of Legal Affairs, and Public Service Commission. Should GRUCom decide to provide cable services it would need to be responsive to the Department of Agriculture and Consumer Services investigation of quality complaints concerning cable or video services. GRUCom would also need to be aware that the Department of Legal Affairs is responsible for investigating complaints of discrimination based on race or income that pertain to the statewide franchise holders under the state's unfair and deceptive trade practices law. The Public Service Commission oversees telecommunications companies but does not have regulatory authority over the video services that they provide.

While the state legal process for entry as a provider of cable services is relatively straightforward and the cost for a franchise certificate is modest, the opposite is true for securing and managing actual programming agreements. Many agreements can be secured via consortia but some not, which often leads to the need for in-house expertise. In the event it is decided to offer cable services, this subject can be revisited.

Voice Services

GRUCom is in the process of installing a voice switch to sell voice services to the City and also to businesses in the City. GRUCom is already a registered as an Alternate Access Vendor and an Alternate Local Exchange Carrier for provision of voice services. In discussion with GRUCom it was established that the legal requirements as a retail carrier of switched voice services and/or VOIP services is likely to be re-visited as the service map evolves.

Summary of Legal Concerns

Revenue Bonds. There is some ambiguity in the financing language of Section 2(a)(1). It discusses the use of revenue bonds to finance a communications service. The only type of bond that is named is “revenue bonds”. This singular naming of revenue bonds introduces some ambiguity which could be the legal basis for challenging the use of any other kinds of bonds such as general

obligation bonds. This is troublesome since it's exceedingly difficult to get pure revenue bonds in today's bond market. It could stop the project if a challenge on this point led to a court determination that only revenue bonds could be used to finance expansion of the network.

In the city's favor and making it somewhat unlikely that this type of challenge could stop the project is the fact that Gainesville has been using non-revenue bonds to finance the expansion of the current fiber network to date, with no controversy. That doesn't mean the City can't be challenged on the issue, but it would be hard to argue successfully that in this case Gainesville may not use types of bonds that have already been used in expansion of a communications project. The history of Gainesville is in its favor. In addition, the section does not implicitly or explicitly exclude the use of other types of bonds for financing the provision of a communications service and the City has acted in just that way by the use of other forms of bonds to finance previous expansion.

Referendum. There is also some ambiguity about whether or how a referendum links to any type of financing other than by revenue bonds. In the language that requires a public referendum it is clear that if the project is financed with revenue bonds shorter than a 15-year term, then a referendum is not required. However, there is nothing in the statute as written to link requirement of a referendum to bond issuance if the project were to be financed with other kinds of bonds and requires more than 15 years to mature.

On the face of the statute, a reasonable interpretation is that no referendum is required when financing the project any way other than by revenue bonds. However, there could be a legal basis for challenge on the grounds that the statute meant to link the requirement for referendum to the term of the bonds, regardless of the type of bonds. In short, it is not completely clear how the referendum provision would apply if the project is financed with other kinds of bonds with a maturity date beyond 15 years.

Under these circumstances the City could choose to finance with non-revenue bonds with a maturity date beyond 15 years without a referendum and find no challenge. This would be consistent with its earlier history. If it were challenged it would incur the costs of the legal challenge and if it lost, it would need to conduct a referendum with its attendant delay in the project.

Since it looks nearly impossible to finance a fiber network with a bond term of 15-years or less that most likely means that the strategy with the least uncertainty is to assume that a referendum is required regardless of the type of bonds used. Passing a referendum might be a good tactical strategy because if any type of legal challenge should arise to block the project courts often defer to votes of the people when looking at challenges to this kind of project. However, it does run the risk of an unsuccessful referendum vote.

Profitability Test. There is language in Section 2.1 (1) requiring certain actions by a government entity, namely that four years following the initiation of the provision of communications services by a governmental entity and until the revenues of the project fully cover operating expenses and debt payments the city would have to go through an annual process of analyzing options such as

selling the system, disposing of the system, creating a public-private partnership or continuing to decide to operate the system.

It is unclear how this provision would possibly affect the GRUCom project. Even if there is no explicit exemption from Section 2(1), GRUCom will not be “initiating the provision of communications services” with this project so arguably, it should not be affected if “initiating” is taken as meaning offering communication services for the first time.

However, it is not impossible that a legal challenge might be made and Section (2).1. (1) construed as applicable to the GRUCom project. That would not stop the project because, as noted, the city could elect each year to continue operating the system, but this process would create an opportunity for headlines and criticism from the incumbents.

Overall Summary. The Florida statutes would be more troublesome for any city that is not grandfathered from some of the provisions of the law. The most complicating and troublesome issues posing a risk of legal challenge are those relating to revenue bonds and possible referendum. The potential applicability of a profitability test creates opportunities for the incumbent providers to make a public splash about the city’s effort to expand broadband but does not look to be a show-stopper.

It’s worth noting that there have been several lawsuits brought at the beginning of municipal fiber projects, and to the best of our knowledge the city has always won such suits. It appears that the suits were brought as much as a delaying tactic versus a real expectation that a city would be unable to proceed with building fiber. This means that regardless of the correct interpretation of any ambiguities in the statutes that it’s always possible to get sued. We further remind you that these two incumbents sued to delay the project in Lafayette, Louisiana. We can’t predict that they’d sue Gainesville since your circumstances are different and you’ve already been in the telecom business for many years – but it’s a risk to be aware of.

D. SWOT Analysis

A SWOT analysis looks at the strengths, weaknesses, opportunities, and threats of operating a retail broadband business.

Strengths

Already Operates an Extensive Fiber Network

Since GRUCom already owns and operates a 550-mile fiber network, the company has significant technical expertise that is relevant to building and operating a retail fiber network.

This means that GRUCom already performs many of the functions that are needed to support a retail fiber business. GRUCom already performs such functions like:

- Has field technicians to maintain a fiber network;
- Understands the installation process for new customers;
- Operates an extensive electronics network to light and operate the fiber network;

- Operates a network operations network to monitor network performance;
- Operating a central office that houses core electronics.

GRUCom also recently activated a telephone voice switch, paving the way to offering telephone service for existing broadband customers, but also would support the delivery of retail telephone service directly to the new residential and small business customers.

GRU Already Serves Residential Customers

GRU already serves large numbers of residential customers, meaning that the company already understands many of the basic functions needed to provide the retail triple play. While these functions would have to be tailored for the broadband business, the company already performs key functions like:

- Taking new orders for service;
- Billing customers monthly for service;
- Processing customer payments;
- Processing trouble calls and dispatching technicians;
- Performing the customer service functions of answering customer enquiries.

Can Avoid Construction Costs by Placing Fiber in the Power Space

One significant advantage of an electric company building fiber is that GRU can install fiber near to the power lines, which saves significant cost for fiber installation. Otherwise, hanging fiber lower on the poles often requires expensive “make-ready” work where the existing wires hanging on poles often have to be rearranged to accommodate a new fiber cable. In some cases, making room requires placing a new and taller pole. The project should be able to avoid almost all of this potential up-front cost.

Weaknesses

No Experience Selling in a Competitive Environment

The process needed to sell products in a competitive environment is significantly different than today’s monopoly sales of power and water. Most competitive telecom companies rank their ability to sell as one of the top key components to market success. It’s not good enough to have the best network or even the lowest prices in the market if a company doesn’t know how to sell to customers.

We’ve seen other cities learn to master the sales process and thrive, while some struggle with sales for years.

The sales process needed to sell to residents and small businesses is also different, meaning that a retail company has to master both.

Is GRUCom Nimble Enough to be Competitive?

By definition, GRU is a bureaucratic organization that is part of a larger bureaucratic city structure. The bureaucracy largely serves businesses like power and water well. In a bureaucratic structure issues are debated and there is a multi-step process used to make decisions.

Operating a competitive business often requires more nimbleness and quicker decision making. We've seen cities that have found ways to grant more flexibility to a competitive venture, but this has to be done deliberately.

Government Purchasing Practices Can Inflate Cost of the Network

CCG Consulting works with a significant number of both commercial ISPs and government-owned ISPs. We've seen in general that government purchasing processes like a defined process for purchasing through RFP add cost to building a network. The RFP process often requires vendors to set prices that can't be further negotiated after a city selects a vendor. While there are usually steps that can be taken to improve pricing obtained through the RFP process, overall a commercial ISP can often buy assets and build networks for less than a government entity.

The Survey Showed Consumer Dissatisfaction with the City

The survey showed a higher level of customer dissatisfaction with the city as a service provider than for the incumbent ISPs. This likely adds an additional hurdle to the sales process for broadband to overcome the existing bias against the city. We think this bias is baked-into the other responses to the survey. For example, the overall percentage of customers that say they would buy broadband from the city is lower than what we've seen in some other markets. It's really to compare responses from different cities, but this bias could be one of the reasons for the overall lower projected penetration rates.

	<u>Cox</u>	<u>AT&T</u>	<u>City</u>
1 – Extremely dissatisfied	15%	4%	13%
2 – Somewhat dissatisfied	19%	15%	30%
3 – Neutral	35%	55%	40%
4 – Somewhat satisfied	19%	20%	14%
5 – Extremely satisfied	12%	6%	3%

Any Business Operated by the City Draws Significant Overhead

Another competitive ISP that builds and operates a fiber network in Gainesville would incur lower expenses and higher margins due to the overhead costs that come as part of being a part of the city and a part of GRU. GRU fully allocates all joint and common costs to every entity that is a part of GRU.

Bond Financing Requires Rapid Deployment

Commercial companies generally build new fiber networks using construction financing, meaning that they only draw loan funds and begin accruing interest as they build the network and spend money. However, with bond financing a city will borrow the entire cost of building a network up

front and begin incurring interest expense on the full amount of the borrowing from the day the bonds are sold.

Bonds offset this problem to some extent by using capitalized interest – which means borrowing the money up front that’s needed to make interest payments for the first years of a fiber project.

Overall the use of bond funding puts time pressure on a fiber project because the business needs to build quickly and get customers quickly in order to be generating enough margin to make debt payments at the end of the capitalized interest period.

Opportunities

The Broadband Business Can Work

As can be seen by the financial forecasts, there are scenarios that can be profitable and that could return positive cash returns to GRUCom above costs. However, the opportunity for financial success could be offset by the city’s desire to have low-price broadband. The city is going to have to be careful to temper the desire for low rates with the goals of operating a business that wouldn’t need external subsidy.

Can Lower the Prices in the Market for Everybody

If the city keeps the goal of having the lowest cost broadband in the country, then market prices drop for everybody in the market, not just those who are customers of a GRUCom fiber network. The incumbent providers will drop prices rather than allow GRUCom to capture the majority of customers.

Saving money on broadband means an increase in disposable income for every household in the city, and that would largely translate into more money in the community for other needs. Numerous economic studies have shown that there is a multiplier effect of money spent in the local market of about 7 times. We are not economists and we’re sure there are better ways to make a more accurate estimate of this benefit, but using a 7X multiplier, the overall benefit just within the city might be something like:

33,400	Direct Residential Passings
\$140	Current Average telecom bill
15%	Savings due to GRUCom Fiber network
\$8.4 M	Annual Customer Savings
\$59 M	Economic Impact per Year (7 X Savings)
\$590 M	Economic Impact over Ten Years

There are numerous other economic benefits that accrue to the market if the city can bring broadband to everybody. For example, the benefit from getting broadband into homes for all school students is immense, and we don’t know how to quantify it. We know that students without broadband lag behind students with home broadband and never catch up – but how do you quantify the impact of a better-educated student population who grow to become better educated adults.

Could Be one of the First Cities to find a Solution to the Digital Divide

One of the city's stated goals is to provide affordable broadband to everybody in the city. It's clear today that no major city has yet solved the digital divide. That would mean getting broadband into homes that can't afford it today.

The closest we've seen to this effort so far is a recently announced initiative in San Jose, California where the city has pledge \$24 million to help solve the digital divide. The city estimates that it has 95,000 residents with no home broadband. The city is looking for facility-based solutions, most likely some sort of wireless solution. The city knows this funding won't solve the problem and calls it a down payment. The city believes that broadband will help low-income households improve their lives, their earnings potential, and their quality of life. The city is particularly focusing on homes with school students.

This Would Finish the Fiber Build

GRUCom has been spending capital each year to extend the current fiber network to reach new customers. Once a fiber network was constructed to cover every street there should no more need to build fiber. The new fiber in this study would have sufficient numbers of fibers to support customers added to the existing or the new fiber businesses.

Broadband Can Improve the Quality of Life

There are numerous benefits of broadband to the whole community:

Better Education. We've seen the statistics from a number of school systems that report that students who don't have broadband at home underperform students with broadband. Students without broadband also have a higher drop-out rate. It's almost impossible to quantify the benefits to the community from improving the education for students that are otherwise falling behind or falling out of the education system.

Good broadband can also improve education in many other ways. For example, there are school systems in communities with fast broadband that now off students who can't make it to class (such as with illness or after an accident) to take part in the classroom through video conferencing. Your school system probably has a dozen ideas of how to better use fast broadband.

Improved Healthcare. The world is on the verge of a time when broadband will play a major role in healthcare. There are numerous Silicon Valley companies working on technology that use broadband and broadband enabled technologies to help keep the elderly in their own homes for more years. There also are several major studies showing that wearing broadband-enabled medical monitors after a medical procedure can save lives and significantly improve outcome of health treatments. Homes without broadband will not receive the same quality of treatment as homes with broadband.

Gigabit broadband also enables doctors to more easily read x-rays and cat scans from home to help diagnose patients. In communities that build fiber networks the doctors are generally among the first customers on the network.

Citywide Gigabit should Stimulate Economic Development

There is no major city in the country where all households have access to gigabit broadband. There are numerous potential benefits of widespread world-class broadband: Work at Home Economy. Reliable broadband enables the work at home economy.

Numerous employers have come to understand the saving from having home-based employees, either full-time or part-time. There are numerous jobs today that are only home-based. Home-based jobs also increase employment and earning potential for workers with disabilities or with other factors that make it hard for them to work outside of the home.

Unleashing Home-based Entrepreneurs. Cities that have implemented gigabit broadband report an increase in home-based entrepreneurs. Businesses that start at home and then grow to become larger are creating significant numbers of new jobs and are one of the fastest growing segments of the economy.

Attract People who Value Broadband. We've seen evidence that communities with fiber-based gigabit broadband attract people to move to the city. For example, the city of Eugene, Oregon built fiber to downtown office buildings that had low occupancy. They created an open-access network that attracted several ISPs and that competitive market set gigabit rates at \$59 for individuals and \$79 for businesses. The occupancy of the downtown buildings shot up within a year. Most of the new tenants are small software companies that have created hundreds of new jobs with an average salary of \$75,000. We saw a similar influx of high-tech entrepreneurs in Kansas City and Chattanooga, Tennessee. Lafayette, Louisiana leveraged a gigabit fiber network and a government supercomputer to become the new national hub of movie automation.

Better Environment for Businesses. Quality broadband has become a necessity for businesses of all kinds. To some degree GRUCom's existing fiber network already satisfies this need for larger businesses in the community. However, most small businesses in the city do not have affordable access to gigabit broadband.

Increased Home Values. Real estate brokers nationwide have been reporting that having fiber broadband makes it easier to sell a home and that fiber adds at least several thousand dollars of value to a home compared to homes in the same community without fiber. That will translate into higher property taxes over time.

Better Overall Economy / Increased Tax Revenues. All of the above factors accumulate to create a better local economy and increased tax revenues. We've seen private economic papers (meaning not public) that estimate that over 20 years a fiber network in a large city would provide significantly greater benefits to a

community than the cost of building the network. This boost come from the tax revenues associated with more businesses and more profitable businesses in the community, from increased salaries from technical jobs, from greater housing values and the associated property tax revenues. Economists in these same studies speculate that the improved educational opportunities from universal fiber broadband would lead to lower poverty rates, less crime, and all of the community savings associated with those issues.

Creates a Valuable Asset

A functional and profitable fiber business can have significant market value. In today's market fiber businesses like the one you are considering are selling for eight to ten times adjusted EBITDA (earnings before interest, taxes, depreciation, and amortization). In the last few years several cities have decided to sell their fiber business to a private ISP after it was mature – and in several cases the sale was to take advantage of high market value of fiber businesses and a desire to capture and benefit from the accumulated and unrealized value.

Threats

Competitive Response of AT&T and Cox

Covered elsewhere in this report in Section IV.C above is a description of the likely response of AT&T and Cox to a municipal fiber network.

In summary, both companies are going to react to a municipal venture of this magnitude. They might take legal and regulatory steps to try to stop the city from building a retail fiber network. They might push legislation to try to stop you. AT&T might build a competing fiber network, and Cox will upgrade to better be able to sell gigabit products. Both will lower prices. Both will market aggressively using low promotional to keep customers.

State Legal Restrictions

There are a few troublesome provisions of Florida statutes concerning the creation of a retail broadband business. The biggest concern is the requirement that the city use revenue bonds to finance the network. There might not be a market to sell pure revenue bonds.

Less troubling, but potentially expensive is a provision that the city prove that your rates are higher than incremental costs. This involves a specialized kind of economic analysis and can be costly to prove.

Finally, the law provides numerous opportunities for the incumbent providers to challenge the process of getting into the broadband business. There are public hearings required to approve a broadband business plan that include requiring the city to make some uncomfortable findings. There are annual reviews of performance of the fiber business, which can be particularly troublesome in years where revenues don't exceed operating expenses and debt payments.

Raising the Required Funds is an Issue

The financial analysis shows that the cost of financing a fiber business in the city might vary between \$113.6 million for the Gainesville city limits and \$213.5 million for the largest study area we considered that includes the small cities.

That is a formidable amount of money for any city to borrow when considering all of the other demands placed in the city's finances, and one of your earliest tasks if you are going to consider moving forward would be to explore the issues involved with borrowing that much money.

It's even possible that borrowing the amount needed to build fiber could squeeze the city's borrowing power for other project, lower your bond rating and thus increase interest costs for this and other projects.

Passing a Referendum

It seems obvious between the Florida laws concerning telecom and normal bonding practices that the city will need to pass a referendum to approve financing for a fiber network. It's worth noting that the studies do not provide a specific and direct benefit to those living in apartments. That might make getting a positive vote on a referendum harder than normal. This might particularly be an issue for any digital divide proposals – the city would have a huge challenge offering discounted broadband in apartment units since property owners play a big role in the kind of broadband provided to residents.

Also note that both Cox and AT&T are likely to advertise heavily against a referendum on the issue.

Provisioning

One of the biggest challenges of launching a business of this magnitude is developing the processes necessary to install large numbers of customers weekly. In order to be financially successful, we estimate that it will take monthly installations that range from 550 for the Gainesville-only option to 850 if you tackled the full footprint including the small cities. It will require streamlined processes and employees who fully understand their roles to accomplish installations of that magnitude. From our experience at CCG we can say that installing that many new customers each month is a challenge and the company will have to be extremely focused in process to achieve it.

The Impact on GRU for Underperformance

There is never any guarantee that a new fiber business will perform as planned. The city and GRU need to accept that any shortfalls in the fiber business have to be made up for from somewhere else. That might be from cash reserves or GRU or from tax revenues of city.

This is an issue that should be decided up front rather than have a political fight should losses materialize later. It might be required for the source of backstop revenues for the project to be specified in the bond issue. We recommend making this issue part of the enabling law that

authorizes the creation of the fiber business.

Shielding the Business from Politics

There is always a risk for a municipal fiber venture if politics is allowed to influence the operations of the business.

The example I like to cite is the municipal fiber business in Bristol, Virginia. A year after the fiber business launched the City Council, in an election year, voted to cut customer rates by 15%. The company had been performing better than planned, but instantly was hit with cash shortfalls. Within 6 months the Council had to raise rates back to the original levels and they also put in place safeguards to stop future City Councils from meddling in the rates at the fiber business.

Another good example is in Tacoma, Washington where the City Council refused to approve cable TV rate increase for a number of years in a row. The cable rates on the city network grew to be almost 40% lower than the rates in nearby Seattle – and the city business was losing a lot of money.

While GRU is already functionally separated from the city, there is still city input on electric rate increases. A competitive business has to be nimble, and also needs to change rates up or down to react to competition or to pass on cost increases. Ideally this project would be somehow exempt from needing city approval for changes in competitive rates.

The Impact of Future Technologies

Section II.W of the report discusses technologies like 5G that might eventually provide competition to a fiber network.

It's clear that fiber is likely to remain a superior technology to anything else. But that doesn't mean that a competitor couldn't build a competing network to compete for your customers. Many customers are driven more by price than by the underlying technology, and so customers might leave a fiber network for a slower 5G product, if that change could save them money.

Since the city's goal is to have the lowest cost broadband in the country, then technological bypass is less of a risk than in most places. The risk of bypass should decrease if the city set low prices.

E. Implementation Timeline

One of the tasks for this report was to discuss a timeline for building and operating a fiber business should the city move forward.

Typically, the process to move forward after digesting this feasibility study is through tackling several major steps, as follows:

- More research
- Overcome the hurdles
- Make the decision to build fiber
- Raise money

- Build the network and launch the business.

It's impossible to predict the time required for the first four steps. However, I can describe the kinds of steps that must be taken, the decisions that have to be made and the hurdles to overcome. We can talk about the timeline required to build and operate a fiber network.

More Research

This report makes a list of specific recommendations and next steps to take if you want to pursue the idea of building fiber. The main purpose of this feasibility study was to determine if it's financially possible to build and operate a fiber network while meeting the goal of having the lowest priced broadband in the country. The analysis shows that there are financial options that could work.

However, the feasibility study also highlights a number of potential hurdles to overcome before you can undertake this effort. Assuming you want to move forward, the next most important steps are to dig deeper into the major hurdles and determine if there is a reasonable way to overcome them. I think this means That means answering some big questions like:

- What steps are needed to overcome the limitations of Florida law? The city either needs a specific plan that will work under those legal limitations or else create a plan to change the laws. If you decide to fit inside the existing laws, then you are a number of specific questions to answer, such as, can the city reasonably pass a referendum approving a fiber network.
- Is it reasonable to borrow the money? Building a fiber network is expensive and the city needs to explore if you can reasonably borrow the money needed to build the network. This report should enable you to have meaningful discussions with financial advisors. If you are considering building to other cities in the county you ought to see if they might want to contribute funding towards the effort.
- Where to build? The financial analysis shows that the bigger the network the better the financial performance. This is due to economy-of-scale. However, there are issues to deal with if you decide to build outside the city limits or outside of the GRU utility service area.
- What about MDUs? This analysis only looked at bringing broadband to single family homes and to buildings with four or fewer living units. That leaves a lot of residents out of any solution, particularly if the city offers low-price broadband or subsidized digital divide broadband. How does excluding apartments play politically and is there a way to pull apartments into the solution?
- One of the more interesting findings of the study is that it's probably possible to offer both a low-price gigabit product to everybody plus a reduced-price broadband connection to qualifying low-income homes. If you decided to consider this option, then work is needed to define how a subsidized broadband product would work. Who should be eligible? Can you quantify the number of homes that might qualify? What are the rules and the mechanics of a low-income broadband plan?

The results of this research should be actionable plans to overcome hurdles to get the city to the point of being able to decide to move forward.

If you can find a reasonable path past the hurdles, then there is a second round of research that I could label as operational readiness. The purpose of this research is to make sure that GRUCom is ready and able to tackle a major new business line. That might include research such as:

- More market research is needed. This study included a generic survey that asked in general about providing faster broadband on fiber. In order to decide to move forward you probably need to conduct some more focused surveys that explore issues such as specific pricing. You're probably going to want to undertake focus groups and other market research that lets you understand more about how the public feels about your broadband plans.
- The engineering estimates made in this study are high-level. We think they are in the right range of cost, but before undertaking a project this large we recommend taking a second deeper look at the costs.
- There will be other issues discussed in this report that the city might want to explore in more detail before making a decision. For instance, GRUCom could develop a more detailed budget of the costs for operating this business. The forecasts in this study included some high-level estimates that could reasonably be refined with more research.
- You'd want GRUCom to undertake what I call an operational analysis. GRUCom might be tasked with such next steps as:
 - Develop a high-level sales and marketing plan including a budget.
 - Make recommendations on how they might incorporate the needed staff and functions into the existing business.
 - Look in more detail at products and pricing.
 - Explore the technology and vendor relationships needed to make this work. Probably the biggest challenge on the list would be finding an external source of cable TV programming.

Before undertaking this study, the city held a one-day workshop to talk generically what it means to build and operate a retail fiber business. Perhaps the best first step would be to repeat that effort, but this time armed with the results of this study. Such a session could focus on discussing the best next steps to take in the process.

Making the Decision

Armed with all of the above research, and assuming that there is way to overcome the hurdles, the City Commission would be ready to make the go/no-go decision to move forward. We assume that there is a formal process involved in making decisions of this magnitude.

Raise the Funding

In my experience the process of raising funding can take from a few months to a year. The short time frame can be achieved when a city has the clear borrowing capacity to move quickly with a bond issue. The longer time frame might be needed if there is a referendum involved or some other political complication.

Build and Launch the Network

Once funding is received the process of building a fiber network is something that can be planned on a relatively tight timeframe. Assuming that you engage experienced engineers and contractors who have built fiber networks before this is relatively straightforward. However, that comes with the caveat that no two cities are the same. There are going to be local issues that affect the timeline and that will let you go faster or slower than normally expected.

There are a few steps that can be taken that can significantly improve the construction time line. One of the drawbacks of bond financing is that you borrow all of the money up front and then pay interest during the construction process. We've seen cities that undertook some of the engineering preparation before raising bonds. The city could hire the engineers who are going to oversee the design of the network and then work with those engineers to identify the construction contractors. If done properly, construction could commence within a few months after bond closing. There would still be a lag while the construction company lined up crews and order construction materials. Doing these steps up front could shorten the time line included in the feasibility studies by 6 months.

We also assume that GRUCom would tackle many of the step below before bond financing.

There are a number of major categories of tasks to complete to be ready to offer the triple play on your own fiber network. The major groups of tasks are as follows:

Regulatory Readiness. While GRUCom already has some regulatory authority, such as the authority to offer telephone service, there are still some other regulatory matters to complete before you'd be ready to launch a retail triple-play business. Luckily, the list of regulatory requirements has gotten easier in recent years, but there are still a few steps that must be taken.

Product Readiness. You'll want to design the specific products and prices. You want to engage with any vendors needed to provide products and services. The biggest step would be to engage with an outside vendor to provide cable TV on the network.

Staff Readiness. This business effort is going to require hiring new staff and probably in reorganizing the GRUCom. You need a plan to hire and train the needed staff in order to have them on board and ready to serve the first customers.

Software Readiness. GRUCom already owns some of the needed software such as an OSS/BSS system. However, you'll want to get trained in using the retail portions of that software. There are other kinds of software, such as sales software that you've need to identify and install.

Sales and Marketing Plan. Possibly the biggest key to success in launching a fiber business is a successful sales and marketing plan. You want two plans – one for selling to residents and another for selling to small businesses. It's likely that you'll do door-to-door sales for the residential rollout and that you'll train salespeople for consultative sales to businesses. The sales plan also includes the development of things like product literature that explains

your products to customers, a sales-oriented web site, customer documents like price lists and terms of service. You'll also want to develop an advertising plan and strategy.

Process Readiness. Successful fiber businesses develop efficient processes for each step of the customer interface. This includes things like order taking, scheduling installations, properly provisioning each customer with the correct product set, and customer follow-up to make certain customers got what they ordered. None of those process happen spontaneously, and you'll want to define the formal process for each step of the effort so that every employee understands their roles, responsibilities, and authority. There are also processes that follow after customer installation such as the process needed to take and respond to trouble calls from customers.

Operational Readiness. There is a mountain of steps to take that I'd call operational readiness. There are probably hundreds of tasks that must be completed such as buying the needed vehicles or finding and readying a business office. You'll want to define these tasks and make sure that somebody is taking care of everything on the list.

At CCG we are strong proponents of using the Gantt chart process. This is a project management tool that is used to identify every needed task for a complicated project, assign the responsibility for each task and then tracking actual performance. The Gantt chart has the added advantage of putting all tasks on an interactive time line so that you can identify critical path tasks – those tasks that delay the entire implementation of they are finished late. The typical Gantt chart for launching a new fiber business might include a few thousand discrete tasks. The only hope for completing a project of such complexity it to have a formal process like the Gantt chart to make sure that every task is completed and that nothing is missed or forgotten.

Probably the most important date in the timeline is the date of the first customer. Our forecasts assume that you will be able to turn-up a small number of test customers 9 months after the date of funding. While this might sound aggressive, a FTTP network lends itself to being activated in stages. For example, all that's needed for the first customers (assuming you are ready with the items listed above) are that the core electronics are installed at the hub and the first hut is completed in the first construction zone. Once those are in place, you are able to turn up neighborhood PONs as neighborhood fiber is constructed and tested. For example, you wouldn't have to wait until a whole service area around a substation is built with fiber but could turn-up smaller neighborhoods as they are completed and tested.

The other important element on the timeline is fiber construction. In the option of building Gainesville only we assume that fiber construction would be completed 3.5 years after funding. That's an aggressive schedule, but it's necessary to build rapidly so that bond proceeds can be used to connect a lot of the customers.

F. The Opportunity to Create a Public / Private Partnership

One of the scenarios we were to consider for the project is a public / private partnership (PPP). In a PPP, the city would find a commercial ISP partner that is willing to take on a major role in the

business. There are almost endless variations on how a partnership might operate, but there are a few partnership models that have emerged in the marketplace. Following are the most common public / private partnership models we've seen around the country.

Private Operator Only

In this arrangement the city would build the network and would hire a commercial partner to operate the business. The partner in this case might almost better be classified as an operator-for-hire. There are several cities that have chosen this partnership model because they didn't feel qualified to operate a competitive ISP business. They reason that an ISP that is already in the business has the needed systems and processes in place and has the experience and the right mindset to compete in the market.

In this scenario the private operator would typically want to get compensated for operating the business as well as somehow sharing in the success in the business through some sort of profit sharing.

This model is not compatible with the opportunities considered in this study.

- First, a commercial partner would only consider this if there is significant financial upside, and if the goal of the city is to have low prices, then profit margins (and the opportunity for profit sharing) are purposefully suppressed in favor of holding down prices.
- Second, there are not many ISPs with the experience of operating in a market of this size. It would not be surprising to not find any ISP interested in the opportunity. ISPs of this size would rather put their management energy into operating their own networks and businesses.
- Finally, GRUCom already has a lot of the needed expertise. It doesn't make much financial sense to pay a premium price through fees and profit sharing to hire a team to tackle what can likely be tackled at a lower cost instead by GRUCom.

Bottom line, this particular partnership model doesn't make sense for the city.

Private ISP Leases the Network

In this scenario the city would construct the network and would lease it to an ISP to operate. The ISP would guarantee to make bond payments, but otherwise the city would have no role in operating the network. The ISP would operate as they see fit, with their only obligations to make the bond payments. One variation of this partnership model is that the private partner might be expected to contribute some capital, such as the cost of the electronics at a customer's home.

There are a number of reasons why this model doesn't mesh with the city's goals:

- There are very few ISPs that are large enough to reasonably guarantee to make bond payments. This is the model between Google Fiber in Huntsville, that for many reasons fell apart within a few years of getting started. This is the model also used with Ting in markets like Charlottesville, Virginia.
- This model does not support low prices. The ISP is taking a lot of risk by guaranteeing the bond payments, and they are likely to offer products at, or even above market rates. For

example, Ting participates in this model in several cities and has only one broadband product priced at \$80 per month. If the operating ISP guarantees the bond payments, they are going to set prices to make it certain they can meet that obligation. Above that, an ISP would only accept this model if they believed they could make a lot of profit.

- Ultimately, if the venture fails, the network ends up back in the lap of the city with a defunct operator. This is what happened in Provo, Utah which leased the network to an ISP that failed. From a financial perspective the city will still have to guarantee the bond payments regardless of the performance of the ISP.

This PPP model doesn't meet the goal in the city for providing low prices.

Private Operator with Some Funding Obligations

In this scenario a true partnership is formed between a city and an ISP. The city will bring some of the financing for the network as will the private ISP. Typically, the ISP would operate the business, but as a true partnership the city would have some say in the operation of the business.

There are reasons why this scenario would be a challenge:

- There might not be any partners willing to tackle this for a market as large as Gainesville. The examples of this kind of partnership are more typical in small markets. There are not many private ISPs that have the cash needed to fund this kind of partnership in a larger market.
- The operating partner in this scenario is going to want to make a good return on their equity – typically 20% to 30% minimum. That is not a compatible goal with trying to offer low prices or in offering digital divide products.
- It's exceedingly hard to create a true partnership between a city and a commercial ISP. Almost by definition each party has a different set of goals for the business and it's hard to create a business scenario that satisfies both parties. ISPs are also going to be leery for partnering with a city because they understand that politicians change over time and the folks they initially partner with will not be there for the long-run – so the ISP is taking a big gamble that the political environment will not become incompatible over time.
- The city also takes a risk that the ISP will survive over the life of the funding period. There are almost no independent ISPs with a long operating history.
- This arrangement probably would still require the city to provide most of the funding, meaning that the city is likely still going to be the party ultimately responsible for covering losses.

This model also wouldn't help the city meet the goals of low-price broadband. Low prices are not compatible with an ISP's goal to make a profit.

Private Funding Partner

In this scenario some private entity would fund and own the fiber network and the city would operate it. This is almost the exact opposite of the other kinds of partnerships.

There are no examples of this kind of partnership today for broadband, although this kind of arrangement is common for other kinds of municipal ventures.

There are both positive and negative aspects of this kind of partnership:

- On the plus side, this means that the network could be constructed without needing bond funding from the city. One of the big hurdles of doing this project the conventional way is the size of the bond funding required.
- Another plus is that this bypasses the Florida law since the city is not building or owning a broadband network.
- A third positive is that the network can be built to commercial standards, meaning no use of RFPs, negotiating with vendors for good pricing, etc.
- The city would be the operator of the network, essentially the operator-for-hire. This would give the city a considerable amount of say in how to operate the network. The city would have some say in pricing, but could not set prices so low as to threaten
- The city also might earn some profit sharing, although that possibly could instead be directed towards the digital divide product.

It's an interesting concept. There are two funding mechanisms that might work in the circumstance. One would be private activity bonds that would be sold to large institutional investors. The second possibility is to somehow take advantage of the new Opportunity Zones. This is a just-emerging market, but it appears there will be billion-dollar funds looking for investment opportunities. There are also endless permutations on this idea that would create more of a partnership. For example, a partner might bring most of the financing while the city guaranteed a debt service reserve fund.

The bottom line of this idea is that it might be a way to overcome the major hurdles to building a broadband network. The idea also might allow for some lowering of broadband prices, but probably not as low as if the city funded the network directly. For example, perhaps this scenario would result in \$60 gigabit pricing instead of \$50 gigabit pricing.

We did not create a model for any of these partnership opportunities. Our conclusion is that the more typical kinds of partnerships are not compatible with the city's goals of offering low broadband prices. While there is some chance that finding a financing partner might achieve the goals, that's nearly impossible to model without having a partner at the table – there are too many permutations on how this might work.

G. The Connect America Fund

The Connect America Fund is part of the FCC's Universal Service Fund and is aimed at improving broadband in rural parts of the country. 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 Connect America Fund II (CAF II) fund was made available to the large telcos in the county. Nationally the fund distributed \$1.7 billion per year for the 6 years starting with 2015 to build or

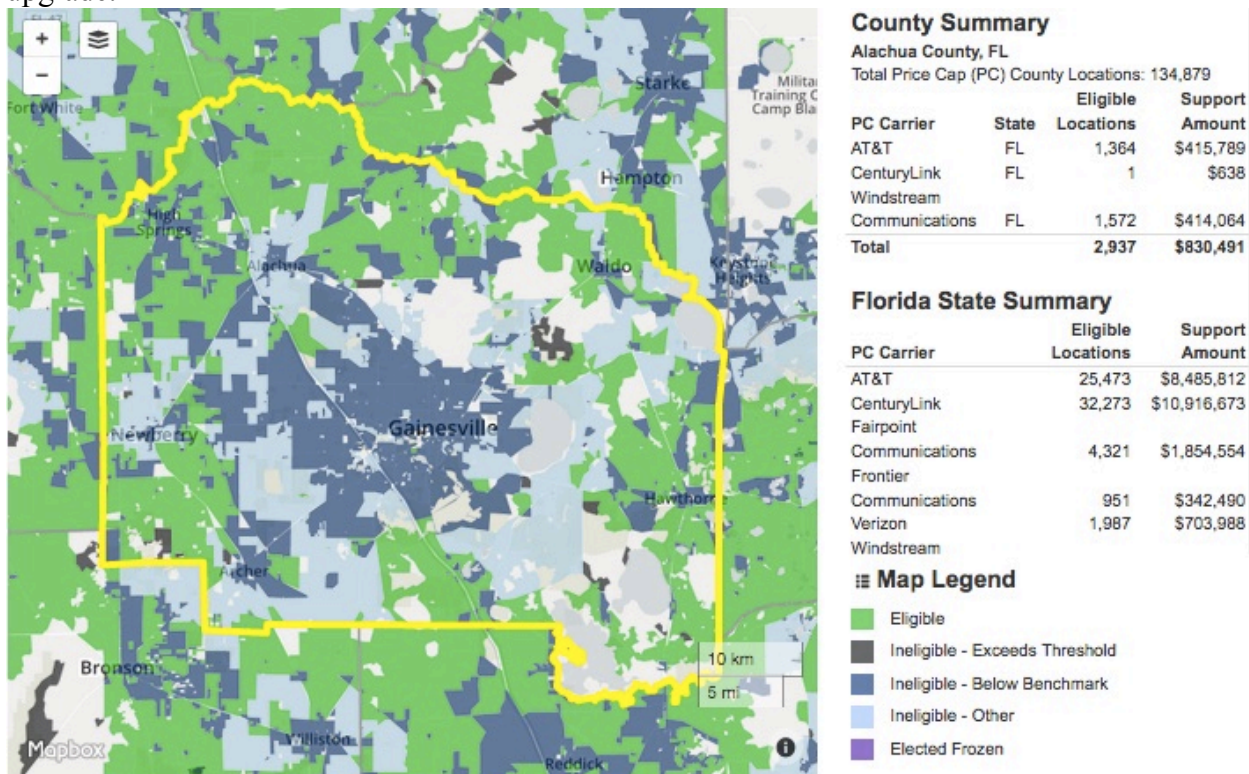
upgrade rural broadband. These funds were made available to census blocks that have little or no broadband today.

The FCC awards in the county were as follows:

- The FCC awarded \$830,491 per year for 6 years (\$4,982,946 in total) to expand broadband in Alachua County.
- AT&T accepted funding of \$415,789 per year, or \$2,494,734, to bring better broadband to 1,364 rural households in their service area.
- Windstream accepted \$414,064 per year, or \$2,484,384, to bring better broadband to 1,572 rural customers.
- CenturyLink accepted \$638 per year, or \$3,828 to bring faster broadband to 1 rural customer.
- This is a significant investment to make in the county and is about \$1,696 per household.

These funds are being distributed to the telcos over 6 years, with the final year being 2020. There are buildout requirements and the telcos should have upgraded at least 60% of the customers in the whole state as of the end of 2018. That doesn't mean that they would have upgraded that many in the county. The upgrades are supposed to all be done by the end of 2020.

In the map below, the areas shown in green are the places that should be seeing the broadband upgrade.



Summary of Section IV

Competitive Response from Incumbents

We predict a significant response from AT&T and Cox if the city decides to build a retail fiber network. Those companies might pursue legislative and legal ways to stop such a project. They will campaign vigorously against any referendum vote. They would take full advantage of Florida law and would intervene continuously and loudly in the process of approving and funding a network. They would also continue to monitor and create bad press against the project.

SWOT Analysis

We looked at the existing strengths, weaknesses, opportunities and threats associated with starting a retail fiber business in the city.

Strengths. The biggest strength for tackling a retail fiber business is that GRUCom already operates an extensive fiber network and has the technical knowledge and skills needed to tackle the deployment of a retail fiber network. GRU as a utility also already has the experience and systems designed to support a large residential and small business base of customers.

Weaknesses. One of the biggest concerns is that the city currently doesn't operate any competitive businesses at the retail level. One must always ask the question of a city can be nimble enough to be a competitor in the telecom business.

There are also inherent aspects of being a government entity that add challenges to undertaking such a large undertaking. For example, financing a fiber network with bonds can add significantly higher interest costs due to having to borrow the full cost of the network upfront and due to having to borrow the funds needed to make interest expense payments during the first several years of the project. Municipal purchasing practices can also add to the cost of the constructing a network compared to a commercial builder that is freer to negotiate prices.

The surveys also indicate that there is a sizable segment of households that dislike the city as a provider of services, meaning that a city-owned fiber business might have to overcome built-in bias against trusting the city.

Opportunities. The analysis shows that it is possible to successfully operate a profitable fiber business in the city while also offering low prices. Such an opportunity is not a slam dunk and there are numerous hurdles to overcome to operate a retail fiber business successfully – but the numbers show it can work.

We know from experience that having a municipal fiber network lowers prices for everybody in the market. If the city offers low-price broadband the savings for the community could be gigantic.

The city also has the opportunity to be one of the first ones to tackle the digital divide. Almost every city that builds fiber has that high on the list as a reason to build the network, but we're not aware of any city that has tackled getting affordable broadband into homes that can't afford current market prices.

There are a huge number of benefits to the community from better broadband. One of the biggest is the economic development and economic stimulus that we think would result from providing gigabit service to everybody. There is also the immediate benefit of lower rates – broadband rates should drop for everybody in the City.

Threats. Past experience tells us that you are likely to see a significant response from both Cox and AT&T if you undertake building a citywide gigabit fiber network. Those companies may try to thwart the effort with legislation or lawsuits. Both would likely beef up their network and AT&T might even build fiber to selected neighborhoods to make it harder for the city to succeed.

The current legislative restrictions in Florida present a number of hurdles for the city to overcome. The incumbents will be watching closely to make sure that the city fully complies with those laws.

It's likely to be a challenge to raise the needed funds. We estimate bond issues of between \$113 and \$213 million to fund the various scenarios.

It's almost certain that the city would have to pass a referendum to approve the bonds to build fiber. It's worth noting that the proposed fiber would only directly benefit single family homes and those living in townhouses, duplexes and small apartments with fewer than 4 units. While the current GRUCom fiber network is bringing big bandwidth to many apartment buildings, the actual method and cost of providing broadband in apartments is generally decided by the landlord. The city does not have the authority to build fiber to apartment units without the permission of the property owner. It's hard to imagine a scenario where the city can offer low-cost digital divide products in apartment buildings.

There are also performance risks for anybody undertaking a new business of this magnitude. There have been notable failures by both municipal and commercial fiber overbuilders and there is no guarantee of success. The sensitivity analysis conducted as part of this study show that changes in key variables can have a big impact on the financial performance of the business – so it's essential to fully understand and try to control those variables before launching a new broadband business.

One of the biggest challenges for a new business will be gearing up to be able to install significant numbers of customers. We estimate that the number of customers that must be installed monthly varies from 550 in the Gainesville-only scenario to 850 if the city tackles the full footprint including the small cities.

We also know from experience that there is risk if a municipal fiber business is not shielded from politics. If future politicians can influence or change rates for the business, then it's always at risk for underperformance.

There is also risk from other technologies. While none are as good as a fiber connection, there are likely to be future technologies that might lure some percentage of the market.

Funding Options.

The most likely source of revenue for building fiber is municipal bonds. Florida statutes suggest that the project should be funded with revenue bonds, and we don't think there is a market today for selling pure revenue bonds.

The size of the needed borrowing is likely to be a hurdle. The size of the bond funding, using general obligation bonds ranges from \$113 million to build fiber in the Gainesville city limits to over \$213 million to build fiber to all populated parts of the county including the small cities.

We don't think there is any realistic possibility of creating a public / private partnership. We find it unlikely that a partner will be interested in a business where the primary goal is to provide low-price broadband. Commercial ISP partners would instead be seeking high profits.

Timeline

The nature of bond funding makes it mandatory to build and add customers to a new network as quickly as reasonably possible. Since bonds borrow the full cost of the project up front, it's necessary to add enough customers expeditiously in order to be able to make the bond payments by the end of the use of bond proceeds. The need to move quickly is going to be a significant challenge. It's possible to speed up the timeline by undertaking some of the selection of vendors and some of the engineering effort before bond funding. It ought to be possible to add the first customers to a new network within 9 – 10 months after funding, although significant customer additions wouldn't occur until the second year.

Public / Private Partnership Opportunity

We believe that the goal to have low gigabit broadband prices would make it difficult to partner with a commercial ISP. Low prices pass margins back to customers while a private partner would be looking for an opportunity to make profits.

Appendix I – Business Plan Assumptions

Following are the major assumptions used in creating the business plan forecasts. for each of the primary business models.

To repeat what's been mentioned before, there are four sets of studies that look at four different geographic footprints, as follows:

- Gainesville City Limits. This covers everything inside the city limits but excludes the University of Florida. The University already provides broadband within the campus boundaries.
- GRU Service Area. This covers the city limits plus all areas where GRU currently provides utility services.
- Urban Reserve. This includes the GRU Service area plus an area in the county with significant housing density that was defined by the city in the ITN document that defined the study. In this area we considered areas that have current housing and did not include undeveloped rural areas.
- Adding Small Towns. Finally, the largest study area looks at the developed parts of the cities of Newberry, Hawthorne, Archer, High Springs, Wald, and Alachua. In all cases GRUCom already has a fiber presence in these cities.

All of the scenarios consider bring fiber to residential customers and small businesses in the city. In all cases the studies exclude large MDUs (multi-dwelling units) which are apartment buildings and condominium buildings with more than four units. Larger apartment buildings are excluded because the city already reaches many of them through the existing fiber network. Owners of large apartment buildings generally choose the method by which residents get broadband and many apartment owners now include broadband in the rent.

The studies include single family homes, duplexes, townhouses small apartment buildings with four or fewer units. From a network and sales perspective all such living units would be treated identically, with fiber connections made to each living unit and marketing done directly to the residents.

The studies also exclude most of the customers and entities already served on the existing GRUCom fiber network. GruCom is a complex telecom business today and engages in a number of different lines of businesses. We expect that most of the business done by GRUCom would remain on the existing network.

GRUCom has been providing retail telecommunications services since 1995. Services provided by GRUCom include Internet and data transport services to local businesses, government agencies, multiple dwelling units ("MDU") housing communities, various Internet service providers, and other telecommunications carriers. Additional services provided by GRUCom include tower space leases for cellular providers, public safety radio services for all the major public safety agencies operating in the County and collocation services in the System's central office. GRUCom is licensed by the Florida Public Service Commission as an Alternative Access Vendor and as an Alternative Local Exchange Carrier.

The services provided by GRUCom fall primarily into the following five major product lines: telecommunications services; Internet access services; communication tower antenna space leasing; public safety radio services; and collocation services.

- The telecommunications services provided by GRUCom are primarily Private Line and Special Access transport circuits delivered in whole, or in part, on the GRUCom fiber optic network. These high bandwidth circuits are capable of carrying voice, data or video communications. Private Line circuits are point-to-point, unswitched channels connecting two or more customer locations with a dedicated communication path. Special Access circuits are also unswitched and provide a dedicated communication path, but these circuits connect a customer location to the Point of Presence of another telecommunications company. GRUCom transport services are provided at various levels ranging from 1.5 Mbps to 10 Gbps. Part of GRUCom's business strategy is to use unbundled network elements from the incumbent local exchange carrier, AT&T, in anticipation of fiber extensions to specific service locations.
- GRUCom also uses the fiber optic network to provide high speed Internet access services. Business Internet and Dedicated Internet Access ("DIA") class service connections are offered at access speeds ranging from 10 Mbps up to 10 Gbps and bulk residential Internet access service is provided to participating MDU communities at speeds up to 1 Gbps under the brand name GATOR NET. In 2017, GRUCom upgraded its bulk GATORNET services to deliver Symmetrical bandwidth, a first in the Gainesville area.
- GRUCom operates eleven communications towers in the Gainesville area and leases antenna space on these towers as well as on two of the System's water towers, for a total of thirteen antenna attachment sites. Wireless communications service providers lease space on the towers and, in most cases, also purchase fiber transport services from GRUCom to receive and deliver traffic at the towers. GRUCom provides transport services that carry a substantial portion of cell phone traffic in the Gainesville urban area.
- Two of the five transmitter sites for the countywide public safety radio system are also located on these communications towers. The GRUCom public safety radio system began operation in 2000. These services are provided over FCC-licensed 800 MHz frequencies, that is compliant with the frequency allocations enacted by the FCC in 2010 to accommodate personal communication services ("PCS") providers. The trunked radio system meets current industry standards for interagency operability. The trunked radio system consists of 22 trunked voice frequencies. Antenna sites are linked to the network controller and various dispatch centers utilizing GRUCom's transport services.

In the industry, much of what GRUCom sells would be described as wholesale sales – which are sales of fiber products and services to other entities that then serve end-user customers. The sales of services to entities like cellular carriers, telephone companies, competitive carriers and ISPs would fit the wholesale category. GRUCom also provides retail services today to businesses, apartment complexes, and to all branches of the city and the utility.

CCG works nationwide and is aware of most similar municipal fiber networks. We believe that GRUCom drives far more revenue from its fiber network than does any other city that does not provide retail services to residential customers.

Again, the studies assume that most of the revenue on today's fiber network would remain on that network, although there are likely some businesses on today's network that might be attracted to the lower-price shared broadband products that are contemplated in this study.

There are four separate studies considered that cover different geographic areas, as follows. These areas are shown on maps included in Appendix IV through Appendix VIII.

Retail ISP

All scenarios assumed that GRUCom would become a retail ISP for residential customers and small businesses. GRUCom already today acts as the ISP for the city, the utility and for many businesses in the city. GRUCom already operates an extensive 550-mile fiber network.

Incremental Analysis

All studies were conducted as an incremental analysis that determined the new revenues, the new expenses, the new debt, and the new capital required for each scenario. and expenses that would be incurred by the new business. This is the same way that commercial ISPs consider new business opportunities – they see if a new venture will pay for itself. This means the studies do not show the impact of combining the revenues and expenses with the exiting fiber business.

From a financing perspective the scenarios all assume a separate financing just for this project. The main ramification of this assumption is that the projections predict that excess cash generated by the business remain with the business. While that probably wouldn't happen in actual practice, it's important to recognize the overall impact to GRU from excess cash by assuming interest income on excess cash. Again, this is a standard method of analyzing opportunities used by commercial ISPs.

Revenue Assumptions

Services Considered

All of the scenarios look at a retail ISP business and consider the following products. Note that the studies look at scenarios for subsets of these products. We considered three different product scenarios a) the triple play of broadband, cable TV and telephone service, b) the double play of broadband and telephone service, and c) broadband only as a standalone product.

High-Speed Bandwidth. The network designs in our analysis had the goal of being able to deliver a gigabit of broadband to every customer. Most of the scenarios we considered provided a gigabit of broadband to every residential customer and a more traditional array of different bandwidth products for businesses. We did consider a scenario where residential customers also were offered a more traditional tiered set of multiple bandwidth products.

Traditional Telephone Services. GRUCom is in the process of activating a traditional telephone switching platform referred to in the industry as a smart switch. GRUCom plans

to use the smart switch to provide voice services to the city and also to offer to carriers and existing broadband customers. The existing switch is capable of providing a wide array of voice products for residential and small business customers.

Cable Television. The studies consider offering cable TV as a retail product. The surveys showed a strong preference by the public for including cable TV in the service offering.

The studies all assume that cable TV would be purchased from some other cable provider on a wholesale basis. The alternative to this would be to build a cable TV headend, which would cost more than \$3 million and that would include all of the electronics needed to receive programming signals from satellites and transmitting the product to customers. Since the penetration rate nationally for cable TV services is dropping due to cord cutting it doesn't seem justified to consider building a new cable headend in the city.

Managed WiFi. Most ISPs now offer managed WiFi, which means that the ISP installs and controls the WiFi router and network at the customer premise. It has become obvious to ISPs over the past few years that a large percentage of the problems experienced by customers are due to poor WiFi routers in the home rather than quality issues of the broadband connection.

With managed WiFi an ISP installs a high-quality WiFi modem. If a house is large, they install a meshed network of several WiFi routers. A side benefit of having WiFi routers connected to the ISP is that it's possible to monitor broadband performance within the home or business. This saves service calls because the ISP can fix problems, often before the customer even knows there is a problem. This also reduces truck rolls since the ISP is more easily able to identify inside versus outside problems.

The forecasts assume rates for managed WiFi of \$7 for residential customers and \$10 for business customers. While this product is optional, we know ISPs that have already gotten more than a 70% penetration for this product.

Other Future Products. Today many ISPs are expanding their product lines to add additional product lines that rely upon broadband. Perhaps the best example of this is Comcast. They now offer a wide range of new products. For example, they have sold home security monitoring to many millions of customers. They are now probably the largest single nationwide provider of smart home products and they have a line of products such as smart lighting, smart watering systems, smart door locks, smart thermostats, etc. Comcast has recently begun testing a cellular product and announced that they already have over a million customers.

We find it likely that any ISP operating a fiber network in Gainesville will eventually offer some of these same kinds of products along with products that have yet to be developed. This could include things like medical monitoring to help the elderly live in their homes longer. It might involve intensive gaming, including support for virtual reality and holograms.

It's impossible to build a business case for future products, but it's reasonable to believe that any sizable ISP will offer new products over time. The business plans incorporate a generic revenue for "new products" which is undefined.

Internet Services (ISP, email, web hosting, security etc.). These products were not included in the studies. It was traditional in the industry for an ISP to provide all services related to the Internet as part of their ISP service. This included such things as email, web page development and storage and other Internet related services. A decade ago there was also a booming ISP business line of providing off-site storage for customer data.

Most ISPs no longer offer services like web site development and storage. While ISPs take steps to make sure their networks are safe and free of viruses and malware, few ISPs sell security as a service. Most small ISPs have decided that their primary function ought to be maintain a network designed to provide minimal downtime and leave these various ancillary services to somebody else.

The Challenge of Setting Rates

It's always a challenge to set rates for a broadband feasibility study for various reasons:

- It's hard to know the "pricing philosophy" up front. ISPs price in different ways. Some set what they consider to be simple rates and don't vary from those rates. Others set rates but are willing to "negotiate" with customers to get their business. Others develop complicated rates and may try to match the incumbents by having numerous different bundles of service.
- It's often hard to understand the rates charged by the competition. Consider something as simple as a home landline telephone. Incumbent providers tend to disguise the real cost of their voice products on bills. For example, there are usually several "fees" listed on telephone bills that customers might perceive to be taxes, but which are actually part of the cost of the service. are part of the telco revenue but which are made to look like external taxes or fees. Telephone service also can be included in a bundle with other products, with the customer not knowing what they pay for any one service.
- Not all potential customers pay the same rate. Many customers will have taken advantage of specials or promotions to get temporarily low rates. Other customers call in yearly to negotiate for lower rates. Interestingly, it is the long-term steadiest customers of the big companies that typically pay the most.
- There are often "grandfathered" products, meaning products that a customer purchased years ago but which are no longer available to a new customer.

Our studies take the approach of setting what we think are simple rates that are reasonable for the market. The goal with pricing at the feasibility study level is to get a reasonable range of revenues. If a company was ready to launch a broadband business and had specific bundles in mind, then we'd match them. But at the feasibility study, the more complicated the rate structure the more chance for developing a bad estimate.

When clients ask us, we also recommend that client adopt a simple pricing structure. There are numerous benefits to an ISP of having simple rates:

- It makes life easier for customer service reps and other employees if everybody pays the same rates.
- It's easy to advertise simple rates – “Our rates are the same for everybody, no gimmicks, no tricks, no hidden fees.”
- It eliminates the option for employees to discriminate among customers. This is especially important for a city. Nobody wants to deal with finding out that some churches in the city got far lower rates than other churches or that friends of politicians have lower rates.
- It makes it easy to bill. We've often found during audits that customers sometimes aren't billed for all of their products when the product structure is complicated and confusing.
- It's a lot easier to provision a new customer. As an example, most of these studies assume that all customers get gigabit broadband. We contrast that with a city we encountered a few years ago that allowed for “design-your-own-speeds” and that was literally selling hundreds of different combinations of download and upload speeds at a huge array of prices.
- It eliminates the process of having to negotiate rates annually with customers. There is a subset of customers in every city that will come and go to ISPs based upon the latest special pricing. It's costly to add a customer to a fiber network and we recommend not chasing these customers who will buy a service for a year and then bounce back to the incumbent. In the short-run you're better off without them – and in the long run many of them become your customers anyway.
- It's easier on customers. Customer appreciate simple, understandable bills and they don't like the idea that their neighbor might have negotiated a cheaper price than them.

With that said, following are the specific revenue assumptions used in the forecasts.

Broadband Rates

There are two basic kinds of broadband products – dedicated broadband and shared broadband. A dedicated broadband customer gets an allocation of broadband that is dedicated to them, meaning they are the only customer using their data connection. Dedicated broadband can be dedicated just on the local network or can be dedicated the whole way to the connection to the Internet. A good example of a connection that is shared only on the network might be a chain of grocery stores that want a dedicated connection between every store in a market. They would buy a dedicated connection to each store and the ISP would then tie all of the stores together at a hub location. This would allow the store chain to manage their own data connections. They might safely share data between stores; they might put all of the stores on a voice over IP network for telephone communications.

The other kind of broadband is shared, meaning that different customers share the same overall bandwidth pipe. The basic broadband products sold by the telephone company, cable company or over a normal fiber network are shared.

The sharing is done in different ways. In both the fiber and cable networks customers are physically separated into nodes, and all of the customers in a node share the bandwidth. In the fiber network we've designed for the city most of these nodes are small and would have between 16 and 32 customers sharing 2.4 Gigabits of data speed. In a cable network the nodes are generally larger,

probably averaging at least 100 customers in most networks, but the data connection to the node is also likely larger.

Sharing does not mean there is no security. In a fiber network every customer is served with an encrypted virtual private network connection that is incredibly hard to hack. We've never heard of an example of a customer on a PON network being hacked at the network connection level. What's shared is the amount of bandwidth available to a customer, but each customer still maintains a secure and separate connection.

The amount of sharing in a network is referred to as oversubscription. If you are told that a network has an oversubscription of 100, that means that 100 customers are sharing the same local data connection. A few years ago, it was common for cable company networks to bog down in the evenings when many customers were using the network at the same time. The cable companies solved this by reducing the number of customers in a node.

Setting the price of broadband for a new ISP is always one of the hardest decisions they have to make. It can be tempting to set prices far below incumbent rates in order to attract the most customers. But doing so leaves a lot of margin on the table. We also know that incumbents often lower their rates to match and eliminate an advantage of a competitor. Most competitive ISPs generally charge rates that are only a little lower than the incumbents.

The pricing for residential broadband in these studies is simple. In most scenarios we begin with the assumption that all customers get a symmetrical gigabit of broadband speed (symmetrical means the same download and upload speed). In the base studies we chose a price of \$50. This is obviously significantly below the market rates for broadband, but it reflects our interpretation of the goal of these studies, which is to find if there is a way to offer the lowest broadband prices in the country in Gainesville.

In various versions of the studies we then considered other rates. For example, for each scenario we also considered a residential broadband rate of \$60 for a gigabit.

We also considered a scenario where the city offered market-price broadband for residential customers. For that option we considered a three-tier pricing structure as follows:

<u>Speed</u>	<u>Price</u>
Tier 1	\$50.00
Tier 2	\$65.00
Gigabit	\$80.00

We didn't specify the speeds of the products – something that would be determined when the business goes to market. If this was launched today, the first tier might be set at 200 Mbps to match Comcast's new base speed and tier 2 set at something like 400 Mbps or 500 Mbps.

We also considered what we called digital divide pricing. One of the stated goals of the project was to see if there is a way to get broadband into all of the homes in the city, particularly homes

with school students. To try to satisfy that need we looked at a two-tier pricing structure – a regular market price and a low-price for low-income homes that qualify to buy subsidized broadband.

The digital divide analysis considers prices like \$50 regular / \$20 digital divide; \$60 regular / \$20 digital divide and \$70 regular / \$20 digital divide. We also looked at other options. For example, we looked at one scenario where we set the regular price and then determined how low we could drive the digital divide price and still break even. We also look at what we called the breakeven price - the lowest price we could charge to everybody in the city and still have a solvent business. The various options digital divide options and results are described in more detail in above in Section A above.

For small and medium businesses, we set broadband rates at:

Tier 1	\$60
Tier 2	\$75
Gigabit	\$90

Most ISPs charge higher rates for businesses for several reasons. First, businesses have historically paid more to the incumbent providers and expect to pay a higher price. In general, business customers also tend to use more bandwidth than residential customers due to often having more simultaneous users of the network during the business day.

The forecasts include future rate increases for broadband. We increased rates by 5% every 5 years. That equates to an annual rate increase of less than 1%. It's important to predict rate increases in the studies because a broadband business is like any other business and needs to keep up with inflation of expenses over time.

Over the last decade it has been common in the ISP industry to not raise rates, but that is changing. ISPs are now regularly raising broadband rates. For example, we saw Charter, the second biggest cable company, raise broadband rates by \$5 per month late last year – the biggest increase in broadband rates we can remember.

The big ISPs are starting to feel earnings pressures. They are now losing cable TV and landline voice customers at a steady pace. They are seeing drops in TV advertising revenue as they lose cable customers and as the average age of cable viewers grows older each year.

The big telcos and cable companies have posted increased earnings each quarter for many years due to the ever-growing number of broadband customers in the market, but overall broadband penetration is now over 85% of all households and the rate of annual customer growth has slowed – we are nearing a time where everybody that wants broadband will have it.

Since the big cable companies and telcos are publicly traded companies they will do everything possible to maintain their stock prices. That means that broadband prices will have to increase. The primary Wall Street analyst for Comcast predicted last year that Comcast would raise basic broadband rates to \$90 over the next 5 years. We've already started to see a few big cable

companies cut back on the amount of “special” pricing they offer to customers as a way to increase revenues.

We also see Comcast, Cox and a few others starting to enforce their data broadband cap. Cox has a monthly data cap of 1 terabyte of broadband usage (uploading and downloading combined) for a residential customer. The company charges customers \$10 for every 50 GB over the cap, with a total ceiling in monthly charges set at \$50 extra over the price of the broadband.

The company OpenVault measures broadband usage for big ISPs and they recently reported that 4.12% of homes nationwide exceeded a terabyte of data usage per month in 2018, almost double from 2.11% in 2017. OpenVault reports that the total amount of data used in homes is growing rapidly. They recently reported that the average monthly data use for households grew from 201.6 gigabytes in 2017 to 268.7 gigabytes in 2018 – a growth rate of 33%. The company also reported that the medium use per household grew from 103.6 gigabytes in 2017 to 145.2 gigabytes in 2018 – a growth rate of 40%. The medium represents the midpoint of users, with half of households above and half below the medium.

To some degree these statistics are not news because we’ve known for a long time that broadband usage at homes, both in total download and in desired speeds has been doubling every 3 years since the early 1980s. The growth in 2018 is actually faster than that historical average and if the 2018 growth rate was sustained, in 3 years usage would grow by 235%. What I find most impressive about these new numbers is the magnitude of the annual change – the average home used 67 more gigabytes of data per month in 2018 than in 2017 – a number that would have seemed unbelievable only a decade ago when the average household used only 25 gigabytes of data per month.

We’ve now reached that point when the terabyte data caps are starting to have teeth, and over the next few years a lot of homes are going to pass that threshold and have to pay a lot more for their broadband. We’ve assumed no data cap for the city’s broadband products.

Telephone Rates

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

<u>Residential Rates</u>	
Basic Local Line	\$15.00
Line with Unlimited Long Distance	\$25.00

We’ve assumed that both kinds of lines include a full package of features like voice mail, caller ID, etc. AT&T offers features in packages but still also offers these features a la carte, which can drive up the cost of a monthly bill.

There are no extra telephone “fees” in the above suggested prices. Both Cox and AT&T charge fees that are actually part of the local rate. Customers often assume these fees are some kind of tax.

We have not assumed any long-distance revenue on top of the basic lines. Many our clients no longer sell long distance by the call since it's expensive to track and bill the calls. We've found that most people now use cellphones to make long distance calls and customers rarely rack up large long-distance bills on home phones like happened a decade ago. Our assumption is conservative and adding long distance would a little revenue and cost that wouldn't change the bottom-line answer much.

Our models include the following rates for business telephone service:

<u>Business Rates</u>	
Basic Local Line	\$35.00
Line with Unlimited Long Distance	\$45.00
Business Trunk Line	\$42.00

These lines would also include the features desired by businesses. In addition to features like caller ID and voice mail, customers could also have "business" features that let them use business telephone sets that perform functions like putting calls on hold, transferring calls, etc.

Trunk lines are lines sold to customers that operate their own small telephone switch, called key systems of PBXs. These switches allow efficiency for the customer by sharing lines. For instance, they might buy eight trunk lines to support twenty phones on desk, if they know that no more than 8 employees are likely to be calling outside the business at the same time.

The studies do not include the sales of telephone products to existing customers on the current fiber network and only consider sales of telephone service to new small businesses that would be served on the new PON fiber network, We've assumed that the new average small business has 2.5 telephone lines. This is likely a conservative assumption

We've also excluded PRIs from the studies. These are T1 lines that can carry up to 24 telephone calls at the same time. These are generally sold to medium-sized and larger businesses that have a number of employees. We've assumed PRIs would be provided across the existing fiber network. This is another conservative assumption since there will probably be PRIs carried on the PON network.

Our assumption in the study is that the basic line would have the same limited local calling scopes that exist in the county today. Today customers in each of the many telephone exchanges only get free calling to a small number of other places, as shown below. Customers must pay long distance to call anywhere else on their landline. Following are the long-distance calling scopes for the exchanges in the county today.

<u>Exchange</u>	<u>Phone Company</u>	<u>Can Call for Free</u>
Alachua	Windstream	Brooker, Fort White, Gainesville High Springs, Lake Butler, Newberry
Archer	AT&T	Bronson, Cedar Keys, Chiefland,

		Gainesville, Micanopy, Newberry, Willison
Gainesville	AT&T	Alachua, Archer, Bronson, Brooker, Cedar Key, Chiefland, Cross City, Fort White, Hawthorne, High Springs, Keystone Heights, Lake Butler, McIntosh, Melrose, Micanopy, Newberry, Old Town, Trenton, Waldo, Williston
Hawthorne	AT&T	Gainesville, Melrose, Micanopy
High Springs	Windstream	Alachua, Branford, Fort White, Lake City, Newberry, Trenton
Newberry	AT&T	Alachua, Archer, Bronson, Gainesville, High Springs, Trenton
Waldo	Windstream	Brooker, Gainesville, Keystone Heights, Lawtey, Melrose, Starke

Cable TV Rates

The primary issue with selling cable TV service is that programming costs—the costs to buy all of the content on a fiber system—are very expensive, meaning that the product line doesn't have a lot of margin. Further, programming costs have increased an average of 15% annually over the past 5 years – far faster than the rate of inflation. The programming cost increases are the reason that cable companies raise cable rates every year. Most of our clients raise cable rates each by enough to offset the programming cost increases.

From a modeling perspective this causes a dilemma. If we show big increases in programming costs each year then we also need to show the rate increases needed to offset the higher costs. Since there are multiple cable products it easy to end up distorting the model by raising retail rates at a different rate than is needed. We don't want to distort future financial results by having the programming rate increases and the resulting retail rate increases to get out of synch and distort future earnings.

We elected to address this issue by showing zero increases in both programming and retail cable rates. We assume instead that if the city was in the cable business that you would raise retails rates every year to offset the cost increase. By doing so you would maintain the current margin on the cable product. Our models achieve that same result by maintaining the current margin.

Because of the low margins on cable, most competitive providers don't try to compete with lower-than-market prices for cable TV. They instead set cable rates at, or even above the rates charged by the incumbent cable company.

We still think that you probably need to offer a cable product in order to be competitive. We look back just a few years ago to when Google Fiber launched a fiber network with no cable and no telephone product. They were getting miserably low customer penetration rates and amended their offering to add a cable product. The survey we did for Gainesville shows that cable is still an important product in the city. Those survey results are overinflated to some degree by the practice where Cox has forced a bundle of products in order to buy broadband. But even accounting for that, a large majority of customers in Gainesville are still interested in buying a traditional cable package.

Like with telephone service, we assumed that GRUCOM would not have separate or hidden fees. Cox has fees for local broadcasting and for sports programming that are part of the cost of buying cable TV but are shown separately on the bill. We've assumed GRUCOM would roll those into the basic rates.

The models make the following assumptions for the cable products. The models assume the same products for residents and businesses. We note that Cox has higher cable rates than most of the other big cable companies.

Basic Cable: \$35. This is the line-up of network channels like ABC, NBC, CBS, FOX, and PBS plus a few other local channels.

Expanded Basic: \$80. This includes about 75 channels. It includes the basic lineup and adds the most popular cable networks like ESPN, Disney, the Comedy Channel, etc.

Digital / Premium: \$110. This would include over 200 channels and will basically match the top tier offering by the satellite or local cable companies.

Movie Channels: These are extra, and the models assume that the rates charged for these networks just barely cover the cost of buying the programming (which is true for cable providers today).

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

DVR Service: We've assumed a monthly fee of \$12 for DVR service, or the ability for a customer to record shows. This would be equivalent to the fee charged by a company like TIVO or the cable companies.

Settop Box Fees: The models assume there will be a \$5 monthly charge for each cable settop box. Cox currently charges \$10.00 per box.

Future Products

There are going to be new revenue opportunities over time that arise from having a fiber connection in homes. This might include such things as security, energy management, home automation, the

Internet of Things, or some form of wireless phone service. It also might involve things like health products that help seniors stay in their homes longer, or better data platforms for gamers. CCG already has some clients that are successfully selling IP-based security systems and home automation systems.

The business plans include a small amount of unspecified new products starting in the fifth year of the business plan that grows slowly over time. The model does not predict what these future revenues will be, only there will be new products sold over time. Since we can't understand the margins of each business plan the assumption has been used to show just the margins from the new business. We start the new products in the fifth year of the new business. Grow these revenues grow to a margin of \$15.00 per month for 34% of the customers by the end of 25 years. We believe this to be extremely conservative.

Churn

Churn is the industry term that refers to customers that leave the network. Churn is of major concern with an FTTH network because there is significant investment at each customer location for the fiber drop and electronics. When a customer comes on the network and then leaves before that investment is recovered it means that other customers have to make up for that shortfall.

The models assume that there is churn at a rate of about 3% of broadband customers each year. That is a net churn, meaning locations that need a new fiber connection. A lot of market churn comes through somebody moving out of a home but the new resident then buying again from that location. That kind of churn does not cost a new connection. The 3% may not sound like a lot, but over a 25-year business plan it would mean building a significant amount of fiber to homes that don't have service. The assumed churn for telephone and cable TV is higher and assumed at 6% per year to reflect customers that leave those services and don't return.

Impact on the Existing Fiber Business

Operating a retail FTTH business is going to impact the existing fiber business. If the city offers a retail gigabit service, at least some of the businesses served by the existing fiber network are likely to migrate to the new PON network. For the most part this will mean lower revenue for GRUCom. This shouldn't cause big losses, but you'd lose the difference between the rates for dedicated broadband on the existing network and the retail rates for shared broadband on the new PON network. The forecasts assume that there is net reduction of 5% of the margin on existing revenues.

We have some experience with this since we saw retail networks added on top of robust existing fiber networks in both Lafayette, Louisiana and Chattanooga, Tennessee. In both of those cities there was not a large drop-off in existing revenues. Our experience is that most of the customers on the existing network are there for a reason and prefer some aspect of the dedicated services that are provided on the current fiber network. .

Expense Assumptions

Incremental Expenses

All expenses were estimated on an incremental basis. That means that we only considered new costs of operating the business, not allocations of existing expenses. For example, while some existing employees would become involved in helping to operate the new network we didn't include their cost since that is already on the books and is supported by the existing fiber business. We instead recognized the labor cost for new employees that would be hired to support the new residential and small business retail venture. This incremental analysis is the same way that commercial ISPs consider new business opportunities – they see if a new venture will pay for itself and don't cloud that analysis by mixing in existing revenues or costs.

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

Changes in the GRUCom Organization Chart

There are two ways to integrate the new business into the existing fiber business – as a standalone new department or integrated into the current structure. There are pros and cons to both structures.

For purposes of this study we elected to use an integrated structure. The primary impact of that decision was not assuming new department heads in the forecasts. The other new employees needed to operate a retail business are needed regardless of the manager structure.

Direct versus Allocated Expenses

We obtained recent ledgers and also forward-looking budgets for GRUCom. We tried to match up various expected expenses in a similar way to how GRUCom incurs the same expenses.

We estimated expenses in two ways – direct expenses and allocated expenses.

Direct expenses are new expenses that the retail business would spend that are not currently incurred by GRUCom. For example, the new retail business would be expected to have a significant budget for sales and advertising that would be significantly different than the way that GRUCom interfaces with its existing customers. We estimated direct expenses based upon our experience of working with hundreds of ISPs.

Some of the expenses at GRUCom are allocated from the larger GRU utility. For example, GRUCom is allocated the cost for functions like accounting, IT, utilities, rents for office space, etc. These kinds of allocated expenses are real outlays that would also be incurred on behalf of the new retail business. For example, the new business would require an extensive effort by the accounting department at GRU. The new business would need office space to house new employees.

We estimated the cost for the new business based upon the costs already allocated to GRUCom per employee. We then allocated in similar costs based upon the projected employees of the new retail business. Finally, we looked at the results of this process for reasonableness. For example, the amount of accounting expense that would be allocated to the new business looked reasonable to us. In fact, as you would expect from allocations from a large accounting department, the

allocated accounting expenses were less than what it would cost the new business to hire its own accounting staff.

Employees

Labor is generally one of the largest expenses of operating a broadband business. The models all assume that the business will employ a local staff to operate the network and to operate the business. Salaries are set at rates that we think are realistic for your market (and we solicited feedback on many of the salaries). All salaries assume an annual wage increase at 2.5% inflation.

Following are the specific employees assumed for each of the four scenarios. These are the counts by the end of year 5 when the business would be fully staffed. At the end is the estimated count of employees at the end of year 25.

<u>Year 5 Employees</u>	<u>City Limits</u>	<u>GRU Territory</u>	<u>Urban Reserve</u>	<u>Plus Small Cities</u>
Business Unit Manager	1	1	1	1
Office Manager	1	1	1	1
Marketing Analyst	1	1	1	1
Salespeople	3	3	4	4
Electronics Technician	1	1	1	1
Engineer	1	1	1	1
Provisioning Coordinator	1	1	1	1
Fiber Optic Foreman	1	1	1	2
Installation Technicians	8	11	12	14
Billing Applications Specialist	1	2	1	1
Customer Service Supervisor	1	2	2	2
Customer Service Representative	11	14	15	17
Total at Year 5	31	39	41	46
Total at Year 25	36	43	48	52

CCG chose this level of staffing based upon the number of expected customers and our experience with hundreds of clients operating similar businesses. For example, we project that there is a technician in a truck required for every 2,500 customers. We've estimated that there would be a customer service representative for every 2,000 customers. There is a chance that as the business got larger that these functions would become more efficient, meaning that it's likely that fewer employees are required than what we forecast.

Cable Programming Costs

Cable programming is a major expense. We've estimated the cost of programming for the products assumed in the study. CCG has access to the costs of programming paid by many of our clients and we used representative recent costs. We are covered by a nondisclosure agreement from all of the major programmers and cannot publicly discuss individual costs for a given channel.

There are two kinds of costs for programming. First is the cost of local network affiliates – the nearest stations that carry ABC, CBS, FOX, and NBC. These costs are defined by a retransmission agreement with the local network affiliates that is covered by FCC rules. As recently as a decade ago cable companies paid nothing to get access to local programming. Since then local stations have begun to charge for access to content and these fees are one of the reasons that the cost of programming is growing rapidly. Most local affiliates charge between \$2 per customer per month in small TV markets and \$5 per customer per month in a few large NFL city markets.

Other programming is purchased from the companies that own the programming. There are a few companies that own a lot of cable networks such as Disney/ESPN, Discovery, Comcast/NBC, and the MTV group. Most of the programmers sell programming to smaller cable operators through a national cable cooperative, NCTC. The cooperative buys programming on behalf of hundreds of small cable companies, and collectively is the third largest buying of programming after Comcast and Charter. If the city was in the cable business, you'd be able to get programming at roughly the same costs as Cox. Not all programmers work through the cooperative and cable providers need individual contracts with typically 15 – 20 other programmers.

We know that the cable TV product doesn't make much money. We were able to test that our cost assumptions are reasonable by looking at the difference if the business carries or doesn't carry cable TV. The comparison showed a tiny positive margin for the cable product.

Voice Service

GRUCom is in the process of activating a new voice switch that will be used to provide telephone service for the city, the utility and for existing business customers. This switch can also be used to provide telephone service to new residential and small business retail customers. We estimated the cost of providing voice service based upon recent analysis of the cost of operating the voice switch. For example, there is a software activation fee for every new customer on the voice switch.

Facility-Related Expenses

This includes such expenses as:

- Vehicle expense;
- Computers and software for employees;
- Tools;
- Building rent for both the equipment space as well as a retail business office;
- Utilities like power and cellphones;
- Pole Attachments. GRUCom pays pole attachments to GRU.

We estimated these various expenses either by mimicking how these costs were charged today to GRUCom or else by making our direct estimate of each kind of expenses based upon our experience with other ISPs.

Maintenance Contracts

It is typical for small ISPs to buy maintenance contracts. These contracts provide for annual updates of all software and other improvements to electronics plus some base level of technical assistance from the vendors. The study assumes a maintenance contract for the fiber electronics.

Internet Backbone

ISPs need to buy a large data pipe to the Internet to provide connectivity to the open Web. This is referred to in the industry as an Internet backbone connection. GRUCom already buys a large data pipe to the Internet to serve the city, the schools, as well as retail ISP customers. GRUCom also has existing peering arrangements where they save money by handing data directly to the biggest data users on the web like Google, Netflix, etc. We estimated the cost of layering on the new needs for bandwidth over what GRUCom is already paying today.

Sales and Marketing Expenses

The forecasts include a marketing budget. The assumption is made that there would be relatively high advertising costs in the first few years, but a continuous advertising cost forever. Most of our clients today that launch new networks use software tools that help them pre-sell before the network is built. Those tools significantly reduce marketing expenses because they often help to find the bulk of the needed customers early in the business launch process. The forecast also includes a full-time sales/marketing position that would oversee the advertising process but who would also sell to businesses. Finally, the forecast includes three to four salespeople who sell broadband to businesses in the city.

If the city decides to move forward with this idea, we strongly suggest you develop a preliminary marketing plan as part of that process. There would be several major issues that a marketing plan should consider. First would be to find the best way to pre-market to customers as the network is being built. The goal would be to have a significant number of customers pledged to use the network before it is operational. This differs from a sales plan, which is something developed after funding that looks at the specific tactical issues required to sign-up customers.

Billing and Software

GRUCom recently purchased a new software platform referred to in the industry as OSS/BSS (Operational Support System / Billing Support System). This is a major software package that that is used to manage many of the workflows of the current GRUCom business. This software can also be used to support the retail ISP business. The software supports a large number of functions such as:

- Taking new orders for service. Maintains the product catalog of prices;
- Provisioning – making sure each customer gets the specific sets of products and services they've requested;
- Billing and Invoicing;
- Payment processing. Tracks payment by each customer to always maintain a current account balance and history;
- General ledger interface; tracks payments and revenues to and from the general ledger accounting system;

- Late payment / disconnects. Manages the whole process of notifying customers that don't pay including the process of disconnecting service if necessary;
- Trouble reporting. Logs notifications of problems from customers and tracks each trouble through resolution;
- Workflow. Does things like schedule technicians to visit customer locations and defines the work to be done;
- Device management / inventory. Tracks company-owned devices used by each customer.
- Revenue assurance. Makes sure that everything that should be billed is billed;
- Plant record management. Integrates mapping programs with customer records to make it easier for employees to help customers with problems;
- Management reporting.

We estimated the cost of the software and related functions based upon current contracts with the OSS/BSS vendor.

We also layered on other costs of the customer service and billing function such as the cost to mail bills, the cost to accept customer payments by credit card, etc.

General & Administrative (G&A) Expenses

As described earlier, we tried to match the way that GRUCom is charged for various direct overhead functions. In some cases we estimated these costs directly. This includes functions like:

- Legal expense;
- Accounting expense;
- Rents / utilities;
- Training;
- Regulatory compliance;
- External consultants;
- And, finally, a catchall account called Other G&A—there are always expenses that are hard to put into a category.

Taxes

The business is exempt from many taxes, like income tax, due to being part of a municipality. However, GRUCom does pay some minor local taxes and the models matches this.

There are a number of taxes and fees in a telecom business that are charged to customers. These are not recognized in the forecasts using the assumption that the business would collect the taxes and pass them on to the tax authorities. These taxes are not an expense of the business.

Start-Up Costs

There are considerable start-up costs included in each scenario. It's our experience that there are a number of one-time expenses associated with launching a new business and rather than list them, they have been included generically as start-up costs.

Capital Assumptions

Capital is the industry term for the assets required to operate the business. The capital expenditures predicted in these models reflect the results of the engineering estimates described in Section II of the report. The launch of a broadband network requires a significant investment in the fiber network and electronics, which are by far the biggest cost of getting into the business.

Capital includes several broad categories of equipment including fiber cable, electronics for FTTH, and the electronics needed to provide the triple-play services. In addition to capital needed for the network, there are expenditures predicted for assets like furniture, buildings, computers, vehicles, tools, inventory, and capitalized software. The amount of investment required is going to vary by the type of technology used as well as by the number of customers covered by a given business plan.

One of the major capital costs of building a fiber network is the cost of installing each customer. This work consists of several components—the fiber drop to get from the street, the fiber electronics that translate the light on the fiber into usable bandwidth, and any electronics needed to provide services like WiFi modems or cable settop boxes.

Our goal was to be conservatively high with capital estimates. The estimates include a construction contingency to cover potential cost overruns. It is important to remember that these estimates are high level. The goal of these estimates was to provide estimated costs that are detailed enough to see if it makes sense to move forward and consider a fiber project. However, before raising the money to build this project it would be prudent to do additional engineering to better pin down the cost of the network.

Specific Assets. Following are the assets that are in service by the end of the fifth year for each of the service footprints. Following that is a second table summarizing the total assets needed for each of the four scenarios. That date was chosen because it represents a fully constructed network with subscribers. These assets all represent a 48% customer penetration rate.

	City	GRU	Urban	Plus Small
	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Cities</u>
Vehicles	499,429	130,330	39,975	131,381
Tools & Work Equipment	75,000	25,000	0	0
Buildings	1,165,000	466,000	293,000	879,000
Furniture	48,000	10,500	3,000	7,500
Computers	102,041	23,442	6,374	16,588
CATV Electronics	2,316,826	1,142,536	289,166	589,188
Fiber Electronics	10,648,100	4,941,860	1,165,308	2,347,560
WiFi Modems	2,298,030	1,070,265	279,930	563,850
Fiber Drops	13,184,822	5,890,909	1,539,162	3,127,949
Fiber	66,046,030	45,042,315	12,209,013	15,554,804

Software	1,375,592	620,790	163,132	327,610
Spares	200,000	0	0	0
Total	97,958,870	59,363,948	15,988,059	23,545,429
Passings	42,729	19,814	5,142	10,511
Investment per Passing	2,293	2,996	3,109	2,240

As can be seen, the cost per passing for each of the scenarios is different. This largely a factor of housing density. In general, the more tightly packed the housing, the lower the cost of the fiber network needed to reach an area. This generality doesn't hold for the downtowns of major NFL cities where the cost of fiber construction is extraordinarily high. Interestingly, the cost per passing for the small cities is slightly lower than the cost in Gainesville. The density is similar, but our study assigns all of the cost of core electronics to the Gainesville market.

	City Limits	GRU Area	Urban Reserve	Plus Small Cities
Vehicles	499,429	629,759	669,734	801,115
Tools & Work Equipment	75,000	100,000	100,000	100,000
Buildings	1,165,000	1,631,000	1,924,000	2,803,000
Furniture	48,000	58,500	61,500	69,000
Computers	102,041	125,483	131,857	148,444
CATV Electronics	2,316,826	3,459,362	3,748,528	4,337,716
Fiber Electronics	10,648,100	15,589,960	16,755,268	19,102,828
WiFi Modems	2,298,030	3,368,295	3,648,225	4,212,075
Fiber Drops	13,184,822	19,075,731	20,614,893	23,742,842
Fiber	66,046,030	111,088,345	123,297,358	138,852,162
Software	1,375,592	1,996,382	2,159,514	2,487,124
Spares	200,000	200,000	200,000	200,000
Total	97,958,870	157,322,818	173,310,877	196,856,306
Passings	42,729	62,543	67,685	78,196
Investment per Passing	2,293	2,515	2,561	2,517

Construction Contingency

The above numbers include a 6% construction contingency, with that cost added to the cost of the fiber network. We routinely add a contingency when we make feasibility estimates since our estimates are high-level. However, once engineered the construction contingency might not be needed. Before funding a project of this size, we strongly recommend first doing more detailed engineering to better tie-down the cost of the network.

Construction Inflation

We have not included any inflation in the cost of building the fiber network. Since the construction is assumed to stretch multiple years, it's possible that latter phases of construction could cost more than estimated. In recent years we've not seen big swings in construction costs. Where the cost of the fiber might increase, it's also likely over time that the cost of the electronics could decrease.

We note that the overall cost of building new FTTH networks has not increased significantly on a per-passing basis for the last decade. While there have been some increases in the labor component for building fiber, we've seen the fiber cable and electronics costs drop. There is no guarantee that this trend will continue.

Drop Costs. It might be possible to install fiber drops for costs lower than assumed by this study. There are at least three approaches that ISPs take to constructing drops. The most expensive option is to have the drops installed by the company that builds the network. They generally charge a premium for this due to the fact that they bring high hourly rate technicians to build the network. The opposite approach is for the ISP to build all drops. That tends to be the lowest cost way to do this on an incremental cost basis if the staff that builds the drops are already on the payroll. Finally, an intermediate method is to hire a local contractor that specializes in only building drops.

For a project of this size it would probably be impractical to build drops using staff, although employees could install some drops. Many ISPs use their own staff to build drops to business and contractors to build the rest. It's almost certain you'll have to use a contractor. We've seen clients that have negotiated lower installation rates for drops than shown in these studies.

Other Assets

A description of the buildings (huts), the fiber network, and the core electronics is included in Section II of this report. Here is a brief description of the other assets included in the study.

Vehicles. Needed for the employees who work outside on the network.

Tools. These are capitalized tools like test equipment used to monitor network performance and to diagnose network problems.

Furniture. Needed for employees.

Computers. For employees and including basic software.

Inventory. This includes spare electronics as well as spare fiber needed to make quick repairs.

WiFi Routers. The model includes WiFi routers to support the managed WiFi product. Customers can elect to provide their own WiFi router and not lease the one provided by the ISP.

At CCG we recommend that our client not include WiFi routers directly in the customer ONT. First, it's a wasted investment to pay for a WiFi router for customers that use their own router. More importantly, we've seen that WiFi technology is evolving rapidly. There is a great likelihood that the WiFi router built into an ONT will become obsolete before the ONT electronics. That could force the ISP to replace the ONT prematurely. A built-in WiFi router also might not always fit the circumstances. For example, the business might elect to install a meshed network consisting of several WiFi modems into homes that are large or have challenging coverage characteristics. Finally, there are higher quality routers available when purchased separately.

Capitalized Software. The models also assume capitalized software. For study purposes we have capitalized software that has a benefit over multiple years. There are several kinds of capitalized software included in the study including:

- OSS/BSS operating system: There is an incremental cost to add a customer to the software.
- Cable TV software. Even if cable TV is purchased externally the industry practice is to require the ISP to pay for industry standard software such middleware (the software that communicates with the settop box) and encryption software which is required by programmers whenever a cable signal is transmitter over an all-digital network.
- Smart Switch software. There is an incremental cost to add a customer to the telephone soft switch.

Debt Assumptions

One of the most important assumptions affecting all of the scenarios is the cost of financing the new business. There are several key factors that affect financing costs.

- Interest Rate. The higher the interest rate, the higher any annual debt payments, just like with a home mortgage. For the last decade or so bonds have had much lower interest rates than commercial loans. That is not always the case throughout a longer history, but it's generally the case. It's possible for interest rates to increase at any time. We've enjoyed low municipal bond rates for the last decade, but nobody expects low rates to hold forever.
- Loan Term. The loan term means how long the borrower has to repay the loan. The studies assumed a bonds term of 25 years for the base study. We also examined the impact of using 20-year and 15-year bonds. The primary benefit of a longer loan term is lower annual debt payments.
- Financing Construction. With bonds it is typical to borrow all of the money up front in a lump sum, meaning that interest accumulates immediately. Commercial loans more typically use what is called construction financing, meaning that the project borrows money each month as needed during construction, which greatly reduces the interest cost for the first few years.
- Capitalized Interest. Because bonds require the money to be borrowed up front, it's typical for a fiber project to have to borrow the funds needed to make the first 3–4 years of interest payments on the bonds, until the project generates enough cash to cover those payments. Commercial loans more typically excuse interest payments for the first few years (which

is made up by applying a higher interest rate in the future). The studies assume that the first 3 years of interest payments are borrowed with the bonds.

- **Bond Surety.** Bonds sometimes include some sort of surety, meaning some amount of money to cushion the bondholders against losses. This might include borrowing something called a Debt Service Reserve Fund, which is an amount of money that is borrowed and held in escrow during the life of the bond. This money would be used to pay principle and interest payments in case the project doesn't make enough to cover the needed payments. Bonds might also require bond insurance, which is an insurance policy, funded up front with the bond to cover future defaults. The forecasts assume that surety is not required.

Financing Assumptions. The financing assumptions for each base scenario are as follows.

	City Limits	GRU Territory	Urban Reserve	Plus Small Cities
Assets Financed	95,562,432	149,078,515	164,130,812	183,384,874
Capitalized Interest	11,076,000	16,848,000	18,603,000	20,816,250
Working Cash	5,665,000	5,000,000	6,000,000	7,000,000
Cost of Issuance	1,261,000	1,853,000	2,033,000	2,260,000
Rounding	35,568	20,485	33,188	38,876
Par Value of Bonds	113,600,000	172,800,000	190,800,000	213,500,000
Interest Rate	3.25%	3.25%	3.25%	3.25%
Term	25 Years	25 Years	25 Years	25 Years

You will note that the assets included for bond funding are not as high as the assets built by the end of year 5. That's because some of the asset costs can be covered by revenues collected by customers. Following is an explanation of the components of the bond cost:

Assets Funded. These are the assets built during the first 5 years of the project that are financed with debt.

Cost of Issuance. These are fees paid to raise the bond funds. They include numerous legal fees. The primary cost are fees charged by bond sellers to market and sell the bonds.

Working Capital. Federal bond law requires that bond proceeds must primarily be used to pay for the capitalized cost of a project. However, the bond can also finance the early operating expenses needed until the project is cash self-sufficient. In this case the working capital would be used to cover operating expenses during the first few years before revenues are high enough to cover costs. Working capital can be set as high as 5% of the total bond proceeds, but in these examples is a smaller amount.

Capitalized Interest. This represents the first 3 years of interest payments that are borrowed up front to make interest payments after issuance of the bonds.

Summary of Financial Business Plan Assumptions

Following are some of the basic assumptions that are common to all of the financial business plans:

- We assumed that a new fiber business would be operated by GRUCom and would be incorporated into the current GRUCom operations rather than being created as a new entity within GRU.
- We arbitrarily chose a 48% market penetration (the percentage of customers using the network) for all base studies based upon the way that we interpreted the residential survey. There is no guarantee that the city would achieve this penetration rate. It would also be possible for the city to exceed this target penetration rate. We needed to choose a base penetration rate in order to be able to compare between various options and scenarios.
- All financial models cover a 25-year period, which matches the longest expected period for financing the network bonds.
- The financial studies estimate every aspect of operating a fiber business and include projected revenues, projected operating costs, projected financing costs and the projected cost of building the network as discussed above. One of our primary goals was to see if there are scenarios where the revenues of the fiber business will cover all of the operating costs such that the resulting business would never need an external subsidy.
- Telephone and cable TV products are priced at, or modestly below market prices.
- The key assumption in the studies is that the city would provide a low-price gigabit broadband product to every customer. Since the goals of this feasibility was to determine if low-price gigabit is possible, our base studies start with the assumption of a \$50 gigabit product – which would be the lowest-priced product in the US.
- The operating expenses used in the projections represent our best estimate of the actual cost of operating the fiber business and are not conservative. Most operating expenses are adjusted for inflation at 2.5% per year.
- One of the most expensive costs of expanding the fiber business is labor and we used projected salaries that fit within the GRUCom pay scale.

	<u>City</u> <u>Limits</u>	<u>GRU</u> <u>Territory</u>	<u>Urban</u> <u>Reserve</u>	<u>Plus</u> <u>Small</u> <u>Cities</u>
Employees in 5 Years	31	39	41	46
Employees in 25 Years	36	43	48	52

- We performed what we call sensitivity analysis where we calculated the impact of changing the key variable such as market penetration, interest rates on bonds, prices for broadband service, etc.
- We also considered options with different product offerings include the triple play, Internet plus telephone service, and standalone Internet only
- We looked at a series of scenarios that we call digital divide scenarios which look to see if it would be possible to offer low-price broadband for low-income homes. We began this analysis by considering a \$20 digital divide broadband product and looked at numerous other options.
- We estimated the cost of the required assets for each of the four scenarios as follows. For purposes of estimating costs, each of the following scenarios assumes a 48% customer

penetration rate. The study only provides a fiber drop and customer electronics for subscribers to the network. These costs are at the end of five years of operation.

	<u>City</u>	<u>GRU</u>	<u>Urban</u>	<u>Plus</u>
	<u>Limits</u>	<u>Area</u>	<u>Reserve</u>	<u>Small</u>
				<u>Cities</u>
Vehicles	499,429	629,759	669,734	801,115
Tools & Work Equipment	75,000	100,000	100,000	100,000
Buildings	1,165,000	1,631,000	1,924,000	2,803,000
Furniture	48,000	58,500	61,500	69,000
Computers	102,041	125,483	131,857	148,444
CATV Electronics	2,316,826	3,459,362	3,748,528	4,337,716
Fiber Electronics	10,648,100	15,589,960	16,755,268	19,102,828
WiFi Modems	2,298,030	3,368,295	3,648,225	4,212,075
Fiber Drops	13,184,822	19,075,731	20,614,893	23,742,842
Fiber	66,046,030	111,088,345	123,297,358	138,852,162
Software	1,375,592	1,996,382	2,159,514	2,487,124
Spares	200,000	200,000	200,000	200,000
Total	97,958,870	157,322,818	173,310,877	196,856,306

Appendix II – Business Plan Results

The underlying assumptions used to create the financial projections are included in Appendix I.

Financial Reports in the Forecasts

The financial forecasts were created to follow basic GAAP accounting. This means that intangible expenses like depreciation and amortization are applied to assets like bond financing costs. Each projection includes three standard financial reports—an income statement, a balance sheet, and a statement of cash flows. Each projection also includes balance sheet items like accounts receivable and accounts payable in order to more accurately predict future cash balances.

The models assume interest income on accumulated cash. There is a general model assumption that cash is never paid out as dividends or distributions to other parts of the city, but fully retained for the 25-year period. This assumption makes it easier to compare different scenarios. In real life any excess cash would probably not be retained by GRUCom but used to operate the larger utility.

The summaries below introduce a few new terms:

- Positive Net Income. This is when the books of a business show a positive profit. This is the standard way that commercial companies define a profit. A positive net income shows that the business is covering operating expenses as well as interest, depreciation, amortization, and taxes. Net income does not consider repayment of debt principle and annual operating capital. Still, this is an important milestone for a new business, because it measures when a commercial business is profitable for accounting purposes. Note however, that it is possible to have a positive net income and still not have enough cash to operate the business. It's worth noting that government businesses don't use this as a financial measure of a government business, but we still find it useful to track in order to create a point of comparison between the different scenarios.
- Debt Breakeven. This is when the business has generated enough excess cash that could be used to retire the remaining debt.
- Cash After 25 Years. This is the cash balance expected for the new fiber venture at the end of the 25th year after financing. For a scenario with 25-year bonds this also represents the date of the last payment on the bonds.

The best way to measure profitability differs according to the structure of the business. A municipal business typically defines financial success as generating enough cash to operate the business without any external subsidy. However, a for-profit business would generally use a measurement like net income to measure profits, which is similar to the IRS definition of profitability.

Subsidies are always a sensitive topic for a government-operated business. The business plan scenarios were created with a goal of trying to always have some reasonable level of operating cash on hand to provide a cushion against nonlinear expenditures. A cash cushion is needed since not all expenditures are spent evenly throughout the year and so a business needs to have a cash reserve to allow for those times of the year when the expenses are higher than normal or when revenues are lower than normal.

In the following presentation we first show the results of each of the four scenarios individually – the four different geographic footprints. At the end of this analysis we compare the results of each scenario.

1. Gainesville City Limit Scenarios

This scenario considered a retail ISP operating only within the city limits. This scenario covers 42,729 residential and business passings.

Customer Penetration Rates. We interpreted the results of the survey to indicate that approximately 48% of the households in the market would support a retail ISP. We decided to use this as the starting point for each study so that they were all consistent. We also then considered the impact of getting a greater or lesser number of customers and just used the 48% penetration as the baseline.

Base Study

The base study is the first scenario we studied and the one against which all other scenarios can be measured. For example, we can calculate the impact of changing the interest rate on debt by running a second scenario with a different level of debt than this base study. The key assumptions included in the base study are:

- 48% market penetration for both residential and small business broadband;
- 3.25% Interest rate on bond debt;
- 25-year term for bond debt;
- A single residential broadband product - \$50 gigabit. This is the most non-standard assumption in the studies. However, the city’s directions for these studies was to determine if there is a way for Gainesville to have the lowest-priced gigabit broadband in the country. The \$50-dollar gigabit product would be exactly that, so we selected that as the starting product in the analysis. We also consider higher and lower prices below.
- Includes telephone and cable TV products;

These are the results for the base study for the city limits is as follows. We then compare all other scenarios to this base in order to understand the incremental changes in earnings that come from changing the many key variables in the studies.

<u>Base Study</u>	<u>48% Penetration</u>
Asset Costs	\$97.96 M
Bond Debt	\$113.6 M
Interest Rate	3.25 %
Penetration Rates	48 %
Years Until Positive Net Income	Year 5
Years Until Cash Covers Debt	Year 21
Cash After 25 Years	\$35.23 M

The primary conclusion that can be drawn by this scenario is that if all of the assumptions made in this scenario were realized in an actual ISP, then this is a scenario that generates positive excess cash over the 25-year bond period. It's worth always noting that the business would generate significant cash once the debt was retired. In this scenario the annual debt payments are \$7.3 million.

Note again that this scenario assumes an across-the-board price of \$50 as the only ISP residential product – something that would be the cheapest gigabit in the country.

Varying the Price

This scenario considers the different the impact on the business performance by varying the residential broadband prices. First, we look at a more normal set of market-based broadband rates, with rates and the product mix set as follows. We also looked to see the impact of raising the gigabit price as the only product to \$60.

<u>Speed</u>	<u>Price</u>	<u>Mix</u>
Tier 1	\$50.00	70%
Tier 2	\$65.00	20%
Gigabit	\$80.00	10%

These would be typical broadband rates for a fiber overbuilder. There would generally be an affordable introductory broadband product, in this case set at \$50, and the majority of customers would buy this product. This assumes two additional products, with the top on being a gigabit priced at \$80. That price is higher than the \$70 price offered by Google Fiber in a few cities but is still lower than the gigabit products offered today by Cox and AT&T.

We also looked a second option of raising the price on gigabit, as the only product, to \$60.

	Base - \$50 <u>Gigabit</u>	Market <u>Rates</u>	\$60 <u>Gigabit</u>
Asset Costs	\$97.96 M	\$97.96 M	\$97.96 M
Bond Debt	\$113.6 M	\$113.6 M	\$113.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 5	Year 5	Year 5
Years Until Cash Covers Debt	Year 21	Year 18	Year 16
Cash After 25 Years	\$35.23 M	\$73.23 M	\$94.04 M

These results tell us several things. First, eliminating the product mix and offering only 1 product at \$50 lowers cash over 25 years by \$28 million. But the business is still viable and profitable even with a universal residential \$50 gigabit. If anything, this scenario is a little conservative since the survey indicated that a \$50 gigabit product would likely draw a larger market share than 48%.

The difference in performance between a \$50 gigabit product and a \$60 gigabit product is dramatic, at \$88.8 million over 25 years. It's an interesting comparison because a \$60 gigabit product would still be one of the lowest prices in the country. However, we know from long experience that price is a driving issue for people deciding to change ISPs. We would expect a lower market penetration rate for the \$60 gigabit product compared to the \$50 product – there is no way to guess the likely market penetration with a \$60 gigabit rate.

But this scenario also quantifies the impact of changing prices. Changing broadband prices by \$1 changes cash over 25 years by \$5.88 million. This means that if a broadband business was launched and was underperforming a little that shortfalls could probably be made up through modest rate increases for broadband. But this difference also provides a cautionary tale. We know of municipal broadband businesses where politicians were allowed to set prices – and they will tend to lower prices if given the opportunity. The above results show that great harm could be caused to the business by unilaterally lowering prices – we strongly recommend elsewhere in this report that ways be found to isolate the rate-setting process from the political process.

Varying the Interest Rate

In this scenario we look at the impact of changing a few of the major financing assumptions. In this scenario we increased interest rates from 3.25% to 3.75% - fifty basis points in financial lingo.

	Base - \$50 <u>Gigabit</u>	Higher <u>Interest Rate</u>
Asset Costs	\$97.96 M	\$97.96 M
Bond Debt	\$113.6 M	\$115.7 M
Interest Rate	3.25 %	3.75 %
Penetration Rates	48 %	48 %
Years Until Positive Net Income	Year 5	Year 5
Years Until Cash Covers Debt	Year 21	Year 22
Cash After 25 Years	\$35.23 M	\$22.25 M

One of the key factors in any long-term financing is the interest rate on debt. We've just gone through an almost unprecedented period of both low and stable interest rates for municipal bonds. However, historically the interest rates demanded for bond financing has varied according to the performance of the whole economy. Further, bond interest rates vary according to the creditworthiness of the borrowing city. This credit worthiness is determined by obtaining a bond rating from one of several companies like Moody's that assess the overall financial strength of government entities. Generally, the higher a city's bond rating, the lower the interest rate that must be paid to obtain bond financing.

The higher interest rate decreased cash flow over 25 years by around \$13 million. This is a significant shift in cash flow and demonstrates that this project is highly sensitive to interest rates. In periods where interest rates fluctuate the market timing for a bond sale becomes an important consideration. We've participated in bond sales in the past that were delays due to high interest rates.

Varying the Bond Term

The bond term is the length of time over which a bond issue is repaid. We started our analysis considering a 25-year bond term. This is pretty typical of the term used for other municipal fiber projects. The bond term is important, because just like with a home mortgage, the longer the term on the loan the lower the payments on the debt.

For the issuance of tax-free bonds, the bond term is generally limited on the high end to not exceed the average useful life of the assets. Many other cities have used that basis to finance fiber over 25 to 30 years based on the average useful life of fiber – the primary asset constructed with the bonds.

	Base		
	<u>25-Years</u>	<u>20-Years</u>	<u>15-Years</u>
Asset Costs	\$97.96 M	\$97.96 M	\$97.96 M
Bond Debt	\$113.6 M	\$113.6 M	\$113.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 5	Year 5	Year 14
Years Until Cash Covers Debt	Year 21	Year 20	N/A
Cash at end of Bond Term	\$35.23 M	\$1.43 M	(\$29.33M)
Cash After 25 Years	\$35.23 M	\$41.98 M	\$52.36 M

This analysis shows that the project could be funded over 20 years. However, that is basically a breakeven scenario meaning that the business would have to achieve the full 48% market penetration to succeed. This is why, given the choice that cities usually elect to finance a fiber project over the longest term possible since the lower annual debt payments provide an easier opportunity to be successful.

This project cannot be financed over 15 years with a \$50 gigabit rate. This result was no unexpected. You may hear of commercial fiber ventures that finance fiber projects for 12 to 15 years, but that is only possible because they essentially make a down-payment on the project with cash equity. We rarely have seen a fiber project anywhere that works with 100% financing and a 15-year term.

Our analysis shows that this scenario could be financed over 15 years by increasing the gigabit rate to \$64.

The 15-year financing is an issue because under Florida law, any bond issues longer than 15 years must be approved by a referendum. This analysis makes it clear that the project will not be able to meet the 15-year test and that a referendum is likely going to be mandatory.

Finally, these results are a good demonstration of how cash accumulates after the end of bond financing. In both the 15-year and the 20-year scenarios the cash accumulated after the bond is retired results in significantly increased cash by year 25.

Changing the Penetration Rate

The most important variable in any broadband forecast is the number of customers for the projected business. The best plans in the world are no good if a new fiber business doesn't land the needed customers. Again, this study began with a base forecast of 48% based upon the results of the survey.

One of the most important figures to understand is what we call the breakeven penetration, or the minimum number of customers needed for the projected business to always maintain a positive cash balance and never require outside subsidy after the initial financing. In a breakeven scenario there is always sufficient revenues generated to cover operating expenses, debt payments and maintenance and replacement capital.

In this scenario – serving the city limits of Gainesville with a \$50 gigabit broadband product the breakeven penetration rate is calculated to be 44%. That means any penetration greater than that ought to be cash solvent.

We also looked at the impact of performing better than expected and looked at the results of obtaining a 50% market share.

	48% <u>Base</u>	44% <u>Breakeven</u>	50% <u>Penetration</u>
Asset Costs	\$97.96 M	\$95.79 M	\$99.05 M
Bond Debt	\$113.6 M	\$112.5 M	\$113.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	44 %	50 %
Years Until Positive Net Income	Year 5	Year 5	Year 5
Years Until Cash Covers Debt	Year 21	Year 20	Year 19
Cash After 25 Years	\$35.23 M	\$2.59 M	\$51.66 M

As would be expected, surpassing the breakeven penetration rate results in the generation of significant excess cash. These results show that each 1% of market share increases cash flow over 25 years by a little more than \$8 million.

Changing the Construction Contingency

This scenario is looking at the impact of changing the capital costs of the project. We specifically changed the construction contingency in this example, but changing the cost for any part of the project would achieve the same results.

The construction contingency is an amount that is added on top of our best engineering estimates of the cost of the network. Cities often borrow extra when financing big projects to hedge against cost overruns.

	Base	No	10%
--	------	----	-----

	<u>25-Years</u>	<u>Contingency</u>	<u>Contingency</u>
Asset Costs	\$97.96 M	\$94.06 M	\$100.56 M
Bond Debt	\$113.6 M	\$109.0 M	\$116.7 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 5	Year 5	Year 5
Years Until Cash Covers Debt	Year 21	Year 20	Year 21
Cash After 25 Years	\$35.23 M	\$43.68 M	\$29.59 M

The construction contingency in this scenario is was set to equal 6% of the cost of the fiber and the core fiber electronics, which is \$3.9 million. Eliminating that much capital spending increases cash flow over 25 years increases cash flow by \$8.45 million. That basically is the cost of interest expense over 25 years needed to finance that much capital.

We also looked at the impact of increasing capital spending. In this case, increasing the construction contingency to 10% increases capital spending by \$2.6 million. That extra capital would decrease cash flow over 20 years by \$6.5 million.

This demonstrates the importance of understanding capital costs before undertaking the construction of a network of this magnitude. The engineering estimates made for this study are high-level. We've made the best estimates we can based upon as many facts as we could gather, and we believe that the projected costs are probably within 10% of the cost of building the network. It would take significantly more engineering analysis to pin that cost down to a tighter range – something that we highly recommend before financing this much money.

Varying the Product Mix

We also studied the impact of offering different mixes of products on the network. The base study contemplates offering the triple-play products of broadband, cable TV and telephone service. We wanted to quantify the bottom-line benefit to the business for both the cable TV and the telephone product.

	<u>Base</u>	<u>No</u>	<u>Broadband</u>
	<u>Triple Play</u>	<u>Cable TV</u>	<u>Only</u>
Asset Costs	\$97.96 M	\$95.36 M	\$95.25 M
Bond Debt	\$113.6 M	\$110.8 M	\$110.8 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 5	Year 5	Year 14
Years Until Cash Covers Debt	Year 21	Year 21	Never
Cash After 25 Years	\$35.23 M	\$33.88 M	(\$54.05 M)

The results are interesting. Eliminating cable TV reduces profitability only slightly reduces cash flow by over 25 years by \$1.35 million. That implies that the cable produces, on average loses only \$54,000 of margin each year. That's very consistent with what we see from our many other

clients who report that cable TV is a slight winner or loser for them. This contrasts with cable TV provided by Comcast. The company owns over a dozen major programming networks like NBC, and so they are more profitable with cable TV than their competitors since Comcast pays themselves for a significant part of their programming costs – what in accounting terms we often refer to as funny-money, or spending kept inside of a corporation. An internal charge within Comcast for programming means both an internal revenue for one division and an internal expense for another division, which cancel each other out when looking at actual Comcast corporate earnings.

Many ISPs elect to offer cable TV because it's something that customers want. The residential survey showed that 43% of the residents of the city said that they want a competitor to offer traditional cable TV. That kind of sentiment makes it hard to decide to not put cable TV in the mix.

The analysis shows that a broadband business in the city must have a telephone product if it is to be profitable or if your goal is to lower the broadband prices. The above results show that the telephone product contributes over \$89 million of margin to the business over 25 years. That equates to a margin every year of more than \$3.5 million. When compared to an average telephone revenue per year of about \$4.1 million, that indicates that telephone has an overall margin of about 85% - which is consistent to what we see from other clients that offer telephone service using their own voice switch. That margin would be lower, perhaps 75% to 80% were you to instead resell purchased VoIP service.

Our analysis calculated that the broadband-only option requires a broadband rate of at least \$60 to break even.

Digital Divide Scenarios

One of the primary motivations for the City Commission to consider broadband is to see if there is a way to offer low cost broadband in the city. The stated goal of the Commission is for Gainesville to have the lowest broadband prices in the country and also to find a way to get broadband into every home.

The base study with \$50 gigabit could be considered as a digital divide offering since that would be the lowest price gigabit in the country. However, as attractive as a \$50 gigabit product would be, it would still be too expensive for many homes. So we decided to dig deeper to see if there are scenarios that would lower the price even more.

We looked at scenarios where some homes would qualify for lower-price broadband. We didn't define how that determination might be made. It's likely that the city would determine guidelines under which households could qualify for lower-price broadband. This might mean linking qualifications to a household's eligibility to receive WIC or some other federal, state, or local low-income program.

We also don't have any way to estimate how many homes might qualify for subsidized broadband. For study purposes we set it equal to 40% of total broadband customers. It's particularly hard to

estimate the proper number since the study is only looking at single family homes and MDUs with 4 or fewer units.

Following are a few different ways to consider offering subsidized broadband. The following three are all breakeven scenarios, meaning that we calculated the lowest price possible to make each scenario work.

- The first scenario looks at how far you could lower the \$50 price for a gigabit product that would be provided to everybody. It turns out that a price of \$44.50 could be offered if all of the other assumptions made in the study are met.
- The second scenario looks at increasing the gigabit price to \$60 - a price that would still be among the lowest in the country, and then calculating the maximum price required for the subsidized broadband. In this case, if regular customers paid \$60 for broadband then low-income homes could be offered a price of \$21.25.
- The third scenario considers setting the gigabit price to \$70. This has become the national “standard” price for gigabit after Google Fiber started using this price in all of their markets. If normal gigabit pricing was at \$70, then the low-income broadband could be lowered to \$6.25 per month.

	Lowest Everywhere	\$60 Gigabit	\$70 Gigabit
Regular gigabit Pricing	\$44.50	\$60.00	\$70.00
Low-Income Pricing	\$44.50	\$21.25	\$ 6.25
Asset Costs	\$97.96 M	\$97.96 M	\$97.96 M
Bond Debt	\$113.6 M	\$113.6 M	\$113.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 6
Years Until Cash Covers Debt	Year 25	Year 25	Year 25
Cash After 25 Years	\$0.44 M	\$0.44 M	\$0.44 M

Finally, we looked at a scenario where that set the price low in the hopes of capturing almost the entire market. In this example, we calculated that the price could be as low as \$32 for a gigabit product if 90% of the market purchased it – which is almost everybody. We have no idea how the market would really react to a price that low, so this result is more in the nature of a thought exercise than a serious idea to consider.

Free Broadband for All

One scenario requested in the ITN was to quantify the cost of giving free broadband to everybody. It’s an interesting idea and is similar to what San Francisco had in mind a few years ago. They proposed levying a \$26 “utility” fee to all households and using that money to build a FTTH network. In the case of San Francisco, they didn’t plan on making broadband free, but instead proposed to give free access to the fiber network to ISPs to offer broadband. The city was estimating that the average price of broadband would be around \$25, making the net cost to homes

of \$51 to get gigabit broadband (\$26 utility fee plus \$25 broadband). One of the policy issues cited for the plan is that homes that don't use or want broadband would still pay the \$26 utility fee.

In this case I assumed that the city would provide free gigabit broadband to customers. I further assumed the following as part of this scenario:

- The city would still sell broadband to businesses at the same prices assumed in the other Base 1 scenarios, and with the same 48% penetration rate – businesses don't get free gigabit service.
- We assumed that the city would not offer cable TV. The product doesn't make money and causes extra work.
- The city would offer landline voice, at the prices assumed in the other studies.
- Since there would significantly less billing and likely fewer customer issues, there would be some operational savings with fewer customer service representatives, lower billing costs, etc.

	Base - \$50 <u>Gigabit</u>	Free <u>Gigabit</u>
Asset Costs	\$97.96 M	\$114.29 M
Bond Debt	\$113.6 M	\$133.9 M
Interest Rate	3.25 %	3.25 %
Penetration Rates	48 %	95 %
Years Until Positive Net Income	Year 5	Never
Years Until Cash Covers Debt	Year 21	Never
Cash After 25 Years	\$35.23 M	(\$306.12 M)

That's obviously a gigantic loss since there is not nearly enough revenue to cover operating and financing costs. However, the number looks a lot more manageable if examined per year on a per customer basis.

For example, in 2025, the year after the network is completed, the loss equates to a cost per residential passing of \$27.21 per month. By 2045 that number grows to \$38.29 per residential passing per month.

This means that if the city could find some other source of revenue to generate \$11.6 million annually (or \$27.21 per household per month) in cash in 2025 then you could provide free gigabit broadband to everybody. The city would need to be creative to find the alternate source of revenue. For example, the city of San Francisco recently considered this same option and they considered funding broadband by charging what they called a utility fee to every household. This could be funded by increases in some other tax such as sales taxes, property taxes or any other tax. Ultimately, taxpayers would be getting gigabit broadband for a net cost of \$27.21 per month per household.

This is a really interesting result and demonstrates how paying for part of a broadband network from some other revenue source could change the broadband prices. In this example, if the city

could find \$11.6 million in 2025 you could give free broadband. That amount grows every year with inflation.

This does raise an interesting scenario we didn't study. The city could allocate something less than 100% of tax revenue to a broadband business and subsequently lower the broadband rates. This analysis shows that contributing \$11.6 million in 2025 could fund free Internet. Contributing something less could result in lower broadband prices.

One issue to keep in mind with this scenario is that Florida law requires the city to charge more than incremental costs for products. That's an easy test to meet for normally-priced products, but impossible to meet if broadband was free.

Another issue to consider is that giving away free broadband would almost certainly see a lawsuit from the incumbents and perhaps even a legislative reaction.

2. GRU Service Territory

Following are the key results for extending the service area to cover the GRU service territory where they provide utility services today. This scenario considers 62,543 passings. This scenario maintains the same assumptions other than looking at the additional passings for the larger service area as well as the extra construction and operational costs involved in serving a larger footprint. Below we will present the same results as above but will not again explain the results in as much detail.

There are two factors that come into play when extending service to a larger footprint. First is economy-of-scale. Telecom businesses are all considered to be economy-of-scale businesses since the business gets more efficient with the additional of customers. The textbook example of this is that a business only needs one general manager. The cost of that general manger becomes lower, on a per-customer basis as more customers are added. Many of the costs required to get into the retail broadband business are fixed, meaning that such costs are similar to the general manager salary and are more efficient with greater numbers of customers.

Offsetting the economy-of-scale efficiencies is the question of customer density. Some of the areas outside the city have a lower household density than in the city. Lower density means a higher fiber cost per customers if there are fewer households along a mile of new fiber.

It's always impossible to know which of these factors is the most important until you crunch the numbers. Adding an additional footprint to a fiber network can result in either higher or lower margins per customer based upon the interplay of these two factors.

Base Study

These are the results for the GRU service territory is as follows.

	48%
<u>Base Study</u>	<u>Penetration</u>

Asset Costs	\$157.32 M
Bond Debt	\$172.8 M
Interest Rate	3.25 %
Penetration Rates	48 %

Years Until Positive Net Income	Year 6
Years Until Cash Covers Debt	Year 21
Cash After 25 Years	\$65.35 M

In this scenario the annual debt payments are increased to \$11.1 million due to the increased bond debt. Note again that this scenario assumes an across-the-board price of \$50 gigabit as the only ISP residential product – something that would be the cheapest gigabit in the country.

Varying the Price

This scenario considers the different the impact on the business performance by varying the residential broadband prices. First, we look at a more normal set of market-based broadband rates, with rates and the product mix set as follows. We also looked to see the impact of raising the gigabit price as the only product to \$60.

<u>Speed</u>	<u>Price</u>	<u>Mix</u>
Tier 1	\$50.00	70%
Tier 2	\$65.00	20%
Gigabit	\$80.00	10%

These would be typical broadband rates for a fiber overbuilder. There would generally be an affordable introductory broadband product, in this case set at \$50, and the majority of customers would buy this product. This assumes two additional products, with the top on being a gigabit priced at \$80. That price is higher than the \$70 price offered by Google Fiber in a few cities but is still lower than the gigabit products offered today by Cox and AT&T. We also considered the same option as before looking at a \$60 gigabit price.

<u>Base Study</u>	Base - \$50 <u>Gigabit</u>	Market <u>Rates</u>	\$60 <u>Gigabit</u>
Asset Costs	\$157.32 M	\$157.32 M	\$157.32 M
Bond Debt	\$172.8 M	\$172.8 M	\$172.8 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 5
Years Until Cash Covers Debt	Year 21	Year 18	Year 16
Cash After 25 Years	\$65.35 M	\$124.52 M	\$163.97 M

These results tell us several things. First, eliminating the normal product mix and offering only 1 product at \$50 lowers cash over 25 years by \$59 million. But the business is still viable and profitable even with a universal residential \$50 gigabit. If anything, this scenario is a little

conservative since the survey indicated that a \$50 gigabit product might draw even a greater market share than the 48%.

The difference in performance between a \$50 gigabit product and a \$60 gigabit product is dramatic, at \$98.6 million over 25 years. It's an interesting comparison because a \$60 gigabit product would still be one of the lowest prices in the country. However, we know from long experience that price is a driving issue for people deciding to change ISPs. We would expect a lower market penetration rate for the \$60 gigabit product compared to the \$50 product – there is no way to know that impact.

But this scenario also quantifies the impact of changing prices. Changing broadband prices by \$1 changes cash over 25 years by almost \$10 million.

Varying the Interest Rate

In this scenario we look at the impact of changing a few of the major financing assumptions.

<u>Base Study</u>	<u>Base - \$50 Gigabit</u>	<u>Higher Interest Rate</u>
Asset Costs	\$157.32 M	\$157.32 M
Bond Debt	\$172.8 M	\$175.8 M
Interest Rate	3.25 %	3.75 %
Penetration Rates	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6
Years Until Cash Covers Debt	Year 21	Year 22
Cash After 25 Years	\$65.35 M	\$45.67 M

In this scenario we increased interest rates from 3.25% to 3.75% - fifty basis points in financial lingo. The higher interest rate decreased cash flow over 25 years by around \$19.7 million. This is a significant shift in cash flow and demonstrates that this project is highly sensitive to interest rates.

Varying the Bond Term

The bond term is the length of time over which a bond issue is repaid. We started our analysis considering a 25-year bond term. This is pretty typical of the term used for other municipal fiber projects. The bond term is important, because just like with a home mortgage, the longer the term on the loan the lower the monthly payments on the debt.

<u>Base Study</u>	<u>Base 25-Years</u>	<u>20-Years</u>	<u>15-Years</u>
Asset Costs	\$157.32 M	\$157.32 M	\$157.32 M
Bond Debt	\$172.8 M	\$175.6 M	\$175.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %

Years Until Positive Net Income	Year 6	Year 6	Year 6
Years Until Cash Covers Debt	Year 21	Year 20	N/A
Cash at end of Bond Term	\$65.35 M	\$3.61 M	(\$48.54M)
Cash After 25 Years	\$65.35 M	\$74.71 M	\$91.77 M

This analysis shows that the project could be funded over 20 years. However, that is basically a breakeven scenario meaning that the business would have to achieve the full 48% market penetration to succeed. This is why, given the choice that cities usually elect to finance a fiber project over the longest term possible since the lower annual debt payments that come with longer bond terms lowers the risk of meeting bond obligations.

This project cannot be financed over 15 years with a \$50 broadband rate. Our analysis shows that the gigabit rate would have to be increased to \$61.50 to break even with a 15-year bond.

Changing the Penetration Rate

The most important variable in any broadband forecast is the number of customers for the projected business. The best plans in the world are no good if a new fiber business doesn't land the needed customers. Again, this study began with a base forecast of 48% based upon the results of the survey.

In this scenario – serving the GRU service territory with a \$50 gigabit broadband product the breakeven penetration rate is calculated to be 43%. That is 1% lower than the breakeven for the city limits, with the lower breakeven due to the economy of scale.

We also looked at the impact of performing better than expected and looked at the results of obtaining a 50% market share.

	48%	43%	50%
<u>Base Study</u>	<u>Base</u>	<u>Breakeven</u>	<u>Penetration</u>
Asset Costs	\$157.32 M	\$153.38 M	\$158.93 M
Bond Debt	\$172.8 M	\$172.6 M	\$173.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	43 %	50 %
Years Until Positive Net Income	Year 6	Year 10	Year 5
Years Until Cash Covers Debt	Year 21	Year 25	Year 19
Cash After 25 Years	\$65.35 M	\$6.52 M	\$89.33 M

As would be expected, surpassing the breakeven penetration rate results in the generation of significant excess cash. These results show that each 1% of market share increases cash flow over 25 years by a little more than \$12 million.

Changing the Construction Contingency

This scenario is looking at the impact of changing the capital costs of the project. We specifically changed the construction contingency in this example, but a change in the cost of building the network for any other reason would achieve the same results.

<u>Base Study</u>	<u>Base 25-Years</u>	<u>No Contingency</u>	<u>10% Contingency</u>
Asset Costs	\$157.32 M	\$150.81 M	\$161.67 M
Bond Debt	\$172.8 M	\$165.5 M	\$177.7 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 6
Years Until Cash Covers Debt	Year 21	Year 20	Year 21
Cash After 25 Years	\$65.35 M	\$79.28 M	\$56.03 M

The construction contingency in this scenario is was set to equal 6% of the cost of the fiber and the core fiber electronics, which is \$6.5 million. Eliminating that much capital spending increases cash flow over 25 years increases cash flow by \$13.9 million. That basically is the cost of interest over 25 years needed to finance that much capital.

We also looked at the impact of increasing capital spending. In this case, increasing the construction contingency to 10% increases capital spending by \$4.35 million. That extra capital would decrease cash flow over 20 years by \$9.3 million.

Varying the Product Mix

We also studied the impact of offering different mixes of products on the network. The base study contemplates offering the triple-play products of broadband, cable TV and telephone service. We wanted to quantify the bottom-line benefit to the business for both the cable TV and the telephone product.

<u>Base Study</u>	<u>Base Triple Play</u>	<u>No Cable TV</u>	<u>Broadband Only</u>
Asset Costs	\$157.32 M	\$153.44 M	\$153.31 M
Bond Debt	\$172.8 M	\$169.2 M	\$169.1 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 14
Years Until Cash Covers Debt	Year 21	Year 21	Never
Cash After 25 Years	\$65.35 M	\$61.62 M	(\$49.31 M)

The results are interesting. Eliminating cable TV reduces cash over 25 years by \$3.7 million. That implies that the cable product loses roughly \$150,000 each year.

The analysis shows that a broadband business in the city must have a telephone product if it is to be profitable or if your goal is to lower the broadband prices. The above results show that the telephone product contributes over \$114 million of margin to the business over 25 years.

Funding at 15 years can be made to work by increasing broadband prices to at least \$59.

Digital Divide Scenarios

We looked at scenarios where some homes would qualify for lower-price broadband. Following are a few different ways to consider offering subsidized broadband. The following three are all breakeven scenarios, meaning that I calculated the lowest prices that might be achieved.

- The first scenario looks at how far you could lower the \$50 price that would be provided to everybody. It turns out that a price of \$43.75 could be offered if all of the assumptions made in the study are met.
- The second scenario looks at increasing the gigabit price to \$60 - a price that would still be among the lowest in the country, and then calculating the maximum price required for the subsidies broadband. In this case, if regular customers paid \$60 for broadband then low-income homes could be offered a price of \$20.00.
- The third scenario considers setting the gigabit price to \$70. This has become the national “standard” price for gigabit after Google Fiber started using this price in all of their markets. If normal gigabit pricing was at \$70, then the low-income broadband could be lowered to \$4.00 per month.

<u>Base Study</u>	<u>Lowest Everywhere</u>	<u>\$60 Gigabit</u>	<u>\$70 Gigabit</u>
Regular gigabit Pricing	\$43.75	\$60.00	\$70.00
Low-Income Pricing	\$43.75	\$20.00	\$ 4.00
Asset Costs	\$157.32 M	\$157.32 M	\$157.32 M
Bond Debt	\$175.6 M	\$175.1 M	\$175.1 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 9	Year 9	Year 9
Years Until Cash Covers Debt	Year 25	Year 25	Year 25
Cash After 25 Years	\$0.18 M	\$5.29 M	\$1.38 M

Finally, we looked at a scenario where you set the price low in the hopes of capturing almost the entire market. In this example, we calculated that the price could be as low as \$31.80 for a gigabit product if 90% of the market purchased it – which is almost everybody. We have no idea how the market would really react to a price that low, so this result is more in the nature of a thought exercise than a serious idea to consider.

3. Urban Reserve

This scenario includes the GRU service area plus the area that was designated for the study as urban reserve. These are parts of the county where there is some housing today and where future

growth might be directed. This scenario considers 67,685 passings. This scenario maintains the same assumptions other than looking at the additional passings for the larger service area as well as the extra construction and operational costs involved in serving a larger footprint. Below we will present the same results as above but will not again explain the results in as much detail.

Base Study

These are the results for the urban reserve service territory is as follows.

	48%
<u>Base Study</u>	<u>Penetration</u>
Asset Costs	\$173.31 M
Bond Debt	\$190.8 M
Interest Rate	3.25 %
Penetration Rates	48 %
Years Until Positive Net Income	Year 6
Years Until Cash Covers Debt	Year 22
Cash After 25 Years	\$40.77 M

In this scenario the annual debt payments are increased to \$12.3 million due to the increased bond debt. Note again that this scenario assumes an across-the-board price of \$50 gigabit as the only ISP residential product – something that would be the cheapest gigabit in the country.

Varying the Price

This scenario considers the different the impact on the business performance by varying the residential broadband prices. First, we look at a more normal set of market-based broadband rates, with rates and the product mix set as follows. We also looked to see the impact of raising the gigabit price as the only product to \$60.

<u>Speed</u>	<u>Price</u>	<u>Mix</u>
Tier 1	\$50.00	70%
Tier 2	\$65.00	20%
Gigabit	\$80.00	10%

These would be typical broadband rates for a fiber overbuilder. There would generally be an affordable introductory broadband product, in this case set at \$50, and the majority of customers would buy this product. This assumes two additional products, with the top on being a gigabit priced at \$80. That price is higher than the \$70 price offered by Google Fiber in a few cities but is still lower than the gigabit products offered today by Cox and AT&T.

	Base - \$50	Market	\$60
<u>Base Study</u>	<u>Gigabit</u>	<u>Rates</u>	<u>Gigabit</u>
Asset Costs	\$173.31 M	\$173.31 M	\$173.31 M
Bond Debt	\$190.8 M	\$190.8 M	\$190.8 M

Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 5
Years Until Cash Covers Debt	Year 22	Year 19	Year 17
Cash After 25 Years	\$40.77 M	\$105.40 M	\$148.50 M

These results tell us several things. First, eliminating the normal product mix and offering only 1 product at \$50 lowers cash over 25 years by \$64.6 million. But the business is still viable and profitable even with a universal residential \$50 gigabit. If anything, this scenario is a little conservative since the survey indicated that a \$50 gigabit product might draw even a greater market share than the 48%.

The difference in performance between a \$50 gigabit product and a \$60 gigabit product is dramatic, at \$107.7 million over 25 years. It's an interesting comparison because a \$60 gigabit product would still be one of the lowest prices in the country. However, we know from long experience that price is a driving issue for people deciding to change ISPs. We would expect a lower market penetration rate for the \$60 gigabit product compared to the \$50 product – there is no way to know that impact.

But this scenario also quantifies the impact of changing prices. Changing broadband prices by \$1 changes cash over 25 years by almost \$10.7 million.

Varying the Interest Rate

In this scenario we look at the impact of changing a few of the major financing assumptions.

<u>Base Study</u>	<u>Base - \$50 Gigabit</u>	<u>Higher Interest Rate</u>
Asset Costs	\$173.31 M	\$173.31 M
Bond Debt	\$190.8 M	\$194.1 M
Interest Rate	3.25 %	3.75 %
Penetration Rates	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6
Years Until Cash Covers Debt	Year 22	Year 24
Cash After 25 Years	\$40.77 M	\$19.07 M

In this scenario we increased interest rates from 3.25% to 3.75% - fifty basis points in financial lingo. The higher interest rate decreased cash flow over 25 years by around \$21.7 million. This is a significant shift in cash flow and demonstrates that this project is highly sensitive to interest rates.

Varying the Bond Term

The bond term is the length of time over which a bond issue is repaid. We started our analysis considering a 25-year bond term. This is pretty typical of the term used for other municipal fiber

projects. The bond term is important, because just like with a home mortgage, the longer the term on the loan the lower the monthly payments on the debt.

<u>Base Study</u>	<u>Base</u> <u>25-Years</u>	<u>20-Years</u>	<u>15-Years</u>
Asset Costs	\$173.31 M	\$173.31 M	\$173.31 M
Bond Debt	\$190.8 M	\$190.8 M	\$190.8 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 6
Years Until Cash Covers Debt	Year 22	N/A	N/A
Cash at End of Bond Term	\$65.35 M	(\$15.5 M)	(\$63.92M)
Cash After 25 Years	\$65.35 M	\$53.72 M	\$72.75 M

This analysis shows that this scenario could not be financed over 20 years with increasing the price of the penetration rate. Our analysis shows that the gigabit rate would have to be increased to \$52.50 to support a 20-year bond with a 48% penetration.

It's even harder to finance this scenario over 15 years. Our analysis shows that the gigabit rate would have to be increased to \$62 for that to breakeven.

Changing the Penetration Rate

The most important variable in any broadband forecast is the number of customers for the projected business. The best plans in the world are no good if a new fiber business doesn't land the needed customers. Again, this study began with a base forecast of 48% based upon the results of the survey.

In this scenario – serving the expansion reserve scenario with a \$50 gigabit broadband product the breakeven penetration rate is calculated to be 45%. That is 2% higher than the breakeven for the GRU service territory and indicates that the urban reserve is not as densely populated as the GRU service territory.

We also looked at the impact of performing better than expected and looked at the results of obtaining a 50% market share.

<u>Base Study</u>	<u>48%</u> <u>Base</u>	<u>45%</u> <u>Breakeven</u>	<u>50%</u> <u>Penetration</u>
Asset Costs	\$173.31 M	\$170.75 M	\$175.07 M
Bond Debt	\$190.8 M	\$189.0 M	\$192.5 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	45 %	50 %
Years Until Positive Net Income	Year 6	Year 6	Year 5
Years Until Cash Covers Debt	Year 22	Year 25	Year 21

Cash After 25 Years	\$40.77 M	\$3.56 M	\$67.03 M
---------------------	-----------	----------	-----------

As would be expected, surpassing the breakeven penetration rate results in the generation of significant excess cash. These results show that each 1% of market share increases cash flow over 25 years by a little less than \$13 million.

Changing the Construction Contingency

This scenario is looking at the impact of changing the capital costs of the project. We specifically changed the construction contingency in this example, but a change in the cost of building the network for any other reason would achieve the same results.

<u>Base Study</u>	Base <u>25-Years</u>	No <u>Contingency</u>	10% <u>Contingency</u>
Asset Costs	\$173.31 M	\$166.08 M	\$178.13 M
Bond Debt	\$190.8 M	\$183.1 M	\$196.0 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 6
Years Until Cash Covers Debt	Year 22	Year 21	Year 23
Cash After 25 Years	\$40.77 M	\$55.18 M	\$31.41 M

The construction contingency in this scenario is was set to equal 6% of the cost of the fiber and the core fiber electronics, which is \$7.2 million. Eliminating that much capital spending increases cash flow over 25 years increases cash flow by \$14.4 million. That basically is the cost of interest over 25 years needed to finance that much capital.

We also looked at the impact of increasing capital spending. In this case, increasing the construction contingency to 10% increases capital spending by \$4.82 million. That extra capital would decrease cash flow over 20 years by \$10.2 million.

Varying the Product Mix

We also studied the impact of offering different mixes of products on the network. The base study contemplates offering the triple-play products of broadband, cable TV and telephone service. We wanted to quantify the bottom-line benefit to the business for both the cable TV and the telephone product.

<u>Base Study</u>	Base <u>Triple Play</u>	No <u>Cable TV</u>	Broadband <u>Only</u>
Asset Costs	\$173.31 M	\$169.11 M	\$168.96 M
Bond Debt	\$190.8 M	\$186.4 M	\$186.2 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 14

Years Until Cash Covers Debt	Year 20	Year 23	Never
Cash After 25 Years	\$40.77 M	\$31.41 M	(\$79.74 M)

The results are interesting. Eliminating cable TV reduces cash over 25 years by \$9.3 million. That implies that the cable product loses roughly \$370,000 each year.

The analysis shows that a broadband business in the city must have a telephone product if it is to be profitable or if your goal is to lower the broadband prices. The above results show that the telephone product contributes almost \$121 million of margin to the business over 25 years.

Funding for broadband-only can be made to work by increasing broadband prices to at least \$59.75.

Digital Divide Scenarios

We looked at scenarios where some homes would qualify for lower-price broadband. Following are a few different ways to consider offering subsidized broadband. The following three are all breakeven scenarios, meaning that I calculated the lowest prices that might be achieved.

- The first scenario looks at how far you could lower the \$50 price that would be provided to everybody. It turns out that a price of \$46.25 could be offered if all of the assumptions made in the study are met.
- The second scenario looks at increasing the gigabit price to \$63.75 in order to maintain the \$20 subsidized broadband product.
- The third scenario considers setting the gigabit price to \$70. This has become the national “standard” price for gigabit after Google Fiber started using this price in all of their markets. If normal gigabit pricing was at \$70, then the low-income broadband could be lowered to \$11 per month.

<u>Base Study</u>	<u>Lowest Everywhere</u>	<u>\$60 Gigabit</u>	<u>\$70 Gigabit</u>
Regular gigabit Pricing	\$46.25	\$63.75	\$70.00
Low-Income Pricing	\$46.25	\$20.00	\$11.00
Asset Costs	\$173.31 M	\$173.31 M	\$173.31 M
Bond Debt	\$190.8 M	\$190.8 M	\$190.8 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 6
Years Until Cash Covers Debt	Year 25	Year 25	Year 25
Cash After 25 Years	\$0.36 M	\$0.36 M	\$1.97 M

Finally, we looked at a scenario where you set the price low in the hopes of capturing almost the entire market. In this example, we calculated that the price could be as low as \$28 for a gigabit product if 90% of the market purchased it – which is almost everybody. We have no idea how the market would really react to a price that low, so this result is more in the nature of a thought exercise than a serious idea to consider.

4. Adding the Small Cities

This scenario adds the cities of Alachua, Archer, Hawthorne, High Springs, Newberry, and Waldo onto the study area that includes the urban reserve. This basically brings broadband to all of the pockets of population in the county, other than rural locations. This scenario considers 78,196 passings. This scenario maintains the same assumptions other than looking at the additional passings for the larger service area as well as the extra construction and operational costs involved in serving a larger footprint. Below we will present the same results as above but will not again explain the results in as much detail.

Base Study

These are the results for the urban reserve service territory is as follows.

	48%
<u>Base Study</u>	<u>Penetration</u>
Asset Costs	\$196.86 M
Bond Debt	\$213.5 M
Interest Rate	3.25 %
Penetration Rates	48 %
Years Until Positive Net Income	Year 6
Years Until Cash Covers Debt	Year 21
Cash After 25 Years	\$70.11 M

In this scenario the annual debt payments are increased to \$13.7 million due to the increased bond debt. Note again that this scenario assumes an across-the-board price of \$50 gigabit as the only ISP residential product – something that would be the cheapest gigabit in the country.

Varying the Price

This scenario considers the different the impact on the business performance by varying the residential broadband prices. First, we look at a more normal set of market-based broadband rates, with rates and the product mix set as follows. We also looked to see the impact of raising the gigabit price as the only product to \$60.

<u>Speed</u>	<u>Price</u>	<u>Mix</u>
Tier 1	\$50.00	70%
Tier 2	\$65.00	20%
Gigabit	\$80.00	10%

These would be typical broadband rates for a fiber overbuilder. There would generally be an affordable introductory broadband product, in this case set at \$50, and the majority of customers would buy this product. This assumes two additional products, with the top on being a gigabit

priced at \$80. That price is higher than the \$70 price offered by Google Fiber in a few cities but is still lower than the gigabit products offered today by Cox and AT&T.

<u>Base Study</u>	Base - \$50 <u>Gigabit</u>	Market <u>Rates</u>	\$60 <u>Gigabit</u>
Asset Costs	\$196.86 M	\$196.86 M	\$196.86 M
Bond Debt	\$213.5 M	\$213.5 M	\$213.5 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 5
Years Until Cash Covers Debt	Year 21	Year 18	Year 17
Cash After 25 Years	\$70.11 M	\$145.38 M	\$195.63 M

These results tell us several things. First, eliminating the normal product mix and offering only 1 product at \$50 lowers cash over 25 years by \$75.3 million. But the business is still viable and profitable even with a universal residential \$50 gigabit. If anything, this scenario is a little conservative since the survey indicated that a \$50 gigabit product might draw even a greater market share than the 48%.

The difference in performance between a \$50 gigabit product and a \$60 gigabit product is dramatic, at \$125.5 million over 25 years. It's an interesting comparison because a \$60 gigabit product would still be one of the lowest prices in the country. However, we know from long experience that price is a driving issue for people deciding to change ISPs. We would expect a lower market penetration rate for the \$60 gigabit product compared to the \$50 product – there is no way to know that impact.

But this scenario also quantifies the impact of changing prices. Changing broadband prices by \$1 changes cash over 25 years by almost \$12.6 million.

Varying the Interest Rate

In this scenario we look at the impact of changing a few of the major financing assumptions.

<u>Base Study</u>	Base - \$50 <u>Gigabit</u>	Higher <u>Interest Rate</u>
Asset Costs	\$196.86 M	\$196.86 M
Bond Debt	\$213.5 M	\$217.2 M
Interest Rate	3.25 %	3.75 %
Penetration Rates	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6
Years Until Cash Covers Debt	Year 21	Year 23
Cash After 25 Years	\$70.11 M	\$45.78 M

In this scenario we increased interest rates from 3.25% to 3.75% - fifty basis points in financial lingo. The higher interest rate decreased cash flow over 25 years by around \$24.3 million. This is

a significant shift in cash flow and demonstrates that this project is highly sensitive to interest rates.

Varying the Bond Term

The bond term is the length of time over which a bond issue is repaid. We started our analysis considering a 25-year bond term. This is pretty typical of the term used for other municipal fiber projects. The bond term is important, because just like with a home mortgage, the longer the term on the loan the lower the monthly payments on the debt.

	Base		
<u>Base Study</u>	<u>25-Years</u>	<u>20-Years</u>	<u>15-Years</u>
Asset Costs	\$196.86 M	\$196.86 M	\$196.86 M
Bond Debt	\$213.5 M	\$213.5 M	\$217.8 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 6
Years Until Cash Covers Debt	Year 21	Year 25	N/A
Cash at End of Bond Term	\$65.35 M	\$4.47 M	(\$64.09 M)
Cash After 25 Years	\$65.35 M	\$91.01 M	\$103.02 M

This analysis shows that this scenario can be financed with financing over 20 years, and that scenario is basically a breakeven.

It's even harder to finance this scenario over 15 years. Our analysis shows that the gigabit rate would have to be increased to \$62.25 for that to breakeven.

Changing the Penetration Rate

The most important variable in any broadband forecast is the number of customers for the projected business. The best plans in the world are no good if a new fiber business doesn't land the needed customers. Again, this study began with a base forecast of 48% based upon the results of the survey.

In this scenario – serving the expansion reserve scenario with a \$50 gigabit broadband product the breakeven penetration rate is calculated to be 45%. That is 2% higher than the breakeven for the GRU service territory and indicates that the urban reserve is not as densely populated as the GRU service territory.

We also looked at the impact of performing better than expected and looked at the results of obtaining a 50% market share.

	48%	43.5%	50%
<u>Base Study</u>	<u>Base</u>	<u>Breakeven</u>	<u>Penetration</u>
Asset Costs	\$196.86 M	\$192.43 M	\$198.51 M

Bond Debt	\$213.5 M	\$210.9 M	\$215.3 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	45 %	50 %
Years Until Positive Net Income	Year 6	Year 6	Year 5
Years Until Cash Covers Debt	Year 21	Year 25	Year 20
Cash After 25 Years	\$70.11 M	\$5.34 M	\$100.61 M

As would be expected, surpassing the breakeven penetration rate results in the generation of significant excess cash. These results show that each 1% of market share increases cash flow over 25 years by a little more than \$15 million.

Changing the Construction Contingency

This scenario is looking at the impact of changing the capital costs of the project. We specifically changed the construction contingency in this example, but a change in the cost of building the network for any other reason would achieve the same results.

<u>Base Study</u>	Base <u>25-Years</u>	No <u>Contingency</u>	10% <u>Contingency</u>
Asset Costs	\$196.86 M	\$188.72 M	\$202.28 M
Bond Debt	\$213.5 M	\$204.9 M	\$219.2 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 5	Year 6
Years Until Cash Covers Debt	Year 21	Year 20	Year 22
Cash After 25 Years	\$70.11 M	\$87.26 M	\$58.69 M

The construction contingency in this scenario is was set to equal 6% of the cost of the fiber and the core fiber electronics, which is \$8.1 million. Eliminating that much capital spending increases cash flow over 25 years increases cash flow by \$17.1 million. That basically is the cost of interest over 25 years needed to finance that much capital.

We also looked at the impact of increasing capital spending. In this case, increasing the construction contingency to 10% increases capital spending by \$5.42 million. That extra capital would decrease cash flow over 20 years by \$11.4 million.

Varying the Product Mix

We also studied the impact of offering different mixes of products on the network. The base study contemplates offering the triple-play products of broadband, cable TV and telephone service. We wanted to quantify the bottom-line benefit to the business for both the cable TV and the telephone product.

<u>Base Study</u>	Base <u>Triple Play</u>	No <u>Cable TV</u>	Broadband <u>Only</u>
-------------------	----------------------------	-----------------------	--------------------------

Asset Costs	\$196.86 M	\$191.99 M	\$191.83 M
Bond Debt	\$213.5 M	\$208.5 M	\$208.3 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 14
Years Until Cash Covers Debt	Year 21	Year 22	Never
Cash After 25 Years	\$70.11 M	\$58.41 M	(\$68.11 M)

Eliminating cable TV reduces cash performance over 25 years by \$11.7 million. That implies that the cable product loses roughly \$470,000 each year.

The analysis shows that a broadband business in the city must have a telephone product if it is to be profitable or if your goal is to lower the broadband prices. The above results show that the telephone product contributes over \$138 million of margin to the business over 25 years.

Funding for broadband-only can only be made to work by increasing broadband prices to at least \$58.50.

Digital Divide Scenarios

We looked at scenarios where some homes would qualify for lower-price broadband. Following are a few different ways to consider offering subsidized broadband. The following three are all breakeven scenarios, meaning that I calculated the lowest prices that might be achieved.

- The first scenario looks at how far you could lower the \$50 price that would be provided to everybody. It turns out that a price of \$44.50 could be offered if all of the assumptions made in the study are met.
- The second scenario looks at increasing the gigabit price to \$61.00 in order to maintain the \$20 subsidized broadband product.
- The third scenario considers setting the gigabit price to \$70. This has become the national “standard” price for gigabit after Google Fiber started using this price in all of their markets. If normal gigabit pricing was at \$70, then the low-income broadband could be lowered to \$6.50 per month.

	Lowest	\$60	\$70
<u>Base Study</u>	<u>Everywhere</u>	<u>Gigabit</u>	<u>Gigabit</u>
Regular gigabit Pricing	\$44.50	\$61.00	\$70.00
Low-Income Pricing	\$44.50	\$20.00	\$ 6.50
Asset Costs	\$196.86 M	\$196.86 M	\$196.86 M
Bond Debt	\$214.6 M	\$214.6 M	\$214.6 M
Interest Rate	3.25 %	3.25 %	3.25 %
Penetration Rates	48 %	48 %	48 %
Years Until Positive Net Income	Year 6	Year 6	Year 6
Years Until Cash Covers Debt	Year 25	Year 25	Year 25
Cash After 25 Years	\$0.65 M	\$1.90 M	\$1.90 M

Finally, we looked at a scenario where you set the price low in the hopes of capturing almost the entire market. In this example, we calculated that the price could be as low as \$27 for a gigabit product if 90% of the market purchased it – which is almost everybody. We have no idea how the market would really react to a price that low, so this result is more in the nature of a thought exercise than a serious idea to consider.

Appendix III: Summary of Financial Results

	Year 1 - 5 Assets	Penetration Rate	Passings	Bond Debt	Cash at End of Bond	Net Income Positive	Cover Debt
GAINESVILLE CITY LIMITS							
1	Base 1	\$97.96 M	48%	42,729	\$113.6 M	\$35.23 M	Year 5 Year 21
2	Normal Market Prices	\$97.96 M	48%	42,729	\$113.6 M	\$73.23 M	Year 5 Year 18
3	Normal Market Prices Breakeven	\$94.06 M	41%	42,729	\$108.4 M	\$7.98 M	Year 6 Year 25
4	With \$60 Gigabit	\$97.96 M	48%	42,729	\$113.6 M	\$94.49 M	Year 5 Year 16
5	Higher Interest Rate	\$97.96 M	48%	42,729	\$115.7 M	\$22.25 M	Year 5 Year 22
6	15-Year Bond Term	\$97.96 M	48%	42,729	\$113.6 M	(\$29.33 M)	Year 5 Never
7	20-Year Bond Term	\$97.96 M	48%	42,729	\$113.6 M	\$1.43 M	Year 5 Year 20
8	Breakeven Penetration – 44%	\$95.79 M	44%	42,729	\$112.5 M	\$2.59 M	Year 5 Year 20
9	50% Penetration	\$99.05 M	48%	42,729	\$113.6 M	\$51.66 M	Year 5 Year 19
10	\$1 Lower Prices	\$97.96 M	48%	42,729	\$113.3 M	\$27.57 M	Year 5 Year 21
11	No Cable TV	\$95.36 M	48%	42,729	\$110.8 M	\$33.88 M	Year 5 Year 21
12	Broadband Only	\$95.25 M	48%	42,729	\$110.8 M	(\$54.05 M)	Year 14 Never
13	Broadband Only Breakeven - \$60	\$95.25 M	48%	42,729	\$110.8 M	\$0.33	Year 9 Year 25
14	No Construction Contingency	\$94.06 M	48%	42,729	\$109.0 M	\$43.68	Year 5 Year 20
15	With 10% Contingency	\$100.56 M	48%	42,729	\$116.7 M	\$29.59	Year 5 Year 21
DIGITAL DIVIDE MODELS							
16	Breakeven Broadband Price - \$44.50	\$97.96 M	48%	42,729	\$113.6 M	\$0.44 M	Year 6 Year 25
17	With \$50 / \$20 Gigabit	\$97.96 M	48%	42,729	\$113.6 M	(\$36.39 M)	Year 14 Never
18	With Normal Broadband Products	\$97.96 M	48%	42,729	\$113.6 M	(\$9.89 M)	Year 9 Never
19	Breakeven with \$60 / \$21.25 GB	\$97.96 M	48%	42,729	\$113.6 M	\$0.44 M	Year 6 Year 25

		Year 1 - 5	Penetration		Bond	Cash at	Net	
		Assets	Rate	Passings	Debt	End of	Income	Cover
						Bond	Positive	Debt
20	With \$70 / \$20 Gigabit	\$97.96 M	48%	42,729	\$113.6 M	\$35.23 M	Year 5	Year 21
21	Breakeven with \$70 / \$6.25 Gigabit	\$97.96 M	48%	42,729	\$113.6 M	\$0.44 M	Year 6	Year 25
22	Breakeven w/ 90% of Households - \$32	\$116.70 M	90%	42,729	\$136.5 M	\$3.47 M	Year 6	Year 25

GRU SERVICE TERRITORY

23	Base 2	\$157.32 M	48%	62,543	\$172.8 M	\$65.35 M	Year 6	Year 21
24	With Normal Market Prices	\$157.32 M	48%	62,543	\$172.8 M	\$124.52 M	Year 5	Year 18
25	With \$60 Gigabit	\$157.32 M	48%	62,543	\$172.8 M	\$163.97 M	Year 5	Year 16
26	Higher Interest Rate	\$157.32 M	48%	62,543	\$172.8 M	\$45.67 M	Year 6	Year 22
27	20-Year Term	\$157.32 M	48%	62,543	\$175.6 M	\$3.61 M	Year 6	Year 20
28	15-Year Term	\$157.32 M	48%	62,543	\$175.6 M	(\$48.54 M)	Year 6	Never
29	Breakeven Penetration – 43%	\$153.38 M	43%	62,543	\$172.6 M	\$6.52 M	Year 10	Year 25
30	0.2% Higher Growth Rate	\$157.57 M	48%	62,543	\$172.9 M	\$77.30 M	Year 6	Year 20
31	50% Penetration	\$158.93 M	48%	62,543	\$173.6 M	\$89.33 M	Year 5	Year 19
32	\$1 Lower Prices	\$157.32 M	48%	62,543	\$172.8 M	\$53.99 M	Year 6	Year 21
33	No CATV	\$153.44 M	48%	62,543	\$169.2 M	\$61.62 M	Year 6	Year 21
34	Broadband Only	\$153.31 M	48%	62,543	\$169.1 M	(\$49.31 M)	Year 14	Never
35	Broadband Only Breakeven - \$59	\$153.31 M	48%	62,543	\$172.9 M	\$27.27 M	Year 9	Year 24
36	No Construction Contingency	\$150.81 M	48%	62,543	\$165.5 M	\$79.28 M	Year 5	Year 20
37	With 10% Contingency	\$161.67 M	48%	62,543	\$177.7 M	\$56.03 M	Year 6	Year 21

DIGITAL DIVIDE MODELS

38	Breakeven Broadband Price - \$43.75	\$157.32 M	48%	62,543	\$175.6 M	\$0.18 M	Year 9	Year 25
39	With \$50 / \$20 Gigabit	\$157.32 M	48%	62,543	\$172.8 M	(\$45.78 M)	Year 14	Never
40	With Normal Broadband Products	\$157.32 M	48%	62,543	\$175.1 M	(\$6.06 M)	Year 9	Never
41	With \$60 / \$20 Gigabit	\$157.32 M	48%	62,543	\$175.1 M	\$5.29 M	Year 9	Year 25

		Year 1 - 5	Penetration		Bond	Cash at	Net	
		Assets	Rate	Passings	Debt	End of	Income	Cover
						Bond	Positive	Debt
42	With \$70 / \$20 Gigabit	\$157.32 M	48%	62,543	\$172.8 M	\$65.34 M	Year 6	Year 21
43	Breakeven w/ \$70 / \$4 Gigabit	\$157.32 M	48%	62,543	\$175.1 M	\$1.38 M	Year 9	Year 25
44	Breakeven w/ 90% Households - \$31.80	\$187.03 M	90%	62,543	\$218.7 M	\$0.27 M	Year 10	Year 25
URBAN RESERVE								
45	Base 3	\$173.31 M	48%	67,685	\$190.8 M	\$40.77 M	Year 6	Year 22
46	With Normal Market Pricing	\$173.31 M	48%	67,685	\$190.8 M	\$105.40 M	Year 5	Year 19
47	With \$60 Gigabit	\$173.31 M	48%	67,685	\$190.8 M	\$148.50 M	Year 5	Year 17
48	Higher Interest Rate	\$173.31 M	48%	67,685	\$194.1 M	\$19.07 M	Year 6	Year 24
49	20-Year Term	\$173.31 M	48%	67,685	\$190.8 M	(\$15.50 M)	Year 6	Never
50	15-Year Term	\$173.31 M	48%	67,685	\$190.8 M	(\$63.92 M)	Year 6	Never
51	45% Penetration = Breakeven	\$170.75 M	45%	67,685	\$189.0 M	\$3.56 M	Year 6	Year 25
52	50% Penetration Rate	\$175.07 M	50%	67,685	\$192.5 M	\$67.03 M	Year 5	Year 21
53	\$1 Lower Prices	\$173.31 M	48%	67,685	\$190.8 M	\$28.47 M	Year 6	Year 23
54	No CATV	\$169.11 M	48%	67,685	\$186.4 M	\$31.41 M	Year 6	Year 23
55	Broadband Only	\$168.96 M	48%	67,685	\$186.2 M	(\$79.74 M)	Year 14	Never
56	Broadband Only Breakeven - \$59.75	\$168.96 M	48%	67,685	\$189.6 M	\$9.25 M	Year 9	Year 25
57	No Construction Contingency	\$166.08 M	48%	67,685	\$183.1 M	\$55.18 M	Year 5	Year 21
58	With 10% Contingency	\$178.13 M	48%	67,685	\$196.0 M	\$30.58 M	Year 6	Year 23
DIGITAL DIVIDE MODELS								
59	Breakeven Broadband Price - \$46.25	\$173.31 M	48%	67,685	\$190.8 M	\$0.36 M	Year 6	Year 25
60	With \$50 / \$20 Gigabit	\$173.31 M	48%	67,685	\$190.8 M	(\$76.85 M)	Year 14	Never
61	With Normal Broadband Products	\$173.31 M	48%	67,685	\$190.8 M	(\$32.68 M)	Year 13	Never
62	Breakeven with \$63.75 / \$20 Gigabit	\$173.31 M	48%	67,685	\$190.8 M	\$0.36 M	Year 6	Year 25
63	With \$60 / \$20 Gigabit	\$173.31 M	48%	67,685	\$190.8 M	(\$21.57 M)	Year 10	Never

		Year 1 - 5	Penetration		Bond	Cash at	Net	
		Assets	Rate	Passings	Debt	End of	Income	Cover
						Bond	Positive	Debt
64	With \$70 / \$20 Gigabit	\$173.31 M	48%	67,685	\$190.8 M	\$40.76 M	Year 6	Year 22
65	Breakeven with \$70 / \$11 Gigabit	\$173.31 M	48%	67,685	\$190.8 M	\$1.97 M	Year 6	Year 25
66	Breakeven w/ 90% Households - \$28	\$210.94 M	90%	67,685	\$231.1 M	\$2.07 M	Year 6	Year 25
ADD SMALL CITIES								
67	Base 4	\$196.86 M	48%	78,196	\$213.5 M	\$70.11 M	Year 6	Year 21
68	With Normal Marketing	\$196.86 M	48%	78,196	\$213.5 M	\$145.38 M	Year 5	Year 18
69	With \$60 Gigabit	\$196.86 M	48%	78,196	\$213.5 M	\$195.63 M	Year 5	Year 17
70	Higher Interest Rate	\$196.86 M	48%	78,196	\$217.2 M	\$45.75 M	Year 6	Year 23
71	20-Year Term	\$196.86 M	48%	78,196	\$213.5 M	(\$4.33 M)	Year 6	Never
72	15-Year Term	\$196.86 M	48%	78,196	\$217.8 M	(\$64.09 M)	Year 6	Never
73	Breakeven Penetration – 43.5%	\$192.43 M	43.5%	78,196	\$210.9 M	\$5.34 M	Year 6	Year 25
74	50% Penetration	\$198.51 M	50%	78,196	\$215.3 M	\$100.61 M	Year 5	Year 20
75	\$1 Lower Prices	\$196.86 M	48%	78,196	\$213.5 M	\$55.91 M	Year 6	Year 22
76	No CATV	\$191.99 M	48%	78,196	\$208.5 M	\$58.41 M	Year 6	Year 22
77	Broadband Only	\$191.83 M	48%	78,196	\$208.3 M	(\$68.11 M)	Year 14	Never
78	Broadband Only Breakeven - \$58.50	\$191.83 M	48%	78,196	\$211.7 M	\$23.67 M	Year 6	Year 24
79	No Construction Contingency	\$188.72 M	48%	78,196	\$204.9 M	\$87.26 M	Year 5	Year 20
80	With 10% Contingency	\$202.28 M	48%	78,196	\$219.2 M	\$58.69 M	Year 6	Year 22
DIGITAL DIVIDE MODELS								
81	Breakeven Broadband Price - \$44.50	\$196.86 M	48%	78,196	\$214.6 M	\$0.65 M	Year 6	Year 25
82	With \$50 / \$20 Gigabit	\$196.86 M	48%	78,196	\$213.5 M	(\$69.61 M)	Year 14	Never
83	With Normal Broadband Products	\$196.86 M	48%	78,196	\$214.6 M	(\$30.63 M)	Year 10	Never
84	Breakeven with \$61 / \$20 Gigabit	\$196.86 M	48%	78,196	\$214.6 M	\$1.90 M	Year 6	Year 25
85	With \$70 / \$6.50 Gigabit	\$196.86 M	48%	78,196	\$214.6 M	\$69.70 M	Year 6	Year 21

		Year 1 - 5 Assets	Penetration Rate	Passings	Bond Debt	Cash at End of Bond	Net Income Positive	Cover Debt
86	Breakeven with \$70 / \$6.50 Gigabit	\$196.86 M	48%	78,196	\$214.6 M	\$1.90 M	Year 6	Year 25
87	Breakeven w/90% Households - \$27	\$240.42 M	90%	78,196	\$261.3 M	\$0.98 M	Year 6	Year 25

Appendix IV: Results of the Residential Survey

GAINSVILLE Residential Survey

Triple Play Service

1. Who provides Internet service to your home?

Cox	219	59%
AT&T	101	27%
Windstream	20	5%
Uniti Fiber	1	.05%
Century Link	5	1%
Only use Cellphone data	13	4%
Don't have Internet	10	3%
Other - Hot Spot	1	.05%

2. Who is your current cable TV provider?

Cox	228	62%
AT&T	40	11%
Windstream	7	2%
Satellite Dish (Dish or DIRECTV)	61	16%
Watch only on-line (Netflix)	22	6%
Don't have Cable TV	12	3%

3. If you have a telephone landline, who provides your telephone service?

Cox	162	44%
AT&T	42	11%
Windstream	10	3%
Century Link	4	1%
Don't have a landline telephone	151	41%

4. What do you pay for:

Standalone Cable TV		
\$50 - \$75	12	46%
\$76 - \$100	12	46%
\$100+	1	4%
Standalone Telephone		
\$35	2	100%

Standalone Internet			
	\$30 - \$50	20	71%
	\$51 - \$80	8	29%
Bundled Services			
	\$75 or Less	22	7%
	\$76 - \$100	79	25%
	\$101 - \$125	113	35%
	\$126 - \$150	67	21%
	\$151 - \$175	18	6%
	\$176 - \$200	19	6%

5. Do you know the Internet speed the company says they are providing?

Don't Know	229	66%
10 - 19 Mbps	24	7%
20 - 30 Mbps	36	11%
80 Mbps	1	0%
100 Mbps	49	14%
150 Mbps	1	0%
200+ Mbps	7	2%

Do you know the actual download speed you are getting?

Don't Know	249	72%
10 - 19 Mbps	23	7%
20 - 30 Mbps	32	9%
100 Mbps	40	11%
200+ Mbps	3	1%

6. Please rate your Internet service provider regarding the following from 1 to 5, where 1 is extremely dissatisfied and 5 is extremely satisfied.

Download Speed		
1 - Extremely dissatisfied	50	14%
2 - Somewhat dissatisfied	44	13%
3 - Neutral	107	31%
4 - Somewhat satisfied	105	30%
5 - Extremely satisfied	41	12%

The value I get compared to the price I pay		
1 - Extremely dissatisfied	41	12%
2 - Somewhat dissatisfied	60	17%
3 - Neutral	165	47%
4 - Somewhat satisfied	58	17%
5 - Extremely satisfied	23	7%

7. Please give your perception of the quality of service provided by the following today from 1 to 5 where 1 is extremely dissatisfied and 5 is extremely satisfied.

Cox		
1 – Extremely dissatisfied	53	15%
2 – Somewhat dissatisfied	67	19%
3 – Neutral	129	35%
4 – Somewhat satisfied	67	19%
5 – Extremely satisfied	45	12%

AT&T		
1 – Extremely dissatisfied	15	4%
2 – Somewhat dissatisfied	51	15%
3 – Neutral	189	55%
4 – Somewhat satisfied	70	20%
5 – Extremely satisfied	22	6%

The City		
1 – Extremely dissatisfied	47	13%
2 – Somewhat dissatisfied	109	30%
3 – Neutral	144	40%
4 – Somewhat satisfied	50	14%
5 – Extremely satisfied	13	3%

8. Are you aware that the city already owns and operates a 600-mile fiber network that serves many of the area's largest businesses?

Yes	112	30%
No	258	70%

9. In general, how do you feel about the idea of the city building and operating a gigabit fiber network to serve homes and small businesses in the city?

I support the idea	141	38%
I do not support the idea	100	27%
I might support the idea but need more information	129	35%

10. The city has established goals for operating a fiber network in the city. Which of these goals do you support? You may choose all of the responses that apply.

Bringing broadband competition and choice	229	62%
Offering the lowest broadband prices in the country	310	84%
Providing broadband speeds up to 1 gigabit	110	30%
Providing better customer service	104	28%

11. If you do not support a city fiber network, what are your reasons? You may choose all of the responses that apply.

I am happy with my current provider	84	67%
I believe that city government should not compete with the private business	15	12%
I worry about the higher taxes	20	16%
I do not believe the city would provide better service.	6	5%

12. If the city builds a fiber network, what factors would influence your decision to move your current services to the new network? You may choose all the responses that apply.

Faster Internet speeds for the same price I pay today	97	26%
Lower price than I pay today	290	78%
Same price I pay today but better customer service	12	3%
Choosing the city service would keep the dollars I pay in our community	39	11%

13. Would you buy Internet service from the city if they guaranteed faster speeds than the competition at rates similar to what is currently available?

Yes definitely	59	16%
Probably	124	33%
Maybe	106	29%
Probably not	56	15%
Definitely not	25	7%

14. If the city builds a new network, how important is it to you that the city provides Cable TV service along with Internet access?

I want cable TV in the bundle	158	43%
An option for cable TV would be nice but not mandatory	136	37%
Cable is not important to me	67	18%
Other - Don't support or Don't care	9	2%

15. Would you buy cable TV service from a new city network if they offered similar channel line-ups and prices as today?

Yes definitely	45	12%
Probably	113	31%
Maybe	116	31%
Probably not	58	16%
Definitely not	38	10%

16. Would you buy a landline telephone from a new city network if they could offer affordable prices?

Yes definitely	54	15%
Probably	59	16%
Maybe	75	20%
Probably not	86	23%
Definitely not	96	26%

17. The city is considering having a program to make sure that low-income homes with school students gets fast Internet access. Would you support the fiber network if your monthly fee for Internet service helped to pay for these connections?

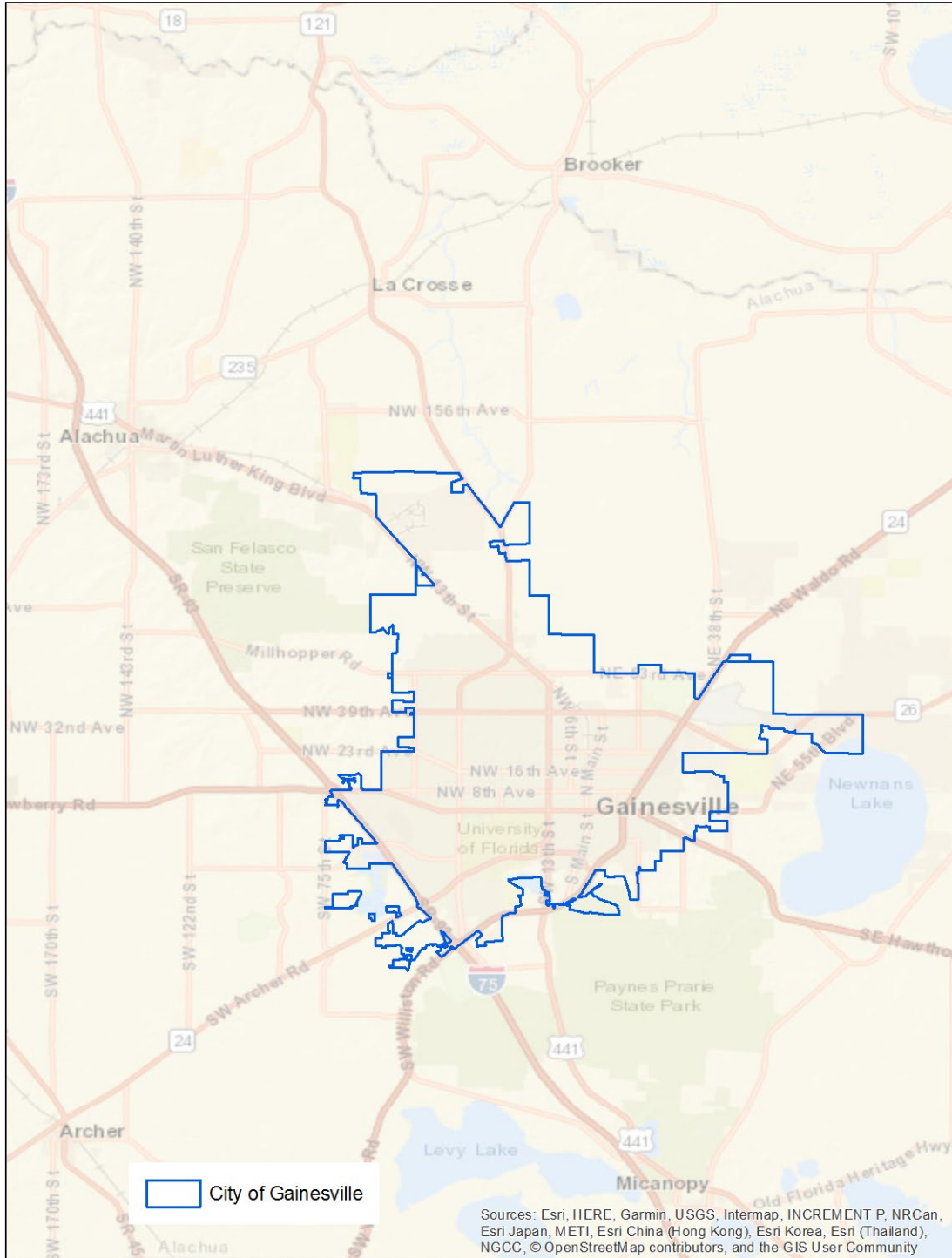
Yes definitely	81	22%
Probably	91	25%
Maybe	129	35%
Probably not	49	13%
Definitely not	20	5%

18. One of the city's primary goals is to bring the most affordable broadband in the country to the city. Would you subscribe to a city fiber network if it provided gigabit Internet access for \$50 per month?

Yes definitely	86	23%
Probably	121	33%
Maybe	119	32%
Probably not	26	7%
Definitely not	18	5%

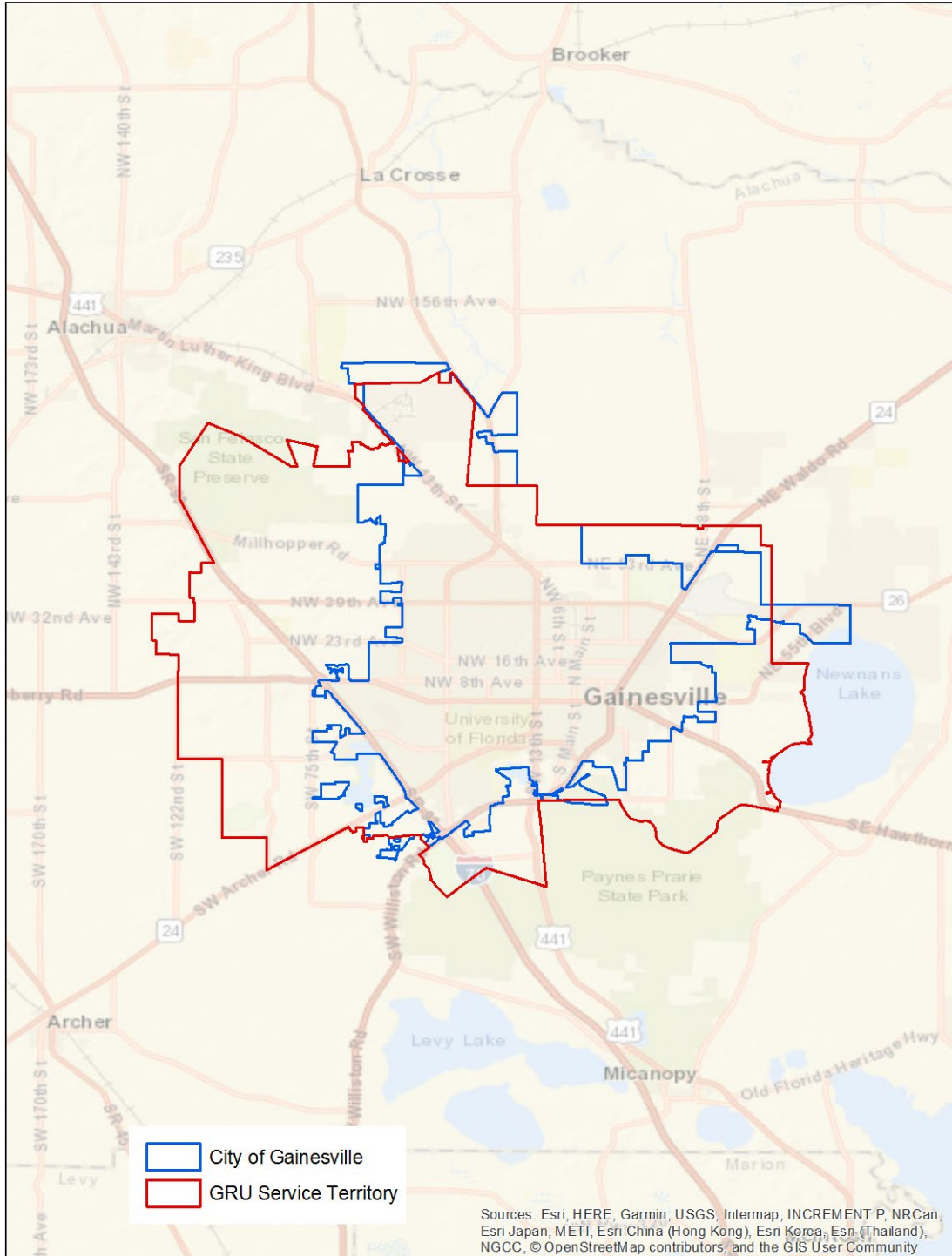
Appendix V: Map of Gainesville City Limits

Gainesville City Limits Map



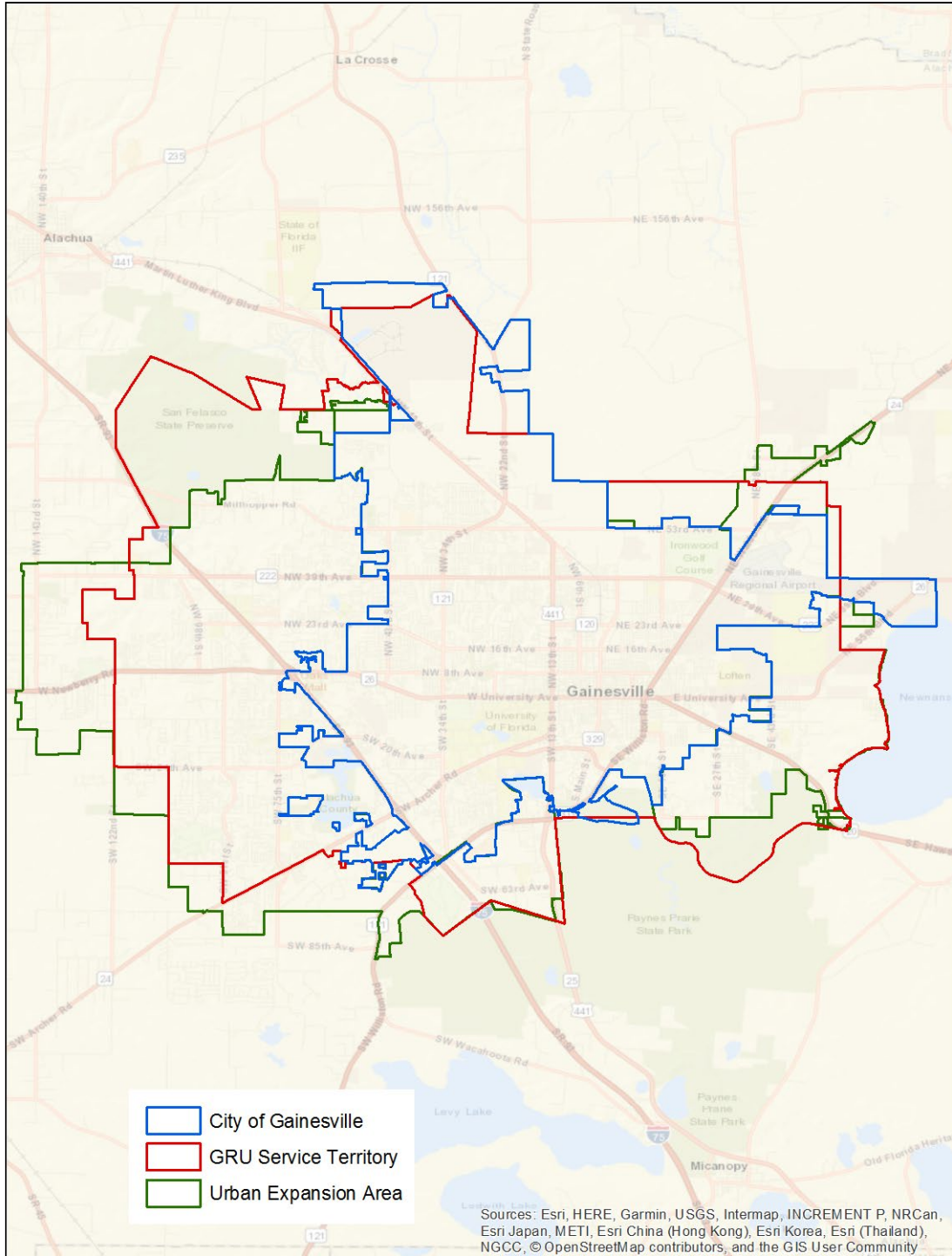
Appendix VI: Map of GRU Service Territory

GRU Service Territory Map



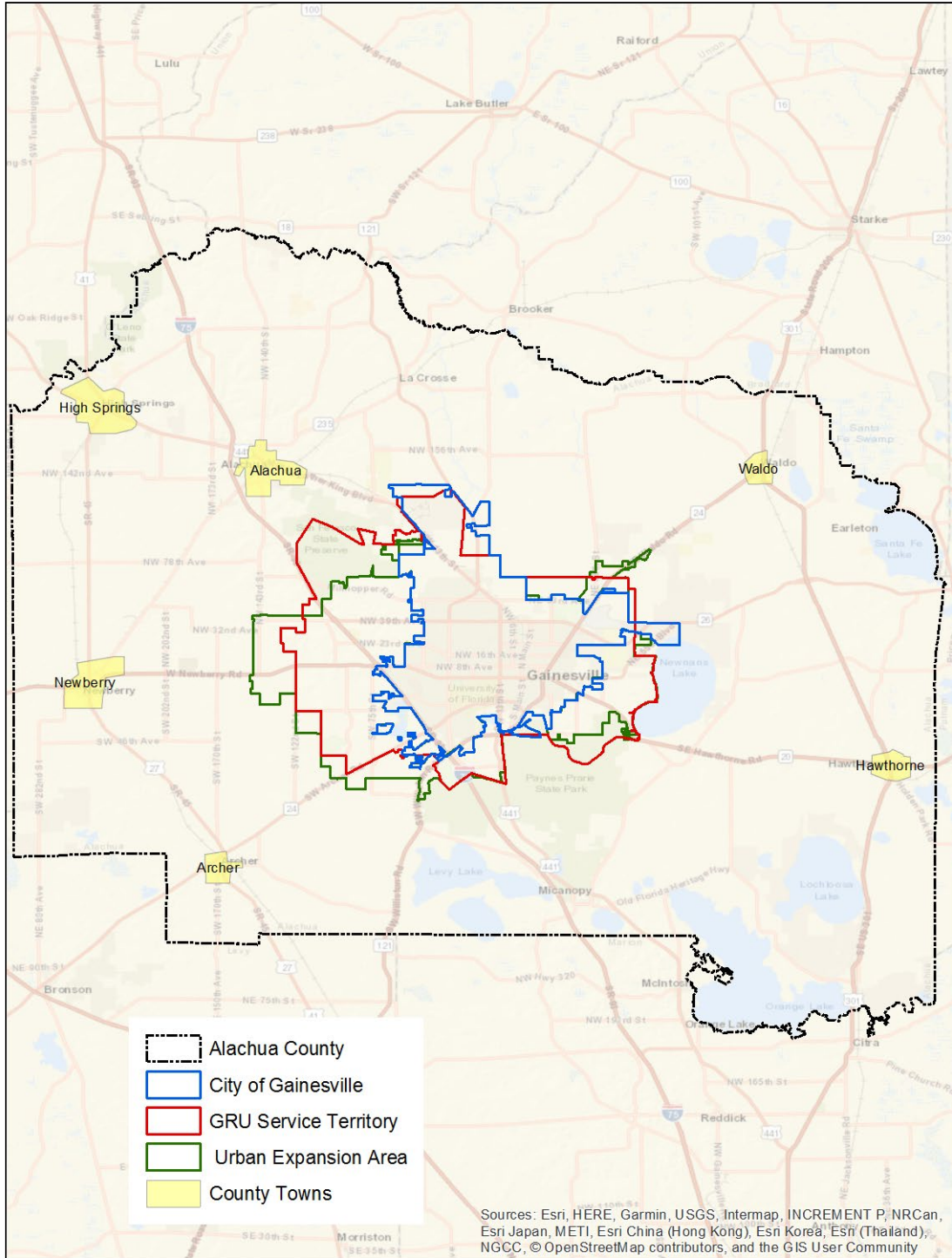
Appendix VII: Map of Urban Expansion Area

Urban Expansion Area Map



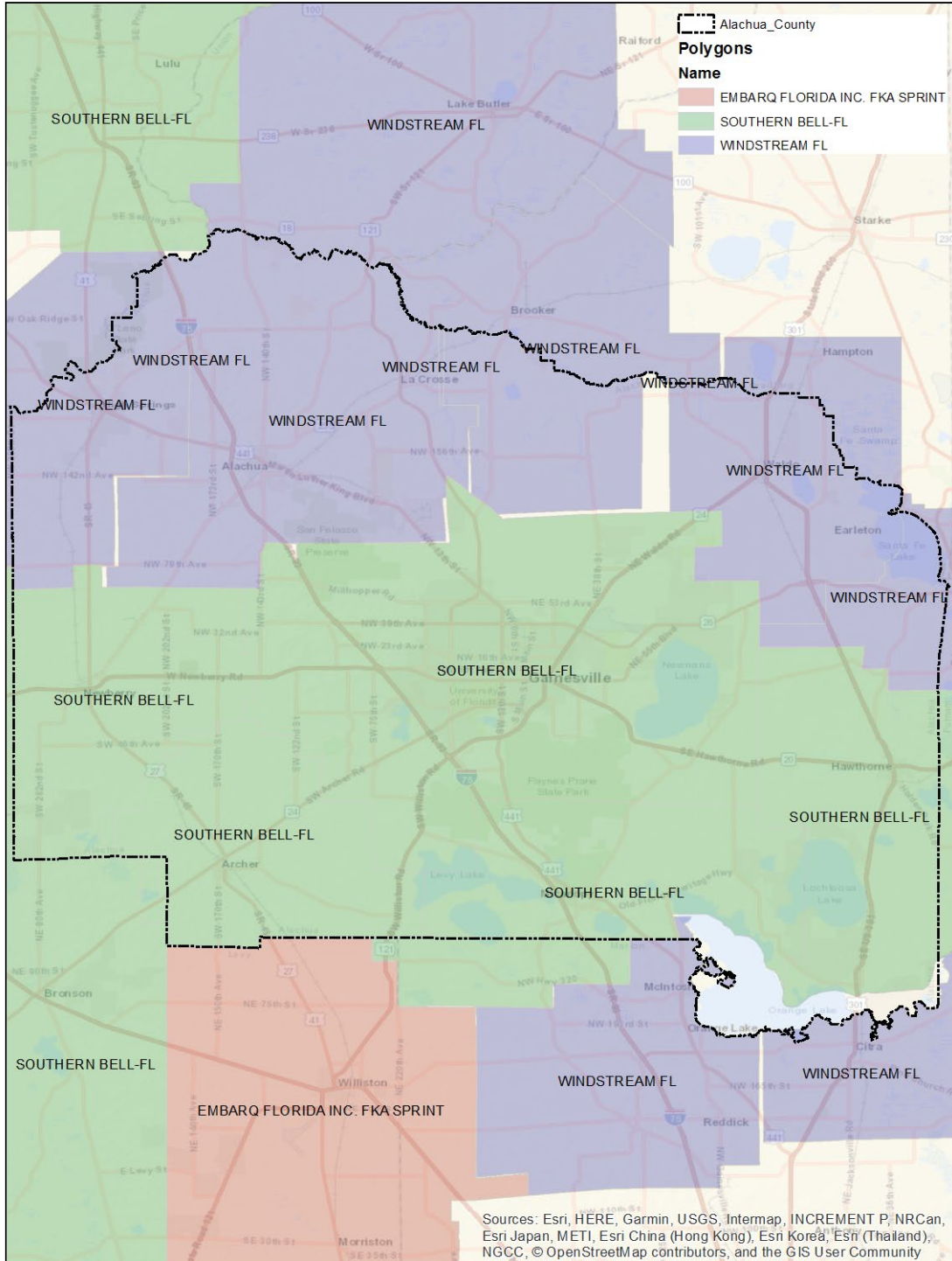
Appendix VIII: Map Adding Small Cities

County Towns Map



Appendix IX: Map of Incumbent Telephone Companies

Incumbent Telephone Company Service Areas



Appendix X: Map of Alachua County Opportunity Zone

Gainesville Opportunity Zone

