LEHI CITY, UTAH

12.15.2020

Fiber Feasibility Study

EST 1852

LEHI CITY

PIONEERING UTAH'S FUTURE

Magellan ADVISORS

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1. EXECUTIVE SUMMARY

In late 2019, Lehi City released a competitive RFP for a feasibility study of the City building a fiber-optic broadband network to provide high-speed Internet services to its community. Magellan Advisors was selected by the City to provide the Study. This report provides a summary of the feasibility study, with detailed information, designs, costs, and business analysis of the City building and operating a fiber to the home broadband network.

The intent of this Study is to inform City leadership of the requirements to build and operate a broadband business. It answers the following questions:

1. What are the benefits of building a fiber network for Lehi City and its community?
2. Are Lehi City's residents and businesses satisfied with their Internet services today and what is the demand for additional high-speed Internet services?
3. What are the City's advantages and disadvantages of building and operating a fiber to the home ("FTTH") network?
4. What is the recommended business model to operate and manage broadband, given the State of Utah statutory requirements for municipal broadband providers?
5. What are the costs of building the network?
6. What is the financial feasibility of building and operating the network and how would the project be funded?

The Study conducted extensive quantitative market research, regulatory analyses, technical analysis, network design, cost estimation and financial analysis to determine the most feasible approaches that the City could utilize to build and operate the network. The City possesses certain advantages to deploying broadband, including ownership of electric poles, property, fiber, and underground conduit, all of which may reduce the total costs of building and managing a broadband network.

The City also faces certain disadvantages, namely its limited experience in the broadband business and statutory restrictions on providing retail Internet services based on the Utah Municipal Cable Television and Public Telecommunications Services Act. The Study assessed these advantages and

disadvantages to craft the most feasible approach for the City to deploy broadband.

Critical to the Study was an assessment of the community's demand for broadband. Household and business surveys conducted in the Study indicated high relevance, importance, and adoption of broadband services among residents and businesses. Through the implementation of a choice-based conjoint survey tool, the market research indicated that Lehi could expect an average of 45% of homes and businesses would sign up for Internet services if offered at comparable or slightly lower rates and faster speeds than are being provided today.

The most feasible way for the City to provide broadband services positions the City as a wholesale provider of broadband rather than a retail Internet service provider. In this model, the City would finance and build the fiber network while inviting one or more Internet service providers ("ISPs") to deliver retail services to residents and businesses. Retail ISPs would sell, market, and compete for customers using the City's network and assume all functions needed to run the broadband business, alleviating the City of the major requirements of operating an ISP.

Citizens and businesses would select their services from one or more providers. Lehi would charge a fee (or revenue share) to the provider(s) for each customer connected, with minimum commitments. ISP residential rates would likely range from $50- $80 per month depending on speeds. Business rates would likely range from $79.99 up to $399.99, again depending on speeds and packages.

The Study found that the wholesale business model is preferred to the traditional retail business model. Why? First, the Municipal Cable Television and Public Telecommunications Services Act provides restrictions on how municipalities can finance broadband networks if they provide retail Internet services. The Act also places restrictions on how the City operates its network, shares resources with other departments and provides startup funding to support these operations.

Second, the City would face more significant challenges competing directly with existing broadband providers than if it were only a wholesale provider. The City could develop its competitive orientation to overcome this challenge, as many municipal broadband providers have nationwide; however, when coupled with the restrictive regulatory environment in Utah, this scenario creates a less feasible outcome than the wholesale scenario. The wholesale model is not covered under the restrictions of the Act and therefore enables Lehi City to alleviate some obstacles while still ensuring that its community receives Internet services.

Several financial scenarios were modeled in the Study to determine the revenues, costs, debt service, renewal and replacement required to build and maintain the network. The most feasible model requires total funding of $70 - $80 million, the proceeds of which would be used for construction of the fiber network, capitalized interest, costs of issuance and working capital. Future capital and operating expenses would be paid for through system revenues. Over the 20-year period modeled in the Study, the system would cover its costs and generate a surplus for the City of $6 – $12 million.

2. INDUSTRY OVERVIEW

WHAT IS FIBER-BASED BROADBAND

Broadband internet services provided over fiber-optic cables is commonly referred to as fiber-based broadband, fiber to the home or fiber to the premise. In each of these cases, individual strands of glass are installed in homes and businesses through cables constructed on utility poles or buried in underground conduit. Fiber-based broadband provides a superior technology to enable high-speed Internet services over traditional telephone, or cable lines, bringing symmetrical bandwidth (the same upload and download speeds), more reliability, greater distances and more scalability to providers' networks and their customers.

Fiber has become the de facto standard for municipal communications, broadband services, and Internet access. Fiber is used to transmit large amounts of data securely over long distances with high reliability. It supports a wide range of applications and is scalable to support nearly unlimited data capacity. Cities that own fiber consider it a capital infrastructure asset similar to water, roads, and electric infrastructure.

Over 3,000 cities in the US own some form of municipal fiber and have used it for decades to support their communities. These networks are becoming increasingly important to cope with the rapid growth in connected devices, from utility assets, to streetlights, to traffic signals, to surveillance cameras. Cities that maintain these networks are able to accommodate these "Smart City" technologies that make them more efficient, reduce costs and increase the value they deliver to their constituents.

Within the past 15 years, some cities have expanded the use of these networks to enhance local broadband Internet services in their communities in order to support the needs of residents, businesses, and community organizations. As high-speed Internet access has become essential to support economic development, education, healthcare, and other community functions, cities have leveraged their networks to provide fiber-

based Internet services, either directly or through partnerships with private broadband providers.

WHY DO CITIES INVEST IN FIBER?

Community owned fiber-optic networks provide a platform for municipal efficiencies, smart city networks, utility cost savings, opportunities to enhance private providers local networks and enhance economic development and quality of life for residents. Fiber networks, when designed correctly, provide ample connectivity opportunities for multiple agencies both public and private, providing the most benefits to the community.

Grid Modernization

Technology is transforming public utilities at a rapid pace and is reshaping how customers both consume energy and interact with their utilities. Most notably, technology made possible through fiber optics breathes new life into aging distribution systems at a time when distributed energy resources and renewable energy are challenging utility business models and centralized generation.

The US Department of Energy acknowledges that "Our electric infrastructure is aging, and it is being pushed to do more than it was originally designed to do." [1]Grid modernization generally refers to the improvements needed in the power grid to accommodate all the rapid technological changes happening in the generation, transmission and distribution of electricity. Local utilities can modernize their local grid to make it “smarter” and more resilient through local sensors and controls that communicate and work together to deliver electricity more reliably and efficiently.

Short term benefits allow utilities to reduce the frequency and duration of power outages, reduce storm impacts and restore service faster when outages occur. Across the longer term, utilities benefit from a modernized grid by improved security, reduced peak loads, data-driven decision-making, and lower operational costs. Additionally, a smart grid allows for the increased integration of renewables and distributed energy generation sources.

[1] https://www.energy.gov/oe/activities/technology-development/grid-modernization-and-smart-grid

Energy customers can manage their own energy decisions and costs through easier access to their own consumption data. Advances in the economical production of lower-carbon energy production, energy storage and control systems are giving rise to consumers being able to drive their own choices. These choices ultimately have impacts on demand and some have the potential to produce a new energy marketplace at the local distribution level.

Utilities today are working to increase monitoring, improve reliability and integrate distributed energy sources to bring a new array of assets online. As energy storage, distributed energy sources and energy-efficient consumer options continue to make advances, grid modernization and secure and real-time data via fiber will be key for the growth and relevance to the smart grid utility.

The drivers of investments that utilities are making to modernize the grid stem, ironically, from assets that utilities often do not own, namely distributed energy sources such as rooftop solar arrays, electric vehicles and battery energy storage systems. To make these investments valuable, utilities can use monitoring, control and automation technologies to unlock the full potential of grid assets for greater reliability, efficiency and security.

Electricity distribution is regulated by the states, and interstate transmission is regulated by the federal government. From a political standpoint, grid modernization is so integrated into the fabric of society that government policies on the environment, the economy and homeland security have influences on the modernizing of the grid. Government policy is motivating the growth in renewables; therefore, modernizing the grid is needed to enable the non-carbon shift in the generation mix, and government policies will continue to encourage this.

Municipal Connectivity

Leveraging new fiber assets to connect public institutions throughout the Lehi City community creates opportunities to establish collaborative technology programs across multiple organizations. Establishing institutional access to Lehi City's conduit and fiber networks would create an inter-governmental backbone through which public organizations have access to network connectivity with very high capacity that can be continuously

upgraded at relatively low costs. This enables municipal and community organizations to futureproof their connectivity needs and reduce ongoing operational expenses for their connectivity. Rather than paying providers for this connectivity, they pay the City to share in overall costs of maintaining the municipally-owned system. In most cases, building and maintaining this fiber provides a substantial savings over leasing these services from providers.

Connecting schools, libraries, local governments, public safety agencies, and community organizations to one another also facilitates the sharing of technology resources among the organizations. Fiber connectivity offers virtually unlimited bandwidth and security that would not be available otherwise.

Economic Development

Increasing the availability of high-speed broadband in Lehi City's corridors provides an opportunity to enhance local economic development efforts. Through the deployment of fiber technology, Lehi City can designate these areas as being fiber-ready, allowing any business moving to Lehi City to recognize that fiber services are readily available and prevalent at competitive rates. Access to high-speed Internet is a significant economic driver for communities looking for ways to attract and retain business. A side benefit is the increase in electric demand from new businesses locating in the area; broadband feeds new business to the electric utility and grows demand.

Magellan's team met with the Lehi City planners who emphasized several new development and growth areas around the City that would be best suited for fiber development to attract new businesses and residents.

Education

Educational institutions around the country have become one of the greatest beneficiaries of locally owned fiber networks. Education has become a broader community responsibility, with organizations such as libraries and non-profits providing support, internships and alternatives as education extends beyond the traditional classroom environment – as students perform assignments outside of school and as adults look to continue lifelong learning.

Connecting to innovative educational programs and tools requires high-speed, reliable and affordable connectivity. As virtual support moves online, and access to free, world-class educational resources expand, so does a community's responsibility to provide for all its learners beyond the school day.

Access to broadband is an important component of education, inside the classroom and in the home. Online applications used to support education and training efforts require high-speed broadband, with services that meet performance requirements to support real-time video and voice applications for distance learning and teleconferencing. Today's teaching resources incorporate multimedia—sound, graphics, video, and data, while the use of online digital textbooks continue to expand.

Many cities have built fiber-based broadband networks to connect local schools to one another and to the Internet backbone. By deploying these networks, schools get access to very high-speed connectivity at often times lower prices than if they leased access from existing providers. Since municipal fiber networks are utilized for multiple purposes and often financially supported across many classes of users, cities can extend fiber to school districts at the marginal cost of extending their fiber backbone to reach each school.

Some examples include:

- **The City of Hillsboro and Hillsboro City Schools**
  In 2018, the City and School District partnered and shared the cost of a Citywide fiber backbone buildout to connect the district's 34 schools, bringing 10 gigabit connectivity to every school and reducing the school district's ongoing communications costs by millions per year. This network is now also being used to bring fiber to the home broadband services to the City's residents and businesses, under the City's new Internet service provider business, HiLight.

- **The City of Lakeland and Polk County School District**
  Over the past 20 years, the City of Lakeland, FL (Lakeland Electric) has connected over 70 Polk County Public School locations with fiber. Schools receive dark fiber connectivity, giving them access to near limitless speeds and control over their connectivity needs, while keeping recurring telecommunications costs low for the District. The City's investments in this fiber have kept budgets down and investments local to the area.

Healthcare

> "We are embarking on new initiatives with our local school district and regional colleges and universities to leverage broadband and to facilitate discussion between schools and the business community to strengthen, retain, and attract a quality workforce." - Dana McDaniel, Deputy City Manager of Dublin, Ohio

In Danville, VA, their municipal broadband has long served the Danville Regional Medical Center, one of the city's largest employers. Medical companies, Ohio Health and Cardinal Health; Battelle Memorial Institute, a non-profit that relies on quantum computing to encrypt information; and numerous educational facilities use the Dublin, OH municipally-owned fiber network for their healthcare, education, and research needs.

Remote aspects of healthcare, both monitoring and acute care, increase demand on bandwidth through the use of robotics and haptic devices. All telehealth fields are growing, including teletherapy and telepsychiatry, with universities and colleges needing real time access to licensed counselors for interventions. Policies in remote imaging, cardiology, and transmission of Electronic Health Records are expected to increase demands further with needs for low latency becoming increasingly critical.

"Aging in place" is a term used to describe seniors living in the place of their choice for as long as possible, while getting the services they require, and all needs met without moving in with children or being placed in a nursing or assisted living facility. New gadgets and technological advancements have been made to make "aging in place" easier and more attainable for the growing population of seniors. Home-based telehealth, or home health monitoring solutions, keep physicians in touch with patients and monitor their health without visiting an office. There have been other advances including but not limited to fall detection systems, wearable sensors that collect real time health data, and stove guards. Reliable, high-speed Internet access is required for these new technological advances, and the retirees of Lehi would see value in being able to utilize these products and services.

Smart City

In considering opportunities for Lehi, the fiber network can be the foundation for programs that increase efficiencies, lower costs, reduce environmental impacts and enhance quality of life by relying more on technology. While this optimized internal connectivity is known as "Smart Grid" for utilities, as better connectivity evolves throughout Lehi Utilities service area communities, the network gives rise to the notion of "Smart Homes" and "Smart Cities."

With a fiber network in place, as Lehi Utilities expands its online services, all applications migrated to a community network enjoy greater availability and increased bandwidths. Limitless bandwidth and capacity create more effective and efficient civic organizations, with reliable broadband enabling organizations to:

- Improve operational efficiencies
- Reduce direct and indirect costs
- Provide enhancements to public safety
- Provide more information to citizens
- Enable interactions with organizations
- Respond quickly to the local needs
- Better serve the local community
- Ensure emergency preparedness

Organizational applications drive the promise of the Smart City through consumer technologies and connectible devices. Such devices scattered by the hundreds, if not thousands, throughout a community are networked seamlessly and generate an enormous amount of data. Individually, Smart

City savings might only be measured in the hundreds of dollars, such as to help wineries monitor their water usage in order to reduce the number of gallons used to create wine. Collectively, however, these savings can add up.

Scaling local level economic impacts to the service area level or even the state level and to a national level could be staggering. Gartner Research reports that IoT supported spending should reach $772[2] billion globally, with IoT spending in the US to total $194 billion this year, with consumer IoT spending to be $62 billion of that. Looking globally, a McKinsey report says that efficiencies and opportunities created by IoT may have collective financial and nonfinancial benefits of as much as $11 trillion per year by 2025 across all sectors.[3]

The Smart Cities Council publishes a "Smart Cities Readiness Guide" with detailed information on Smart City drivers and barriers, benefits, and responsibilities.[4] From that guide, select opportunities are outlined as follows:

- Smart Buildings: Using sensors, meters, and software to monitor and control a range of building functions including lighting, energy, water, HVAC, communications, video monitoring, intrusion detection, elevator monitoring and fire safety.
- Health and Human Services: Transform the delivery of essential health and education services, since "an educated and healthy city is a successful and wealthy city."
- Energy: A priority for Smart Cities, which typically start with smart energy systems.
- Digital City Services: Services to increase citizen engagement, employee productivity, competitiveness, citizen satisfaction and cost reduction, delivered via smartphones.

[2] https://informationmatters.net/Internet-of-things-statistics/

[3] www.mckinsey.com/insights/preparing_it_systems_and_organizations_for_the_Internet_of_things

[4] http://rg.smartcitiescouncil.com/readiness-guide/article/drivers-whats-driving-smart-cities

- Mobility and Logistics: Provides safer, more efficient transportation and parking. While this can ease commuting times for individuals, the macro cost savings are tremendous for a municipal government.
- Public Safety: Infrastructure and staff to keep the public safe, fostering quicker and smarter responses without duplicated effort to save lives, property and resources.
- Smart Payments and Finance: Digital disbursements and collections generate significant savings and increases operational efficiency.
- Smart People: A new City Hall mindset that is more open, transparent, and inclusive to build two-way communications and create stronger initiatives.
- Telecommunications: An adequate infrastructure is vital for business and community development and underlies the Smart City.
- Waste Management: Collect and process efficiently, recovering materials that have value, while benefitting public health and the environment through zero waste efforts.
- Water and Wastewater: Where it takes water to produce electricity, and electricity to pump water, the Smart City provides for production of both energy and water.

LEVERAGING FIBER NETWORKS FOR BROADBAND

Cities that have built their own fiber networks sometimes expand them to support the broadband needs of their communities. In particular, municipal electric utilities in small to midsize communities have leveraged the investments made in fiber to support fiber-optic broadband services to businesses and residents. Cities have used many different strategies to expand broadband, from simply leasing dark fiber to broadband providers, to deploying wholesale, open-access networks, to providing retail Internet services themselves. In each case, many factors influence their strategy and approach to expanding broadband, including:

- State regulatory requirements
- Federal regulatory requirements
- Economic development focus
- Lack of existing broadband services
- Financial capabilities
- Political will

- Competitive environment
- Opportunity cost of funding

Every community has unique circumstances that guide their decision-making and process of deploying broadband services, however, several conditions provide a favorable environment for expanding broadband. In this Study, several conditions were found to give Lehi City an edge in expanding broadband, which are detailed in the following section.

3.LEHI CITY ADVANTAGES

Magellan Advisors assessed the City's existing current advantages and capabilities that can be employed to either reduce the cost of deploying broadband or enable a faster deployment of services. Based on this analysis, we believe that the City is well-positioned to deploy broadband services when compared with many similarly sized communities, due primarily to its ownership of the local electric utility. These advantages consist of the following outlined below.

OWNERSHIP OF THE ELECTRIC UTILITY

Ownership of the electric utility and its infrastructure enables Lehi to design, coordinate and install aerial fiber-optic infrastructure more easily than if an external party owned the poles. This enables Lehi City to control the pole attachment, make-ready and installation functions without dependency on third parties which, in many cities, tend to slow down the process.

It also gives Lehi City more control over deployment of fiber. Lehi City could coordinate new electric undergrounding, rebuild and extend with fiber to support joint installation of fiber lines alongside electric projects in a single capital project (with appropriate cost allocations for electric and fiber separately).

Existing electric personnel, vehicles and systems could be leveraged for fiber deployment. Electric line crews could be trained on fiber deployment and maintenance where resources are available to allow broadband and electric to share available resources. Substations provide valuable property at central points in the distribution network to set fiber cabinets, points of

presence and splitter cabinets. Existing electric call center resources, billing and work order systems can often be outfitted to support broadband operations. In each case, it is important that Lehi City abide by the statutory cost allocation principles when electric and broadband are sharing these resources to ensure no cross-subsidization occurs between electric and broadband.

OWNERSHIP OF PUBLIC PROPERTY

Existing City property and facilities should be considered for use in the broadband project. Property at substations is particularly useful for placement of equipment cabinets and hardened shelters. Substations serve as aggregation points for fiber distribution just as they do for electric distribution. Pole lines and conduits feed from substations into neighborhoods and business districts. Using substations as distribution points for fiber to the home services helps the City reduce the amount of fiber distribution miles needed to serve homes and business. It also enables the City to utilize existing property rather than acquiring new property. Other public property may also be useful for location of fiber cabinets and shelters including City facilities, parks, and yards.

EXISTING CONDUIT

Over the years, the City's electric department maintained a practice of installing extra conduit alongside its underground electric projects. Magellan analyzed this conduit to determine what amount could be utilized for underground fiber installation. The City also employed a proofing program in mid-2020 to determine how much conduit was in usable condition along routes that would be used for fiber installation. The proofing program evaluated about 60 miles of existing conduit. Magellan and the City's electric department reviewed the results of the proofing program and determined a conservative estimate of usable conduit at 18%, or about 11 miles, resulting in a potential savings of between $3 - $5 million on the cost of fiber to the home construction.

RIGHT OF WAY

Deploying fiber within the City's existing right of way allows for more control over the process of fiber construction. Using existing rights of way eliminates the need for procuring private easements and avoiding potential restrictions of use in existing easements. Fiber construction in existing rights of way would need to comply with the City's existing rights of way ordinances and permitting procedures. The City would be treated like any other utility in terms of accessing public rights of way; however, since these rights of way are governed by the City, it would allow the City to streamline the design, permitting and inspection processes to shorten the timeframe and costs for construction.

EXISTING FIBER.

The City's existing fiber-optic network provides a valuable resource to catalyze broadband expansion to residents and businesses. Available capacity in this network could be utilized to reduce the overall cost of fiber backbone deployment and give the City a head start in providing broadband, by deploying services in close proximity to the existing backbone. Although the network was not originally intended to provide broadband services, it could be retrofitted to support fiber to the home distribution in areas where capacity exists.

4.LEHI CITY DISADVANTAGES

STATE OF UTAH STATUTES

Several key disadvantages impact the City's capabilities to provide broadband services. Most importantly, State of Utah statutes provide strict guidelines for municipalities providing retail Internet services, which are detailed in the Regulatory Assessment section of this report. To summarize, State statute limits how the City may finance the broadband system, placing restrictions on the collateralization of sales tax and related revenues, which increase the City's overall costs of funding and reduce the financial feasibility of the project.

COMPETITION

Broadband is a highly competitive business and a new venture for the City. Existing providers in Lehi have strong sales, marketing, and operational capabilities, with extensive financing capabilities and corporate power. The City does not currently possess these capabilities and would be required to do so if it wanted to become an ISP and provide retail services to compete in the marketplace. Providers are also protective of their turf and will attempt to thwart any attempt from the City to get into the business and compete with them, whether the City provides retail or wholesale services. The City should expect this to occur in two phases:

Pre-Funding Phase: Providers will launch negative ad campaigns, lobby City Council and attack the project to dissuade the City from garnering popular support for the project. Incumbent providers are known to enlist taxpayer protection groups to present municipal broadband projects as failures and a waste of taxpayer resources. Many of these publications contain inaccurate and misleading information; however, they can be very convincing, and the City should plan to "get ahead" of these types of issues to ensure that City leadership and the public at large understand facts versus the propaganda that often surrounds these projects.

Post-Funding Construction Phase: Providers will re-market their services to existing customers to dissuade them from switching over to the City's services. This is accomplished by discounting current pricing and offering promos that entice consumers to sign-up for multiyear contracts for service. Providers have the tools to manipulate the pricing within their bundled services to compete against the City. They will offer higher speeds at the same price, reprice services in their bundles for discounted prices and provide additional incentives for signing long-term contracts.

5. STATE OF BROADBAND IN LEHI

RESIDENTIAL AND BUSINESS MARKET RESEARCH

The purpose of the market research assessment was to determine what value residential (households) and commercial (businesses) customers place on various aspects of their broadband services in order to forecast the demand for new broadband services, if it were introduced to the current market by the City of Lehi, either directly or in partnership with a provider.

The market research targets existing customers across the service territory. A random sample of respondents was selected for the email distribution to remove any self-selection bias in the survey. The survey instrument utilized an online platform for distribution of surveys. Individual surveys were distributed electronically via email with a survey link embedded in the email, with a unique survey identifier and URL. The random sample was also geographically tested to ensure all communities across the City area were well represented.

The survey contained a behavioral portion, which solicited information on current residential and business Internet services and included information on pricing, satisfaction, importance and household demographics. The survey also contained a choice-based conjoint ("CBC") portion which determined quantitative demand for services by asking respondents to select their preferred choice from a series of existing market offers, as well as a City-provided offer. Surveys were analyzed to determine the quantitative demand resulting from the CBC, while the behavioral portion of each survey provided additional insight into the preferences of customers.

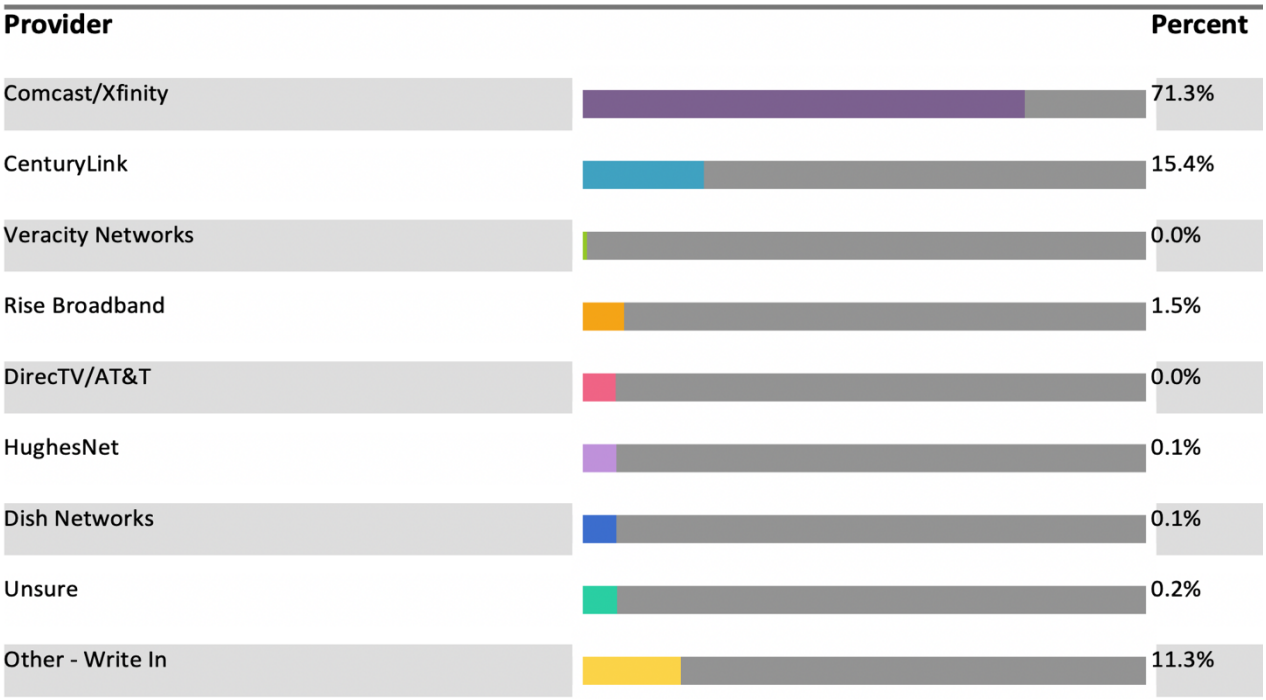
RESIDENTIAL SURVEY FINDINGS

A total of 7,500 surveys were distributed to Lehi electric residential and business customers via email. A total of 2,312 surveys were completed by Lehi households, which yielded a 2% overall margin of error in the results at a 95% confidence interval. The high participation rate, low margin of error and high confidence interval providing an indication that the results of the survey are reliable and represent the greater population of Lehi.

Current Providers

The survey determined the current market share for providers in Lehi's territory to understand what providers Lehi area customers utilize today and the services they offer. Comcast is the dominant provider in the market today, with the majority share of the market at 71.3%. CenturyLink follows as the second leading provider, with 15.4% of Lehi area households. The remaining 13.3% of households report subscribing to a wireless, cellular or satellite-based Internet service as shown in Figure 1.

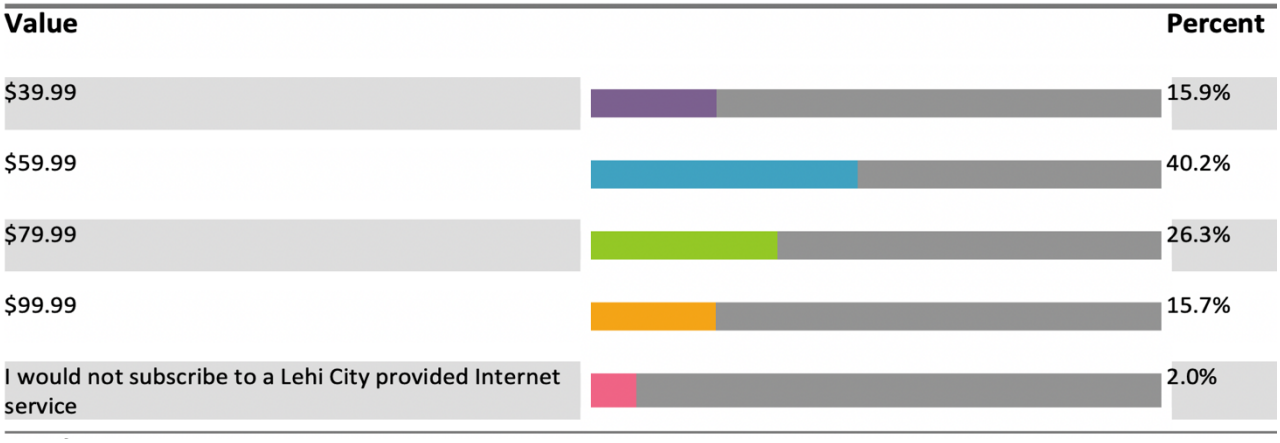
Figure 1: Internet Providers Utilized by Lehi Area Households



Current Pricing

Lehi area households report paying $67 per month on average for their home Internet services. Prices and speeds differed based on packages to which they subscribed. Packages ranged from $99 per month for 400-megabit service to $25 per month for 12-megabit service. Lehi area households were also asked how much they would be willing to pay if the City were to provide service at commensurate speeds with current services. 40.2% of households were willing to pay up to $59.99 while 26.3% were willing to pay up to $79.99. Only 2% of households reported that they would not subscribe to a City-provided Internet service.

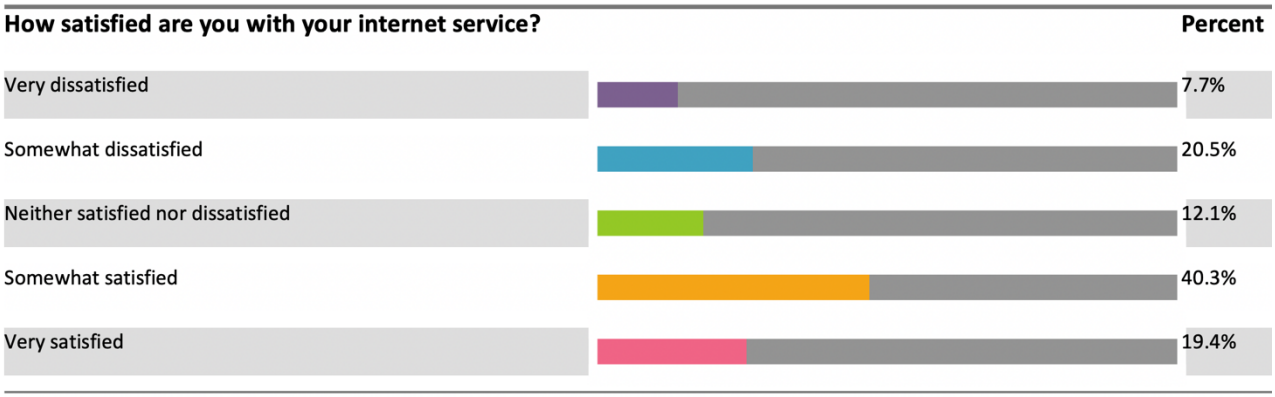
Figure 2: How Much Would Lehi Households Pay for a City-Provided Internet Service?



Satisfaction

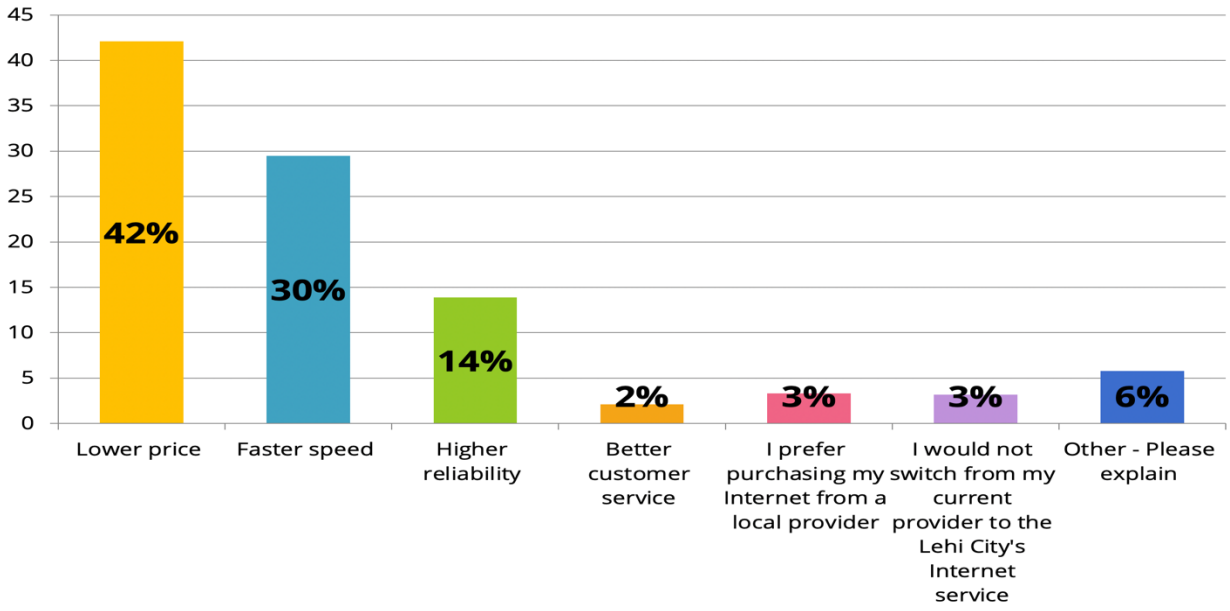
Satisfaction levels for Internet services include 28.2% of households that are dissatisfied with their Internet service, 12.1% which are neutral and 59.7% that are satisfied with their Internet services. These figures assume satisfaction levels at the rates households currently pay for their services.

Figure 3: Lehi Area Household Satisfaction Levels for Internet Services



With what aspects of Internet service are households most dissatisfied? For those customers that were dissatisfied with their current services, Figure 4 illustrates the reasons that customers would switch to a City-provided Internet service. 63.1% cited lower prices as the most important reason, followed by 12.9% citing faster speed and 10.0% citing higher reliability.

Figure 4: Reasons Households would Switch to a City-Provided Internet Service



Service Bundles

Respondents were also asked what other services they purchase from their Internet providers to understand what complementary services may be important for Lehi to consider offering. Figure 5 illustrates these results, which indicate a low percentage of residents that currently subscribe to cable television, home phone and home security services. This indicates that market demand for these services is low.

Further, respondents were asked whether their current practices for cord-cutting and whether they would "cut the cord" over the next 3 years and discontinue their cable television services, as illustrated in Figure 6. Nearly 90% of residents have already discontinued their cable television service or plan to in the next 3 years, indicating that a cable television offering is not highly valued in the marketplace.

Figure 5: Other Services that Lehi Households Purchase from their Internet Provider

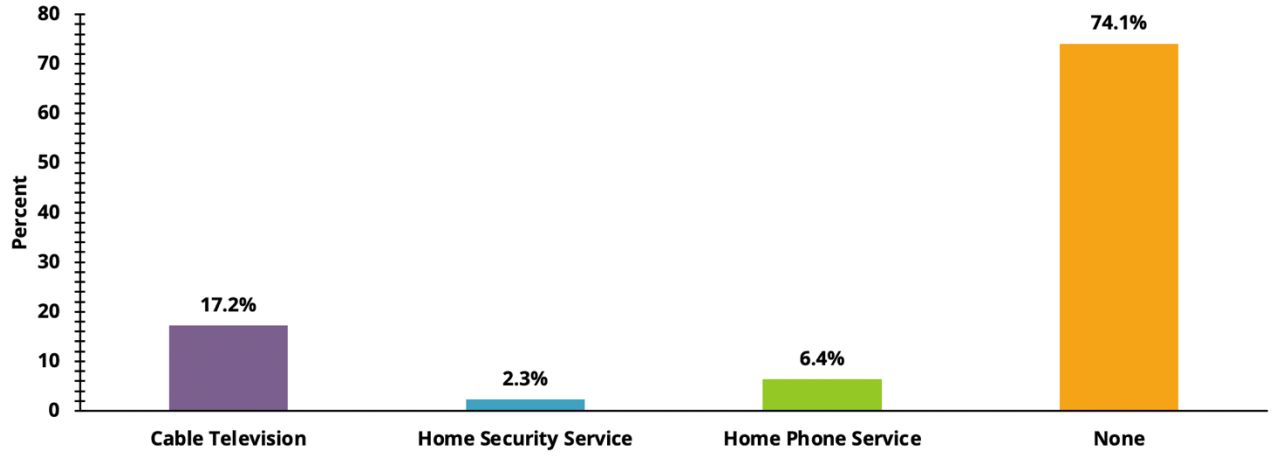
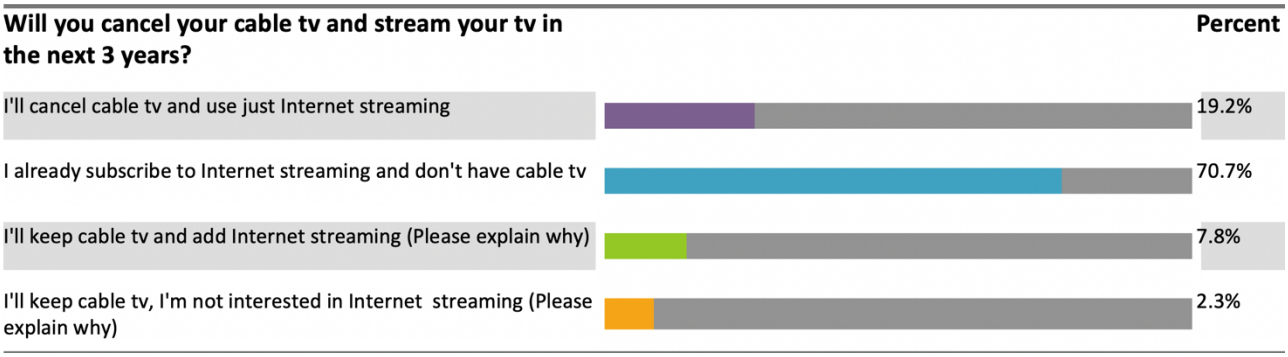


Figure 6: Cord-Cutting Preferences of Lehi's Residents



BUSINESS SURVEY FINDINGS

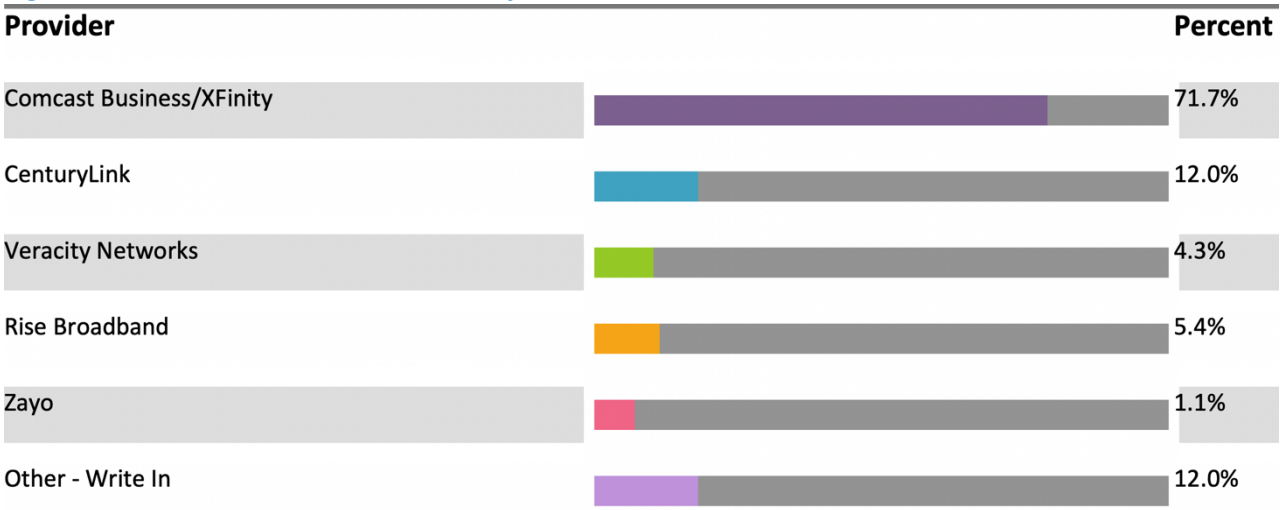
A total of 2,003 surveys were distributed to Lehi Electric business customers via email. A total of 83 surveys were completed by business customers, which yielded an 11% overall margin of error in the results at a 95% confidence interval.

Business Internet Providers

The survey determined the current market share for providers in Lehi's territory to better understand what providers Lehi broadband business customers utilize today and the services they offer. Comcast was reported as the dominant provider in the market today, with 71.7% of Lehi area businesses subscribing to Internet services from the company. CenturyLink follows as the second leading provider, with 12% of Lehi area businesses.

The remaining 22.8% of businesses subscribe to other Internet providers including Veracity Networks, Rise Broadband, Zayo, and others.

Figure 7: Internet Providers Utilized by Lehi Area Businesses



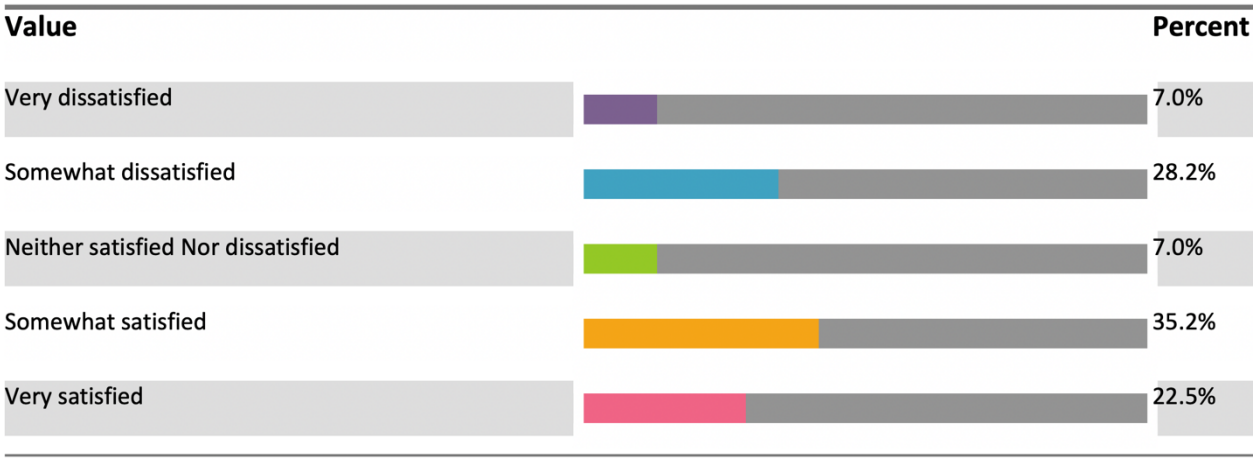
Current Pricing

Lehi area businesses pay on average $140 per month for 140 megabits of service. The survey data was stratified to determine what different sized businesses paid for Internet service, given the wide variation in pricing between small and large businesses. For businesses under 50 employees, their average price paid per month was $94 while businesses over 50 employees averaged $500 per month. Prices ranged from $49 to $650 per month. This is an important distinction to assess the City's future pricing for business Internet services. The majority of businesses with Internet needs are small businesses and are very price sensitive. Therefore, the City will need to set small business rates competitively to incent small businesses to switch to the City's services.

Satisfaction Levels

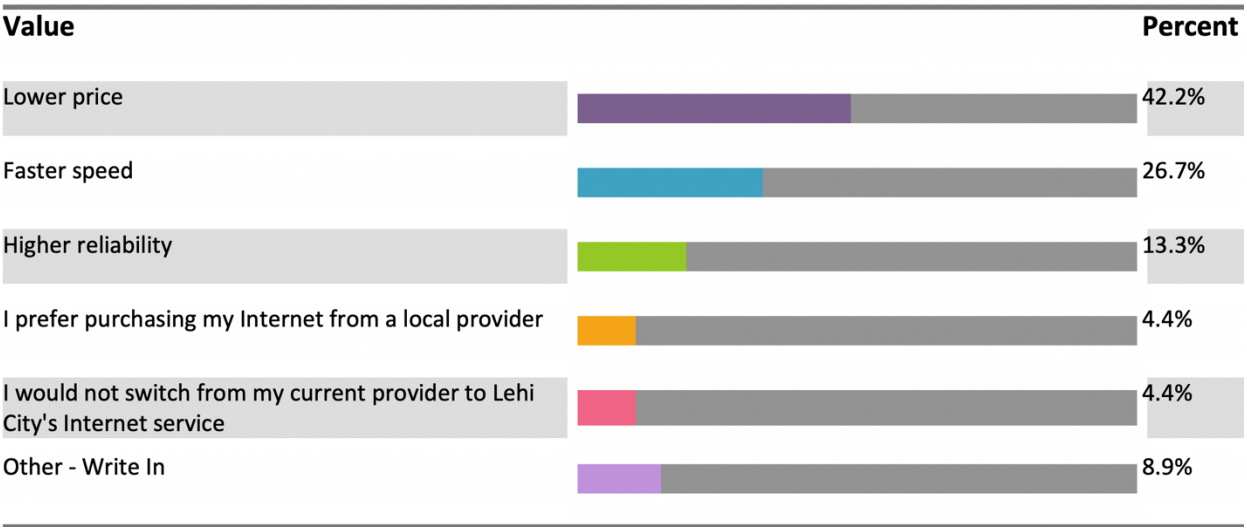
Satisfaction levels include 35.2% of businesses that are dissatisfied with their Internet service, 7% that are neutral and 57.4% that are satisfied with their Internet services.

Figure 8: Lehi Area Businesses Satisfaction Levels for Internet Services



With what aspects of Internet services are businesses most dissatisfied? For those customers that were dissatisfied with their current services, Figure 9 illustrates the reasons that businesses would switch to a City-provided Internet service. 42.2% cited lower prices as the most important reason, followed by 26.7% citing faster speed and 13.3% citing higher reliability.

Figure 9: Reasons Households would Switch to a City-Provided Internet Service



BROADBAND DEMAND

The conjoint analysis conducted in this Study provides a predictive assessment of take rates that the City could achieve, based on actual customer preferences in the market. This technique simulates a consumer's buying decision by presenting multiple offers to the respondent from which they select their most preferred offer.

The survey tool presented Lehi's residents and businesses with a series of offers from which they would choose their preferred combination of provider, speed, and price. A series of 14 questions were presented in each survey. Two offers were presented in each conjoint question and each respondent was asked to pick the offer they preferred from the two offers. Offers were randomized in terms of the attributes tested: provider, speed, and brand to ensure all offers were tested and all sufficient statistical data was collected to calculate part-worth utilities.

Results of the conjoint analysis determined an estimate of market share that the City could attain if it provided Internet services to residential and business customers. Part-worth utilities were calculated for the three attributes: Speed, Brand and Price, along with the relative importance of each attribute. Four levels were utilized for each attribute in the choice-based conjoint. Table 1 illustrates the conjoint design and resulting part-worth utilities.

Table 1: Attributes, Levels, Relative Importance and Part-Worth Utilities for Residential

ATTRIBUTE	RELATIVE IMPORTANCE	LEVEL	UTILITY
SPEED	53.3	1000 Megabit	11.4
		300 Megabit	8.8
		100 Megabit	6.3
		25 Megabit	0
BRAND	10.3	Comcast/Xfinity	0.7
		CenturyLink	0
		Lehi City	1.7
		A New Internet Service Provider	0.9
PRICE	36.4	$99.99 Per Month	0
		$79.99 Per Month	2.9
		$59.99 Per Month	5.4
		$39.99 Per Month	7.7

From these part-worth utilities, take rates (market share preferences) were calculated through use of a market share simulator. This process converted part-worth utilities into shares of market preference, for each provider (brand) studied and provided a market share preference for each product offered by the provider. This was valuable in determining the right product mix of speeds and prices that would drive the greatest market share for the City.

6. REGULATORY ASSESSMENT

State policy and regulatory frameworks vary across the country regarding provision of fiber-optic Internet services by a city. Magellan Advisors and City legal staff evaluated specific policies in Utah along with federal policy to ensure any plans and recommendations regarding the City's potential provision of broadband services is consistent with policy and regulatory requirements in Utah. [5] The assessment also considered implications of regulations related to emerging next generation 5G wireless services.

FEDERAL REGULATION OF BROADBAND

Due to federal preemption, [6] the FCC's approach to regulating broadband often determines the extent that state and local governments may also regulate broadband. However, the FCC has less ability to use its preemption powers to invalidate state laws which govern municipalities. Because municipalities are considered a creation of state law and agencies of the state, stricter rules apply which limit when federal law can preempt a state's ability to regulate its municipalities.[7] Accordingly, while it is important for a municipal provider to understand the interplay between federal and state law in governing broadband, state laws which apply specifically to municipal broadband are likely valid and not preempted by contradictory federal policy.[8]

Besides contradictory state laws which apply specifically to municipal broadband, FCC orders and regulation do have considerable ability to limit and determine state law in the area of communications, and a federal policy of deregulation generally limits state and local laws which would limit

[5] The following discussion does not constitute a legal opinion and should not be construed as such. Questions about interpretation or applicability of these or other provisions of federal or Utah law should be referred to legal counsel. The state portion of the regulatory assessment was provided by Lehi City's outside counsel, however.

[6] When commercial activities primarily occur interstate, as opposed to intrastate, Congress has the ability to regulate these commercial activities and invalidate state or municipal regulations which contradict or oppose the federal regulations. *See In the Matter of Restoring Internet Freedom (*In Re: Internet Freedom), 33 F.C.C. Rcd. 311, ¶¶ 194-204 (2018).

[7] *Tennessee v. Fed. Commc'ns Comm'n*, 832 F.3d 597, 610 (6th Cir. 2016) (citing *Nixon v. Missouri Mun. League*, 541 U.S. 125, 140 (2004)).

[8] *See id*. at 613.

deployment of broadband infrastructure or have an anticompetitive effect. As discussed above in the introductory paragraph, in 2018, the FCC reclassified "broadband Internet access service"—including both fixed and mobile service—as an "information service" instead of "telecommunications service," as each are defined in the Telecommunications Act of 1996 ("TA96").[9] This was a reversal of its 2015 Open Internet Order[10] in which the FCC initially classified broadband Internet access service (both fixed and mobile) as a telecommunications service. The FCC described the effect of this reclassification as ending "utility-style regulation of the Internet . . . ."[11] As classified as a "telecommunications service," broadband Internet service was subject to many of the regulatory obligations of Title II of the Communications Act, and broadband Internet service providers were generally subject to common carrier requirements.[12] In ending this utility-style regulation in favor of deregulation, the FCC announced its preemption of any state or local laws which would contradict this approach.[13]

In addition to defining what communication technologies are designated "telecommunications services" and "information services," the FCC otherwise interprets other provisions and definitions of the TA96, including defining different types of broadband services and infrastructure. Providers of broadband should familiarize themselves with the FCC's interpretations and guidance, as its classifications can determine which federal rules apply to specified broadband services, and the applicability of certain federal requirements can influence which state and local rules apply, to the extent such federal rules preempt the state or local law.

[9] *See* In Re: Internet Freedom (interpreting 47 U.S.C. § 153(24), (53)).
[10] *Protecting and Promoting the Open Internet*, WC Docket No. 14-28, Report and Order on Remand, Declaratory Ruling, and Order, 30 FCC Rcd 5601 (2015) (*Title II Order*).
[11] *Id.* at ¶ 2.
[12] *Id*. at 37 – 57.
[13] We therefore preempt any state or local measures that would effectively impose rules or requirements that we have repealed or decided to refrain from imposing in this order or that would impose more stringent requirements for any aspect of broadband service that we address in this order. Among other things, we thereby preempt any so-called ""economic" or "public utility-type" regulations, including common-carriage requirements akin to those found in Title II of the Act and its implementing rules, as well as other rules or requirements that we repeal or refrain from imposing today because they could pose an obstacle to or place an undue burden on the provision of broadband Internet access service and conflict with the deregulatory approach we adopt today. *Id*. at ¶196.

As the FCC considers "broadband Internet access service" an "*information service*," and thus deregulated (as opposed to "*telecommunications service*" – i.e., basic telephone service – which are regulated as common carriers), it is important to note the FCC's current definition of "broadband Internet access service," which it defines as:

> ". . . mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all Internet endpoints, including any capabilities that are incidental to and enable the operation of the communications service, but excluding dial-up Internet access service.
>
> The term "broadband Internet access service" includes services provided over any technology platform, including but not limited to wire, terrestrial wireless (including fixed and mobile wireless services using licensed or unlicensed spectrum), and satellite. For purposes of our discussion, we divide the various forms of broadband Internet access service into the two categories of "fixed" and "mobile." With these two categories of services—fixed and mobile—we intend to cover the entire universe of Internet access services at issue in the Commission's prior broadband classification decisions, as well as all other broadband Internet access services offered over other technology platforms that were not addressed by prior classification orders. We also make clear that our classification finding applies to all providers of broadband Internet access service, as we delineate them here, regardless of whether they lease or own the facilities used to provide the service. "Fixed" broadband Internet access service refers to a broadband Internet access service that serves end users primarily at fixed endpoints using stationary equipment, such as the modem that connects an end user's home router, computer, or other Internet access device to the Internet. The term encompasses the delivery of fixed broadband over any medium, including various forms of wired broadband services (e.g., cable, DSL, fiber), fixed wireless broadband services (including fixed services using unlicensed spectrum), and fixed satellite

> broadband services. "Mobile" broadband Internet access service refers to a broadband Internet access service that serves end users primarily using mobile stations. Mobile broadband Internet access includes, among other things, services that use smartphones or mobile-network-enabled tablets as the primary endpoints for connection to the Internet. The term also encompasses mobile satellite broadband services."[14]

The FCC has also listed certain services it does not consider "broadband Internet access service," including: (i) data services which provide connectivity to a limited number of Internet endpoints in conjunction with the offering of certain products or services such as "e-readers, heart monitors, or energy consumption sensors;" (ii) video or voice services provided by Internet service providers, as these services are otherwise regulated; (iii) virtual private network (VPN) services; (iv) content delivery networks (CDNs); (v) hosting or data storage services; (vi) Internet backbone services (if those services are separate from broadband Internet access service, as these services have historically not been considered "mass market," because they usually do not provide the capability to transmit data to and receive data from substantially all Internet endpoints); (vii) premise owners such as coffee shops, bookstores, and airlines and providers of private end-user networks such as libraries and universities, and other businesses which acquire broadband Internet access service from an Internet service provider in order to provide their guests and invitees Internet access on location; and (viii) personal Wi-Fi networks created by users of broadband Internet access service who do not intentionally offer the benefit to others. Each of these are not considered service providers because they do not market and sell the broadband Internet access to residential customers, small businesses, or other end-users such as schools and libraries.[15] A municipality which markets Internet access to its residents, businesses, and schools and libraries is likely to be considered a broadband Internet access service provider by the FCC and subject to FCC regulations; therefore, any municipal provider of telecommunications services should familiarize themselves with the various FCC reporting, filing and other requirements regarding fees, reports and data. While the FCC's current

[14] *Id*. at ¶¶ 21-22.
[15] *Id*. at ¶¶23-25.

regime supports deregulation and free-market principals in relation to these services, the agency is limited in its authority to preempt state laws related to municipalities, even if those state laws create greater restrictions than the federal regulations.

UTAH MUNICIPAL CABLE TELEVISION AND PUBLIC TELECOMMUNICATIONS SERVICES ACT

The Utah Municipal Cable Television and Public Telecommunications Services Act, Utah Code Ann. Title 10, Chapter 18 (the "Utah Municipal Broadband Act," or the "Act") regulates Utah municipalities offering cable television services or public telecommunications services. While fixed broadband Internet access service is not considered a "public telecommunications service" in itself,[16] a municipality which offers voice or video service through fiber to the home (FTTH), would be offering "public telecommunications service" as defined in the Act. Further, the Act also governs municipalities' purchasing, leasing, constructing, or equipping facilities that it then, by written contract, leases, sells capacity in, or otherwise grants rights to private providers for the purpose of the private providers' offering the services.[17] The Act regulates municipal broadband services in the following two areas: (i) prior conditions which must be satisfied and (ii) limitations on how a municipality can fund such services once approved. A municipality is subject to these requirements of the Act whenever it offers, directly or indirectly, the covered cable or telecommunications services, "including through an authority or instrumentality: acting on behalf of the municipality; or for the benefit of the municipality; by itself; through: a partnership; or joint venture; or by contract, resale, or otherwise."[18]

[16] *See Application of Utah Broadband LLC for A Certificate of Pub. Convenience & Necessity to Provide Facilities-Based & Resold Local Exch., Access, & Interexchange Telecommunications Servs. in the State of Utah*, No. 19-2614-01, 2019 WL 4345194, at *1 (Sept. 5, 2019) (holding that Internet service providers are not offering a "public telecommunications service" subject to the Public Service Commission's jurisdiction).
[17] Utah Code Ann. § 10-18-105 (West 2020) (specifying that a municipality's offering backbone facilities by contract to private service providers is subject only to §10-18-302 and §10-18-303(3) and (4) of the Utah Municipal Broadband Act).
[18] Utah Code Ann. § 10-18-201 (West 2020).

(a) Conditions which Must be Satisfied for a Municipality to Offer Services

Before "engaging" or "offering to engage in" the broadband activities covered by the Utah Municipal Broadband Act, several conditions must be met[19] including (1) a preliminary Council hearing; and, (2) approval of a feasibility consultant to provide a feasibility study which meets specified requirements including completion within 180 days, whether municipal provision of service(s) will hinder or advance competition, discussion of the fiscal impact of the municipality, current and five-year financial projections which incorporate a "full cost accounting". Then if the feasibility study shows that the projected first and five-year average revenues will exceed average costs by at least the amount necessary to meet the bond obligations of any bonds, the municipality must hold at least two public meetings within 60 days (which must be scheduled at the next regular meeting of the legislative body after the results of the feasibility study are received). The feasibility consultant must be present at these public meetings to explain the results of its study; these public meetings must be advertised by proper notice; and, the council must adopt the feasibility study by resolution. The issue of whether the municipality should offer the services may be, but is not required to be, put to voters in general or special election. This Report is the "feasibility study" required by the Act.

(b) General Operating Limitations

The Act also states several operating limitations, many of which would be good governance regardless – such as "observe all laws" regarding cable TV and telecommunications, and no cross-subsidization. The limitations include the municipality must observe all federal laws and regulations regarding cable TV and telecommunications, and Utah PSC regulations; cross subsidy is prohibited; no grant of any undue preference or advantage to the municipal operation; all ordinances, rules and regulations apply to the municipal operation without discrimination; prices shall include in rates all fees and taxes that would be paid by a private provider, and all direct and indirect costs as well as fees and taxes; a publicly available comprehensive price list including all terms and conditions, shall be maintained and provided to all customers; services may not be offered to subscribers outside municipal

[19] Utah Code Ann. § 10-18-202 to 203 (West 2020).

geographic boundary; the municipal operation's books and records are subject to legislative audit; no exercise of power of eminent domain to provide service is allowed; and, an ordinance must be passed governing the quality of service to be offered that are substantially similar to the standards imposed on private providers under federal and state law, including rules from the Utah Public Service Commission.[20]

(c) Limitations on how a Municipality Funds its Broadband Services[21]

The Utah Municipal Broadband Act requires a separate enterprise fund with separate budgeting for the municipality's cable or telecommunications service, and prohibits transfers between this enterprise fund and any other enterprise fund of the municipality and any cross-subsidizing of the covered broadband services, generally requiring that the full costs of the services to the municipality (including direct and indirect costs) be passed on via consumer rates. The Act allows a municipality to issue one or more revenue bonds to fund the capital costs for the facilities necessary for the cable or telecommunications service, which shall be secured and paid for from (a) revenues from the cable or telecommunications service or (b) from sales and use tax revenues which are pledged to repay bonds and annually appropriated as security and repayment. Bonds secured by sales and use tax must be approved in a bond election or in a regular general election if more than 50% of the average annual debt service of all bonds issued by the municipality under the Utah Municipal Broadband Act will be secured by sales and use tax revenue the Act.

Public-private partnerships (PPP) are an available avenue under the Act and pursuant to Utah Code Ann. Title 11, Chapter 13, the Interlocal Cooperation Act; Title 63n, Chapter 13, Part 3, the Facilitating Public-Private Partnerships Act; and Title 63g, Chapter 6A, Part 1, General Procurement Provisions; however, there are no known state-law incentives to entering into a PPP, though, under §63g-6A-712, a municipality may consider an unsolicited proposal for a PPP.

[20] Utah Code Ann. § 10-18-305-306 (West 2020).
[21] Utah Code Ann. § 10-18-301-303 (West 2020).

(d) Interconnection and Facility Sharing

The FCC generally has authority to regulate the rates, terms, and conditions under which cable and telecommunications operators attach to any pole, duct, conduit, or right of way owned or controlled by a utility.[22] However, the FCC does not have this jurisdictional authority in states that have certified to the FCC that they regulate such terms and conditions, and Utah is one such state. While the Utah Public Service Commission (UPSC) generally oversees these interconnections in the state, municipal utilities, such as electricity and public telecommunications services, are not under the jurisdiction of the of the UPSC.[23] However, in the Utah Municipal Broadband Act, the state legislature has imposed certain requirements of non-municipal utility providers on municipal cable and public telecommunications services. Pursuant to the Act, a municipality offering cable or public telecommunications services must comply with Utah Code Ann. § 54-8b-2.2 and accompanying rules of the UPSC.[24] These rules require essential facility sharing and interconnection agreements to be provided on a reasonable and nondiscriminatory basis.

FEDERAL REGULATION OF WIRELESS SERVICES

Wireless services and technology have been largely unregulated since its inception in the late 1980's – from a rate and tariff standpoint. However local authorities and the Federal Communications Commission have been in an ongoing jurisdictional battle over siting practices and zoning requirements for wireless facilities for some time, which will be discussed further below. At the center of the jurisdictional battle today is 5G wireless service.

The placement of wireless facilities is governed by an interrelated legal framework characterized by shared jurisdiction between state/local authorities and federal authority (the Federal Communications Commission or FCC). The past two decades have seen increasing federal preemption of state and local authority by the Federal Communications Commission (and

[22] 47 U.S.C.A. § 224 (West 2020).
[23] *Qwest Corp. v. Utah Telecommunications Open Infrastructure Agency*, 438 F. Supp. 2d 1321, 1325 (D. Utah 2006) (interpreting Utah Const. art. VI, § 28).
[24] Utah Code Ann. § 10-18-305-306(2)(c) (West 2020).

Congress), most recently in its "Small Cell Order".[25] The U.S. Code provides the basis for federal preemption where it allows local authorities to regulate the "placement, construction, and modification" of wireless communications facilities but subject to certain limitations.[26] Those limitations include:

- City regulations may not "prohibit or have the effect of prohibiting the provision of personal wireless services"[27];
- City regulations may not "unreasonably discriminate among providers of functionally equivalent services"[28];
- Any denial of an application to place, construct, or modify a personal wireless facility must be based on "substantial evidence contained in a written record"[29]; and,
- City regulations may not "regulate the placement, construction, and modification of personal wireless service facilities on the basis of the environmental effects of radio frequency emissions to the extent that such facilities comply with the Commission's regulations concerning such emissions."[30]

In one specific area – radio frequency (RF) emissions – the Federal Communications Commission (FCC) has been assigned complete regulatory jurisdiction, under the 1996 Telecommunications Act which preempted local regulation of RF safety standards in favor of a uniform national RF safety standard under FCC jurisdiction.[31] "The FCC's limits for maximum permissible exposure (MPE) to RF emissions depend on the frequency or frequencies that a person is exposed to. Different frequencies may have different MPE levels."[32] Local authorities can require compliance with FCC RF standards be

[25] Declaratory Ruling and Third Report and Order; In the Matter of Accelerating Wireless Broadband Deployment by Removing Barriers to Infrastructure Investment; WT Docket No. 17-79; In the Matter of Accelerating Wireline Broadband Deployment by Removing Barriers to infrastructure Investment; WC Docket No. 17-84; Released by the Federal Communications Commission, September 27, 2018. ("Small Cell Order" or "Order".)
[26] 47 U.S.C. § 332(c)(7)(A).
[27] 47 U.S.C. § 332(c)(7)(B)(i)(I).
[28] 47 U.S.C. § 332(c)(7)(B)(i)(II).
[29] 47 U.S.C. § 332(c)(7)(B)(iii).
[30] 47 U.S.C. § 332(c)(7)(B)(iv).
[31] 47 U.S.C. § 332(c)(7).
[32] A Local Government Official's Guide to Transmitting Antenna RF Emission Safety: Rules, Procedures, and Practical Guidance; Local and State Government Advisory Committee, Federal Communications Commission, June 2, 2000, at page 3.

demonstrated in evaluating 5G siting applications. Applicants often make this demonstration part of the application package. Local authorities may not however deny wireless communications facilities siting applications based on RF emissions – Congress has preempted local authority on this subject and placed jurisdiction in the hands of the FCC.

WHAT IS 5G?

"5G" is the fifth generation of wireless technology driving evolution of the wireless communications technology platform. First generation, "2G" and "3G" wireless service was provided beginning in the 1980's and 90's using large towers, "4G" was characterized by development of "apps" that needed sustained reliable connectivity which in turn drove antenna densification, while "5G" relies upon even more closely spaced, small antennas. Consequently, wireless carriers such as AT&T, Verizon, the newly merged T-Mobile/Sprint and their contracted outsourced infrastructure providers (e.g., Crown Castle, Mobilitie, etc.) are increasing demand for access to city-owned and utility-owned structures and public rights of way to accommodate "4G/4G+" and "5G" "small cell" deployments. Current "4G/4G+" deployments are aimed at densification and increasing capacity in high-use areas while 5G small cell facilities are also being deployed in larger numbers to greatly increase speed and data capacity on a "fill-in" basis. Deployment of high-band "5G" is distinguished from the present "4G" based wireless service by use of low power transmitters with coverage radius of approximately 400 feet, 5G thus requires closer spacing of antennas and more of them. Small cells bring the network "closer" to wireless service users to deliver greatly increased data capacity, faster connectivity speeds and an overall better wireless service. As stated by the FCC,

> "The wireless industry is currently deploying and planning for additional construction of large numbers of small cells – the number of these facilities is expected to grow rapidly over the next decade. S&P Global Market Intelligence estimates that between 100,000 and 150,000 small cells will be constructed by the end of 2018, and that small cell deployments are expected to reach 455,000 by 2020 and nearly 800,000 by 2026. AT&T has reported that a substantial majority of its infrastructure deployments over the next five years will be small cell sites. In

addition, Verizon is deploying small cells in several urban areas, including New York, Chicago, Atlanta, and San Francisco. Sprint announced last year a goal of deploying 70,000 small cells within two years."[33]

In the years following this FCC pronouncement all wireless providers did indeed begin deployment of 5G (during 2019), and the deployment continues in the US with three wireless carriers (given the recent merger of T-Mobile and Sprint) but perhaps at a reduced pace given financial and business impacts of the COVID-19 pandemic. However, both AT&T and T-Mobile are on target to offer "nationwide" 5G using low-band spectrum by mid-year.[34]

5G networks operate multiple frequencies in three bands using millimeter wavelengths – the highest of which is anticipated to offer download/upload speeds of 1 Gbps. The actual speed and range the consumer gets depends on a variety of factors, including what frequency is being used by the service provider – low-band, mid-band, or high-band. There are tradeoffs among the different bands, between speed and distance/coverage. General observations:

- Low-band frequencies work well across long distances and in rural areas; speeds are greater than 4G but slower than other 5G frequencies.
- Mid-band frequencies are currently sought after since they permit greater speeds while covering relatively large areas.
- High-band frequencies provide the fastest speeds but in more limited circumstances such as close to the antenna and in areas without physical obstructions (i.e., windows, buildings, walls). Thus, high band will work well in dense areas where antennas can be placed every few

[33] Streamlining Deployment of Small Cell Infrastructure by Improving Wireless Facilities Siting Policies; Mobilitie, LLC Petition for Declaratory Ruling, WT Docket No. 16-421, Public Notice, 31 FCC Record 13360, December 22, 2016, at page 3-4 (citations omitted). ("Improving Wireless Facilities Siting Policies Public Notice")*.*

[34] AT&T "plans to reach nationwide coverage this summer" (2020). https://about.att.com/newsroom/2020/5g_announcements.html (viewed on May 27, 2020). "T-Mobile has launched nationwide 5G: Here is what that means." https://www.cnn.com/2019/12/03/tech/tmobile-5g/index.html (viewed on May 27, 2020). See also, "What is 5G? The definitive guide to the 5G network rollout"; https://www.tomsguide.com/us/5g-release-date,review-5063.html (viewed on May 27, 2020).

hundred feet. This spectrum delivers the high speeds that are commonly associated with 5G when the subject comes up.
- It is therefore likely that 5G networking will be a combination of low, mid, and high-band frequencies.
- Also, obtaining 5G service requires using a 5G-ready device, of which at present there are only a handful (though the number is growing).

5G networks are designed to provide increased efficiencies while decreasing latency and are designed for improving the performance of connected devices that define the "Internet of Things" or IoT.[35] Examples include autonomous vehicles, healthcare monitoring technologies, ultra-high-definition video, virtual reality, and many more applications that are ripe for development. Indeed, any "tech buzzword" will benefit from 5G's faster speeds and reduced latency. The transition to 5G will not occur overnight, and 4G and 5G will coexist such that when a device drops 5G signal a handoff to 4G LTE should be imperceptible.

(a) Does Wireless Service Require Fiber Optic Facilities?

There is a common public misconception that "wireless service" is indeed fully wireless, end-to-end. In fact, typically the only "wireless" component to wireless service is the wireless transmission over radio spectrum between the user's cell phone and the cell tower at either or both ends of the call.[36] Wireless service places significant demands on the wireline network for connection of each cell tower or small cell antenna to wireless providers' network facilities.

In recent years, wireless providers connected their towers to their network with fiber connections under "Fiber-to-the-Tower" programs, procuring fiber connectivity from incumbent local exchange companies and other sources.

[35] There is not a universal definition of "Internet of Things" but it generally refers to scenarios where network connectivity and computing capability extends to objects, sensors and everyday items not normally considered computers, and allows these devices to generate, exchange and consume data with minimal human intervention.
[36] In some cases, operators have used radio spectrum to transmit consumer data and voice traffic from the transmitter on the tower to the base, where it is then connected to the landline network. But this engineering practice is going by the wayside as it consumes valuable radio spectrum and is otherwise less desirable from an engineering perspective, in favor of fiber connection of the transmitters on the tower to the base for connection to the landline network.

The 4G LTE evolution of wireless technology and services supported and encouraged much greater consumer demand for bandwidth and data, which in turn required fiber capacity for each cell tower to carry all the traffic to the wireless provider's network. Evolution to 5G network technology greatly increases wireless provider demand for fiber-based network capacity. 5G relies on an even denser network of cells with shorter range at higher frequencies. This denser cell network will require an even denser fiber network to support those cells. Verizon's CEO Lowell McAdam characterized just how dense in a presentation to investment analysts:

> "Verizon small cells and densification efforts are driving the deployment of 1700-strand fiber in Boston, where the company is undertaking a major network upgrade, McAdam told attendees at a Verizon analyst meeting … In comparison, he said, the company deployed six-strand fiber when it began deploying its FiOS landline broadband and Internet service in the early 2000s. Verizon worked closely with its supplier Corning to get 1700 fiber strands in a single sheath, McAdam said, also noting that the company recently placed a $300 million order with another fiber supplier Prysmian.
>
> The largest fiber network in the country will be wireless" and will be operated by Verizon to provide backhaul and other types of connectivity.
>
> In Boston, Verizon is leveraging fiber that will support small cells to also support an expansion of the company's FiOS offering and a smart city trial. Potentially the company could repeat that strategy in other markets as its wireless network densification continues.
>
> Placing fiber across the country is a big opportunity"[37]

A recent study and report by Deloitte noted that "Deep deployment of fiber optics into our nation's network infrastructure might not be as glamorous as the eagerly anticipated launch of fifth-generation mobile networks (5G); however, it is just as important—if not more so. In fact, 5G relies heavily on

[37] http://www.telecompetitor.com/ceo-verizon-wireless-network-densification-will-drive-deployment-of-largest-fiber-network-nationwide/

fiber and will likely fall far short of its potential unless the United States significantly increases its deep fiber investments."[38] The study estimates that the US will need to invest $130 - $150 billion in the next 5-7 years in fiber infrastructure in order to support the roll out of next generation wireless.

Just as in other cities, in Lehi City requests to encroach on public rights of way and attach small cell antennas to City-owned streetlights, for example, will be accompanied by requests to place fiber-optic cable for backhaul and network connection, whether via boring, trenching, or other placement technique. The City needs to have appropriate administrative practices and policies in place to address these requests for encroachment permits and placement of antennas on City-owned structures when they come. In addition, the City may consider policy steps such that the City benefits from future fiber deployments in the public rights of way.

THE FCC'S SMALL CELL ORDER

The FCC's Small Cell Order limits local authority in many areas, including fees (most notably the annual fee limit of $270 per pole), requirements and criteria that may be used, time frames, and provisions of some state laws. The Order permits fees only to the extent they are non-discriminatory ("no higher than the fees charged to similarly-situated competitors in similar situations"), and are a "reasonable approximation" the government entity's "objectively reasonable costs" specifically related to the deployment.[39]

The Order sets out fee levels which are "presumptively reasonable" at $270 per small wireless facility per year, $500 application fee for up to five facilities, plus $100 for each facility beyond five.[40] Higher fees can be charged if the state or local government entity can show the higher fees are a reasonable approximation of cost and the costs themselves are reasonable and being assessed in an non-discriminatory manner.[41] Beyond fees, the Small Cell Order also addressed state and local requirements in the areas of aesthetic requirements, undergrounding requirements, and minimum

[38] https://www2.deloitte.com/us/en/pages/consulting/articles/communications-infrastructure-upgrade-deep-fiber-imperative.html
[39] Small Cell Order, at paragraph 50.
[40] *Id*., at paragraphs 78-79.
[41] *Id*., at paragraph 80.

spacing requirements using the "materially inhibits" standard created by the FCC in its Small Cell Order.

The Small Cell Order was appealed to the Ninth Circuit Court of Appeals, which recently issued its Opinion[42] largely upholding the Small Cell Order but with one exception:

> "The exception is the Small Cell Order provision dealing with the authority of local governments in the area of aesthetic regulations. We hold that to the extent that provision requires small cell facilities to be treated in the same manner as other types of communications services, the regulation is contrary to the congressional directive that allows different regulatory treatment among types of providers, so long as such treatment does not "unreasonably discriminate among providers of functionally equivalent services." 47 U.S.C § 332(c)(7)(B)(i)(I). We also hold that the FCC's requirement that all aesthetic criteria must be "objective" lacks a reasoned explanation."[43]

And:

> "In sum, the requirement that aesthetic regulations be "no more burdensome" than those imposed on other technologies is not consistent with the more lenient statutory standard that regulations not "unreasonably discriminate." The requirement that local aesthetic regulations be "objective" is neither adequately defined nor its purpose adequately explained. On its face, it preempts too broadly. We therefore hold those provisions of Paragraph 86 of the Small Cell Order must be vacated."[44]

[42] City of Portland et al. v. Fed. Commc'n. Comm'n., ____ F. 3rd ____ (9th Cir., Docket No. 18-72689, August 12, 2020), at page 31.
[43] *Id*., page 31.
[44] *Id*., page 52.

THE FCC RULES UNDER THE SPECTRUM ACT

Prior to the Small Cell Order, the "Spectrum Act", [45] enacted by Congress in 2012, added new requirements and directives to the Federal Communications Commission (FCC) for processing and approval of wireless deployments. To implement the Spectrum Act, the FCC issued new regulations to interpreting the Section 6409(a) requirements and directives of the Act related to local authorities processing of applications for wireless communications facilities. In brief, the Act tightens the application of "shot clock" timelines, and requires local jurisdictions to approve certain collocations and modifications to existing wireless communications facilities under shortened explicit deadlines, if it is an "eligible facilities request" – which is defined as any request for modification of an existing tower or base station that does not substantially change the physical dimensions of such tower or base station, involving (1) collocation of new transmission equipment; (2) removal of transmission equipment; or (3) replacement of transmission equipment. The new FCC regulations established defined standards for what for "substantial change" and implemented the statutory changes to "shot clock" regulations.

THE FCC'S "CLARIFICATION" RULING

The FCC recently made another ruling which attempts to preempt local authority regarding placement of wireless facilities by "clarifying" "the meaning of our rules implementing Congress' decisions in section 6409(a) of the Spectrum Act of 2012" [46]. The Declaratory Ruling on June 10, 2020 has been appealed by numerous parties including state and local government organizations and entities.[47] Among other things the Declaratory Ruling purports to "clarify" existing FCC rules originally adopted in 2014 to

[45] *See* Middle Class Tax Relief and Job Creation Act of 2012, Pub. L. No. 112-96, 126 Stat. 156, § 6409(a) (2012) ("Spectrum Act"), *codified at* 47 U.S.C. § 1455(a).
[46] *In the Matter of Implementation of State and Local Governments' Obligation to Approve Certain Wireless Facility Modification Requests Under Section 6409(a) of the Spectrum Act of 2012*, WT Docket No. 19-250 and RM-11849, FCC 20-75 (released Jun. 10, 2020) ("Declaratory Ruling")
[47] Appeals include The League of California Cities, the League of Oregon Cities, and the cities of Glendora, Rancho Palos Verdes and Torrance in California, Texas Municipal League, Texas Coalition of Cities for Utility Issues, Michigan Municipal League, the US Conference of Mayors and many other cities.

implement the Spectrum Act. The cities challenge the FCC's ruling on the basis that it violates federal requirements for rulemakings, and is arbitrary, capricious and an abuse of discretion in seeking to change existing FCC rules regarding applicability of "eligible facilities requests".

STATE REGULATION OF WIRELESS SERVICES

In 2018, Utah adopted the Small Wireless Facilities Deployment Act, the model code advocated by wireless industry experts, with input from the Utah League of Cities and Towns (as adopted by Utah in 2018, the "Utah Act").[48] Arizona, Colorado, Delaware, Florida, Hawaii, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, New Mexico, North Carolina, Ohio, Oklahoma, Rhode Island, Tennessee, Texas, and Virginia adopted similar state legislation that year.[49] By 2019, 21 states had enacted small cell legislation intended to provide uniformity amongst states and municipalities' regulation of small wireless facilities.[50] In the 2019 legislative sessions, 25 states considered small-cell-related legislation,[51] and in the year 2020, 16 states did.[52] Although the Small Wireless Facilities Deployment Act was published and adopted in Utah prior to the BDAC model state code in December 2018 and prior to the FCC's related regulations found in the Small Cell Order, which was approved in September of 2018, there are some overlapping definitions and requirements. The FCC's regulations include a definition of what constitutes a small wireless facility and time limits on local approvals of applications or permits; the Small Cell Order itself contains FCC guidance of allowable fees (presumptively reasonable), explains penalties if the applicable application deadlines are missed, and includes guidance on

[48] UT SB 189 Standing Committee Hearing Audio, UT SB 189 Senate Floor Debate Audio.
[49] *See Mobile 5G and Small Cell 2018 Legislation. Heather Morton,* Dec. *31, 2018, National Conference of State Legislatures;* https://www.ncsl.org/research/telecommunications-and-information-technology/mobile-5g-and-small-cell-legislation.aspx (containing a summary of each state's 2018 legislation, with a number of that states' acts being referred to as a "uniform" act or the "Uniform Small Wireless Facility Deployment Act").
[50] *Mobile 5G and Small Cell 2019 Legislation*. Heather Morton, Dec. 21, 2019, National Conference of State Legislatures; https://www.ncsl.org/research/telecommunications-and-information-technology/mobile-5g-and-small-cell-2019-legislation.aspx.
[51] Id.
[52] *Mobile 5G and Small Cell 2020 Legislation. Heather Morton, May. 4, 2020, National Conference of State Legislatures;* https://www.ncsl.org/research/telecommunications-and-information-technology/mobile-5g-and-small-cell-2020-legislation.aspx..

local restrictions related to spacing, undergrounding, and aesthetics; and the BDAC model code and the Utah Act address each of these matters as well.

Following passage of the Small Wireless Facilities Deployment Act, in August 2018 Lehi City adopted its Wireless Communications Facilities ordinance, Lehi City Municipal Code, Title 8, Chapter 1A. This ordinance provides the requirements for wireless facilities including small cell and covers the subjects of:

- Small wireless facility definition which relies upon the FCC definition and allows equipment up to 28 cubic feet whether ground mounted, or pole mounted;
- "Substantial modification" of existing wireless support structures and adoption of FCC rules for such modifications;
- Allowable fees as set in the statute;
- Site applications, including Lehi City preferred locations and limits on new poles adjacent to residential properties;
- Height and size restrictions;
- Equipment placement limitations;
- Visual impact, concealment and stealth design;
- Site permit application processes and requirements;
- Application process for macrocells;
- Construction and technical requirements, including maintenance and inspections; and,
- Enumeration of various service provider and Lehi City responsibilities.

Lehi City's wireless ordinance was enacted per the Legislature's direction on small cell wireless policies and thus it appears that there is not a need for additional amendment to the wireless ordinance at the present time in the context of this project.

7. OWNERSHIP OPTIONS

BUSINESS MODELS

Several viable business models exist for the City to expand Internet services to its community. The figure below compares and contrasts the two major models, retail, and wholesale. This information is useful for the City to understand the requirements of each, although the core recommendation for the City is to develop a wholesale model for broadband.

Figure 10: Broadband Business Models

Retail Services **City is the ISP**	**Wholesale Services** **City Owns Network, ISPs provide service**
Lehi City provides retail Internet services to homes and businesses directly. Lehi assumes all funding and operational responsibilities, including billing, customer service, operations, sales, marketing, maintenance and support functions. Lehi City would compete directly with private service providers and be responsible for ensuring sufficient customers sign up for service to support the ongoing costs of the broadband business and debt service. Lehi City will be required to comply with all State of Utah statutory requirements as detailed more fully in the regulatory assessment, which places specific restrictions on funding and operations of the network.	Lehi provides the physical network infrastructure, continuing its expertise in "poles and wires" and manages the equipment necessary to provide an open-access network. The City could build the infrastructure only and develop an exclusive partnership with a single provider or build an open-access network and partner with multiple retail providers to provide services to the community. In either case, the retail provider(s) are responsible for all retail Internet services to homes and businesses. The partners maintain the customer relationship, billing, operations, customer service, upgrades and ongoing maintenance.
Cities Using this Model	**Cities Using this Model**
City of Longmont, CO City of Fort Collins, CO City of Loveland, CO City of Chattanooga, TN City of Bristol, TN City of Clarksville, TN City of Cedar Falls, IA City of Waverly, IA City of Lafayette, LA	City of Huntsville, AL City of Westminster, MD City of West Des Moines, IA City of Breckenridge, CO City of Centennial, CO City of Lincoln, NE City of Rancho Cucamonga, CA City of Burbank, CA City of San Leandro, CA

A. Lehi Provides Services

Under a retail business model, the City would own, operate and provide Internet access directly to residential and business customers. It would compete with existing broadband providers directly for customers and it would be responsible for all operations, customer service, billing, provisioning and management of the broadband network. Customers would pay the City for services, and the City would incur all costs and assumes all risks.

Lehi would need an organizational structure to support delivery of broadband services in a competitive environment. This would require a broadband enterprise fund with management and staff to support all functions of the business, sales, marketing, general management, network operations, customer service, maintenance and engineering. Based on the size of the projected customer base in Lehi, the City would need between 20 – 30 FTEs to support the broadband system.

B. Lehi Provides Wholesale Services

Under a wholesale model, the City would wholesale its network to retail ISPs. There are several variations in this model, but in most cases, Lehi would be responsible for financing and managing the fiber network itself, including some equipment necessary to establish wholesale services. This equipment enables the City to connect ISPs to customers over the City's fiber network. In this example, the City is a passive infrastructure provider while multiple retail ISPs provide all Internet services. ISPs pay the City a monthly fee per customer connected.

In a dark fiber wholesale model, the City would only finance and manage the outside plant fiber network without any requirements for the equipment needed to establish wholesale services. A primary ISP would be responsible for funding equipment and providing retail services. The primary ISP is responsible for all functions of the network and pays the City a fixed lease fee for use of the network or alternatively, develops a long-term revenue sharing agreement with the City.

A key difference in these two versions of wholesale is the number of retail ISPs are able to offer services. In the first version, multiple retail ISPs can

utilize the network, giving residents and businesses more choices in providers, which increases competition. In the second version, only one retail ISP offers service to customers in most cases, and this version is often viewed as a public-private partnership rather than a wholesale model.

Figure 11 illustrates the responsibilities of the parties under each model.

Figure 11: Lehi's Responsibilities in Each Business Model

Component	Wholesale Model	Retail Model
Engineering Design	City	City Provides All Functions
Feeder and Distribution		
Premises Fiber Drop		
Access Equipment		
Headend Equipment		
Facilities and Data Center		
Fiber Maintenance		
Access Equipment		
Retail Internet Services	Retail ISPs	
Network Operations		
Customer Service		
Billing and Provisioning		
Sales and Marketing		

8. NETWORK DESIGN

The City's network design will be based on a leading-edge fiber-optic broadband platform that provides direct fiber-optic connections ("FTTP") to homes, businesses, and community anchors across the service territory. Fiber-optic connectivity is the "gold standard" for broadband service providers. It is the only current technology that provides the best long-term scalability for broadband networks to accommodate the ever-growing bandwidth (i.e. speed) needs of users. In a fiber-based network, the bandwidth is almost solely dependent on the capabilities of the network equipment. As equipment capabilities are improved, only upgrades to the network equipment are needed to achieve greater bandwidth.

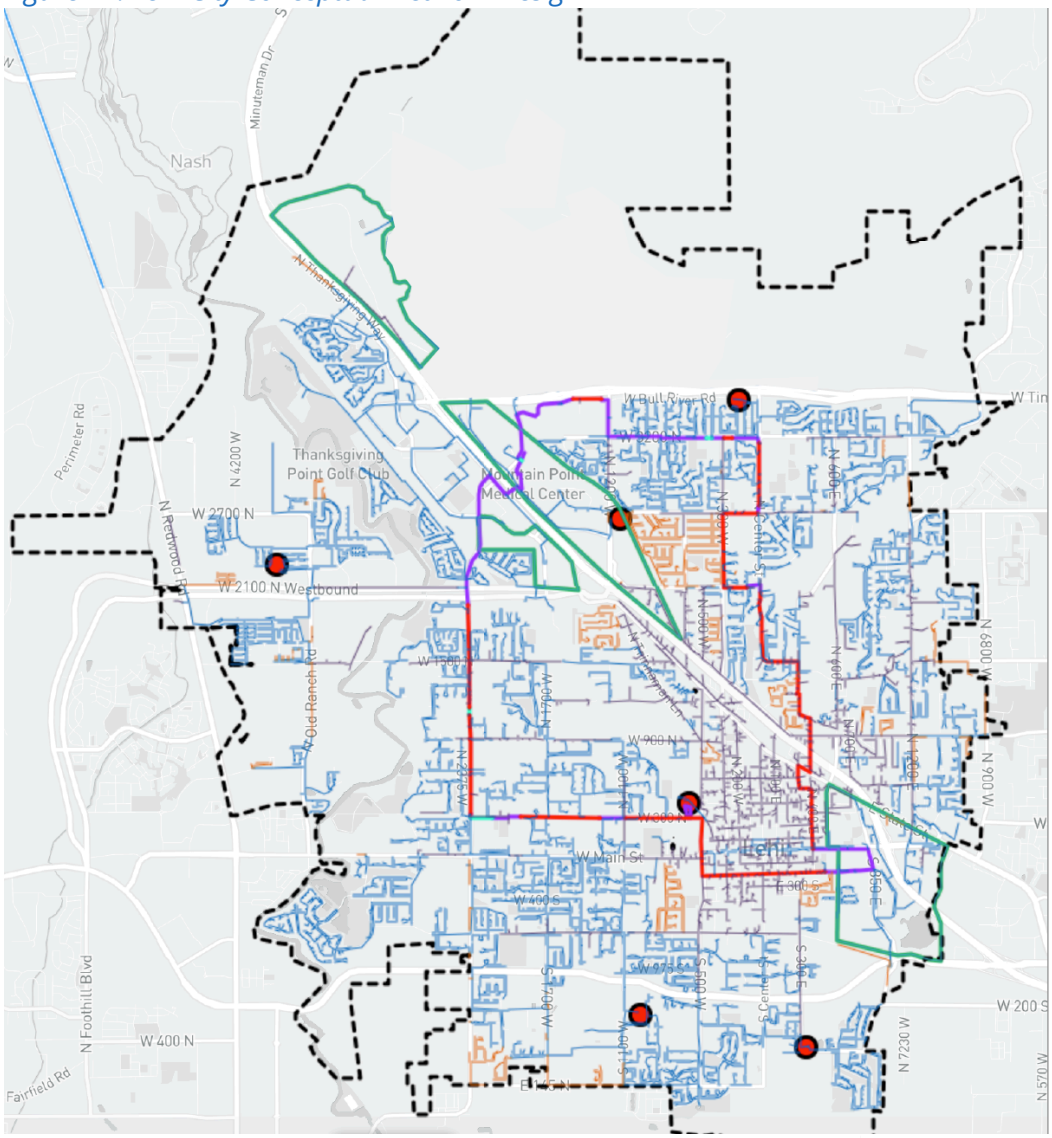
The network will be capable of providing 1 and 10 gigabits to the home and businesses through use of both XGS-PON and Active Ethernet technologies to deliver broadband services. These two technologies together will allow the City's network to offer high-bandwidth Internet services using a wholesale architecture. The City may choose to utilize either Active Ethernet or GPON for its deployment, based on the business model selected and final engineering design.

As a foundational part of the Study, Magellan developed a conceptual fiber distribution design for the City. The network supports connectivity to 100% of residents, businesses, and community anchor institutions located within the City limits, excluding the Traverse Mountain area, since an existing fiber provider already operates in this area. With the completion of the conceptual design of the network, estimates of formal design and build out costs were developed. These capital cost structures provided the foundation for the development of a detailed financial model.

Currently, the proposed fiber network is a mixed underground and aerial solution with the expectation that 89% of the network will be buried (8% in existing conduit; 81% new underground install) and 11% placed overhead on existing utility poles.

The conceptual network design will be the basis for low-level design engineering for the City's fiber network should the City go forward with the project.

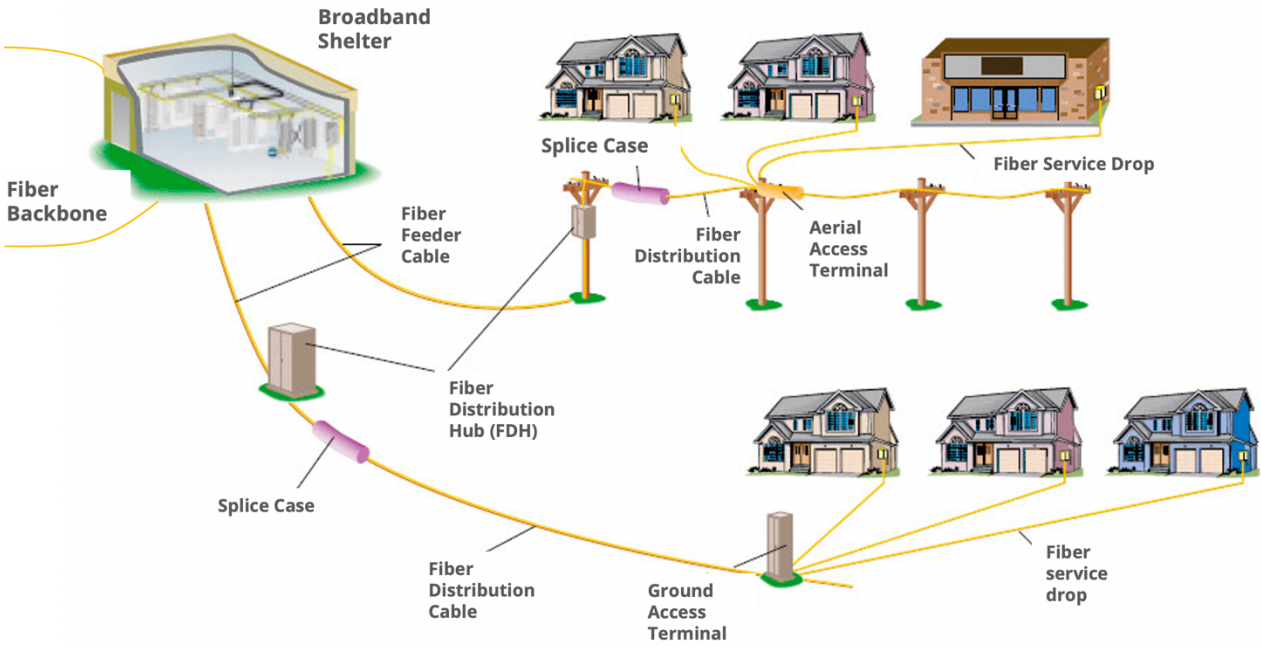
Figure 12: Lehi City Conceptual Network Design



NETWORK ARCHITECTURE

The City's network will be designed as a passive optical ("PON") and active ethernet architecture to support high bandwidth broadband services while minimizing operational costs. Backbone fiber will be designed to connect the City's data center to the customer access equipment in a ring topology, thereby providing service protection in the event of an equipment failure or fiber cut.

Figure 13: Architecture for a fiber to the home network



Fiber Backbone

The fiber backbone will contain 432 fibers and serves two critical functions of the network's operation, including protected connection of the distributed customer access equipment to the core network and connection of the core network to commercial data centers and retail ISPs.

The backbone will traverse the Lehi service area to connect distributed customer access equipment located within shelters and/or cabinets at strategic points of presence (POP) throughout the service area. The connections will be made using redundant uplinks to reduce the possibility of fiber cuts or equipment failures from taking down large groups of customers. These POPs may consist of powered cabinets, prefabricated shelters, or existing structures with sufficient space for equipment racks and other components. The backbone routes may also serve to connect other critical city networks such as SCADA and AMI, saving operating costs and supporting increased functionality and operational benefits. The City network would also connect to retail ISPs at one or more locations across its service area. Internet connectivity will require diverse routes to multiple upstream service providers for fault protection.

Data Center/Headend

A central office/data center/headend ("CO") owned and operated by the City will be required in a location central to the service area to provide an interconnection hub for retail ISPs. The CO will house core and edge equipment needed to interconnect with retail ISPs and route them to customers within the service area.

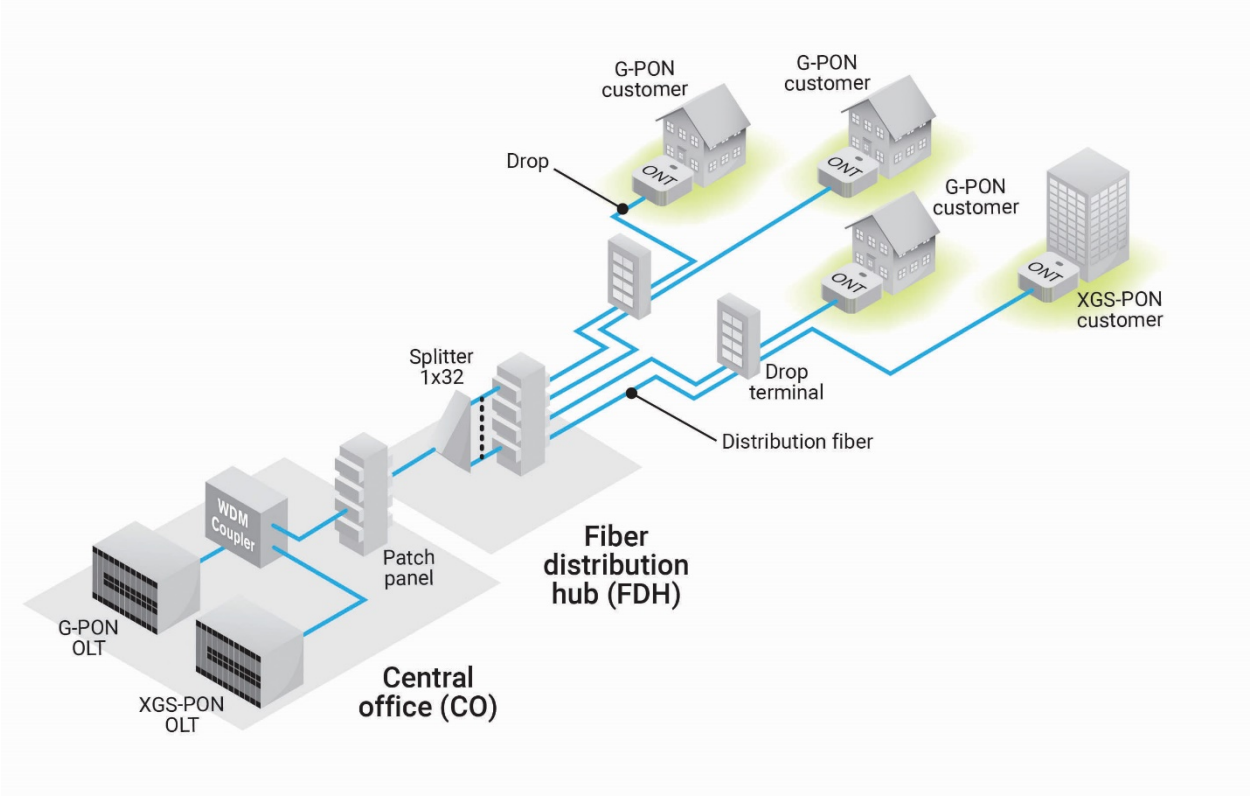
Feeder Distribution Fiber

Feeder/distribution fiber will extend services from the POPs to neighborhoods and business districts. Feeder fiber will connect OLT ports to passive splitters located in outdoor cabinet enclosures called fiber distribution hubs ("FDH"), placed strategically throughout the service area. Splitters may also be located within the access POP itself. In areas where aerial deployment will be used, FDHs may be placed aerially or transitioned from the aerial pole to a ground mounted FDH. Feeder fibers will be sized based on the demand forecast and sizing of each enclosure to ensure that each service area is well equipped for both PON and Active Ethernet services. These details will be fully developed in the engineering design process.

Distribution fiber extends from the splitters in the FDHs to network access points ("NAP") which provide access to the individual fibers required for customer connections. NAPs may be attached to aerial strand, located in

ground level pedestals or placed in underground vaults (handholes) located near the sidewalk or curb in residential neighborhoods or business districts. Fiber distribution to NAPs will be sized based on the service area density to provide service to between 8-12 premises per NAP.

Figure 14: Fiber Distribution Network



Fiber Service Drops

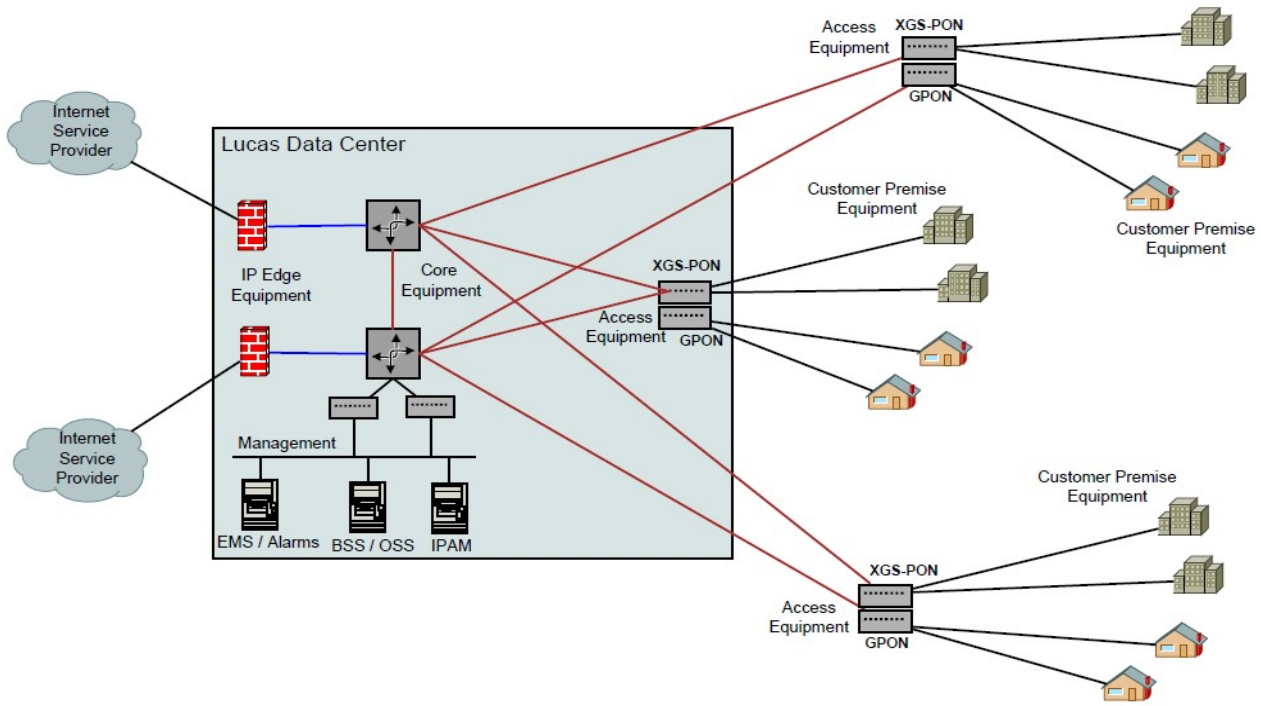
Fiber drops connect from each NAP to the customer premise equipment that delivers broadband service. A drop will extend fiber from the closest NAP to each home or business procuring service within the NAP service zone. A fiber drop will be connected to the NAP then buried outside of the customer premise. At the customer premise, the drop cable will be routed to a protective "clamshell" enclosure attached to a home or building for storage of slack and connection to the home equipment. Drop fiber installation costs in the model are based on a maximum to 200' from the NAP/handhole to the premise. It is expected that distances greater than 200' will be at an additional cost and borne by the subscriber. Subscribers could also incur

additional drop costs for special circumstances such as burying fiber through difficult landscapes or under driveways.

Network Equipment

The network equipment required to deliver broadband services to customers is comprised of several functional groups and multiple components within each group. Each functional group and a brief overview of how it is used to deliver service to the end customer follows below. The City will operate a mixed access network consisting of both PON and Active Ethernet services. The diagram below demonstrates the functional components of the network and how customers connect to the network to receive services.

Figure 15: Service Delivery Schematic



Core Equipment

The Core Equipment serves to aggregate all of the access equipment connecting customers and route their network traffic to and from the IP edge equipment or other end-point destinations. This equipment makes use of standard network protocols to provide link redundancy and dynamic traffic re-routing in the event of an equipment failure or fiber cut. Core Equipment will easily support thousands of customers and hundreds of

gigabits of traffic throughput at deployment and will accommodate future system growth through the addition of service modules, optical interfaces, and/or software licenses. Table 5 defines the key features of the Core Equipment and associated service requirements.

Optical Network Terminal

An Optical Network Unit ("ONU"), sometimes called an Optical Network Terminal ("ONT"), serves as the demarcation point between the City's fiber network and the router or firewall connecting to the customer's local area network ("LAN"). There are two general methods for installing ONTs. The first method involves mounting an outdoor rated ONT on an exterior wall of the structure and extending service wiring inside the premise. The second method involves extending the fiber into the premise and installing an indoor-rated ONU inside.

In either case, the ONT is typically installed somewhere near the fiber entrance and an AC power source. The ONT terminates the fiber based PON signals and provides customer access to their services through traditional copper interfaces. XGS-PON ONT's supporting greater than 1 Gbps data service may also support optical small form-factor pluggable ("SFP") interfaces for connection to enterprise-class LAN equipment.

In addition to the ONT, the City may also provide a managed residential gateway ("RG") to customers who do not have an existing router or who are interested in receiving managed services from the City. The RG looks and operates similar to consumer routers purchased from department stores or online. However, they contain software that allows the City to diagnose problems with the customer's service and provide managed Wi-Fi and other services for incremental revenue. Indoor units combining the ONT and RG into a single component at a reduced cost are available. However, the City may be limited in the available feature sets of the RG and the ability to extract incremental revenue from them.

Internet Protocol Edge (IP Edge) Equipment

Separate from the core switches, the broadband utility will maintain an "Internet perimeter." The Internet perimeter will include Internet routers and Internet firewalls to be used to manage routing throughout the network. Firewalls will be utilized to protect critical back office systems, including provisioning, network management, data storage, and other information. The City's two core switches will be interconnected to two Internet routers providing redundancy for Internet services in the event of a single interface or equipment failure.

Magellan recommends that the City contract with two Internet providers, allowing for failover if either provider becomes unavailable. To do so, Magellan recommends that the utility purchase a primary "tier 1" Internet provider connection that will be used during normal operations. Tier 1 is recommended to ensure that the utility provides a high-quality Internet service to its users, although this service will come at a slightly higher cost than other Internet transit providers offer. The utility will balance this cost with a tier 2 Internet provider to be used for its backup connection which will automatically carry the City's Internet traffic in the event that the primary provider becomes unavailable. The cost of the tier 2 connection will be significantly lower than the cost of the primary connection, thus bringing the average cost of Internet wholesale service to the utility down significantly.

9. FINANCIAL ASSESSMENT

FINANCIAL PLAN OVERVIEW

The Broadband Financial Plan information provided below depicts a financial outlook for the City's proposed network based on forecasts, projected revenues, capital costs, operational costs, and debt service for the project. This financial plan provides a model that projects the City's financial performance under a particular set of conditions based on fiber-optic deployment using approximately 11% aerial, 7% underground in existing duct, and 82% underground in new duct.

The financial information provided in this Study is a snapshot at a particular moment in time based on current information available. As costs, markets and business conditions change over time, assumptions are also subject to change. Therefore, it is important that the City periodically update its forecasts and financial model over time to ensure that they reflect the current environment.

Magellan recommends a quarterly review of the forecast and financial plan for the first 24-month period to ensure that the assumptions made throughout this project remain valid. Magellan's modeling software has been designed to allow the City to request changes to key parameters and then automatically update the underlying financial plan.

CAPITAL EXPENDITURES

Based on the high-level conceptual design for the City's fiber network, 20-year estimated costs for fiber buildout labor and materials, needed equipment, buildings, fiber management and network monitoring software, and project/construction management estimations have been established. Material and equipment costs include sales tax of 7.15%. Breakdown of the 20-year capital costs encompassing initial rollout costs along with periodic renewals and replacements based on expected life of the associated assets are as follows.

Design, Engineering and Permitting - $2,434,713

Design, engineering, and permitting consists of the low-level, formal design of the network. The design will encompass the backbone and distribution networks for the City. Design specifications are required for construction vendor bids and the subsequent actual construction. Cost for design is included in the needed capital funding. Obtaining necessary permits for the buildout will also be initiated during this phase. This amount includes the cost of PE Stamps on all drawings.

Construction - $43,360,226

Construction includes estimated labor and materials for the fiber backbone, feeder/distribution and remaining plant, including a 15% contingency on all costs. A summary of labor and material items included in the estimate are as follows:

Table 2: Construction Costs

CONSTRUCTION EXPENSES	
LABOR	**$29,044,638**
MATERIALS	**$14,315,588**
TOTAL:	**$43,360,226**

Network Equipment - $5,246,175

Costs consist of equipment needed to install, configure, and support the ongoing operation of the wholesale network. Equipment renewal and refresh costs have been included at 7-10 year intervals. Below are the types of equipment and services included in the costs:

- Core routing and switching
- Edge aggregation
- Optical line terminals
- Network management systems
- Fiber management systems
- Professional services for installation and configuration of software

General Equipment - $923,428

General equipment covers the equipment and tools needed for premise installations, maintenance, and overall support of the network. As with network equipment, renewal and costs refresh have been included at 7-10 year intervals.

Equipment/tools include:

- Bucket trucks and service vehicles
- Network testing tools and diagnostic tools including OTDRs
- Splicing trailers

Building Improvements and Network POPs - $3,078,241

Building improvements encompass design and construction of a data center facility or retrofit of an existing facility. Network Points of Presence (POPs) are usually small physical buildings/units located throughout the network to house equipment and to serve as interconnection points between the backbone and the distribution network. The current network design utilizes five POPs located throughout the City. The final location and design of the data center will be completed during engineering design.

Fiber Service Drops - $9,926,682

Premise drops consist of the labor, equipment, and material costs to connect residential and commercial customers to the network and are incremental, only connecting those customers that take service. All premise drops are envisioned to be underground from the nearest underground connection point ("handhole") to the fiber termination device ("ONT") located on the interior or exterior of the premise. Exterior ONTs are connected to interior wireless routers.

1. *Equipment and Materials*
   - Exterior premise connection hardware ("clamshell") or ONT
   - Connectorized drop fiber from nearest handhole to clamshell
   - Cable for wiring inside of premise from clamshell to ONT or ONT to interior wireless router
   - ONT with wireless gateway and power supply
2. *Labor*
   - Installation of exterior clamshell or ONT
   - Trenching and installation of drop fiber to premise clamshell

Construction and Turnkey Project Management - $ 2,350,000

During the critical design and buildout years, management is essential for the oversight of all facets of the broadband project from buildout to customer rollout. A few of the key areas include:

1. Overall management of the activities needed to create a broadband utility.
2. Daily management of construction vendor assuring the buildout is done as designed and meets all standards for underground installation.
3. Daily inspection of buildout construction, documenting needed corrections, and assuring that corrections are made in a timely manner.
4. Verification of construction invoices to ensure invoices match actual work completed.
5. Inspection of materials and assist with ordering, if needed.
6. Documenting and updating design for agreed upon changes.
7. Establishment of processes and procedures for all facets of the utility such as sales and marketing, customer ordering and support, back office functions (accounting, billing, payments, etc.), warehousing, facilities management to name a few.
8. Assist in hiring and engaging needed personnel.
9. Track all project tasks and hold timely status updates with the City of Lehi Project Team to ensure projects meets expectations and timelines.

20-Year Capital Cost Recap

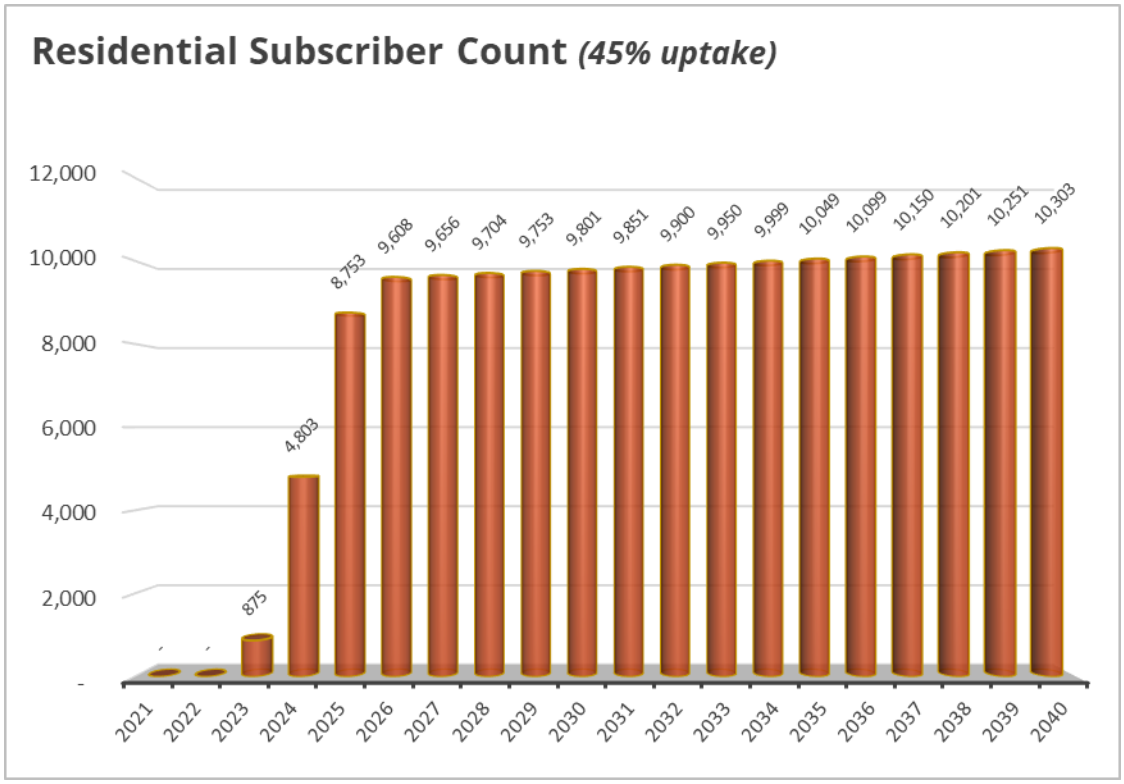
Table 3: 20-Year Capital Cost Summary

AREA	ESTIMATED 20-YEAR COSTS
NETWORK DESIGN	$2,434,713
CONSTRUCTION	$43,360,226
NETWORK EQUIPMENT	$5,246,175
GENERAL EQUIPMENT	$923,428
BUILDING IMPROVEMENTS	$3,078,241
PREMISE DROPS	$9,926,682
CONSTRUCTION AND TURNKEY PROJECT MANAGEMENT	$2,350,000
	$67,319,465

RESIDENTIAL & BUSINESS UPTAKE

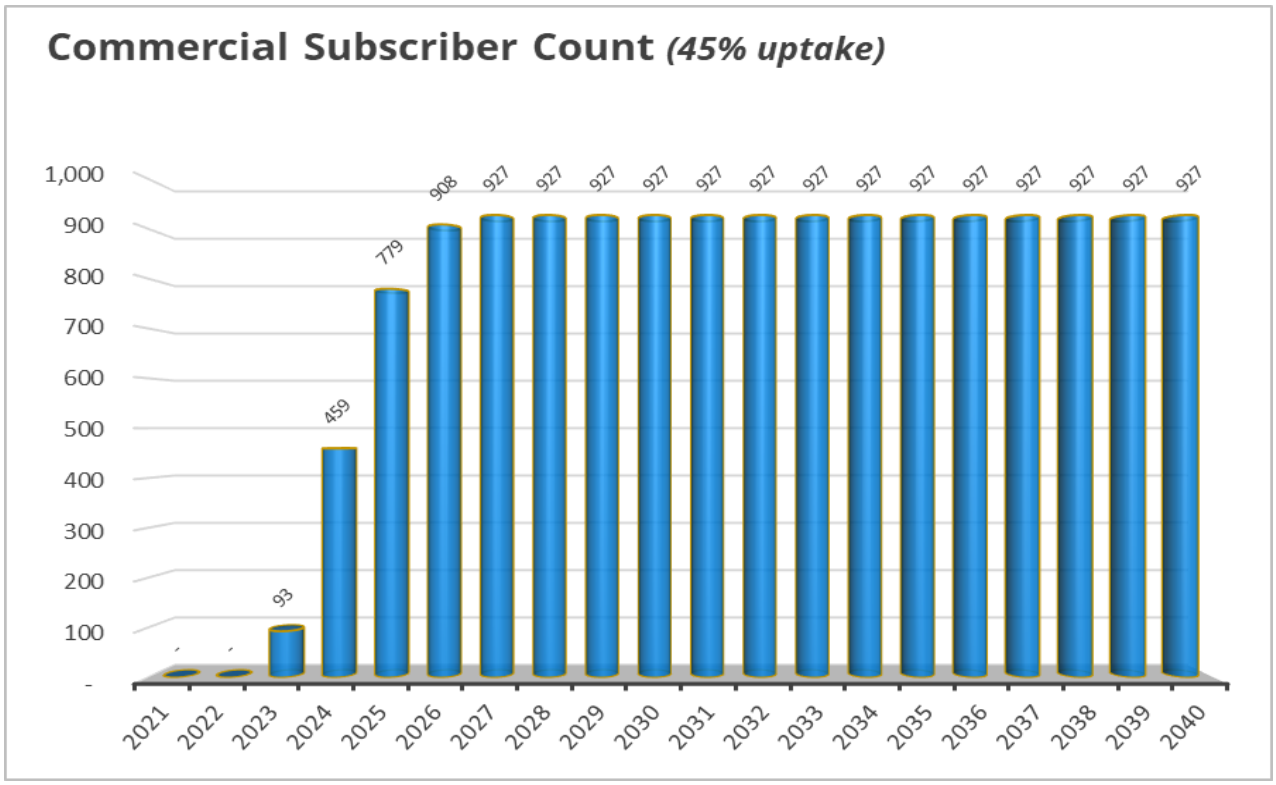
With wholesale residential and commercial subscriber uptake expectations of 45%, the following graphs exhibit the 20-year residential and commercial subscriber count projections.

Figure 16: Residential Demand Uptake



45% residential subscriber count is based on a three-year phase rollout starting in year 3 culminating with the complete subscriber base available in year 5. Expected growth rate from the current premise count (20,826) is relatively flat at 0.50% or approximately ten residential premises each year post year 5.

Figure 17: Business and Anchor Demand Uptake

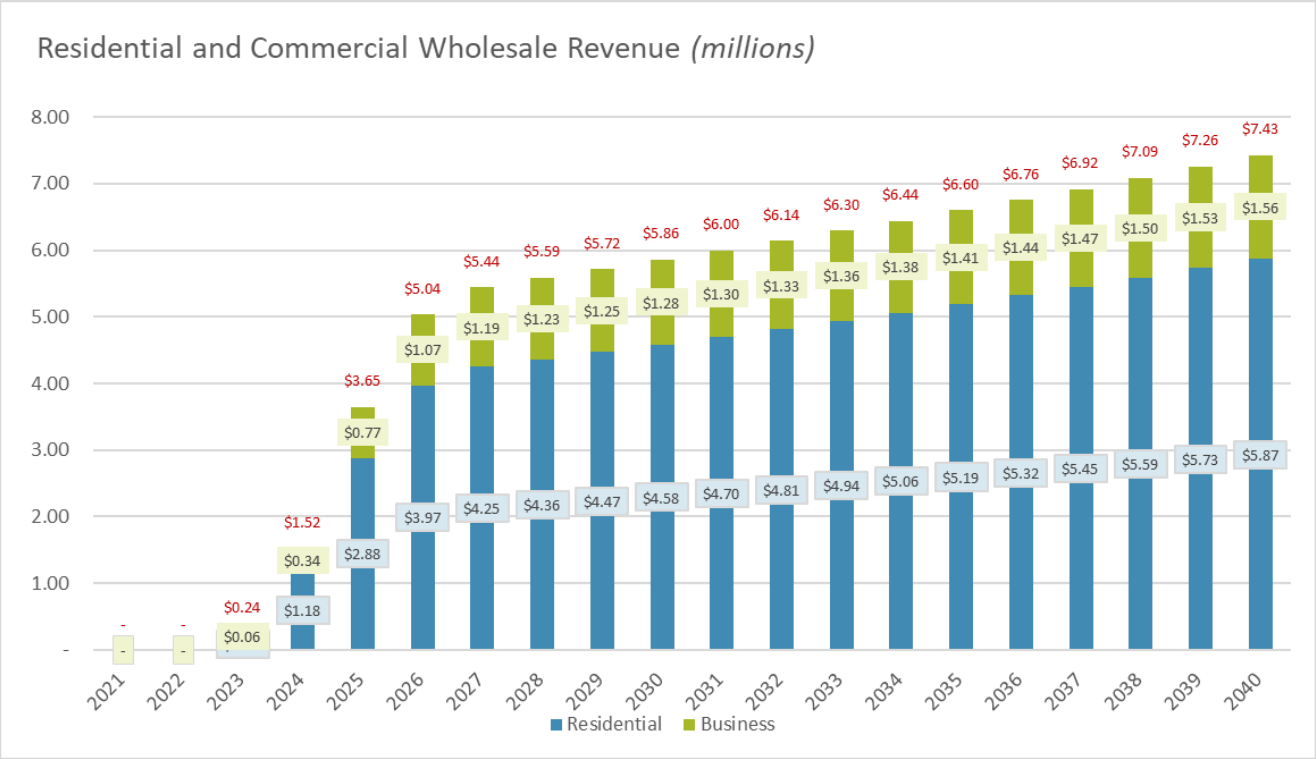


As with the residential subscribers, business subscriber rollout will occur over three years starting in year 3. Number of possible businesses is projected to remain relatively flat from the current business count (2,061).

WHOLESALE REVENUES

Residential and commercial wholesale annual revenue growth is aligned with subscriber rollout and growth. Revenue grows significantly during the first five years of rollout to $5.44 million per annum, and then gradually grows to approximately $7.43 million by 2040. Wholesale rates are projected at $30 - $34 per subscriber for residential and $90 - $100 per month for commercial subscribers.

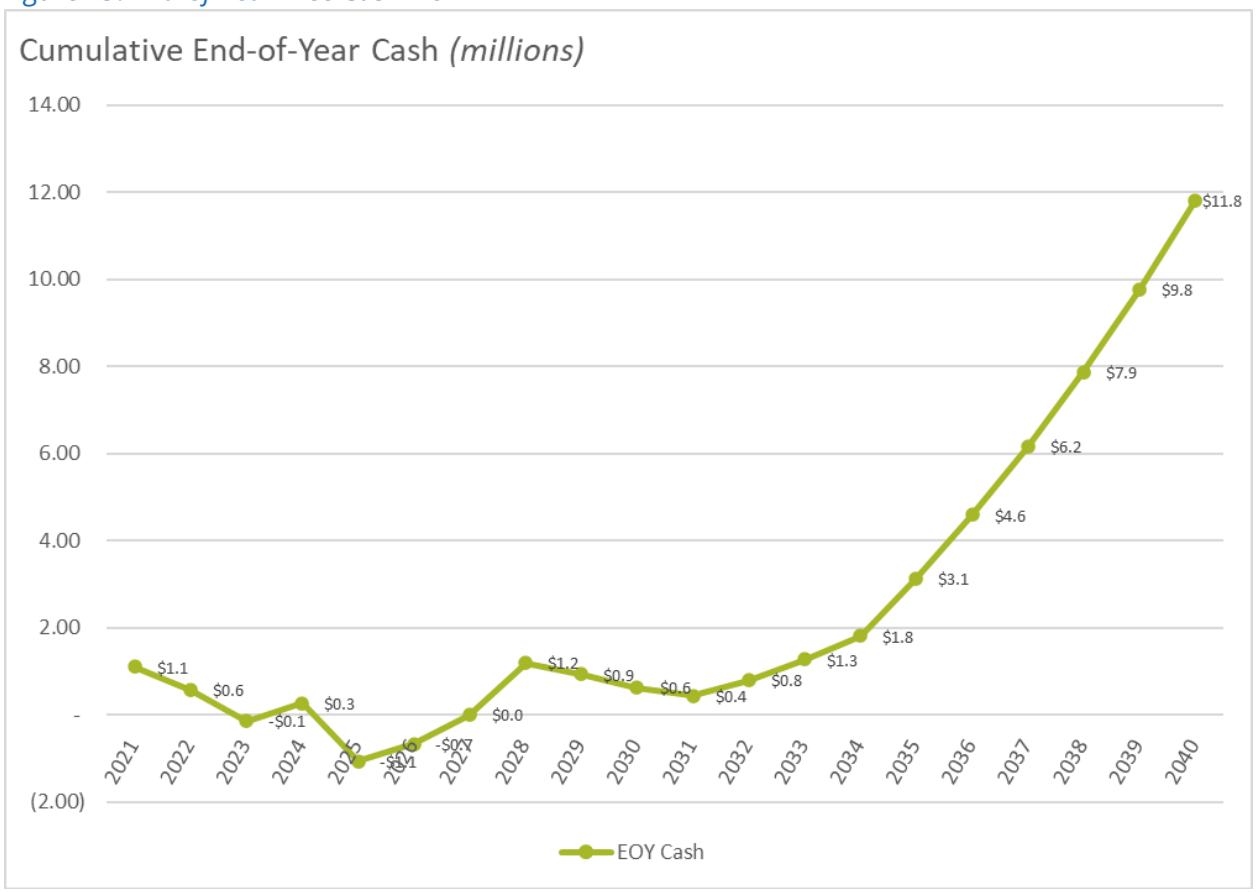
Figure 18: Service Revenues



END-OF-YEAR FREE CASH

Based on projected expenses and revenues, the City would achieve a 20-year cumulative end-of-year free cash of approximately $11.8 million with the yearly cash flow depicted below. Negative cash flows in the early years of broadband networks are very common and the City could backstop any cash needs in these years with working capital using interfund loans. These working capital needs have been built into the model to ensure sufficient funding is appropriate to meet operating needs.

Figure 19: End-of-Year Free Cash Flow



FUNDING

Bonds for construction of the network are estimated at $65 million. Magellan Advisors worked with the City's financial advisor to develop the following structure for the bonds. Bond proceeds would be utilized for the following:

- Five years of outside plant costs. This encompasses the design, labor, and materials for building the physical fiber network.
- Five years of network equipment, buildings, and general equipment costs plus construction and project management. After year five, renewal and replacement of equipment will be funded through use of system revenues.
- First year of working capital.

Calculation of needed bonding dollars include:

Table 4: Bonding Breakdown

BOND BREAKDOWN	AMOUNT
OUTSIDE PLANT CONSTRUCTION	$50,331,962
CORE & AGGREGATION EQUIPMENT & SHELTERS	$8,616,494
HOME EQUIPMENT & INSTALLATIONS	$4,878,872
1ST YEAR OF WORKING CAPITAL	$1,100,000
TOTAL AMOUNT OF BOND	**$64,927,328**

Financing will be structured with an initial three years of capitalized interest, followed by 1.5 years of interest only payments, followed by a 28-year general obligation bond with interest rate projected to be 4.0%.

Additional funding for startup costs and working capital is estimated at $7 - $11 million and could be funded directly by interfund loans.

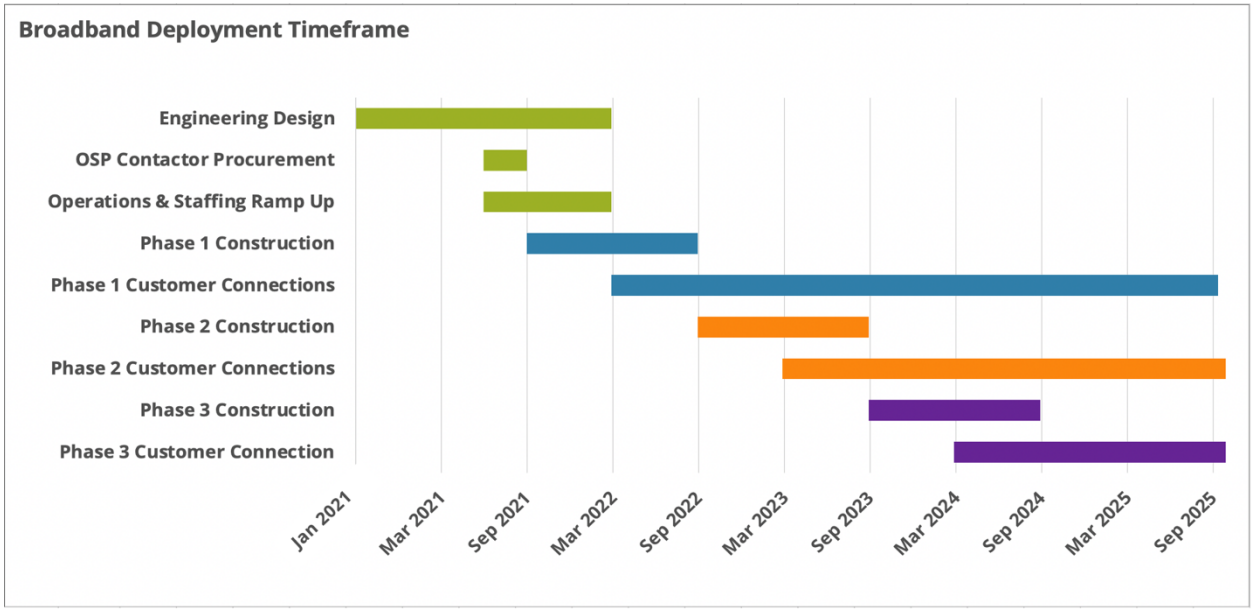
10. PROPOSED TIMELINE FOR BUILDOUT

Figure 20 illustrates a potential timeline for the deployment of broadband services, assuming that the City moves forward in late 2021 early 2022.

The critical steps to achieving this goal are:

- Creation and approval of a formal business plan
- Network design engineering for the City network
- Obtaining project funding
- Selection of construction, material, network equipment, and drop vendors
- Direct purchase of needed materials, if desired
- Implementation of data center and installation of equipment
- Establishment of operation policies and functions

Figure 20: Broadband Deployment Timeline



As financial projections are subject to changes in costs, markets, rates, business conditions and external variables over time, Magellan Advisors cannot guarantee that financial outcomes will match those forecasted in financial feasibility studies. No representation, warranty, or undertaking (express or implied) is made and no responsibility is taken by Magellan Advisors for the merchantability, adequacy, accuracy, or completeness for the financial information contained herein.

APPENDIX A: NETWORK SPECIFICATIONS

NETWORK STANDARDS

Standards simplify management and operations. They ensure that infrastructure deployed at different times, in different locations, by different entities is consistent and functional. Standardization is a governance best practice that goes directly to all of governance's purposes, that must be managed and operationalized. Generally, management adopts standards based on input from stakeholders, and operations assures the standards are met. Standards include contracts and operating procedures, as well as network facilities. The number of standards increase with service offerings. Regardless, there is no shortage of issues and resources that should be standardized.

Fiber, aerial, and underground standards are summarized below. Aerial specifications would be highly dependent on the pole segments and ownership. Actual pole routes selection, if required, will occur in the network design process. A future design engineering study will also identify the final overhead requirements and specifications. Overhead placement standards and specifications should be coordinated through the public policy process with input from relevant community partners.

Outside Plant Underground Specifications[53]
Basic Fiber Specifications

- Backbone cable size – 288-count fiber
- Distribution cable size – 96-count fiber
- Lateral cable size – 12 and 24-count fiber
- Single mode, loose-tube non-armored cable
- Jacketed central member
- Outer polyethylene jacket
- Sequential markings in meters
- All dielectric
- Gel-free/dry buffer tubes
- 12 fibers per buffer tube

[53] Outside Plant Specifications change from time to time.

- Color coded buffer tubes based on ANSI/TIA/EIA 598-B Standard Color

Underground - Basic Conduit Specifications

- 36” minimum acceptable depth
- 2” HDPE smooth wall reel-mounted pipe for underground duct
- Warning tape installed at 12” or 18”
- Maximum fill ratio of 50%
- Innerduct where appropriate for subdividing duct space
- Vault placement at intersections, every 500ft in commercial corridors
- Vaults sized appropriately to house underground lid-mounted pedestals and splice enclosures
- Aerial
- All installation shall comply with all requirements as listed on any pole attachment agreements
- All aerial construction shall be installed using the strand and lashing method
- Strand, unless specifically directed, shall be 6m galvanized strand
- Fiber cable shall be double lashed to strand
- Cable shall be installed at specific height/location per construction drawings
- New aerial construction shall be located in the communication space on the poles
- 40” minimum separation from pole neutral is required
- Midspan cable height shall meet regulations as to minimum height for passage of vehicular traffic
- Installed aerial cables shall match sag of all existing cables to prevent midspan rubbing
- Down guy installations shall be at proper “rise and run”
- Down guys shall be galvanized 6m strand with yellow guy guards
- All anchors installed shall be either Manta Ray type or screw-in anchors
- All cable slack shall include the use of slack organizers ("snow shoes")
- 150’ of slack shall be installed every 1500’ unless specified in construction plans
- Snow shoes shall be secured to the 6m strand per manufacturer instructions

- Orange high-visibility cable tags shall be installed at every pole attachment and splice case
- Cable tags shall be weather rated and read “City of Lehi Fiber Optic Cable”
- Splice cases shall be tagged per requirements as to identify cable size, routing and count
- All pole attachments, down guys and splice cases shall be properly grounded utilizing #6 solid wire and 5/8”x8’ copper clad ground rods

It is advisable to establish a pool of spare equipment, materials, and tools for operating the network, especially for rapid response to any emergencies or outages. These assets may be held by operations or by a contracted agent to be deployed when replacement or new facilities are required. The storage and common access of such assets could reduce or eliminate the duplication of costs by any party to the network in building-out aspects of the city-wide infrastructure.

Table 5: Service / Core Equipment Requirements

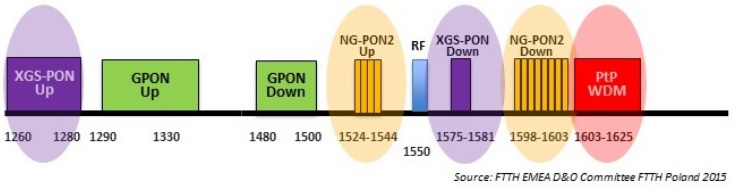
SERVICE REQUIREMENT	CORE EQUIPMENT REQUIREMENT
SCALABLE INFRASTRUCTURE PARTICULARLY FOCUSING ON ADVANCED BROADBAND APPLICATIONS.	Core network platform that will provide high-availability, redundancy, performance and scalability to grow broadband offerings and provide guaranteed service levels to customers and service providers.
REDUNDANCY FACTORS	The core network equipment must be offered in a choice of different form factors purpose built for high availability. Equipment must have several levels of redundancy built-in to allow for a maximum amount of uptime and redundancy.
PERFORMANCE FACTORS	The equipment must be capable of providing line-rate forwarding for all core interfaces and have enough line card storage to grow out to full capacity.

SERVICE REQUIREMENT	CORE EQUIPMENT REQUIREMENT
SCALABILITY FACTORS	The broadband network will be required to support a minimum of 1 Gigabit for all core interconnections. Upgrades to existing capacity must be available in increments of 1 Gbps, 10 Gbps, and 100 Gbps speeds.
QUALITY OF SERVICE FACTORS	Equipment must provide QOS to classify, mark, prioritize, queue and forward multiple types of traffic that require different service levels from the network. Management of the QOS system is also an important part of managing the new core infrastructure and the network management systems should be capable of providing reports, graphs, alarms and fault management.
MANAGEMENT FACTORS	The core network equipment must support management protocols that will allow staff to easily monitor, manage and maintain the network infrastructure. An accompanying network management system capable of configuration, software and device management is important to manage the core network.

ACCESS EQUIPMENT

The Access Equipment will consist of Optical Line Terminals (OLT) and supporting components in each access POP for connection of customers to the network. OLTs support both GPON and XGS-PON technologies in the same or separate shelves and come in various capacities to support a few hundred to several thousand customers per shelf. Access Equipment will consist of a single or dual GPON shelves located in the CO. Each PON shelf will be equipped with redundant supervisory modules, power supplies, and

Figure 21: ITU Family of PON Standards



fan trays to reduce the impact of individual hardware faults on customer operations. PON service line cards will be hot swappable for in-service replacement. The Access Equipment will connect to the Core Equipment using 10Gbps and/or 100Gbps uplinks in redundant pairs.

The ITU standards for PON networks support coexistence of multiple technologies over the same feed/distribution fibers by assigning separate optical wavelengths downstream and upstream to each one. G.984 (GPON) assigns 1490nm down/1310nm up, whereas G.9807 (XGS-PON) assigns 1577nm down/1270 up. Both technologies supporting splitting ratios up to 1:128, although 1:32 and 1:64 are typical to best balance cost and performance. This standardized coexistence will allow the City to deploy the appropriate technology at the best price point to service multiple customer needs using the same fiber cable plant. The standards also provide a blueprint for the addition of NG-PON2 services in the future. Figure 21 shows the entire ITU family of PON standards and their assigned wavelengths for reference.

PON shelves within each access POP will contain both GPON (for customer services up to 1 Gbps) and XGS-PON (for customer services over 1 Gbps) line cards. Customers may receive service from either system through a simple change of CPE. To facilitate the coexistence, a passive optical combiner called a "coexistence element" is installed between the PON ports and the splitter input. The coexistence element combines the separate GPON and XGS-PON wavelengths onto a single feeder fiber connected to the splitter input. Customers are then connected to a splitter output port using the distribution fiber assigned to their premise.

PON services will be provisioned through the network management and provisioning systems, allowing the City to auto-provision customers without manual configuration of the systems. For residential and small business

users, auto-provisioning will enable the City to significantly reduce the amount of staff hours required to manage customer activations, terminations, and changes. It will also allow the City to minimize errors in the provisioning process due to misconfiguration of resources within the Access Equipment.

APPENDIX C: FINANCIAL DISCLAIMER

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