CITY OF
ELK GROVE

Digital Access Report

July 2023

Digital Access Report

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SECTION 1

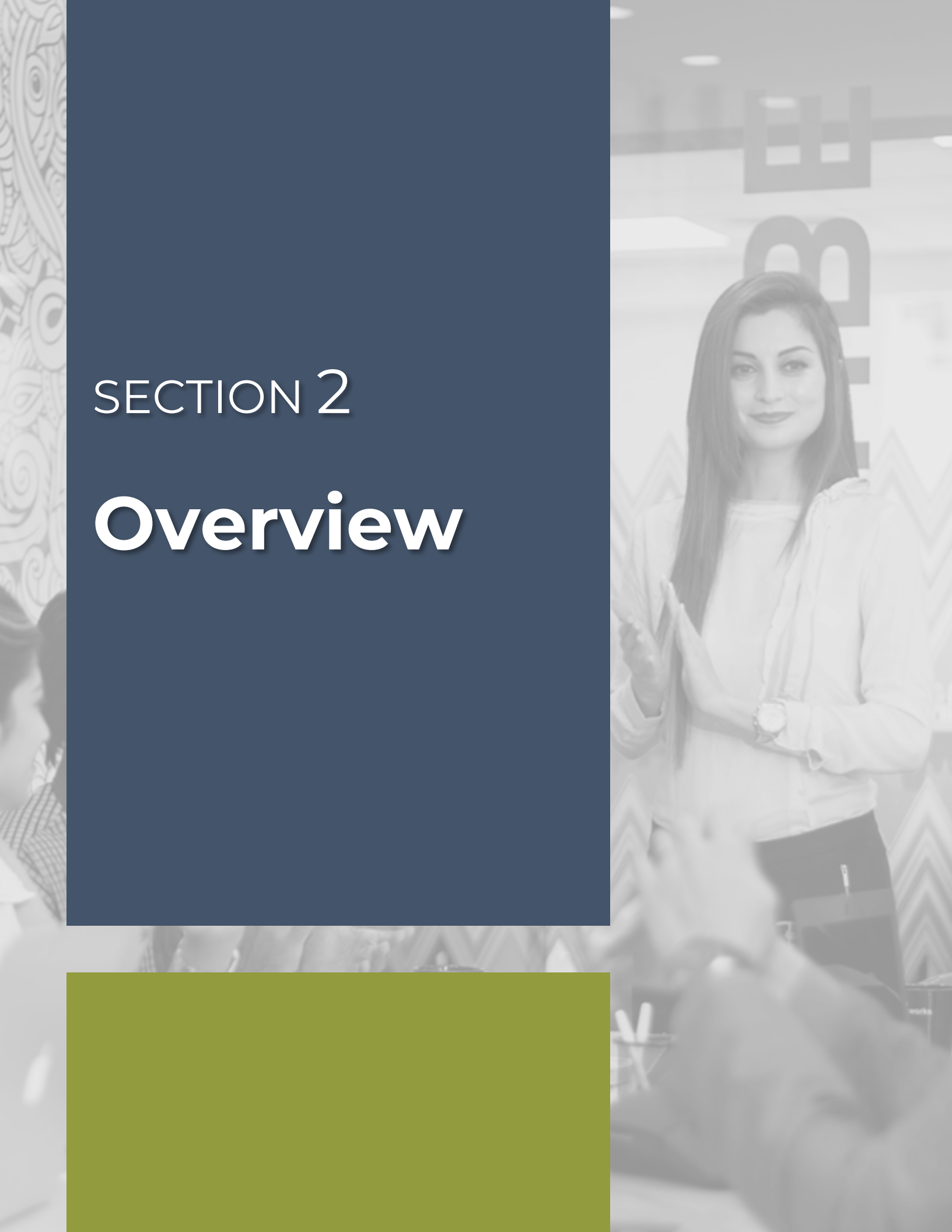
Vision Statement

VISION STATEMENT

Broadband is an essential utility, necessary to fully access and participate in education, business, healthcare, entertainment, finances, and government. As an essential utility, broadband should be affordable, accessible, and reliable for all residents. The City of Elk Grove seeks to ensure that all residents have high quality, high bandwidth internet access.

SECTION 2

Overview



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Overview

In January 2022, the City of Elk Grove adopted the Connected Elk Grove Smart City Strategy. One of the goals of the Strategy is to expand broadband connectivity, stating:

> "Broadband connectivity and internet access serve critical needs for residents to flourish economically, and to connect to their schools and communities. Elk Grove will focus on providing infrastructure, training, and hardware, particularly to areas with poor access including industrial areas and disadvantaged communities."

The relationship between digital connectivity and the ability to fully participate in community life are more inextricably linked than ever. Ensuring internet access to homes and businesses is a critical public need. This was particularly highlighted during the COVID-19 pandemic, when having reliable internet connectivity was the only link for education, engagement, or the economy. This document is the first steps for the City of Elk Grove (the City) to understand digital equity gaps and to make recommendations on next steps to address digital equity. The work helps to fulfill identified next steps in the Connected Elk Grove Strategy around research and data gathering related to broadband and mapping out additional activities.

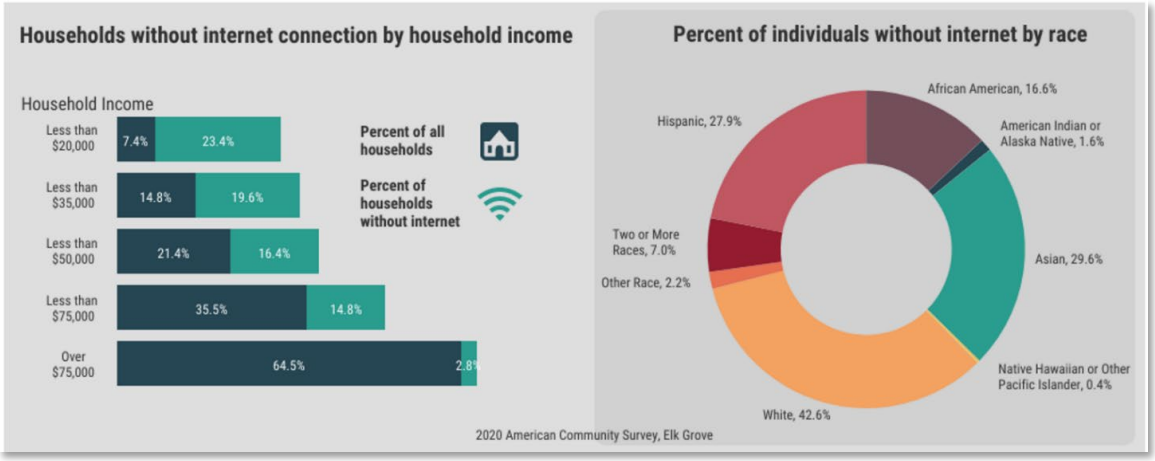
This document was funded through a Build Better Broadband grant from Connect Humanity, a project supported by the Tides Center in 2022. Connect Humanity is a stand-alone non-profit and spun out of the Tides Center in January 2023. Staff from the City of Elk Grove worked with EntryPoint Networks, Connect Humanity, and Biarri Networks to develop this Digital Access Report. It is intended to help City leaders articulate digital equity gaps, identify options to improve broadband affordability, access, equity, and reliability, and to determine whether it is feasible and advisable to deploy and operate a municipally owned fiber network for the residents, businesses, and anchor institutions in the City of Elk Grove. This report seeks to assist City leaders in understanding the operational implications, important risk factors, and a realistic cost framework for developing and operating City-owned fiber-optic infrastructure.

SECTION 3

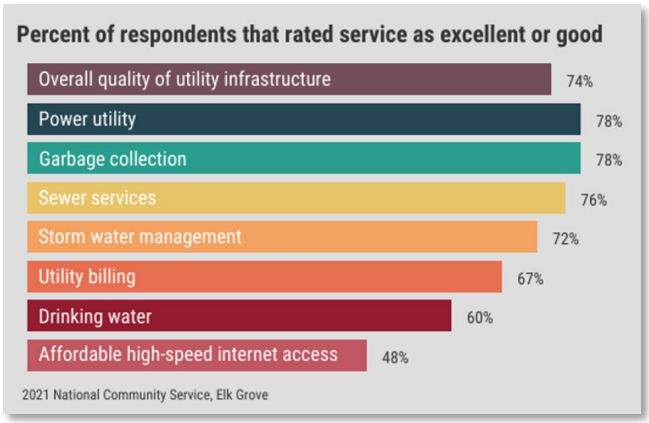
Digital Access In Elk Grove

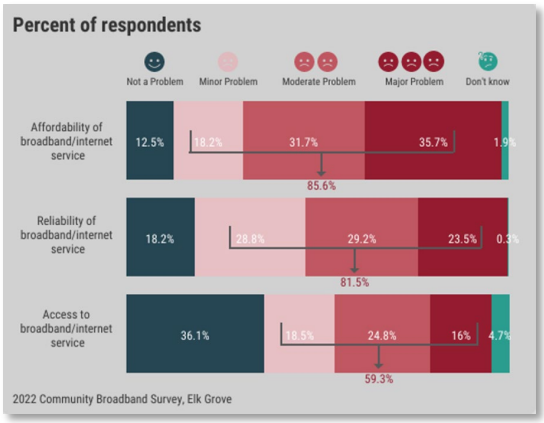
Digital Access in Elk Grove

This project is the first effort by the City to analyze digital equity gaps. Data is a critical piece in understanding digital equity concerns. The 2020 American Community Survey reports that 97.4% of Elk Grove households have a computer in the home and 93.4% of households have access to broadband. Within these numbers, there are significant gaps for specific population groups. Over 16% of Elk Grove households making less than $50,000 per year have no internet connection, a number which increases to 20% of households with income of less than $35,000. Of the households with no internet connection, almost 60% earn incomes of less than $50,000—though these households make up only 20% of all Elk Gove households. In addition, while Hispanic or Latino residents make up only 19% of Elk Grove residents, they make up almost 30% of households without internet access. Similarly, while African Americans constitute just 11% of the Elk Grove population, they account for 20% of residents without computers and 17% of residents without internet.



Resident sentiment related to internet service is a key consideration. The 2021 National Community Survey asked Elk Grove residents to rate the quality of affordable high-speed internet access along with other utility services. Only 48% of residents rated internet access as excellent or good, the lowest for all utility services.





To gather additional input and understanding of resident sentiment related to internet service, the City conducted a community broadband survey from June 6, 2022, to July 30, 2022. There were 329 responses received from residents and business owners. Almost 68% of respondents identified affordability as a major or moderate problem, 53% identified reliability as a major or moderate problem, and 31% identified accessibility as a major or moderate problem. (See detailed survey results at the end of this report.)

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Demographic & Income

The following are key statistics in Elk Grove:

- Total population – 178,997
- Gender – 51.9% Female, 48.1% Male
- Race & ethnicity:
    - White – 33.5%
    - Asian – 28.9%
    - Hispanic – 19%
    - Black/African American – 11%
    - Two+ – 9.9%
    - Native Hawaiian and Other Pacific Islander – 2%
    - American Indian and Alaska Native – 0.6%
- Median age – 38.2
- Foreign born population – 24.2%
- Language other than English spoken at home – 33.8%
- High school degree or higher – 91%
- Bachelor's degree – 36.7%
- Square miles covered – 42
- Number of people per square mile – 4,262
- Number of households – 53,627
- Number of Biarri premises* – 51,416
- Households that are owner occupied – 74%
- Average household size – 3.2
- Persons below the poverty line – 8%
- Median household income – $101,776
- Sacramento County Median household income – $70,684
- California Median household income – $78,672
- National Median household income – $64,994
- Households that have a computer – 97.4%
- Households with a broadband internet subscription – 93.6%

** Note: The difference between the household count and the premise count provided by Biarri is likely attributable to households living in multifamily dwelling units.*

Source: *Census Bureau Quick Facts, Elk Grove, CA (https://www.census.gov/quickfacts/elkgrovecitycalifornia)*

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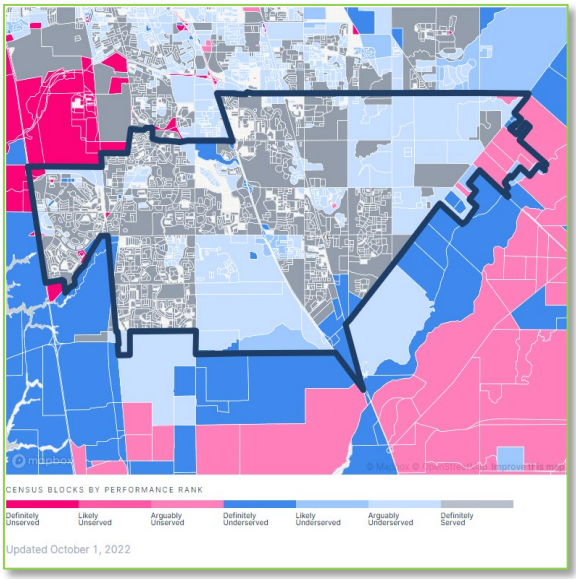
Current Broadband Offerings

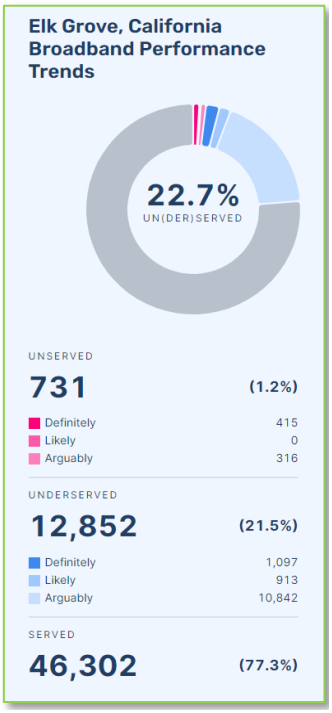
Currently, there is some fiber deployment in the City, both public and private. The City has deployed fiber in specific locations, primarily along major thoroughfares to support improved traffic control and accident detection. For businesses and residents, the incumbent model is focused on private companies who provide access in the form of DSL, cable, Wi-Fi, or fiber in various locations around the City. While there may be some areas of the City with multiple options for broadband service, many locations have just one provider available. Consolidated has deployed fiber in its service area, and Frontier is working to upgrade and expand its services around fiber. Comcast is the dominant cable provider, with approximately 70% of survey respondents indicating they use this provider. Currently, much of the City has access to Comcast/Xfinity cable, with very limited fiber availability. Still, there continue to be some areas of the City with poor broadband coverage, connectivity, and that continue to rely on dial up/DSL service. It is anticipated that as work/school from home increases along with increased demand from connected appliances and entertainment, these issues will be exacerbated.

> Many cities do not know where fiber is deployed. This may be due to past practices, incumbent refusal to release that information to a city, or other circumstances. We would note that not providing data to city officials about where fiber is, hampers a city's ability to know how to plan and improve local conditions. Companies should not be in the driver's seat regarding municipal planning. They should be a partner that is accountable and responsive to municipal and local governance entities—not just Federal.

Readily found data on unserved and underserved citizens in cities, towns, townships, and municipalities is under dispute due to discussions about the latest information released by the Federal Communications Commission (FCC) in their broadband maps. According to FCC maps, the fastest typical speeds are 25/3 Mbps. Many communities are finding errors, and the information we include in this report is from official sources. Each municipality must validate the data as it goes forward with official network development plans.

Broadband Money audits tell a different story. This map shows the total demand points and quality of broadband coverage in Elk Grove. The map clearly outlines places most in need of improvement and can serve as a resource when considering improvement or expansion of broadband services. The graphic illustrates broadband performance trends. Click here to learn more.





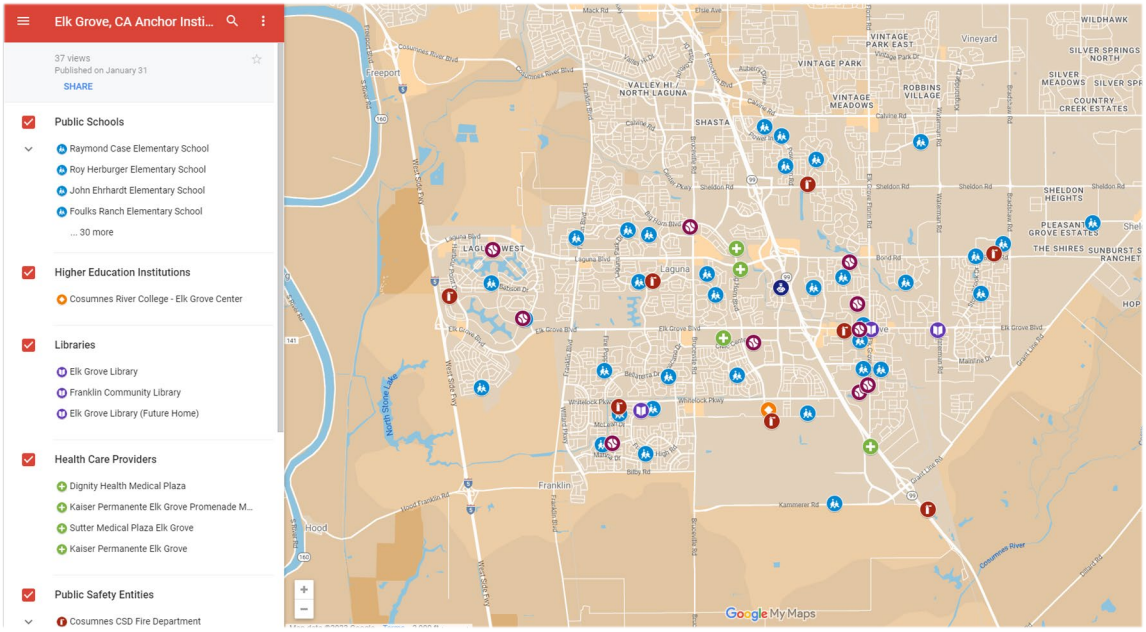
Anchor Institutions

The Infrastructure Investment and Jobs Act (IIJA) has provided funding to several federal agencies to help improve broadband coverage across the United States. One of the key agencies administering funds is the National Telecommunication and Information Administration (NTIA). The grant program that NTIA administers to help states with broadband development is the Broadband Equity, Access, and Deployment (BEAD) program. Section I.C.(f) of the BEAD Notice of Funding Opportunity (NOFO) defines a community anchor institution (CAI*)* as an entity such as a school, library, health clinic, health center, hospital or other medical provider, public safety entity, institution of higher education, public housing organization, or community support organization that facilitates greater use of broadband service by vulnerable populations, including, but not limited to, low-income individuals, unemployed individuals, children, the incarcerated, and aged individuals.

An Eligible Entity *(the State Broadband Office)* may propose to NTIA that additional types of institutions should qualify as CAIs within the entity's territory.

Source: *Page 11 – https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf*

Schools, hospitals, libraries, and other community institutions will be key partners in the City approach if the City moves forward with Citywide fiber-optic infrastructure. The City will likely seek out these anchor institutions as customers, service providers, and locations for digital literacy education. Click here to access the interactive Google Map below that maps key CAIs in Elk Grove.



SECTION 4

Opportunities

Opportunities

Digital infrastructure is the road system in a digital economy and is critical to nearly every function of a city. A reliable digital infrastructure is a critical necessity to fully enable participation in the economy, education, governance, and healthcare. For local jurisdictions, a reliable and robust digital infrastructure is a basic requirement for the functioning of City services and operations, from finance to transportation to emergency services. Similarly, businesses require reliable and fast digital infrastructure to connect with customers, ensure their supply chain and continue to operate. The education and healthcare systems require digital infrastructure to connect with students or patients, to communicate between facilities, and ensure timely and appropriate services. Connecting to individuals from disadvantaged groups, either because of income, race, age, or language abilities, is even more critical to ensure these groups have full access and availability to benefit from today's digital society.

The incumbent model is intended to optimize profit for private companies rather than optimizing affordability, equity, and accessibility for all. As additional fiber deployment takes place in Elk Grove, there is limited incentive for multiple private operators to install fiber in the same locations in the City, leading to more limited choices going forward. Due to the critical nature of digital infrastructure, ensuring a reliable and equitable network is a clear public policy concern. This places cities in a unique position to deploy an infrastructure asset that can have a far-reaching impact on all the systems that are important in a city that impact businesses and people.

Key limitations of the incumbent model include:

1. The infrastructure is treated as an amenity or luxury item rather than as essential in modern life.
2. Competition happens at the infrastructure layer rather than at the services layer. This is very expensive and not financially sustainable. It also leads toward monopoly control over services.
3. The infrastructure and services are bundled together. This conceals the actual cost of infrastructure and services and adds to the lack of competition among service providers.
4. As a critical infrastructure, a market-based model does not lend itself to optimal access. The interests of incumbent service providers are to charge the maximum price the market will bear, leading to disadvantaged communities being unable to access the services.
5. There is little to no local influence over the pricing, governance, deployment accountability, or quality of digital infrastructure and services (internet).

The deployment of a municipal fiber network would overcome these limitations. Like the City road network, deploying a municipal fiber network would provide equitable, reliable access to all residents and businesses, and continue to encourage competition. As the road network supports competition among various delivery services, a digital network could support competition among various internet service providers.

What Would a Sustainable Model Look Like for a Municipal Fiber Network?

The following opportunities to improve digital infrastructure are unique to a municipal entity and may enable long-term benefits in education, health care, public safety, efficient delivery of government services, and the general economy. Commercial internet service providers (ISPs) are unlikely to pursue any of these opportunities because they are contrary to existing incentives.

1) Improved Affordability

The dominant national ISPs have developed a business model that is "rent seeking" and sustained by controlling the infrastructure. Network control allows incumbents to impose premium pricing on network rents (ISP fees). The actions listed below can effectively overcome these "rent seeking" practices and drive down the cost of access in a meaningful way. These include the following:

1. Apply established municipal utility operational models for funding, construction, operation, and fees and leverage established municipal utility powers, tax exemptions, and liability benefits to drive costs down.
2. Put downward pressure on price by enabling dynamic competition between service providers via an open access network model.
3. Separate and optimize the key cost components of digital access into the three main network categories: (1) Capital Infrastructure Investment, (2) Monthly Maintenance & Operations Expenses, and (3) Monthly Internet Access Free from ISP.
4. Allow households in multi-tenant buildings to share the infrastructure, maintenance, and operations costs.
5. Allow subscribers to pay off the cost of infrastructure and eliminate that line item once the infrastructure debt has been retired.
6. Leverage automation to lower operational expenditures.
7. Apply for state and federal grants targeted to offset the cost of deploying new fiber-optic infrastructure.

2) A Reduced Digital Divide

The 2021 bipartisan Congressional infrastructure bill (H.R. 3684, Infrastructure Investment and Jobs Act (IIJA)) defines digital equity as "the condition in which individuals and communities have the information technology capacity that is needed for full participation in society and economy of the United States."

Persistent barriers to universal internet access, availability, affordability, and adoption are now public domain concerns. The internet is necessary and a feature of modern life—like other utility infrastructure—it is not a luxury item. The incentives for private industry are not aligned toward resolving persistent gaps and the solutions advanced by private industry have not addressed these critical public needs or provided effective

sustainable solutions. Informed public policies coupled with targeted public investments are needed to provide lasting solutions. These public policies must be informed by the fact that reliable internet is now necessary for access to educational systems, economic activities, healthcare, public safety systems, and many other cultural and societal interactions.

3) Fiber-Optic Infrastructure is Treated as a Public Utility

Fiber-optic networks managed as a public utility makes sense because it is essential infrastructure in the modern economy. Utility frameworks, such as roads, water, sewer, storm drains, and electricity, exist to support essential functions critical for societal success. Providing digital access as a public utility will result in maximum service at the lowest possible cost for residents, businesses, and anchor institutions. The current lack of adequate competition and the practice of treating this as an amenity rather than a utility affects affordability, ubiquity, equity, and quality of service.

4) Increased Competition Through an Open Access Model

Open access is a model that divides the infrastructure and services into two separate systems and then shares the infrastructure between multiple service providers, like road systems and airports. A key goal of an open access system is to lower costs and improve service by increasing choice and competition. For an open access system to realize its potential, it is critical for the infrastructure owner to be a neutral host of the infrastructure. The role of a neutral host is to control and manage the infrastructure without privileging one service provider over another. A true open access network depends on enabling robust shared infrastructure that is operated on a non-discriminatory basis.

5) Unbundled Infrastructure and Services

The dominant national ISPs bundle the infrastructure and services together to insulate the infrastructure owner from outside service providers. An open access model depends on unbundling or separating the primary functions and network costs into three buckets: 1) Infrastructure Capital Deployment, 2) Ongoing Network Operations, and 3) Services. To optimize each function and to enable the City to become a neutral host, it is important to unbundle the key network functions and costs.

6) Alignment with Users

Residents, business owners, and visitors of Elk Grove should receive maximum value for minimum cost. The City has established goals of enhancing livability, increasing economic development, ensuring equity, enabling important anchor institutions like healthcare and education, and caring for natural and human resources. As digital infrastructure becomes increasingly important to each of these things, the significance of alignment with the network owner and operator also increases. The City of Elk Grove is aligned with the interests of residents and business owners to support a network that delivers maximum value for the minimum cost.

7) Local Control Over Pricing and Reliability

Local control over critical infrastructure allows for the needs of residents and business owners in Elk Grove to drive policy and regulations. Today's dominant ISPs are nationwide companies that are not organized to align the network with local needs and interests. Digital infrastructure will be positioned to increase local value when it is owned and controlled by a local neutral host. The digital divide, education, economic development, public safety, and healthcare are all examples of local variables that can best be understood and addressed locally. Control over network infrastructure will allow Elk Grove to leverage the power of the network in advancing communication solutions for these issues.

8) Spurred Economic Development

We live in a digital economy. Communication infrastructure is now fundamental to commerce and economic development because it provides the foundation for the economy. Historically, economic development has followed investment in infrastructure for all major systems including transportation, water, sewer, or communications. Until now, municipalities have mostly remained independent of a governance role over digital infrastructure, allowing private companies to decide where they will build, what they will build, the cost of services, and the kind of innovation that will happen on these systems. However, due to the lack of build-out to citizens even when provided federal subsidies for years and years, and the fact that equitable internet networks are fundamental to modern life and commerce, municipalities are increasingly taking a more active role in the governance of this infrastructure.

SECTION 5

Feasibility Analysis

Financial & Feasibility Analysis

Evaluating the feasibility of deploying municipal broadband infrastructure requires comparing current market factors (pricing, customer satisfaction, services, speeds) to realistic projections for a City controlled infrastructure. This section presents this comparison. However, before we look at those comparisons, it is important to consider the potential financing opportunities for municipal broadband.

California Loan Loss Reserve Fund

Initial funding of a municipal fiber network is a key feasibility consideration. A unique tool available to California cities is the Loan Loss Reserve Fund (LLR) established in SB 156 in 2021. The Fund provides collateral to local governments to enable more favorable borrowing rates and terms for bonds issued to deploy broadband infrastructure. The Electronic Frontier Foundation describes the fund this way:

> "The loan loss reserve fund is a first in the nation approach to providing public, non-profit, and tribal entities a long-term debt financing vehicle suitable for long term fiber infrastructure deployment. Federal loan programs are restricted to areas classified as "rural" that look more midwestern/southern rural. The existence of large population centers near rural parts of CA disqualifies many areas, so California made its own fund specifically for broadband. Cable industry efforts during SB 156 to try to subject the economic development program to only being accessible to "unserved/underserved" areas were rejected. This is the only broadband infrastructure program that is generally open ended on who is eligible to apply in terms of service territory."

The fit for the Loan Loss Reserve Fund and Elk Grove's objectives will be explored further in the next steps following the completion of this project.

Financial Feasibility

Take-rate is a key consideration related to the financial feasibility for a broadband infrastructure project. Take-rate is the percentage of potential subscribers who are offered the service and that subscribe. Feasibility is a function of take-rate. Take-rate is a function of creating value and effectively communicating that value to subscribers. Higher take-rates lead to lower shared infrastructure costs.

Elk Grove is an urban area with medium urban density, allowing for a combination of both underground (buried) or above ground (aerial pole) infrastructure construction. Projected costs are provided below for both an aerial fiber and buried fiber implementation. The aerial projections do not include an analysis or cost projection for pole make-ready work. It is likely that a combination of the two construction types would be used, depending on the condition of existing/planned municipal infrastructure in a given neighborhood.

If Elk Grove can achieve a take-rate of 60% (the number used for financial modeling by most companies), the projected monthly aerial/buried fiber combination rate of $54.59 per month for 1,000/1,000 Mbps would represent a savings of $55.41 per month over the premium cable offering from Xfinity/Comcast of 1200/20 Mbps (see Market Analysis section for incumbent pricing).

Ultimately, feasibility will depend on the quality and effectiveness of community engagement to educate residents on the value proposition of a locally controlled and municipally sponsored network.

Financial Modeling Assumptions

Our financial modeling analysis is based on the following demographic information for the City of Elk Grove:

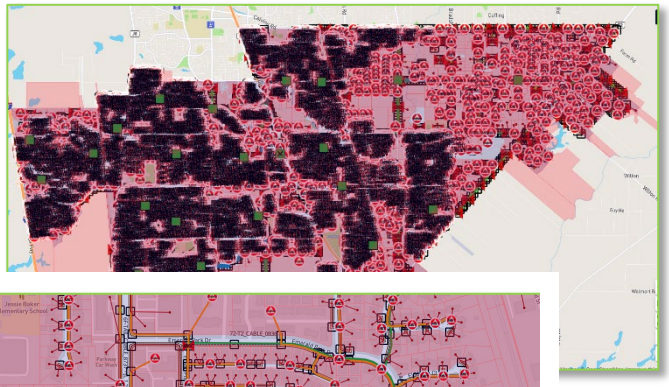
Total Potential Premises: 51,416 (see page 5)
(Households and Businesses)

Subscribers @ 60%: 30,850

Interest Rate for Modeling: 8% - short-term financing, 4.5% - long-term financing

Biarri Networks develops end-to-end technical solutions that accelerate the design and deployment of fiber, broadband, and 5G networks. They blend 21st-century best practices in software engineering with civil engineering and infrastructure development. They simplify and accelerate the work of upgrading and building telecommunications networks across the globe. Biarri Networks performed the feasibility level design for the Elk Grove study which informed the financial modeling assumptions.

Sample of the Biarri design in Elk Grove.



Projected Citywide Infrastructure Capital Costs

The total projected construction costs for a Citywide deployment are summarized in the table below. The table lists the capital cost for a 100% aerial network deployment, a 70% buried/30% of aerial network, and a 100% buried network with a 60% take-rate and an interest rate of 4.5%.

Projected Infrastructure Investment

Financial Pro-Forma of Full Project Costs – Four-Year Build – Ethernet Architecture

	100% Aerial	70% Buried/ 30% Aerial	100% Buried
Projected Cost Per Premise (Common and Drop)	$2,823	$3,605	$3,941
Estimated Subscribers	30,850	30,850	30,850
Total Projected Project Costs	**$87,089,550**	**$111,214,425**	**$121,579,850**

Note: *The modeled 100% aerial cost assumes that aerial is possible in 100% of the City but it does not include the possibility of pole replacement fees or other unexpected make-ready charges. Since some sections of the City have underground utilities, the 100% aerial modeling is not possible and is only a point of comparison for the other options.*

Common: The shared fiber infrastructure in a neighborhood that runs from a drop to the closest aggregation hut.

Drop: The fiber that runs from the street to the premise (home or business).

Make-ready: Before an internet service provider (or any entity) can add a new attachment or line to a utility pole, the existing attachments may need to be moved around so that the pole can be made ready to handle a new attachment or line.

Projected Monthly Cost to Subscribers

Projected Monthly Subscription Cost

Projected Residential Services Monthly Costs	100% Aerial	70% Buried /30% Aerial	100% Buried
Infrastructure	$18.08	$23.10	$25.25
Maintenance and Operations	$21.50	$21.50	$21.50
ISP Services (Dedicated 1 GB Symmetrical)	$9.99	$9.99	$9.99
Monthly Total	**$49.57**	**$54.59**	**$56.74**

The $9.99 assumes a competitive open access marketplace and is derived from experience with ISPs operating on other open access networks which have expressed a desire to provide similar pricing in new open access networks.

Why Take-Rate is Important to Total Infrastructure Cost

Take-rate is a variable that is critical to project success because the operational sustainability of a project depends on crossing a certain take-rate threshold to spread the common broadband infrastructure costs across a broad number of subscribers, therefore translating into an attractive and affordable cost per premise. At this point, no formal analysis has been completed. We have provided information below related to take-rate, based on baseline assumptions.

The following table illustrates the impact of take-rate on total capital cost per premise under a 60% aerial and 40% buried network with a take-rate of 60% modeled as neutral on impact.

Take-Rate Modeling

Take-Rate	Cost/Sub	Subscribers	Par = 60% Take-Rate
40.00%	$4,939	20,566	($1,333)
45.00%	$4,494	23,137	($889)
50.00%	$4,139	25,708	($533)
55.00%	$3,848	28,279	($242)
60.00%	**$3,605**	**30,850**	**$0**
65.00%	$3,400	33,420	$205
70.00%	$3,224	35,991	$381
75.00%	$3,072	38,562	$533
80.00%	$2,939	41,133	$667

Network Management and Operations

The work required for network operations includes network monitoring, network management, outside plant repairs, and new customer installations. Network operations could be provided by City personnel or by a third-party partner. The recommendation is that if the City goes forward with construction, then it should pursue outsourcing operations to third-party partners at least until the network is stabilized with an established and sustainable take-rate. At that time, the City can evaluate whether it makes financial and operational sense to move operations inside a City department. During that evaluation, the City can consider outsourcing logical network responsibilities (customer support, network operations center (NOC), monitoring, and troubleshooting) to its network management partner (open access or single ISP) and utilize a local company to manage outside plant, physical repairs, maintenance of physical assets, new customer turn-ups, and emergency response for the physical plant. This model has budgeted $21.50 per subscriber per month to cover the total cost of maintenance and operations. This number represents a 25% increase in the M&O cost of other active open access networks and is expected to be sufficient for higher California labor costs.

Aggregate Internet Connectivity Cost in Elk Grove Today

The graphic below is a conservative estimate of the amount of money the residents of Elk Grove are paying for internet access today. This reflects a weighted average of the incumbent pricing from the 2020 Cost of Connectivity report (New America – The Cost of Connectivity).**This estimate is meant to illustrate the current cash flow available to support a locally owned network.** The estimate is likely to underestimate actual 2022 expenditures and it does not include the current cost for business internet subscriptions which is typically higher than residential costs.

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Internet Spend in Elk Grove Today

Average monthly cost of home internet connectivity in US today $68.38

Number of Premises (Households)	**53,627**
Average Monthly Internet	**$68.38**
Annual Internet Spend	**$44,004,171**
20 Year Internet Spend	**$880,083,420**

SECTION 6

Market Analysis

Market Analysis

Incumbent Offers and Pricing

In Elk Grove, most residents and businesses currently subscribe to one of several cable and telephone internet providers. The content below comes from the websites of these incumbent providers.

Residential

Xfinity/Comcast

Xfinity/Comcast advertises the following residential services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
50/5	$30.00	$60.00	TBD
100/10	$50.00	$70.00	TBD
300/10	$60.00	$80.00	TBD
600/12	$70.00	$90.00	TBD
900/18	$80.00	$100.00	TBD
1200/20	$90.00	$110.00	TBD
6000/30	$299.95	$299.95	TBD

Taxes and fees often represent an additional (10% - 15%) of standard pricing.
Shared Network – Speeds are "up to" and are not guaranteed.
Speeds are not symmetrical.
Modem with Wi-Fi – additional $14.00 per month.
Cancellation charges may apply.
A contract may be required.
Availability depends upon location – not available in all areas.

Frontier Communications

Frontier advertises the following residential services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
12/1	N/A	$55.00	$85.00
18/2	N/A	$55.00	$85.00
25/5	N/A	$55.00	$85.00

Note: *The numbers provided above for Frontier are pre-2023 Frontier offerings. The City expects updated speeds, pricing, installation, and equipment rental similar to Comcast and Consolidated if Frontier moves forward with its fiber project in 2024/2025. Frontier emerged from Chapter 11 bankruptcy on April 30, 2021.*

Taxes and fees often represent an additional (10%-15%) of standard pricing.
Speeds are "up to" and are not guaranteed.
Speeds are not symmetrical.
Phone line required – additional $34.99 per month.
Availability depends upon location – not available in all areas.

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Consolidated Communications

Consolidated advertises the following residential services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
50/50	$35.00	$65.00	Included
250/250	$65.00	$95.00	Included
1,000/1,000	$70.00	$105.00	Included

Taxes and fees often represent an additional (10%-15%) of standard pricing
Speeds are "up to" and are not guaranteed
Availability depends upon location – not available in all areas

AT&T

AT&T advertises the following residential services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
25/2	$60.00	$70.00	$99.00
50/5	$60.00	$70.00	$99.00
100/10	$60.00	$70.00	$99.00

Business

Comcast Business

Comcast Business advertises the following business services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Contract [Period]	Promotional Rate [Conditions Apply]	Standard Pricing [+ Taxes and Fees]	Equipment [Required]	Install [Fee]
35/5	2-Year	N/A	$71.95	$19.95	$99.95
100/15	2-Year	$140.00	$165.00	$19.95	$149.95
200/20	2-Year	$175.00	$190.00	$29.95	$149.95
300/30	2-Year	$205.00	$220.00	$29.95	$149.95
600/35	2-Year	$280.00	$295.00	$29.95	$149.95
940/35	2-Year	$380.00	$395.00	$29.95	$149.95

Taxes and fees often represent an additional (20%-30%) of standard pricing.
Shared Network – Speeds are "up to" and are not guaranteed.
Speeds are not symmetrical.
Availability depends upon location – not available in all areas.

Digital Access Report

Frontier Business

Frontier Business advertises the following business services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Contract [Period]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
300/300	2-Years	$50.00	TBD
700/700	2-Years	$90.00	TBD
940/880	2-Years	$150.00	TBD

Note: *The numbers provided above for Frontier are pre-2023 Frontier offerings. The City expects updated speeds, pricing, installation, and equipment rental similar to Comcast and Consolidated if Frontier moves forward with its Fiber project in 2024/2025. Frontier emerged from Chapter 11 bankruptcy on April 30, 2021.*

Taxes and fees often represent an additional (10%-15%) of standard pricing.
Speeds are "up to" and are not guaranteed.
Speeds are not symmetrical.
Modem with Wi-Fi – additional $15.00 per month.
Availability depends upon location – not available in all areas.

Consolidated Business

Consolidated Business advertises the following business services in Elk Grove on their website:

Speed (Mbps) [Down / Up]	Contract [Period]	Promotional Pricing [+ Taxes and Fees]	Standard Pricing [+ Taxes and Fees]	Install [Fee]
250/250	3-Years	$80.00	Not Disclosed	TBD
500/500	3-Years	$120.00	Not Disclosed	TBD
1,000/1,000	3-Years	$170.00	Not Disclosed	TBD

Taxes and fees often represent an additional (10%-15%) of standard pricing.
Speeds are "up to" and are not guaranteed.
Availability depends upon location – not available in all areas.

Note: *Market research was conducted in June 2022.*

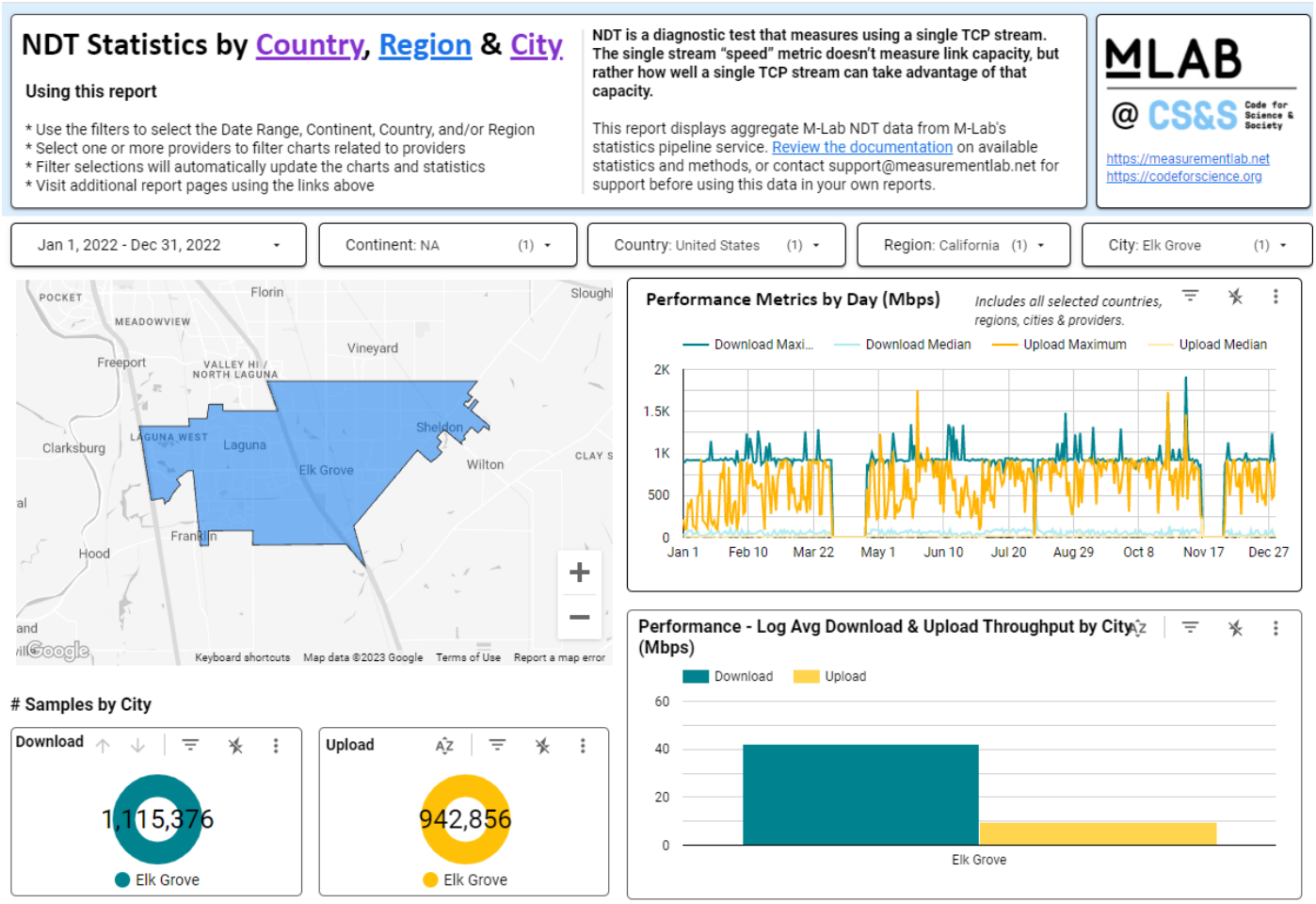
Digital Access Report

Speed Test Data

M-Lab is a research consortium that provides open data from speed tests across the United States. Academic, scientific, and public interest research organizations rely on M-Lab's open data. Every time an individual runs a speed test through an open source integration of M-Lab's tools, the data is saved in Cloud Storage hosted by Google and made available to the public via BigQuery. The data below is the speed test results for Elk Grove from January 1, 2022, to December 31, 2022

The average speeds delivered by the ISPs in Elk Grove are:

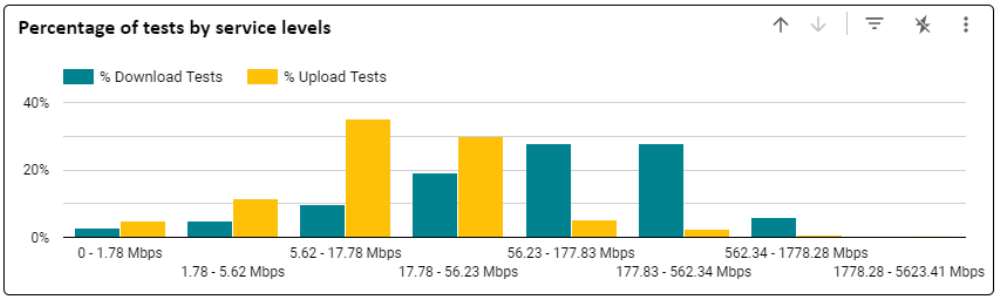
- **Xfinity/Comcast = 89.78 download/8.69 upload**
- **Consolidated Comm = 77.79 download/42.05 upload**
- **Frontier Comm = 14.61 download/2.24 upload**



Digital Access Report

NDT statistics used in this report are provided as daily histograms, consisting of the percentage of measurements within a range of "service levels" or speed ranges.

The chart on the right presents the histogram of tests that measured at these levels over the selected date range and locations, across all providers.

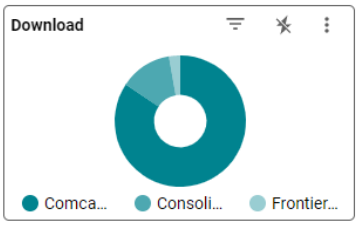


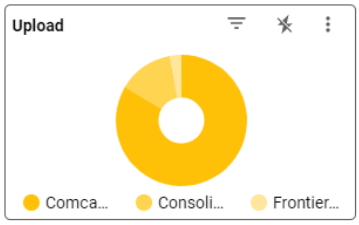
Provider Statistics

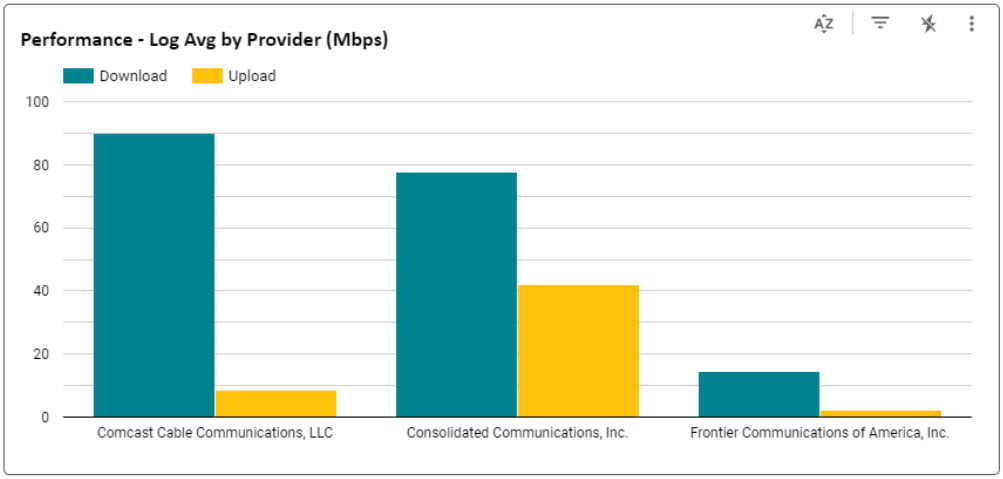
Provider: Comcast Cable Communic...(3)

In the NDT dataset, each test is associated with the Autonomous System operating the IP address from which each test was conducted. This may be different than the ISP that offers service.

Samples by Provider







Note: *AT&T is not listed above because there was no speed test date for AT&T at the time of the report query.*

SECTION 7

Next Steps

Next Steps

The objective of this "Next Steps" section is to provide a roadmap to City leaders for actions to take once they approve moving forward.

Current Strategy

The growing number of municipally owned networks is a response to the misalignment between private incentives and the essential nature of access in modern society. Incumbent operators have been free to establish most of the rules governing their infrastructure and services, including service levels, maintenance standards, network reinvestment, and service territories with little to no municipal oversight and accountability. Alternatively, public entities are perfectly positioned to be a neutral host of fiber-optic infrastructure organized to enable competition and lower costs, while also ensuring local people are covered.

The Importance of Strategy

As state and federal grant opportunities evolve, municipalities are positioning themselves as favorably as possible to attract funding into their jurisdictions to enable meaningful change.

Three key questions will provide direction to subsequent phases of the decision-making process. These require careful consideration before endorsing a specific implementation model for expanding broadband access.

KEY DECISIONS

1) **Ownership / Control:** Decide the degree to which the City wants to control or influence the outcomes it desires for digital access.
2) **Governance:** Determine the governance structure that is appropriate to advance the City's objectives.
3) **Business / Operational Model:** Decide whether a vertically integrated (single ISP) or an open access model aligns with the City's objectives.

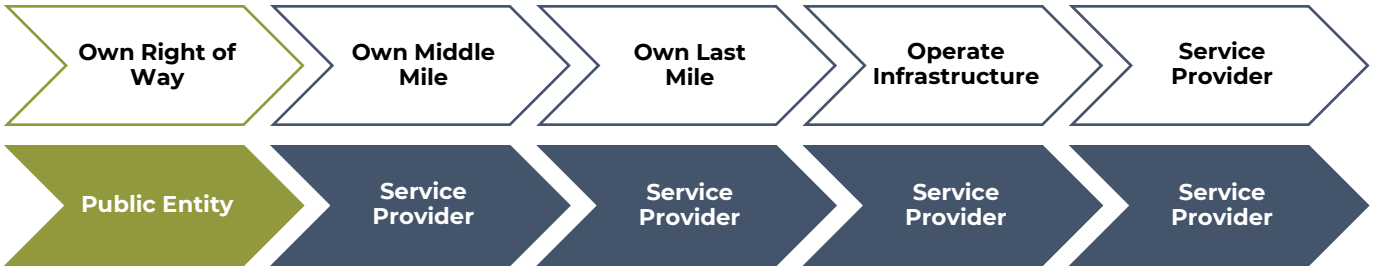
KEY DECISION #1: INFRASTRUCTURE OWNERSHIP

Elk Grove's proposed digital infrastructure will either be owned by a private company, a public entity (the City), or a hybrid private-public partnership (PPP). Each of these is explained below.

Private Network Ownership

The easiest course for a city is to do nothing and allow private companies to continue to own and operate internet infrastructure. Private companies who own the infrastructure dictate which business model is used and typically select a model to maximize the company's return on investment rather than emphasizing public benefit. The dominant model used by most providers in the industry is a vertically integrated model with a single service provider operational model where consumers have access to privately owned infrastructure supporting one provider's services.

Figure 1: The Existing Deployment and Operation Model



A single internet service provider often dominates rural areas because costs are higher due to greater distances and lower population density. Consumers may have access to multiple internet service providers in denser urban areas. Still, these entities compete through facilities-based competition by building siloed infrastructure that they use exclusively.

Public Network Ownership

Public ownership of network infrastructure can produce many tangible benefits for individuals and communities. Public owners have greater incentives to solve the digital divide. Costs can be lower if the network is operated as a non-profit enterprise and if the public entity increases competition through an open access system. It is more likely that the City is aligned with residents on what they want from the network (e.g., low cost, high reliability, abundant bandwidth) than a third-party owner. Third-party owners will always be motivated first by the survival of their organization (e.g., profits, financial reserves), while the City's focus is on making the system self-sustaining and adding value. The City also has much broader and different interests related to broadband infrastructure. These include economic development, livability, public safety, education, healthcare, emergency communications, smart grid, efficient government services, environmental stewardship, universal access, and smart city applications. All these things are now network dependent and the value from the network to the City aligns perfectly with the interests of constituents who subscribe to the network.

Figure 2: Municipal Infrastructure Ownership and Operation Model

Additionally, the public entity will not have to get permission or incur new expenses whenever it wants to connect the network to a new service or application. Furthermore, public ownership of the network will allow the City the ability to optimize the network for local needs rather than organizing the operation to serve a national market.

Locally-owned public infrastructure protects the community from a private owner operating as an unregulated monopoly or selling the network to a monopoly operator. It also makes the network operator accountable to subscribers via an election cycle where subscribers are empowered to influence outcomes. Finally, the network will have significant value once it is built. and the local community can share that value.

The figure below summarizes some differences between privately owned and publicly owned infrastructure.

Public vs. Private Broadband Models Summary

Public

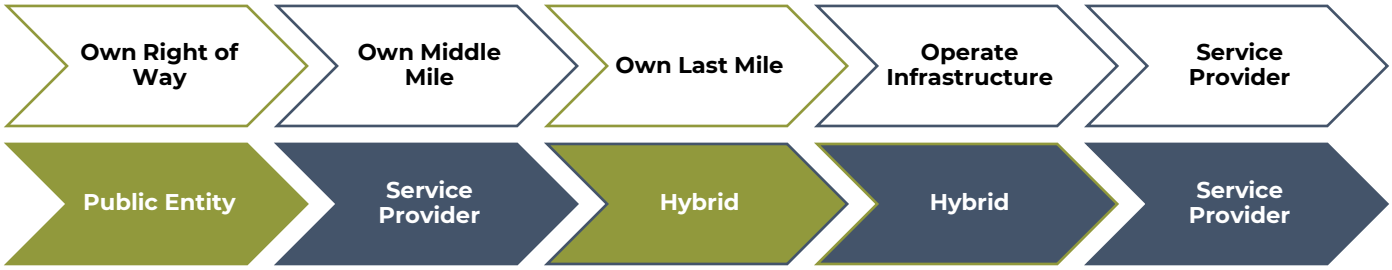
> Customers are Key Stakeholders
> Not-for-Profit
> Assets Held Publicly
> Public Board Meetings
> Elected Board Sets Rates
> Local Control

Private

> Investors are Key Stakeholders
> For Profit
> Assets Held Privately
> Private Board Meetings
> Private Board Sets Rates
> Investor Control

Hybrid Ownership and Operations

Figure 3: Hybrid Deployment and Operation Model



Hybrid ownership and operational models are emerging but are now in their infancy. An example of this model is a special purpose entity or special purpose vehicle (SPV). An SPV is a legal entity established to separate an asset, subsidiary, or financial transaction from a larger corporation or government agency. These are typically created to help isolate risk in a transaction or manage the risks associated with the development of an asset. A special purpose entity can also be established for collaborations between a government agency and a privately owned company via a public-private partnership (PPP). An SPV may be a politically acceptable vehicle for managing risk for infrastructure projects. It can help local governments complete projects sooner since the private company may have the resources needed to complete an infrastructure project and may be less encumbered by public sector operational processes. SVPs can vary based on their founding legal and financial agreements. The specific role can be unique to the partnership between the government agency and the private entity.

Ownership Decision Making

The following guidelines may be helpful to the municipality as its leaders determine whether private, public, or hybrid ownership is right for them.

1. If the City's key priorities are to limit ownership and operational responsibilities and is willing to forgo any level of control or ownership, then pure private models should be given favorable consideration.
2. If the City's broadband goals include universal access for all residents and reliable digital access to providers and services, models that provide for public or hybrid ownership of the local infrastructure should be given favorable consideration.
3. If long-term municipal funding is available for construction of broadband facilities through a revenue bond or property assessment vehicle, then models that provide for public ownership of the local infrastructure should be given favorable consideration.
4. If the City desires to limit ownership and operational responsibilities but would like to maintain some level of control and the possibility of future public ownership, then hybrid models should be given favorable consideration.
5. If the City desires to facilitate a shift away from facilities competition to competition among service providers, then public or hybrid ownership should be given favorable consideration.

KEY DECISION #2: GOVERNANCE MODEL

Governance includes the statutory frameworks that define what is possible and not possible for a city that seeks to own and operate this infrastructure and the policies and operational processes that a city imposes on itself, third-party partners, and subscribers.

The State of California allows the municipality to own, operate, and function as an internet service provider if desired. The City should seek legal advice as it determines which structure is best for its funding and operational strategy.

The following information outlines non-statutory governance considerations which may be relevant to the City's decision-making process for governance of infrastructure and services. The ownership and business model strategies the City Council selects to increase broadband access will narrow the options for the governance structure. For instance, some structures will be more suitable for municipally owned infrastructure, while others will better support privately owned infrastructure. If the City pursues a hybrid ownership model, governance will be specified in the agreement between the parties.

Governance Considerations

Maximize Funding Opportunities

Successful models can draw from multiple funding sources that maximize opportunities, including the ability to apply for state and federal grants and loans and leveraging other funding mechanisms such as bonds should be given critical consideration.

Long-Term Stability

The long-term stability of the selected model is essential. Sustainable and predictable long-term outcomes are critical when selecting the preferred model(s).

Required Authorities
The legal authorities of the selected model are critical. The ability to carry out the required actions must be explicitly provided in statute to avoid legal challenges and the financial losses they incur.

Risk Mitigation
Each model has a level of risk associated with a combination of unique participants. Risks related to the various models include subscriber churn (when customers stop using a reoccurring service), take-rate (percent of the available market that subscribes to a service), technology, community engagement, cost models, timeline, and design risks depending on the model.

Flexibility
Models with flexible statutory requirements have implementation advantages over more rigid models. Short-term flexibility can provide the ability to change and adapt as needed or desired, resulting in better outcomes than less flexible models.

Required Initial Investment
Some models can achieve sustainable outcomes with minimal investment(s). This will have the effect of minimizing risks while at the same time creating a safety net for future investments.

Implementation Simplicity
Models that reduce implementation complexity related to design, installation, maintenance, and operation will improve efficiencies and result in more successful outcomes.

Cross-jurisdictional Collaboration
The digital divide is agnostic to borders. In many cases, having a model that allows for regional collaboration is beneficial. The ability to encourage and develop regional consensus should be considered in determining effective governance models. Regional project paths require that some projects span across unincorporated and incorporated territories. Some models natively have this ability, while others will require a combination of two structures to provide regional project paths. Regional projects will require stakeholder consensus influencing the City Council's ability to affect regional outcomes. Separate consideration will need to be given to projects that impact tribal communities as that applies to a community or communities.

POLICY & OPERATIONAL CONSIDERATIONS

Opt-In (Voluntary Participation)
Will residents be able to voluntarily participate, or will the infrastructure be treated like other utilities where connection to the infrastructure is mandatory? Voluntary participation is much more politically tenable.

Billing
Does the City have other utility billing processes, and can broadband be added to those mechanisms? If not, how will billing be handled for the capital cost, the maintenance and operations cost, and the ISP services? Also, how will billing be handled for residents that may not have a banking relationship or are not connected to modern digital financial transaction systems?

Treating the Infrastructure as an Improvement to Property

When a resident connects to municipal water, sewer, or other utility infrastructure, the connection is treated as an improvement to the property. The resident is obligated to pay off the infrastructure up front or overtime. However, the incumbent facilities-based competition model does not impose a commitment to the infrastructure.

Customer Premises Equipment

It is common for the initial cost of the equipment that goes into the customer's home to be included in the initial capital cost. Will the replacement cost of that equipment be the customer's responsibility, or will it be financed through the maintenance and operations budget?

Customer Support

If the City pursues an open access model, how will support be handled to minimize frustration for the subscriber?

KEY DECISION #3: OPERATIONAL MODEL

Choosing the right operational model depends on the roles of the market participants in the broadband value chain. For this report, three possible roles are in focus:

1. The Physical Infrastructure Provider
2. The Network Operator
3. The Service Provider(s)

Different business models arise depending on which roles the market participants take within the operational model. The following summarizes key considerations for important network attributes for the main operational models.

Model → Attributes ↓	Vertically Integrated	Dark Fiber Leasing	Manual Lit Fiber	Automated Lit Fiber
Ownership	Same entity owns the infrastructure, operations, and services	A neutral host owns and operates the infrastructure to the curb; the ISP owns the drop	A neutral host owns and operates infrastructure but does not own services	A neutral host owns and operates infrastructure but does not own services
Closed vs. Open	Infrastructure is closed to outside service providers	Mixed—the backbone is open; the drop is closed	Infrastructure is open to outside service providers	Infrastructure is open to outside service providers
Retail vs. Wholesale Services	A single ISP is offered on a retail basis	Multiple ISPs are offered wholesale	Multiple ISPs are offered wholesale	Multiple ISPs are offered wholesale
Bundling of Roles – Are the three primary roles separated?	All three roles are bundled together—vertically integrated	Mixed	Ownership and operation of the infrastructure is unbundled from the services	All three roles are unbundled
Neutral Host	No	Mixed—the backbone is owned	Yes	Yes

		by a neutral host; the drop is owned and operated by the service provider		
Facilities-Based Competition vs. Services-Based Competition	Facilities-Based Competition	Mixed— backbone network is open to multiple services; drop is not open	Services-Based Competition	Services-Based Competition
Provisioning	The operator manually provisions services	The service provider manually provisions services	The operator manually provisions services	The subscriber provisions services via automation
Virtualization	Each service requires a physical fiber	Each service requires a physical fiber	Each service requires a physical fiber	Many services can be delivered across a single fiber strand
Multiple Services Simultaneously	One service at a time	One service at a time	One service at a time	Multiple services at a time
Hardware-Defined vs. Software-Defined	Hardware	Hardware	Hardware	Software
Examples	Comcast, Charter, AT&T, Frontier, Verizon	Huntington, AL, Westminster, MD	Utopia SiFi Network	Ammon, ID, Chico, CA Eagle, ID Mountain Home, ID

Ownership: Digital infrastructure will be owned by a private company, a public entity (the City), or a hybrid private-public partnership (PPP).

Closed vs. Open: Open access combines a business model and architecture that creates a single shared infrastructure operated by a neutral host which gives service providers open, wholesale access at fair, reasonable, and equal terms. A city is perfectly positioned to function as a neutral host. Closed infrastructure does not allow outside service providers onto the infrastructure. This results in a single ISP offering with facilities-based competition.

Open infrastructure allows for third-party service providers which typically leads to services-based competition.

Facilities-Based Competition: Industry incumbents always follow a facilities-based model. This means that every service provider is required to construct their exclusive infrastructure to compete in a market. This increases the barriers to entry, puts more infrastructure in crowded infrastructure channels, reduces resiliency, and results in higher consumer costs. Incumbent industry models almost always follow a vertically integrated model with single ownership for the infrastructure and services offered to end users.

The alternative to facilities-based competition is services-based competition. This occurs when service providers compete on a single shared infrastructure, preferably owned, and operated by a neutral host that treats all service providers equally. An important goal of a neutral host should be to lower the barriers to entry to accelerate competition.

Provisioning: The provisioning of new services can either be done by the network owner/operator, the service provider, or the subscriber. The concerns for the subscriber include whether alternative services are available, how long a new service takes to be provisioned, and whether an appointment with a technician is required.

Virtualization: A technical term that describes using software to separate traffic to enable more than one service to be delivered across a single fiber strand. Virtualization is commonly used in data centers but is less common in fiber-to-the-home networks.

Multiple Services Simultaneously: A virtualized network can deliver multiple services simultaneously. A network that is not virtualized will not be able to deliver more than one service at a time. This capability will grow in importance as smart city applications gain traction.

Retail vs. Wholesale Services: The infrastructure is available to all market participants under equal conditions in an open access network. This requires a neutral party rather than a service provider to own and operate the infrastructure.

Bundling of Roles: If one market participant takes or bundles all three roles, it functions in a vertically integrated model. "Unbundling" or separating the three primary roles (infrastructure, operations, and services) is an enabling requirement for a true open access network. It is necessary to optimize the functionality and cost of each role. Unbundling allows the infrastructure to be operated by a neutral party (neutral host). The unbundling of roles does not necessarily result in the unbundling of subscriber costs. Establishing a clear separation of roles and responsibilities within the operational model requires successfully unbundling subscriber costs.

Hardware vs. Software-Defined Management: The distinction between hardware-defined and software-defined is an emphasis on how resources are pooled and managed. For the subscriber, this translates into key concerns with respect to how long it takes to make needed network changes, the cost for these changes, and whether the subscriber is captive to a single hardware vendor. In general, it is faster and less expensive to make changes in software than in hardware and a software defined network can be liberated from vendor lock-in.

Operational Model Summary

In January 1999, the City of Portland, and Multnomah County, Oregon, filed a lawsuit to block AT&T's acquisition of a local cable network. Oregon public officials said they would approve the transfer if AT&T agreed to open its broadband assets to competition. The 9th U.S. Circuit Court of Appeals ruled that providing high-speed internet access is very different from the cable television business and should not be subject to the same set of regulations and AT&T and other large incumbents were not required to open their existing infrastructure to competing service providers.

One result of this ruling has been a gradual decrease in regulations over telecommunication services over time. Another result has been that the vertically integrated model became entrenched as the de facto internet access model because legacy cable and telephone companies had the enormous advantage of existing infrastructure that could deliver the internet to the public. Comcast (Xfinity), Frontier, and Consolidated operate in Elk Grove under this model.

The inherent limitation of the single provider model is that it gives customers few choices and naturally trends toward monopoly control for the provider that can offer the greatest bandwidth. Alternatively, open access networks are growing in popularity for public infrastructure owners because the model improves choice, competition, and affordability and works in rural and urban settings, and has great appeal in tribal communities.

The most advanced open access networks support multiple service providers delivering services simultaneously over the network. End users can freely view the services and their associated costs and subscribe at any time. Service providers can create new categories of services and subscribers can easily subscribe to them via an online marketplace without assistance. Additionally, the implementation is in software and can support rapid change and integration. The introduction of network automation enables self-service provisioning for stakeholders and creates a more open environment, improving adoption and reducing costs.[1]

Identifying Service Providers

Identifying the best fit for service providers in a particular community will depend on the ownership and operational models selected. Finding service providers will not be difficult regardless of the model selected, but the chosen partners should align with operational objectives.

Federal Policy and Opportunities

Numerous federal programs have demonstrated a clear preference for open access fiber. The Reconnect Loan and Grant Program will not fund legacy copper or wireless systems, only fiber by listing a requirement for 100 Megabits symmetrical service. The program awards extra points for applications meeting public ownership and open access requirements.[2]

The recent NTIA Middle Mile Grant Program was open to public entities, also requiring fiber and favoring open access in scoring proposals.[3]

NTIA's Broadband Equity, Access, and Deployment (BEAD) Program will open to applications from public entities, prioritizing the deployment of fiber and encouraging scoring that favors open access on the part of the state offices overseeing the application and award processes.[4]

State Policy and Opportunities

Executive Order N-73-20, signed by Governor Newsom, prioritizes fiber-optic deployment statewide.[5]

In response to this executive order, the California Broadband Council developed the "Broadband for All" Action Plan which prioritizes fiber and open access for middle mile deployments.[6]

[1] https://www.lightreading.com/gigabit/fttx/debunking-the-open-access-myths/a/d-id/720514
[2] https://www.usda.gov/reconnect
[3] https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/MIDDLE%20MILE%20NOFO.pdf
[4] https://broadbandusa.ntia.doc.gov/sites/default/files/2022-05/BEAD%20NOFO.pdf
[5] https://www.gov.ca.gov/wp-content/uploads/2020/08/8.14.20-EO-N-73-20.pdf
[6] https://broadbandcouncil.ca.gov/wp-content/uploads/sites/68/2020/12/BB4All-Action-Plan-Final.pdf

SB 156 directed the California Department of Technology to develop a statewide, open access middle mile network. SB 156 provides $3.25 billion to build the necessary infrastructure to bring internet connectivity to homes, businesses, and community institutions.[7]

SB 156 also established a $750 million Broadband Loan Loss Reserve (LLR) Fund to support the costs related to the financing of local broadband infrastructure development. The reserve fund expands 'local governments' ability to secure financing for building last mile projects, with an emphasis on public broadband networks.[8]

Formalize the Selection of an Operational Model

There are downstream architecture and business plan decisions that require operational model selection. This makes selecting the operational model an important next step for Elk Grove. This will require stepping through the formal process of presenting the options outlined in this report to the broader City committee and leaders, providing technical support to inform the decision-making process. The final selection should be clearly memorialized in the meeting minutes and properly documented to inform the procurement process that will follow.

BEYOND THE THREE KEY DECISIONS

Business Model RFP

Once City leaders have decided a preferred direction for (1) ownership, (2) governance, and (3) business model, we recommend conducting a public process (request for proposal (RFP), request for information (RFI), or request for qualifications (RFQ)) to select a solution partner for the selected business model. Whether the City is pursuing a single ISP model or an open access model, is an appropriate next step because the partner needs to advise the City on network design, network architecture, equipment selection, quality control on construction, provisioning and turn-up of network electronics, selection of other key partners, and general project oversight. It will be appropriate to organize the RFP to identify a solution partner for the implementation of the business model as the owner's representative for the overall project. *Sample RFPs issued by other cities may be provided upon request*.

It is important to select a partner with the demonstrated technical expertise necessary to guide and manage downstream procurement processes with the City's oversight and approval.

Additional Procurement

Once selected, the business model partner can assist with organizing the specifications and solicitations for a public process (request for proposal (RFP), request for information (RFI), or request for qualifications (RFQ)) for the following:

- **Assume or Procure the Network Operator Role**
  If Elk Grove selects an operational model where it will assume the network operator role, clear responsibilities will need to be assigned, and resources will need to be allocated within Elk Grove to establish the workforce and expertise necessary to perform network architecture, oversee design, select materials and equipment for cost modeling, and so forth.

[7] https://middle-mile-broadband-initiative.cdt.ca.gov/
[8] https://www.cpuc.ca.gov/industries-and-topics/internet-and-phone/broadband-implementation-for-california/loan-loss-reserve-fund

If network operations are outsourced to a third-party, selecting a partner with the demonstrated ability to support the desired operational model and business plan at this stage is critical to achieving desired outcomes. The technical and economic ability to deliver desired functionalities will be directly related to the network provider's capabilities. Procuring this partner will be required to complete applications for state, federal, or private funding.

- **Design/Engineering RFP**
  Select a design/engineering firm. The design process includes developing construction-ready plan documents, refining cost modeling based on network design, and initiating the make-ready process for utility pole attachments for aerial portions of the network.

- **Materials RFP**
  Provide technical assistance in organizing a solicitation for network materials.

- **Construction RFP**
  Select a design/engineering firm and help prepare the technical specifications for the construction work.

- **Project Management**
  The business model partner will need to provide high-level project management for the project, but will not be onsite daily to manage timelines, project milestones, and work schedules to name a few. If the City is going to handle project management internally, the business model partner can be an advisor to assist internal project leadership. If the City outsources project management, the business model partner can assist in organizing the specifications for a public process (request for proposal (RFP), request for information (RFI), or request for qualifications (RFQ)) to select a project management partner and then collaborate with that partner throughout the construction process.

  Key project management skills and knowledge may include, but are not limited to:

  - Managing fiber-optics projects and budgets, directing construction in accordance with the approved design, and coordinating work with other staff and design team members.
  - Interfacing with City staff, participants, and local government officials.
  - Reviewing project design as needed and coordinating adjustments to support constructability and budget outcomes.
  - Reviewing work products, quality control, and budgeting.
  - Mentoring, developing, and supervising staff.
  - Providing core project management functionality.

Project Budget

Developing a budget that can be trusted requires a process of moving from projected costs to hardened costs. This process includes a collaboration between City staff, the business model partner, and the engineering/ design partner working together to develop a construction-ready design. This construction-ready design will be the basis for the construction RFP. The design will be refined once a construction partner is selected. Still, the construction-ready design should be 98% accurate.

Phasing

The business model partner can assist with refining the phasing options being considered and provide financial analysis on these options. The primary phasing decision will be whether to build as quickly as possible or pursue an extended process which may be necessary due to internal constraints. Potential internal considerations specific to Elk Grove may include:

- Leveraging planned road construction of City water system and install conduit.
- Leveraging planned sidewalk construction of City water system and install conduit.
- Build in conjunction with other large construction or public works projects in Elk Grove.
- Strategically select neighborhoods most impacted by affordability constraints.

The City can do aerial or underground (buried) fiber and is expressing a preference for a buried network, initially using conduit placement in conjunction with ongoing public works projects.

SECTION 8

Appendices

Appendices

The content in the following Appendices provides additional detail related to:

- > Infrastructure Grants
- > Network Architecture
- > Media Comparison
- > Business Model Options
- > Risk Assessment
- > Community Engagement
- > Community Broadband Survey

Infrastructure Grants

The City and its partners should pursue all available federal and state broadband grant opportunities that may be a fit for Elk Grove's proposed project.

Potential supplementary capital sources may include the following:

- > Coronavirus State and Local Fiscal Recovery funds – American Rescue Plan Act (ARPA)
- > Infrastructure Investment and Jobs Act funds (IIJA)
- > State Grants
- > Other

American Rescue Plan Act

The Coronavirus State and Local Fiscal Recovery funds allocated through ARPA may be used to make necessary investments in broadband infrastructure, which was shown to be critical for work, education, healthcare, and civic participation during the Pandemic. The final rule broadens the set of eligible broadband infrastructure investments that recipients may undertake to address challenges with access, affordability, and reliability.

Source: *https://home.treasury.gov/system/files/136/SLFRF-Final-Rule-Overview.pdf*

Infrastructure Investment and Jobs Act (IIJA)

President Biden's Infrastructure Investment and Jobs Act (IIJA) seeks to ensure every American has access to reliable high-speed internet. Broadband internet is necessary for Americans to do their jobs, to participate equally in school learning, health care, and to stay connected with each other. Yet, by one definition, more than 30 million Americans live in areas where there is no broadband infrastructure that provides minimally acceptable speeds—a particular problem in rural communities throughout the country. And, according to the latest Organization for Economic Cooperation and Development (OECD) data, among 35 countries studied, the United States has the second highest broadband costs. The Bipartisan IIJA will deliver $65 billion to help ensure that every American has access to reliable high-speed internet through an historic investment in broadband infrastructure deployment. The legislation will also help lower prices for internet service and help close the U.S. digital divide, so that more Americans can afford internet access.

Source: *https://www.whitehouse.gov/bipartisan-infrastructure-law/*

Federal Grants Administered by the State

Broadband Equity, Access, and Deployment (BEAD) Program Funding from the IIJA includes $42.45 billion for a new program focused on connecting underserved areas by distributing money through state grants. The legislation gives the National Telecommunications and Information Administration (NTIA) 180 days to establish the program and develop funding guidelines.

Each of the 50 states will receive an initial allocation of $100 million from the $42.45 billion allotment, with additional funding to be distributed based on coverage maps that have been commissioned by the Federal Communications Commission (FCC) and are being actively disputed as inaccurate. To receive funding, each state must submit a five-year action plan that identifies locations that should be prioritized for support; outlines how to serve unconnected locations; and assesses how long it would take to build out universal broadband.

Facilitate Access to the Affordable Connectivity Program

The $14 billion Affordable Connectivity Program (ACP) is a targeted subsidy which provides up to $30 per month for qualifying households. However, analysis done by the City of Baltimore in 2021 found that only 40.7% of city residents have access to a broadband subscription. This means that nearly 96,000 individuals Citywide do not have access to a broadband subscription. Additionally, 33.3% or 75,000 residents do not have access to a computer. The federal subsidy program was designed to address both challenges. However, according to the FCC's data, only 34,734 households in the Baltimore area had registered for the federal subsidy at the time of the analysis. Three barriers identified by a Baltimore task force were that the subsidy seemed "too good to be true," and providers promoting the subsidy through marketing materials and sales representatives attempted to upsell customers. A key takeaway from the Baltimore task force that is relevant for Elk Grove and other cities with a known digital divide gap is that a "trusted point of contact for community members to call made it easier to help wary residents enroll in the program." Additionally, having resources available to help overcome language barriers also made It easier to get residents enrolled.

Source: *https://www.benton.org/headlines/baltimore-and-emergency-broadband-benefit-program*

Overview of Network Financing Considerations

Historic levels of funding for digital infrastructure seek to close existing gaps, support public ownership, and encourage open access. Public opinion supports treating digital access just like roads, bridges, water, sewer, and power. Combining these key aspects will provide Elk Grove with a fiber-optic network utility capable of providing maximum service, including reliability and accessibility, for least cost.

Network Architecture

Network architecture has a meaningful impact on network reliability. The description below covers variables that should be considered for network reliability.

The two main network designs are Switched (Active) Ethernet and Passive Optical Networks (PON). The key difference between these two models is that PON is a shared infrastructure (32, 64, or 128 neighbors share a connection) and fiber systems following the ethernet protocol gives subscribers their own dedicated connection to a switch.

Switched Ethernet Network

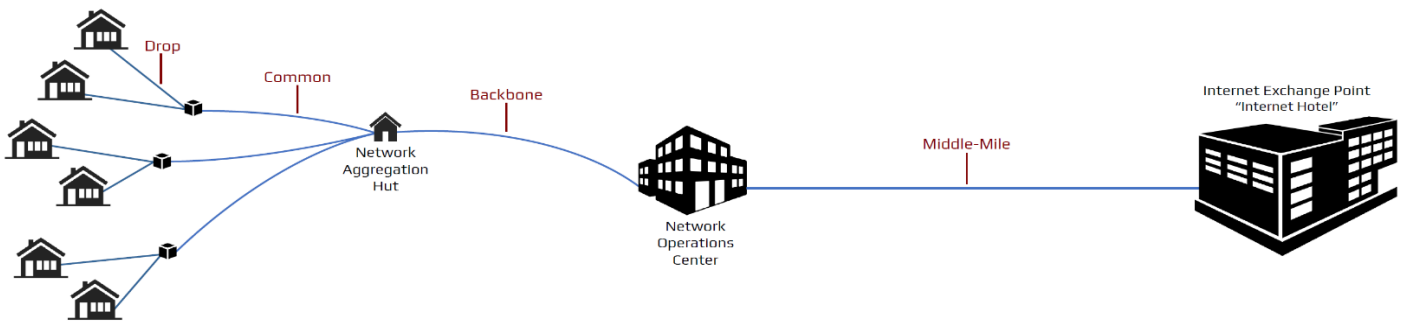
The switched ethernet architecture provides a dedicated connection for each customer rather than a shared connection and the customer experience is significantly better than in a shared architecture during periods of network congestion because the throughput of a switch-based architecture is superior. A switched ethernet network does require electronics and back-up systems in aggregation huts out in the field, but our analysis indicates that the systems are comparable in construction cost and the total cost of ownership is lower with switched ethernet.

Passive Optical Network (PON)

Passive Optical Networks (PON) make use of Time Division Multiplexing (TDM) technologies to create a bus or shared architecture with performance very similar to coaxial cable installations. In a PON network, splitters are placed in the field and a single fiber connection is shared between 32, 64, or 128 premises. This shared architecture may result in packet loss during periods of peak usage. Additionally, upgrading individual connections relies on complicated vendor specific solutions if possible. It can also be more difficult to isolate and troubleshoot faults in a PON network because of the topology. PON equipment suppliers also use proprietary management platforms to establish long term vendor lock-in.

Proponents of PON architecture will argue that PON is less expensive than an ethernet design. That was true historically. This change in pricing differences was driven by the fact that all data center deployments use switched ethernet architectures and the enormous growth of data centers over the past 20 years has driven down the cost of ethernet switches and other electronic components.

Network Segments – Definitions & Costs Allocations



Drop = The drop is the fiber that runs from the street to the premise (home or business).

Common = The common is the shared fiber infrastructure in a neighborhood that runs from a drop to the closest aggregation hut.

Backbone = The backbone fiber runs from an aggregation hut back to the network operations center.

Middle Mile = The middle mile is usually third-party fiber that runs from the network operations center to the closest internet exchange point. The cost of the middle mile is included in the monthly maintenance and operations (M&O) utility fee and is borne by all network subscribers.

Internet Exchange Point = An internet exchange point is the central point where all internet traffic flows for routing. This is analogous to the role of a central post office for the U.S. postal system.

Comparison of Available Media

The primary media used for internet access today in the United States includes DSL, coaxial cable, wireless, and fiber-optic cable.

DSL stands for Digital Subscriber Line, and it is one of the technologies used to provide internet connectivity to homes and businesses. DSL uses existing telephone lines and a transceiver, or modem to bring a connection into a home or business and allows the household to use the internet and make telephone calls at the same time. Verizon is the incumbent telephone company in Elk Grove and uses DSL technology. DSL is asymmetrical (the download speed is much faster than the upload speed), is a dedicated connection capable of download speeds up to 100 Mbps depending on the DSL standard, copper line age, and distance. Most consumers accessing the internet via DSL experience speeds between 5 – 25 Mbps.

Coaxial Cable uses copper cable designed with one physical channel that carries the signal surrounded by a layer of insulation and then another physical channel, both running along the same axis—hence the coaxial name. Coaxial cable is primarily used by cable TV companies to connect transmission facilities to customer homes and businesses to deliver cable TV and internet access. Comcast/Xfinity is the incumbent cable company in the Elk Grove area. Coaxial cable is asymmetrical and shared between up to 200 customers or more. The most recent cable standard of DOCSIS 4.0 can provide up to 10 Gbps in shared bandwidth depending on supported standards and other environmental factors. The standard currently implemented in Elk Grove is 3.1 and the maximum speed available is 940 Mbps. In addition to the limitation of sharing among many customers, another limitation of coaxial infrastructure is that the signal begins to degrade after 300-400 feet.

Fiber-Optic Cable sends information down strands of glass known as optical fibers which are less than the size of a human hair. These fiber-optic strands can transmit 25 Tbps today and researchers have successfully demonstrated a transmission experiment over 1045 km with a data-rate of 159 Tbps.[9]

Fiber-optic cables carry information between two places using optical (light-based) technologies which convert electrical information from the computer into a series of light pulses. Fiber-optic cable is capable of symmetrical speeds up to 25 Tbps and the signal can travel as far as 60 kilometers or approximately 37 miles without degrading. Fiber-optic infrastructure is also less expensive to deploy than any other existing wireline infrastructure. Because the difference in capacity between fiber-optics and alternative media is so significant, fiber-optics should be the foundational media for any new broadband infrastructure project when financially feasible.

Wireless Internet access is made possible via radio waves communicated to a person's home computer, laptop, smartphone, or similar device. Wireless internet can be accessed directly through cellular providers like AT&T Wireless, Verizon Wireless, T-Mobile, or by a wireless internet service provider (WISP). Wireless reliability can be affected by poor weather conditions and may require line of sight.

5G is the 5th generation of technology used in cellular networks and refers to a standard for speed and connection. Because of the extensive marketing around the emergence of 5G, many people wonder whether 5G will replace fiber-optic cables. In fact, 5G depends on fiber-optic infrastructure. All wireless technologies

[9] Source: https://phys.org/news/2018-04-fiber-transmission.html

work better the faster they get back to fiber optics. 5G is not broadcast on a single frequency, rather there are several frequencies used by 5G networks and these different frequencies have different advantages and disadvantages—depending on the application.[10]

- **Low-band 5G** operates between 600-850 MHz. This is only moderately faster than 4G with speeds between 50-250 Mbps and offers similar coverage areas for each cell tower.

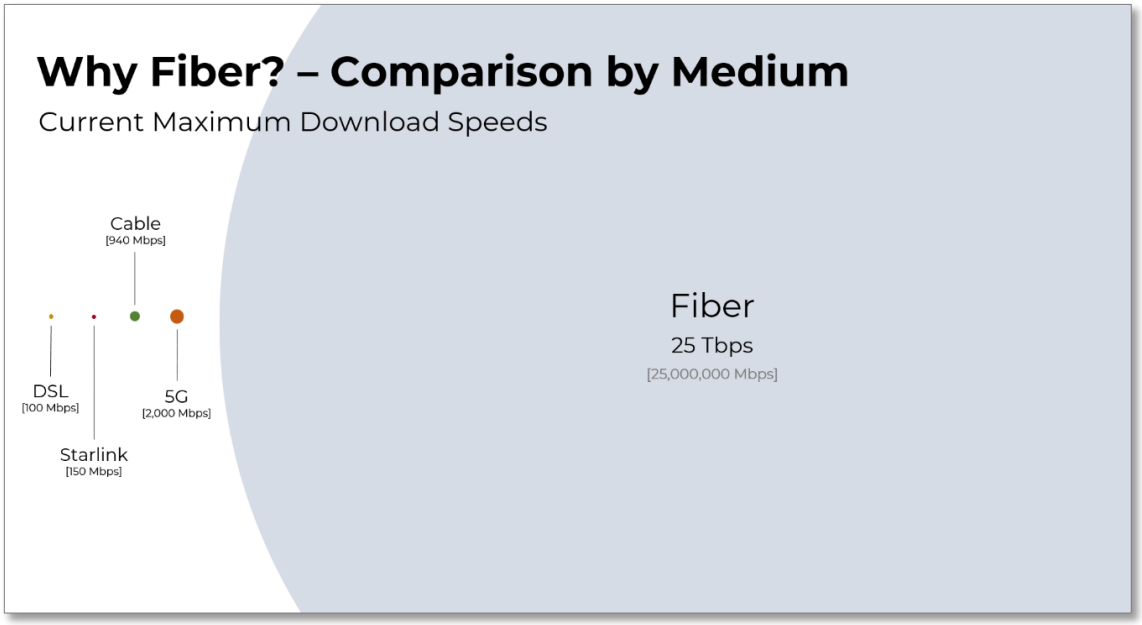
- **Mid-band 5G** operates in the 2.5-3.7 GHz range and delivers speeds between 100-900 Mbps. While offering less range per cell tower, this type of 5G is going to be the most common implementation of 5G networks for many years to come. It is a compromise between network speed and range in both medium-density urban areas and less dense rural regions.

- **High-band 5G** is the band that is most commonly associated with 5G. Operating at 25-39 GHz, this is known as the "millimeter wave" spectrum and delivers gigabit speeds (currently tested as high as 3 Gbps). The millimeter wave transmitters have limited range and require the deployment of many small transmitters. Each transmitter connects to fiber optics.

Satellite Internet is a wireless internet connection that is available in the U.S. While it is relatively slow in comparison to cable or fiber-optic connections, satellite internet access is faster than some DSL options. This makes it a good option for some rural premises.

Satellite internet speeds range from 1 Mbps – 100 Mbps for download speeds and it is common to have latency and packet loss issues because the signal must travel to space and back. Satellite internet providers include HughesNet, ViaSat, and Starlink. These providers DO NOT promote themselves as a solution for suburban or metro areas.

Satellite internet does require special equipment, including a satellite dish that connects to a communication satellite in space.



[10] Source: https://www.businessinsider.com/what-frequency-is-5g

Wi-Fi is common in homes and commercial buildings and is a way to deliver a network connection from a network hub over a wired connection to wireless devices via a wireless access point. Most people access the internet over a wireless connection, but it is important to remember that wireless connectivity ultimately depends on a wired connection and wireless access works best the faster it gets back to a wire. The Institute of Electrical and Electronics Engineers (IEEE) developed the Wi-Fi standard.

Upload vs Download Speeds

In addition to the fact that fiber-optic cable will offer exponentially greater bandwidth than DSL and coaxial cable, fiber-optic cable also offers the ability to deliver symmetrical speeds. In an asymmetrical connection, the download speeds are much faster than upload speeds.

Upload speed is the amount of data a person can ***send*** in one second and download speed is the amount of data a person can ***receive*** in one second. Upload speeds can be especially important for businesses, including home-based businesses or people who work from home. It is also important for telemedicine and online schooling to ensure good picture quality with video calls. Applications that depend on good upload speeds include sending large files, cloud applications like Microsoft365/OneDrive, Google Docs, Dropbox, VoIP, FaceTime, Skype, Zoom, WebEx, Teams video calls, hard drive backups, and in-house web hosting.

Municipal Network Models

Municipal Broadband Models Comparison

To compare the various models that exist in the United States today, the following model variables are important to understand:

Broadband Network Models

- Vertically Integrated – Privately Owned & Operated
- Publicly Owned & Privately Operated
- Publicly Owned & Operated

Access

- Closed Networks (Single ISP)
- Open Access Networks (Multiple ISPs)
  - Dark Fiber
  - Lit Manual
  - Lit Automated

A mix of prominent municipal fiber-optic projects were selected to illustrate the types of models that have been deployed. The following comparison summarizes different approaches to funding and operating municipal broadband infrastructure and services followed by a description of the advantages and disadvantages of each:

Municipality	Population	Model Type	Open vs. Closed	Dark vs. Lit	Manual vs. Automated	Take-Rate	Cost of 1 Gig
Chattanooga, TN	179,139	Electrical Utility ISP	Closed	Lit	Manual	60%	$68.00
Lafayette, LA	126,000	Electrical Utility ISP	Closed	Lit	Manual	40%	$99.95
Westminster, MD	19,000	City Fiber, Private ISP	Closed	Lit	Manual	30%	$89.99
Huntsville, AL	194,585	Dark Fiber Open Access	Closed	Dark	Manual	No Data	$70.00
Sandy, OR	10,000	Municipal ISP	Closed	Lit	Manual	60%	$59.95
Longmont, CO	86,000	Electrical Utility ISP	Closed	Lit	Manual	55%	$69.95
Ammon, ID[11]	17,000	Automated Open Access	Open	Lit	Automated	65%	$47.50
Monmouth, OR	15,083	Municipal ISP	Closed	Lit	Manual	80%	$129.65
Lexington, KY	321,959	Private Partner Owned	Closed	Lit	Manual	No Data	$59.95
Santa Monica, CA	110,000	Dark Fiber Business Only	Closed	Lit	Manual	N/A	N/A
Fort Collins, CO	165,000	Electrical Utility ISP	Closed	Lit	Manual	No Data	$59.95
UTOPIA	150,000+	Manual Open Access	Open	Lit	Manual	No Data	$70.00

[11] Disclosure: Ammon, Idaho is a client of EntryPoint Networks.

Ownership Considerations

Vertically Integrated – Privately Owned & Operated

A private owner designs, builds and operates a network. The private builder and operator assumes all the risk and does the work of overseeing design, project management, construction, customer acquisition and operations.

This model leaves the community vulnerable to the private owner operating as a monopoly or selling the network to a monopoly operator. A national or regional private operator reduces the ability of the subscriber to influence the policies, practices, and pricing of the operator. Historically, private owners have not demonstrated a willingness or ability to solve the digital divide.

Publicly Owned & Privately Operated

A community (e.g., city, town, or county) owns the network and utilizes a third-party operator to maintain and operate the network. The primary value of publicly owned infrastructure is that the network will not be under the control of an unregulated or semi-regulated private company that is not accountable or vulnerable to an election cycle where subscribers are empowered to influence outcomes. A private operator may be more expensive for subscribers due to the additional cost for profit. However, this depends on variables like efficiency, the cost of employment, and the percentage the operator takes for profits. Public owners have greater incentives to solve the digital divide.

The current model assumes that each ISP will build their own infrastructure. Multiple infrastructure instances are not necessary with fiber optics. One good fiber network will provide up to a 50+ year infrastructure. Multiple fiber networks will only drive up the costs for consumers and will provide no new or added value to the community.

Publicly Owned & Operated

A neutral host such as a city or county owns and operates the network. This model protects the community from the control of a private owner operating as an unregulated monopoly or a private owner who may sell the network to a monopoly operator. It also makes the network operator accountable to subscribers via an election cycle where subscribers are empowered to influence outcomes. Public owners have greater incentives to solve the digital divide.

Access Model Considerations (Single ISP vs Open Access)

Single ISP – Closed Access

This model is the most common infrastructure built out today and mainly provides advantages to the ISP. A single ISP does not expand choice or competition and may be more expensive for subscribers than an open access model.

Dark Fiber Open Access

Dark fiber open access is a model where infrastructure is built to the curb and the subscriber then selects an ISP as its provider. The ISP finishes the connection to the home with its own infrastructure and electronics. Operating a dark fiber network is less complicated than operating a lit network and the dark fiber model also enables public ownership of infrastructure. While the dark fiber model increases initial choice for subscribers, it does not increase long-term choice. Once the home has been connected to a specific ISP, it would be costly

to change as changing to a new ISP would require a new drop, therefore duplicating fiber unnecessarily. So future homeowners would not necessarily have the same kind of actual choices as they would have in other open access systems. Because the subscriber and operator give up control over the drop from the curb to the premise, the dark fiber model limits the usability of each strand of fiber. With an isolated dark fiber connection, it is impossible to connect to services that may be available through other service providers beyond services running across the internet. The dark fiber model also does not scale efficiently due to difficulty in anticipating the required fiber count to meet the demand. This can create significant complications for the network operator.

Lit Fiber – Manual Open Access

Lit Fiber - Manual Open Access is a model where the network is lit end to end. This means the network operator places and controls the electronics at both ends of the network. Switching internet service providers can be requested from a web portal and may appear to be automated when the network provisioning is done manually. A manual open access network increases choice for consumers. However, it does not necessarily produce the desired effects of competition if the business model presents barriers to competition. Operating a manual open access network is more complex than operating other models because of the requirement for human management of network tasks and any increase in the number of services or service providers adds to network complexity.

Lit Fiber – Automated Open Access

Lit Fiber – Automated Open Access is a model where the network operator places electronics at both ends of the network and subscribers can dynamically select service providers in real-time. Software-defined networking is used to automate various network management tasks. In this model, multiple service providers can deliver services simultaneously and independently across a single wire. When a subscriber selects a new service provider, the provisioning is done using automation and therefore happens on-demand. Automated provisioning creates a marketplace for services which includes ISPs and private networks for other services. The ability to switch service providers on demand increases choice and competition. This network model also includes the ability to provide local network resilience via local communications if connections over the middle mile are down.

Disclosure: *EntryPoint Networks owns and operates a SaaS model automated open access solution and is a technology solution provider in these networks.*

Risk Assessment

The City seeks to understand the primary risks of building and operating a municipal fiber-optic network and to actively manage those risks not only during construction but also on an ongoing basis during network operations.

The following is an analysis of the main risk factors facing the City of Elk Grove if it pursues its fiber-to-the-premise deployment. Ten risk factors are identified:

1. Take-Rate Risk
2. Subscriber Churn Risk
3. Project Execution Risk
4. Equipment and Technology Risk
5. Community Engagement Risk
6. Cost Modeling Risk
7. Timeline Risk
8. Regulatory Risk

Take-Rate Risk

Take-Rate Risk (demand risk) is the risk that the City builds out the network and ends up with a take-rate that is lower than expected.

Likelihood: Take-rate risk is an important risk factor and is a function of the value proposition of the network and how well that value proposition gets communicated and managed before, during, and after construction. High take-rates lead to lower network costs for subscribers. This creates a virtuous cycle where lower costs lead to higher take rates. The reverse is also true.

Impact: Positive take-rates and performance will compound to the benefit of all stakeholders. Negative take-rates lead to higher costs and churn which create a negative spiral that compounds until the network is not sustainable.

Mitigation: To mitigate take-rate risk, demand aggregation must be managed before, during, and after construction and give consumers a value proposition that makes them voluntarily committed to the network infrastructure.

Subscriber Churn

Subscriber Churn is the risk that customers sign up and then do not remain subscribers to the network.

Likelihood: Today, customers are primarily motivated by cost, speed, and customer service. Churn is possible and is a consequence of the customers pursuing an option to get better value from an alternative solution. The likelihood of churn is higher if a new market solution simply replicates the incumbent model.

Impact: The impact of churn on the network is potentially catastrophic if it reaches a level where the capital and operational cost abandoned infrastructure cannot reasonably be shared by remaining subscribers.

Mitigation: The risk of churn goes down under a business model where: 1) the customer connection is treated as an improvement to the property, and 2) the value proposition is strong enough to make the customer committed to the network.

Project Execution Risk

Project Execution includes strategy, planning, project management and fulfillment of the project plan and operational execution.

Likelihood: Project execution failure is possible and is a function of the effectiveness of project planning, management, controls, and execution.

Impact: The severity of impact is in proportion to the effectiveness of project management and execution. A worst-case scenario is one where project execution affects the value proposition, which in turn affects take-rate and churn.

Mitigation: This risk is reduced by hiring or partnering with skilled project managers and key strategic partners and creating alignment among key team members on the project and operational plans. Further, it is important to develop project controls that are monitored and reported to senior leadership monthly.

Equipment & Technology Risk

Equipment & Technology Risk includes both software and hardware solutions and is the risk that equipment failure rates are higher than expected, major software bugs are unresolved, operational reliability is lower than expected, and/or that the technology lifecycle leads to faster obsolescence than is expected.

Likelihood: Solutions with short deployment histories, unreliable references, unclear quality assurance and test procedures, weak professional teams, and poorly architected scalability abstractions present increased equipment and technology risk.

Impact: The impact of this risk category is moderate because it is possible to vet both software and hardware systems to assess this risk. The base technology of the network will be fiber-optic cable. It has sufficient history to present a minor risk to the project. Remaining risks include electronics and software systems.

Mitigation: Implement thorough due diligence processes with trained professionals to scrutinize references, architecture, software abstractions, quality control systems and the professional histories of vendors being considered.

Community Engagement Risk

Community Engagement includes the marketing, education, and communication processes and strategies used to inform residents and businesses about the value proposition offered by the network. It also can refer to the level of engagement with a community to educate them about digital inclusion, digital skills, and the benefits of using a network for socio-economic development.

Likelihood: Community engagement risk is possible but something that can be managed and monitored through proactive engagement. Poor planning, management and execution increases the level of risk. Community engagement can be handled by internal City staff. However, the risk increases if staff member resources are inadequate for a project of this size. There are external marketing professionals available to assist with the community engagement processes. With the right amount of training, there is limited risk if digital skills, and digital equity and inclusion training has taken place before the network is rolled out or during network roll-out.

Impact: Community engagement is a key driver of project success due to the relationship between community engagement and take-rate. It also is a key driver for uptake and continued use of the network for work, school, and social purposes.

Mitigation: Leverage the skills of marketing professionals and provide sufficient resources to make it easy for residents to learn the basic value proposition through a variety of education and communication strategies.

Cost Modeling Risk

Cost Modeling Risk is the risk that the financial modeling performed significantly misstates actual design, construction, and/or operational costs.

Likelihood: There is enough industry data available to reasonably validate cost estimates. However, there is significant market volatility currently due to supply chain disruptions and labor supply pressures. These increase the risk of cost modeling errors.

Impact: Cost overruns can have a meaningful impact on network construction and sustainability.

Mitigation: Risk is reduced by utilizing binding RFP processes, validating financial assumptions against industry assumptions, market conditions, and accounting for local economic variables.

Timeline Risk

The benefits of building the network at an accelerated pace includes the following:

1. Each phase requires legal, financing, and accounting transaction costs. Building the network with fewer phases will lower the overall transaction costs for the project.
2. Building at a faster pace will result in an accelerated time to break-even.
3. An accelerated timeline reduces the potential for unexpected movement in interest rates.

Likelihood: Costs are likely to be higher for an extended build-out period. However, there may be execution risk exposure for accelerating the buildout, depending on the experience and capacity of the construction partner.

Impact: Costs will be incrementally higher for an extended build-out schedule and maintenance and operations will have a longer ramp to sustainability.

Mitigation: The City can manage the build-out schedule following a cost/benefit analysis of the options. An important consideration is alignment with construction partners. If the City is going to outsource construction, it should consult with potential construction partners about alternative construction schedules to make sure that the City's strategy is amenable to key construction partners.

Regulatory Risk

Regulatory Risk is the risk that state or federal regulations become an impediment or barrier to the City successfully building or operating a municipal network. The City should continue to review the regulatory environment in California and, in working with its lobbyist and the League of California Cities, monitor for changes in State law and advocate for legislation and regulations to foster municipal broadband systems.

Likelihood: Historically, incumbent operators have taken legal action to stop several municipalities from building a competing network whenever they have a legal basis for doing so. It seems clear that cities in California have a legal basis to build this infrastructure as summarized above and the likelihood of a legal challenge is relatively low.

Community Engagement

Evaluation & Education

Document the current state of broadband and determine the level of interest among residential users and business owners.

Community Survey

A survey for residents and business owners was conducted to determine the level of interest in a municipal fiber network. Education and promotion programs should be influenced by ongoing survey engagement and response.

Publish Educational Information

Leverage website content specific to the municipal fiber program to outline the core message of broadband as a local utility that offers lower costs, an increase in choice, subscriber control, and fosters digital inclusion. Use customized videos to educate online visitors on topics such as: functionality of the community fiber network, options for services, frequently asked questions (FAQ's), and more.

Mapping Community Interest

Distribute an "I am interested" sign-up form with associated heat map where residential and business property owners can register as someone interested in municipal fiber.

Work with the community to map the number of community organizations providing broadband skills and training, and digital navigator training to continue training and/or to use these organizations as outreach organizations.

Marketing & Promotion

Utilize press releases to promote the municipal fiber network, driving traffic to the fiber website with the goal of educating community members, generating interest, and encouraging community participation. Use all available social media platforms (e.g., Facebook, Instagram, Twitter) to promote the fiber network.

Work with local organizations to get the word out through digital navigators and other like-minded organizations.

Neighborhood Entrance and Yard Signs

As construction (fiber build) begins in a neighborhood, Elk Grove can post signs at neighborhood entrances announcing the construction and letting residents know they can still sign-up to get connected while crews are in the neighborhood.

As homes are connected in the neighborhood, yard signs can be placed in the yards of subscribers indicating that the home now enjoys a fiber broadband connection.

Grassroots Engagement

Webinars & Open House Events

Elk Grove can use webinars and open house events to educate residents and business owners about the fiber project, ask questions, become educated about the business model, infrastructure, and costs.

Webinars and open houses are promoted using utility bill inserts, press releases, public service announcements, local news reports, City websites, social media platforms, and more.

Webinars and open house events are intended to educate residents, promote the network, and identify fiber champions in the various neighborhoods (fiber zones).

Fiber Champions

Fiber champions are individuals that demonstrate a voluntary commitment to promoting the network within their neighborhood. Fiber champions may be incentivized by a practice of building to those neighborhoods that have the highest level of engagement or demand (initial fiber zones are connected in order of take-rates – highest to lowest). Fiber champions assist sign-up efforts within their designated neighborhood (fiber zone). They organize and lead neighborhood meetings where neighbors can learn about the Elk Grove fiber program. Elk Grove leaders and employees provide support to the fiber champions in their efforts. Fiber champions drive conversations and contractual commitments of neighbors via the door-to-door sales and education campaign.

Door-to-Door Campaign

Individuals representing the local network contact residents and business operators within the planned footprint to answer questions and ascertain the potential subscribers' interest in participating. [Yes (Opt-in) or No (Opt-out)].

This direct person-to-person contact gives everyone in the community an opportunity to ask questions, clarify understanding, and express a level of interest in participating.

To maximize the effectiveness of this process, door hangers are distributed to every home and business prior to canvassing a neighborhood. These inform property owners that a representative will be stopping by to explain the value proposition, answer questions, and determine the level of interest from potential subscribers.

Door-to-door campaigns are very effective in giving people an opportunity to learn and ask questions in a one-on-one interaction.

It is important to support this effort with public notifications, press releases, mass emails, websites, social media sites, mobile applications, and other community outreach venues. This may include outside professional marketing and/or PR firms.

Commissions for a door-to-door campaign can be funded by a sign-up fee or wrapped into the infrastructure installation cost.

Community Broadband Survey

December 2, 2022

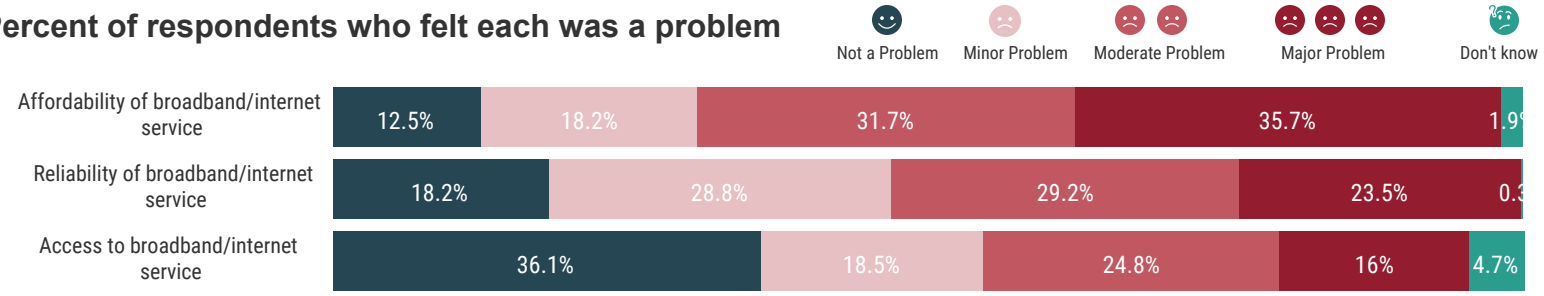
In February 2022, the City of Elk Grove was selected for a Build Better Broadband grant through the Tides Center/ Connect Humanity Project. As part of this effort, the City of Elk Grove conducted a resident and business survey to gain increased understanding of attitudes and perceptions of broadband services in Elk Grove. The survey was available from June 6, 2022 to July 30, 2022. It was promoted on the City's social media platforms during this time. In addition, it was included in special emails and in the City's weekly emails providing information on activities. The survey was also promoted at the City booth at the NeighborGood Market on July 7, 2022.

A total of 329 responses were received, with 320 indicating they were responding for residential service and nine (9) responding for business service. The survey results are not representative of the views of all Elk Grove residents or business owners. This is due to selection bias as the respondents were not a random sample of the population. Data presented here are for the 329 responses received without adjusting for these factors.

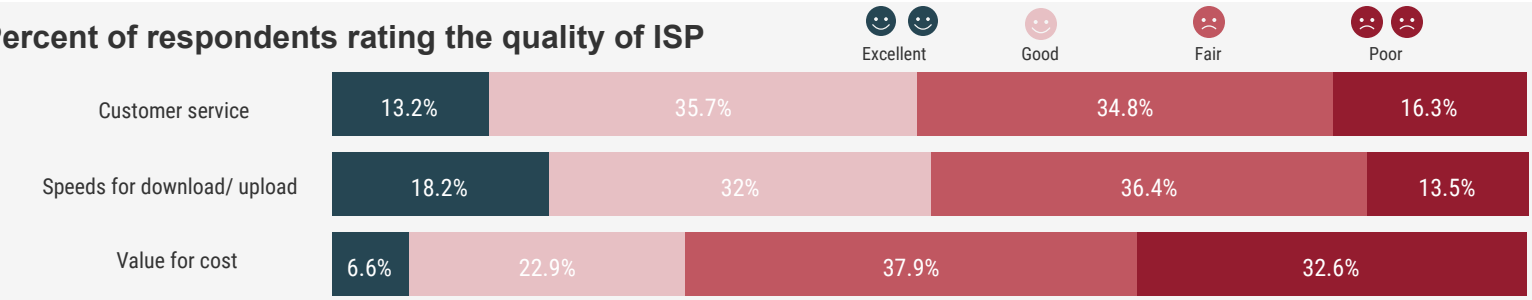
Perceptions on Internet Service

The majority of respondents (85.6%) felt that affordability of internet service was a problem, with 67.4% indicating a moderate or major problem. Reliability of internet was also seen as a problem, with 52.7% indicating a moderate or major problem. These figures were similar across all income groups.

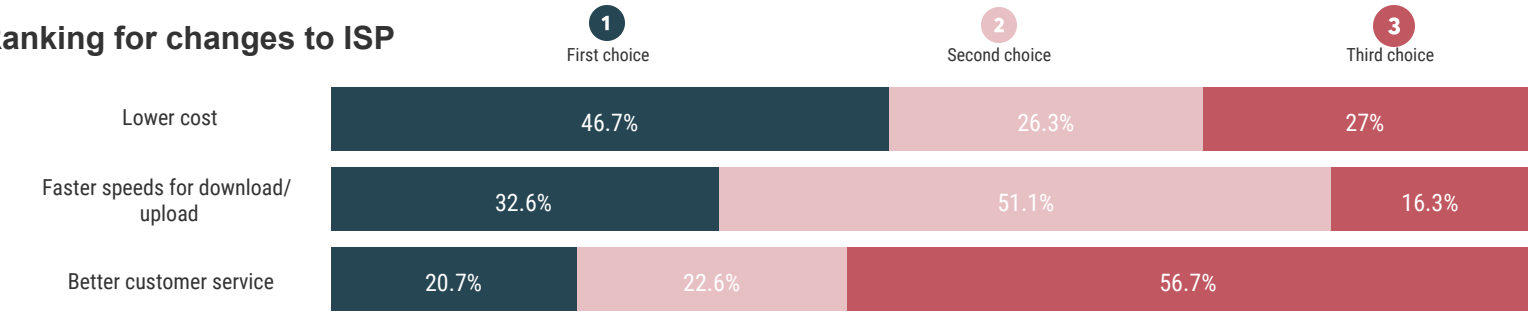
Percent of respondents who felt each was a problem



Percent of respondents rating the quality of ISP



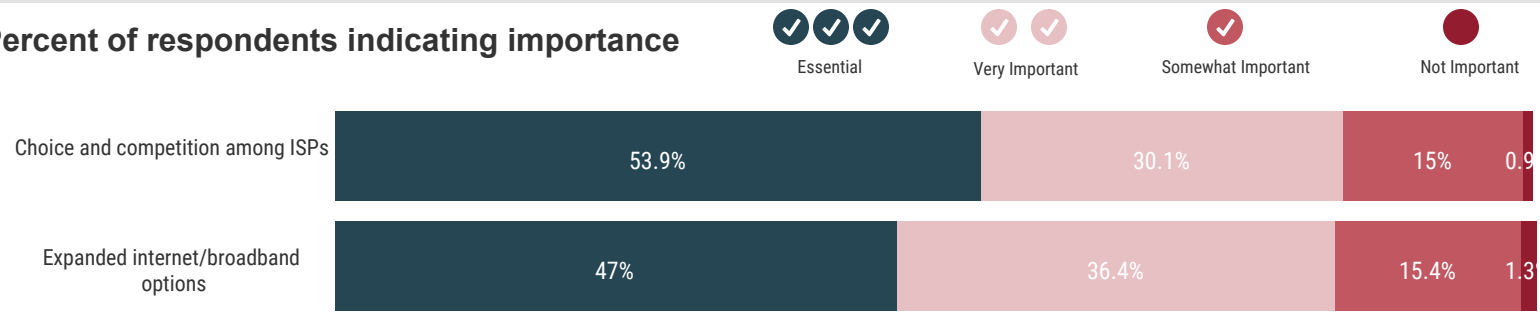
Ranking for changes to ISP



Choice and Competition

The majority of respondents (85.6%) felt that affordability of internet service was a problem, with 67.4% indicating a moderate or major problem. Reliability of internet was also seen as a problem, with 52.7% indicating a moderate or major problem. These figures were similar across all income groups.

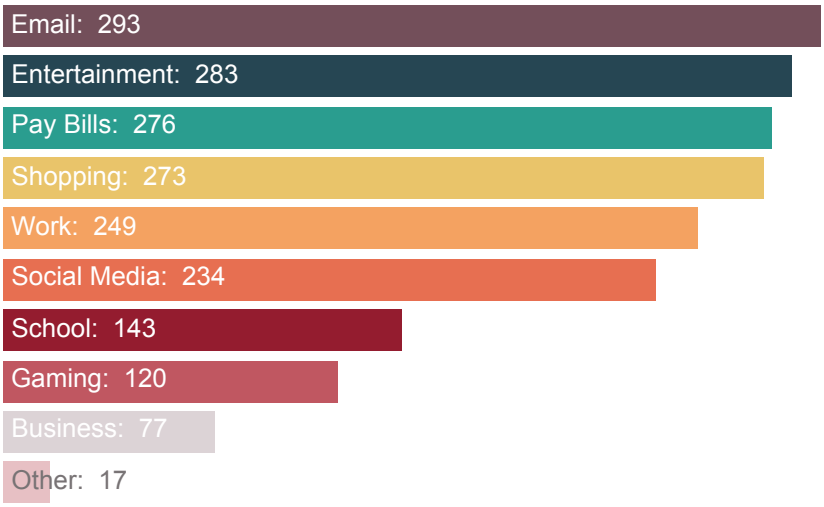
Percent of respondents indicating importance



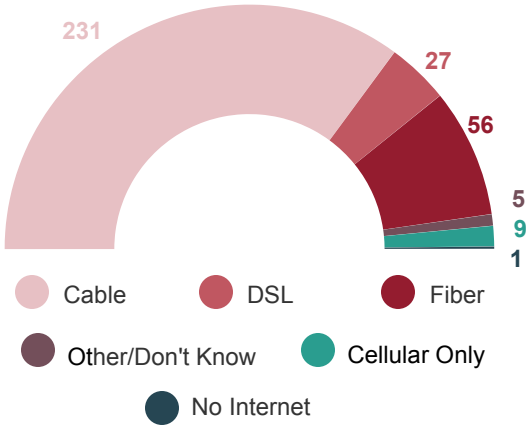
Internet Service Type and Uses

The majority of respondents have cable internet service, followed by fiber and DSL as the most common. Only a small number have only cellular service, and no respondents indicated they used a satellite internet provider. The primary uses for the internet included emails, entertainment, paying bills and shopping.

Primary Internet Use



Type of Internet Service

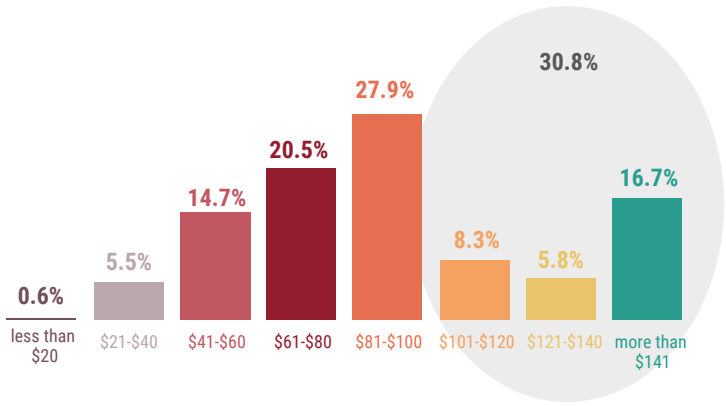


Cost and Affordability

The majority of respondents think that less than $60 per month is an affordable price for internet service, with 66.3% responding in this price range. Only 20.8% of respondents actually pay less than $60 per month for internet, with over 30.8% paying more than $100 per month, a price that only 4.8% of respondents felt was affordable. The average respondents currently pay for internet is $103 per month.

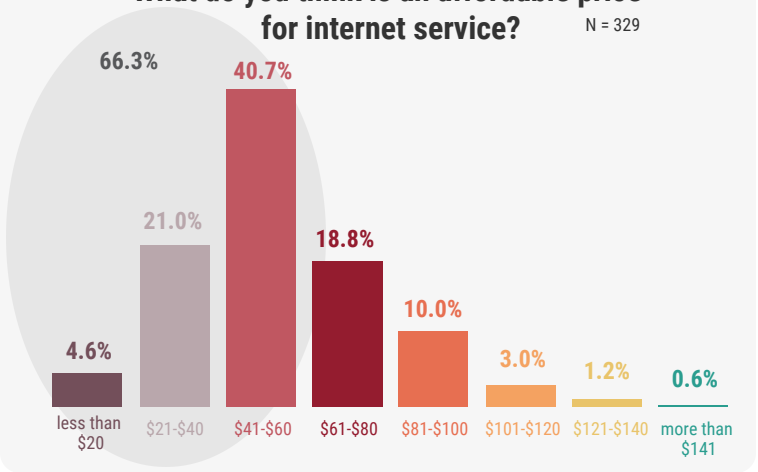
How much do you currently pay for internet service?

N = 312



What do you think is an affordable price for internet service?

N = 329

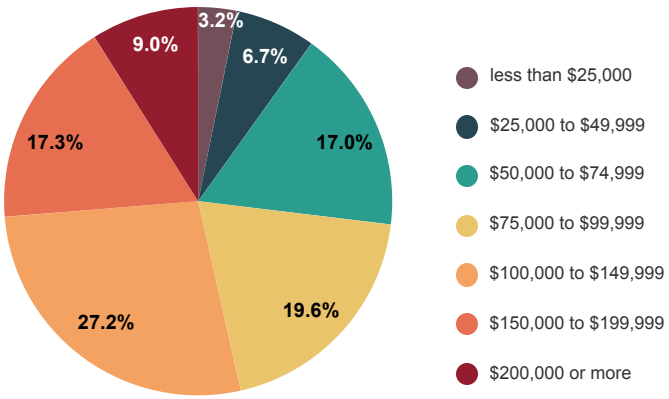


Respondent Background

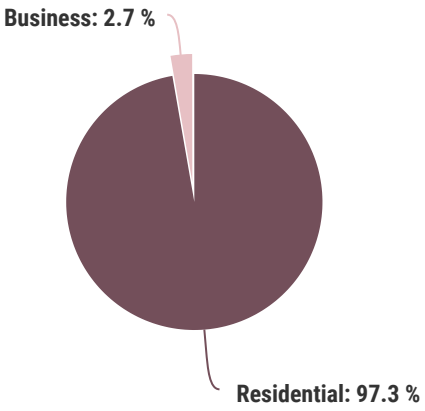
The majority of respondents reported a household income above $100,000, accounting for 54% of responses. The largest single income category was between $100,000 and $150,000, with almost 28% of respondent households included here. In addition, the majority of respondents were residents and not business internet users.

Household Income of Respondents

N = 312



Type of Internet User



SECTION 9

Glossary

Glossary

Industry Terms and Abbreviations

Term	Description	Definition / Narrative
Aerial	Fiber-optic network cables installed on existing utility poles	Aerial fiber deployments are one of the most cost-effective methods of installing fiber cables. Rather trenching and/or boring for underground installations, operators can simply use existing pole infrastructure to deploy the cables.
Asymmetrical	Broadband Download and Upload Speeds are not the same	An asymmetrical connection does not have equal download/upload speeds. For example, 60/3 means 60 Mbps download and 3 Mbps upload speed.
Bit	Binary Digit	The most basic unit of data in telecommunications and computing. Each bit is represented by either a 1 or a 0 in binary code.
Buried	Fiber-optic network cables installed underground in conduit	Buried fiber deployments, unlike aerial, are protected from weather damage by being buried below the freezing point in the ground.
Microtrenching	Fiber strands in conduit are placed in a 2”-3” wide trench that is usually cut in asphalt roadways.	Microtrenching is a fiber network construction technique that lays the protective conduit that houses the fiber strands below and at the side of a roadway. It requires much less digging and much less disruption than other network building methods.
Digital Divide	Digitally unserved and/or underserved neighborhoods and/or demographic - typically lower-income and rural communities	The gulf between those who have ready access and affordability to the internet, and those who do not.
DOCSIS	Data Over Cable Service Interface Specification	An international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable television (CATV) system.
DSL	Digital Subscriber Line	A technology for the high-speed transmission of digital information over standard phone lines.
Fiber	Fiber-optic	Thin flexible fibers with a glass core through which light signals can be sent with very little loss of strength.
GB or Gig	Gigabit = 1,000,000,000 Bits or 1,000 Megabits	A unit of information equal to one billion (10^9) or, strictly, 2^{30} bits.
Gbps	Gigabits per Second	Billions of bits per second.
GHz	Gigahertz	One billion hertz, especially as a measure of the frequency of radio transmissions or the clock speed of a computer.

Internet Exchange Point	IXPs or IXes or Internet Exchange Hotel	Internet exchange points (Ixes or IXPs) are common grounds of IP networking, allowing participant internet service providers (ISPs) to exchange data destined for their respective networks.
ISP	Internet Service Provider	A company that provides subscribers with access to the internet.
K or KB	Kilobit(s)	A unit of computer memory or data equal to 1,024 (2^{10}) bits.
MB or Meg	Megabit = 1,048,576 Bits	A unit of data size or network speed, equal to one million or 1,048,576 bits.
Mbps	Megabits per Second	Millions of bits per second.
MHz	Megahertz	One million hertz, especially as a measure of the frequency of radio transmissions or the clock speed of a computer.
Middle Mile	Middle Mile Communications Provider	In the broadband internet industry, the "middle mile" is the segment of a telecommunications network linking a network operator's core network (central office) to the nearest internet aggregation point.
M-LAB	Measurement Lab	M-Lab provides the largest collection of open internet performance data on the planet.
NTIA	National Telecommunications and Information Administration	NTIA is the Executive Branch agency that is principally responsible for advising the President of the United States of America on telecommunications and information policy issues.
PON	Passive Optical Network	A passive optical network, or PON, is designed to allow a single fiber from a service provider the ability to maintain an efficient broadband connection for multiple end users.
Symmetrical	Broadband Download and Upload Speeds are the same	A connection with equal download and upload speeds. For example, with a 500/500 Mbps fiber internet connection you get 500 Mbps of download AND 500 Mbps of upload speeds.
Take-Rate	The Percentage of Subscribers in a Network	A tabulation of broadband penetration rates. The calculation is determined by dividing the number of subscribers by the total number of potential subscribers in a network footprint.
Tbps	Terabits per Second	Trillions of bits per second.
8K Video	Ultra-High-Definition Video	Television resolutions of 7,680 pixels horizontal x 4,320 pixels vertical.

Open Access Network Terms

Term	Description	Definition / Narrative
Backbone	Shared Fiber Infrastructure from Aggregation Point to Network Operations Center	The backbone fiber runs from an aggregation hut back to the network operations center (NOC).
Common	Shared Fiber Infrastructure from Drop to the Closest Aggregation Point	The common is the shared fiber infrastructure in a neighborhood that runs from a drop to the closest aggregation hut.

Drop	Segment of the Fiber Network from Street into Home or Business	Drop is the fiber that runs from the street to the premise (home or business).
Middle Mile	Shared Fiber Infrastructure from Network Operations Center to Internet Exchange Point	The middle mile is usually third-party fiber that runs from the network operations center to the closest internet exchange point. The cost of the middle mile is included in the monthly M&O utility fee and is borne by all network subscribers.
Network Operator	Department or Company that Manages the Network Physical Infrastructure	The organization that manages the network physical infrastructure on a day-to-day basis. The network operator may or may not be the owner of the physical network infrastructure.
Service Provider	A Company that offers Services to Consumers on the Network	A company or organization that offers services (ISP and other) over the open access physical network infrastructure.
Subscriber	A Customer/Consumer on the Network	Household or business that participates as a subscriber on the network.

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