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Douglas County Broadband Service Study
Phase 1 Report

February 2022

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Chapter 1: Introduction

Douglas County, Colorado, commissioned a Broadband Study to evaluate the current state of broadband availability, affordability, and needs in different parts of the County in Phase 1 of the project. This report summarizes the information gathering portion of the study to provide the information needed to set the desired course for Phase 2 of the study, which will explore potential options to leverage existing and future resources to improve broadband.

This report is organized as follows: a market assessment detailing public sources of information on broadband availability, pricing, and plans; a public survey report showing the results of community feedback on their internet service; interview summaries of County stakeholders and community groups; a technology assessment detailing advantages and disadvantages of different types of technologies for varied geographies; and a sample colocation policy that can create opportunities for cost-saving cooperative fiber installations.

Phase 1 is focused on gaining a base understanding of the variety and quality of internet services offered in the County and providing contextual information for broadband deployment. This study is particularly appropriate at this time for several reasons. The first is the prolonged state of the COVID-19 pandemic. After two years, people have become increasingly accustomed to relying on internet applications to supplant the diminished ability for in-person social and professional interactions. Reliance on work-from-home, telehealth, and online education have increased the importance of high-quality internet capacity to never-seen-before levels. The second reason for this study's timeliness is the incoming federal assistance programs established to support broadband deployment. Federal grant programs for broadband in the Infrastructure Bill, the Capital Improvements Fund, and the American Rescue Plan Act will drastically surpass any previous broadband support programs. The opportunity to leverage these resources in a long-term strategic County plan begins with the assessment and knowledge of existing capacity and unrequited needs.

Key Takeaways

Urban areas of Douglas County are much better served by a broadband marketplace than the rural and remote areas of the County.

Whether it's rocky soil, dense forest, or limited transportation corridors, challenges with broadband infrastructure are closely related to the County's terrain and topology. Findings show that in areas more closely accessible by large transportation pathways result in denser population centers and a higher return on investment for broadband providers. Residents and businesses could have a choice of one or more service providers with competitive pricing plans. Alternatively, as with many rural communities, low population density in remote areas precludes infrastructure investment by many incumbents. These areas typically lack the technology infrastructure necessary to subscribe to higher quality service. It is not likely that those areas will attract broadband investment in the near future.

Broadband leadership opportunities exist in neighborhoods, metro districts, HOAs, and other governing subdivisions.

Outside of the County's denser population centers, there have been high-speed broadband deployments in the County that started with local-level leadership. By organizing and collaborating with the private sector, communities in areas which were un- and under-served have solved the digital divide. However, this approach is not a panacea, as the economics of bringing improved broadband to Rural and Remote areas in the County, has an equal number of unsuccessful attempts due to unfavorable economics. Douglas County has many active and involved residential developments, regional economic development organizations, metro districts, and other community-oriented organizations. The County can leverage the skilled leadership of these groups to coordinate and facilitate broadband initiatives.

Cities, anchor institutions, and other stakeholders have varied internet service capabilities and needs.

Discussions with representatives from stakeholder groups within the county revealed adequate broadband capacity for some organizations and poor service for others. Generally, those that felt their current and future capacity needs are being met were serviced with fiber or hybrid fiber/coaxial (HFC) infrastructure by larger broadband companies. Organizations in smaller cities and more remote areas where internet service infrastructure was limited to non-fiber technologies had lower quality of service, greater frequency of outages, and more anticipated future needs.

There are opportunities to leverage new funding streams to solve broadband issues.

Prior federal and state broadband grant programs provide funding only to areas in which current-available broadband speeds do not meet the FCC's 25Mbps Download/3Mbps upload standard. Since much of the County meets this standard, there have been limited opportunities for providers to pursue grant funds which would make improvements economically feasible.

Three major federal broadband grant programs have either been published (ARPA) or are being developed (Capital Projects Fund and BEAD) to expand funding to areas that lack 100/20 Mbps service. This will create an opportunity for the County's providers to improve service to the targeted improvement zones where residents and businesses are reporting sub-standard service, and where the largest impacts can be made.

There is a role for the County to facilitate broadband improvements.

County Commissioners and Leadership have expressed a strong belief that the private sector and the free market should drive the solutions necessary to resolve broadband issues in underserved areas of the County. County leadership does not believe it is the role of government to be a direct service provider or compete with private sector providers in delivery of broadband services.

However, County leadership is an advocate for addressing underserved residents and inefficient market conditions through public-private partnerships and exploring opportunities for creating joint or shared broadband infrastructure. The presence of Rural and Remote population centers inside Douglas County have made private-sector deployment of advanced infrastructure an economic challenge for many of the private carriers. Meetings with incumbent providers indicates an interest in creating partnerships with the county to extend and improve services in underserved areas.

The best opportunities for partnership exist where the County can help the private sector share or defray costs through the creation of low cost middle-mile access; by providing direct grants to providers; or through the creation of colocation opportunities.

Proposed Next Steps

Based on these key takeaways, the County has an opportunity to work collaboratively with the private sector to leverage pending funding streams to create a broadband infrastructure that could solve the Digital Divide across much of Douglas County. The Planning Phase of this project will evaluate alternatives, costs, and opportunities in order to provide a holistic Master Plan, with a programmatic approach to implementation. Moving forward, it is our recommendation that the County pursue the following approaches.

Identify Targeted Service Areas for Improvement

While the Colorado Broadband Map indicates that much of the County has service that meets the current 25/3 Mbps FCC standard for broadband, the County's Broadband Survey and research conducted in the Vision Phase of the project shows clearly that there are numerous areas in the County that would be eligible for funding under coming programs. HR Green will work with the County to identify Targeted Service Areas (TSAs) and create a phased approach to prioritize those areas that will have the largest impact in the County.

Create a Public Private Partnership (P3) model to improve connectivity

Based on the County's preferred model (P3), HR Green will develop a technical delivery plan in which the county and a private partner(s) can deploy and allocate capacity in a middle-mile network to serve public and anchor institution needs. The development of this network model will include dense fiber counts capable of supporting private sector companies interested in extending last mile service to underserved, Targeted Service Areas in the county.

Preliminary designs will be completed to develop both planning-level cost estimates and to create financial models that will help the County determine its path forward in this model based on the financial feasibility of the options and alternatives.

Quantify the Impact of SB-152 on planned improvements

Douglas County is not currently exempt from the provisions of Colorado's SB-152 law, which prevents public sector entities from operating communication facilities. The ability to apply for emerging streams of federal broadband grant funding may also be compromised by the County's public service prohibition, depending on the terms of the applications. Decisions must be made by the County to pursue exemption under SB-152 if it desires to move forward with a broadly facilitative solution as noted in the Proposed Next Steps outlined in this document.

Create Short Term Impact via Direct Grant Funding

Douglas County has access to $68.2 million in ARPA funding, and improved broadband services are an allowed use for these funds. The County would like to leverage these funds to create immediate impacts in partnership with the private sector ***and*** its diverse and active HOAs, Metro Districts, and other partners. The County must establish the level of funding for this program, and create a process by which funds can be equitably distributed to projects which will improve service in those TSAs selected.

Develop County Broadband Program Management Plan

The final deliverable of the next phase will be to develop the county resource plan and strategy to develop and oversee this multi-year program. It is likely that the majority of available funding will come to market in the next 3-6 years, requiring the development and execution of a program management office to oversee progress, ensure desired movement of the program, and provide close coordination with the County's partners.

Chapter 2: Douglas County Market Assessment

Introduction

Broadband services has changed from something nice to have to becoming incredibly important. Education, working from home, economic development, keeping youth in the area, telemedicine, etc. all need good connectivity. Competitive analysis of the availability of coverage is challenging due to the fluidity of market pricing, products offered, and differences in the various sectors.

One of the beginning points of understanding broadband in a community is to research the industry reported data. We begin the task of understanding coverage with a Market Assessment. This is an analysis of industry data that shows what providers report their coverage to be. As part of licensing, broadband providers are required to provide certain data for the customers they serve. That data is available from the FCC and other secondary sources that provide additional insight.

This is helpful information, but it is known to be flawed. The shortcomings of this data are:

- There is a reporting and displaying cycle that can, in some instances, make the data one to two years old before it is available.
- There are not significant repercussions for inaccurate reporting and inaccurate entering of the data.
- There can be secondary incentives for some providers to overstate their coverage (grants may not be available to potential competitors if coverage appears to be adequate)
- Data is recorded at the census block level – in a given census block, the highest coverage is generalized to the entire census block.

This data is known to be flawed for several reasons, but it is important for two reasons:

- Provide a baseline of data to work from
- This data is used for many federal and state grants. If it is incorrect, it is important to correct it.

Because of these problems in the data, a high-level market assessment cannot be fully relied upon, but it does provide a beginning point to understand coverage and it can also point out areas that need to be compared to the actual data that comes from the surveys. It is why the Market Assessment data is supplemented with a Survey to the community and community stakeholder interviews.

To begin this analysis, service offerings of each primary provider in the Douglas County will be examined, cataloged, and detailed.

A second step to verify this data can be focused feedback. We discuss options for that in the next Task. These can shed light on the actual practice of providers and, more importantly, on pricing and satisfaction, as well as determining what needs are in demand and are either not supplied by the marketplace or underserve the market.

One word of caution: If you do a market analysis without some sort of real feedback, there could be significant errors in the data. This information is gathered from self-reporting by providers. There have been important studies that have shown this data to be lacking. It is helpful as an overview, but we recommend some level of checking the data.

The residents and businesses in Douglas County can obtain internet access services from a variety of ISPs (internet service providers) via DSL (over copper), cable, fiber, fixed wireless, and satellite.

This section describes consumer internet offerings available to residents and businesses from established ISPs. Its goal is to draw a representative picture of the internet market in Douglas County and include one or more providers that serve their customers via copper (DSL), cable, fiber, fixed-wireless, and satellite.

The following statistics describe internet availability by transport medium (DSL, cable, etc.) in Douglas County with some of the data drawn from the following three dedicated websites.

- BroadbandNow (https://broadbandnow.com/)
- DecisionData (https://decisiondata.org/)
- AllConnect (https://www.allconnect.com/)

Findings

Since data is provided by zip code, all of the following findings are provided for the area of zip codes:

1. 80108 (Castle Pines North)
2. 80109 (Castle Rock)
3. 80104 (Castle Rock)
4. 80116 (Franktown)
5. 80126 (Highlands Ranch)
6. 80129 (Highlands Ranch)
7. 80130 (Highlands Ranch)
8. 80118 (Larkspur)
9. 80124 (Lone Tree)
10. 80131 (Louviers)
11. 80134 (Parker)
12. 80138 (Parker)
13. 80125 (Roxborough Park)
14. 80135 (Sedalia)

In summary, BroadbandNow states statistics for:

Colorado:

- Almost 94% of consumers in Colorado have access to a wired connection with true broadband speeds faster than 25mbps.
- 90.2% of Coloradans have access to 100mbps or faster broadband.
- Colorado is the 26th most connected state in the U.S.

Douglas County:

- Approximately 96.9% of Douglas County has access to an internet service provider
- In Douglas County, approximately 10,000 people do not have access to 25 Mbps wired broadband, approximately 3% of the County's population.
- Approximately 3,000 people in Douglas County don't have access to any wired internet.
- 100% of residents in Douglas County have access to fixed wireless internet service.

In the figure below, FCC data on the number of competitive providers in Douglas County implies that there are a notable number of providers and market competition. The survey chapter of this report provides more specific details for this generalized publicly-available information.

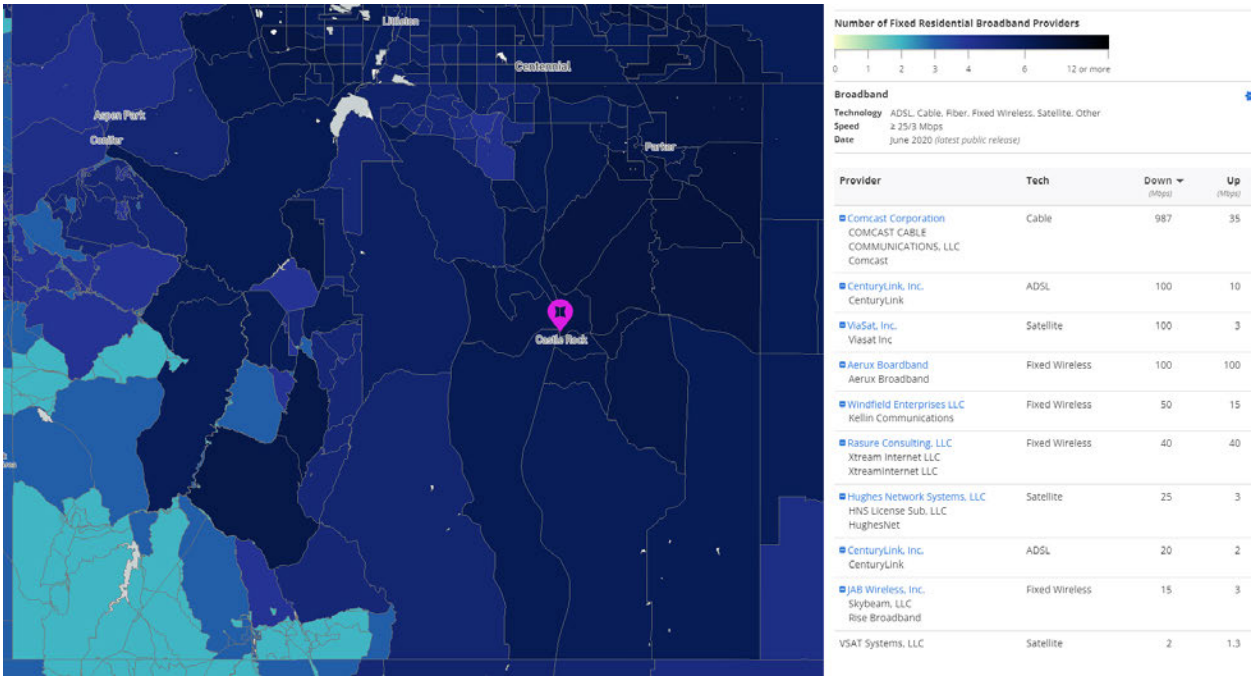

Figure 1: FCC Data Demonstrating Number of Providers in Douglas County

The State of Colorado also collects provider data on a biannual basis. As of October 2021, Figure 2 shows the unserved areas of Douglas County, while Figure 3 shows the spread of speed tiers within the county. A large portion of the county is shown to have service over 1 Gbps.

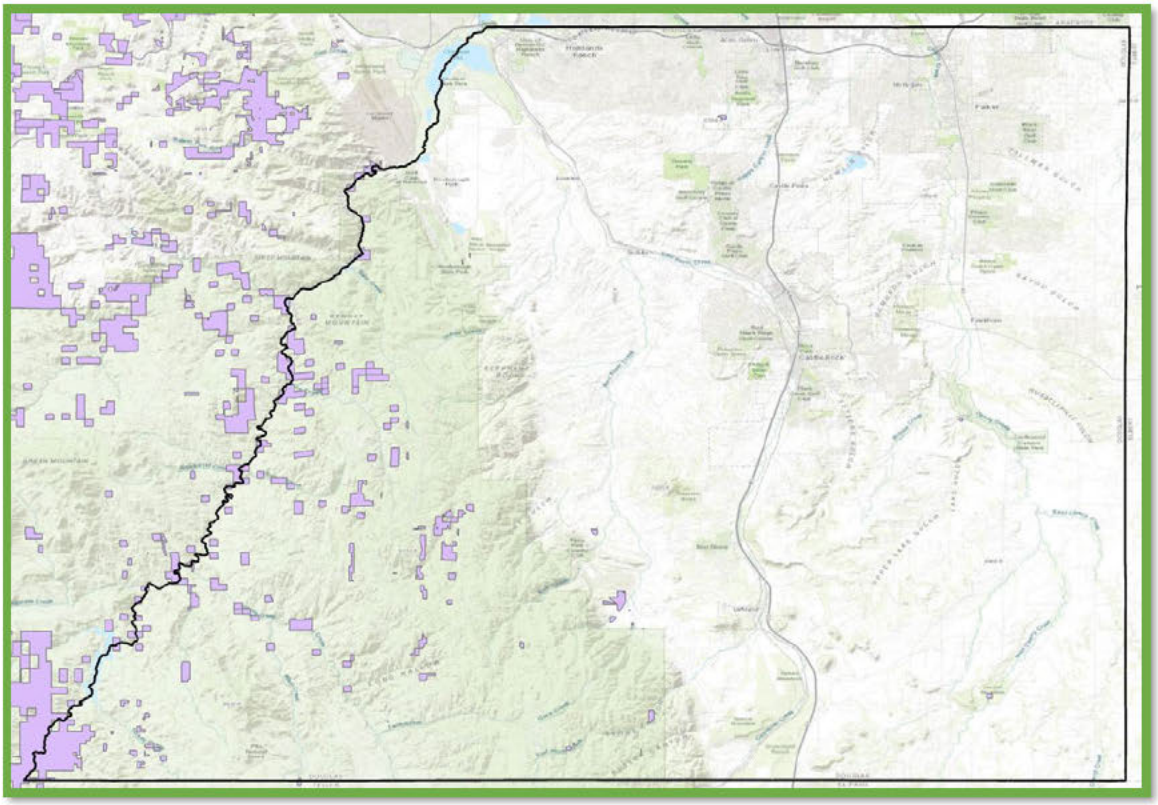

Figure 2: Unserved Areas in and around Douglas County (Colorado Broadband Map data as of October 2021)

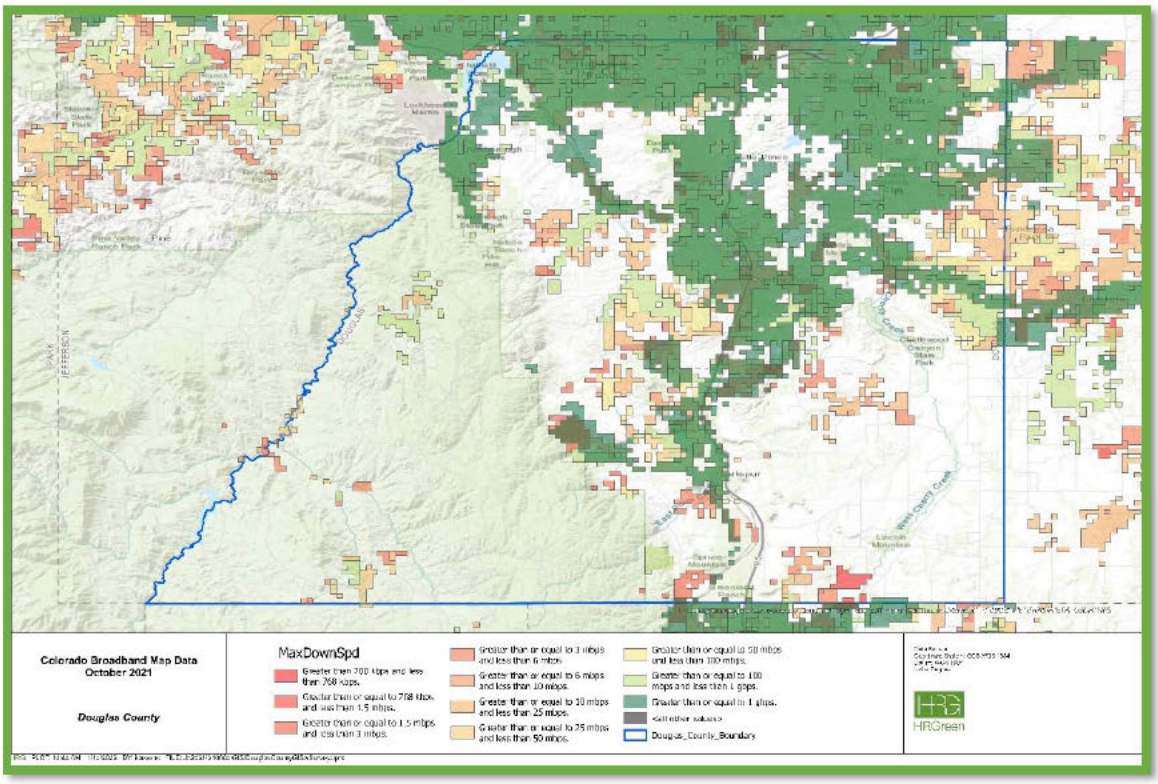

Figure 3: All Speed Tiers - Wireline

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Each of these providers is noted in a per zip code basis in the next two sections. In interpreting and providing a proper context for viewing the data in the provided tables, which should be used as a guideline for understanding the present state of internet services in the Douglas County, rather than an absolute measure, a few notes are in order.

In regard to speeds, all ISPs advertise a maximum achievable or "up to" data speed which is what a consumer can expect to experience only under the best of all circumstances. The following tables show the highest speed plans and the lowest priced plans, but they are generally not related. The actual speeds enjoyed by customers on average are typically lower than the advertised "up to" speeds and can be highly variable across a given 24-hour period. This is because all internet service providers, regardless of transport medium, employ in their designs some degree of concentration and sharing of network resources. In a survey of informational and provider websites, no service provider publishes a guaranteed minimum throughput speed. For example, DSL is a competitive product whose realized speeds can vary significantly due to a number of factors, from as low as 1Mbps/.25Mbps to 12M/3M, but engineering guidelines typically dictate that the distance to the customer from the central office or DSLAM (Digital Subscriber Line Access Module) will not exceed 5,000 ft. of data-conditioned cable to qualify for DSL at all. DSL is available to most of the historically populated residential and business markets in Douglas County.

At the opposite end of the availability spectrum is satellite service. Because of their extra-terrestrial access scheme, satellite service providers theoretically can, and in practice often do, boast of availability approaching 100%. Here is a representative statement from HughesNet's website describing the availability of their internet services. "Because HughesNet® provides Internet service to customers through the use of satellite technology, virtually every residential home and business in the continental U.S. can get HughesNet service. Service can be installed in any building with a clear view of the southern sky, making it a great option for people who live in rural areas". In non-remote areas, satellite providers offer a very unsatisfying, and low-speed option as a provider of broadband services. Further lessening the attractiveness of satellite providers are frequent and aggressive overall data caps, which limit the overall consumption (similar to cellular plans that cap data use on their networks).

Residential Providers by Zip Code in Douglas County

80108 (Castle Pines)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux	XtreamInternet	DirectLink
Download (Mbps)	940	1,200	50	100	25	50	50	50	100
Upload (Mbps)	940	35	3	3	3	10	20	50	25
Coverage	99%	96.4%	72.7%	100 %	100%	100%	78.3%	77.5%	4.9%

80109 (Castle Rock)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux	XtreamInternet	DirectLink
Download (Mbps)	940	1,200	50	100	25	50	50	50	40
Upload (Mbps)	940	35	3	3	3	10	20	50	25
Coverage	97.3%	93.1%	83.2%	100%	100%	100%	85.3%	96.8%	6.4%

80104 (Castle Rock)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux	XtreamInternet	DirectLink
Download (Mbps)	940	1,200	50	100	25	50	50	50	100
Upload (Mbps)	940	35	3	3	3	10	20	50	100
Coverage	99.9%	97.8%	69.6%	100%	100%	100%	90.3%	84.8%	5.7%

80116 (Franktown)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux	XtreamInternet	DirectLink	Netlive Networks	Force Broadband
Download (Mbps)	940	1,200	50	100	25	50	50	50	40	100	100
Upload (Mbps)	940	35	3	3	3	10	20	50	25	25	n/a
Coverage	87.5%	23.6%	87.9%	100%	100%	100%	81.3%	24.5%	46.1%	10.5%	10.5%

80126 (Highlands Ranch)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux
Download (Mbps)	940	1,200	50	100	25	50	50
Upload (Mbps)	940	35	4	3	3	10	20
Coverage	99.1%	98.7%	28.7%	100%	100%	100%	30.7%

80129 (Highlands Ranch)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux
Download (Mbps)	940	1,200	50	100	25	50	50
Upload (Mbps)	940	35	4	3	3	10	20
Coverage	99.1%	99.1%	98.3%	100%	100%	100%	97%

80130 (Highlands Ranch)

	CenturyLink	Comcast (Xfinity)	Viasat	HughesNet	Kellin Communications	Aerux
Download (Mbps)	940	1,200	100	25	50	50
Upload (Mbps)	940	35	3	3	10	20
Coverage	98.1%	99.4%	100%	100%	100%	7.8%

80118 (Larkspur)

	CenturyLink	Comcast (Xfinity)	Viasat	HughesNet	Kellin Communica	Aerux	XtreamInternet	Netlive Networks	Force Broadband	Thrive Broadband	Thrive Broadband
Download (Mbps)	940	1,200	100	25	50	50	50	100	200	2000	40
Upload (Mbps)	940	35	3	3	10	20	50	25	n/a	2000	n/a
Coverage	91.2 %	43.2 %	100 %	100 %	100 %	38.7 %	29.6 %	53.6 %	6.6 %	18.9 %	8.4 %

80124 (Lone Tree)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux
Download (Mbps)	940	1,200	50	100	25	50	50
Upload (Mbps)	940	35	5	3	3	10	20
Coverage	99.6%	98.8%	17.5%	100%	100%	100%	26.9%

80131 (Louviers)

	CenturyLink	Comcast (Xfinity)	Viasat	HughesNet	Kellin Communications	Aerux	DirectLink
Download (Mbps)	100	1,200	100	25	50	50	40
Upload (Mbps)	2	35	3	3	10	20	25
Coverage	6.6%	100%	100%	100%	100%	100%	14.4%

80134 (Parker)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux	XtreamInternet
Download (Mbps)	940	1,200	50	100	25	50	50	50
Upload (Mbps)	940	35	5	3	3	10	20	50
Coverage	98%	96.3%	87.2%	100%	100%	100%	77.5%	29.3%

80138 (Parker)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communica	Aerux	XtreamInternet	DirectLink	Aerux Fiber
Download (Mbps)	940	1,200	100	100	25	50	50	50	200	1000
Upload (Mbps)	940	35	15	3	3	10	20	50	250	n/a
Coverage	99.3%	82.8%	92.9%	100%	100%	100%	80.1%	51.7%	22.5%	1.3%

80125 (Roxborough Park)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communications	Aerux	XtreamInternet
Download (Mbps)	940	1,200	100	100	25	50	50	50
Upload (Mbps)	940	35	15	3	3	10	20	50
Coverage	96.9%	92.6%	9.2%	100%	100%	100%	67.5%	9.7%

80135 (Sedalia)

	CenturyLink	Comcast (Xfinity)	Rise Broadband	Viasat	HughesNet	Kellin Communica :	Aerux	XtreamInternet	DirectLink	Thrive Broadband
Download (Mbps)	940	1,200	50	100	25	50	50	50	40	40
Upload (Mbps)	940	35	4	3	3	10	20	50	30	n/a
Coverage	88.7%	10.8%	6.1%	100%	100%	98.5%	60.1%	71.7%	56.8%	33.5%

Business Internet Service Providers by Zip Code in Douglas County

80108 (Castle Pines)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	Windstream
Download (Mbps)	50	100	987	10	1000	1000	n/a	100
Upload (Mbps)	50	5	35	10	1000	940	n/a	8
Coverage	97.4%	81.3%	79.4%	100.0%	100.0%	49.3%	5.0%	0.7%

80109 (Castle Rock)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	Fusion Connect
Download (Mbps)	50	100	987	10	1000	1000	n/a	20
Upload (Mbps)	50	3	35	10	1000	940	n/a	20
Coverage	100.0%	70.3%	57.4%	100.0%	100.0%	64.0%	5.2%	16.4%

80104 (Castle Rock)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	Verizon Business	GTT
Download (Mbps)	50	50-100	987	10	1000	940	n/a	1.5	6
Upload (Mbps)	50	5	35	10	1000	940	n/a	1.5	0.768
Coverage	73.9%	59.6%	55.2%	83.9%	100.0%	31.4%	0.5%	0.4%	0.8%

80116 (Franktown)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Directlink	Unite Private
Download (Mbps)	50	50-100	987	10	1000	940	40	1000
Upload (Mbps)	50	5	35	10	1000	940	25	1000
Coverage	19.2%	99.2%	22.1%	79.1%	100.0%	42.4%	10.8%	77.4%

80126 (Highlands Ranch)

	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	GTT
Download (Mbps)	25 or 100	987	10	1000	940	6
Upload (Mbps)	4	35	10	1000	940	0.768
Coverage	28.1%	93.5%	47.0%	100.0%	80.6%	2.7%

80129 (Highlands Ranch)

	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	Windstream	GTT	Telefonica USA
Download (Mbps)	25 or 100	987	10	1000	1000	n/a	100	3	1.5
Upload (Mbps)	4	35	10	1000	940	n/a	8	3	1.5
Coverage	100.0%	100.0%	100.0%	100.0%	85.4%	2.1%	2.7%	8.1%	1.8%

80130 (Highlands Ranch)

	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	GTT
Download (Mbps)	987	10	1000	1000	n/a	3
Upload (Mbps)	35	10	1000	940	n/a	3
Coverage	100.0%	48.0%	75.7%	79.9%	5.8%	3.0%

80118 (Larkspur)

	Xtreaminternet	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Thrive Broadband	Unite Private networks
Download (Mbps)	50	987	10	1000	1000	1000	1000
Upload (Mbps)	50	35	10	1000	940	1000	1000
Coverage	21.7%	13.6%	88.7%	100.0%	19.9%	11.8%	17.3%

80124 (Lone Tree)

	Rise Broadband	Comcast Business	Aerux Broadba	MHO	CenturyLink	Allstream	GTT	Verizon Business	Forethought.net	Brainstorm	T2 Technolo	Unite Private	Fusion Connect
Download (Mbps)	50 or 100	987	10	1000	1000	n/a	6	1.5	10	10	50	1000	20
Upload (Mbps)	5	35	10	1000	940	n/a	3	1.5	10	10	50	1000	20
Coverage	29.5%	74.6 %	61.5 %	90.3 %	84.0 %	4.0 %	8.8 %	5.1 %	1.8 %	1.8 %	1.6 %	1.5 %	0.9 %

80131 (Louviers)

	Comcast Business	Aerux Broadband	MHO	Fusion Connect
Download (Mbps)	987	10	1000	20
Upload (Mbps)	35	10	1000	20
Coverage	100.0%	100.0%	100.0%	1.5%

80134 (Parker)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	Unite Private	GTT
Download (Mbps)	50	50 or 100	987	10	1000	1000	n/a	1000	6
Upload (Mbps)	50	5	35	10	1000	940	n/a	1000	1.5
Coverage	79.0%	99.7%	74.7%	99.7%	100.0%	74.6%	1.7%	21.8%	4.8%

80138 (Parker)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Allstream	Verizon Business	GTT
Download (Mbps)	50	100	987	10	1000	940	n/a	1.5	6
Upload (Mbps)	50	15	35	10	1000	940	n/a	1.5	0.768
Coverage	46.0%	100.0%	54.6%	100.0%	100.0%	46.8%	0.6%	0.6%	0.6%

80125 (Roxborough Park)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business
Download (Mbps)	50	100	987	10	1000	1000
Upload (Mbps)	50	15	35	10	1000	940
Coverage	28.7%	72.4%	76.2%	100.0%	100.0%	100.0%

80135 (Sedalia)

	XtreamInternet	Rise Broadband	Comcast Business	Aerux Broadband	MHO	CenturyLink Business	Fusion Connect	GTT	DirectLink
Download (Mbps)	50	25 or 100	987	10	1000	1000	20	3	40
Upload (Mbps)	50	4	35	10	1000	940	20	3	30
Coverage	49.5%	19.0%	7.7%	100.0%	59.4%	42.0%	2.9%	5.0%	0.5%

Internet Service Providers & Plans

Comcast (Xfinity)

Comcast is the biggest cable television company and the second biggest internet provider in the United States. The company offers the following internet service plans. Multiple prices were available for the same plans, which likely depends on the specific region in which the service is offered:

Plan	Download Speed – Up To (Mbps)	Cost/Month
Performance Pro+	200	$49.99/$59.99
Performance Starter+	25	$19.99
Performance Select	100	$34.99/$55
Blast! Pro+	400	$64.99/$74.99
Extreme Pro+	600	$60/$84.99
Gigabit	1000	$70/$94.99

SuddenLink

Founded in 1992, the cable internet provider went through several name changes, including Classic Communications, Cerbridge Connections, and then Suddenlink. In the mid-2000s, it acquired most of its customers from Cox and Charter communications. Prior to its acquisition by Altice USA in 2016, it was the seventh largest cable operator in the country. Following the acquisition, it was combined with Cablevision. Suddenlink operates services in 11 states, including Arizona, Arkansas, California, Kentucky, Louisiana, Mississippi, Missouri, North Carolina, Oklahoma, Texas, and West Virginia.

Download Speed	Cost/Month
Internet 100 Mbit/s	$89.99
Internet 200 Mbit/s	$99.99 Current promotion is $30 per month for a year with 1 month free
Internet 400 Mbit/s	$119.99
1 Gig Internet	$139.99

EarthLink

Earthlink provides a variety of Internet services for more than one million customers throughout the United States, among which include more than 150,000 business clients. Since the company was first established back in 1994, Earthlink's services include DSL, satellite, cable and wireless solutions. Half of the United States can order packages through Earthlink. However, not all options are available throughout all these states; some may only have the option to order satellite or dial-up Internet. Earthlink also provides standalone DSL, allowing customers to opt out of telephone services.

The table below shows the cost of EarthLink's plans:

Provider	Type of Service	Business / Residential	Download Speeds (Mbps)	Upload Speeds (Mbps)	Cost/Month
EarthLink	DSL	Residential	3	UA	$40
EarthLink	DSL	Residential	6	UA	$45
EarthLink	DSL	Residential	7	UA	$50
EarthLink	DSL	Residential	15	UA	$55
EarthLink	Fiber	Residential	75	UA	$70
EarthLink	Fiber	Residential	100	UA	$80
EarthLink	Fiber	Residential	200	UA	$90
EarthLink	Fiber	Residential	1000	UA	$100

Rise Broadband

Rise Broadband (Rise). Rise, headquartered in Englewood, Colorado, is the nation's largest fixed wireless broadband service provider, delivering high-speed Internet and digital voice services to nearly 200,000 residential and commercial customers across 16 states. Rise's parent company, JAB Wireless, Inc., was incorporated in 2005 and previously operated as Skybeam, Digis, T6, Prairie iNet and Rhino Communications. All names were re-branded under the Rise name in 2015. Rise provides pricing discounts based on contract term length including installation discounts.

Download Speed	Cost/Month
25 Mbit/s	$80
50 Mbit/s	$90
100 Mbit/s	$100

HughesNet

Hughes Network Systems, LLC (formerly Hughes Communications) was founded in 1971. It is a wholly owned subsidiary of EchoStar (DirecTV). Hughes Network Systems is headquartered in Germantown, Maryland and provides a high-speed satellite internet service, HughesNet.

The key aspect that differentiates it and other satellite operators from terrestrial purveyors is not speed but data caps - how much data is allowed per month in a given plan. As you increase in service tiers, you pay more for more data.

Plan	Download Speed – Up To (Mbps)	Upload Speed – Up To (Mbps)	Cost/Month
Internet	25 (10GB cap)	3	$59.99
Internet	25 (20GB cap)	3	$69.99
Internet	25 (30GB cap)	3	$99.99

Internet	25 (50GB cap)	3	$149.99

ViaSat (formerly Exede)

ViaSat Inc. (formerly Exede) was founded in May 1986. It is based in Carlsbad, California, with additional operations across the United States and worldwide. In 2017, Exede was rebranded Viasat Internet. ViaSat is a provider of high-speed satellite broadband services and secure networking systems covering military and commercial markets.

The table below shows the cost of ViaSat's plans. Their plans have data caps in place.

Plan	Download Speed – Up To (Mbps)	Cost/Month
Bronze	12	$49.99
Silver	25	$69.99
Gold	50	$99.99

Fusion Connect

The table below shows the cost of Fusion's business plans:

Provider	Type of Service	Business / Residential	Download Speeds Low to High (Mbps)	Upload Speeds Low to High (Mbps)	Cost/Month Low to High
Fusion	DSL	Business	1.5 to 6.0	1.5 to 6.0	UA

Fusion, which has been in business since 1997, provides solutions for business customers. Over the years, it has brought together a number of voice, data, and cloud services companies. Fusion has fused these respected businesses into one technology provider that can offer customers a full and comprehensive suite of solutions.

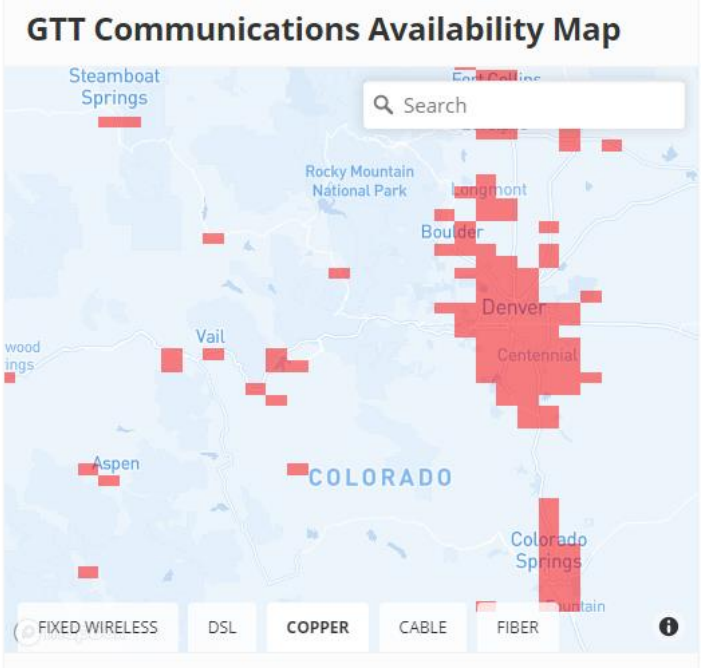
GTT Communications

GTT is a small telecommunications provider, only serving 1.61% of the United States. It is a DSL provider that uses existing legacy copper telephone lines. According to their website they offer download and upload speeds ranging from 1.5 mbps to 8 mbps. According to BroadbandNow, they offer some limited amount of businesses service in Douglas County.

The table below shows the cost of GTT Communications' business plans:

Provider	Type of Service	Business / Residential	Download Speeds (Mbps)	Upload Speeds (Mbps)	Cost/Month
GTT Communications	DSL	Business	20	12	UA

The following Availability Map shows there is some limited service in the area.



GTT Limited Business Service Around the Denver Metro Area

Neither public sources nor the GTT website offer any specific data on service offerings in Douglas County.

Forethought.net / San Isabel Telecom / Brainstorm Internet

Established a in 1995, Forethought.net provides internet services throughout Colorado and Northern New Mexico in the following locations:

- Denver: Littleton, Englewood
- Grand Junction / Mesa County: Fruita, Palisade, Collbran, DeBeque, Mesa
- Telluride / San Miguel County: Telluride Ski Ranches Association, Norwood, Placerville
- Durango / La Plata County: Mancos, Ignacio, Hesperus, Animas Valley, Cascade Village
- Silverton/San Juan County: Silverton – Anvil Mountain Apartments, Cascade Village
- Ouray County: Ouray
- Eagle County: Gypsum – Buckhorn, Gypsum – Chatfield, Gypsum – Airport Business Park, Dotsero, Eagle, Eagle – Castle Peak Ranch, **Avon**, Vail, Red Cliff, Lake County
- Leadville: Leadville – Railyard
- Lake County
- Teller County: Woodland Park, Cripple Creek
- New Mexico: Farmington, Aztec, Bloomfield

Forethought.net's stated mission is to "bring state-of-the-art communications to the rural mountain communities of Colorado." They have offices in Denver Grand Junction, Durango, and Eagle. They provide service through fiber, copper (DSL), fixed wireless, or LTE depending on location.

In 2019, Forethought announced they were chosen to provide fiber service to the Eagle Valley Library District to provide fiber-optic Internet service to the Libraries in Eagle and Gypsum. They announced they

were providing a "50 times speed increase to the libraries for less than half the price they are paying today for service from the incumbent."

In 2019, BroadbandNow recognized FORETHOUGHT.net as the "#1 Fastest Internet Provider in Colorado."

According to AllConnect.com, their plans are priced as follows:

Download Speed – Up To (Mbps)	Cost/Month
30	$40
100	$50
1000 (1 Gbps)	$70

A. Merger with San Isabel Telecom

As of April 2017, San Isabel Telecom, Inc. became a Forethought.net subsidiary. In 2004, San Isabel Telecom deployed one of the first FTTH systems in the County in Gypsum. It then built fiber networks to most areas in the Chatfield, Buckhorn, and Two Rivers areas in Gypsum.

B. Merger with Brainstorm Internet

Brainstorm Internet is a FORETHOUGHT.net company. It is a Colorado Internet provider serving the Four Corners, the Western Slope and the Front Range. Based out of Durango, Colorado, Brainstorm offers business and residential services ranging from DSL, wireless, and fiber broadband to cloud hosted PBX, web hosting and colocation. Founded in 1999, Brainstorm Internet currently serves over 11,000 customers, from Grand Junction, CO to Denver, CO to Farmington, NM.

Although public sources list Brainstorm internet as a service offering, their website states: "Brainstorm DSL is available in Downtown Durango, Hillcrest, Skyridge, Durango West II, and Rockwood. We also offer Brainstorm DSL in downtown Grand Junction." Similarly, business service "is available out of the Durango, Bayfield, Cortez, and Grand Junction wire centers in Colorado and the Farmington wire center in New Mexico. For service outside of these areas in the states of Colorado and New Mexico please contact us for a custom quote."

So it appears that the data on BroadbandNow about Brainstorm's residential service offerings is not accurate. It is likely that for any of those offerings, they would offer service directly through Forethought.net.

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Chapter 3: Public Community Survey

Introduction

The initial step of the Study was the development and implementation of a community engagement program (for full Engagement Plan, see **Appendix A**). Since the available data on broadband speeds and coverage is known to be poorly representative of the reality of broadband in many locations, a public broadband survey was launched to the public to facilitate full understanding of the broadband situation in Douglas County. This survey of residents and business owners helps decision makers better understand community needs. The large-scale statistically significant public survey asked questions to determine the community's internet services, usage patterns, current market conditions and deficiencies, and desire for improved service in the community. Identifying questions were also asked about the household composition and demographic information. Some of the questions asked what is important to them personally, what do they value about communications services, and what is important to the community; and, most importantly, what they think the County should do. The survey garnered 1033 residential responses. For the full list of survey questions, please see **Appendix B.**

These findings help to illustrate the conditions today and indicate a need for more robust broadband services in some areas of the County. Identification of needs in the survey results will facilitate the development of network model alternatives that may be helpful to mitigate some of the most significant gaps between the community's capabilities and needs. The questions relating to the community's broadband vision will facilitate an understanding of what role Douglas County could take in facilitating broadband service.

Survey Findings

Urban Areas are Well-Served, while Rural and Remote Areas are Likely to Be Unserved or Underserved

The following map shows the distribution of survey results by download speed in Douglas County. Please note that all of the survey results are analyzed in charting survey results, while the map data may have

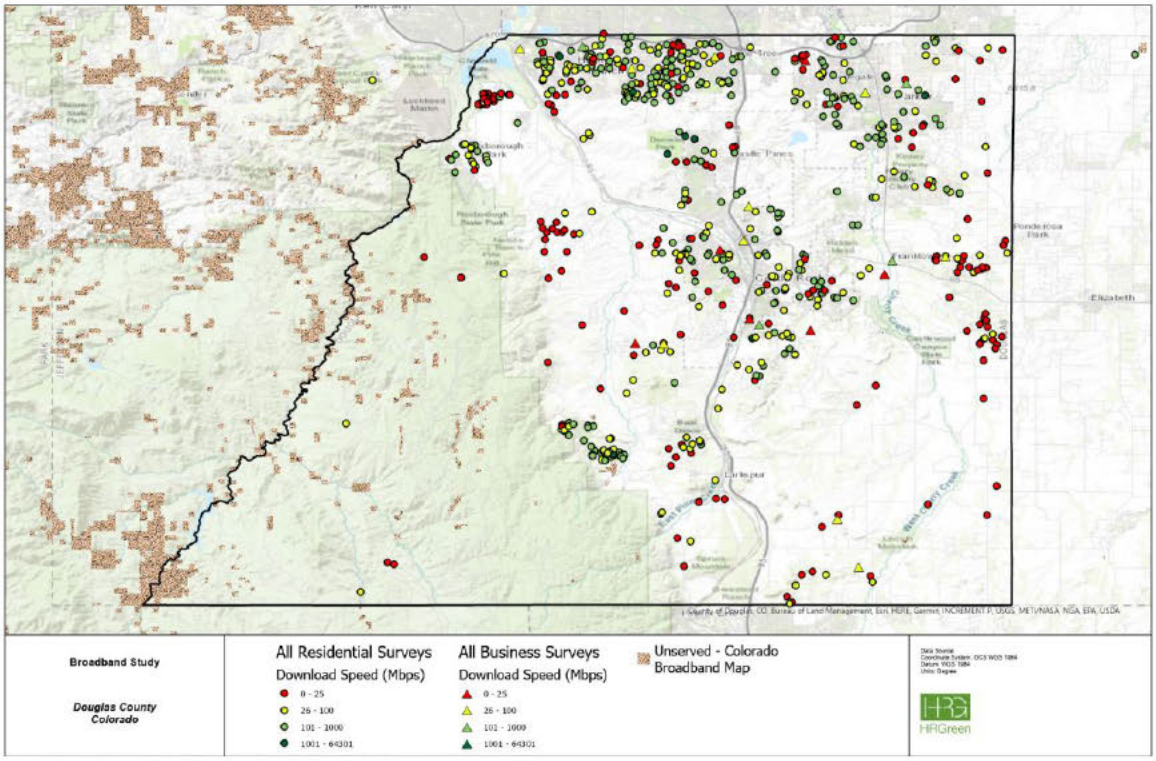

Figure 4: Survey Results by Data Rate

geocoding outliers due to technical or user errors. When measured against the federal definition of Broadband, the residents of Douglas County report significant gaps. The survey respondents were asked to take a speed test through an online tool and report their actual speeds. While this method is reliant on variables such as the quality of in-home networking equipment, the results are generally accurate to show actual speed of service received, if not precise to the Mbps level.

Since it is a relatively large County, the companies providing internet service are numerous, with some providing service to select locations. Overall, Comcast is the primary internet service provider in the County with more than half of all service subscriptions, followed by CenturyLink serving about a quarter of the survey respondents.

Below is a map of the distribution of respondents' providers.

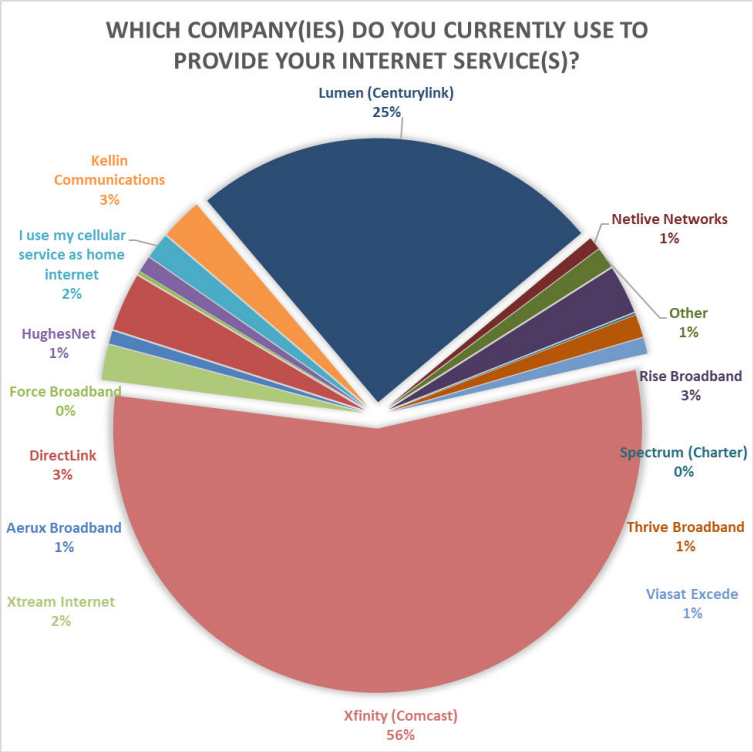

Figure 5: Internet Service Providers of Survey Respondents

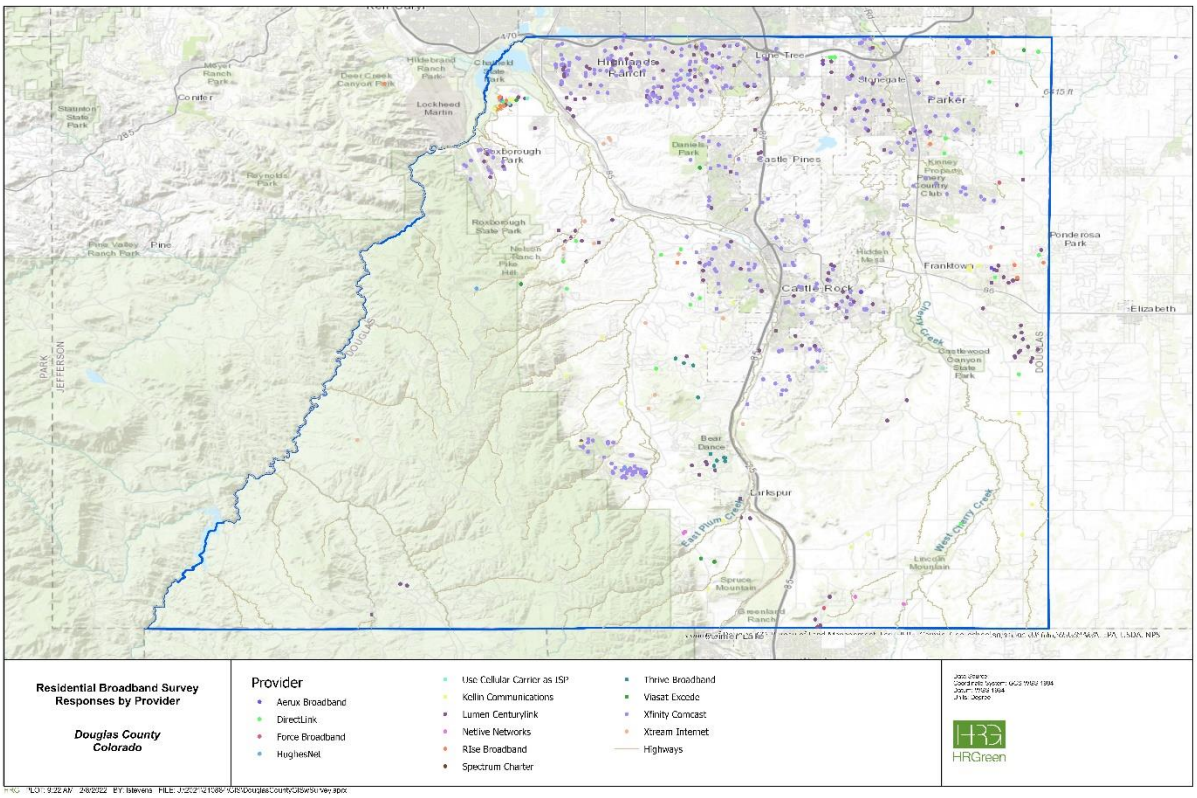

Figure 6: Internet Service by Provider

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Survey respondents were also asked about the likelihood of them recommending their service provider to a friend or colleague. The majority of respondents indicated they were neutral, with a total of thirty-eight (38%) saying they were likely or very likely to recommend the service and thirty (30%) saying they were unlikely or very unlikely to recommend.

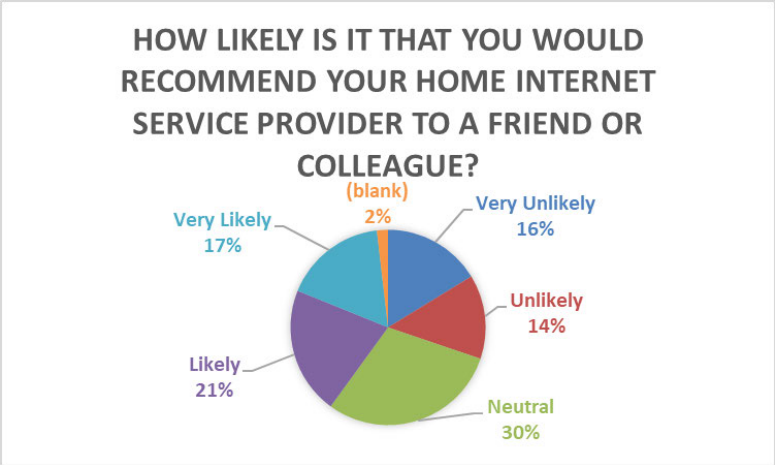

Figure 7: Likelihood to Recommend ISP

In addition, the following map demonstrates the overall satisfaction level of residents with their service.

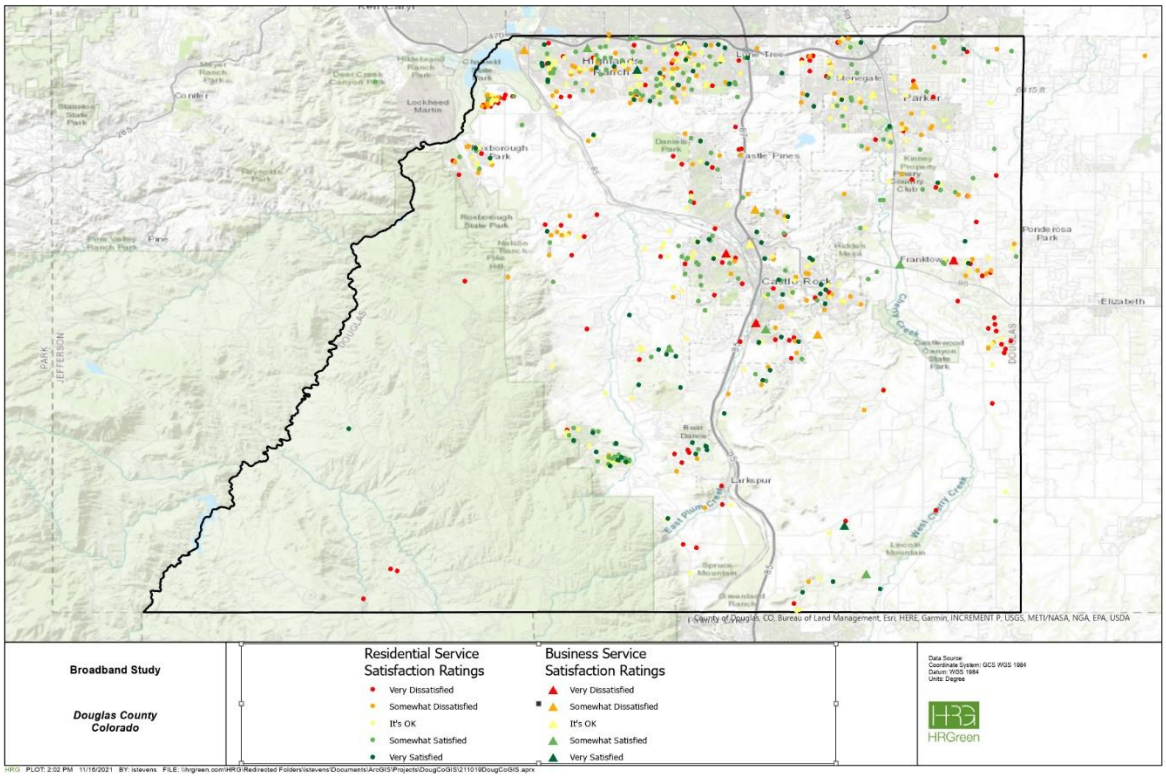

Figure 8: Satisfaction with Providers

As may be expected, the map shows that areas with lower speeds produce generally lower over satisfaction with the internet service provider; but more surprisingly, it also shows that customers in urban areas can have lower satisfaction rates as well.

Another survey question relates to whether dissatisfaction with internet service can incentivize residents to move to a different area, with the majority indicating no, but some answering that maybe or yes, they have considered moving as a result.

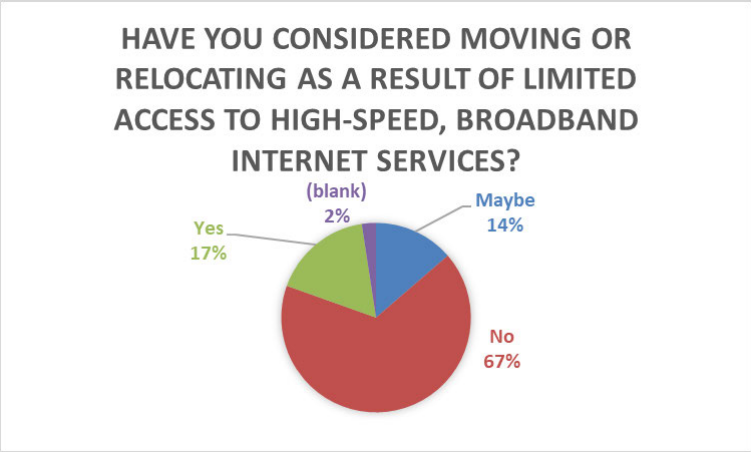

Figure 9: Likelihood of Moving Due to Internet Service Quality

Usage

Aggregated by the number of mentions, the usage statistics for the County's residents include a variety of internet applications, the most common ones being email, social media, and streaming. Those who work full or part time from home are approximately 9% of the responses, while telehealth and online education is approximately 7% of internet usage.

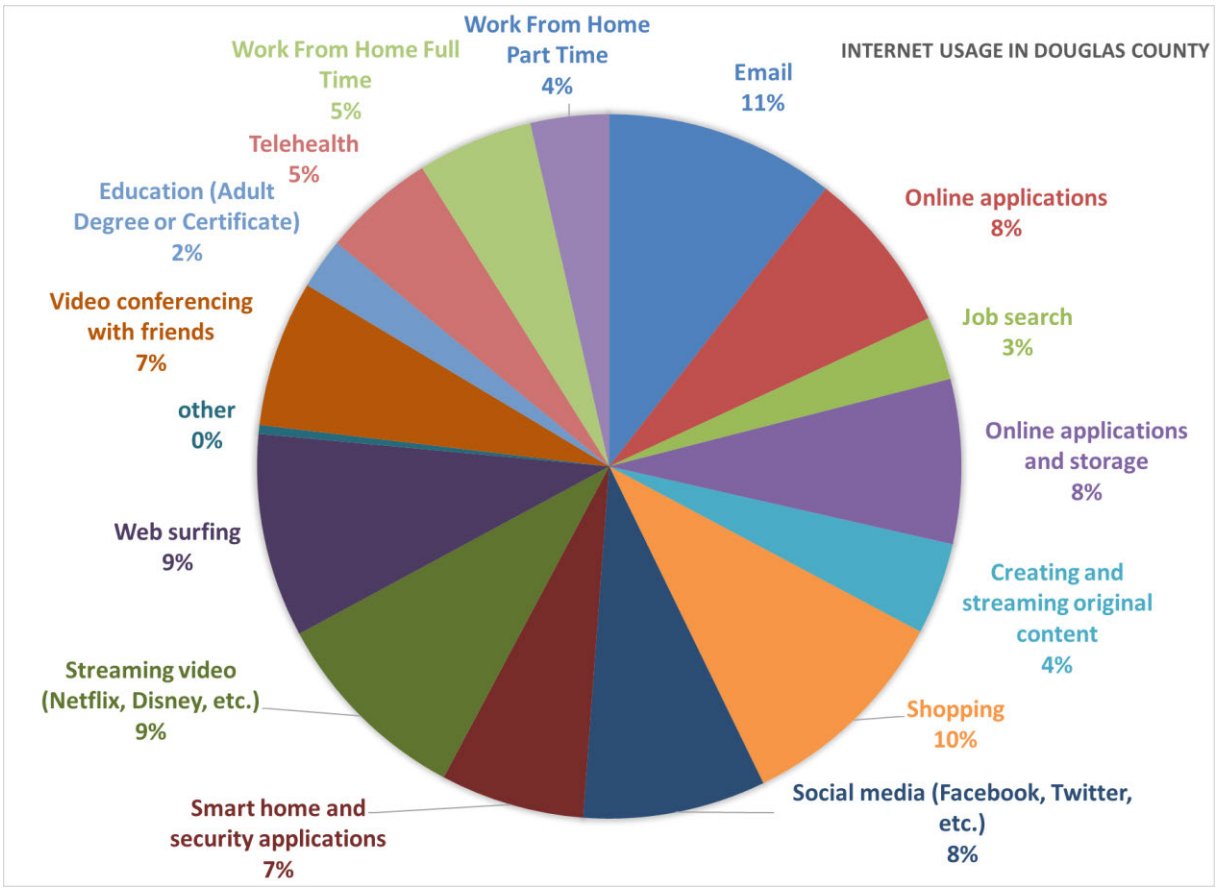

Figure 10: Usage of Internet Applications

In another question (Figure 10), respondents were asked if anyone in their home is currently working work home or running a business. This question is a reflection of the remote work culture instigated by the

pandemic, and if this question was asked pre-pandemic, the results would not have likely included close to three-quarters of the respondents answering "yes".

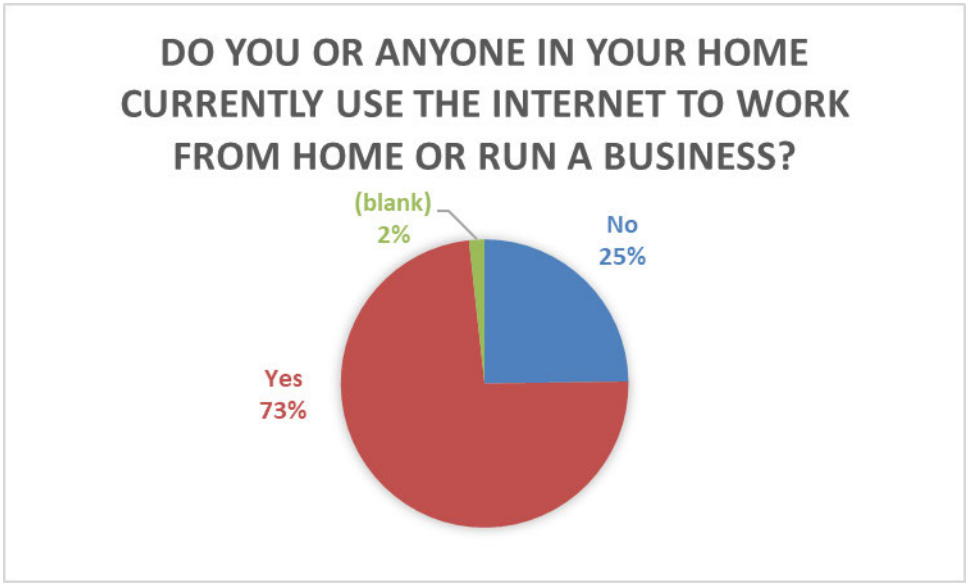

Figure 11: Work from Home Statistics

Service Interruptions are Manageable in Douglas County

Many survey respondents indicated that service interruptions are not relatively common. Eight (8%) of residential service subscribers have outages for an hour or less a month. A significant percentage, fifty-four (54%) of residential service subscribers have experienced an outage for an hour or less a week, with nineteen (19%) experiencing them more than one hour or less a day, and five (5%) experiencing an outages more frequently than 1 hour per day.

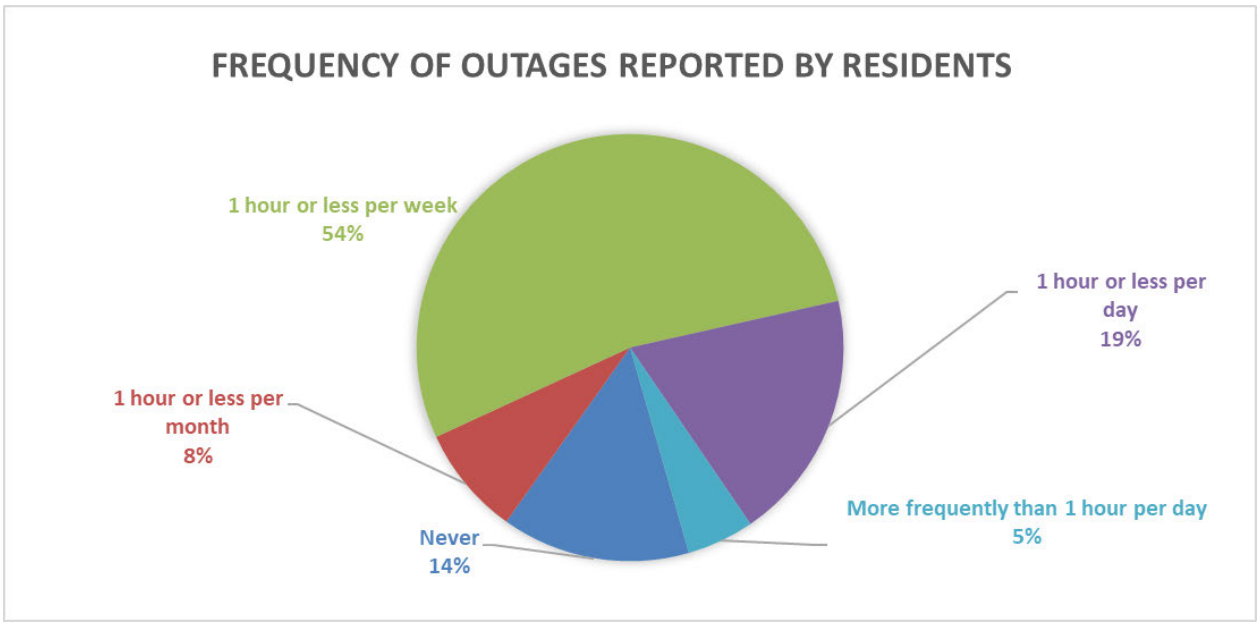

Figure 12: Frequency of Outages

Satisfaction vs Importance of Service Categories

The colored bar graphs in Figure 12 shows level of satisfaction in each of the following service categories (data rate, reliability, price, data allowance, customer service), the lighter teal blue color is very satisfied in the category. Most respondents feel "ok" about these categories. Note that price is a concern for the respondents as is shown by the width of very dissatisfied.

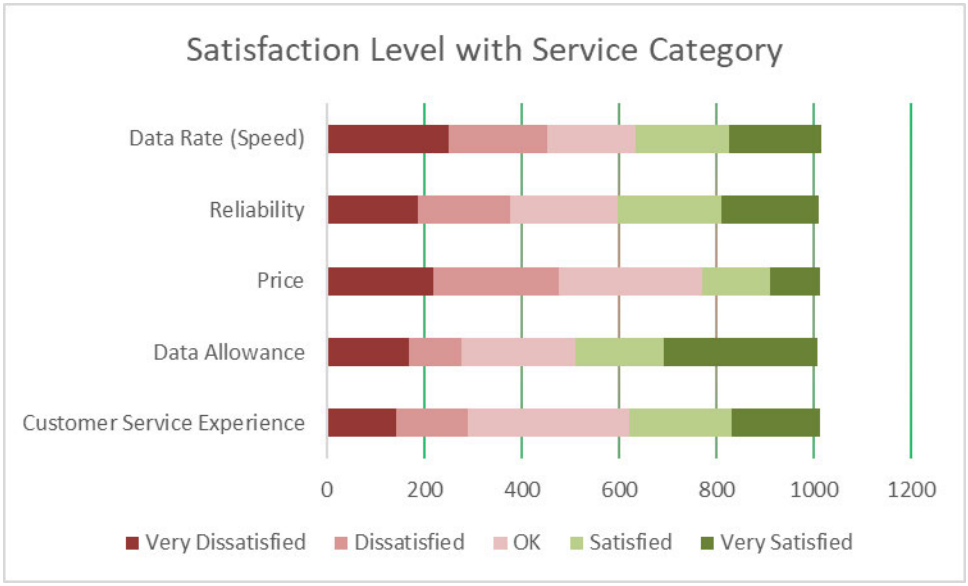

Figure 13: Satisfaction Level with Service Category

Figure 14 shows how important the service category is to the individual respondents. Here, the lighter teal color shows a service category is very important to an individual respondent. In rank order, the perceived importance is in the following order: reliability, data rate, data allowance, price, and customer service. These perceived importance rankings show that respondents have relatively reliable service, and the cost of said service is in line with their willingness to pay.

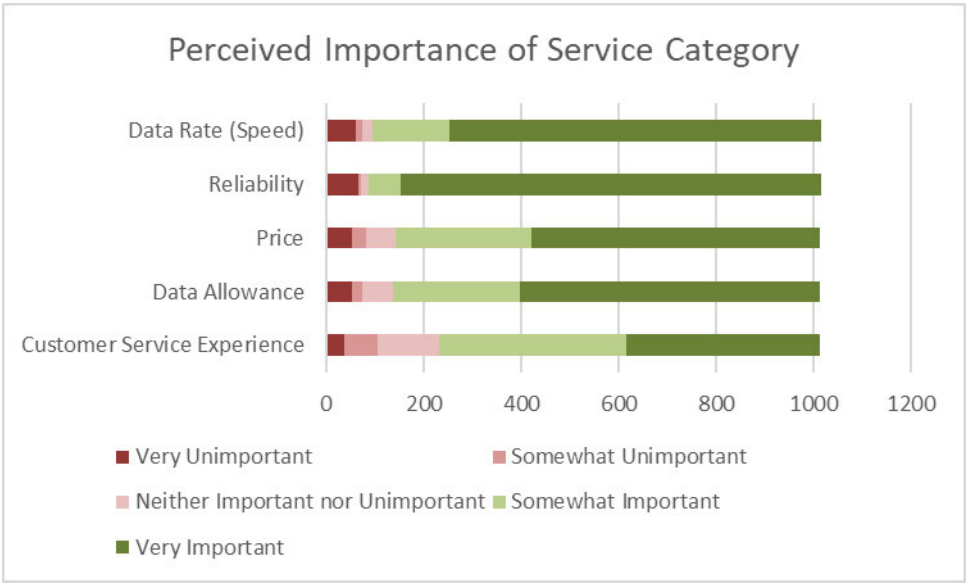

Figure 14: Importance per Service Category

Demographics of Respondents

Figures 15 through 18 provide a visual representation of the respondents' demographics. The respondents are characterized by a slight lean toward male respondents and a relatively even distribution of ages, although most were over the age of 35 years old. The income reported was household income and not an individual's income. The relatively high income of the respondents is likely a selection bias of broadband users; that is, higher income bracket workers are typically concerned with quality connectivity as they likely use broadband for their jobs and are typically power users of the latest technologies. Similarly, the majority of the respondents have a higher education. Typically, higher education and higher income are correlated and this distribution is intuitive, the higher educated are also typically more concerned with being connected and more likely to leverage current technologies.

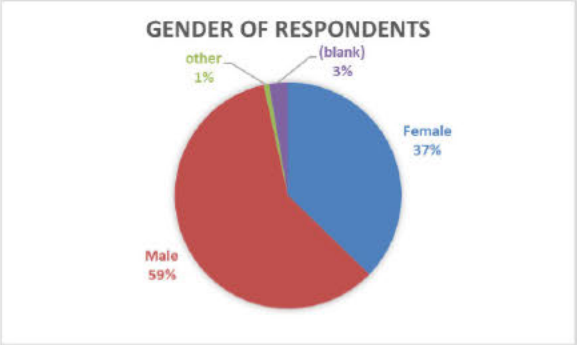

Figure 15: Gender of Respondents

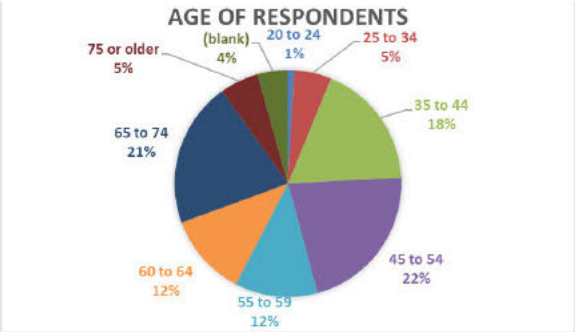

Figure 16: Age of Respondents

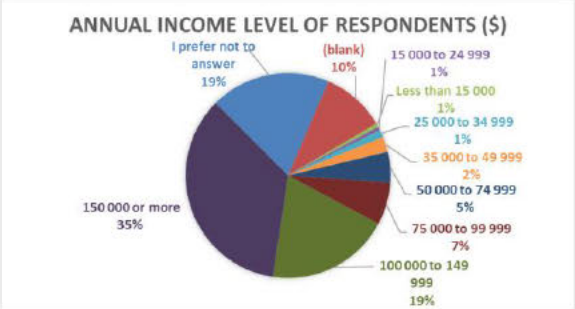

Figure 17: Income Level of Respondents

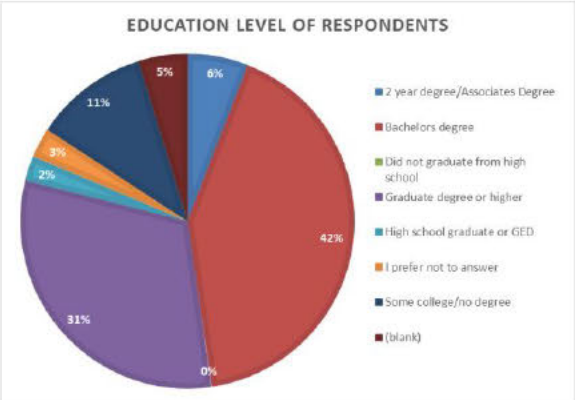

Figure 18: Education Level of Respondents

Level of Support for Community Involvement to Facilitate Broadband Service

Survey respondents were questioned to determine their support for public action to promote broadband service for their community. Ninety-three (93%) of respondents consider internet to be an essential public infrastructure consider Internet as an essential utility like electricity, water, and transportation.

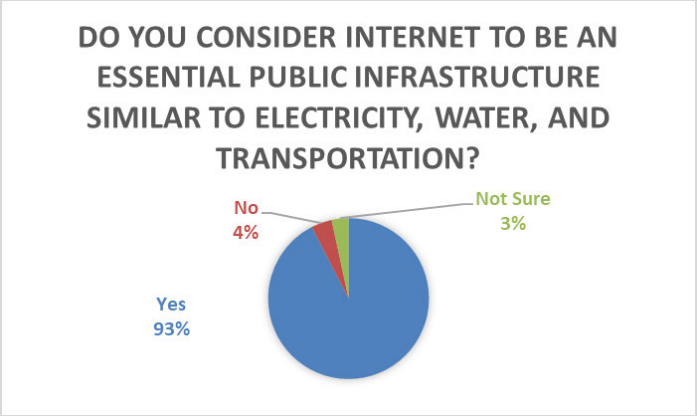

Figure 19: Internet as an Essential Infrastructure

In relation to the priorities that have moved online during the pandemic, respondents were asked about the importance they place on broadband services supporting remote work, health care, and education in the community, with the following results:

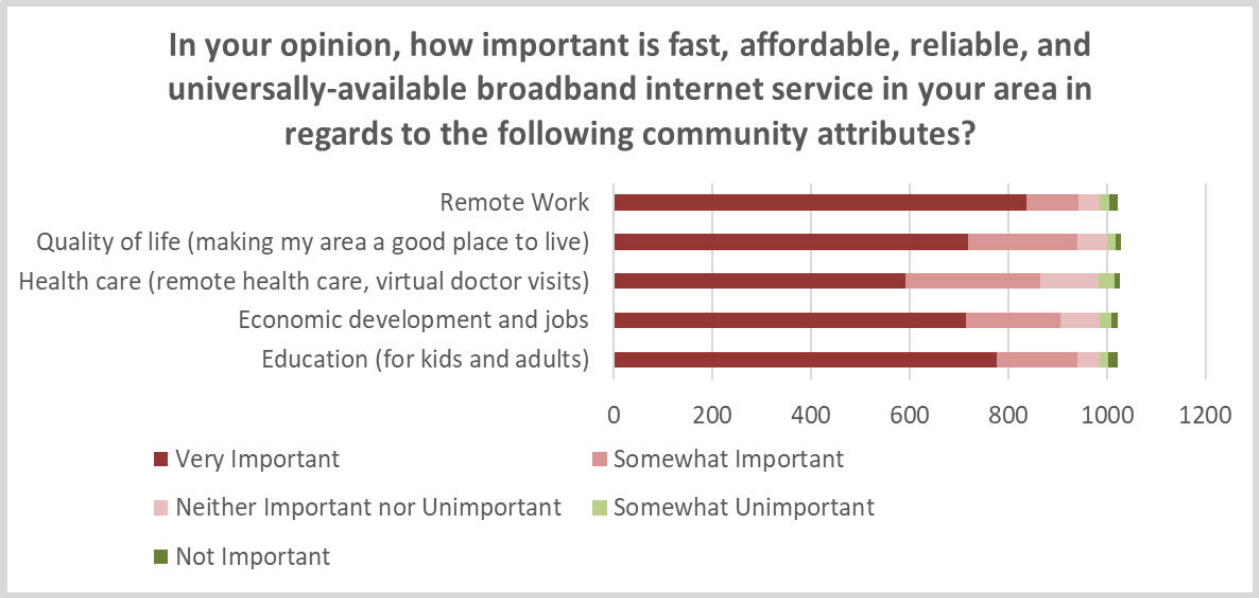

Figure 20: ISP Community Attributes

These results indicate that the community strongly believes that those community attributes are very important or somewhat important, and when asked how well providers are meeting these needs, approximately 47% of respondents indicated that they met the bare minimum or not at all.

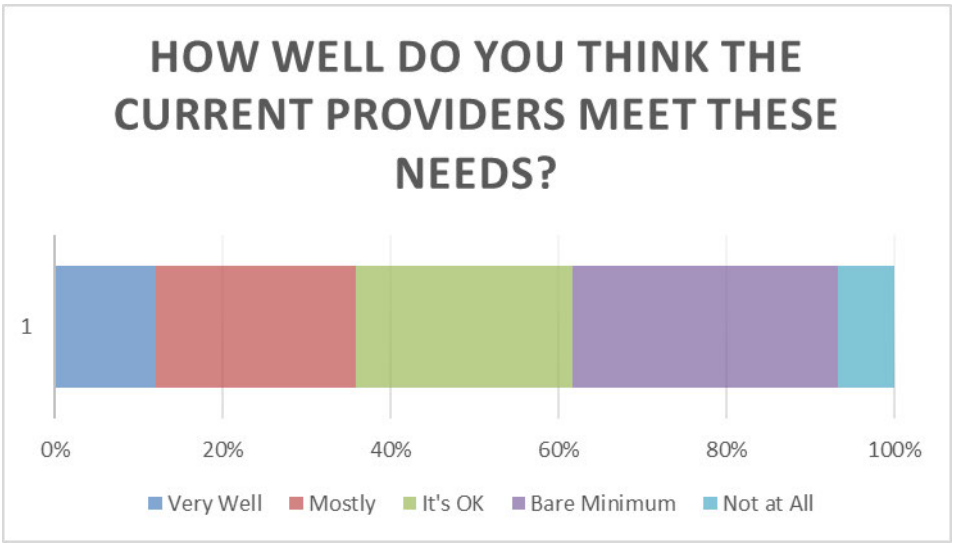

Figure 21: Rate of Current Providers Meeting Community Needs

In taking potential action to facilitate better broadband, most of the respondents indicated that they felt the County should take action. Furthermore, more than half of the respondents would participate in an organized effort led by their neighborhood to improve broadband service, with some being not sure, depending on time and resources required.

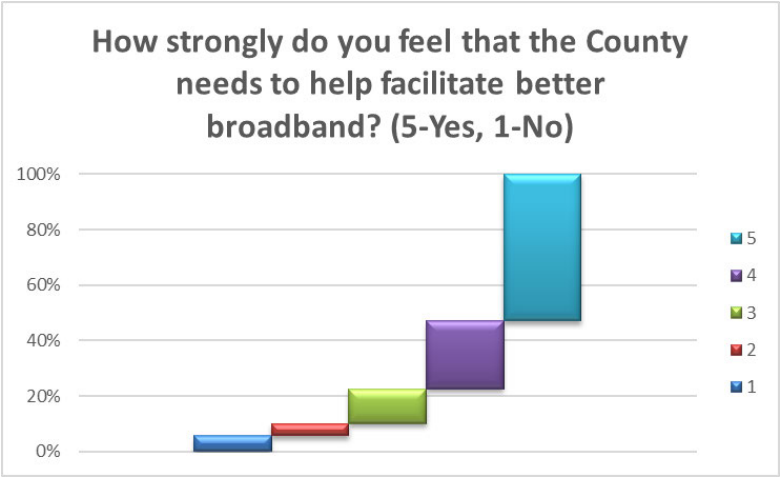

Figure 22: Desire for County to Facilitate Broadband

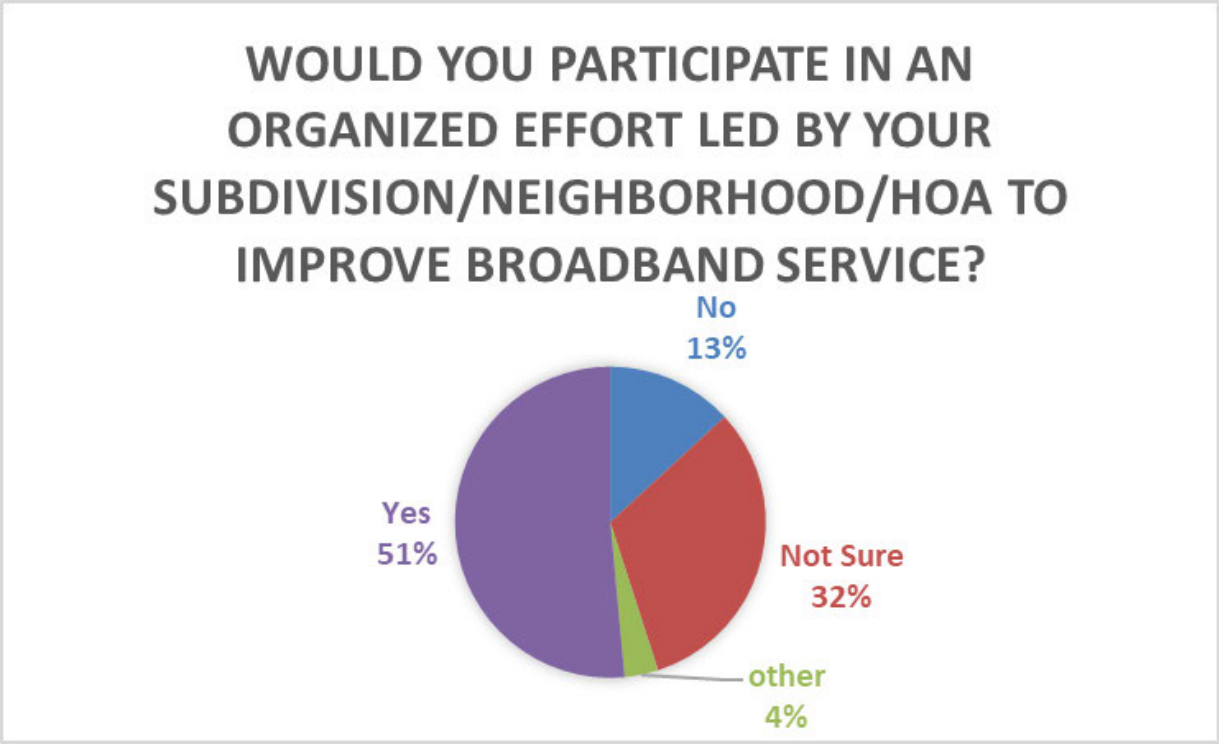

Figure 23: Support for Neighborhood Broadband Action

Survey Findings

- If a resident or business is in an area of population concentration – the odds are better that they will have a decent option, probably through Comcast or CenturyLink
- Rural and remote areas can have adequate service, but many are dependent on copper DSL, fixed wireless, or satellite – services that are not meeting their bandwidth or reliability needs.
- A segment of the population wants further County or neighborhood-level public involvement to help facilitate broadband service.

The creation of digital "haves" and "have nots" is commonly referred to as the digital divide. If there is good connectivity in one area, but not another, then those with better broadband have greater opportunity for economic development, higher home sale prices, health care, more diverse jobs, etc. In Douglas County, the more remote rural areas are not as well served by providers, but urban areas are generally adequately served by a marketplace of providers. Resident satisfaction rates about their internet service indicate that many in urban areas are still not satisfied with their service. This finding is relatively suprising as providers tend to have better service in more population dense areas. However, due to bandwidth limitations for non-fiber technologies and the potentially high cost of service for some residents result in a significant threshold of poor service in the most populated areas of the County as well as rural.

Chapter 4: Public Stakeholders Outreach

Introduction

The public engagement campaign in Douglas County involved individual and group interviews with stakeholder organizations identified in the Outreach Plan (Appendix A). Identified stakeholders included representatives from organizations that represent community groups and municipal entities that are large consumers of broadband services in the County. Due to the County's centralized business parks and sprawling residential neighborhoods and developments, HR Green interviewed Homeowner Associations (HOAs), Chambers of Commerce, and Economic Development Districts (EDCs). To better understand the utilization of broadband by County public service and anchor institutions, interviews focused on current broadband use and future plans of cities within the County and groups such as emergency response organizations, parks and recreation services, libraries, and other public sector entities. Internet Service Providers (ISPs) were interviewed as well to gain an understanding of each provider's network services offered within the County, including the extent of coverage, technology base, and offered customer plans.

Feedback by Stakeholder Group

Providers:

A. Comcast

Comcast is the franchise cable holder in Douglas County. They provide service in all locations where they have an obligation is to build to meet residential density. They serve about 4000 residents in Douglas County with a hybrid fiber coax network, particularly in Castle Pines, Highlands Ranch, and Castle Rock. They also serve some unincorporated areas where there is enough population density like Perry Park. Any new household within their service region can be connected in an average of 7 days.

They provide up to 100 Gbps symmetrical service for businesses and over 1 Gbps for residents after updates to their network were completed in April 2021; they are also upgrading to 3 Gbps in some residential areas, and potential 10 Gbps service when the next generation standard is officially rolled out. Their plans are consistent across Douglas County, and promotional pricing is available as well.

Comcast does not typically upgrade existing brownfield developments, but enters into greenfield, new residential, communities when construction is taking place. They prefer to engage in exclusive agreements with developers before construction, recuperate construction deficit costs from HOAs, and take advantage of any joint trenching and colocation opportunities that exist, but do not participate in open access network agreements or public-private partnerships. If a district is pursuing undergrounding requirements and construction, Comcast would participate in joint trench builds.

Part of the difficulty in retrofitting existing properties is the need for mapping of underground utilities which requires extensive potholing. Another issue is the expense of boring in the rocky mountains and plains of Colorado. If there was more certainty about existing placements and construction standards, combined with bulk permitting, those costs could be avoided, and they would be more likely to build in existing neighborhoods.

B. Lumen (CenturyLink)

Lumen provides a hybrid copper-fiber network internet service. In areas where fiber is available, it can provide 940 Mbps symmetrical service. In Castle Rock, they plan to connect at least 200 more homes and are currently pursuing financing for the project. Regionally, Lumen is currently engaging in an extensive build in Denver over the next 5 years with 200,000 homes planned to be connected. When it is completed, Quantum Fiber will be the brand known for their fiber product.

CenturyLink can be more open than its competitors to engage in open access network agreements or public private partnerships. In some areas, they engaged in a municipal fiber build and now lease the lines from

them. However, they've found that historically, most municipal open access networks are built where they are not needed, that is, they do not facilitate the last mile that actually supplies needed residential service. If a County is willing to place infrastructure where the network has gaps, it would be more helpful.

C. Mountain View Electric Association (MVEA)

In 2021, MVEA announced that they will be building out fiber to their entire customer footprint. Building the fiber not only creates internet service for unserved and underserved areas, but also facilitates their Smart Grid operations. Over 90% of MVEA customers are located in El Paso County, but approximately 1300 members in live to the north, in Douglas County. It is planned to be a 5-year project, but they have put some plans on hold, waiting to hear about potential Federal grant opportunities.

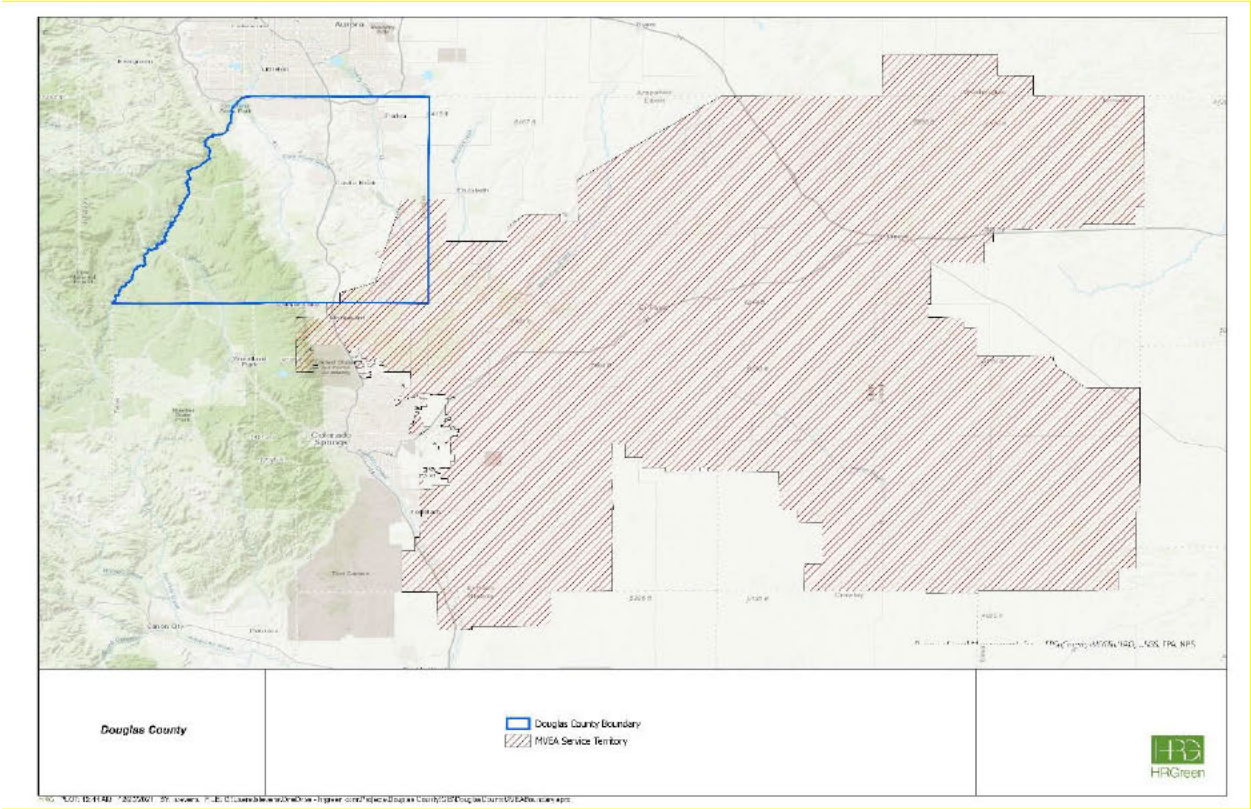

Figure 24: MVEA Utility Footprint

In Douglas County, MVEA indicated that the residents in their Electric Service Area (see Figure 21) will be connected to the ubiquitous, planned build. While MVEA hasn't finalized their buildout plan, it appears that MVEA's planned build will provide a significant improvement in speeds in its ESA. MVEA indicated that the availability of grant funding will guide its planning, so a County grant program may enable residents and businesses in this ESA to receive connectivity on the front end of their planned, five-year build.

The network will supply up to 2 Gbps symmetrical speeds to residential customers, with lower tier plans of 100 Mbps and 1 Gbps. Other carriers will be welcome to lease excess capacity. Thrive Broadband offers a fiber to the home or business multigigabit service and fixed wireless service. Within Douglas County, the network spans the South Castle Rock and Larkspur area, and is planned to expand to nearby areas. Expansion plans include Franktown, which currently only has DSL service. They have known success in overbuilding DSL, with at least a 35% take rate by customers. West Creek is another potential area of expansion as well. They also offer service in Denver, but not in El Paso County because of the notable competition from Mountain View Electric and the contractor responsible for their network design and construction ,Underline. The company considers themselves as a regional provider, and perhaps the only tier 2 regional fiber provider in Douglas County, except for CenturyLink and Comcast. Their plans include $75 for 50 Mbps, $180 for 1

Gbps, and $60 for 25-50 Mbps depending on the area. All offerings are symmetrical, and some areas have subsidized pricing, including a plan for 1 Gpbs for $89 per month and 2 Gbps for $125 a month.

Thrive would be willing to supply more information on their network footprint depending on the data's use and nondisclosure considerations. The company would be interested in partnering with the County to deliver service where the County has identified need. They have engaged in similar public private partnerships in Texas, where they build an open access middle mile network for a consortium of 12 counties.

D. Xtream Internet

Xtream is a Wireless Internet Service Provider. Relatively new, it started about 4 years ago by providing service to a 20-mile area centered on Castle Rock, as well as remote areas of Larkspur, and East Parker. They primarily concentrate service offerings on rural areas in Douglas County, particularly south of Highlands Ranch, but also provide service in Gunnison County, where instead of their typical wireless unlicensed (2.4/5 Ghz, 60 Ghz) and licensed (11 Ghz) frequencies, they've built some fiber. In the next 5 years, they plan to expand to other counties, including El Paso. Their plans include 20 Mbps symmetrical for $89 per month and 40 Mbps symmetrical for $129 per month.

About 10% of current customers in two communities are having their speeds increased from 40/40 Mbps to 60/60 Mbps and 60/60 Mbps to 100/100 Mbps without a change in price. The topography of an area determines the technology. Fixed wireless is useful in many places, but in a mountainous bowl that is heavily treed, direct wireless would be replaced with a hybrid solution delivering wireless backhaul and extending to each household through telephone pole fiber infrastructure.

The company would be interested in working with the County to expend service to any rural area, and willing to share their network topography map if necessary. The area around Castle Rock is of particular interest, but it can be difficult to know where there is further demand. Any funding support would be helpful, for example – in an isolated community with no service, as small of an influx of funds as $20,000 would make a difference in being able to deliver service. For gigabit speeds to communities with 2 acre lots, that number climbs to about $50,000, and to build fiber to a neighborhood is approximately half to a million dollars.

Cities:

HR Green interviewed major cities within Douglas County, including Castle Rock, Castle Pines, Larkspur, Lone Tree, and Parker.

A. Castle Rock

Castle Rock reports that they rarely experience concerns expressed by their citizens regarding broadband through their tracking system. Complaints about cellular coverage are much more common. They pay approximately $30,000 a year for fiber leasing contracts with Comcast and CenturyLink. They consider connectivity relatively good and do not have a telecommunications plan for the future. The City owns 20 miles of fiber, mostly to connect 9 facilities and about 75% of their traffic signals. They also have an agreement with CDOT for fiber.

B. Castle Pines

Castle Pines has mixed quality of service throughout the City's footprint. Comcast and CenturyLink provide service for approximately 40% of the residents, and claim they have upgraded to the best technology available with the current backhaul capacity supporting their networks. The City mentioned the need for more conduit to support greater backhaul and middle mile networks for both improved commercial broadband service and internal traffic management and monitoring uses. They are also looking to extend WiFi to public places such as parks.

Internal City departments rely on a lease of 1 fiber line from Comcast for approximately 400-600 Mbps service for $153 a month with a two year contract. The current trends indicate they will need more capacity in the future, and are looking for new partnerships, potentially with some of the new regional broadband companies.

C. Larkspur

Larkspur is a very small municipality of approximately 200 residents. The sole provider in the Town is Comcast, and there are spotty services available from CenturyLink. Comcast has a very large base in the Town and they have coax near or to most households. However, because the Town is so small, the company does not seem to have any plans for further investment.

The town's IT is outsourced to a small contractor in Monument. Download speed is 60 to 80 Mbps, but upload speed is 3 Mbps. Services are being delivered over coax. The Town's Internet services are bundled with their cable services with the bill totaling $376.45 per month. Of that amount, the Town pays $149.95 for 75 Mbps Business Internet and $24.95 for 5 statis IPs. The remaining amount is for VoIP and cable services.

The Mayor's primary concern is around the physical security of town facilities, particularly the Town Hall. It's not clear if Comcast provides enough bandwidth to support the security cameras around the Town Hall, but the footage is currently unreliable. The Town could potentially use CenturyLink as a redundant service, but it is not in the plan today.

The Town would be interested in participating in discussions with the County regarding broadband services. Internet is being viewed as a utility and it is becoming a core utility. It is becoming just as important as gas, water, and electricity. There is a dependency, not just at the Town Hall, for reliable Internet, but for every business and resident. For example, they implemented an online service for the Renaissance Festival vendors to pay the sales taxes online. It turns out that there are no Internet services available at the site of the festival, which is on private property. They expect such cloud services and data needs to grow in the future. While the Town does not have the staff to manage the providing of Internet services, if it received funding, it could probably provide broadband service to other entities that may enable the support of additional staff to maintain the network.

D. Lone Tree

Lone Tree is served by Comcast with a reliable uptime of around 99.8%. The municipal building receives 100 Mbps service for $1,780.00/month (this includes other services – Internet alone is $1,170/month). The City is working with Comcast to increase the bandwidth of the pipe at the municipal building from 100Mbps to 1 Gbps at a cost of an additional $240 per month. They have a 3-year contract, renewed in 10/2021. For the upgrade to 1 Gbps bandwidth, Comcast is going to extend the contract from a 3-year term to a 5-year term to lower the monthly cost.

Lone Tree uses CenturyLink voice services, but the City recently transitioned to Zoom. Today, the majority is softphones. They are moving their audio and video services off premises.

The Arts Center is also using a 30 Mbps pipe from Comcast. The City would like to increase the bandwidth at the Arts Center to between 200 Mbps to 500 Mbps, but unfortunately, due to declines in sales tax revenue, the City cannot increase the bandwidth at the Arts Center at this time.

Currently, the City might not be interested in finding a new provider because their internet services are very robust and would not need changing. One of the City's concerns is how participating with the County would impact their current contracts with private sector providers. Also, decisions such as participating with the County are made by the City's executive and political leadership. However, in the long run, if services can be improved and prices reduced then the City might be interested.

All City services are currently on premise but looking at going to cloud based services. In order to go to the cloud, the City needs a more robust and higher-speed network then they have today. They are looking at sending their virtualized environment into the cloud that would reduce their physical on-premises IT footprint. This would lead to accessibility from anywhere. This would also lead to improved reliability, sustainability, maintainability, and disaster recovery.

E. Parker

Parker has 6 strands of fiber that interconnects most of their facilities and approximately 95% of the City's traffic signals through 30 linear miles of conduit. They receive 1 Gbps service on their intranet. The City is well served with few complaints and no plans for internet projects. Internally, they have no further need for internet service and do not expect to make it an area of focus in the future. Residents are known to take independent action on improving services; for example, residents pay a $5 monthly fee to IREA/CORE for their streetlights, and can implement a similar strategy for any further future needs.

Homeowner Associations (HOAs)/Neighborhoods:

A. Lumiere Fiber in Sterling Ranch

The fiber project in the Sterling Ranch Development was initially approved in 2011 and began in 2013 to connect 600 units. The total buildout is projected to cover 12,050 homes on 3,400 acres over the 20-year lifecycle of the project.

The impetus for the project was the recognition that fiber infrastructure is the future-proof technology that will guarantee the latest technological upgrades to maximize lifestyle convenience and online opportunities. Maintaining control of the network was important to the community because it could be guaranteed to support the high-tech applications planned for the homes in the development, remain in control of the development's residents, and retain independence from large commercial providers to resolve any

connectivity issues. The community plans to use the robust Fiber-to-the-Home network for emerging technologies like 5G and other forward-looking applications. Most of the new homes in the community have a strong technological base, including solar panels on the roof, water and energy consumption meters, irrigation controllers, streetlight system management, and more planned in the future.

[redacted]

The Sterling Ranch fiber project serves as in interesting case study for the rest of Douglas County. The County's residential neighborhoods are generally organized around developments such as Sterling Ranch and may have the same opportunities to leverage their strategies. [redacted] Secondly, the project benefits from colocation partnerships with the local electricity and gas service provider, [redacted]

[redacted]

The community would be interested in working with Douglas County on currently planned fiber expansion projects as well as new projects to extend fiber in areas adjacent to the development through combining resources such as federal grants and funding available from the HOAs.

B. Highlands Ranch Metropolitan District

Lumen (CenturyLink) is the service provider for Highlands Ranch Metropolitan District (HRMD). The services are not meeting their needs and they will be switching to Comcast in 2022. Currently, they receive approximately 300 Mbps and are looking to switch to a 1 Gbps service for about the same price from Comcast. Outages with CenturyLink have not been a regularly occurring problem, but it has occasionally happened due to weather events, power outages, and cars running into poles and pedestals. The customer service has also been found lacking.

Their current network connection is fed into the main building, which also hosts their data center, and then continues to the parks and recreation facility, the water plant, and the wastewater facility. The HRMD Mansion is on its own Comcast connection, which is adequate and will not be upgraded. The District is also in the process of planning a new Senior Center, which may be included on the same circuit as well.

The District uses bandwidth for several data intensive applications, including its asset management system for water and wastewater, and soon by the Parks Department. The Centennial Water and Sanitation District, which is part of HRMD, already uses a system called CityWorks that enables remote access, job tracking, data entry, etc. The District also has SCADA system that are independent from the CityWorks system. Access to the SCADA systems is through Verizon cellular services today. They may consider upgrading that wireless system to a priority service, such as CBRS. In addition, VoIP and Zoom systems are being used today and will continue to be heavily used by the District going forward, hopefully also for streaming live video of Commissioner public meetings.

The District notably receives lease revenues for cellular macro sites that are on their property from providers for about $900,000 per year. They also charge processing fees by parcel for easements through the property footprint that is located next to the County owned rights-of-way. Over the years, they have provided a lot of

easements to Comcast, CenturyLink, Zayo, and Verizon. The District uses these funds for maintenance projects.

The following map highlights the HRMD HOA location within Douglas County. For reference, the map also shows the other county HOAs as well.

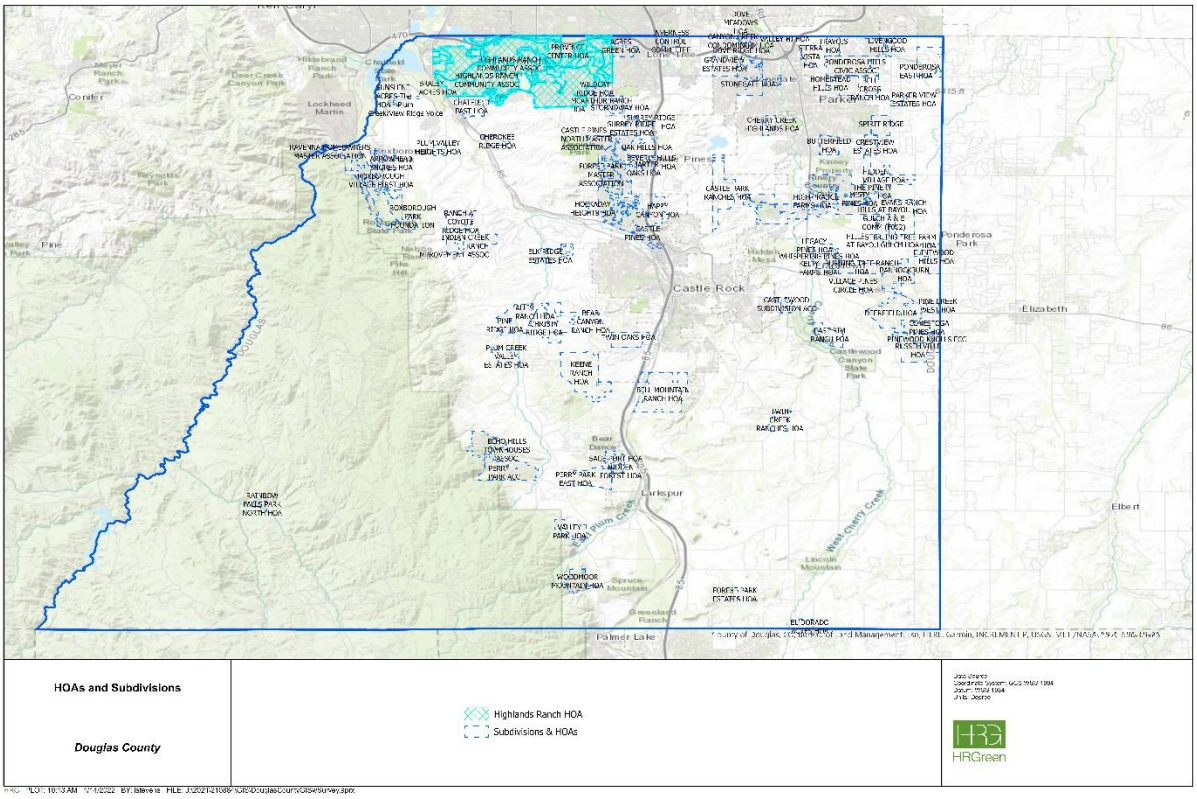

Figure 26: HRCA HOA and other HOAs in Douglas County

The District would be interested in having conversations with the County regarding the County's plan concerning fiber, conduit, and services with the understanding that the County is not interested in competing with the private sector but being more of a facilitator. They would like to receive a copy of the study and the broadband survey map when it is completed, if possible.

Utilities:

A. IREA/CORE

IREA, recently renamed CORE, provides electric utility service to most of Douglas County and the surrounding counties. It is a historical cooperative, not an investor-owned utility, that serves approximately 170,000 customers. When asked about potential plans for telecommunications service, the organization has no plans to invest in any consumer service. Any fiber they install is for internal operational use only. Their focus is more centered on investing in solar power and fire mitigation technologies than internet services.

They consider the broadband service plans of the neighboring electricity provider, Mountain View Electric, discussed earlier in this chapter, as ambitious. Due to their cooperative status, they are way of a broadband service potentially becoming a for-profit business line. They engage in pole attachment services for private providers as their primary way to facilitate fiber deployment.

Parks and Recreation:

The forest service has an office in Franktown that is responsible with managing open space, outreach and education, wildfire mitigation, and emergency response. In recent years, the personnel typically works through email and virtual meetings, but the CenturyLink service there is very slow and prone to outages. Internet disconnections are almost daily, it makes it hard to hold virtual meetings. They pay about $140 a month for a phone line and internet which is advertised to be high speed. Most of the neighborhood is on the same system.

The Castle Rock recreation facility in Douglas County uses Allstream which leases fiber from CenturyLink. The main office is in unincorporated Douglas County on East County Line Road. It is a one gigabit internet connection and has sufficient connectivity and reliability for their needs. They have about two years left on their current contract where they pay about $150,000 a year for 7 facilities in Douglas County, each of which is either 1 Gbps or 100 Mbps. However, they have more trouble with the Lone Tree Golf Course as well as the Lone Tree Rec Center that will be built in the next five years, and since there aren't many other buildings nearby, it may have internet service needs.

There haven't been emergency situations that require reliable connectivity, but it's a possibility. There could be a heart attack while swimming in a pool, or a person getting hit by lighting at a golf course. The forest service facility used to respond to fires, but now they partner with Douglas County Office of Emergency Management. They do use texting to foresters in the field through Verizon cell service. It doesn't provide coverage everywhere, and they've had to get emergency satellite beacons in hard-to-reach areas, but those are for extreme emergencies.

Both organizations rely on State funding, and do not receive County funding. The Forest Service facility in Franktown has similar issues with other sister agencies, and together they have looked at connecting other state facilities on the same network to install fiber and save costs. If the County invested in fiber or facilitated it through a private provider, they would like to lease it. The value these organizations provide to the community is important, and having good internet service is a direct service to local residents.

Chambers and Economic Development Councils (EDCs):

Arapahoe Douglas Works is an organization that helps job seekers connect with training programs, labor market information, and resume development, as well as matching job candidates with employers. The Denver South Regional Economic Development Group is located south of Denver, and helps residents of Douglas County, as well as Greenwood Village and Centennial. Their funding stems from a small business tax within an improvement metro district that they serve. The Group facilitates job creation, putting the business community in touch with resources, and entrepreneurial small business development and growth. They also serve as a transportation management organization for planners. They have done several projects relating to improvements to certain infrastructure, including the installation of fiber.

Neither organization has issues with connectivity within their facilities, but occasionally do have outages. They also hear about issues with broadband in Douglas County from some businesses and job seekers in more rural areas. During the pandemic, Arapahoe Douglas Works created an initiative to pay for home internet service plans for select businesses, employees, and job seekers struggling with the transition to working from home. Since many libraries, career centers, and business offices were shut down, it was a logical step to support home internet connectivity.

In addition, many large businesses in the area are reliant on running data centers for payment services and cloud computing. These businesses have some of the best broadband connectivity in the country, which attracts similar businesses looking for that capability, at least in part due to the presence of large telecom companies located in the region, including Dish Network and the largest Comcast facility (9000 employees – largest employer in South Denver) outside their headquarters in Philadelphia.

These economic development organizations would be willing to work closer with the County to improve broadband for businesses and remote workers. They are experienced in helping businesses, have an

organizational structure to support development projects, may have pools of funding for infrastructure initiatives, and can facilitate marketing campaigns for broadband projects. Business trends are moving to a hybrid work arrangement, and real estate is moving toward a light industrial flexible space that depends on cloud, distribution-based technology. Five years ago, Castle Rock was not seen as a connected community like now, and the demand for fiber in that area due to remote work is very high.

Emergency Response Organizations:

The interviewed emergency response organizations in Douglas County, which include entities such as the County's Office of Emergency Management, the Sheriff's Office, South Metro Fire, and others, say that they have sufficient internet capacity to complete their mission critical responsibilities, and find ways to work around connectivity limitations in remote low-or-no-signal areas.

Emergency response organizations rely on different types of connectivity within their offices and in the field. Generally, the internet connectivity within their offices is adequate. In field, they rely on FirstNet, AT&T's emergency response network, Verizon's cellular network, and Land Mobile Radio (LMR), the traditional radio system for patrol units and emergency response services. Issues in some of the western and southwestern portions of the County where terrain and foliage create connectivity dead zones. Many of those areas are national forest land, and it can present challenges in getting in touch with field personnel and transmitting reports. While their vehicles are enabled with digital technologies that are used for data storage and recording, they may not be in an area with sufficient wireless connectivity to upload the data. In highly remote areas with no cellular coverage and tenuous LMR connectivity, they rely on driving to a select few areas with known cell signal as well as written paper records. Many of these practices are well-established and their connectivity does not compromise emergency response operations or preparedness, it is mostly an inconvenience to time-consuming record keeping and personnel training.

Specific plans and pricing are typically offered on an organizational-level for several facilities and can vary widely. The West Metro Fire Rescue Station 15 is the only station in Douglas County, in addition to 20 facilities in Jefferson County. In total they pay about $250 a month for 20 Mbps capacity. They previously looked into a fiber network for Jefferson County schools. The fire station on the western size has a station with less than 1 Mbps connectivity that costs about $600 a month. It is unusable about 80% of the time. There are power outages that can be made up with generators. In the area of Sedalia and Jackson, coverage is bad, and they rely on LMR for response. While, the County emergency buildings are 100% connected by dark fiber, there are a few small locations that have T1 DSL lines. The connectivity contracts are either owned by the County, come through Intergovernmental agreements, supplied by the municipalities within the County or CDOT.

Responding to environmental issues has not been a problem. There is a lot of good environmental technology in use such as floodgauges and wind monitors. There could be a use for fire sensing technology in the future, but for now, there is a manned fire station for the forest service in the mountains, one of the only ones in the country. It does not have connectivity and could benefit from useful technologies.

Ideally, having a major communication facility of Highway 105 would be helpful. It would set the stage to branch off to Highway 85, and the areas of Louviers, Sedalia, and the eastern slope where there are no facilities. If there was a fiber ring, it would be run out from Highway 85 through Castle Rock and Park Meadows. In addition, the ability to monitor some public areas could be useful; these include public spaces such as parks, trails, and parking lots subject to car break-ins like the Roxborough lot, Sandstone Ranch trail heads with parking lots, and the I-25 parking lots. In the West Metro facility, connectivity is adequate, but redundancy is a concern. In addition, Sandstone Ranch is an open space where events are held, and it would be helpful to have significant improvements of connectivity at that location.

The emergency response facilities would be willing to explore options for combining purchasing power or aggregating their facilities as a consortium customer to lower individual costs. Some of the smaller sites that still use DSL are expensive and do not receive good service.

Libraries:

The six library district locations in Douglas County are well served by the Comcast Metro-E (ENS) services as well as Comcast EDI, which is a fiber service. There is also backup Comcast coaxial cable at those same locations. The District gets 1 Gbps service to their data center and at their backup center located in Lone Tree, and 500 Mbps at all the other locations all over ENS. As far as the EDI is concerned, they typically run 1 Gbps primary Internet over fiber and 1 Gbps over coax if they can get it. Sometimes all they can get is 500 Mbps. They have two networks, one for public access computers that includes a public Wi-Fi network, and one for their corporate computers. If the fiber is down, then they still have access through coax, or if coax is down then they have access over fiber. If they loose both fiber and coax, then they are out of luck.

Reliability is a priority for the District, and the Comcast service meets their requirements and they've had no complaints. There was one full outage (lost fiber and coax) in Lone Tree last year for a half a day. Internet outages do not compromise other library services like checking out materials with offline mode system capabilities.

The District uses E-Rate to reimburse the District for their internet service costs. Their E-rate is based on the number of students enrolled in the free and reduced lunch program within the Douglas County School District. The District's costs before the E-Rate reimbursement are: approximately $8,000 per month for primary Internet connections. Approximately $6,000 per month for WAN connections and $1,500 per month for backup coax connections. Currently, they are one year into a five-year contract. They are interested in hearing about the results of the County's study and interested in any potential partnership opportunities.

Chapter 5: Geographic Service Areas & Technologies

Across the United States, Internet Service Providers (ISPs) are deploying a variety of technologies to deliver broadband services. Each of these technologies bring with them certain advantages as well as disadvantages, including cost of deployment, coverage extent, and other financial and technical issues. Currently, broadband speeds are currently defined as "up to" 25 Megabits per Second (Mbps) in download and "up to" 3 Mbps in upload capacity (25/3Mbps). This service meets the minimum requirements from the FCC to qualify as "high speed broadband" but survey speeds reported as part of the County's study indicate that many homes are receiving speeds significantly below this "up to" qualifying speed.

While the Colorado Broadband Deployment Fund uses the same criteria for its awards, from a broader perspective, the federal government in its recent broadband grant funding initiatives has acknowledged that the 25/3 speed designation is no longer sufficient to meet the needs of most people in the country. For example, the USDA ReConnect Program defines sufficient access to broadband as over 100 Mbps download and 20 Mbps upload speeds. The U.S. Treasury Capital Projects Fund (stemming from the American Rescue Plan) seeks to provide funding for providers that will deploy networks capable of at least 100 Mbps symmetrical (both download and upload) speeds.

Different available technologies have advantages and disadvantages in bringing broadband to a region. While fiber-optic connectivity is viewed as the "gold standard" due to its high capacity and symmetrical service, the County's mountainous terrain, disparate population centers, and other features would make it cost prohibitive to envision and build a full, fiber-to-the-home solution in many rural and remote areas. Nevertheless, some regional companies are engaging in such efforts. Mountain View Electric Association, which services a portion of Douglas County residents with electricity (as shown in Figure 24 in the previous section), recently announced that it will be building fiber to its entire utility footprint.

In many other parts of the County, ubiquitous fiber deployment is not likely. Because of this, HR Green and its study partners instead recommend a path in which technology is matched to the varying demographics of the region to create the most cost-efficient and highest impact solution across the region.

Defining Broadband Service Areas

In some parts of the Douglas County study area, ***access*** to high-speed internet technology is the key concern. Conversely, in some inner-City and urban areas, physical technology may be deployed but cost makes ***adoption*** prohibitively expensive for lower-income residents. While there is no universal definition, we find it useful to consider a segmentation of the overall market as shown in Figure 2 below:

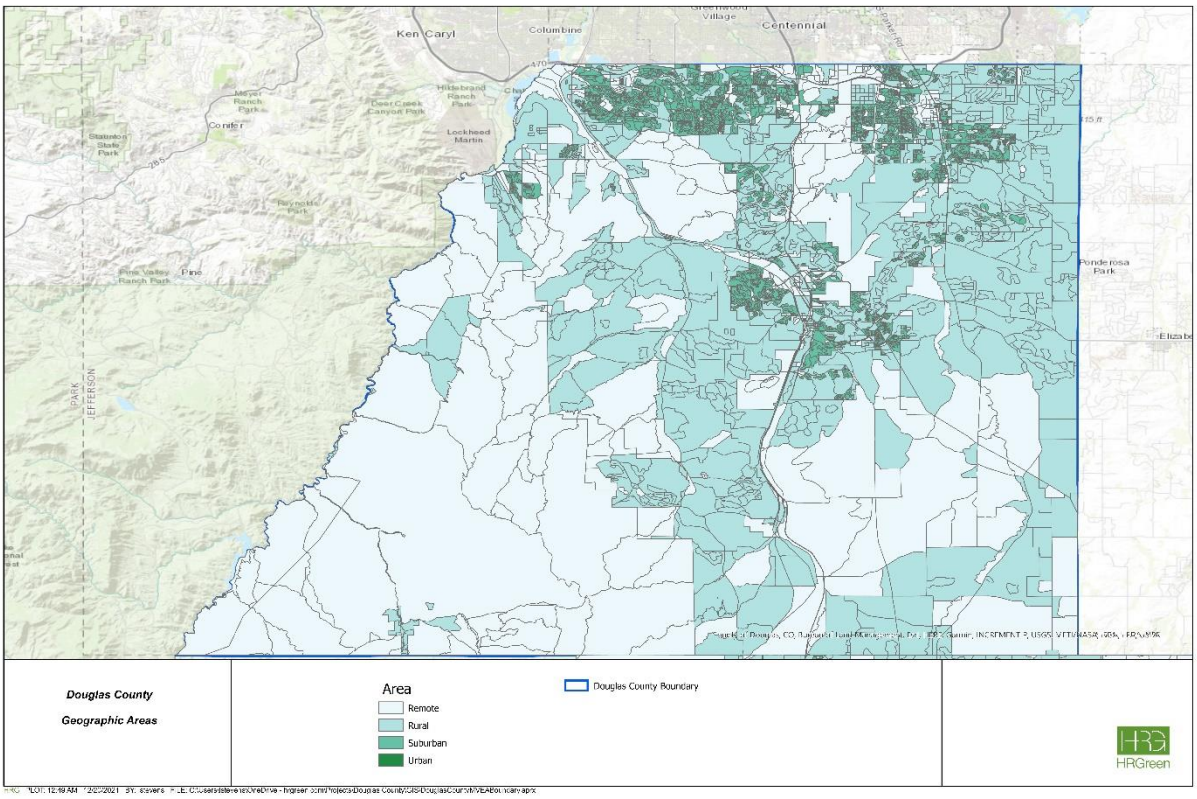

Figure 27: Area Classification Based on Population Density - Urban, Suburban, Rural, and Remote

Urban

In larger, metro settings, population densities support the deployment of higher capacity technologies. Copper-based technologies have been largely supplanted by the deployment of coaxial cable or fiber optic services. In many urban areas of Douglas County, there are at least two providers who provide at least 100/20 Mbps service resulting in some level of consumer choice between providers.

For the purposes of grant opportunities, the FCC defines urban areas as cities with a population of 50,000 or more, with the City boundaries being the same as its jurisdictional boundaries.[1] Urban areas typically benefit from the best availability of internet service providers and broadband market competition. Population density incentivizes industry investment due to economies of scale and scope in attracting the greatest number of customers relative to the geographical area of deployment.

However, while access to acceptable broadband is generally present in these areas, there are remaining challenges. The most apparent from this survey is that while the technology is present, adoption is often precluded due to affordability issues. In general, the cost of service exceeds the capacity of residents particularly in more rural and less socio-economically advantaged areas.

A second challenge in Urban areas, which was beyond the scope of this study, is that "digital redlining" may occur. Individual provider coverages were not analyzed in this market to a sufficient depth to determine whether this is present in Douglas County, but there are documented cases where providers have not deployed next generation technology to socio-economically disadvantaged neighborhoods, instead deploying capital in suburban or other geographies which result in higher take rates and revenues.

[1] https://docs.fcc.gov/public/attachments/DOC-358434A1.pdf

Suburban (Including Towns)

Throughout this study, many suburban geographies were generally well-served with broadband above the 100/20 standard. Suburban areas generally feature relatively dense population, more modern infrastructure and income levels which make costs less of a barrier to adoption. Since many suburban areas have a widespread grid of sidewalks, roads, and rights of way, placing underground or above ground equipment can be easier in avoiding obstacles or existing utilities. The presence of higher-value business and enterprise customers in these markets also makes deployment of fiber optic service a positive investment for providers in these markets.

It is important to note that most homes and businesses in suburban markets have access to at least two (and sometimes more) providers capable of meeting the 100Mbps download speed.

Rural (Unincorporated Areas)

Much of the current national policy debate, and significant funding both approved and currently under consideration is focused on solving the rural broadband issue. The Digital Divide, as this issue is known, is not limited to just rural America, but this has received the headlines in the current national policy debate. The results of this study validated that this divide is real, and results of speed tests can be found elsewhere in this study.

The FCC has formally reinforced its definition of "rural" for the purposes of receiving rural telecommunications development grants and eligibility for rural healthcare programs as counties with a population density of 100 persons per square mile or less.[2] They maintain that the definition based on the Census Bureau's Core Based Statistical Areas is the most reliable measure of rural areas. Due to their low population density, topographical challenges, widespread geographical distances, investment in broadband is often cost-prohibitive in the balance between cost of investment and potential customer subscription revenue.

Remote

It is not a coincidence that the findings of speed tests in this report showed the largest disparity in speeds for homes, farms, and businesses located in the most remote portions of Douglas County. The low population densities of remote locations makes the economics of serving these potential customers less attractive for commercial service providers, resulting in less investment in technology upgrades and a higher reliance on slower technologies such as DSL over copper infrastructure. The Colorado Broadband Map shows that a few of the Remote areas in Douglas County are, in fact, designated as unserved and eligible for funding to both public and private sector providers who want to deploy next-generation networks.

Evaluating Current and Emerging Broadband Technologies

Based on the current evolution of broadband funding at the state and national level, and the economic realities of broadband deployment costs, it is crucial to understand the relative advantages and costs of various broadband technologies. The information below is intended to provide a basic understanding of the most common current technologies, along with a discussion of emerging technologies such as Low Earth Orbit (LEO) satellite service.

Broadband network performance is frequently judged by throughput (or speeds). However, a more holistic evaluation of technologies will also consider more technical components, which make them more or less supportive of emerging use cases like two-way video (videoconferencing), distance learning, telemedicine and other uses.

[2] FCC document 04-166. Docket WT 02-381. REPORT AND ORDER AND FURTHER NOTICE OF PROPOSED RULE MAKING. Facilitating the Provision of Spectrum-Based Services to Rural Areas and Promoting Opportunities for Rural Telephone Companies To Provide Spectrum-Based Services

For purposes of this review, technologies were evaluated on the following criteria:

- Area of Coverage: Fixed wireless and satellite broadband have the advantage of covering large geographic territories from a single point of presence such as a tower or orbiting station. Copper, coaxial and fiber require direct connection and physical network at each individual service point.
- Cost to Subscribers: For lower-income homes and small businesses, broadband service plans can represent a meaningful barrier to adoption. Cost of service, therefore, is a key consideration in evaluating possible technical solutions.
- Deployment Cost: Deployment of broadband technology nearly always involves the deployment of large amounts of capital with a business plan that typically seeks to cover the cost of that deployment plus interest, operating expenses and profit over a long-service window (typically 4-20+ years). Costs vary significantly from high-capital deployments for fiber and coaxial cable to lower cost technologies such as fixed wireless or satellite.
- Throughput/Speed/Data Rate: the amount of data per unit of time successfully delivered through the network over a communication channel between two points.
- Service Reliability: the frequency of potential outages that compromise consistent access to the service. Wireless service is inherently less reliable due to propagation characteristics being heavily influenced by obstacles, clutter, and weather.
- Latency: the delay in the amount of time it takes for a unit of data to reach its destination across a network.
- Jitter: the variation in latency when transferring data. It is a defining metric in the network's ability to consistently transfer real-time data traffic such as Voice over IP (VoIP), video conferencing, and virtual desktop infrastructure.
- Packet Loss: the measure of unsuccessful attempts to transfer units of data to its destination.

Fiber to the Premises (FTTP)

Fiber optic deployments rely on the construction of networks that convert electrical signals carrying data to light and send that information directly over small glass fibers about the diameter of a human hair. The key advantage of fiber optic cables is its capacity to carry massive amounts of information at nearly the speed of light, resulting in service that is symmetrical, low latency and capable of extremely high speeds. FTTP deployments are frequently viewed as the "gold standard" due to the technical advantages noted above. Providers of FTTP deployments frequently offer service plans of 100/100 Mbps or 1,000/1,000 Mbps (or Gigabit service).

Fiber deployments are either completed with buried or aerial construction methods. Buried fiber is the most secure method and avoids many of the risks of aerial deployment because they are immune to the effects of wind and ice damage. On the other hand, many providers prefer to deploy aerial cables on public rights of way and existing utility pole infrastructure. Aerial deployments create more risk of service disruption but the initial capital deployment for aerial fiber can be as much as 40 to 50 percent less than the cost of a buried deployment.

Fiber optic service does have many technical advantages, but the cost of deploying the physical infrastructure and supporting electronics necessary to operate the network can make fiber optic too expense for many Rural and Remote areas. This can be especially true in areas where geology includes rock and other difficult-to-dig areas.

Coaxial Cable (DOCSIS 3.0/3.1)

Most of the homes and businesses served by the incumbent cable providers are receiving their video and broadband on a technology known as Data Over Cable Service Interface Specification, DOCSIS 3.1. DOCSIS was launched by the cable industry to convert its original video distribution plant to a system capable of carrying not only video, but two-way transmission of data to and from customer premises. DOCSIS relies on a hybrid of coaxial cable and fiber optic cable to deliver services.

Like fiber optic networks, DOCSIS service technology relies on either buried or aerial distribution of cables to carry data and video to customer premises. The implementation of DOCSIS 3.1 allowed the cable industry to compete with new fiber-to-the-home providers by significantly increasing download speeds for customer. The technology is capable of up to 10Mbps (10 Gigabit) speeds, but most cable service plans currently available in the market feature 100Mpbs or 250Mbps offerings.

One of the limitations of coaxial cable plant is the significant expansion of available upload speeds. Many cable providers, in fact, still offer uploads speeds between 3 and 35 Mbps. This capacity has been sufficient for many of the historic uses of broadband, but many emergent uses (telemedicine, video conferencing, remote learning) rely on both up and download capacity and there have been reports of dissatisfaction with DOCSIS in this more symmetrical environment.

The cable industry is also investing in direct fiber-to-the-premises for business and enterprise customers, while continuing to develop future DOCSIS evolutions to increase both download and upload speeds.

Digital Subscriber Link (DSL)

DSL service was implemented by the incumbent telephone companies as a replacement for dial up internet. The technology has seen several upgrades and is capable of supporting asymmetrical speeds of up to 25/3Mbps. DSL is one of the most prevalent technology deployments available in Douglas County, as local and incumbent providers have continued to update older 10/1 DSL service to newer technologies capable of meeting the federal broadband standard of 25/3 and, with some upgraded equipment speeds of up to 100/10.

One concern with DSL is the use of "up to" speeds when compared to actual speeds realized by customers. Because DSL is reliant on existing copper pair telephone lines, physical proximity to transmitting equipment is a key factor in determining actual speeds. While customers who are close to DSL gear receive speeds near the advertised speeds, there is a significant degradation of DSL speeds as customers move further away from the point of presence.

DSL, on the other hand, continues to provide some of the lowest cost of service in the industry. The typical DSL internet bill is in the $50-$60 range, which compares favorably with the pricing of GEO satellite providers.

Fixed Wireless

A large section of the Douglas County study area relies on fixed wireless as a primary broadband technology. Fixed wireless internet uses radio waves transmitted from a cell tower to foster an internet connection. This connection can be transmitted over either federally licensed spectrum or via unlicensed spectrum. Unlike the wired services outlined above, fixed wireless simply relies on an exterior antenna to provide homes and businesses with broadband level services.

Fixed wireless also is different from satellite broadband in that signals are usually connected at the tower to a backhaul fiber network to carry the signal onward to the internet. While speeds and latency are generally inferior to fiber and coaxial technologies, speeds and latency are generally superior to satellite service.

Fixed Wireless internet broadband is frequently a positive alternative to traditional DSL service, offering higher connectivity speeds than those available from DSL providers. Because it is not dependent on physical connections, it is well suited to Rural and Remote settings. Many wireless providers offer low latency and higher data allowances that are available from satellite providers that are a traditional alternative to DSL in Rural and Remote geographies.

Fixed wireless technology does have some distinct technical challenges. First, fixed wireless relies on a direct line of site from the antenna to the tower site transmitting the signal. While fixed wireless is capable of serving many addresses and a large geography from a single tower, trees, hills and other topography can make

connections less efficient and service coverage. Second, the technology is subject to disruption from weather and frequency disruptions, which can cause service and equipment issues.

Satellite Broadband

B. Geostationary Orbit

Most known satellite internet service has been traditionally provided from geostationary (GEO) orbit satellites that orbit at 22,236 miles above the earth, but recent technology is enabling service from other orbits as well, most notably Low Earth Orbit (LEO) - less than 1,200 miles in altitude. In between, Medium Earth Orbit (MEO) satellites, such as GPS, are at approximately 12,550 miles in altitude.

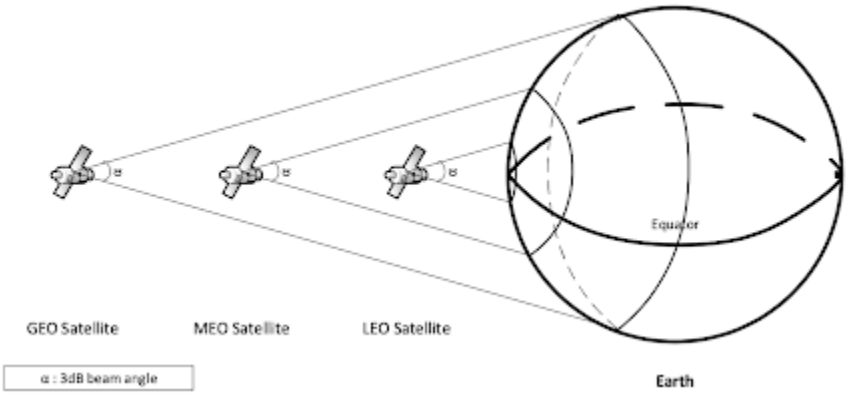

Figure 28: Distances of Satellite Orbits from Earth

Geostationary Earth Orbit (GEO) satellites have been used as an internet service technology by providers such as ViaSat and Hughes Network Systems for decades. HughesNet was formed in 1996 to provide satellite internet service, and controls roughly 60% of the satellite internet market in the United States. Many GEO satellite internet companies are located in Colorado. EchoStar Corp, a division of HughesNet and Dish Network are both based in Douglas County. ViaSat has many consumer internet service offices in the south Denver Metro Area.

GEO satellite service represents an improvement over early dial up and copper-based technologies, which only offered speeds up to 10/1Mbps. Because of this, adoption of GEO satellite service has been primarily in geographies described above as Remote, and in some Rural and Remote areas it represents the only available alternative that meets the 25/3Mbps FCC standard for broadband.

With GEO satellite internet, a consumer can receive .5 Mbps download and 80 Kbps (less than .1 Mbps) upload speeds.[3] These data rates are typically lower than any other internet service technology, except dial-up which is now an exceedingly rare service.

A report by the Congressional Research Service in August 2021 notes a number of key challenges with GEO satellites as a technology that supports future-forward broadband needs.[4] The distance that data must travel to a satellite in orbit and back results in lower data rate, higher latency, and a lack of reliability in using many real-time applications such as video conferencing. Latency of GEO providers averages nearly 636 milliseconds for the two large commercial providers. Technology experts have noted many challenges with the use of this technology during the recent pandemic.

[3] https://transition.fcc.gov/indians/opportunity.pdf

[4] https://crsreports.congress.gov/product/pdf/R/R46896

The report also notes that GEO service carries a higher average price to consumers and businesses. The average price of a GEO satellite plan is $123 per month, compared to an average of $52-$59 per month of traditional wired services.

For decades, satellite constellations have been lauded as terrestrial alternatives, and there has been a boom and bust economy for satellite constellations hoping to replace commercial wireline and wireless networks. Due to high start-up costs, launch costs, and a slowness to respond to communications technology upgrades, notable satellite internet companies such as Teledesic, Iridium, Globalstar filed for bankruptcy protection throughout the 1990s and 2000s. More recently, Intelsat, OneWeb, Speedcast, and Global Eagle continue to experience bankruptcy issues.[5]

C. Low Earth Orbit

While GEO satellite broadband has been available for dozens of years, a number of companies announced (or are already deploying) constellations of low-earth orbit (LEO) satellites to improve on the traditional challenges with existing satellite provider services. Due to the constellation's closer distance to the earth, LEO satellite service promises to significantly improve on speed of service issues, with a particular focus on latency and upload speed improvements.

Speculation on LEO internet service focuses on its promise to provide broadband service similar in quality achieved with wireline or terrestrial wireless technology. The technology holds the potential to resolve the digital divide in areas with challenging topography where it is difficult to deploy terrestrial infrastructure and to provide service to mobile users (in cars, airplanes, at sea).

LEO satellites are operating at much lower altitudes comparing to MEO and GEO satellites but require a network of thousands of satellites that orbit at a height of 300+ miles above earth. The vastly larger number of satellites allow the allocation of more network resources, but also require many frequent handovers between satellites when communicating with ground receivers.

This relatively low[6] orbit proximity to the earth's surface reduces latency when compared to higher satellite orbits, but is still a much longer distance than cellular (LTE/5G) networks. Weather and the consumer's line of sight to the satellite can also greatly vary service quality and reliability.

D. Starlink

Starlink is a proposed and partially implemented Low Earth Orbit (LEO) constellation of over 12,000 satellites intended to provide internet service in underserved areas. There are currently 1,700 satellites in a 340-mile-high orbit.[7] Their sunlight reflections can be seen at dusk in many places.

The project is expensive. Estimated to cost $6.1 billion to launch with an additional $10 billion for the required base station, a LEO space vehicle has a predicted operating life of five years. For access to this service, a Starlink customer is asked to pay $500 for equipment for their home and $99 per month for internet service.[8] It will take 2.7 million customers paying $99/month for five years to recoup that initial investment of LEO and ground station infrastructure.

Colorado is 104,185 square miles or about 0.05% of the covered satellite area. That means having about six of the satellites over the state at one time. Since each satellite can transmit speeds up to 20 GB/s, Colorado should have access to 120 GB/s for the state. If only 1% of Colorado homes (2.5 M) were to sign up, each would have access to 4.8 Mb. That is substantially below any service offered through a fiber optic network. Thus, Starlink is a solution for very rural areas.

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[5] https://spacenews.com/op-ed-satellite-bankruptcies-circa-2000-vs-2020-weve-come-a-long-way/

[6] Low as compared to middle earth orbit or geocentric earth orbits.

[7] https://www.bizjournals.com/denver/news/2021/08/18/echostar-viasat-spacex-satellite-broadband.html

[8] https://www.techradar.com/news/everything-you-need-to-know-about-spacexs-starlink-plans-for-space-internet

As such, in 2020, the FCC awarded the company $885.5 million in federal funding to assist with deployment of the technology. This represented one of the largest awards in the Rural Digital Opportunity Fund (RDOF) funding cycle.[9] In Colorado, the award was approximately $40 million to connect almost 20 thousand homes.[10] In Douglas County, Starlink may not launch service until 2023.[11]

E. Other LEO Services

Starlink is highlighted here as it is the most market-ready commercial LEO product on the market. Amazon's "Project Kuiper" was approved by the FCC to launch and operate more than 3,200 satellites in order to provide broadband service. OneWeb will provide service estimated at up to 200 Mbps and Telesat is projecting service at 50 Mbps. In all instances, latency of the new LEO providers is in the 30-60 millisecond range, in tolerance with fixed wireless and some wired connection solutions.

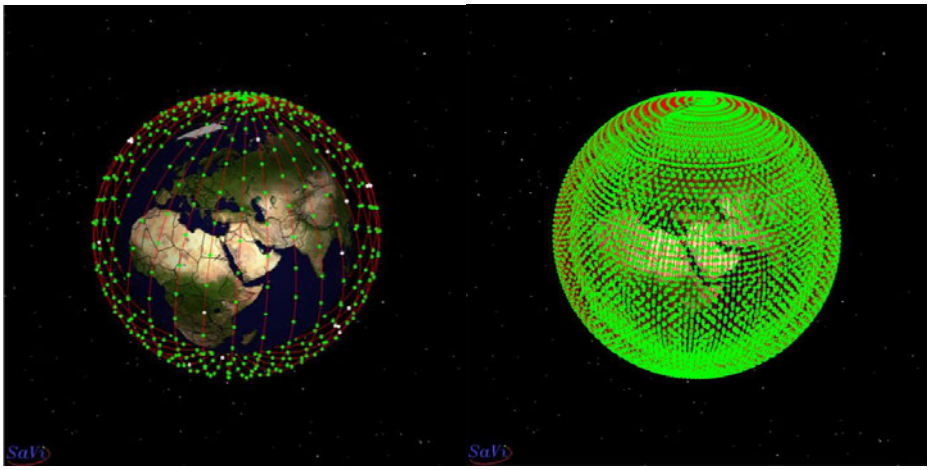

Figure 29: Planned deployments of (a) OneWeb and (b) Starlink

The following table compares five LEO constellations, namely Iridium, LeoSat, OneWeb, Starlink, and the Hongyun Project on key comparison indicators. Starlink has, by far, the most number of planned satellite launches which enables it to estimate "up to a gigabit" customer speeds.

[9] https://spacenews.com/spacex-wins-big-share-of-9-2b-rdof-broadband-subsidy/

[10] https://docs.fcc.gov/public/attachments/DA-20-1422A2.pdf

[11] https://www.pcmag.com/news/spacex-pushes-wait-times-for-starlink-to-late-2022-early-2023-for-more

	Iridium NEXT	LeoSat	OneWeb	Starlink	Hongyun Project
Number of Satellites	66	108	648 (+ 1,972)	4,425 + 7,518	156
Orbit Altitude	781 km	1,400 km	1,200 km	1,200 km and 340 km	1,000 km
Signal Transmission Frequency	L-band Ka-band	Ka-band	Ku-band (V-band)	Ku-band Ka-band V-band	Ka-band
Capacity per Satellite	N/A	11.6 Gbps	N/A	N/A	4 Gbps
Data Speed	128 kbps 1.5 Mbps 8 Mbps	50 Mbps-1.6 Gbps 5.2 Gbps	50 Mbps	"Gigabit per second"	40 Mbps
Transmission Latency	N/A	< 20 ms	N/A	~25 ms	N/A
Year of Operation	2015	2022	2019	2019	2024
Supporting Enterprises	Iridium Inc.	LeoSat	Qualcomm, Virgin Group, Airbus, etc.	SpaceX	CASIC

Cellular Broadband

The evolution of cellular connectivity through 4G, LTE, and now 5G service have created opportunities for some customers to eliminate traditional wired or wireless broadband services and to rely entirely on their cell phone or cellular hot spots as a means to provide home connectivity. Cellular broadband is designed for mobility, particularly in higher traffic areas. It varies widely in service quality depending on service area, signal strength, technology hardware, software protocols, modulation coding and schema, number of active users, applications, and many other factors which can significantly compromise its consistent use and reliability. It can be an option in rural and remote areas where alternatives are not available, but wireline internet service access is likely to be more reliable.

Technology Options Criteria Evaluation

The following table demonstrates each of the described technologies within given evaluation criteria on a scale of Good = Green, Average = Yellow, and Poor = Red.

	Fiber	Cable	DSL	Fixed Wireless	GEO Satellite	LEO Satellite	Cellular
Area of Coverage							
Cost to Subscribers							
Deployment Cost							
Throughput/Speed/Data Rate							
Service Reliability							
Latency							
Jitter							
Packet Loss							

Speed remains one of the most important metrics by which the quality of broadband is measured. One recent report compares DSL, cable, and fiber download and upload speed ranges to demonstrate the wide disparity between different technologies:

Broadband Technology	Download Speed Range	Upload Speed Range
DSL	5-35 Mbps	1-10 Mbps
Cable	10-500 Mbps	5-50 Mbps
Fiber	250-1,000 Mbps	250-1,000 Mbps

Figure 30: Comparison of Speeds Between Different Technologies

LEO Comparison with Fiber

An important discussion that has dominated the broadband market in recent years is the potential to close the digital divide with LEO technology as a replacement for expensive fiber network, an attractive proposition.

While fiber is the best broadband technology in terms of metrics, LEO can avoid many of the challenges in deploying in rural and remote areas.

Fiber is faster, lower latency, provides many orders of magnitude more throughput, enables many types of over the top applications, and costs less per user served. Fiber is not affected by weather or electromagnetic interference like a wireless LEO signal.

However, fiber cannot directly provide service to an end user that is mobile or in an area where trenching is impossible or not economically viable. Once a LEO network is launched, it can provide service anywhere.

Nevertheless, the cost of a LEO network is very high, and the required replacement cycle of satellites is also very expensive. Increasing the number of users on a LEO satellite network has a significant impact on each of those customers' service quality and reliability. The following graphic shows a qualitative comparison of costs and features between LEO and Fiber:

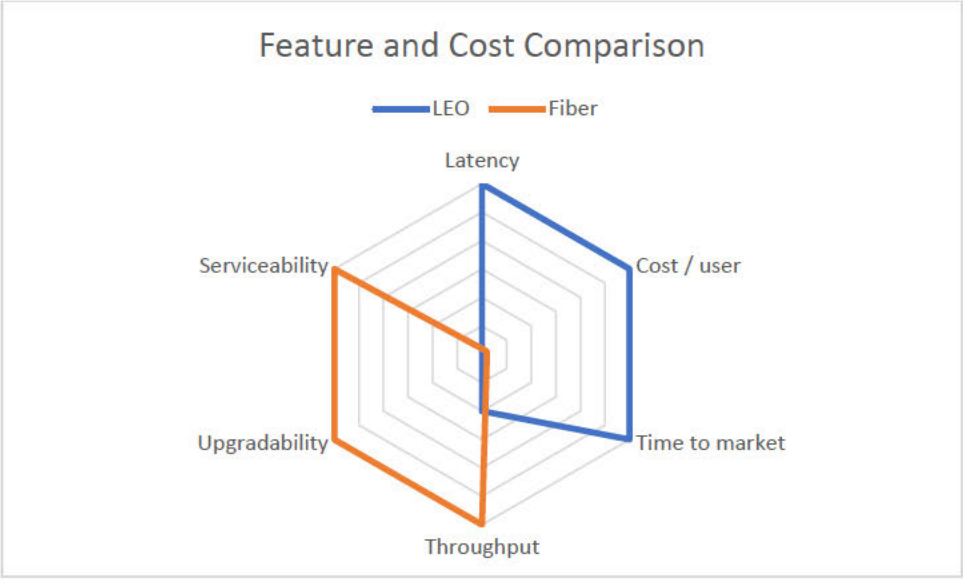

Figure 31: Tradeoffs between LEO and Fiber Networks

The tradeoffs between the two technologies demonstrate a clear preference toward fiber where it can be feasibly deployed, and a partiality toward LEO satellite where the density of users is very low and the cost of terrestrial infrastructure is high. While fiber is an established, quality technology, the uncertainty surrounding the future performance of LEO networks is high. It will take many years to resolve challenges with the required satellite upgrade cycle, the network performance issues associated with many users, the protocols for distributing and securing transmitted communications signals, and interference from environmental causes.

Matching Technologies to Geography

In an ideal world, there would be available and robust resources to provide fiber optic connectivity to every home and business in the Douglas County service area.

There are numerous benefits available to the region to improve service across the geography. However, the region's investment can and should reflect an economically based matching of technologies to the requirements of Urban, Suburban, Rural, and Remote geographies in the market.

The table below shows the four geographies, and an assessment of which technologies are most likely to improve broadband connectivity collectively. Again, these improvements may not create an entirely level playing field but are intended to reflect an overall improvement in broadband availability to as many residents, farms and businesses as possible, while reflecting the likely availability of funding from state and federal sources and the private sector. The color scheme is Good = Green, Average = Yellow, and Poor = Red.

	Urban	Suburban	Rural	Remote
Fiber Optic				
Coaxial				
DSL*				
Fixed Wireless				
GEO Satellite				
LEO Satellite				
Cellular Broadband				

* DSL Technology is obsolete and better technology can be obtained for the same cost

Chapter 6: Public Policies – Colocation Policy

Introduction

Douglas County can make key public policy decisions that can make the County more "fiber friendly" to incumbents and other service providers.

There are several different types of programs, which are inter-related, that could be developed concurrently to support broadband. These include:

- Joint-Build initiatives with the private sector
- Piggybacking and dig-once programs
- Consideration of reduced incentives for utility open trenching
- Required Co-locations for installers
- Exploring street cut and pavement degradation fee exemptions and other complementary initiatives

As the County seeks to develop advanced communications infrastructure, it has a unique opportunity to deploy assets at a fraction of the cost of overbuilding individually. By developing a colocation program, the County can leverage builders with open trenches and boring projects to deploy conduit and/or fiber on behalf of the County.

HR Green has reviewed the County's current policies and created a colocation policy that aligns with the County's strategy to improve broadband capacity in the County. This policy will give the County the opportunity to deploy assets alongside other projects and it creates long-term assets that can be leveraged by the County going forward.

It is HR Green's recommendation that Douglas County consider implementation of a Fiber Optic Colocation Policy to create a cost-effective method of deploying potential assets should the County Commissioners determine that such assets support the goals of improved broadband, and should the assets available under this policy be conducive to furthering the broader strategic broadband goals outlined in this plan.

Background

Public policy developments to control pavement utility cuts in highways and streets and to minimize damage to public infrastructure, evolved from requirements outlined in states and local government codes for rules to control the rights-of-way access demands of telecommunication companies. The rush of telecommunications companies requesting access magnified the need for better control of utility street cuts and improved standards for how cuts are repaired. [1]

Government agencies began to realize that excessive utility cuts in pavements under their responsibility were causing premature deterioration of the pavement structures. They also realized that additional money was required to maintain these pavement structures at acceptable levels of serviceability. One method of recovering the cost of damaged pavements is to require the telecommunications companies or their contractors that are performing the work to pay a fee commensurate with the damage done to the pavement. [1]

Many states and local governments have seen the effects of excessive pavement utility cuts in their highways and streets. Potential problems that can arise from uncontrolled and frequent utility cuts include, but are not limited to: [1]

- Excessive delays to the traveling public due to closed traffic lanes.
- Increased traffic congestion and related air quality issues.
- Damage to vehicles due to excessive road roughness.
- Rapidly deteriorating pavement structures in the vicinity of the cuts.

- Accelerated funding requirements to maintain, rehabilitate and reconstruct prematurely failed pavement structures.

Some of the other potential impacts of pavement cuts include the perception of the public, which often is of the opinion that the state or local government is always working on the roads, and that road construction never ends. Additional impacts include other indirect costs, or those that cannot be directly quantified, such as localized air quality and the financial impact to local businesses whose access is impeded due to construction work zones. [1]

As demand for access to the public ROW increases, these impacts will become more prevalent if traditional trenching remains the predominant form of utility construction. The effect on pavement deterioration is likely to become more pronounced as states and local governments continue to struggle with diminishing budgets and increasing pavement deterioration. Without means of repairing prematurely deteriorated pavements in a timely manner, these agencies expect greater backlogs in maintenance and rehabilitation requirements. [1]

1996 Telecommunications Act

On February 8, 1996, President Clinton signed the Telecommunications Act of 1996 (the Act) into law. Overall, the intent of the bill was the development of competition in the telecommunications marketplace by allowing local telephone exchange carriers to provide long distance telephone service, as well as cable television, audio services, video programming services, interactive telecommunications, and Internet access. Similarly, long distance providers, cable operators and utilities are now permitted to offer local exchange telephone service. The legislation represents the first major rewrite of the Telecommunications Act of 1934. It is complex and the rules and regulations adopted to implement the Act have a significant impact on a state and/or local government's authority to manage access to, and use of, the ROW under its authority. [1]

Nationally, state legislatures have passed legislation that limit the basis for which ROW rental fees can be charged. In some cases, state and local governments' rental and franchise fees have been limited to the actual cost for regulating access to ROW. Around the United States, state and local governments are taking steps to re-examine current ROW management policies subject to the 1996 Act. The proliferation of new technologies has resulted in additional demands being placed on the allocation of public property. As both the trustee and the landlord of the public ROW, state and local governments have an obligation to develop a framework that provides for efficient and cost-effective management of the rights-of-way, protection of public safety and maximizes revenue and recovers costs associated with the regulation and management of rights-of-way access. [1]

Moreover, the framework adopted by state and local governments must establish a level playing field that will allow qualified providers within each classification of service to enter the market on a competitively neutral basis. Thus, jurisdictions need to examine existing rights-of-way access policies, fees, and compensation methods to assure the proposed policies and fee structures are implemented on a fair and competitively neutral basis. [1]

Some of the effects of the Act include the following: [1]

- Affects every provider of telecommunications services.
- Has numerous implications for local governments.
- Encourages new entrants into the marketplace to compete with incumbent providers in all aspects of telecommunications.
- Removes regulatory barriers to entry and allows existing providers to enter new arenas to compete.
- Encourages the proliferation of new technologies.
- Addresses the convergence in technology in the cable and telecommunications industries.
- Has resulted in additional demands being placed on the public rights-of-way and roadways.

Implementation of Policies

Local governments today are implementing public policy initiatives that are designed to improve the quality of street cut repairs as well as encourage joint use of facilities. Strategies used by these agencies generally fall into three categories: incentives, fees, and regulations. Examples of incentive-based policies include providing financial incentives for: [1]

- Using trenchless technology where technically suitable (and requiring justification for not using trenchless technology when the agency deems it suitable).
- Performing higher quality pavement cut repairs or for making smaller or less-damaging cuts.
- Coordinating with other utility companies to share trenches or underground resources.

Examples of fee-based policies include: [1]

- Assessing appropriate fees for pavement degradation.
- Assessing appropriate permit fees.
- Implementing a lane rental fee to encourage utility companies to restore traffic as quickly as possible.
- Requiring a deposit prior to beginning work to protect against poor repairs.
- Assessing penalties for non-compliance or for failed repairs within a specified period.

Examples of regulation-based policies include those that do not require fees nor provide incentives but place requirements on the contractor regarding quality of work and restrictions on when and where trenching can be done. Examples of this type include: [1]

- Establishing moratorium periods that restrict trenching in new and newly resurfaced pavements for a specified time.
- Requiring the pavement repair to encompass a larger area than simply the area of the trench.
- Enhancing inspections and enforcement of specification requirements.
- Requiring agency-owned utilities to meet repair quality standards and all other policies established for private utility companies.

Colocation Policy

Governmental entities have recognized that it is within their police power to preserve the physical integrity of their streets and highways, control the orderly flow of vehicles and pedestrians, and efficiently manage the gas, electric, water, cable, broadband, telephone, and other facilities that crisscross their streets and public rights-of-way.

Additionally, government can focus on efficiently using public rights-of-way for a variety of infrastructure and utilities to provide public services; advance their goal of increasing opportunities for access to traffic control, communication, and broadband services; limit the frequency of street closures and cutting of public streets; and reduce road degradation caused by repeated boring and trenching of public rights-of-way.

To that end, some entities have started to require that all street construction permit applications, which involve directional boring or open trenching within a public right-of-way, include the colocation and installation of conduit owned by the entity simultaneously with the permit applicant's street construction activity.

Timely placement of empty broadband conduit, that is conduit for fiber optic cables that support broadband or, where appropriate, wireless facilities for broadband service, can dramatically reduce costs and speed up network upgrades. The National Broadband Plan noted that "the cost of running a strand of fiber through an existing conduit is 3-4 times cheaper than constructing a new aerial build." [2]

The cost of building or upgrading a network in areas where streets need to be dug up is substantially higher than the cost of building or upgrading a network where there is sufficient empty space in conduit that was placed with foresight years earlier. So, a colocation policy is important because it gives the jurisdiction the

ability to create assets, which is a key driver of enhanced broadband. More importantly, it is a very-low-cost path to create assets that can drive outcomes. If it is done well, it allows the jurisdiction to maintain control of its own destiny.[2]

A colocation policy or dig once policy is "a broadband deployment policy focused on increasing coordination between government agencies and utility companies to decrease the frequency of highway or street excavation." These policies aim to facilitate joint trenching cost savings and ensure that broadband infrastructure improvements are considered alongside other infrastructure and public works projects. To this end, these policies encourage or require that every infrastructure project includes notification and facilitation of opportunities to lower the costs of broadband infrastructure investment. Localities can add connectivity standards to their building codes, ensuring that new constructions are equipped with broadband access.[2]

There are two main benefits to Dig Once policies:[2]

- Lowering costs of infrastructure deployment when completed in conjunction with other infrastructure improvements
- Promoting and facilitating integration of broadband infrastructure as part of local and regional economic development initiatives.

The Federal Highway Administration has listed several best practices for Dig Once policies, noting that Dig Once practices have been "recognized by state and local stakeholders as sensible solutions to expedite the deployment of fiber along main routes when implemented as part of a cooperative planning process." [2]

Evaluate Current Policies

Douglas County's current policies regarding its rights-of-way can be found in the most current version of the *Douglas County Roadway Design and Construction Standards*. The following is some general information regarding each of the Roadway Design and Construction Standards. More specific and detailed information about the Roadway Design and Construction Standards is available via the County's website: https://www.douglas.co.us/land/regulations-and-procedures/roadway-design-construction-standards/

Chapter 1 *General Provisions* of the *Douglas County Roadway Design and Construction Standards* describes the scope and intent of the Roadway Standards manual as follows:

> *These Roadway Standards apply to all land within the unincorporated areas of the County, except when superseded by State of Colorado (Department of Transportation) jurisdiction. All roads, public or private, must conform to these standards, unless the Douglas County Engineering Division accepts alternative standards. No construction shall be undertaken without an approved Rights-of-Way or Public Easement Use Permit.*
>
> *Presented in these Roadway Standards are the minimum design and technical criteria for the analysis and design of roadway facilities. All subdivisions, re-subdivisions, planned developments, or any other proposed construction submitted for acceptance under the provisions of the Douglas County Subdivision Resolution (hereinafter called Resolution), or 35-acre land survey plats, shall include adequate roadway system analysis and appropriate roadway system design. Policies and technical criteria not specifically addressed in the manual shall follow the provisions of the American Association of State Highway and Transportation Officials "A Policy on Geometric Design of Highways and Streets," (Green Book) as amended; the Colorado Department of Transportation (CDOT) Design Standards and Construction Standards, as amended; the CDOT Access Code, as amended; and the Manual on Uniform Traffic Control Devices (MUTCD), as amended.*
>
> *The County will review all submittals for general compliance with the Roadway Standards. Once Douglas County has determined that plans are in general compliance with the Roadway Standards and the Acceptance Block has been signed on all plan sheets, the plans will be considered Accepted. Acceptance by the County does not relieve the owner, engineer, or designer from the responsibility of ensuring that the calculations, plans, specifications, construction, and Record Drawings are in compliance with the Roadway Standards as stated in the engineer's certification.*

The *Douglas County Roadway Design and Construction Standards* manual includes the following Chapters:

1. *General Provisions*

2. *Submittal Procedures*
3. *Submittal Requirements for Construction Documents*
4. *Roadway Design and Technical Criteria*
5. *Pavement Design and Technical Criteria*
6. *Bridges and Major Drainage Structures*
7. *As-Built Drawings*
8. *Roadway Inspection and Testing Procedures and Construction Guidelines*
9. *Trench Backfill Compaction*
10. *Permit Procedures and Bonding Requirements for Contractor*
11. *Acceptance Procedures and Requirements*
12. *Utility Locations*
13. *Access Requirements and Criteria*
14. *Improvement Agreements and Exhibits*
15. *Private Roads*
16. *Forms*

Appendix A Standard Plates
Appendix B Guidelines for Traffic Impact Studies
Appendix C Guidelines for Traffic Control During Construction
Appendix D Construction Specification Tolerances
Appendix E Denver/Colorado/Swell-Consolidation Test
Appendix F Traffic Signal Specifications
Appendix G Signage & Striping Supplement

Colocation Policy

The Roadway Standards manual was reviewed to determine if the County has a Colocation or Dig-Once policy. The results of the review indicated that the most recent version of the Roadway Standards manual does not seem to include these policies. It is recommended that the County consider adopting a Collocation Policy. An example of this policy is included later in this document.

Conduit and Fiber Construction Specifications

The Roadway Standards manual was also evaluated to determine if the County has conduit and fiber construction specifications. The results of the evaluation are that the most recent version of the Roadway Standards manual does contain these specifications. They are in *Section 6 Underground Facilities* and *Section 10 Fiber Optic Cable* of *Appendix F Traffic Signal Specifications*. Appendix F was last updated on May 1, 2018.

The scope and intent of *Appendix F Traffic Signal Specifications* is:

> *These specifications describe the installation of necessary material, equipment, and work procedures to complete traffic signals and/or other electrical systems as shown on the drawings, in the special contract provisions, or herein, for projects in Douglas County, Colorado. These specifications provide minimum functional requirements that must be satisfied for all such work.*

As the title suggests, subsection *6.20 Conduit* in Section *6.00 Underground Facilities* of *Appendix F Traffic Signal Specifications* describes the County's conduit specifications, and subsection *6.30 Pull Boxes* describes pull box specifications.

Subsection *10.00 Fiber Optic Cable* of *Appendix F Traffic Signal Specifications* describes the County's fiber optic cable specifications. Section 10 includes the following subsections:

10.10 Fiber Optic Cable Industry Standards

10.20 Fiber Optic Material Specifications

10.30 Fiber Optic Cable Installation

10.40 Fiber Optic Cable Testing

10.50 Fiber Acceptance

10.60 Emergency and Non-Emergency Repairs During Construction and Burn-In Period

10.70 Submittals

The specifications described in each of these subsections seem to align with current industry standards and specifications.

Recommendations

Colocation Policy

As previously mentioned, it is recommended that the County consider the development and adoption of a colocation policy, should such a policy support the broader County Strategic Broadband Plan. After reviewing the Roadway Standards manual, this policy could become part of Chapter *9 Trench Backfill Compaction*, since the policy aligns with trenching and boring.

The following is an example of such a policy that was developed for a County but could be revised for the County.

Colocation of County Infrastructure.

The County recognizes that it is within its police power to preserve the physical integrity of its streets and highways, control the orderly flow of vehicles and pedestrians, and efficiently manage the gas, electric, water, cable, broadband, telephone, and other facilities that crisscross its streets and public rights-of-way. It is the County's policy to efficiently use public rights-of- way for a variety of infrastructure and utilities in order to provide public services; increase the opportunities for access to traffic control, communication, and broadband services; limit the frequency of street closures and cutting of public streets; and reduce road degradation caused by repeated boring and trenching of public rights-of-way. To this end, the County requires any individual or company (Permit Holder) seeking to install a utility system, including but not limited to fiber optic cables or other private similar systems, that involves directional boring or open trenching within a public right-of-way that extends for more than 500 feet in length to collocate and install County conduit simultaneously with any individual or company's installation of a utility system in compliance with the following:

A. Applications to install a utility system that involves directional boring or open trenching within a public right-of-way associated with the same improvement shall not be divided into multiple applications for the purpose of evading obligations for colocation of County conduit.

B. The County shall not be restricted in its use of County conduit installed through a colocation pursuant to this Section.

C. The County will review all permit applications in a competitively neutral manner and make all permit decisions based on substantial evidence.

D. The County may, upon initial review of the permit application, determine that the proposed installation of a utility system that involves directional boring or open trenching within a public right-of-way does not demonstrate a need for colocation of County infrastructure.

E. For any installation of a utility system that involves directional boring or open trenching within a public right-of-way that requires colocation of County conduit, the County shall, as a condition of the issuance of the Permit or continued validity of a Permit, require the Entity/Permit Holder to install County conduit with tracer wire and associated infrastructure, as identified by the County, concurrent with the installation of the Permit Holder's infrastructure. The requirement for the Entity/Permit Holder to install County conduit with tracer wire and the associated infrastructure shall be completed after the County has reviewed and approved all estimated costs associated with the co-location of the County conduit. The Permit Holder shall install the County conduit with tracer wire adjacent to the Permit Holder's infrastructure and within the same bore or trench alignment.

F. *The County will bear all costs associated with the colocation, including the County conduit, pull boxes, and all other materials and infrastructure to be installed, including the incremental labor and equipment cost incurred by the Permit Holder (or its contractor or subcontractor) that are reasonably (true industry costs) and directly attributable to the required colocation of County conduit, materials, and infrastructure.*

G. *A completion inspection with the County's designated representative is required. When a colocation of County conduit is required, this completion inspection shall include physical verification of the installed County conduit.*

H. *Upon the County's request, the Permit Holder shall submit to the County signed as-built documentation of the County's conduit and provide the County with a County-approved bill-of-sale or similar document evidencing County conduit ownership following the colocation. The as-built documentation should also be delivered in the form of 3D GIS data, to within a few inches' accuracy, that can be imported into the County's GIS system.*

I. *The County may waive Application Fees set forth in the master fee Schedule for any individual or company seeking to install a utility system that involves directional boring or open trenching within a public right-of-way associated with a County colocation project.*

J. *All applicable fees to restore and/or repair pavement, as establish by the County or as set forth in the County's master fee schedule, shall apply unless and until a written waiver is obtained from the County.*

K. *A Permit Holder may appeal a colocation condition imposed by the County in accordance with the appeals procedure set forth in County Code.*

L. *The Colocation of County Infrastructure with the installation of a utility system, including but not limited to fiber optic cables or other private similar systems, that involves directional boring or open trenching within a public right-of-way shall comply with all the requirements of the County's Right-of-Way Regulations and County Code.*

Conduit and Fiber Construction Specifications

As presented previously, the Roadway Standards manual already includes Conduit and Fiber Construction Specifications. They are in *Section 6 Underground Facilities* and *Section 10 Fiber Optic Cable* of *Appendix F Traffic Signal Specifications* of the manual. Also, as previously mentioned, these specifications seem to align with industry standard specifications and best practices. The only recommendation is that the County might need to clarify that these specifications are applicable to any right-of-way project that involves the installation of conduit and fiber, not just traffic signal projects.

References

[1] "Pavement Utility Cuts". (2018 April 19). Federal Highway Administration (FHWA). Retrieved May 25, 2019, from https://www.fhwa.dot.gov/utilities/utilitycuts/man01.cfm

[2] "Collocation Conduit Installation". (2016 September). Connected Nation. Retrieved October 21, 2021, from http://www.connectmycommunity.org/wp-content/uploads/2016/09/Local-Policy-Guide.pdf

Appendix A: Douglas County Stakeholders Engagement Plan

HRGreen

Douglas County, CO

Broadband Assessment and Feasibility Study

Community Engagement Plan

Overview

One key component of the Broadband Assessment and Feasibility Study is community engagement. This is important to understand the current connectivity in Douglas County, gaps where stakeholders are not served, gaps where there are organizations or citizens who are underserved (not enough capacity, not enough speed, lack of reliability, too high cost, etc.) and to have real information to compare to the Market Assessment (especially if any grants are possible).

This community engagement plan will include the following groups:

- Citizens
- Businesses
- Anchor institutions - Mainly quasi-government: Libraries, Post Office, health and can include key businesses either already present or thinking about locating
- Public entities

In our outreach to these groups, our primary goals are to find out each entity's or household's:

- Current service (provider, capacity, speed, price)
- Satisfaction with their current service
- Concerns with their current service (reliability, capacity, price)
- Anticipated needs for connectivity in the future

The following *Community Engagement Plan* outlines the strategies and tactics we recommend for informing the organizations and households about the study, encouraging their participation and the specific questions we will ask to find out the above information.

The key messages to communicate include:

- The reason why the County is conducting this study and potential benefits to businesses, organizations, and citizens: the goal of this study is to specifically understand where there are broadband connectivity issues (inadequate options, lack of reliability or price issues) for businesses and residents, so that the County can explore options to improve broadband service.
- Encourage businesses, organizations, and residents to take the online survey.
- Encourage businesses, organizations, and residents to engage with public outreach and stakeholder interviews.

Strategies

- Survey:
  - Sample survey for review
    - https://bit.ly/SampleSurveyDouglasCty
  - View submissions results link for the sample survey:
    - https://bit.ly/SampleSurveyDouglasCtyViewResults
  - A significant key to the success of this project will be the surveys. The key to getting enough responses to receive statistically valid response rates is **promotion**. Thus, the form of the survey (virtual only, printed, etc.) and how those will be made available become very important.
  - Survey will be online only. It will be promoted in several formats. We have not included the Scope for printing or mailing surveys (if they could be distributed in utility bills or made available at the County facilities)
  - Online is, typically Plan A. Plan B (backup plan if we are not getting enough responses can include):
    - Printed survey (possibly mailed or dropped off at the courthouse; etc.) – this is possible as Plan B, but not currently in Plan A
    - It is also possible to do some door or door or phone canvassing, but those can become very costly.
  - Survey will be open for 45 days.
  - Statistically significant threshold of responses for a County of 351,154 people, with a confidence level of 95%:
    - Confidence interval of +/- 3% = 1064
    - Confidence interval of +/- 4% = 600
    - Confidence interval of +/- 5% = 384
- Distribution:
  - Working with County public information personnel is very important.
  - What roles will the County, or any local utilities play in promotion and distribution of the survey?
  - Websites – see website list below
  - Social media – see Facebook pages below
  - Email lists – if available, emails can be sent that include the survey link. Do those email lists exist?
  - Printed surveys can be included in utility billings, available at the Courthouse, handed out at public meetings and at information tables (if there are any of these that make sense) – this is possible, but not planned
  - Put on digital billboards on roads and bridges?
- Audience:
  - County residents
  - County Businesses
  - Both – those operating businesses from their homes
  - Anchor Institutions – these will be done in group or individual meetings with questions very similar to the surveys. We meet with them separately to discuss their specific needs, timelines and if they own any broadband infrastructure – see page below for sample questions)
    - Schools
    - Libraries
  - Public entities
    - Fire
    - Police
    - Emergency Management
    - County departments (Administration, Public Works/Engineering, Planning, IT, Finance,

Utilities, Economic Development, Parks, Emergency Management, Police)
        - County departments (where applicable)
    - Other key stakeholders – examples of these could be Chambers of Commerce, Business leaders, major developers (particularly if there are new planned commercial or residential developments that might needs broadband service
- Outcomes:
    - Current market conditions and deficiencies
    - List of local providers
    - What they currently pay
    - Whether their current service is adequate
    - What they like and dislike today
    - Do they have any needs for the future
    - What they do with Internet services
    - Predicted take rate and optimum monthly cost they would be willing to pay – to develop feasibility of options and to use to talk with potential provider partners
    - Whether they want the County taking an active role in improving broadband
    - Demographic questions (their location, age, etc.)
- Stakeholder Outreach:
    - Key Douglas County staff including:
        - Community Development
        - Public Works
        - IT
        - Administration / elected officials (upon request)
    - Chambers and EDCs including:
        - Denver South Economic Development Partnership (EDP),
        - Northwest Douglas County Chamber & EDC
        - Castle Rock Chamber and Visitor Center
    - Educational Agencies including:
        - Douglas County Schools
        - Douglas County Libraries
        - Key Charter Schools
    - State of Colorado staff including:
        - OEDIT, DORA and DOLA (undergoing a consolidation as of July 1 2021)
        - CDOT
    - Incumbent Electric and Telecommunications Providers including:
        - Comcast
        - CenturyLink
        - Conexon /Mountain View Electric Broadband provider/Conexon (announced "P3" service in June 2021)
        - IREA
        - Xcel Energy
    - Local Government Agencies including:
        - DRCOG
        - Highlands Ranch Metro District
        - Castle Rock
        - Castle Pines
        - Lone Tree
        - Franktown
        - Parker
        - Larkspur
    - Emergency Management

- Douglas County Office of Emergency Management
- South Metro District Fire
- West Douglas County Fire Protection District
- Franktown Fire Protection

Social Media

- Monthly Newsletter: email mailing list
- County Website Page:
- Instagram:
- Twitter:
- Facebook:
- Radio/Public Access Channel?
- Other?

Public Meeting

- In these Covid-19 times, meetings are difficult. They can be good to answer questions and to generate interest in the survey. They are best done in person, but they can be done virtually. We find attendance is lower in the virtual setting, but they can still be beneficial. As with the surveys, the key is promotion.

Anchor Institution/Public Sector Stakeholder Input Questions

Current Internet Usage:

- Who is your current provider(s)?
- What service(s) do you have (particularly up/down speed and capacity)?
- Do you feel like it is adequate? How well does your current technology meet the needs of your staff and of the community?
- Do you feel like their service is reliable? How frequently do users experience outages on your current platform?
- What are your current uses? Technologies used within the organization? Can you describe the equipment, standards and versions are currently deployed on your network? Is any of your communications equipment nearing end-of-life?
- Are you leveraging fiber, wireless or other connections to communicate with your equipment in the field?
- Do you have redundancy that you are comfortable with (and - do you know if your redundancy is on the same fiber as their provider)?
- What improvements would you like to see inside your organization in terms of improved connectivity?
- Can you provide any maps or diagrams that would help us better understand the technology and locations for the things we've just discussed?

Future Internet Usage:

- What plans do you have in the next five to 10 years to make significant improvements that will require new applications or upgraded technology?
- Can you describe the capital plan for your department and the types of improvements that you feel the community needs?

Costs:

- Do you feel like your pricing is fair (are you getting what you pay for)?
- How much are you currently paying?
- What is your contract term (when does it expire)?
- What price point would compel you to make a change?
- Do you currently have any grants available for connectivity upgrades?

Other:

- Would you be supportive of a County-led broadband improvement effort.
- Are there any other considerations that you are thinking about with your broadband service?

THERE WILL BE ADAPTATIONS OF THESE QUESTIONS TO SPECIFIC ORGANIZATIONS

Draft Press Release

FOR IMMEDIATE RELEASE

DOUGLAS COUNTY SOLICITING INPUT REGARDING BROADBAND SERVICES
FOR RESIDENTS AND BUSINESSES

Douglas County has initiated a discovery study to gain a clearer understanding of broadband needs in the County An online survey is now available to gather specific information from residents and businesses The survey will be available through XXXXXXXXXX, and may be accessed at XXXXXXXXXX

The County understands that broadband is a critical service for businesses, organizations, and citizens This study will allow the County's leadership to gain a clearer understanding of what steps may be required to gain and maintain a competitive advantage in terms of broadband and to make sure that the community's needs are met The initial phase of the study includes gathering input from County residents, businesses, and key stakeholders to compare against industry data

"We want to take the steps to make sure our citizens and businesses have the connectivity they need to thrive in Douglas County We also view broadband as a competitive issue in keeping the County as one of the top destinations to work and live," said XXXXXXXXXX "To do that, we have to start by having a good picture of what connectivity there currently is and what connectivity issues our citizens and businesses have which will help us determine out what next steps to take "

"We will be gathering input through XXXXXXXXXXX," said [XXXXXXXXXX] "We'd like as many residents and businesses as possible to complete the survey, so we have a clear picture of the needs and gaps in service Our project consultant, HR Green, will also be interviewing government representatives and leaders from various industries during that time to gather additional information "

The study and analysis will be completed this summer The County has contracted with HR Green, a national broadband consulting firm who has worked extensively throughout Colorado, to complete the broadband study

###

Contact: XXXXXXXXXXXXXXX, Title XXXXXXXXXXXXXXXXXXXX at XXXXXXXXXXXXXXXXXXXX or (XXX) XXX-XXXX

HRGreen
Building Communities. Improving Lives.

Stakeholder Interview Schedule

Individual Interviews				
Category	Name	Organization	Email Address(es)	Phone Number(s)
Local Government/HOA	Sam Bishop	Castle Pines	Sam.bishop@castlepinesgov.com	
	Kelly First	Lone Tree	Kelly.first@Countyoflonetree.com	
	Bryce Matthews	The Town of Parker	bmatthews@parkeronline.org	
	Sean Hogan	Larkspur	shogan@townoflarkspur.org	
	Kelly First	Lone Tree	Kelly.first@Countyoflonetree.com	
	Brad Boland	Castle Rock	bboland@crgov.com	
	Forrest Dykstra & Jeff Case	Highlands Ranch Metro Dist & HRCA	Fdykstra@highlandsranch.org & jcase@highlandsranch.org	Jeff: 720-240-4930
	Andrea Mimnaugh	Littleton	drt@littletongov.org	
State/Highway	Richard Solomon	CDOT	Richard.solomon@state.co.us	
	Peggy Davenport	E470 Public Highway Authority	pdavenport@e-470.com	
	Geoffrey Chiapella	DRCOG	gchiapella@drcog.org	
		CBO/OEDIT		
Richard Incumbent Electric and Telecommunications Providers*	Brooks Kaufman	IREA / CORE	BKaufman@Irea.Coop	720-733-5493
	Donna George	Xcel Energy	Donna.L.George@xcelenergy.com	303-571-3306
		Conexon / Mountain View Electric Broadband		
	Scott Moore	Comcast	scott_moore@cable.comcast.com	720-413-0171
	Will Benson	Centurylink	William.Benson2@lumen.com	
	John Rasure	Xtream Internet	rasure@xtreaminternet.com	970-901-6737
	Kelly Judy	Kellin Communications	kelly@kellin.net	720-788-7204
	Jim Carey	DirectLink	jim@mydlmail.com	303-234-3370
	Zachary Schmidt	Thrive Broadband	zachary@thrivebroadband.com	720-907-1642
	Rachel Hall	Vetrofiber	rachel@vetrofibermap.com	954-706-5777
Group Interviews				
HOAs/Metro Districts	Randal Johnson	Perry Park Metro	rjohnson@larkspurfire.org	
	Kristen Bear	Pinery Metro	kbear@wbapc.com	
	Eric Hecox	Meridian Village Metro	Eric.Hecox@sheaproperties.com	
	Stan Myers	Ravenna Metro	stanm@pinnacleconsultinggroupinc.com	
Emergency Services	Jeff Miller	Douglas County Sheriff's Office	wmccormick@douglas.co.us	303-814-7083

	Tim Johnson	DC Office of Emergency Management Director	tmjohnso@dcsheriff.net	303-660-6103
	Sgt. Luke Pinner	Colorado State Patrol	Luke.pinner@state.co.us	
	Aaron Miller	South Metro District Fire	aaron.miller@southmetro.org	720-989-2246
	Terry Thompson	West Douglas County Fire Protection District	t.thompson@westdouglasfire.org	303-688-6055
	Tim Stover	Littleton Fire	Tim.stover@southmetro.org	
	David Woodrick	Franktown Fire Protection	dwoodrick@franktownfire.org	303-688-3811
	Kelly Brooks	West Metro Fire Protection District	kbrooks@westmetrofire.org	
Chambers and EDCs	Becky Nelson & Daniel Hutton	Denver South Economic Development Partnership (EDP)	becky@denver-south.com; Daniel@Denver-South.com	
	Amy Sherman	Northwest Douglas County Chamber & EDC	asherman@nwdouglasCounty.org	
	Frank Gray & Birgit Braehler	Castle Rock Chamber and Visitor Center	frank@castlerockedc.com; birgit@castlerockedc.com	
	Stephanie Mufic & Kelly Folks	Arapahoe/Douglas Works!	smufic@arapahoegov.com; kfolks@arapahoegov.com	Kelly Folks: 720-891-7862
	Rhonda Bilek	Franktown Business Area Metro	rbilek@crsofcolorado.com	
	Bob Blodgett	Compark Business Campus	Bob.blodgett@cliftoncpa.com	
	Michael Penny	South Metro Chamber	Michael.penny@castlepinesco.gov	303-705-0206
Water & Sanitation	Matt Collitt	Louviers Water & San	mcollitt@louvierswsd.org	
	Andrea Cole	Dominion Water & San	andrea.cole@dominionwsd.com	
	Emmalyn White	Centennial Water & San	ewhite@highlandsranch.org	
	Kurt Schlegel	Chatfield South Water Dist	kurt@specialdistrictsolutions.com	
	Chuck Reid	Cherry Creek Basin Water Authority	landusereferral@ccbwqa.org	
	Barbara Price	Sedalia Water & San	Barbaraprice2016@msn.com	
	Kelly Conover	Cottonwood Water & San	kelly@mulhernmre@com	
	Chris Douglass	East Cherry Creek Valley Water & San	cdouglass@eccv.org	
	Barbara Biggs	Roxborough Water & San	barbara@roxwater.org	
Anchor Institutions	Richard Cosgrove	Douglas County Schools	Richard.cosgrove@dcsdk12.org	

	Patti Delay	Douglas County Libraries	powendelay@dclibraries.org	
	Linda Watson & Adam Klatskin	Sky Ridge Medical Center	Linda.watson@healthonecares.com; adam.klatskin@healthonecares.com	
Parks and Recreation	Meg Halford	Colorado State Forest Service	Meg.halford@colostate.edu	
	Brian Banks	Pike National Forest	bbanks@fs.fed.us	
	Maleia Good	Rueter-Hess Rec Authority	mgood@pwsd.org	
	Brett Collins	South Suburban Park & Rec	Planningsupport@ssprd.org	

* For some provider meetings, include Peter Smith/Citizen (Peter.smith@reagan.com)

Later Interviews

Category	Name	Organization	Email Address(es)	Phone Number(s)
Planning & Economic Development	Dan Dertz	Planning Manager	ddertz@douglas.co.us	303-814-4399
	Shanna Austin	Planning Manager	saustin@douglas.co.us	303-814-4349
	CJ Gates	Planner	cgates@douglas.co.us	303-814-4313
	Lauren Pulver	Public Policy Analyst	lpulver@douglas.co.us	303-814-4357
	Matt Williams	DougCo Public Works	Mwillia1@douglas.co.us	303-814-3427
	Andrew Copland	Finance Director	acopland@douglas.co.us	303-660-6175
	Martha Marshall	Budget Director	mmarshal@douglas.co.us	303-663-6174
	Tim Hallmark	FFESS Director	thallmar@douglas.co.us	303-663-7275 M: 303-842-2113
	Zeke Lynch	Traffic Operations Manager	traffic@douglas.co.us	303-663-6237
IT	Laura Kesner	Program Mgt Manager	lkesner@douglas.co.us	303-663-6243
	Gail Stere	GIS Analyst	gstere@douglas.co.us	303-663-6216
	Bill McCormick	Cybersecurity/Network Operations Manager	wmccormick@douglas.co.us	303-660-7323

Appendix B: Douglas County Residential Internet Survey

Douglas County is evaluating high-speed internet access (also known as broadband) within the County to understand availability, service options, and connectivity strength. Residents are invited to provide information about high-speed internet access at your **HOME** that will be used to identify current and future needs.

The survey takes only a few minutes to complete. All responses are anonymous and confidential. Please limit participation to one person per household. Participants should use a device connected to a high-speed internet connection (through WiFi or Ethernet), NOT a cellular connection (4G/LTE/5G), to take the survey. The survey is open through October 31, 2021.

1 Please provide your home address.
The information is only used to identify your location for purposes of the internet speed test.
Please make sure that the location selected in this question is where you would receive home internet service.
Press the ◌ circle symbol for the tool to find your location. If the tool does not accurately represent your location, please type your address into the address box at the top.
Tip: This question will try to use your location. Press to continue.
Find address or place
Esri, HERE, Garmin, FAO, USGS, NGA, EPA, NPS

2 If you are having technical difficulties with the tool above, please enter your residential subdivision name in the box below:
Please be as specific as possible. Your location information is important in determining internet service quality in your neighborhood.

3 Does your home subscribe to Internet Service? *

4 Home Internet Service

5 Who is your PRIMARY home internet service provider?

6 Now, we'd like to determine your actual internet download and upload speeds.

CLICK HERE to open up a new browser window and conduct a speed test (using www.speedtest.net).

This speed test should be using your HOME INTERNET CONNECTION (over WiFi or Ethernet), NOT your cellular data connection (4G/LTE/5G - unless you've indicated you ONLY use cellular as an internet provider).
After the speed test is complete, please type your results in the boxes below.

7 Download Speed (in Mbps):

8 Upload Speed (in Mbps):

9 How do you use internet service at home? (check all that apply)

10 Please rate your level of SATISFACTION with your home internet service in the following categories:

	Very dissatisfied	Somewhat dissatisfied	It's OK	Somewhat satisfied	Very Satisfied
Price					
Reliability (frequency and length of service interruptions)					
Speed/Data Rate					
Overall Satisfaction					

	Very dissatisfied	Somewhat dissatisfied	It's OK	Somewhat satisfied	Very Satisfied
Price					

11 Please rate the level of IMPORTANCE you consider each of the previous categories:

	1-Very unimportant	2-Somewhat unimportant	3-Neither important nor unimportant	4-Somewhat important	5-Very important
Customer service experience					
Data allowance					
Price					
Reliability (frequency and length of service interruptions)					
Speed/Data Rate					

12 Do you or anyone in your home currently use the internet to work from home or run a business?

13 How often do you experience outages of an hour or longer due to connection problems or slow/inoperable speeds?

14 Have you considered moving or relocating as a result of limited access to high-speed, broadband internet services?

15 How likely is it that you would recommend your home internet service provider to a friend or colleague?

Very Unlikely
Unlikely
Neutral
Likely
Very Likely

16 Do you have any other comments, questions, or concerns about your current home internet service?

17 Not an Internet Subscriber
For purposes of the study, we would like to learn more about why you choose not to subscribe to internet service at your home

18 What are the reason(s) you do not subscribe to internet service at home? Check all that apply.

19 Broadband Internet In Your Community

20 Do you consider internet to be an essential public infrastructure similar to electriCounty, water, and transportation?

21 In your opinion, how important is fast, affordable, reliable, and universally-available broadband internet service in your area in regards to the following community attributes?

	1-Not important	2-Somewhat unimportant	3-Neither important nor unimportant	4-Somewhat important	5-Very important
Education (for kids and adults)					
Economic development and jobs					
Health care (remote health care, virtual doctor visits)					

	1-Not important	2-Somewhat unimportant	3-Neither important nor unimportant	4-Somewhat important	5-Very important
Quality of life (making my area a good place to live)					
Remote work					

22 How well do you think the current providers meet these needs?

Not at All
Bare Minimum
It's OK
Mostly
Very Well

23 How strongly do you feel that the County needs to help facilitate better broadband?
1 = Not at All
5 = Strongly feel there is an issue and would like the County to help facilitate

24 Would you participate in an organized effort led by your subdivision/neighborhood/HOA to improve broadband service?

25 Additional comments, questions, or concerns

26 Tell Us About Your Household!
Please tell us more about the person answering this survey. This will allow us to ensure that the people who answer the survey are representative of the community as a whole.
Again, all responses will be kept private and are used only for demographic purposes.

27 Gender (of the person answering this survey)

28 EthniCounty (of the person answering this survey). Check any that apply.

29 Age (of the person answering this survey)

30 What is your annual household income?

31 What is the highest level of education you have completed? (for the person answering this survey)

32 Thank You!
We appreciate you taking the time to participate in this survey!
Please click SUBMIT below