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# Regional Broadband Strategic Plan

*Five-Year Broadband Development Strategy*



**COLORADO**  
Department of Local Affairs

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Mid-State Consultants – OHLvey  
Sponsored By Colorado Department of  
Local Affairs



# Regional Broadband Strategic Plan

*Five-Year Broadband Development Strategy*

## Overview



Broadband infrastructure and services have become essential components of community economic vitality and quality of life. As such, local, state, and federal entities see that the public sector can and must play an important role in broadband development. In the Upper Arkansas area (comprising Chaffee, Custer, Fremont, Lake, and Park Counties), citizens, business groups, economic development organizations, and others have recognized the essential contribution of broadband services and have begun working on improving services throughout the region. Some of these efforts have been led by Local Technology Planning Teams, others by economic development organizations, still others by forward looking private sector service providers. This Regional Broadband Strategic Plan aims to better coordinate these ongoing efforts and to chart a future course by asking three questions about the Upper Arkansas Area broadband environment:

1. Where are we now?
2. Where do we want to be?
3. How do we bridge the gaps?

### **Where Are We Now**

The state of broadband in the Upper Arkansas area is typical of much of rural Colorado (and of rural America). In the body of the report, we will examine last mile and middle mile infrastructure and services.

#### *Middle Mile*

The middle mile is that infrastructure and those services that connect aggregation points to each other and connect the region to the rest of the world.

The region enjoys more middle mile route diversity than many other rural areas in Colorado. However, weaknesses in middle mile availability, capacity, and reliability (through both logical and physical diversity) may be undermining economic development in the region.

#### *Last Mile*

The last mile is that infrastructure and those services that connect individual subscribers to the network.

In the last mile, the area is characterized by generally available DSL service from CenturyLink. The quality of DSL service degrades the further the customer's premises is from the serving DSLAM. Because of this, regional customers in more urbanized areas (typically closer to the CenturyLink central office) or near remote node sites get better DSL service. In addition to DSL service, some more urbanized areas benefit from Charter's cable modem services. Cable modem customers can experience significant differences in quality of service depending on the congestion of node they connect to, the capacity of and congestion on the cable company's "backhaul", and other factors.

Very limited areas in the region have access to metropolitan optical Ethernet services or other very high speed services.

Much of the region is served by one or more fixed wireless providers. Fixed wireless services significantly extend wireline service areas and make broadband services available to more remote areas. However, fixed wireless services are typically characterized by higher prices per Mbps and often more limited in the maximum bandwidth available to subscribers.

### **Where Do We Want to Be**

Local governments, citizens groups, businesses, and others throughout the region recognize a growing trend towards a location neutral workforce – that is workers that can function as well from the Upper

Arkansas area as they can from the more urbanized Front Range or other metropolitan areas. They also recognize the importance of broadband to tourism, the medical industry, and other existing and target business sectors in the region. The Internet doesn't know or care if you are accessing services from Bailey, Colorado or Buffalo, New York; Fremont, California or Fremont County. To be competitive from a broadband perspective, the region must offer services and pricing reasonably comparable with more urbanized areas.

Broadband development that benefits only the more densely populated areas may be pragmatic but it seems fundamentally unfair. America included both urban and rural areas in its electrification and universal telephone service. In the region, we recognize we may not be able to provide equal service to all addresses, but we should make an effort to develop broadband in such a way that no residents or businesses are left without benefit.

To ensure the region remains a competitive and economically viable area, the participating entities want to ensure an available, adequate (both in capacity and reliability), affordable, and sustainable broadband environment.

### **How Do We Bridge the Gaps**

In this Regional Broadband Strategic Plan, we have developed both general and specific recommendations. Some of the actions described herein affect a specific area or service. Others are more general and adoptable by the region as a whole. Four ideas stand as important guidelines for efforts to "bridge the gaps":

1. Broadband development is a moving target. Twenty years ago, broadband didn't exist; ten years ago it was a new idea gaining broad acceptance through the implementation of cable modem services; five years ago the FCC defined broadband as "...high-speed Internet access that is always on and faster than the traditional dial-up access."<sup>1</sup> Today, the FCC defines broadband as 25 Mbps download speeds with 3 Mbps upload speeds.<sup>2</sup> Because the target is constantly shifting, solving today's broadband problems does not mean there will be no need for new development tomorrow.
2. Each County in the region – and even areas within the individual counties – has different broadband needs and development expectations.
3. Even though each County has unique needs and objectives, broadband development in the region will benefit from cooperative efforts, market aggregation, and other regional efforts. To

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<sup>1</sup> <http://www.fcc.gov/encyclopedia/types-broadband-connections>

<sup>2</sup> <http://www.fcc.gov/document/fcc-finds-us-broadband-deployment-not-keeping-pace>

help coordinate these regional efforts, the Steering Committee or some like body should continue beyond this regional broadband strategic planning effort.

4. Rural areas represent significant business justification issues for private sector broadband providers. Public sector broadband development in coordination and cooperation with private sector providers will likely produce the most desirable results.

The following Regional Broadband Strategic Plan offers a template for broadband development throughout the Upper Arkansas Area. It provides a framework for continued broadband development throughout the region and makes complementary recommendations to help each community advance the quality of their individual broadband environment within the context of regional progress. This plan does not provide sufficient detail to execute individual recommended actions – this detail is the responsibility of individual communities.

## About This Document

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The project to create this document was sponsored by the Upper Arkansas Area Council of Governments ([UAACOG](#)) and its member jurisdictions with the assistance of a grant from the Colorado Department of Local Affairs ([DOLA](#)).

Mid-State Consultants and OHlvey created this document and the accompanying web site under the guidance and direction of the UAACOG Regional Broadband Strategic Plan Steering Committee. The committee includes:

- From Chaffee County
  - Bob Christiansen
  - Wendell Pryor
- From Custer County
  - Charles Bogle
  - Dale Mullen
- From Fremont County
  - Lisa Hall
  - John Papen
- From Lake County
  - Dolores Semsack
  - Nicole Thompson
- From Park County
  - Mike Brazell
  - Alex Telthorst

Judy Lohnes is the project responsible administrator and de-facto committee chair. Paul Recanzone of [Mid-State Consultants](#) and [OHivey](#) is the primary author.

Much of the background information supporting assertions made in this plan document is found on an accompanying web site at [www.ohivey.com/bbplanning/uaacog](http://www.ohivey.com/bbplanning/uaacog). This document is designed for both electronic and print distribution. To that end, we have included links to supporting information on the web site throughout the document.

## Change History

Ver.	Date	Author	Notes
1.00	18 Mar 2015	Recanzone	Original version. Future versions will incorporate web links.
1.01	26 Mar 2015	Recanzone	Updated Fremont County logo on the cover.

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## Basic Principles



*Broadband is the great infrastructure challenge of the early 21<sup>st</sup> century.*

*Like electricity a century ago, broadband is a foundation for economic growth, job creation, global competitiveness and a better way of life. It is enabling entirely new industries and unlocking vast new possibilities for existing ones. It is changing how we educate children, deliver health care, manage energy, ensure public safety, engage government, and access, organize and disseminate knowledge.<sup>3</sup>*

As the Internet got started, it was in the “slow” lane. From the first data connections in the late 1950s through the development of the commercial Internet in the 1990s, data was typically passed on dedicated lines or using dial-up modems to connect at 56 Kbps. In the late 1990s and early 2000s, broadband technologies started becoming widely available. First, ISDN services offered data speeds of up to 128 Kbps. Shortly on the heels of ISDN came DSL with data speeds above 1 Mbps and the DOCSIS standard which allowed for two way data transmissions on the cable companies’ coaxial systems.

Today broadband speeds are delivered over the airwaves via fixed and mobile wireless, through traditional twisted pair wire using a variety of DSL technology, over cable companies’ coaxial networks, and at the speed of light over fiber optic cabling.

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<sup>3</sup> National Broadband Plan Executive Summary. <http://www.fcc.gov/national-broadband-plan>.

The current FCC definition of broadband is 4 Mbps download and 1 Mbps upload (4/1 Mbps)<sup>4</sup>. In mid-December, of 2014, the FCC increased the definition of rural broadband speeds under the Connect America Fund. “The FCC will now require companies receiving Connect America funding for fixed broadband to serve consumers with speeds of at least 10 Mbps for downloads and 1 Mbps for uploads. That is an increase reflecting marketplace and technological changes since the FCC set its previous requirement in 2011.”<sup>5</sup> In early 2015, the FCC signaled that it will begin the process to redefine broadband as 25/3 Mbps. While these recent announcements do not change the FCC definition of broadband, they do signal the potential for change.

The definition of adequate broadband speed is constantly shifting. As data capacity increases, application developers build services that take advantage of the new speed. As applications require more data transfer capacity, broadband network owners look for ways to increase speeds. On their Broadband.gov web site, the FCC states:

*Broadband provides access to the highest quality Internet services—streaming media, VoIP (Internet phone), gaming, and interactive services. Many of these current and newly-developing services require the transfer of large amounts of data that may not be technically feasible with dial-up service. Therefore, broadband service may be increasingly necessary to access the full range of services and opportunities that the Internet can offer.*<sup>6</sup>

Regardless of the FCC’s definition, we like to joke that broadband is internet access that is faster than whatever you have now. The joke, however, does not strike too far from the truth. As we look at improving broadband in the Upper Arkansas area, we have devised a strategic plan that has potential to improve broadband for everyone. Those that have no broadband today may see a 4 or 10 Mbps wireless link as a significant improvement; but those speeds would not “provide access to the highest quality Internet services.” To get the highest quality Internet services, residential subscribers need access to data speeds today closer to the 20 to 30 Mbps range. Even at 20 to 30 Mbps many businesses find their broadband speeds to be inadequate. They struggle with their connectivity and hope for improvements that will lift them to above 100 Mbps. To attract data centers, call centers, and other data intensive businesses, 100 Mbps service is inadequate. Economic development may demand broadband improvements to the 1 Gbps range or better. Even at these faster speeds, if the network isn’t reliable, if it doesn’t have diverse paths, or if costs are too high, communities are at a disadvantage when trying to attract and retain 21<sup>st</sup> century businesses. While the economic development director unable to attract a call center and the jobs it represents to her town and the potential subscriber

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<sup>4</sup> Defined in 2011 and current as of December 2014.

<sup>5</sup> [http://transition.fcc.gov/Daily\\_Releases/Daily\\_Business/2014/db1211/DOC-330989A1.pdf](http://transition.fcc.gov/Daily_Releases/Daily_Business/2014/db1211/DOC-330989A1.pdf).

<sup>6</sup> Broadband.gov. “What is Broadband?” FCC. [http://www.broadband.gov/about\\_broadband.html](http://www.broadband.gov/about_broadband.html).

outside the range of any broadband service at all have very different problems, they both have broadband problems.

## Economic Vitality and Quality of Life

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Solving broadband problems is in the public interest. Improved broadband brings improved quality of life and better economic development opportunities.

Many public safety functions depend on communications. This Regional Broadband Strategic Plan is not intended to directly address public safety, however, improved broadband creates improved public safety opportunities. Because of broadband development, police and private security companies can deploy high definition and heat sensitive security cameras for remote monitoring of sensitive areas. Fire departments can take advantage of data provided via intelligent alarm systems. Police departments can more effectively use systems like Shot Spotter to detect and deter violent crime.

Broadband development supports economic development. As the 21<sup>st</sup> century economy evolves, many “knowledge” jobs continue to develop. Many of these knowledge jobs are “location neutral” meaning the worker can be anywhere and still contribute – so long as the worker has adequate and affordable access to resources, the rest of their team, and the world through broadband connectivity.

Economic vitality is dependent upon the availability of affordable and abundant broadband services. Businesses large and small are already heavy users of the Internet, and their bandwidth needs will increase dramatically as two business trends accelerate:

- Business travel costs continue to outpace inflation – both the cost of ordinary commuting to the workplace and the cost of out of town business travel. Businesses are investing in HD quality business videoconferencing systems and will make more use of them to reduce travel costs. These systems require significant bandwidth; bandwidth not reliably available throughout much of the Upper Arkansas area.
- Perhaps more importantly than enabling reductions in business travel, affordable and abundant broadband makes telecommuting and working from home a viable reality. High performance, reliable and affordable broadband services make it possible for workers with jobs on the Front Range and around the country or home based entrepreneurs and other location neutral workers to live and work in the beautiful environment of the Upper Arkansas area.

Broadband development is a critical component of an economic development strategy but it is no silver bullet. Broadband investments need to be tied to a wider set of community and economic development strategies that help make regions engaging and interesting places to locate and run businesses, and to make communities vibrant and safe places to live. Communities that have made broadband investments without taking the time to identify a broader set of goals and expected outcomes have

often been disappointed when their broadband investments have made insignificant impact. However, it is clear that broadband investments are critical for economic vitality. In May of 2012 David Salway, in an article for About.com suggests, “There is little debate that increasing broadband access spurs economic development, but can this be quantified?”<sup>7</sup> Salway then compiles a list of some of the leading research completed on the economic effects of broadband. Paraphrasing Salway’s list:

- Robert Atkinson of The Information Technology and Innovation Foundation<sup>8</sup> claims in an Associated Press/USA Today article by Joelle Tessler that, “a \$10 billion investment in broadband would produce as many as 498,000 new jobs.”<sup>9</sup>
- In “The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data,” Robert Crandall, William Lehr, and Robert Litan of the Brookings Institute, the authors determine that for every one percentage point increase in broadband penetration in a state, employment is projected to increase by 0.2 to 0.3 percent per year.<sup>10</sup>
- In “Broadband Infrastructure and Economic Growth,” Nina Czernich, et. al. find that “a 10 percentage point increase in broadband penetration raises annual per-capita growth by 0.9-1.5 percentage points.”<sup>11</sup>
- Between 1998-2002 communities that gained access to broadband service experienced an employment growth increase of 1% to 1.4%, a business establishment increase of 0.5% to 1.2%, and a rental value increase of 6%.
- Kristen Van Gaasbeck, et. al. found in their “Economic Effects of Increased Broadband Use in California Research Report” that “this analysis paints a clear picture of how increased broadband use (and the migration from dial-up to broadband) affects employment and payroll in California and a select group of its regions – the direction of the effect is always positive and the magnitude depends on the size of the shift in the percentage of the adult population using a broadband Internet connection. Even a small increase in broadband use could generate a

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<sup>7</sup> Salway, David (May 2012). “Broadband as an Economic Driver.” About.Com.

<http://broadband.about.com/od/economicdevelopment/a/Broadband-As-An-Economic-Driver.htm>.

<sup>8</sup> <http://www.itif.org/>

<sup>9</sup> Tessler, Joelle (6 February 2009). “Broadband Funding in Stimulus Plan Sparks Debate.” USA Today.

[http://www.usatoday.com/tech/news/2009-02-06-broadband-funding\\_N.htm](http://www.usatoday.com/tech/news/2009-02-06-broadband-funding_N.htm).

<sup>10</sup> Crandall, Robert W., William Lehr, and Robert Litan (July 2007). “The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data.” The Brookings Institute Issues in Economic Policy; Washington, DC. <http://www.brookings.edu/views/papers/crandall/200706litan.pdf>.

[http://www.brookings.edu/~media/research/files/papers/2007/6/labor%20crandall/06labor\\_crandall.pdf](http://www.brookings.edu/~media/research/files/papers/2007/6/labor%20crandall/06labor_crandall.pdf).

<sup>11</sup> Czernich, Nina, Oliver Falck, Tobias Kretschmer, and Ludger Woessman (December 2009). “Broadband Infrastructure and Economic Growth.” CESIFO Working Paper.

[http://www.cesifo.de/pls/guestci/download/CESifo%20Working%20Papers%202009/CESifo%20Working%20Paper%20December%202009/cesifo1\\_wp2861.pdf](http://www.cesifo.de/pls/guestci/download/CESifo%20Working%20Papers%202009/CESifo%20Working%20Paper%20December%202009/cesifo1_wp2861.pdf).

substantial cumulative gain over the next 10 years compared to what could be expected under business as usual conditions.”

- For every \$1 million granted for broadband development, 15 jobs would be created.

Community investments in infrastructure in cooperation with local providers will accelerate the availability of broadband options within the Upper Arkansas communities.

Broadband development supports key economic vitality sectors in the Upper Arkansas area like tourism/outdoor recreation and healthcare.

### Broadband Development and Tourism/Outdoor Recreation

Broadband is increasingly becoming essential for tourist destinations and business in the resort and tourism industry. Travelers may seek out distant locales to “get away from it all” but they still want – or need – to be somewhat connected to the rest of the world. Put simply, visitors expect their cell phones to work, expect to access the Internet from their mobile devices, and expect broadband service at their lodging and other locations. Failure to provide these basic levels of service will drive visitors away – temporarily while they go to a nearby location to connect to the world or permanently as they schedule visits to other locales that offer these basic 21<sup>st</sup> century amenities.<sup>12</sup>

The Upper Arkansas area, with the rugged beauty of the Continental Divide and numerous outdoor recreation opportunities, has a vested interest in ensuring the region’s resort and tourism industry is equipped to handle the changing needs of today’s travelers. Of course, this also means the communities in and around tourist destinations must have the basic infrastructure to support the broadband needs of their visitors.

Tourism businesses create jobs and ensure the vitality of communities in the Upper Arkansas area. Not only is broadband connectivity expected by visitors to the area, tourism and resort businesses can leverage broadband to attract new visitors, train employees, and market their products or services in a way that makes size and location less relevant than ever before.

1. Resort and tourism broadband is characterized by three critical (though not necessarily unique) issues: Resorts and tourist destinations must be able to reach out to potential visitors,
2. Like all businesses, resorts and tourist destinations must be able to use the internet to bank, manage personnel, conduct training, and otherwise conduct business, and
3. Visitors need connectivity when they arrive and businesses need connectivity to support them.

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<sup>12</sup> Some of the data for this section comes from research done by the Missouri broadband development organization MoBroadbandNow. MoBroadbandNow can be found on the web at <http://mobroadbandnow.com/>.

Increasingly, travelers are planning trips and making reservations online. Booking online is usually cheaper as it avoids the added commission and cost of a travel agency, and there are some great deals to be found on transportation and lodging. If a resort, travel destination, or supporting business is not found online, it's likely invisible to all but locals and regularly returning clients.

More than just an advertising tool, small businesses are increasingly using cloud and other bandwidth intensive services to manage their businesses. They use online accounting to track their finances and issue payroll. They use credit services to run credit cards. They conduct market research online. They connect to parent companies and partners. They manage supply chains electronically. All of these functions require significant reliable bandwidth.

Once visitors have planned their trip using online information provided by local businesses, they expect to connect when they arrive. Not only do they expect to connect, but they expect the businesses they are dealing with to be connected as well.

In his paper, "Broadband and the Hospitality Industry"<sup>13</sup>, Douglas Rice writes:

*Proliferation of e-mail, growing sizes of attachments, and the advent and refinement of multimedia content have continually raised the bar for bandwidth. Ten years ago, most homes with Internet access had bandwidth of perhaps 28 kilobits per second. Today, standard home offerings in many markets can start at 10 megabits per second downstream, and 50 megabits or more is not unusual – nearly a two thousand-fold increase in ten years. ...it sets the expectation of virtually instantaneous response for any type of content, no matter how bandwidth-intensive.*

*The vast majority of hotels have lagged behind this trend, however. Many hotels have only a few megabits of capacity to share among hundreds of potential users in their guest rooms and administrative offices. This may be sufficient for light use such as e-mail, where only a handful of users may be active at any point in time. But with the recent growth in video streaming, hotel usage of Internet bandwidth has become heavily skewed toward the evening hours when guests are in their rooms, and those guests expect performance similar to what they have at home. The numbers simply don't work: if just 10 guests are streaming video at one time, even at low quality, they will overwhelm the capacity of most of today's hotel Internet connections. Not only will those particular guests be unhappy, but in most hotels, this will prevent other guests from even accessing their e-mail or doing light web surfing.*

Rice suggest that hotels and resorts are reluctant to purchase sufficient bandwidth to meet their guests expectations because a) they are constrained by ISP business and pricing models that don't align with

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<sup>13</sup> Rice, Douglas (no date). "Broadband and the Hospitality Industry". Viewed 5 November 2013 at <http://10yearsofbroadband.com/public/images/pdf/Douglas%20Rice%20Hotel%20Technology%20Next%20Generation.pdf>.

the hospitality industry and b) hoteliers and resort property owners see very little opportunity for direct cost recovery from offering broadband services. Nonetheless, he suggests that if a property could get “cheap, effectively unlimited bandwidth” they could add services that would enhance the property’s competitive edge. Rice lists:

- Entertainment content that might include:
  - Licensed programming from Internet-based sources, which may be free, subscription-based, or pay-per-view;
  - High-value programming such as sports and concerts, as well as traditional cinema, television, and short subject programming;
  - Content stored elsewhere, such as on a guest’s home DVR; and
  - Content that was broadcast live at an earlier point in time and stored on a network-based device.
- Videoconferencing and meeting technology.
  - Rice writes, “To be sure, face-to-face meetings and conferences will always have important advantages over electronic ones, and hotels will always be a preferred venue for face-to-face meetings. But few meetings and conferences cannot be enhanced by videoconferencing and virtualization technology.”
- Virtualization of hotel systems.

Besides the rural nature of the Upper Arkansas area and the difficult terrain (making broadband deployment generally difficult), resort communities in the region generally face an additional hurdle to advancing broadband in that a significant user base – the tourist population – expects connectivity as an amenity but has low tolerance for paying to support the infrastructure needed to provide connectivity. Thus, the burden of deploying and supporting broadband infrastructure for this customer base is shifted to the residents and local businesses who only indirectly benefit from their guests’ broadband usage. Communities may need to develop secondary revenue sources like room taxes or other use taxes to support broadband implementation or subsidize operations.

## Broadband Development and Healthcare

The US healthcare system is expensive, overburdened, and inefficient. In 2006, national healthcare costs grew 6.7 percent to \$2.1 trillion, or \$7,026 per person, and accounted for 16 percent of gross domestic product (GDP). Similar growth is projected to continue past 2017 at which point healthcare will account for nearly 20 percent of GDP. Some of this expense can be attributed to the inappropriate reliance on costly hospital emergency rooms, which are often sought after traditional office hours or in communities with a shortage of physicians. In fact, over half (55 percent) of the 114 million emergency room visits Americans make each year are for non-emergencies, accounting for \$31 billion annually, or \$300 per American household. Broadband technology can dramatically reduce these expenses by providing the tools to remotely monitor patients, allow collaboration between healthcare professionals,

facilitate the transfer of healthcare data and images, and increase access to emergency services in remote areas. By one estimate, these services can lead to savings of \$165 billion per year<sup>14</sup>. “Always-on broadband” is “essential” for some of these applications and greatly improves others that “depend on uninterrupted real-time transmission.”

Some of the ways broadband improves the healthcare sector include storage and transmittal of healthcare information, enabling of remote health monitoring, potential for lowering medical transportation costs, and otherwise improving efficiencies in service.

## Broadband Characteristics

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Broadband is described by four characteristics: availability, adequacy, affordability, and sustainability.

### Available

Extending broadband availability involves efforts to reach locations not already served or to extend additional capabilities or competitive choice to locations with limited capabilities. Initial efforts to extend reach typically rely on fixed wireless technologies. Extending reach and increasing capacity are complementary, especially in rural and remote areas.

### Affordable

The broadband environment improves when costs go down. Users may see higher monthly bills but still benefit from lower costs. For example, subscribers previously purchasing a 5 Mbps download wireless service for \$45 per month may now be paying \$75 per month for a 100 Mbps connection. Their monthly bill has gone up by nearly 2/3 but they are paying \$0.75 per Mbps per month instead of \$9 per Mbps per month.

### Adequate

The adequacy of broadband services is judged by its capacity and reliability

- Capacity  
Broadband capacity – measured in megabits per second download and upload speeds – affects the experience in the online world. Increasing capacity must be targeted at capacity bottlenecks. If adequate backhaul, or middle mile, capacity exists to support subscribers but their access level infrastructure, or last mile, does not provide sufficient connectivity to capitalize on that backhaul, increasing backhaul capacity will only have a marginal effect.
- Reliability

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<sup>14</sup> Extrapolated from Rand Health in 2005 as cited by the Business Roundtable in [http://businessroundtable.org/sites/default/files/BRT\\_Hill\\_Event\\_Brochure\\_Split-10-13.pdf](http://businessroundtable.org/sites/default/files/BRT_Hill_Event_Brochure_Split-10-13.pdf).

In order to provide a satisfactory user experience and to ensure an adequate platform for economic development, services must be available when needed or desired.

Reliability is typically improved by building redundancy into the system. Redundancy is achieved through path diversity, logical redundancy, operational redundancy, etc.

#### Sustainable

Broadband competition spurs innovation and drives costs down. However, small markets can only sustain a reasonable number of broadband providers. Middle mile and last mile infrastructure deployment is capital intensive. Sustainable broadband development requires careful management of the market and, especially in rural areas, may require public subsidization or other public efforts.

As we discuss these broadband characteristics, we may use quantitative or qualitative measures to compare their state in the Upper Arkansas area with other areas, national averages, or ideal objectives. When we use qualitative measures, we will discuss the relative quality of the characteristic as non-existent, very poor, poor, good, very good, and excellent.

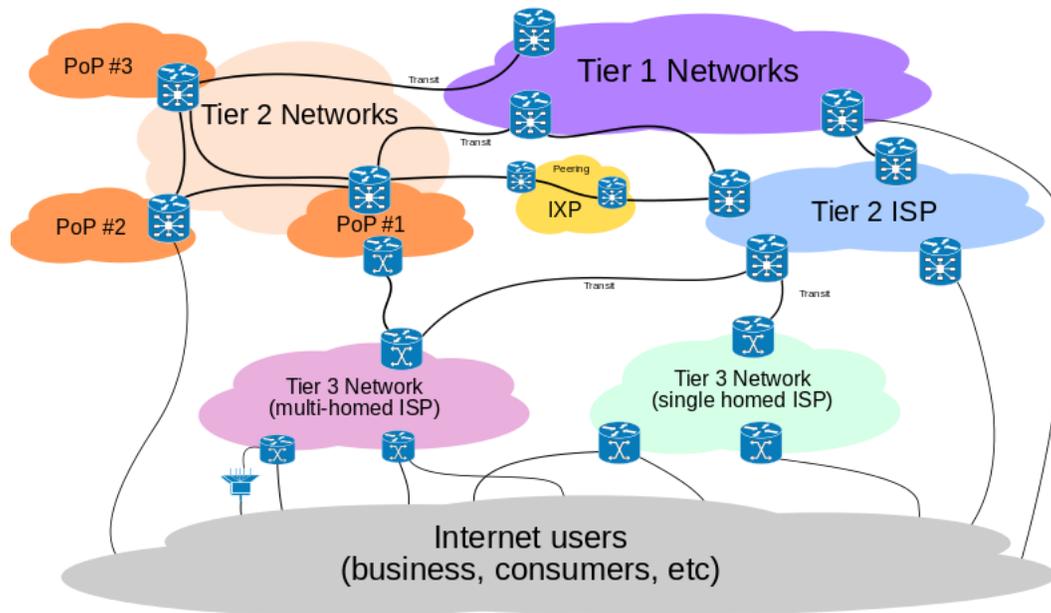
## Broadband Infrastructure

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The Internet is sometimes called the “information superhighway” and it can be understood using a road analogy. Like the road system, the Internet has “highways” and “surface streets”. On the information superhighway, the highways are called “middle mile” infrastructure and the surface streets are called “last mile”.

Of course surface streets and freeways come in many varieties. Highways range from multi-lane interstate freeways to two-lane state highways. Surface streets can be major collector roads, neighborhood streets, or even driveways. The broadband road system has just as much variety as the streets. Because of this variety, we may sometimes need to break last mile infrastructure into distribution level infrastructure (collector roads), access level infrastructure (neighborhood roads), or drop level infrastructure (driveways). We may need to talk about “off-ramps” or add/drop points on middle mile infrastructure. We may need to layer Internet access by local, regional, and national/international Internet service providers.

To complete the analogy, we need one more piece. Just like the road system tends to channel vehicle traffic towards large population centers where multiple roads (and other transportation options) come together, broadband networks channel data traffic towards “peering points” or “internet exchange points” (IXPs). Peering points are data centers where national and international broadband networks (called Tier 1 Networks) converge. At these peering points, Internet traffic can easily cross from one major network to another and, for the user, viewing a web page from South Africa can be just as easy as watching a movie hosted on a server in South Carolina; sending an email to your grandkids in Denver can be just as easy as video conferencing with a client in Dusseldorf.



**Figure 1: High Level Internet Diagram**

“Figure 1: High Level Internet Diagram” depicts how these pieces interrelate. The black route lines at the bottom of the diagram (from the “Internet users” cloud) represent last mile infrastructure. The black route lines in between the local and regional ISPs (the pink and green clouds) and between the national and international networks (the purple, orange, and blue clouds) represent middle mile infrastructure.

## Middle Mile

Sometimes called “backhaul”, middle mile paths provide extra-regional connectivity. It is important to have sufficient capacity, path diversity, logical redundancy, and reasonable pricing on middle mile paths.

The preferred transport medium for middle mile infrastructure is fiber optic cable. Good quality fiber cables lend themselves to extraordinary data capacity. Commonly available systems can divide a single fiber pair into up to 80 channels carrying 10 Gbps each or 800 Gbps total. More advanced systems can create more channels at faster speeds. In 2011 NEC demonstrated an experimental system with 370 channels each with a capacity of more than 270 Gbps for a total line speed on a single pair of fiber of 101 Tbps (101,000,000 Mbps). The limiting factor is the connecting technology, the technology does not yet exist that will saturate a fiber pair. Thus the deployment of fiber infrastructure can be expected to survive many connecting technology turns, multiple generations of subscribers and an extended return on investment.

Consider the following illustration of the long term scalability of fiber: if a standard drinking straw represent dial up speeds (56K), then a pipe about a foot in diameter equals a 100 Mbps connection. Using the same scale, a Gigabit connection would be represented by a pipe about 3 feet in diameter. Commercially available connections for a single fiber pair would be represented by a pipe about 115 feet in diameter. To represent the theoretical capacity of a single fiber pair, we would need a pipe about 1,600 feet in diameter – or as large as the Hoover Dam.



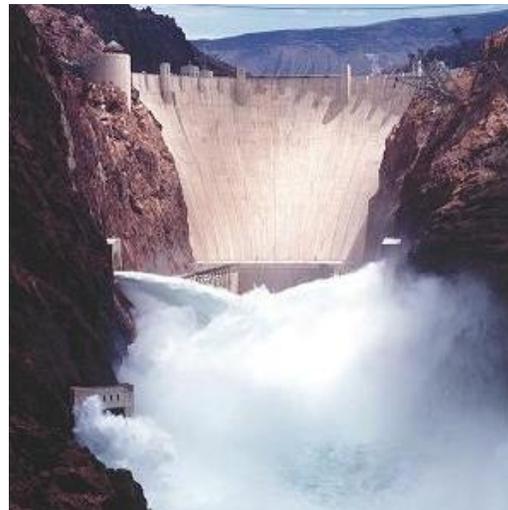
*If we establish a scale where the straw on the left represents typical dial-up speeds, the straw on the right represents basic DSL speeds.*



*On this same scale, a 1 foot diameter pipe represents a 10 Mbps connection. It takes the 3 foot diameter pipe on the ground to represent the Gbps connections being delivered in many cities today.*



*Commercially available systems can deliver capacity that, on this scale, would be represented by a pipe about 115 feet in diameter.*



*On this scale, the theoretical capacity of a single pair of fiber would require a pipe about 1,600 feet in diameter – or as large as the Hoover Dam.*

Because of its phenomenal capacity, fiber is the preferred medium for middle mile infrastructure. Licensed microwave links offer a lower cost reasonable alternative to more expensive fiber optic deployments. Licensed microwave links typically provide 1 Gbps speeds. Multiple channels can be “bound” to provide speeds of up to 4 Gbps.

Because middle mile infrastructure is extra-regional, it is difficult for individual communities to influence the quality of their middle mile environment. Local jurisdictions can wield influence on middle mile quality by working to persuade private carriers to provide robust, high capacity, reasonably priced backhaul. Communities can also work to aggregate demand to increase their purchasing power and then use that increased purchasing power to influence carrier behavior. As a region, the Upper Arkansas area can work together to influence carrier behavior and implement middle mile solutions.

## Last Mile

As noted above, when we talk about last mile infrastructure, we may need to talk about distribution, access, or drop architecture.

### Distribution

Middle mile paths usually terminate at a facility or location from which data connectivity is distributed in a local area. In the traditional circuit switched telecommunications world, this facility is called the central office and this term is still used by many carriers. Others call this “meet me” point a colocation facility or a point-of-presence (POP).

Distribution paths are usually developed in a ring architecture to provide path diversity and redundancy. Some intra-regional distribution paths may connect disparate communities and others may provide a path through a community itself.

Distribution architecture is fundamental to enabling demand aggregation. This level of architecture is seldom highlighted by those incumbent providers who work to disaggregate demand in order to maximize profit.

Sometimes distribution architecture is considered “middle mile” and other times it is considered a portion of the “last mile” network.

Distribution architecture can be fiber, wireless (licensed or unlicensed), or copper based (DSL on twisted pair or Cable). Many incumbent providers are replacing legacy copper distribution architecture with fiber (sometimes called fiber to the node) to enable higher capacity connections. New implementations of distribution architecture are typically fiber or licensed point-to-point wireless.

Many communities engaged in broadband development focus on distribution architecture. It is a fairly straightforward task to build distribution infrastructure to connect the disparate community anchor

institutions within a community. This distribution infrastructure path can aggregate the demand from the multiple community anchor institutions. The increased purchasing power that aggregated demand affords can be used to influence backhaul provider behavior and pricing. Some communities also elect to offer services (either directly or through a third party provider) to businesses and other locations along their distribution ring or municipal area network path.

Some communities extend distribution paths to neighboring jurisdictions – thusly increasing aggregation opportunities and extending capabilities.

### **Access**

Access level architecture extends the network into the community making it available to potential subscribers. Access architecture can originate at the POP or at designated locations along a distribution path.

Access architecture can be fiber, wireless (usually unlicensed), or copper (telephone or cable).

Improving access architecture by developing fixed wireless assets is a very low cost alternative to deploying or upgrading wireline infrastructure. Deploying new or improving existing wireline access architecture is a capital intensive proposition. However, without improved access level architecture, the benefits of any broadband development may be limited to very localized areas.

### **Drop Level**

Drop level architecture extends access level infrastructure into the subscriber’s premises.

### ***Last Mile Technologies***

Last mile services can be delivered in a number of ways. We will usually discuss DSL, fixed wireless, cable, and fiber. In some cases, people use mobile wireless as their only means of connecting to the Internet; others use satellite services.

### **DSL**

DSL transmits digital information on a twisted pair of copper wire – usually the very same twisted pair that delivers traditional voice service to the home.

CenturyLink is the primary DSL network owner in the Upper Arkansas area. Federal regulation requires that owners of telephone infrastructure make elements of that infrastructure available to competing providers at fair rates. This “unbundling” means that other providers can offer DSL service across CenturyLink’s infrastructure.

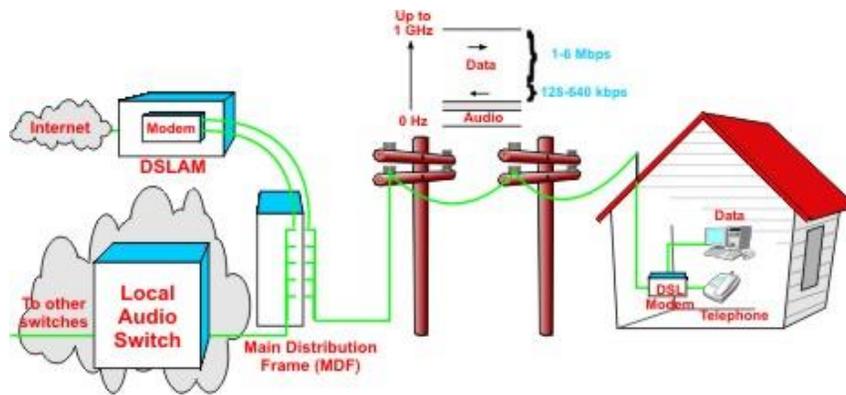


Figure 2: DSL

“Figure 2: DSL” shows a simplified DSL system.

There are many varieties of DSL but CenturyLink typically offers either ADSL or VDSL in the Upper Arkansas area. ADSL has a maximum download speed of about seven Mbps. VDSL can perform up to about 45 Mbps. Both ADSL and VDSL are asymmetrical services offering faster downloads than uploads. ADSL usually has upload speeds below 1 Mbps. VDSL can have upload speeds up to 10 Mbps.

The data signal from the DSLAM (DSL Access Multiplexer) suffers attenuation, or loss, as it travels along the twisted pair cable. In general, the further the subscriber is from the DSLAM, the more service degrades.

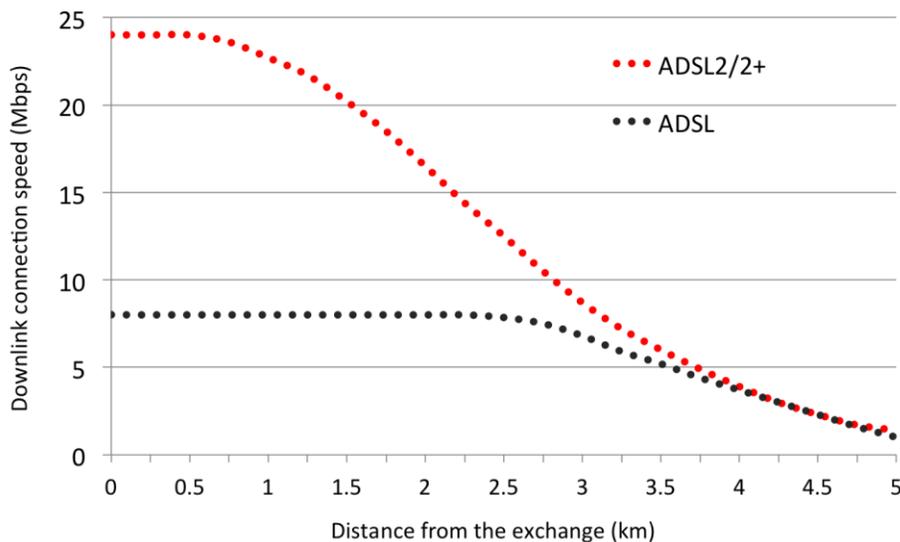
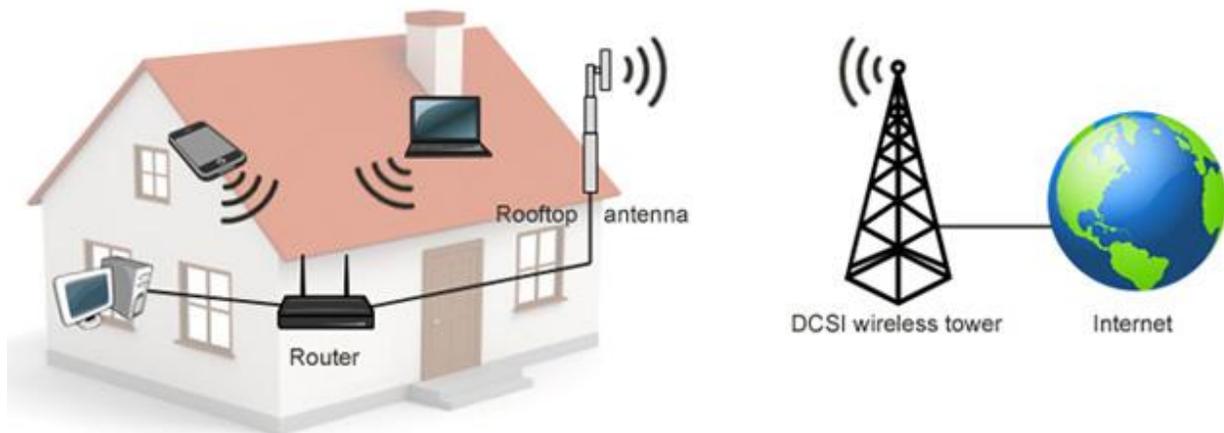


Figure 3: Typical DSL Loss Impact

In many areas, CenturyLink has deployed remote DSLAMs to extend the reach of its DSL service. The distribution network for these remote DSLAMs is usually fiber resulting in a fiber to the node model.

### **Fixed Wireless**

Fixed wireless differs from mobile wireless (or cellular broadband) in the technology used to deploy services. Fixed wireless services can offer speeds close to 100 Mbps but most providers offer maximum speeds of about 25 Mbps. Fixed wireless service can be provisioned symmetrically but is usually offered with faster downloads than uploads.



**Figure 4: Fixed Wireless**

“Figure 4: Fixed Wireless” depicts a simplified fixed wireless system. Distances from the wireless tower to the rooftop antenna can be up to 30 miles on licensed spectrum. Unlicensed systems usually perform best within seven miles of the wireless tower. Not depicted in “Figure 4: Fixed Wireless” is the distribution infrastructure connecting the wireless tower to a POP where the fixed wireless system connects to the middle mile network. That distribution infrastructure can be wireless, copper, or fiber.

Most fixed wireless systems outperform ADSL systems. Fixed wireless is easier and less capital intensive to deploy than wired systems.

Unlicensed systems can suffer degraded throughput from interference in the same frequencies. Licensed systems face the same general terrain and atmospheric signal degradation but have reserved spectrum. Licensed spectrum is scarce and can be expensive.

**Cable**

In the late 1990s and early 2000s cable TV companies began providing data service on existing coaxial cable TV systems using a standard called DOCSIS. With improvements and optical fiber feeder deployed deeper into the network, cable companies can offer speeds up to 100 Mbps (or faster in some cases).

Only limited communities in the Upper Arkansas area have access to cable internet service. Charter is the primary provider where these services are available.

**Fiber**

Optical fiber is often used in middle mile infrastructure and is becoming more common in last mile infrastructure. Charter, CenturyLink, and some wireless providers use fiber in parts of their distribution networks. CenturyLink offers Metropolitan Optical Ethernet services – a fiber based access infrastructure – to some businesses in some Upper Arkansas area communities.

**Other**

In some cases, subscribers use satellite service, cellular service, or other broadband technologies. These alternative technologies may be the only choice some subscribers have. Trees and terrain impede cellular and satellite services.

	<b>Available</b>	<b>Adequate</b>	<b>Affordable</b>	<b>Sustainable</b>
<b>DSL</b>	Generally available. Availability limited by distance from DSLAM.	ADSL is a very poor broadband solution. VDSL within reasonable distance of a DSLAM is a good broadband solution.	Monthly costs are generally good. Cost per Mbps is poor.	Uses existing twisted pair infrastructure.
<b>Fixed Wireless</b>	Generally available. Availability limited by line of sight requirements and distance from tower sites.	Good.	Monthly costs are generally good. Cost per Mbps is poor. Wireless services typically have the highest cost per Mbps of last mile solutions.	Relatively low cost deployment.
<b>Cable</b>	Available in some more dense areas. Not usually available in rural areas.	Good. Capacity is often degraded by over-subscription at hub sites.	Good.	New deployments are capital intensive and unlikely. Deployments on existing infrastructure are reasonably easy.

	Available	Adequate	Affordable	Sustainable
<b>Fiber</b>	Very poor. Almost no last mile fiber exists in the Upper Arkansas area.	Excellent.	Where fiber to the premises has been deployed, monthly costs are very good to excellent. In particular, the cost per Mbps is excellent.	High cost to deploy but once it is in place fiber has a long expected life cycle and low operating costs.
<b>Other</b>	Satellite service is generally available.	Other technologies are poor to very poor broadband solutions.	Other broadband solutions usually have high prices compared with traditional last mile technologies.	Most other technologies are at constant risk of being superseded by more traditional solutions.

**Table 1: Last Mile Technologies**



# Regional Broadband Strategic Planning



When local governments undertake a study of potential broadband infrastructure investment, a key question is often, “What is the benefit if government involves itself in broadband infrastructure?” or, “What happens if we don’t make strategic broadband investments?”

Likely Outcomes of Strategic Local Government Investment	Likely Outcomes of Dependence on Private Sector Investment
Increased competitiveness with other communities and regions that have made broadband investments and have driven down the cost of Internet and voice services for businesses and residents.	Communities with shared broadband infrastructure are seeing increased economic development activity and increased business attraction success.
Better prepared to attract businesses and jobs to the area.	The area is at an economic disadvantage without a strategy to ensure that affordable adequate broadband is in place as a business attraction and retention tool.
Areas that have made investments have seen the cost of telecom services sharply reduced, keeping more money in the community and freeing up business funds for expansion and jobs creation.	Rural residents and businesses will continue to pay more for voice, video, Internet, and other broadband services as compared with like services in more urbanized areas.
A long term strategy of abundant broadband everywhere gives the area better educational opportunities and improved access to jobs. Fiber service where feasible and improved fixed wireless or other services will attract entrepreneurs and business people who want to work from home.	The area may see less population retention and growth, continued loss of younger workers and families, and diminished educational opportunities.
Aggregation of the broadband marketplace attracts more services and helps keep prices lower.	Private sector providers will continue business practices that limit bandwidth options.

**Table 2: Strategic Broadband Investment Likely Outcomes**

As we develop and execute regional and county strategic plans, we need to do so from a shared understanding of the background. The previous section provided some basic background information. More extensive information is available via an online forum at [www.ohivey.com/bbplanning/uaacog](http://www.ohivey.com/bbplanning/uaacog).

## Potential Funding

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Funding for public broadband development is available from several sources. Rules and availability change for these sources from time to time. Additionally, new sources and one-time opportunities often exist. Therefore, this potential funding list should not be considered comprehensive.

Principal federal funding for broadband development in rural areas comes from the Farm Bill funded Rural Utilities Service in the US Department of Agriculture. USDA provides funding opportunities through loans, loan guarantees, and grants. Four primary broadband development programs current in 2015 include:

- Community Connect Grants  
See <http://www.rd.usda.gov/programs-services/community-connect-grants> for more information.
- Distance Learning and Telemedicine Grants  
See <http://www.rd.usda.gov/programs-services/distance-learning-telemedicine-grants> for more information.
- Farm Bill Broadband Loan and Loan Guarantee Program  
See <http://www.rd.usda.gov/programs-services/farm-bill-broadband-loan-loan-guarantee-program> for more information.
- Community Facilities Direct Loan and Grant Program  
See <http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program> for more information.

In 2014/2015, the FCC set aside \$100 million to begin experimenting with rural broadband development. While this was a one-time program, the experiments may result in additional funding. See <http://www.fcc.gov/encyclopedia/rural-broadband-experiments> for more information.

The state also has some broadband funding mechanisms in place:

- In 2014, the Colorado Legislature passed the Connect Colorado Broadband Act. This act is designed to begin transferring some of the High Cost Support Mechanism to broadband development. Details of the program are pending.
- The Colorado Department of Local Affairs (DOLA) issues both planning and implementation grants through the Energy/Mineral Impact Assistance Fund (EIAF). In 2015, earmarked \$20 million for broadband development that will not compete with other EIAF applications.

The DOLA funds are designated for planning and infrastructure. This Regional Strategic Plan is a result of a DOLA planning grant.

DOLA has provided some guidelines for infrastructure grants:

DOLA Guidelines	Strategic Plan Compliance
<p><b>A. Plans in place</b> Infrastructure grant applications will be considered only after demonstration that the proposed project is consistent with a regional broadband plan.</p>	<p>This regional broadband plan meets this requirement so long as proposed projects align with the objectives and methods described herein.</p>
<p><b>B. Middle Mile Infrastructure Only</b> Middle mile infrastructure is considered any infrastructure that is utilized to provide or enhance the network connection between communities and a provider of core network services, including the interconnection of community anchor institutions.</p>	<p>All infrastructure development recommendations in this plan are middle mile recommendations with the exception of elements of the school household connectivity program recommended in Lake County.</p>
<p><b>C. Not for Service Provision to End User</b> The funds shall not be used for “Last Mile” deployments, which will be considered any infrastructure that terminates at a residential, business or other non-governmental address. This limitation excludes service provision equipment such as routers, switches and the like from consideration for funding from this program. However, projects submitted for funding must demonstrate plans for eventual use of the system, including plans for maintenance and system upgrades. Public/private partnerships to provide service are encouraged.</p>	<p>No infrastructure development recommendations in this plan include components for end user service provisioning with the exception of elements of the school household connectivity program recommended in Lake County. Supporting interconnectivity between multiple service providers in the region to support greater middle mile reliability may require equipment such as routers, switches and the like. Careful coordination should take place with the regional DOLA representative before applying for EIAF grants to support them. All infrastructure development recommendations in this plan lend themselves to public/private partnerships and eventual use of the system.</p>
<p><b>D. Basic Infrastructure</b> Conduit systems, fiber, towers, ROW, appurtenances and similar systems necessary to enhance middle mile connections will be considered for funding. For applicants who are subject to the restrictions of SB 05-152 (CRS 29-27-101 et seq.), funding for fiber that is intended to benefit non-governmental users (e.g., private citizens, businesses) will be limited to dark fiber.</p>	<p>All communities and counties addressed in this plan are currently subject to the restrictions of SB 05-152 (CRS 29-27-101 et seq.). Dark fiber or other limited development may meet some of the objectives described in this plan. In other cases, communities or counties may need to resolve the restrictions imposed by the state law.</p>

DOLA Guidelines	Strategic Plan Compliance
<p><b>E. The awarding of any grants as part of this program does not constitute an acknowledgment that the funded project is in compliance with applicable laws and regulations. As with all DOLA grant programs, it is the responsibility of the applicant to ensure such compliance.</b></p>	<p>As with DOLA, the inclusion of a recommendation in this plan does not constitute a guarantee that the recommendation is in compliance with applicable laws. Each jurisdiction is responsible for compliance with all local, state, and federal laws and regulations.</p>
<p><b>F. Any infrastructure built with the program funds and offered to private entities must be done so in an open access competitively neutral model. Access and rates must be provided on a competitively neutral and non-discriminatory basis for all providers regardless of technology.</b></p>	<p>Some recommendations in this plan are heavily dependent on the cooperation of specific service providers. While all infrastructure recommendation in this plan could comply with this requirement, the nature of a given service provider’s contribution to the project and the service provider’s requirements for that contribution may force the specific implementation of some recommendations in this plan to not comply with this requirement.</p>
<p><b>G. Applicant will be required to allow use of any infrastructure for public safety purposes and encouraged to work with local public safety entities to define their specific needs.</b></p>	<p>Some recommendations in this plan are heavily dependent on the cooperation of specific service providers. While all infrastructure recommendation in this plan could comply with this requirement, the nature of a given service provider’s contribution to the project and the service provider’s requirements for that contribution may force the specific implementation of some recommendations in this plan to not comply with this requirement.</p>
<p><b>H. Applicant must agree to share infrastructure location information (GIS) to assist the state in building an asset inventory.</b></p>	<p>Participating in the state’s efforts to build an asset inventory is an important recommendation in this plan. However, some recommendations in this plan are heavily dependent on the cooperation of specific service providers. While all infrastructure recommendation in this plan could comply with this requirement, the nature of a given service provider’s contribution to the project and the service provider’s requirements for that contribution may force the specific implementation of some recommendations in this plan to not comply with this requirement.</p>

DOLA Guidelines	Strategic Plan Compliance
<p><b>I. Applicant is encouraged to work with the private sector to investigate and secure other available funding, such as the Broadband Deployment fund (HB 14-1328, CRS 40-15-208). Applications which have a private sector application counterpart under consideration by the Broadband Deployment Fund will be given special consideration in order to leverage State funds.</b></p>	<p>No projects are currently under consideration by the Broadband Deployment fund. When the Broadband Deployment Fund establishes application methods and begins to consider projects, all infrastructure deployment recommendations in this plan should be reviewed for possible inclusion.</p>
<p><b>J. Match</b> As with other capital construction projects, applicants are required to match grant funds on a dollar-for-dollar basis. In cases where the applicant’s financial condition does not permit a 50/50 match, a minimum match of 25% is required.</p>	<p>Individual jurisdictions will need to identify match capabilities and funds.</p>

**Table 3: DOLA Infrastructure Grant Guidelines**

Local entities and citizens have funding mechanisms available to them in special districts and improvement districts. Special districts (CRS Title 32) have the distinction of enduring beyond the life of debt service. Thus a special district can be organized not only to serve as an implementation funding mechanism, but also to function as a vehicle for enduring operations and maintenance. Local Improvement Districts (CRS 30-20-6) and Business Improvement Districts (CRS 31-21-12) exist only so long as the debt service requirement exists.

Broadband development is not one of the specified purposes allowed for special districts, local improvement districts, or business improvement districts. Of these mechanisms, local improvement districts are the most flexible.

A Local Improvement District (LID) allows homeowners to construct and finance public works projects over a period of time (usually 10 years) so the whole cost of the improvement does not have to be paid at once. Each County may have a County specific process for LIDs but the process outlined by Larimer County<sup>15</sup> seems to be fairly common.

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<sup>15</sup> See <http://www.larimer.org/engineering/impdist/lidpackt.htm>.

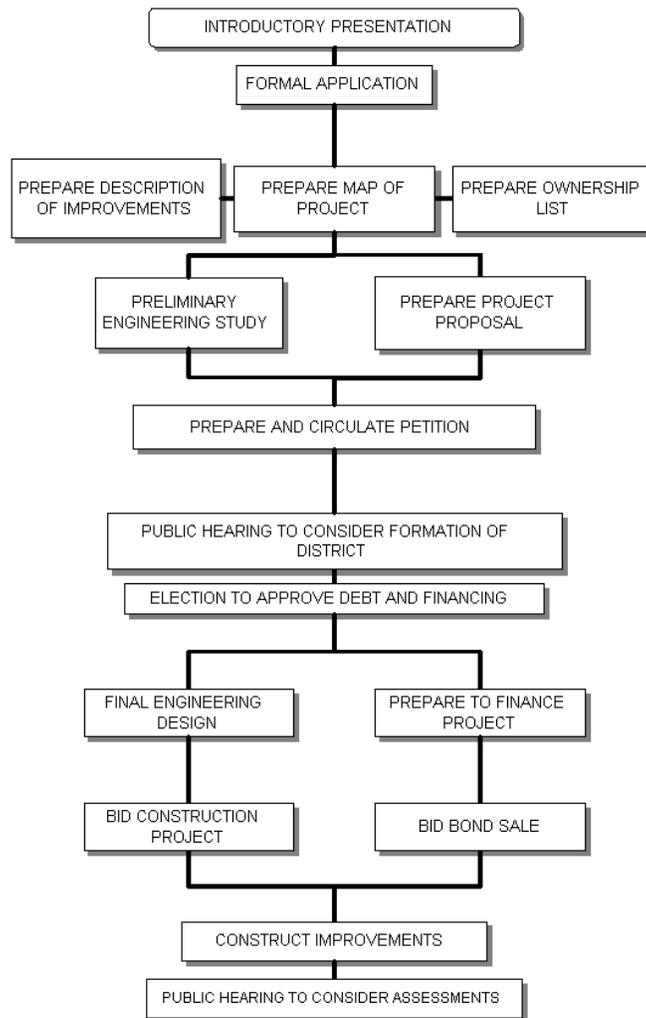


Figure 5: Local Improvement District Flowchart of Events

## Regional Plan

As demonstrated, each of the five Upper Arkansas Regional Broadband Strategic Plan counties – and even disparate localities within each county – have unique needs. Even with the varying requirements identified across the several counties, there are some themes that are evident through all five counties. These themes are best addressed on a regional basis. In particular, regional stakeholders should work to accomplish two tasks: 1) establish a regional broadband development organization and 2) support the development of regional network interconnectivity.

## Regional Broadband Development Organization

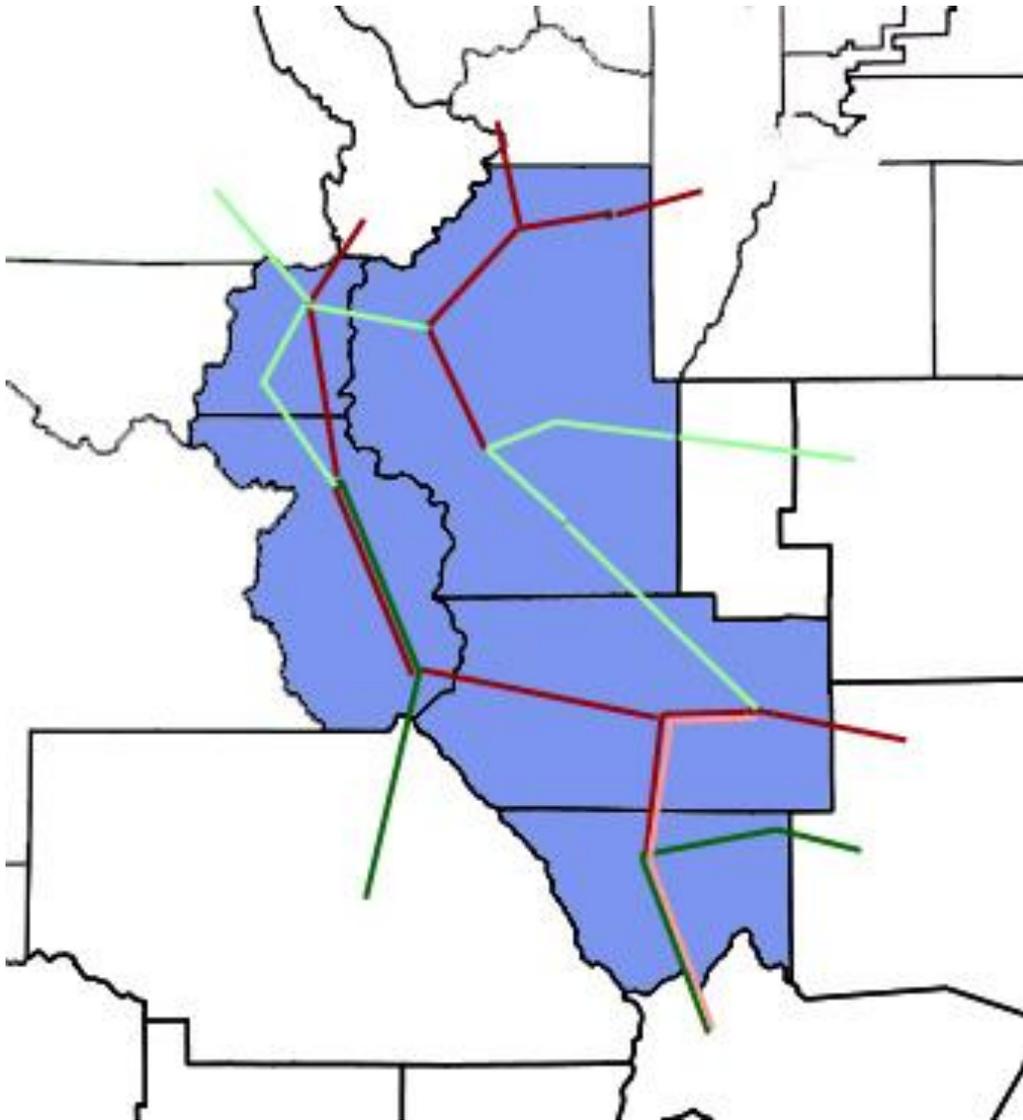
A regional broadband development organization will provide four core functions:

- 1) Coordinate the efforts of the several local jurisdictions in the region,
- 2) Function as a repository for broadband friendly and broadband development best practices,
- 3) Assist with asset mapping and coordination with state programs, and
- 4) Facilitate private broadband development across jurisdictional boundaries.

The Regional Broadband Steering Committee organized to develop this Regional Broadband Strategic Plan should be the governing body for the regional broadband development organization. Using the organizational structure of UAACOG, another existing organization, or a new non-profit organization, the Steering Committee should create a Director of Regional Broadband Development position.

## Regional Network Interconnectivity

Each of the five counties addressed in this Regional Broadband Strategic Plan have unique needs and we have described activities designed to meet them. All community and county broadband development is dependent on sufficient reliable middle mile capacity at reasonable prices. Based on our current understanding of middle mile infrastructure in the Upper Arkansas region (as described below and as depicted by dark red for fiber routes and dark green for wireless routes in “Figure 6: Middle Mile Route Development”), we recommend additional middle mile route development (as described below and as depicted by light red for fiber routes and light green for wireless routes in “Figure 6: Middle Mile Route Development”).



**Figure 6: Middle Mile Route Development**

CenturyLink's middle mile infrastructure in the region is represented by a primary path extending from Pueblo West through Canon City, Salida, Buena Vista, and Leadville and continuing north to the I-70 corridor. This path has a branch extending south into Westcliffe and continuing south but terminating before reaching Walsenburg. CenturyLink also has fiber coming from the Denver area into Bailey and continuing to Como and then north to Breckenridge and the I-70 corridor. This path also has a spur connecting Como and Fairplay. Capacity on this Como to Fairplay spur is limited because of the electronics in use.

Two other vendors have middle mile fiber in the region:

- South Park Telephone has a fiber route from Fairplay to Hartsel. This route does not currently appear to be in use.
- SECOM has a fiber route from Pueblo West into Canon City.

In addition to existing middle mile fiber routes, two providers have established commercial microwave links into the region:

- DD Wireless has a licensed microwave link from Walsenburg into Custer County. The route continues to the east into Pueblo West on unlicensed frequencies.
- In conjunction with SkyWerx, Colorado Central Telecom has a licensed microwave link from the San Luis Valley into Salida with service continuing north to Mt. Princeton.

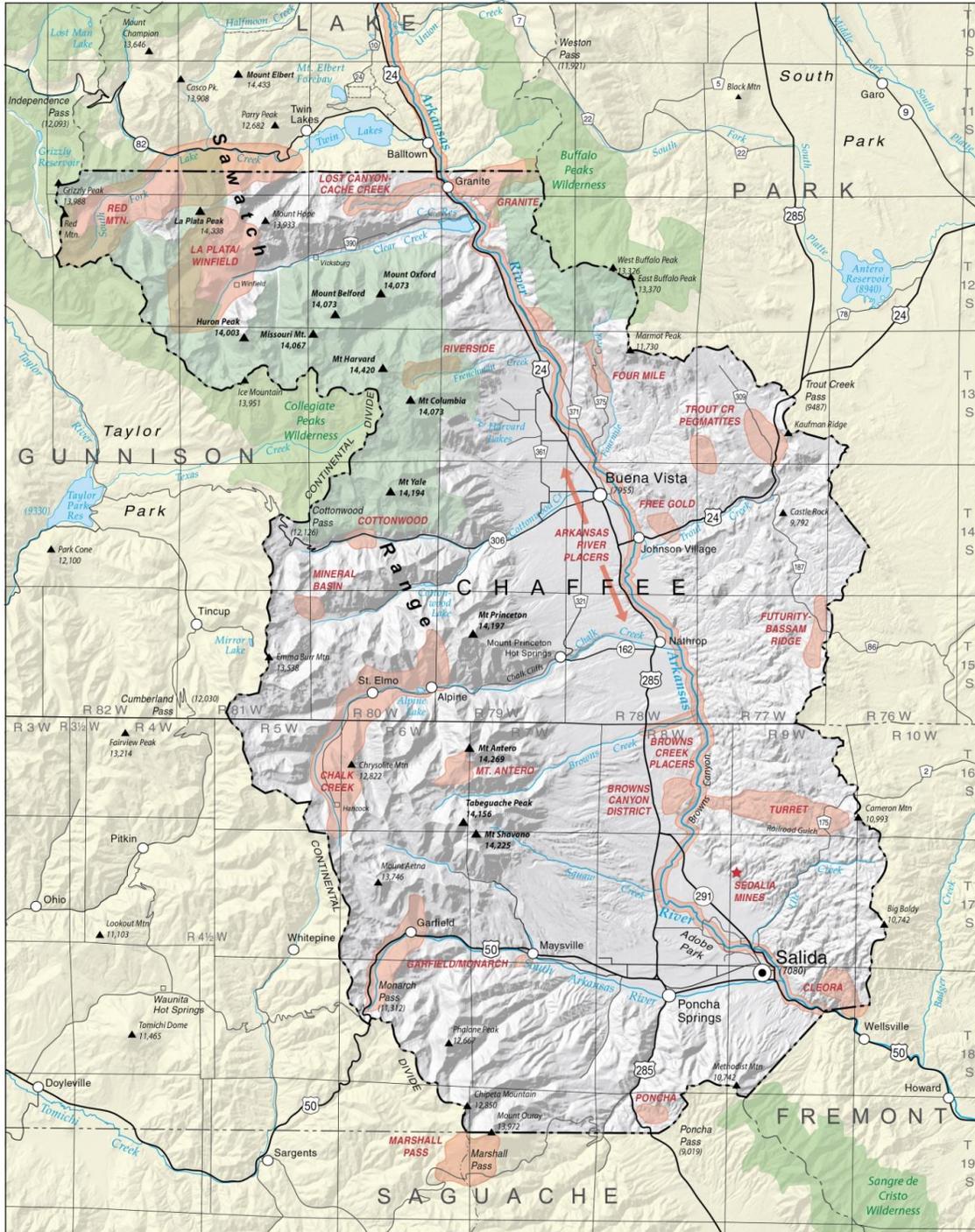
The current middle mile environment in the Upper Arkansas reveals six recommendations to be considered in this five-year strategic plan:

- Capacity and reliability through Chaffee, Lake, and Park Counties should be improved by extending the SkyWerx/Colorado Central Telecom licensed microwave link north into Twin Lakes, Leadville and continuing into Red Cliff and on to the I-70 corridor with an additional link from Leadville into Alma. Colorado Central Telecom and High Country Internet have started discussions to establish most of this link. High Country Internet, Colorado Central Telecom, and South Park Telecom should work together with the multiple jurisdictions to complete these middle mile segments – especially as Park County moves forward with its intent to connect Alma and Fairplay community anchor institutions with fiber. The proposed Fairplay/Alma fiber in conjunction with a microwave link from Alma to Leadville would close a gap in middle mile path diversity.
- Capacity from Como to Fairplay should be increased by supporting CenturyLink’s electronics upgrades in Como and Fairplay. CenturyLink has evaluated the cost of this segment and has begun working on a market aggregation model in Fairplay to help justify the electronics upgrade costs. The County, Fairplay, and South Park Telecom should work with CenturyLink to help create the business justification for the upgrades. The County should then work to gain committed timelines from CenturyLink for the upgrade.  
This proposed upgrade does not circumvent the need to establish other connecting routes like the one from Alma to Leadville or from Fairplay to Hartsel. Rather, upgrading capacity on the Como-Fairplay link significantly enhances the value of these other connecting routes. Only by increasing capacity on this Como-Fairplay route can it play a role in meshing together the region with effective middle mile path diversity.

- Once sufficient capacity is available in Fairplay, South Park Telecom should provide capacity between Fairplay and Hartsel. With reasonably priced capacity available in Fairplay, South Park Telecom should be able to extend capacity into Hartsel on this existing link.
- Reliability in Canon City and reliability and capacity should be improved by working with SECOM to extend their line from Canon City through Westcliffe and into Walsenburg. Rough estimates for buried fiber construction average about \$40,000 per mile for rural implementations. The road mileage from Canon City through Westcliffe and into Walsenburg is 111 miles. This equates to about \$4.5m to complete this route. This cost is probably outside of SECOM's business model parameters. However, if the proposed regional broadband organization were to build this route with DOLA grant funds, SECOM may be willing to provide the required match funds.
- Existing tower infrastructure may be used to create licensed microwave links from Hartsel through Lake George and into Colorado Springs and to extend a licensed microwave link south from Park County into Canon City. These routes would significantly improve physical path diversity throughout the region. The accompanying Google Earth file (Colorado.kmz) depicts much of the existing tower infrastructure.
- Multiple vendors middle mile links should be accessible at common locations and private sector carriers should be encouraged to carry each other's traffic at reasonable rates to improve redundancy throughout the region. Already, Colorado Central Telecom has acquired transport from CenturyLink to create path diversity and improve their redundancy in Chaffee County. The middle mile recommendations made herein have significantly greater value if the multiple vendors in the region cooperate to provide each other redundancy and additional capacity.

While these middle mile recommendations may appear to be overbuild existing middle mile services, that is not the purpose. Middle mile reliability is a function of path diversity, system reliability, capacity, and operational capability. The preceding recommendations would result in creating a meshed middle mile environment for the region with multiple participating vendors. This proposed environment will provide the region with significant middle mile capacity and reliability.

# Chaffee County



Chaffee County covers 1,015 square miles and has a population of 17,809<sup>16</sup>. More than 80% of the land in the county is managed by state or federal agencies. About half the county's population is concentrated in three communities: Salida (pop. 5,236) and Poncha Springs (pop. 737) in the south and Buena Vista (pop. 2,617) in the north. The rest of the population is located in the unincorporated areas of the county resulting in a population density of about 9 people per square mile. Through time, the population appears to be shifting from incorporated to unincorporated areas. The county's population is older (median age of 47 vs. 36) and lower paid (median household income of \$40,357 vs. \$55,430) than Colorado averages. Older, rural, and lower paid populations have statistically lower broadband adoption rates than younger, urban, and higher paid populations. In two other demographic indicator categories that correlate to broadband adoption, education attainment and minority populations, Chaffee County reflects Colorado averages.

The county is primarily a north south valley with prominent mountains on the west. Highway 50 crosses the county east-west in the south providing access to Fremont and Gunnison Counties to the east and west. Highway 285 follows the valley north-south and provides access into Lake and Saguache Counties to the north and south. Highway 24 connects to Highway 285 from the east at Buena Vista and offers access to Park County.

## General Assessment

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Broadband services in Chaffee County are continually improving. The introduction of a middle mile microwave link by Colorado Central Telecom in conjunction with SkyWerx represents a significant improvement in middle mile diversity and capacity. Colorado Central Telecom's fixed wireless solution has extended availability to significant portions of the county that were not previously served. CenturyLink has also improved its network and reports the implementation of middle mile path diversity, the upgrade of some of its service areas in the county to VDSL, and the availability of Metropolitan Optical Ethernet in some areas.

## Infrastructure

### *Middle Mile*

Chaffee County enjoys good middle mile options and individual subscribers or subscriber entities can create middle mile path diversity and redundancy by subscribing to two or more network owners' services.

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<sup>16</sup> 2010 Census

CenturyLink has fiber coming from the southeast along Highway 50 through Salida and generally following Highway 285 through Buena Vista and on to Leadville in Lake County. CenturyLink reports both logical redundancy and path diversity.

EAGLE-Net offers a microwave link from Saguache County into Salida and Buena Vista. This link does not offer path diversity.

In conjunction with Colorado Central Telecom, SkyWerx has developed a microwave link from Saguache County into Chaffee County. This microwave network consists of sites at Monarch Mountain linked into Monarch Mine, Mt. Princeton, S Mountain in Salida, and Methodist Mountain. Monarch Mine, Mt. Princeton, and S Mountain all link to Methodist Mountain which links to a site in Center. From Center, the network offers path diverse backhaul with a microwave path over Wolf Creek pass to Durango and a separate link to Alamosa where the network picks up fiber to the Data 102 Center in Colorado Springs. While this network does not offer path diversity out of the county, it is built with automatic failover in the link radios at each site. Colorado Central Telecom may lease a secondary path from CenturyLink to enable path diversity on the Colorado Central Telecom network.

### *Last Mile*

Three primary last mile networks exist in the county.

CenturyLink offers DSL service to residents and businesses in and around Salida, Buena Vista, and Poncha Springs. CenturyLink's DSL ranges up to 25/1.5 Mbps but more typically provides 7/1.5 Mbps or slower speeds. CenturyLink has some Metropolitan Optical Ethernet services available to limited locations in the county. CenturyLink offers promotional pricing of \$30 per month for the first year jumping \$50 per month afterwards.

Charter Communications offers cable modem service to residents in and around Salida, Buena Vista, and Poncha Springs. Charter's offerings ranges up to 30/5 Mbps in Salida and 15/2 in Buena Vista. Charter offers promotional pricing of \$40 per month for the first year, increasing to \$55 in the second year, and to an undisclosed standard rate in the third year.

Much of the valley and some of the mountainous areas are covered by fixed wireless services. Fixed wireless services may be available from Colorado Central Telecom, Hilltop Broadband, or other smaller providers. Fixed wireless packages range up to 12/1.5 Mbps prices range from \$45 per month for a 4 Mbps service to \$90 per month for a 12 Mbps service.

Additionally, cellular companies offer mobile wireless throughout much of the county and satellite Internet services can be had in most of the county.

## Broadband Characteristics

### *Available*

**GOAL**

Most addresses in the county have access to wireline or fixed wireless broadband services.

Within five years, all addresses in the county should have access to wireline or fixed wireless broadband services.

### *Adequate*

#### **Capacity**

Chaffee County has reasonable middle mile capacity through its three middle mile providers.

Last mile capacity in Salida is good on the cable network and reasonable on the DSL and fixed wireless networks. Last mile capacity in Buena Vista is poor to reasonable on all networks.

In the unincorporated county, last mile capacity is reasonable to addresses that can receive broadband. Some point to point wireless services are available and where subscribers choose this option over point to multi-point solutions, capacity is good.

Some limited areas in the county have access to very good last mile capacity through Metropolitan Optical Ethernet services.

**GOAL**

Within five years, all addresses along municipal area network paths should have access to very good last mile capacity. Other areas should keep pace with general capacity growth.

#### **Reliability**

The county enjoys a reasonably reliable broadband environment.

In the middle mile, the three middle mile providers offer good options. Subscribers can enhance reliability by subscribing to networks carried on diverse paths with diverse operations.

In the last mile, some of the DSL infrastructure is aging and may present reliability issues. Much of the cable infrastructure is oversubscribed. While this will not generally cause outages, it frequently leads to service degradation. Most of the fixed wireless infrastructure is fairly new and generally reliable.

### Affordable

Current post-promotional mid-tier pricing for residential service is:

	Monthly Cost	Download	\$/Mbps Download
<b>Cable Modem</b>	\$55	15 Mbps	\$3.67
<b>DSL</b>	\$50	7 Mbps	\$7.14
<b>Fixed Wireless</b>	\$70	8 Mbps	\$8.75

**Table 4: Chaffee County Price Summary**

These prices are higher than the US average of \$3.50/Mbps and higher than the Colorado average of \$3.09/Mbps.

Business and institutional broadband prices are higher in Chaffee County than on the Front Range.

<b>GOAL</b>	Within five years, business and institutional broadband should be equitably priced with the Front Range. Residential pricing should keep pace with changes in state and national prices.
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### Sustainable

The broadband environment through Chaffee County can sustain reasonable service provider competition. Entry into the market by a large, well funded organization may have a detrimental impact on the development and growth of the relatively new Colorado Central Telecom. Service providers should look for opportunities to support each other while they compete. A good example of this already happening is Colorado Central Telecom’s recent wholesale transport agreement with CenturyLink. By using CenturyLink’s existing infrastructure, Colorado Central Telecom will be able to implement path diversity and greatly improve their reliability in the county.

## Recommended Actions

Because of its mountainous terrain and rural nature, Chaffee County faces significant broadband development challenges. The service providers in the county have engaged in some significant efforts to improve broadband. Those efforts should be encouraged and the county should work alongside its private providers to continue to improve broadband quality. In particular, the county and its incorporated communities can 1) implement municipal fiber rings or municipal area networks and 2) encourage last mile infrastructure development.

### Municipal Area Networks

Salida and Buena Vista should build municipal fiber rings or municipal area networks connecting their various community anchor institutions. These rings should route through business districts to eventually provide service to businesses and to support

<b>INFRASTRUCTURE DEVELOPMENT</b>
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improvements in access level infrastructure. The county should build or lease infrastructure to connect the two municipal rings. The region should build or lease infrastructure to connect the multiple county networks and to interconnect with other regional network efforts.

To support these new municipal area networks, the county and the region should work with local providers to enhance middle mile connectivity to the north into Lake County and through to Eagle County. This middle mile development could support regional network development providing connectivity to Twin Lakes and into Red Cliff.

## ORGANIZATION

This intra- and extra-community connectivity can be built, operated, and maintained by the individual jurisdictions, a regional authority, or private partners. The most likely structure for success is a regional authority comprised of the individual participating jurisdictions coupled with a private partner. The private partner may be the local power companies, a local service provider, an organization that specializes in operating municipal networks, or some combination of the three.

## LEGAL

Regardless of the chosen ownership and operations model, the county may have to resolve constraints imposed by CRS Title 29 Article 27 (also known as “Senate Bill 152”).

## SERVICES

Once the communities and county have established municipal area networks, they should subscribe to all three middle mile providers (CenturyLink, Colorado Central Telecom/SkyWerx, and EAGLE-Net). The communities should also work with the region and regional providers to augment the existing middle mile paths to the south and southeast with a middle mile path to the northeast (through Park County to the Denver metropolitan area), the west to Gunnison, or both.

Subscribing to multiple middle mile providers creates physical, logical, and operational redundancy. It also makes greater bandwidth available to the regional network. Finally, it creates a more competitive middle mile marketplace. Through the municipal area, county, and regional network, these benefits can be extended to community anchor institutions and potential private sector subscribers.

## Encourage Last Mile Infrastructure Development

## POLICY

The simplest action the county and the communities within the county can take to encourage last mile infrastructure development is to reduce any bureaucratic barriers to entry and to implement “fiber friendly community” policies. Because broadband infrastructure isn’t constrained by political boundaries, there is value in coordinating policies across jurisdictional boundaries. The region may also see value in establishing a

regional resource that can help broadband providers navigate the multiple jurisdictional requirements.

**POLICY**

One important “fiber friendly community” policy is an open trench or dig once policy. State law requires that “[t]he state or a political subdivision shall provide notice on a competitively neutral basis to broadband providers of any utility trenching project that it conducts...” and that “...the state or political subdivision shall allow joint trenching by broadband providers ... for the placement of broadband facilities...”. However, this only pertains to state trenching projects and does not address a jurisdiction’s possible desire to place conduit along with private trenching projects. Local jurisdictions may wish to enhance the state’s notification requirements.

Unless available infrastructure is known, it is difficult for broadband developers to take advantage of it. The county should work to map infrastructure and service availability. The county should not duplicate the broadband mapping efforts of the Governor’s Office of Information Technology (GOIT). Rather, the county should coordinate data collection for GOIT and provide information to GOIT.

**MAPPING**

To ensure the most efficient use of county broadband development efforts, the county needs the capability to map infrastructure, parcel level service mapping granularity, and a mechanism to identify source data and aging. The county should work to ensure GOIT includes these capabilities in the broadband mapping tool.

**INFRASTRUCTURE  
DEVELOPMENT**

More aggressively, the county and communities should pursue reasonable and targeted infrastructure improvements in conjunction with private partners. Much like the county worked with Colorado Central Telecom to implement the communications tower in Salida, the county can work with private providers to build additional tower sites and to deploy fiber infrastructure. Optimally, local power companies and local providers could be convinced to participate in a partnership that takes advantage of their existing expertise deploying and operating last mile infrastructure. These private partners may not be interested in developing additional retail broadband business but that should not prevent them from participating in deploying and maintaining infrastructure. The most probable path to significant last mile infrastructure is through a three way partnership involving the county, private partners, and a broadband asset manager. In this model, the county could provide access to grant funds and low interest long term debt financing. Private partners could provide implementation and physical asset maintenance expertise and some capital funding. The broadband asset manager could provide broadband expertise and manage the logical network. The broadband asset manager and any participating private service providers could provide retail services.

## Target Action Plan

### One Year Actions

The county’s one year action plan should focus on the administrative actions needed to effect additional broadband development. These actions should include:

<p>Implement appropriate “fiber friendly community” policy changes</p>	<p><b><u>Cost</u></b> Low – staff time to prepare policy changes. <b><u>Sustainability</u></b> Easy – periodic policy reviews.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the county.</li> </ul>	
<p>Implement an enhanced open trench or dig once policy at all jurisdictional levels</p>	<p><b><u>Cost</u></b> Low – staff time to modify model open trench policy. <b><u>Sustainability</u></b> Moderate – periodic reviews, potential incremental costs to add conduit to open trench project, and mapping of deployed assets.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Imposing open trench requirements on private projects may face some opposition.</li> </ul>	
<p>Develop and participate in a regional collaboration for “fiber friendly policies” and deployment related administrative functions</p>	<p><b><u>Cost</u></b> Low – staff time to participate in regional collaboration. <b><u>Sustainability</u></b> Low – periodic policy reviews.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the region.</li> <li>• May lead to conflict between the multiple participating jurisdictions.</li> </ul>	
<p>Develop infrastructure and services mapping mechanisms and methods of sharing data with the state’s broadband mapping agency</p>	<p><b><u>Cost</u></b> Moderate – requires data collection mechanisms that do not currently exist. This may be a largely volunteer effort, an internship effort, or a paid staff member at the county or regional level. <b><u>Sustainability</u></b> Moderate – the broadband environment is continually changing. Mapping of available infrastructure and services requires constant updating.</p>

<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Mapping accuracy is only as good as data collection and data collection cannot be perfect.</li> <li>• GOIT may not provide a repository for the data needed by the county.</li> <li>• GOIT may limit access to the information collected.</li> </ul>	
<p><b>Complete planning for municipal area networks and inter-community interconnect</b></p>	<p><b><u>Cost</u></b> Low – staff time to establish proposed routes.</p> <p><b><u>Sustainability</u></b> None – move on to implementation cycle.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Planning may not accommodate all needs.</li> </ul>	
<p><b>Identify and, insofar as feasible, secure funding sources for municipal distribution rings and inter-community interconnect</b></p>	<p><b><u>Cost</u></b> Low to medium – staff and consulting time to identify funding sources and to complete any needed applications.</p> <p><b><u>Sustainability</u></b> Low – funding sources change through time.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Planning may not accommodate all needs.</li> </ul>	
<p><b>Identify and, insofar as possible, recruit private partners to participate in last mile infrastructure and services development</b></p>	<p><b><u>Cost</u></b> Low – staff time to identify and work with potential private partners.</p> <p><b><u>Sustainability</u></b> Low – continued staff time to nurture relationships.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Developing public-private partnership relationships with some providers may offend those not participating.</li> <li>• Various potential partners will understand the role of government in broadband development differently.</li> </ul>	

### Three Year Actions

The county’s three year action plan should focus on development and implementation of distribution level architecture. This effort should include:

<p>Implement municipal area networks in Buena Vista and Salida</p>	<p><b><u>Cost</u></b> About \$70k per mile of infrastructure.</p> <p><b><u>Sustainability</u></b> About \$250 per mile of infrastructure per month for locates, break-fix, equipment maintenance, etc.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Within the constraints of CRS 29-27 may never be extendable to private subscribers.</li> </ul>	
<p>Implement inter-community connectivity – preferably with an add/drop location in Poncha Springs</p>	<p><b><u>Cost</u></b> Three primary options exist:</p> <ol style="list-style-type: none"> <li>1. Lease – cost to be determined</li> <li>2. Licensed microwave – cost dependent on tower structure needs</li> <li>3. Fiber – about \$1.75m</li> </ol> <p><b><u>Sustainability</u></b> Dependent on selected option:</p> <ol style="list-style-type: none"> <li>1. Lease – recurring lease fees to be determined</li> <li>2. Licensed microwave – fairly low</li> <li>3. Fiber – up to \$5,000 per month</li> </ol>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Success criteria must be defined.</li> <li>• Not necessary without implementation of municipal area networks.</li> </ul>	
<p>Aggregate the middle mile marketplace on the county-wide network</p>	<p><b><u>Cost</u></b> Low – based on the implementation of the countywide network.</p> <p><b><u>Sustainability</u></b> Low – participating subscribers should offset bandwidth costs.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Participating subscriber fees may not offset bandwidth costs.</li> </ul>	
<p>Execute actions to develop middle mile paths to the west, northeast, or both</p>	<p><b><u>Cost</u></b> Low – staff time to work with private providers to identify the need and assist with planning.</p> <p><b><u>Sustainability</u></b> Low – private providers responsible for sustainability.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Paths may be infeasible.</li> </ul>	

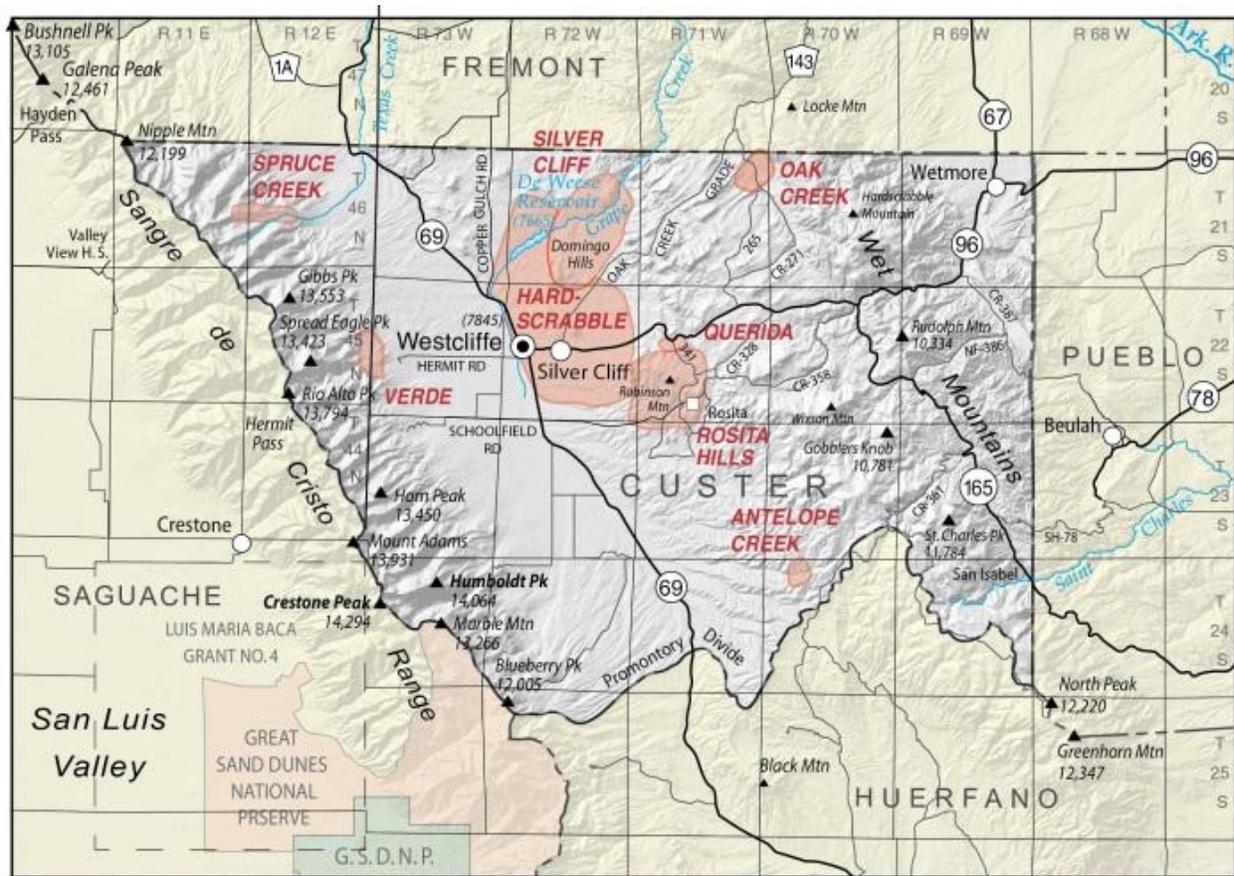
<p>Open opportunities for local providers to access the aggregated middle mile marketplace</p>	<p><b><u>Cost</u></b> Low – local providers should offset any costs to their access.</p> <p><b><u>Sustainability</u></b> Low – Local providers should offset sustainability costs.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Local providers may not be interested in an aggregated middle mile marketplace.</li> <li>• Dependent on implementation of municipal area networks.</li> </ul>	
<p>Extend services to businesses along the municipal network paths</p>	<p><b><u>Cost</u></b> Medium – business subscribers should offset any costs to their access. Some prorating of implementation costs may be needed.</p> <p><b><u>Sustainability</u></b> Low – business subscribers should offset any costs to their access. In a public-private partnership model, local service providers do not lose revenue from this action as they will act as the retail service provider.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Dependent on implementation of municipal area networks.</li> <li>• Businesses may not be interested in services.</li> </ul>	
<p>Work with fixed wireless providers to continue to expand service offerings throughout the county (the county can help build additional tower locations, provide access to additional middle mile services at aggregated prices, provide better connectivity (or backhaul) for wireless access points, and otherwise assist wireless providers with their expansion efforts)</p>	<p><b><u>Cost</u></b> Indeterminate – dependent on the level of participation needed to meet the county’s objectives.</p> <p><b><u>Sustainability</u></b> Indeterminate – dependent on the level of participation needed to meet the county’s objectives.</p>
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Supporting some providers over others may lead to charges of favoritism.</li> </ul>	

### Five Year Actions

The county’s five year action plan should focus on extending expanded services to residences and businesses. This effort primarily involves working with private partners to deploy infrastructure and provided services.



## Custer County



Custer County covers 740 square miles. The population in 2010 was 4,255<sup>17</sup> and is estimated at 4,285<sup>18</sup> in 2013 (representing 0.7 % growth compared 4.8% growth in the state). Approximately 25% of the county's population lives in two adjacent communities: Westcliffe (pop. 568) and Silver Cliff (pop. 587). The county includes two smaller unincorporated communities that warrant mention: Wetmore, located in the northeast corner of the county, sits on the eastern slope of the Wet Mountains and is geographically separated from county's primary valley. State Highway 96 runs through Wetmore. San Isabel is a small seasonal community located in the southeast of the county where State Highway 165 enters Pueblo County. The rest of the population is spread throughout unincorporated rural areas. Overall the county has a population density of 5.8 people per square mile. The unincorporated rural

<sup>17</sup> 2010 Census

<sup>18</sup> 2013 Census estimate

areas have an average population density of 4.2 people and a household density of 2.1 households per square mile.

The county is primarily a rural, geographically isolated, north south valley. To the north lies Fremont County effectively separated from Custer County by the Arkansas River Canyon and Royal Gorge. To the west is the Sangre de Cristo Range, separating the county from Saguache County. On the east lie the Wet Mountains separating the county from Pueblo County. To the south, Promontory Divide lies between Custer County and Huerfano County. About 36% of Custer County is federal lands comprised primarily of National Forest and Wilderness Area in the two mountain ranges.

State Highway 69 crosses the county from north to south connecting Highway 50 in Fremont County to the North to Walsenburg/I-25 in Huerfano County to the South. State Highway 96 connects Westcliffe/Silver Cliff east to Pueblo in Pueblo County. State Highway 165 connects Highway 96 to San Isabel and continues to Colorado City in Pueblo County. Saguache County lies to the west of Custer County. There is no highway access between Saguache and Custer Counties.

Compared with the rest of Colorado, the county's population is older (65+ 27% vs. 12% for the state with a median resident age of 53 vs. 36 in the state) and lower paid (median household income of \$42,534 vs. \$58,244 for the state). National broadband adoption trends suggest rural areas, older Americans, and lower household incomes correlate with lower broadband adoption rates.

## General Assessment

Broadband services in Custer County are limited but improving.

The introduction of a middle mile microwave link by DD Wireless represents a significant improvement in middle mile diversity and capacity. As recently as 2010 the county broadband service was classified as unserved or under-served. However, fixed wireless solutions implemented by DD Wireless and Hilltop Broadband have altered the county's broadband environment. Incumbent service providers now estimate 40% of county households have access to broadband service.

There are no cable broadband or fiber last mile providers in the county and it is unlikely any will enter the market during the plan period. DSL and satellite providers offer Internet service in the county but the services do not meet broadband parameters. Mobile Wireless (3G/4G LTE; ATT, Verizon, t-mobile & Sprint) service is limited in the county and is projected to remain so during the plan period.

A practical goal for the county is to have 80% of its households with access to adequate and affordable broadband via fixed wireless within five years. In addition to fixed wireless services, some households will have access to DSL. About 20% of particularly difficult to reach households in the county may only have access to the Internet through satellite services or, in some few cases, may have no access at all. While this goal may be difficult, it is certainly attainable.

## Infrastructure

### *Middle Mile*

Custer County enjoys reasonable and improving middle mile options.

Middle Mile transport capacity is available through both microwave and fiber optic systems. System designs and implementations exhibit qualities of redundancy and diversity. Middle Mile capacity is adequate for today's usage. Middle Mile reliability is adequate.

CenturyLink has fiber running north south along Highway 69 from Highway 50 to Gardner where it dead-ends.

DD Wireless operates a microwave middle mile system from Walsenburg into Custer County. DD Wireless' system interconnects with SECOM fiber in Walsenburg and at Pueblo West.

Individual subscribers or subscriber entities in Westcliffe/Silver Cliff can create middle mile path diversity and redundancy by subscribing to two network owners' services. Even some subscribers without access to CenturyLink's DSL solutions can achieve path diversity by subscribing to DD Wireless (with its own microwave backhaul) and Hilltop Wireless (with its CenturyLink backhaul).

EAGLE-Net has plans for a microwave system from Pueblo to Westcliffe.

### *Last Mile*

Three primary last mile networks exist in the county.

CenturyLink offers DSL service to households and businesses in and around Westcliffe and Silver Cliff and into some unincorporated areas. Speed test results suggest typical Custer County CenturyLink customers receive average speeds of 3/0.8 Mbps. CenturyLink offers promotional pricing for unbundled Internet service of \$30 per month for the first year increasing to \$50 per month afterwards.

Much of the valley and some of the mountainous areas are provided for by fixed wireless services. Fixed wireless services may be available from DD Wireless or Hilltop Broadband. DD Wireless offers three packages: Basic Residential (\$30 per month for 1.2/1.2 Mbps), Full Residential (\$50 per month for typical speeds of 6/6 Mbps but up to 18/18 Mbps), and Business (which is quoted on an individual case basis and can provide service up to 30/30 Mbps). Hilltop Wireless' service area in Custer County is currently more limited. Hilltop offers four residential packages in the county: Bronze (\$35 per month for 3 Mbps download), Silver (\$55 per month for 6 Mbps download), Gold (\$65 per month for 10 Mbps download), and Platinum (\$79.95 per month for up to 30 Mbps).

CenturyLink and Hilltop Wireless backhaul on the CenturyLink middle mile fiber. DD Wireless backhauls on its own microwave network to SECOM fiber in Walsenburg and Pueblo West.

Cellular providers offer mobile wireless throughout some of the county and satellite Internet services can be had in most of the county.

The FCC definition of broadband is currently terrestrial 4/1 Mbps.

Eleven last mile internet service providers offer service. There is one wireline service provider; two fixed wireless providers; four mobile wireless providers; and four satellite internet providers.

Details on individual service provider offerings are available from:

1. Wireline –
  - a. CenturyLink <http://www.centurylink.com/home/internet/> (CenturyLink fiber backhaul)
2. Fixed Wireless –
  - a. DD Wireless <http://www.dd-wireless.com/> (DD Wireless microwave backhaul)
  - b. Hilltop Broadband <http://hilltop-broadband.com/residential.html> (CenturyLink fiber backhaul)
3. Mobile Wireless –
  - a. AT&T Wireless [http://www.att.com/att/planner/#fbid=LvZ8Pp\\_oOPE](http://www.att.com/att/planner/#fbid=LvZ8Pp_oOPE) (AT&T radios on Verizon owned tower with CenturyLink fiber backhaul)
  - b. T-Mobile <http://www.t-mobile.com/cell-phone-plans/mobile-internet.html> (through partner radios on Verizon owned tower)
  - c. Sprint  
[http://shop.sprint.com/mysprint/shop/plan/plan\\_wall.jsp?tabId=pt\\_data\\_plans\\_tab&IN\\_TNAV=ATG:HE:DataOnlyPlans](http://shop.sprint.com/mysprint/shop/plan/plan_wall.jsp?tabId=pt_data_plans_tab&IN_TNAV=ATG:HE:DataOnlyPlans) (through off-network roaming)
  - d. Verizon Wireless <http://www.verizonwireless.com> (on Verizon owned tower with CenturyLink fiber backhaul)
4. Satellite Internet –
  - a. Excede Internet <http://www.exede.com>
  - b. HughesNet Gen4 <http://www.hughesnet.com/index.cfm?page=Plans-Pricing>
  - c. Dish Internet <http://www.dish.com/entertainment/internet-phone/satellite-internet/>
  - d. DirecTV <http://www.directv.com/DTVAPP/content/packages/internet?CMP=KNC-BR-5-414-730148&keninvocaid>

## Broadband Characteristics

### *Available*

Many households in Custer County have no access to broadband services at even the most basic definition. Because of the low population density and rugged terrain in the county, it is unlikely that broadband will be available to all households in the next five years. Some households will have to rely

on satellite service. Even satellite service may not be available to some households nestled in the shadows of mountains or covered by too much forest.

The number of fixed wireless towers and the types of electronics associated with those towers plays a critical role in the availability of broadband in Custer County.

The area in the State Highway 96 corridor from Silver Cliff east to Wetmore can be supported by the selective placement of fixed wireless towers. The Wetmore area will receive service from providers coming from the north and east rather than from the west. Coverage along State Highway 165 from its intersection with Highway 96 south to San Isabel is particularly challenging because of its low density of largely seasonally occupied households, rugged terrain, and heavy forestation. Wireline and fixed wireless solutions are currently unavailable and unsustainable in this area. Households located in this area are likely to depend on satellite service for the duration of this plan.

**GOAL** Within five years, 80% of households in Custer County will have access to the then current FCC definition of broadband.

#### *Adequate*

#### **Capacity**

Custer County has reasonable middle mile capacity through its two middle mile providers.

Last mile capacity is not available in some areas and poor to good in the rest of the county.

**GOAL** Within five years, 80% of all households in Custer County will have access to good (that is, 40 Mbps download or better) broadband services.

#### **Reliability**

The county enjoys reasonable and improving broadband reliability.

The two middle mile providers offer good reliability. If needed, businesses can enhance reliability by subscribing to multiple diverse networks.

The last mile wireline infrastructure is aging and presents reliability issues. The fixed wireless infrastructure is newer and generally reliable.

The significant broadband reliability issue in Custer County is the result of a lack of availability. Because of availability, many Custer County household may not experience the same online environment as their peers in Front Range communities. The goal to extend availability and increase capacity will improve reliability. As subscriber usage grows, middle mile assets will require upgrades.

**GOAL** Stakeholders must work with existing and potential middle mile providers to expand middle mile capacity. Middle mile capacity in the county will at least double in the plan period.

*Affordable*

Current post-promotional mid-tier pricing for residential service is:

	Monthly Cost	Download	\$/Mbps Download
<b>DSL</b>	\$50	7 Mbps	\$7.14
<b>Fixed Wireless</b>	\$50	6 Mbps	\$8.33

**Table 5: Custer County Price Summary**

These data do not accurately reflect the reality that most DSL customers in Custer County do not receive a 7 Mbps service. The typical DSL customer in the county pays \$50 per month for 3 Mbps average download speeds driving the average \$/Mbps download for DSL to \$16.67.

These prices are higher than the US average of \$3.50/Mbps and higher than the Colorado average of \$3.09/Mbps.

Business and institutional broadband prices are higher in Custer County than on the Front Range.

**GOAL** Over the plan period, commercial broadband services will be equitably priced per Mbps with the Front Range services.

**GOAL** Over the plan period, typical residential prices will remain at about \$50 per month but average speeds will increase through time as per the following schedule:

Year	Bandwidth	\$/Mbps
<b>2015-16</b>	10/5 Mbps	\$10.00
<b>2017-18</b>	20/10 Mbps	\$5.00
<b>2019-20</b>	40/20 Mbps	\$1.25

**Table 6: Custer County Speed and Price Targets**

*Sustainable*

Custer County’s isolated and rural nature represents a challenge to sustainable broadband. DD Wireless and Hilltop Broadband currently enjoy a friendly rivalry. Both providers are local small businesses investing in the community and growing their businesses. The cooperation and competition between these companies contributes significantly to broadband development in the county.

Historically, many smaller local fixed wireless providers collapse under the weight of operational costs and recurring system refresh requirements. Having two strong fixed wireless providers in the county works to ensure against the failure of either of them.

Small companies often outgrow the entrepreneurial nature of their founders. Fixed wireless small businesses must develop organizational strengths to maintain growth and address customer demands.

Smaller fixed wireless carriers are often absorbed by larger providers. Larger providers have less sensitivity to community needs. Larger carriers often postpone system upgrades in favor of maximizing profits.

Efforts must be initiated to maintain the benefits of local small businesses supporting Custer County's broadband environment.

Equipment life-cycle replacement requirements represent a significant burden on middle mile and last mile providers. Middle mile electronics typically require replacement every seven to ten years. Some last mile electronics must be replaced as often as every three to five years to keep pace with growing consumer demand.

Sustaining broadband development in the county requires coordination between the local governments and the region and state. Custer County, Westcliffe, and Silver Cliff must implement organizational elements to support the required coordination.

## Recommended Actions

Because of its mountainous terrain and rural nature, Custer County faces broadband development challenges. The Fixed Wireless service providers in the county have implemented substantial broadband improvements. The county must continue to encourage and support these continuing efforts.

### Last Mile Infrastructure Expansion

#### **POLICY ACTION**

The simplest action local governments can take to encourage continuing last mile infrastructure development is to maintain a minimum level of bureaucratic barriers and implement "broadband friendly community" policies.

Because broadband infrastructure isn't constrained by political boundaries, there is value in coordinating policies across jurisdictional boundaries. The region will see value in establishing a regional resource that can help broadband providers navigate the multiple jurisdictional requirements.

A regional organization will also help expand middle mile capacity as demand grows in Custer County. For example, SECOM has fiber infrastructure into

Canon City and Walsenburg. SECOM has expressed some interest in ensuring their fiber path into Canon City is physically diverse. One way for SECOM to create path diversity is to run fiber from Canon City through Westcliffe and on to Walsenburg. A regional organization may be able to work with the county and SECOM to identify ways to make creation of this path a more viable solution for SECOM while simultaneously ensuring SECOM provides infrastructure complementary to county and regional broadband development objectives.

**ACTION ITEM**

The county will support regional efforts by creating and maintaining a local Broadband Steering Committee. This group will function to guide and support the continuing local expansion of broadband and to coordinate with and support regional broadband efforts.

One important “broadband friendly community” policy is an open trench or dig once policy. State law<sup>19</sup> requires that “[t]he state or a political subdivision shall provide notice on a competitively neutral basis to broadband providers of any utility trenching project that it conducts...” and that “...the state or political subdivision shall allow joint trenching by broadband providers ... for the placement of broadband facilities...”. However, this only pertains to providing the opportunity for private entities to add conduit to public trenching projects and does not address a local jurisdiction’s need to place conduit along with public or private trenching projects. Local jurisdictions may wish to enhance the state’s notification requirements.

In Custer County, the most significant last mile infrastructure development over the next five years will be continued expansion of wireless services. To reach the goal of 80% of households having 40 Mbps downloads available for \$50 per month will require new fixed wireless deployment and upgrades to existing services.

Two key impediments prevent fixed wireless providers from expanding service into additional areas: 1) locating towers to serve new areas and 2) connecting remote towers to the central network or tower backhaul.

**ACTION ITEM**

Wireless providers can establish sufficient tower backhaul via point-to-point wireless solutions. However fiber connectivity for towers is a preferred

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<sup>19</sup> CRS 38-5.5-109

backhaul solution. By pursuing an effective open trench or dig once policy, some tower sites will come within financially feasible reach of fiber construction and wireless providers may be able to migrate some point-to-point backhaul to fiber connectivity.

Local jurisdictions shall establish open trench and dig once policies.

**ACTION ITEM**

Tower sites involve land use, permitting, construction, other implementation requirements, and ongoing maintenance access. Key stakeholders shall facilitate the placement of towers.

**ACTION ITEM**

The wireless propagation survey will identify locations in the county where new towers will have the most significant impact. An initial wireless propagation survey is attached as an appendix to this strategic plan.

### Education and Utility

Available, adequate, affordable, and sustainable broadband all depend, in part, on demand. Demand creates a foundation of subscribers upon which broadband can be sustained and remain affordable. The county needs to encourage demand to strengthen the case for meeting its broadband goals.

A key way to expand demand is through education. Custer County's Local Technology Planning Team has been doing a good job of educating the public and evangelizing the value of broadband services for residents and businesses.

**ACTION ITEM**

This education effort must increase and expand.

**ACTION ITEM**

Broadband functionality increases demand. Custer County has begun putting services online. Local jurisdictions shall continue to develop online resources and expand the ability for citizens to interact with their local governments through online functionality.

**POLICY ITEM**

Demand can be nurtured by making broadband available through wireless hot spots. Free Wi-Fi service in common public areas supports visitors to the area.

**ACTION ITEM**

Stakeholders shall provide free Wi-Fi service in public areas.

**POLICY ITEM**

Unless infrastructure is known, it is difficult to take advantage of it.

**POLICY ITEM**

Stakeholders in the county shall map infrastructure and broadband availability in coordination with mapping efforts of the Governor’s Office of Information Technology (GOIT).

## Target Action Plan

### First Year Actions

The county’s first year action plan shall focus on the administrative actions, relationship development, infrastructure planning, and infrastructure deployment appropriate to affect additional broadband development. These actions should include:

<p>Implement appropriate “broadband friendly community” policy changes</p>	<p><b>Cost</b> Low – staff time to prepare policy changes. <b>Sustainability</b> Easy – periodic policy reviews.</p>
<p>Broadband friendly community policies will help expand available infrastructure and will encourage development of additional middle mile and last mile services.</p> <p><b>Risks</b></p> <ul style="list-style-type: none"> <li>Broadband friendly policies are unlikely to have a significant impact on broadband quality in the county.</li> </ul>	
<p>Provide open trench or dig once opportunities at all jurisdictional levels</p>	<p><b>Cost</b> Low – staff time to modify model open trench policy. <b>Sustainability</b> Moderate – periodic reviews, potential incremental costs to add conduit to open trench project, and mapping of deployed assets.</p>
<p>Open trench or dig once policies create available conduit or other assets that can be used to enhance middle mile and last mile services.</p> <p><b>Risks</b></p> <ul style="list-style-type: none"> <li>Imposing open trench requirements on private projects may face opposition.</li> </ul>	
<p>Develop and participate in a regional collaboration for “broadband friendly policies” and deployment related administrative functions</p>	<p><b>Cost</b> Low – staff time to participate in regional collaboration. <b>Sustainability</b> Low – periodic policy reviews.</p>

Regional coordination of broadband friendly policies creates an environment where service providers can work throughout the region and expect to see fundamentally common rules as they cross jurisdictional boundaries.

**Risks**

- May lead to conflict between the multiple participating jurisdictions.

**Implement infrastructure and services mapping mechanisms and methods of sharing data with the state’s broadband mapping agency**

**Cost**

Moderate – requires data collection mechanisms that do not currently exist. This may be a largely volunteer effort, an internship effort, or a paid staff member at the county or regional level.

**Sustainability**

Moderate – the broadband environment is continually changing. Mapping of available infrastructure and services requires constant updating.

Mapping helps local jurisdictions, potential providers, and subscribers understand the availability of assets. Working with the state for mapping instead of trying to map as a county or region allows the county and region to take advantage of the assets the state is applying to broadband mapping.

**Risks**

- Mapping accuracy is only as good as data collection.
- GOIT may not provide a repository for all data needed by the county.
- GOIT may limit access to the information collected.

**Disseminate and maintain wireless propagation survey work.**

**Cost**

Low – primary responsibility falls on the shoulders of private providers.

**Sustainability**

None – move on to implementation cycle.

The wireless propagation survey will evaluate and identify specific locations where new wireless towers may have the greatest impact on extending last mile fixed wireless system impact.

**Risks**

- Propagation survey may not identify all required tower sites.
- Desirable tower site may be inaccessible.

<p><b>Planning and implementation of Municipal Wi-Fi System in select areas of Westcliffe and Silver Cliff.</b></p>	<p><b><u>Cost</u></b>                  Site survey, prepare report: \$5,000                  Design – RF/power, backhaul, cosmetics: \$10,000                  Equipment selection RFP process: \$5,000                  Equipment purchase, installation, turn-up, testing, handoff training: \$30,000  <b><u>Sustainability</u></b>                  Moderate – operations, customer support and system maintenance can be outsourced.</p>
<p>Wi-Fi hot spots throughout Westcliffe and Silver Cliff support visitors to Custer County. Wi-Fi hot spots may serve to encourage greater broadband adoption as residents learn more of the advantages broadband services offer by watching visitors and by taking advantage of public services.</p>	
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• May have limited users.</li> </ul>	
<p><b>Identify and recruit partners to participate in middle mile and last mile infrastructure and services development and sustainability.</b></p>	<p><b><u>Cost</u></b>                  Low – staff time to identify and work with potential private partners.  <b><u>Sustainability</u></b>                  Low – continued staff time to nurture relationships.</p>
<p>Throughout the US, communities are recognizing the value of municipal broadband development. Public investment has been particularly important in unserved and underserved rural communities. As Custer County’s stakeholders work to develop broadband, public investment will encourage private partners to develop and optimize broadband infrastructure and services. This task of recruiting private providers to participate in middle mile and last mile infrastructure and services involves continuing to develop existing relationships. It may also involve identifying those public investments that will best support private providers’ potential broadband improvements.</p>	
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Developing public-private partnership relationships with some providers may offend those not participating.</li> <li>• Various potential partners will understand the role of government in broadband development differently.</li> </ul>	

### Three Year Actions

The county’s three year action plan will focus on development, implementation, and upgrading of last mile infrastructure. This effort should include:

<p><b>Work with fixed wireless providers to continue to expand service offerings and improved capabilities throughout the county.</b></p>	<p><b><u>Cost</u></b> Indeterminate – dependent on the level of participation needed to meet the county’s objectives.</p> <p><b><u>Sustainability</u></b> Indeterminate – dependent on the level of participation needed to meet the county’s objectives.</p>
<p>The county’s best opportunity to reach the goal of 80% of households with access to 40 Mbps for about \$50 per month is through careful coordination and cooperation with fixed wireless providers. Stakeholders shall help build additional tower sites, help provide better connectivity for remote wireless access points, and otherwise assist wireless providers with their expansion efforts.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Supporting some providers over others may lead to charges of favoritism.</li> <li>• The Custer County market is not large enough for extensive competition. Therefore, stakeholders must work aggressively with a small number of providers. If a provider changes management or otherwise alters its service and/or cooperation profile, the county may lose significant progress and credibility.</li> </ul>	
<p><b>Implement infrastructure elements required to lower barriers to entry for expanded middle mile capacity.</b></p>	<p><b><u>Cost</u></b> Moderate to significant – dependent on the level of participation needed to meet the county’s objectives.</p> <p><b><u>Sustainability</u></b> Moderate – dependent on the level of participation needed to meet the county’s objectives.</p>
<p>As the county achieves its last mile availability and capacity goals, middle mile capacity and reliability will become a more pressing issue. In conjunction with building last mile solutions in cooperation and partnership with fixed wireless providers, the county must invest in infrastructure needed to make the business case for increased middle mile capacity.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• The level of public investment needed to entice private middle mile providers to increase capacity may be impractical.</li> </ul>	

## Five Year Actions

The county's five year action plan will focus on closing gaps identified or created as the one and three year action plans have been completed.

## Conclusion

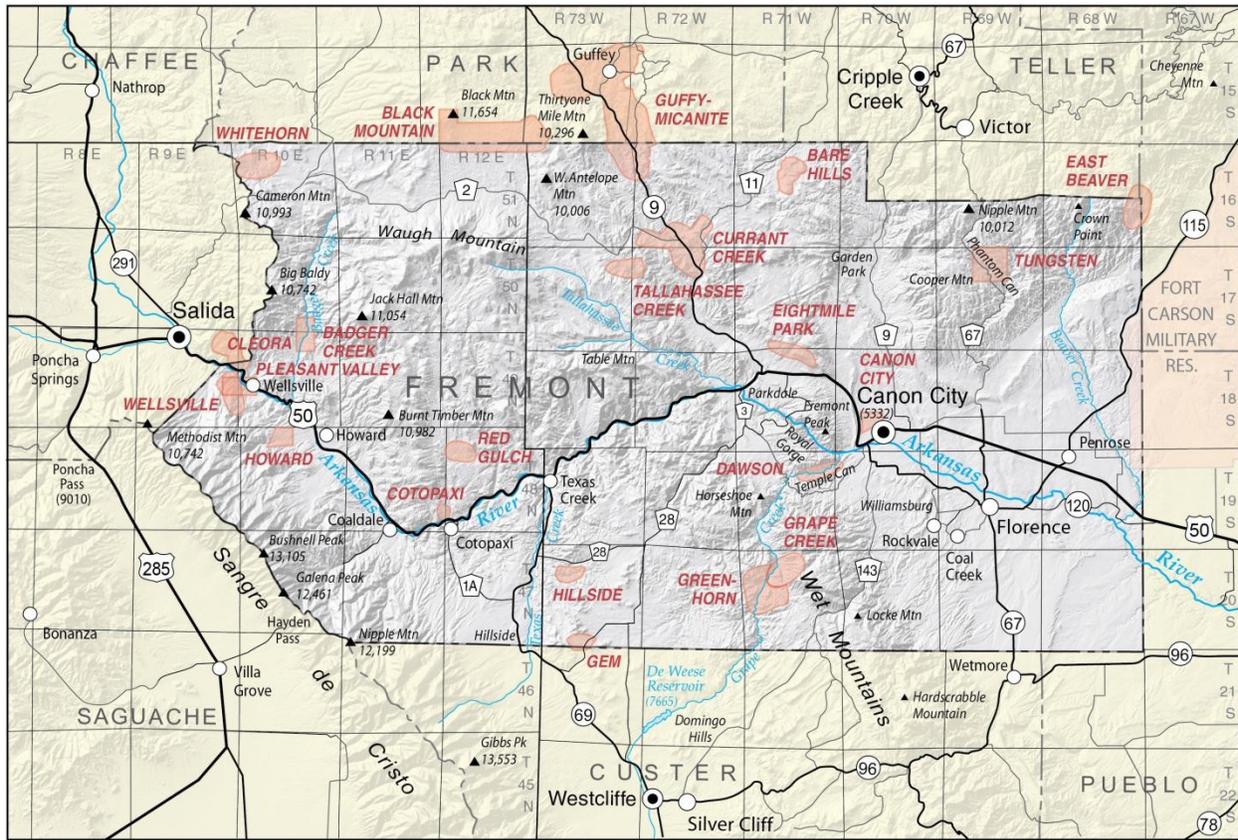
This Custer County specific broadband strategic plan was developed in conjunction with the Upper Arkansas Region broadband Strategic Plan. This county specific section was developed in collaboration with representatives of the Custer County Technology Planning Committee and other stakeholders in the County. This plan reflects the independent observations of the staff of OHIvey and Mid-State Consultants based on available information acquired June through December 2014.

Broadband conditions are continually evolving. We recommend that this plan receive regular updates to reflect progress and changes in the county's broadband environment.

The information and recommendations in this strategic plan can be used to create action schedules, make assignments and track progress. This plan can also be the basis for a program of community education. Community education is instrumental to achieving successful implementation of the necessary steps to develop growing broadband capability in the county. Education is also a key drive for broadband adoption.

We encourage the Custer County Technology Planning Committee to accept this information and these recommendations as a living process. The Committee should develop a time line with appropriate milestones. As each milestone is reviewed, this document should be updated to reflect progress.

## Fremont County



Fremont County covers 1,534 square miles and has a population of 46,824<sup>20</sup>. About  $\frac{3}{4}$  of the population is concentrated in several communities in a 112 square mile Arkansas River valley in the southeastern part of the county starting at about Twin Mountain and spreading out to the southeast to Pueblo. These communities include Canon City (pop. 16,400), Florence (pop. 3,881), Brookside (pop. 219), Coal Creek (pop. 303), Rockvale (pop. 426), Williamsburg (pop. 714), Lincoln Park (pop. 3,904), Penrose (pop. 3,582), and surrounding areas. The rest of the county consists of very rugged terrain characterized by mountains and canyons. These terrain features push population into community pockets like Cotopaxi (pop. 47), Coaldale (pop. 255), and Howard (pop. 723) or spread the population out into fairly isolated ranches. Overall the population density is 30.5 per square mile. Excluding the more densely populated southeast corner of the county, the population density is 8.2 people per square mile.

<sup>20</sup> 2010 Census.

Highway 50 crosses the county from east to west providing access to Chaffee County to the west and Pueblo County to the east. Custer County (to the south) is accessible via Highway 69 and Park County (to the north) is accessible via Highway 9. To the northeast, Highway 115 leads to Colorado Springs in El Paso County. The county has limited or no road access to Teller County to the north and Saguache County to the southwest.

The county's population is older (median resident age of 43 vs. 36 in the state), lower paid (median household income of \$40,101 vs. \$55,430 for the state), in greater poverty (15.8% of households below poverty level income vs. 9.3% in the state), and with a lower college graduate population (13.5% vs. 24.2% in the state) than Colorado averages. National broadband adoption trends suggest rural areas, older Americans, lower household incomes, and lower education attainment all correlate with lower broadband adoption rates.

## General Assessment

The broadband environment in Fremont County is starkly divided between the population centers in the southeast section of the county and everyone else. In the southeast corner, residents and businesses generally have access to DSL, Cable modem, and fixed wireless solutions. These options may be lower capacity and higher price than in other areas in the state but they are available. Most of the rest of the county is underserved or unserved with some exceptions along Highway 50.

## Infrastructure

### *Middle Mile*

Two middle mile fiber providers offer service into Canon City – CenturyLink and SECOM. CenturyLink's fiber continues along Highway 50 into Salida. CenturyLink's fiber also branches south on Highway 69 through Custer County and into Walsenburg. SECOM's fiber does not currently offer path diversity.

### *Last Mile*

Three primary last mile networks exist in the county.

CenturyLink offers DSL service to residents and businesses in the southeast corner of the county and in communities along Highway 50. CenturyLink's DSL ranges up to 25/1.5 Mbps but more typically provides 7/1.5 Mbps or slower speeds. CenturyLink has some Metropolitan Optical Ethernet services available in the county. CenturyLink offers promotional pricing of \$30 per month for the first year jumping to \$50 per month afterwards.

Charter Communications offers cable modem service to residents in much of the southeast section of the county. Charter's offerings are typically limited to bandwidth ranges up to 15/3. Charter offers promotional pricing of \$40 per month for the first year, increasing to \$50 in the second year, and to \$55 beyond the third year.

Vision Broadband provides fixed wireless service to much of the southeast area of the county. Vision offers three residential packages: 5/2 for \$40 per month, 10/3 for \$66 per month, and 15/5 for \$90 per month.

Additionally, cellular companies offer mobile wireless throughout much of the county and satellite Internet services can be had in most of the county.

## Broadband Characteristics

### *Available*

Nearly 20% of the county's addresses have no access to wireline or fixed wireless broadband services. Because of the very mountainous terrain and isolated nature of this population, extending access will be very difficult.

#### **GOAL**

Within five years fixed wireless and fiber service should be extended to the eight mile and Royal Gorge area making residential and business and institutional service packages available.

### *Adequate*

#### **Capacity**

Fremont County has reasonable middle mile capacity through its two middle mile providers in the southeast.

Last mile capacity throughout the county is less than optimal. In lower density areas of the county no service exists. In higher density areas, Charter and CenturyLink offer only relatively slower residential services.

Some limited areas in the county have access to very good last mile capacity through Metropolitan Optical Ethernet or SECOM fiber services.

#### **GOAL**

Within five years, all addresses along municipal area network paths should have access to very good last mile capacity.

#### **GOAL**

Within five years, Charter should be encouraged to upgrade their system to offer good broadband capacity.

### **Reliability**

The county enjoys a reasonably reliable broadband environment.

In the middle mile, the two middle mile providers offer good options. Subscribers can enhance reliability by subscribing to networks carried on diverse paths with diverse operations.

In the last mile, some of the DSL infrastructure is aging and may present reliability issues. Much of the cable infrastructure is oversubscribed. While this will not generally cause outages, it frequently leads to service degradation. Most of the fixed wireless infrastructure is fairly new and generally reliable.

### Affordable

Current post-promotional mid-tier pricing for residential service is:

	Monthly Cost	Download	\$/Mbps Download
<b>Cable Modem</b>	\$55	15 Mbps	\$3.67
<b>DSL</b>	\$50	7 Mbps	\$7.14
<b>Fixed Wireless</b>	\$66	10 Mbps	\$6.60

**Table 7: Fremont County Price Summary**

These prices are higher than the US average of \$3.50/Mbps and higher than the Colorado average of \$3.09/Mbps.

The introduction of SECOM into the southeast portion of the county has put downward pressure on business and institutional broadband prices but they are still higher in Fremont County than in other Front Range areas.

<b>GOAL</b>	Within five years, business and institutional broadband should be equitably priced with the Front Range. Residential pricing should keep pace with changes in state and national prices.
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### Sustainable

Fremont County can sustain greater broadband competition. Greater broadband competition in areas like Brookside, Coal Creek, and Rockvale may be detrimental to providers like BySky and Vision who currently offer service in these communities. However, greater broadband competition in these areas will likely drive higher adoption rates. In interviews in these communities, we discovered many residents are unaware of any available service options.

In the western part of the County, broadband development may need to be subsidized by public capital investments or other means. Existing communications towers in and around the 8-Mile area may be viable candidates for improved service in this area with some structural reinforcement or height increases. These improvements may need to be subsidized for them to make good business sense to the incumbent provider owners and users.

## Recommended Actions

Because of its mountainous terrain and rural nature, much of Fremont County faces significant broadband development challenges. The introduction of SECOM into Canon City and surrounding areas

has had a significant positive impact on the area’s broadband services. However, broadband development in the county is in significant flux and should be carefully nurtured. In particular, the county should 1) pursue policies and actions to increase last mile broadband capacity, 2) extend availability to the Eight Mile area and Royal Gorge, and 3) extend middle mile options.

### Improve Last Mile Capacity

**POLICY**

The simplest action the county and the communities within the county can take to encourage last mile infrastructure development is to reduce any bureaucratic barriers to entry and to implement “fiber friendly community” policies. Because broadband infrastructure isn’t constrained by political boundaries, there is value in coordinating policies across jurisdictional boundaries. The region may also see value in establishing a regional resource that can help broadband providers navigate the multiple jurisdictional requirements.

**POLICY**

One important “fiber friendly community” policy is an open trench or dig once policy. State law requires that “[t]he state or a political subdivision shall provide notice on a competitively neutral basis to broadband providers of any utility trenching project that it conducts...” and that “...the state or political subdivision shall allow joint trenching by broadband providers ... for the placement of broadband facilities...”. However, this only pertains to state trenching projects and does not address a jurisdiction’s possible desire to place conduit along with private trenching projects. Local jurisdictions may wish to enhance the state’s notification requirements.

**MAPPING**

Unless available infrastructure is known, it is difficult for broadband developers to take advantage of it. The county should work to map infrastructure and service availability. The county should not duplicate the broadband mapping efforts of the Governor’s Office of Information Technology (GOIT). Rather, the county should coordinate data collection for GOIT and provide information to GOIT.

To ensure the most efficient use of county broadband development efforts, the county needs the capability to map infrastructure, parcel level service mapping granularity, and a mechanism to identify source data and aging. The county should work to ensure GOIT includes these capabilities in the broadband mapping tool.

**EDUCATION &  
UTILITY**

Adoption rates and potential revenue are key factors leading to a Charter services upgrade in their service area in Fremont County. Creating education opportunities and developing online utilities to drive greater broadband adoption will likely influence Charter’s upgrade path.

## Extend Availability

### INFRASTRUCTURE PARTNERSHIP

The county has pursued fairly effective mechanisms to extend availability to targeted community anchor institution locations. These efforts should continue. The county may want to consider a municipal area network approach where it deploys fiber to several community anchor institutions. It is possible that SECOM may be interested in partnering with the county to complete this type of network.

### INFRASTRUCTURE PARTNERSHIP

Service improvements in the Eight Mile area are within reasonable reach. Black Hills Energy has a microwave site on South Twin Mountain that may have visibility into the Eight Mile area and to the Royal Gorge Park area. These locations may be of use in providing fixed wireless and point-to-point wireless services into the area.

SECOM may also be persuaded to extend their fiber along Highway 50 and eventually through Custer County to Walsenburg. If so, SECOM fiber last mile and middle mile services could be available in this area.

### LEGAL

To work in an infrastructure partnership or to deploy new infrastructure, the county may have to resolve constraints imposed by CRS Title 29 Article 27 (also known as “Senate Bill 152”).

## Extend Middle Mile Options

### INFRASTRUCTURE PARTNERSHIP

SECOM may be persuaded to extend their fiber along Highway 50 and eventually through Custer County to Walsenburg. This would provide additional path diversity for Fremont County’s middle mile environment.

## Target Action Plan

### One Year Actions

The county’s one year action plan should focus on the administrative actions, relationship development, infrastructure planning, and infrastructure deployment appropriate to effect additional broadband development. These actions should include:

Implement appropriate “fiber friendly community” policy changes

**Cost**

Low – staff time to prepare policy changes.

**Sustainability**

Easy – periodic policy reviews.

<p>Fiber friendly community policies can help expand available infrastructure and may encourage development of additional middle mile and last mile services.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the county.</li> </ul>	
<p>Implement an enhanced open trench or dig once policy at all jurisdictional levels</p>	<p><b>Cost</b> Low – staff time to modify model open trench policy.</p> <p><b>Sustainability</b> Moderate – periodic reviews, potential incremental costs to add conduit to open trench project, and mapping of deployed assets.</p>
<p>Open trench or dig once policies create available conduit assets that can be used to enhance middle mile and last mile services.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Imposing open trench requirements on private projects may face some opposition.</li> </ul>	
<p>Develop and participate in a regional collaboration for “fiber friendly policies” and deployment related administrative functions</p>	<p><b>Cost</b> Low – staff time to participate in regional collaboration.</p> <p><b>Sustainability</b> Low – periodic policy reviews.</p>
<p>Regional coordination of fiber friendly policies helps create an environment where service providers can work throughout the region and expect to see fundamentally common rules as they cross jurisdictional boundaries.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the region.</li> <li>• May lead to conflict between the multiple participating jurisdictions.</li> </ul>	
<p>Develop infrastructure and services mapping mechanisms and methods of sharing data with the state’s broadband mapping agency</p>	<p><b>Cost</b> Moderate – requires data collection mechanisms that do not currently exist. This may be a largely volunteer effort, an internship effort, or a paid staff member at the county or regional level.</p> <p><b>Sustainability</b> Moderate – the broadband environment is continually changing. Mapping of available infrastructure and services requires constant updating.</p>

Mapping helps potential providers understand the availability of assets. Working with the state for mapping instead of trying to map as a county or region allows the county and region to take advantage of the assets the state is applying to broadband mapping.

**Risks**

- Mapping accuracy is only as good as data collection and data collection cannot be perfect.
- GOIT may not provide a repository for the data needed by the county.
- GOIT may limit access to the information collected.

**Develop a solution for service to the Eight Mile area and Royal Gorge**

**Cost**

Moderate – most of the cost may be borne by private entities. The county may need to implement some infrastructure to encourage development.

**Sustainability**

Low – most of the sustainability should be borne by private entities.

The Eight Mile area and Royal Gorge are important tourism spots for the county. Service must be improved in these areas.

**Risks**

- A realistic agreement with existing asset owners may be out of reach.

**Identify and, insofar as possible, recruit private partners to participate in middle mile and last mile infrastructure and services development.**

**Cost**

Low – staff time to identify and work with potential private partners.

**Sustainability**

Low – continued staff time to nurture relationships.

Throughout the US, communities are recognizing the value of municipal broadband investment. Public investment has been particularly important in historically unserved and underserved rural communities. As the county works to develop broadband, public investment may better encourage private partners to develop broadband infrastructure and services. This task of recruiting private providers to participate in middle mile and last mile infrastructure and services involves continuing to develop existing relationships. It may also involve identifying those public investments that will best support private providers’ potential broadband improvements.

**Risks**

- Developing public-private partnership relationships with some providers may offend those not participating.
- Various potential partners will understand the role of government in broadband development differently.

### Three Year Actions

The county’s three year action plan should focus on development and extension of middle mile infrastructure. This effort should include:

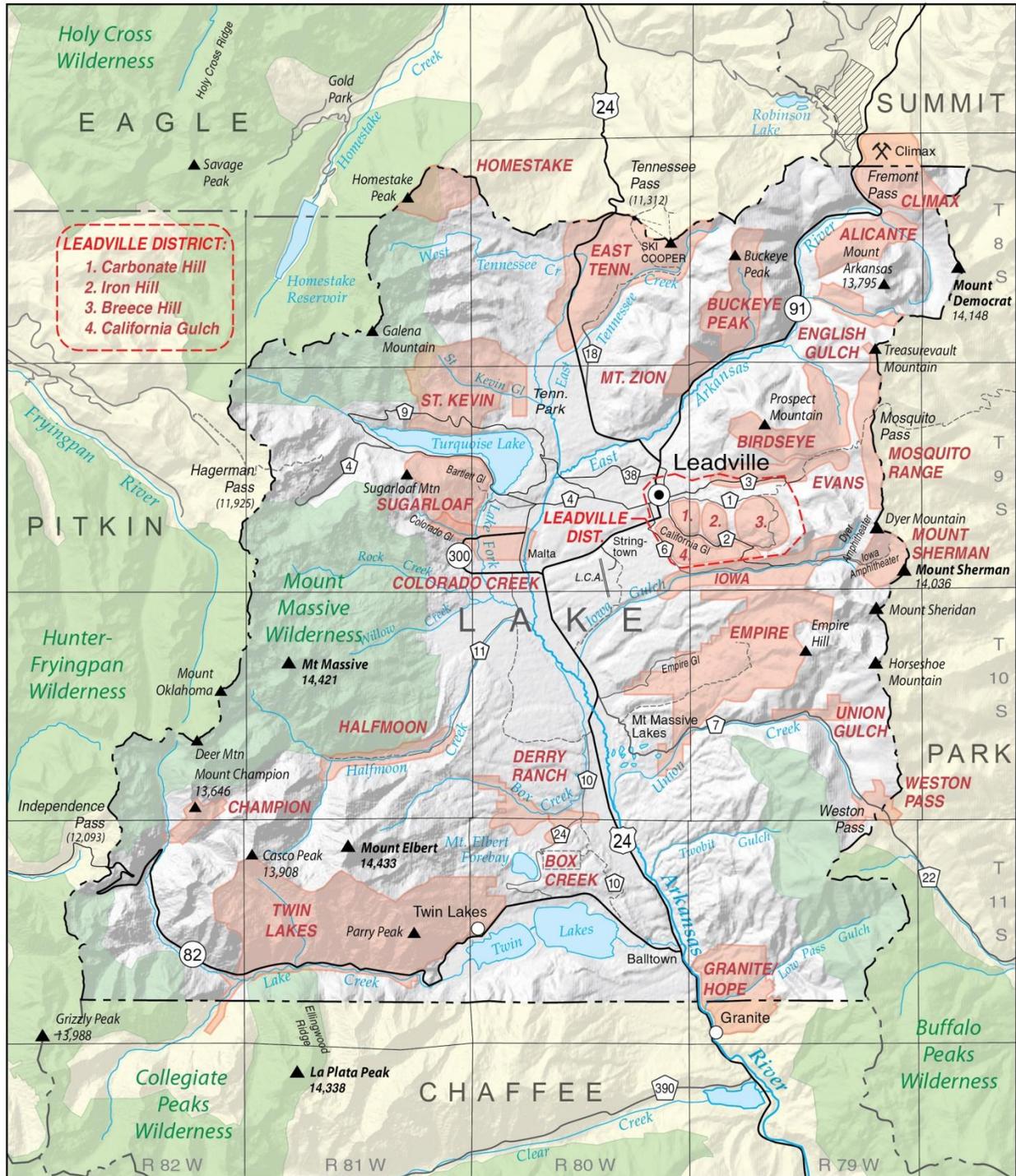
<p><b>Work with SECOM to develop institutional network.</b></p>	<p><b><u>Cost</u></b> Indeterminate – dependent on the level of participation needed to meet the county’s objectives.</p> <p><b><u>Sustainability</u></b> Indeterminate – dependent on the level of participation needed to meet the county’s objectives.</p>
<p>Rather than continuing to pursue individual community anchor institution connectivity, the county should identify a solution to connect all community anchor institutions and allow for potential demand aggregation. It is possible that SECOM will participate in this effort.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Supporting a single provider over others may lead to charges of favoritism.</li> <li>• SECOM may prove to be a difficult partner.</li> <li>• Significant SECOM expansion may discourage CenturyLink network improvements.</li> </ul>	
<p><b>Work with SECOM to extend middle mile infrastructure along Highway 50 and into Custer County.</b></p>	<p><b><u>Cost</u></b> Intermediate – SECOM may require some public subsidization to build this route.</p> <p><b><u>Sustainability</u></b> Low – SECOM will carry the sustainability burden.</p>
<p>This redundancy plan for SECOM serves two purposes: 1) creating greater middle mile reliability for the county and 2) developing a stronger relationship with SECOM that can potentially be used to influence development of new fiber assets throughout the county</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Supporting a single provider over others may lead to charges of favoritism.</li> <li>• SECOM may prove to be a difficult partner.</li> <li>• Significant SECOM expansion may discourage CenturyLink network improvements.</li> </ul>	

### Five Year Actions

The county’s five year action plan should focus on closing gaps identified or created as the one and three year action plans have been completed.



# Lake County



Lake County covers 377 square land miles and has a population of 7,310<sup>21</sup>. Nearly 2/3 of the county's population lives in Leadville (pop. 2,602) and Leadville North (pop. 1,942). The rest of the population is located in the unincorporated areas with another population concentration in Twin Lakes (pop. 171 with significant additional population visiting seasonal homes). Overall the county has a population density of 19.3 people per square mile. Excluding the three noted population centers, the county has an average population density of 6.8 people per square mile.

The county is characterized by its high Rocky Mountain terrain. At 10,152 feet above sea level, Leadville is the highest elevation incorporated city in the US. The very rugged Rocky Mountain terrain serves to isolate Lake County from other areas.

Highway 24 crosses the county from south to north providing access to Buena Vista in Chaffee County to the South and continuing into the Eagle-Vail area on the I-70 corridor in Eagle County to the north. Highway 91 also travels north from Leadville connecting to the I-70 corridor at Copper Mountain. On the southern end of the county, Highway 82 travels west over Independence Pass providing summer only access to Aspen in Pitkin County. Park County lies to the east of Lake County with no road highway through the Rocky Mountains.

The county's population is lower paid (median household income of \$44,260 vs. \$55,430 for the state), in greater poverty (12.9% of households below poverty level income vs. 9.3% in the state), and with a lower college graduate population (19.5% vs. 24.2% in the state) than Colorado averages and has a significant Hispanic population (39.1%). National broadband adoption trends suggest rural areas, lower household incomes, lower education attainment, and minority populations all correlate with lower broadband adoption rates.

## General Assessment

Broadband services in Lake County are insufficient. The county currently has only a single middle mile provider. All last mile providers are dependent on this middle mile service. Last mile infrastructure has seen some minor improvements but exhibits limited capacity, reliability, and availability.

## Infrastructure

### *Middle Mile*

CenturyLink currently provides the only middle mile access via its fiber that follows the Highway 24 route from Buena Vista to Leadville. CenturyLink reports the path continues to the I-70 corridor along

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<sup>21</sup> 2010 Census.

Highway 91. Visual inspection has indicated that CenturyLink has a fiber spur to Twin Lakes though CenturyLink does not advertise service in the area.

High Country Internet, working with several potential partners, is investigating the feasibility of adding a microwave middle mile path.

### *Last Mile*

Two primary last mile networks exist in Lake County.

CenturyLink offers DSL service to residents and businesses in and around Leadville. CenturyLink typically advertises 7/1.5 Mbps but tested speeds are significantly slower. CenturyLink offers residential promotional pricing of \$30 per month for the first year jumping to \$50 per month afterwards.

CenturyLink offers limited Metropolitan Optical Ethernet services in and around Leadville.

Charter Communications offers cable modem service to residents in Leadville. Charter's offering ranges up to 15/3 Mbps though limited testing suggests actual performance is about half that. Charter offers promotional pricing of \$40 per month for the first year, increasing to \$50 in the second year, and to \$55 thereafter<sup>22</sup>.

High Country Internet is working to deploy fixed wireless service in the county.

## Broadband Characteristics

### *Available*

Most addresses in Leadville and Leadville North have access to wireline broadband services. Outside of Leadville and Leadville North, most addresses have no wireline or fixed wireless broadband options.

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<sup>22</sup> Based on an online chat with Charter:

Paul Recanzone: Let's try 901 Copper Street in Leadville, Colorado.

Brandon B: Thank you very much, Paul! Please bear with me just a moment while I am pulling up some information for you.

Brandon B: It looks like for that area it would be 15Mbps download/3Mbps upload

Paul Recanzone: At what price?

Paul Recanzone: Just Internet - no phone or TV

Brandon B: Charter is now offering our 15 mbps Internet Plus for \$39.99 per month for 12 months when you sign up online with us. After the first year, the rate will increase to \$49.99 for the second year and then to the standard price of \$54.99 after that. The service includes a free modem lease to ensure you always have the best possible connection. For the sake of comparison, you can get free Wire Maintenance if you bundle with TV, Internet and Phone service for \$29.99 per service (\$96.96 including an HD receiver). How does that sound?

**GOAL**

Extend availability to Twin Lakes and other unserved or underserved areas via a fixed wireless solution or other mechanism.

*Adequate*

**Capacity**

Lake County has only limited middle mile capacity through the single service provided by CenturyLink. Aggregating broadband demand can help create a marketplace that justifies investment in middle mile infrastructure. Communities can begin aggregating demand by bringing together demand from various community anchor institutions. The point of presence used to aggregate community anchor institutions and the network that brings them there can be offered to private entities. Combining anchor institution aggregation with private enterprise aggregation creates a stronger business case for middle mile providers.

**GOAL**

Aggregate demand to justify the additional capacity of a second middle mile path.

Some limited areas in and around Leadville have access to excellent last mile capacity through Metropolitan Optical Ethernet services.

Excepting Metropolitan Optical Ethernet services, last mile capacity in Leadville and Leadville North is poor because it is constrained by middle mile limitations and aging infrastructure and technology. Outside of Leadville and Leadville North, last mile broadband capacity is practically non-existent.

**GOAL**

Increase last mile capacity throughout the county by creating additional demand and supporting infrastructure upgrades to meet demand.

**Reliability**

The broadband reliability environment in Lake County is poor to good.

In the middle mile, CenturyLink indicates path diversity and redundancy. However, all services in the county are dependent on CenturyLink for middle mile services. The addition of a second middle mile path will improve middle mile reliability.

In the last mile, the DSL infrastructure is aging and may present reliability issues. Much of the cable infrastructure is oversubscribed. While this will not generally cause outages, it frequently results in service degradation. Increased last mile demand and supporting infrastructure investments will improve last mile reliability.

*Affordable*

Current post-promotional mid-tier pricing for residential service is:

	Monthly Cost	Download	\$/Mbps Download
<b>Cable Modem</b>	\$55	15 Mbps	\$3.67
<b>DSL</b>	\$50	7 Mbps	\$7.14

**Table 8: Lake County Price Summary**

These prices are higher than the US average of \$3.50/Mbps and higher than the Colorado average of \$3.09/Mbps.

Business and institutional broadband prices are higher in Lake County than on the Front Range.

**GOAL**

Within five years, business and institutional broadband should be equitably priced with the Front Range. Residential pricing should keep pace with changes in state and national prices.

**GOAL**

Within five years, all households with school children choosing to participate will have the then FCC defined minimum broadband service (4/1 Mbps at the time this report was written) at no cost to the household.

*Sustainable*

Lake County's isolated and rural nature represents significant challenges to sustainable broadband development. These geographic challenges are exacerbated by the county's demographic makeup. Low income populations, Hispanic populations, and lower education attainment populations all tend to adopt broadband at lower rates than other demographic groups. Lake County has higher concentrations of each of these lower broadband adoption populations than the state or nation. Within these demographic groups, "[a]mong adults who do not use the internet, almost half have told [the Pew Research Center] that the main reason they don't go on line is because they don't think the internet is relevant to them."<sup>23</sup> To overcome the demographic challenges in the county, a significant population will need to be convinced of the internet's relevance.

Lake County has a high number of second or seasonally occupied homes (nearly 30% of all homes in the county are seasonally occupied). Seasonally occupied homes generally fall into two groups of broadband subscribers:

- Rental units typically subscribe to low to medium quality broadband services so that renters have services.
- Units seasonally occupied by the owners and not usually rented have fairly low broadband adoption rates.

<sup>23</sup> <http://www.pewinternet.org/fact-sheets/broadband-technology-fact-sheet/>

Broadband development may lead to greater take rates among units occupied seasonally by owners. Some evidence suggests that these owners would spend more time telecommuting or operating location neutral businesses if better broadband was available at their Lake County property.

## Recommended Actions

Lake County must overcome double barriers to broadband development:

- The county's isolated geography and rugged terrain make it difficult and costly to deploy broadband services.
- The county's small population and demographic profile suggest a marketplace that is unlikely to generate significant sustainable revenue for broadband providers.

Our findings of broadband assets, current services, and demand are similar to those of the WMX Systems survey and study conducted in 2013. The action resulting from the WMX Systems survey was a request for proposals (RFP) issued in February of 2014. The RFP hoped to find service providers interested in the Lake County broadband marketplace through demand aggregation. Demand aggregation was focused on businesses and community anchor institutions.

Unfortunately, the RFP was unable to aggregate sufficient demand to attract significant responses.

Two companies did respond to the RFP: Colorado Central Telecom – a relatively new fixed wireless last mile provider in Chaffee County that works with SkyWerx to provide microwave middle mile and High Country Internet – a very new fixed wireless last mile provider working to deploy microwave middle mile through Lake County and into Park County and Eagle County with last mile fixed wireless solutions anticipated in all three counties. Since the response, High Country Internet has secured backhaul from CenturyLink and is working to establish some microwave middle mile infrastructure.

Neither incumbent provider responded. Charter pursues largely residential services with some business class service in Leadville. CenturyLink typically pursues a disaggregation model when evaluating business opportunities in a community or region – that is each business or community anchor institution service must be feasible in isolation of any others. It is CenturyLink's disaggregation model and the College's willingness to pay for service within that model that has brought significant bandwidth availability to the Colorado Mountain College campus but did little to improve other services in the community or county. CenturyLink has indicated to various county stakeholders that they are looking at pursuing a more aggregated market approach in which they will work to secure multiple subscribers to justify needed upgrades instead of tying upgrades to the business case of individual subscribing entities.

A key lesson learned from the WMX Systems report and subsequent RFP effort is that action likely needs to be taken to increase and aggregate demand before the county will see significant investment or service improvements from incumbent or new entrant providers. The actions described in this Lake

County section of the Upper Arkansas Area Council of Governments Regional Broadband Strategic Plan document are designed to achieve increases in broadband demand and to create market aggregation to sustain private and public investments in broadband infrastructure that will significantly improve the broadband environment in the County. As described in the general section of this Upper Arkansas Regional Broadband Strategic Plan, high quality affordable broadband services are a basic building block for economic development and quality of life.

Over the next five years, four actions, if taken, will significantly improve broadband quality in Lake County:

1. Develop new middle mile infrastructure from Buena Vista through Lake County to Fairplay and on to Como (where CenturyLink has significant redundant middle mile capabilities) and Red Cliff and on to the I-70 corridor where interconnectivity with multiple middle mile carriers is available,
2. Create market aggregation amongst community anchor institutions and businesses in and around Leadville<sup>24</sup>,
3. Develop fixed wireless access for Twin Lakes, and
4. Improve residential broadband adoption and quality.

Achieving these objectives will require sustained leadership and both public and private investment.

### Middle Mile Infrastructure

High Country Internet is pursuing mechanisms to deploy microwave middle mile infrastructure from Lake County into Red Cliff and on to the I-70 corridor where interconnection with multiple middle mile carriers is possible. Colorado Central Telecom is pursuing efforts to extend microwave middle mile infrastructure from Mt. Princeton (in Chaffee County) to Lake County. A path may exist through Comnet's site on Mt. Bross to connect microwave middle mile infrastructure through Lake County into Fairplay.

While CenturyLink currently offers reportedly path diverse and redundant middle mile services to Leadville, helping to develop these alternative middle mile resources would add choice to the county's middle mile environment.

#### ORGANIZATION

Currently the best path to develop alternative middle mile infrastructure for Lake County lies through the efforts of High Country Internet. Stakeholders in the county

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<sup>24</sup> Schools are currently connected on a fiber loop.

should continue to support High Country Internet’s efforts. One way the county could help is by joining with other counties in the region (including Pitkin and Eagle Counties) to help companies like High Country Internet overcome the hurdles of federal land use.

## Market Aggregation

The WMX Systems led RFP in early 2014 attempted to create market aggregation primarily by identifying potential demand. In spite of the identified demand, service providers continue to pursue individual Community Anchor Institution (CAI) and business customers in a disaggregated model. This is likely due in part to the absence of aggregating infrastructure.

### INFRASTRUCTURE DEVELOPMENT

With the deployment of an approximate 3 mile fiber path, the demand from the majority of businesses and CAI’s who choose to participate could be aggregated to a single bandwidth purchase. Fiber deployment through a community like Leadville averages about \$60,000 per mile.

### PUBLIC-PRIVATE PARTNERSHIP

Of course, this type of market aggregation requires an intermediate service provider partner who makes the single bandwidth purchase, manages the infrastructure assets, and supports the multiple participating organizations. A model we have seen communities supporting is one in which the public sector builds the aggregation network and “leases” it to a private partner asset manager. The lease can consist of maintenance requirements, revenue shares, public service requirements, price caps, service guarantees, and other elements – like provisioning free public WiFi hotspots along the aggregation path. The private partner is then responsible for securing participating private sector service providers and billing them for their services. The asset manager’s revenue stream comes through fees imposed on private sector service providers using the public infrastructure.

## Improved Residential Quality

### POLICY

The simplest action the county and the communities within the county can take to encourage last mile infrastructure development and to improve residential service quality is to reduce any bureaucratic barriers to entry and to implement “broadband friendly community” policies. Examples of broadband friendly community policies are provided on the web site accompanying this report.

### ORGANIZATION

Because broadband infrastructure isn’t constrained by political boundaries, there is value in coordinating policies across jurisdictional boundaries. The region may also see value in establishing a regional resource that can help broadband providers navigate the multiple jurisdictional requirements.

**POLICY**

One important “fiber friendly community” policy is an open trench or dig once policy. State law requires that “[t]he state or a political subdivision shall provide notice on a competitively neutral basis to broadband providers of any utility trenching project that it conducts...” and that “...the state or political subdivision shall allow joint trenching by broadband providers ... for the placement of broadband facilities...”. However, this only pertains to state trenching projects and does not address a jurisdiction’s possible desire to place conduit along with private trenching projects. Local jurisdictions may wish to enhance the state’s notification requirements.

Beyond implementing policies that lower the costs required to improve residential broadband quality, the community may identify ways to improve private provider return on investment for required capital investments. For example, Charter’s service levels suggest the need for upgraded equipment throughout the community. It is likely that two factors contribute to Charter not having completed these upgrades: 1) backhaul cost and capacity and 2) revenue opportunities.

We have suggested mechanisms to increase backhaul capacity and reduce costs. Should these efforts inure to the benefit of Charter, Charter may be more interested in upgrading services in Leadville.

**EDUCATION &  
UTILITY**

Charter’s evaluation of broadband revenue opportunities in Lake County are likely informed by the county’s demographic profile and their believe that seasonally occupied homes are unlikely to subscribe to Charter’s services with their focus on subscription video. The county should engage in efforts to increase broadband adoption by providing education and by increasing the utility of broadband services.

To support broadband development – and in turn support economic development and improvements to quality of life – we recommend that stakeholders in the county pursue a program to provide free minimum broadband service to every participating household in the county with school children. Doing so would support education in the county and help in the development of a well educated workforce. This program would also demonstrate the utility of the internet to the families of school children and help overcome significant barriers to internet adoption.

In order to extend services to reach all households with school children, the county and other network owners will have to deploy infrastructure that can also be used by households and businesses without school children. This infrastructure, coupled with broadband adoption education and increased utility will drive stronger business cases to increase broadband capacity and reliability throughout the county.

Implementing free service to every participating household with school children will require participation from public and private entities. At a minimum, we would anticipate:

- The Lake County School District should commit to pay a highly discounted fee for services to help offset service provider costs.
- Private sector service providers should subsidize the basic service to minimize costs to the school district.
- The County and/or the City should build certain infrastructure elements needed to expand capacity and availability to reduce service provider capital expenditure requirements.

### Twin Lakes Fixed Wireless Access

Twin Lakes is an unserved area with a little more than 170 residents at the south end of Lake County. In addition to the 170 residents, Twin Lakes includes many seasonal occupied homes.

A summary examination of available resources indicates a reasonable fixed wireless solution could be put into place for Twin Lakes. We find the elevation profile of the power transformer near the corner of Sequoia Drive and San Isabel would make a short tower/pole placed there visible to most of the addresses to the north, east, and in the Twin Lakes area to the southwest. Visual inspection verifies CenturyLink has fiber along Highway 82 to the Mt. Elbert Power Plant (a federal facility) and continuing to an undetermined point further west. The power plant may currently subscribe to significant bandwidth on the existing fiber. If not, a services reseller with a good relationship with CenturyLink (like Mammoth Networks) may be able to procure a Metropolitan Optical Ethernet service for the plant. The plant could purchase more bandwidth than it needs and sell excess capacity to a fixed wireless last mile provider (like High Country Internet). The fixed wireless last mile provider could then use a point-to-point solution to reach the power transformer site and a point to multi-point fixed wireless solution to serve households and businesses in the area.

This discussion is one example of how fixed wireless services could be deployed to the Twin Lakes area. There are other possible solutions. All possible solutions will require cooperation between multiple entities to create a reasonably sustainable model with reasonably low capital expenditures. Because of the effort to develop the relationships needed to develop a sustainable business model for the Twin Lakes area, a public-private partnership wherein the public sector assumes some significant coordination

**INFRASTRUCTURE  
DEVELOPMENT**

**PUBLIC-PRIVATE  
PARTNERSHIP**

burden and the private partners commit resources to take advantage of the coordinated solution is the most likely path to success.

## Structural Resources

### ORGANIZATION

These initiatives require certain shared assets and may require public subsidization of certain private assets. These public and public-private partnership intra- and extra-community connectivity assets can be built, operated, and maintained by the individual jurisdictions, a regional authority, or private partners. The most likely structure for success is a regional authority comprised of the individual participating jurisdictions coupled with private partners. The private partners may be the local power companies, local service providers, an organization that specializes in operating municipal networks, or some combination of the three.

### LEGAL

Regardless of the chosen ownership and operations model, the county may have to resolve constraints imposed by CRS Title 29 Article 27 (also known as “Senate Bill 152”). This state law prevents government entities from developing any commercial broadband services without first passing a citizen’s initiative allowing them to do so. Some of the recommendations in this Lake County section could be considered in violation of state law without resolution to the constraints inherent in the state law.

### MAPPING

Unless available infrastructure is known, it is difficult for broadband developers to take advantage of it. The county should work to map infrastructure and service availability. The county should not duplicate the broadband mapping efforts of the Governor’s Office of Information Technology (GOIT). Rather, the county should coordinate data collection for GOIT and provide information to GOIT. To ensure the most efficient use of county broadband development efforts, the county needs the capability to map infrastructure, parcel level service mapping granularity, and a mechanism to identify source data and aging. The county should work to ensure GOIT includes these capabilities in the broadband mapping tool.

## Target Action Plan

### One Year Actions

The county’s one year action plan should focus on the administrative actions, relationship development, infrastructure planning, and infrastructure deployment appropriate to effect additional broadband development. These actions should include:

<p><b>Implement appropriate “broadband friendly community” policy changes</b></p>	<p><b><u>Cost</u></b> Low – staff time to prepare policy changes. <b><u>Sustainability</u></b> Easy – periodic policy reviews.</p>
<p>Broadband friendly community policies can help expand available infrastructure and may encourage development of additional middle mile and last mile services. Some potential broadband friendly policies are described on the web page accompanying this report.</p>	
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the county.</li> </ul>	
<p><b>Implement an enhanced open trench or dig once policy at all jurisdictional levels</b></p>	<p><b><u>Cost</u></b> Low – staff time to modify model open trench policy. <b><u>Sustainability</u></b> Moderate – periodic reviews, potential incremental costs to add conduit to open trench project, and mapping of deployed assets.</p>
<p>Open trench or dig once policies create available conduit assets that can be used to enhance middle mile and last mile services.</p>	
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Imposing open trench requirements on private projects may face some opposition.</li> </ul>	
<p><b>Develop and participate in a regional collaboration for “fiber friendly policies” and deployment related administrative functions</b></p>	<p><b><u>Cost</u></b> Low – staff time to participate in regional collaboration. <b><u>Sustainability</u></b> Low – periodic policy reviews.</p>
<p>Regional coordination of fiber friendly policies helps create an environment where service providers can work throughout the region and expect to see fundamentally common rules as they cross jurisdictional boundaries.</p>	
<p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the region.</li> <li>• May lead to conflict between the multiple participating jurisdictions.</li> </ul>	

<p>Develop infrastructure and services mapping mechanisms and methods of sharing data with the state’s broadband mapping agency</p>	<p><b><u>Cost</u></b>                  Moderate – requires data collection mechanisms that do not currently exist. This may be a largely volunteer effort, an internship effort, or a paid staff member at the county or regional level.</p> <p><b><u>Sustainability</u></b>                  Moderate – the broadband environment is continually changing. Mapping of available infrastructure and services requires constant updating.</p>
<p>Mapping helps potential providers understand the availability of assets. Working with the state for mapping instead of trying to map as a county or region allows the county and region to take advantage of the assets the state is applying to broadband mapping.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• Mapping accuracy is only as good as data collection and data collection cannot be perfect.</li> <li>• GOIT may not provide a repository for the data needed by the county.</li> <li>• GOIT may limit access to the information collected.</li> </ul>	
<p>Work with private partners to deploy fixed wireless services to the Twin Lakes area.</p>	<p><b><u>Cost</u></b>                  Moderate – some county investment may be needed to support a feasible model. At minimum, the county will need to provide staff time to manage the multiple relationships needed to complete a solution</p> <p><b><u>Sustainability</u></b>                  Low – private partners should bear the sustainability burden.</p>
<p>A wireless solution for the Twin Lakes areas seems to be within reason.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• The most efficient solutions require cooperation from multiple organizations. Some significant effort may be expended only to find any one of the needed resources is unavailable from the owning organization.</li> </ul>	
<p>Identify and, insofar as possible, recruit public and private partners to participate in middle mile and last mile infrastructure and services development including the proposed school children household broadband program.</p>	<p><b><u>Cost</u></b>                  Low – staff time to identify and work with potential private partners.</p> <p><b><u>Sustainability</u></b>                  Low – continued staff time to nurture relationships.</p>

Throughout the US, communities are recognizing the value of municipal broadband investment. Public investment has been particularly important in historically unserved and underserved rural communities. As the county works to develop broadband, public investment may better encourage private partners to develop broadband infrastructure and services. This task of recruiting private providers to participate in middle mile and last mile infrastructure and services (including the proposed school children household broadband program) involves continuing to develop existing relationships. It will also involve identifying those public investments that will best support private providers' potential broadband improvements.

**Risks**

- Developing public-private partnership relationships with some providers may offend those not participating.
- Various potential partners will understand the role of government in broadband development differently.

### Three Year Actions

The county's three year action plan should focus on development and implementation of additional middle mile and improved last mile infrastructure. This effort should include:

**Work with potential middle mile providers to overcome deployment barriers.**

**Cost**

Indeterminate – dependent on the level of participation needed to meet the county's objectives.

**Sustainability**

Indeterminate – dependent on the level of participation needed to meet the county's objectives.

The county's best opportunity to increase middle mile capacity and choice lies through the efforts of private parties – in particular, High Country Internet.

**Risks**

- Supporting some providers over others may lead to charges of favoritism.
- The Lake County market is not large enough for significant competition. Therefore, it is likely the county will work aggressively with a single provider. If that provider changes management or otherwise alters its service and cooperation profile, the county may lose significant progress.

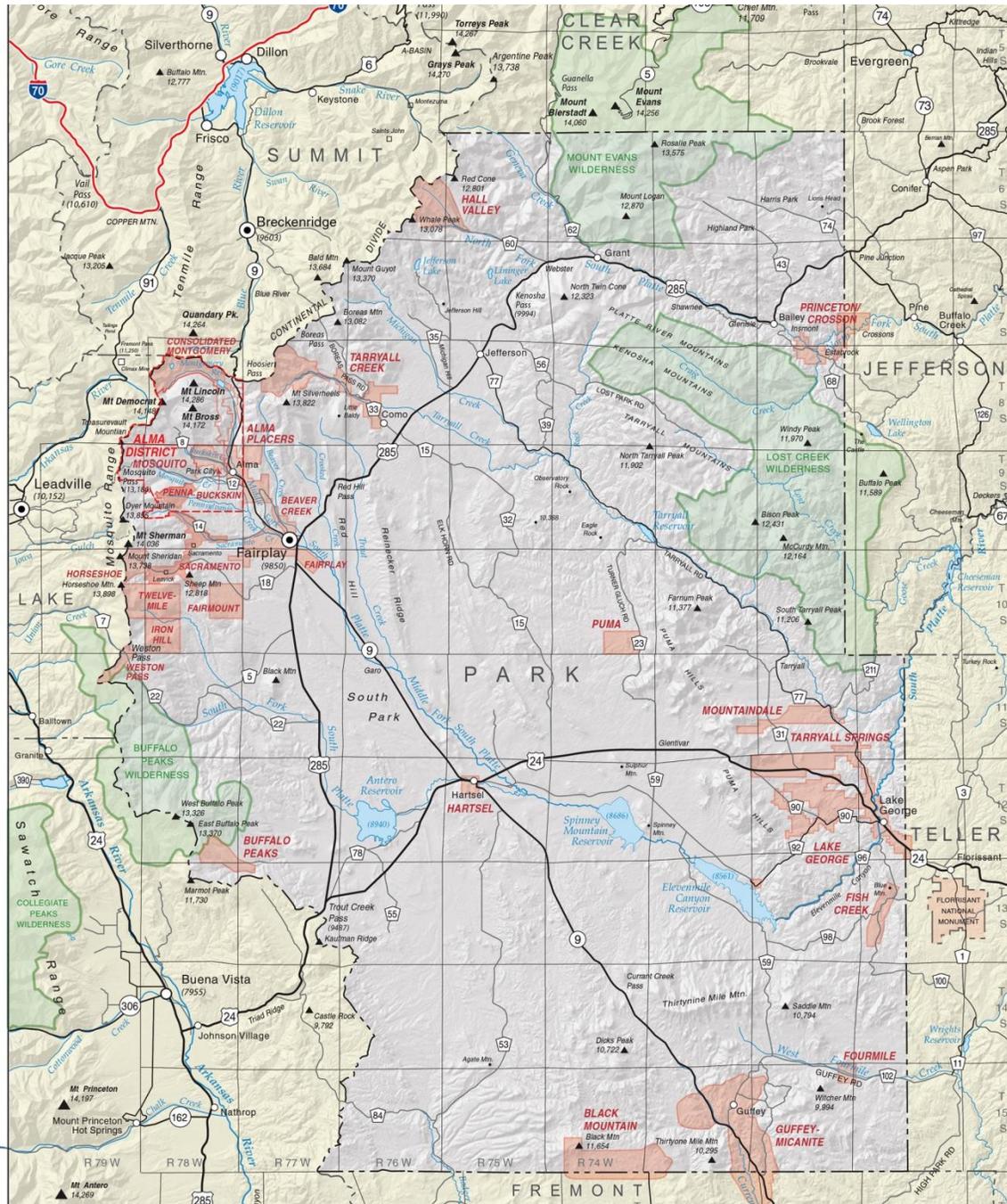
<p><b>Implement infrastructure elements required to aggregate market demand.</b></p>	<p><u>Cost</u> Moderate – about \$180,000 for a three mile aggregation path.</p> <p><u>Sustainability</u> Low – sustainability costs should be transferred to a private provider.</p>
<p>As identified in the WMX Systems report, one path to improving broadband quality in the county is through aggregating demand. Without a municipal area network designed to aggregate demand, the only available demand aggregation tool is to identify potential subscribers.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Represents a significant investment from the community.</li> </ul>	
<p><b>Implement free WiFi hotspots.</b></p>	<p><u>Cost</u> Low – not recommended without the aggregation infrastructure. Represents only a small incremental increase to the proposed aggregation infrastructure.</p> <p><u>Sustainability</u> Low – should be considered as one of the “lease” requirements imposed on the private partner managing the aggregation municipal area network.</p>
<p>WiFi hotspots are valuable for supporting visitors to the community. WiFi hotspots also serve as an education tool for residents. As residents see visitors using broadband services and take advantage of them themselves through the WiFi hotspots, they may see the utility of subscribing at home.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Is dependent of the success of the middle mile aggregation private partner.</li> </ul>	
<p><b>Implement infrastructure elements required to support school children household broadband connectivity program.</b></p>	<p><u>Cost</u> TBD. The aggregation infrastructure introduced above will provide a substantial foundation for this effort</p> <p><u>Sustainability</u> Low – sustainability costs should be transferred to a private provider.</p>
<p>Overcoming low broadband adoption is a prerequisite to private investment in broadband infrastructure. Unfortunately, inadequate broadband infrastructure contributes to low broadband adoption. The proposed school children household broadband connectivity program will help bootstrap demand and investment.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Represents a significant investment from the community.</li> </ul>	

## Five Year Actions

The county's five year action plan should focus on completing the school children household broadband connectivity program and on closing gaps identified or created as the one and three year action plans have been implemented.



# Park County



Park County covers 2,194 square land miles and has a population of 16,206<sup>25</sup>. Alma (pop. 270) and Fairplay (pop. 679) are the only two incorporated communities in the county. The county's population density is 7.4 people per square mile. The county's development is characterized by its large lot/ranchette/mountain residential development.

The County is dominated by the large grassland flat known as South Park. The Mosquito Range forms a high barrier on the west and the Park Range defines the county's eastern border. Ranging clockwise from the north, the county is surrounded by:

- Clear Creek County to the north with summer time access only over Geneva Road/Guanella Pass Road,
- Jefferson County to the northeast with access via Highway 285,
- Douglas County which only kisses the county at a corner,
- Teller County to the east with access via Highway 24,
- Fremont County to the south with access along Highway 9,
- Chaffee County to southwest with access via Highway 285, and
- Lake County to the west with very limited road access over Mosquito Pass and County Road 7 (both of which are dirt roads with limited seasonal access).

Highways 285 and 24 branch from each other on the western edge of the county (coming from Buena Vista). Highway 285 travels north and east eventually entering the Denver metropolitan area. Highway 24 runs eastward into the Colorado Springs area. Highway 9 comes from the south crossing the South Park basin in a northwesterly direction to exit the county north of Alma where it then continues on through Breckenridge and intersecting I-70 at Frisco.

The county's population is higher paid (median household income of \$60,944 vs. \$55,430 for the state), in lower poverty (6.3% of households below poverty level income vs. 9.3% in the state), and with a higher college graduate population (30.3% vs. 24.2% in the state) than Colorado averages. National broadband adoption trends suggest higher household incomes and higher education attainment correlate with higher broadband adoption rates. Many of the addresses in the county are only occupied on a seasonal basis.

## General Assessment

By the current FCC base definition of broadband speeds, most of Park County is unserved by terrestrial based providers (wireline or fixed wireless). Both middle mile and last mile infrastructure and services are inadequate to support broadband services to most of the addresses throughout the county.

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<sup>25</sup> 2010 Census.

## Infrastructure

### *Middle Mile*

Middle mile access to the county is limited. CenturyLink has fiber into Como and extending along Highway 285 into Fairplay. CenturyLink is expanding service in Como to support services in Breckenridge. The path CenturyLink takes from Como to Breckenridge is unclear at this time.

No providers offer microwave middle mile infrastructure in the county.

### *Last Mile*

Two primary last mile networks exist in the county.

CenturyLink offers reasonably good DSL between Bailey east to the edge of the county. Poor DSL service is available in Fairplay and in some other parts of the county.

South Park Telephone (who serves as the ILEC for about 200 addresses in the south central part of the county) offers fixed wireless service from Fairplay down to the Ranch of the Rockies and east to Hartsel and South Park Ranches. South Park Telephone has recently created a limited fixed wireless service area in Guffey.

## Broadband Quality

### *Available*

Many addresses in the county have no access to wireline or fixed wireless broadband services. Those with access are usually restricted to a choice of either fixed wireless (in the South Park Telephone service area) or DSL (in the northeast section of the county where CenturyLink offers reasonable DSL services).

<b>GOAL</b>
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Within five years, 80% of addresses in the county should have access to wireline or fixed wireless broadband services.

### *Adequate*

### **Capacity**

Park County has very little middle mile capacity.

Last mile capacity in the Bailey area is reasonably good. Last mile capacity on the South Park Telephone fixed wireless network is offered at 5 Mbps or 10 Mbps.

Some very limited areas in the county have access to very good last mile capacity through Metropolitan Optical Ethernet services.

**GOAL** Within five years, fixed wireless capacity should reach 20 Mbps or higher. Addresses in and around Fairplay should have access to DSL at broadband speeds. Addresses in the Mill Iron D home owners association should have access to wireline services with packages up to 100 Mbps.

**GOAL** Within five years the county should have alternative middle mile providers (microwave or fiber) with new service coming from the west and east and potentially the north.

**Reliability**

The county’s broadband environment has questionable reliability.

In the middle mile, the CenturyLink fiber path in the north appears to be diverse and redundant. No other significant middle mile service exists in the county.

In the last mile, most existing DSL infrastructure is aging and may present reliability issues. Most of the fixed wireless infrastructure is fairly new and generally reliable.

**GOAL** Within five years, new middle mile offerings should enhance reliability.

*Affordable*

Current post-promotional mid-tier pricing for residential service is:

	Monthly Cost	Download	\$/Mbps Download
<b>DSL</b>	\$50	7 Mbps	\$7.14
<b>Fixed Wireless</b>	\$50	5 Mbps	\$10.00

**Table 9: Park County Price Summary**

These prices are higher than the US average of \$3.50/Mbps and higher than the Colorado average of \$3.09/Mbps.

Where business and institution packages are available, prices are higher in Park County than on the Front Range.

**GOAL** Within five years, business and institutional broadband should be equitably priced with the Front Range. Residential pricing should keep pace with changes in state and national prices.

*Sustainable*

Park County’s generally low density development and significant seasonal housing make sustainable broadband development a difficult proposition. Where the County is more densely populated, the

terrain is much more difficult for broadband deployments. Park County has already engaged in some significant public broadband infrastructure development. The County should continue this course and work to encourage infrastructure cooperation between CenturyLink, South Park Telecom, and High Country Internet as well as other current and potential providers in the region.

## Recommended Actions

Because of its low density and high seasonal occupancy rate, broadband development in Park County is a difficult proposition. In many cases, it is very difficult for a private provider to build a business case and the county may the need to execute capital spending to create a more reasonable model.

Fortunately, the county’s local technology planning team (LTPT) has been very active. The LTPT has developed a good understanding of the county’s needs and has established strong relationships with CenturyLink, South Park Telephone, and other providers. The LTPT should continue to manage projects and nurture relationships.

The county has begun to engage in some infrastructure deployment activities planning fiber to connect Bailey community anchor institutions. Additional targeted public capital expenditures may be needed to improve middle mile options and last mile quality.

## Manage Projects and Nurture Relationships

### ORGANIZATION

One of the most important things the county can do to develop broadband is to continue the good efforts of the Local Technology Planning Team. The LTPT has done a very good job of being more than just a complaint forum. The LTPT should continue its good practice wherein in each meeting, next steps are identified for real projects and assignments made with follow-up required in the next meeting. While it is hard to do, projects that have no identifiable next steps should be tabled or assigned to a sub-group until some action can be identified. Also, the LTPT should ensure it devotes time to countywide issues of middle mile access.

### POLICY

Working with the county, local jurisdictions, and a potential regional authority, the LTPT can identify and implement “fiber friendly policies”.

### POLICY

One important “fiber friendly community” policy is an open trench or dig once policy. State law<sup>26</sup> requires that “[t]he state or a political subdivision shall provide notice on a competitively neutral basis to broadband providers of any utility trenching project that it conducts...” and that “...the state or political subdivision shall allow joint trenching by

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<sup>26</sup> CRS 38-5.5-109

broadband providers ... for the placement of broadband facilities...”. However, this only pertains to state trenching projects and does not address a jurisdiction’s possible desire to place conduit along with private trenching projects. Local jurisdictions may wish to enhance the state’s notification requirements.

**MAPPING**

Unless available infrastructure is known, it is difficult for broadband developers to take advantage of it. The county should work to map infrastructure and service availability. The county should not duplicate the broadband mapping efforts of the Governor’s Office of Information Technology (GOIT). Rather, the county should coordinate data collection for GOIT and provide information to GOIT.

To ensure the most efficient use of county broadband development efforts, the county needs the capability to map infrastructure, parcel level service mapping granularity, and a mechanism to identify source data and aging. The county should work to ensure GOIT includes these capabilities in the broadband mapping tool.

**ORGANIZATION**

To ensure the LTPT and the county have access to regional resources and in order to integrate Park County’s efforts in the greater regional plan, the LTPT and county should participate in a regional organization.

**Targeted Public Capital Expenditures**

**INFRASTRUCTURE DEVELOPMENT**

The planned Community Anchor Institution (CAI) fiber in Bailey will serve to help aggregate demand and may serve to attract new or expanded middle mile services. The county should continue to identify and prioritize projects for additional capital spending. In particular, the county should identify investments that would most likely improve middle mile services, most likely increase capacity in underserved areas, and most likely extend service to unserved areas.

Several microwave options exist that could increase middle mile capacity. Already some non-provider companies have microwave links coming from Colorado Springs and Denver. These assets (especially on Badger Mountain) may be improved to provide commercial backhaul services into Como, Fairplay, Hartsel, Lake George, and other sites. Additionally, Valcom is investigating bringing service from the north and High Country Internet is investigating bringing service from the west.

With improved middle mile services, last mile infrastructure becomes more viable. Fiber deployments in communities like Bailey and Fairplay may be reasonable solutions. Other areas in the county will need to rely on fixed wireless solutions and still others may not have reasonable access to terrestrial broadband in the near future. In all areas, a fixed wireless solution provides a reasonable solution or, where wireline service exists,

a reasonable alternative. To most efficiently select and deploy wireless assets, the county should complete a wireless propagation study. The county has received a study proposal from Maple Net. This proposal may be an effective tool. However, a well defined preliminary wireless propagation study can probably be completed for about 1/3 of the Maple Net price. This preliminary wireless propagation study may result in sufficient information to allow the county to begin to pursue placing towers in strategic locations that could lead to achieving 80% broadband availability within five years.

**LEGAL**

Any county led infrastructure deployment must be conducted within the constraints imposed by CRS Title 29 Article 27 (also known as “Senate Bill 152”).

## Target Action Plan

### One Year Actions

The county’s one year action plan should focus on the administrative actions, relationship development, infrastructure planning, and targeted infrastructure deployment. These actions should include:

<p><b>Implement appropriate “broadband friendly community” policy changes</b></p>	<p><b>Cost</b> Low – staff time to prepare policy changes. <b>Sustainability</b> Easy – periodic policy reviews.</p>
<p>Broadband friendly community policies can help expand available infrastructure and may encourage development of additional middle mile and last mile services.</p> <p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the county.</li> </ul>	
<p><b>Implement an enhanced open trench or dig once policy at all jurisdictional levels</b></p>	<p><b>Cost</b> Low – staff time to modify model open trench policy. <b>Sustainability</b> Moderate – periodic reviews, potential incremental costs to add conduit to open trench project, and mapping of deployed assets.</p>
<p>Open trench or dig once policies create available conduit assets that can be used to enhance middle mile and last mile services.</p> <p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Imposing open trench requirements on private projects may face some opposition.</li> </ul>	

<p>Develop and participate in a regional collaboration for “fiber friendly policies” and deployment related administrative functions</p>	<p><b>Cost</b> Low – staff time to participate in regional collaboration.</p> <p><b>Sustainability</b> Low – periodic policy reviews.</p>
<p>Regional coordination of fiber friendly policies helps create an environment where service providers can work throughout the region and expect to see fundamentally common rules as they cross jurisdictional boundaries.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Unlikely to have a significant impact on broadband quality in the region.</li> <li>• May lead to conflict between the multiple participating jurisdictions.</li> </ul>	
<p>Develop infrastructure and services mapping mechanisms and methods of sharing data with the state’s broadband mapping agency</p>	<p><b>Cost</b> Moderate – requires data collection mechanisms that do not currently exist. This may be a largely volunteer effort, an internship effort, or a paid staff member at the county or regional level.</p> <p><b>Sustainability</b> Moderate – the broadband environment is continually changing. Mapping of available infrastructure and services requires constant updating.</p>
<p>Mapping helps potential providers understand the availability of assets. Working with the state for mapping instead of trying to map as a county or region allows the county and region to take advantage of the assets the state is applying to broadband mapping.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Mapping accuracy is only as good as data collection and data collection cannot be perfect.</li> <li>• GOIT may not provide a repository for the data needed by the county.</li> <li>• GOIT may limit access to the information collected.</li> </ul>	
<p>Complete wireless propagation survey work.</p>	<p><b>Cost</b> Maple Net proposal: \$13,000 A preliminary study could be done for about \$4,000</p> <p><b>Sustainability</b> None – move on to implementation cycle.</p>
<p>A wireless propagation survey can identify specific locations where new wireless towers may have the greatest impact on extending last mile fixed wireless capacity and reach.</p>	
<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Propagation survey may not identify all required tower sites.</li> <li>• Desirable tower site may be inaccessible.</li> </ul>	

<p><b>Deploy Bailey community anchor institution route.</b></p>	<p><b><u>Cost</u></b> High – Typical construction costs are about \$55,000 per mile. The project is nine miles or about \$495,000. <b><u>Sustainability</u></b> Moderate – costs associated with maintenance and services.</p>
<p>The Bailey community anchor institution route may attract significant middle mile improvements. It can also serve as a foundation for deploying additional public, private, and public-private partnership services.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• The demand aggregation the anchor institution route represents may not be enough to attract significant middle mile improvements.</li> </ul>	
<p><b>Plan and deploy Fairplay/Alma community anchor institution route.</b></p>	<p><b><u>Cost</u></b> High – Typical construction costs are about \$55,000 per mile. <b><u>Sustainability</u></b> Moderate – costs associated with maintenance and services.</p>
<p>A Fairplay/Alma community anchor institution route may attract significant middle mile improvements. It may also serve as a foundation for deploying additional public, private, and public-private partnership services.</p> <p><b><u>Risks</u></b></p> <ul style="list-style-type: none"> <li>• The demand aggregation the anchor institution route represents may not be enough to attract significant middle mile improvements.</li> </ul>	
<p><b>Identify and, insofar as possible, recruit private partners to participate in middle mile and last mile infrastructure and services development.</b></p>	<p><b><u>Cost</u></b> Low – staff time to identify and work with potential private partners. <b><u>Sustainability</u></b> Low – continued staff time to nurture relationships.</p>

Throughout the US, communities are recognizing the value of municipal broadband investment. Public investment has been particularly important in historically unserved and underserved rural communities. As the county works to develop broadband, public investment may better encourage private partners to develop broadband infrastructure and services. This task of recruiting private providers to participate in middle mile and last mile infrastructure and services involves continuing to develop existing relationships. It may also involve identifying those public investments that will best support private providers' potential broadband improvements.

**Risks**

- Developing public-private partnership relationships with some providers may offend those not participating.
- Various potential partners will understand the role of government in broadband development differently.

### Three Year Actions

The county's three year action plan should focus on development and implementation of middle mile and last mile infrastructure. This effort should include:

**Work with fixed wireless providers to expand service offerings throughout the county.**

**Cost**

Indeterminate – dependent on the level of participation needed to meet the county's objectives.

**Sustainability**

Indeterminate – dependent on the level of participation needed to meet the county's objectives.

The county's best opportunity to reach the goal of 80% of addresses with access to 20 Mbps is through careful coordination and cooperation with fixed wireless providers. The county can help build additional tower sites, help provide better connectivity for remote wireless access points, and otherwise assist wireless providers with their expansion efforts.

**Risks**

- Supporting some providers over others may lead to charges of favoritism.
- The Park County market is not large enough for significant competition. Therefore, it is likely the county will work aggressively with a single provider. If that provider changes management or otherwise alters its service and cooperation profile, the county may lose significant progress.

Implement infrastructure elements required to lower barriers to entry for expanded middle mile capacity.

Cost

Moderate to significant – dependent on the level of participation needed to meet the county’s objectives.

Sustainability

Moderate – dependent on the level of participation needed to meet the county’s objectives.

In order for the county to achieve its last mile availability and capacity goals, middle mile capacity and reliability must be enhanced. In conjunction with building last mile solutions in cooperation and partnership with fixed wireless providers, the county should invest in infrastructure needed to make the business case for increased middle mile capacity.

**Risks**

- The level of public investment needed to entice private middle mile providers to increase capacity may be unreasonable.

## Five Year Actions

The county’s five year action plan should focus on closing gaps identified or created as the one and three year action plans have been completed.



## Appendix

### Sample Preliminary Wireless Propagation Survey

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We conducted a preliminary wireless propagation survey in Custer County as an example of what this type of work could look like.

Based on the physical site survey of Custer County and extensive research using Google Earth in conjunction with wireless modeling tools the following conclusions have been reached.

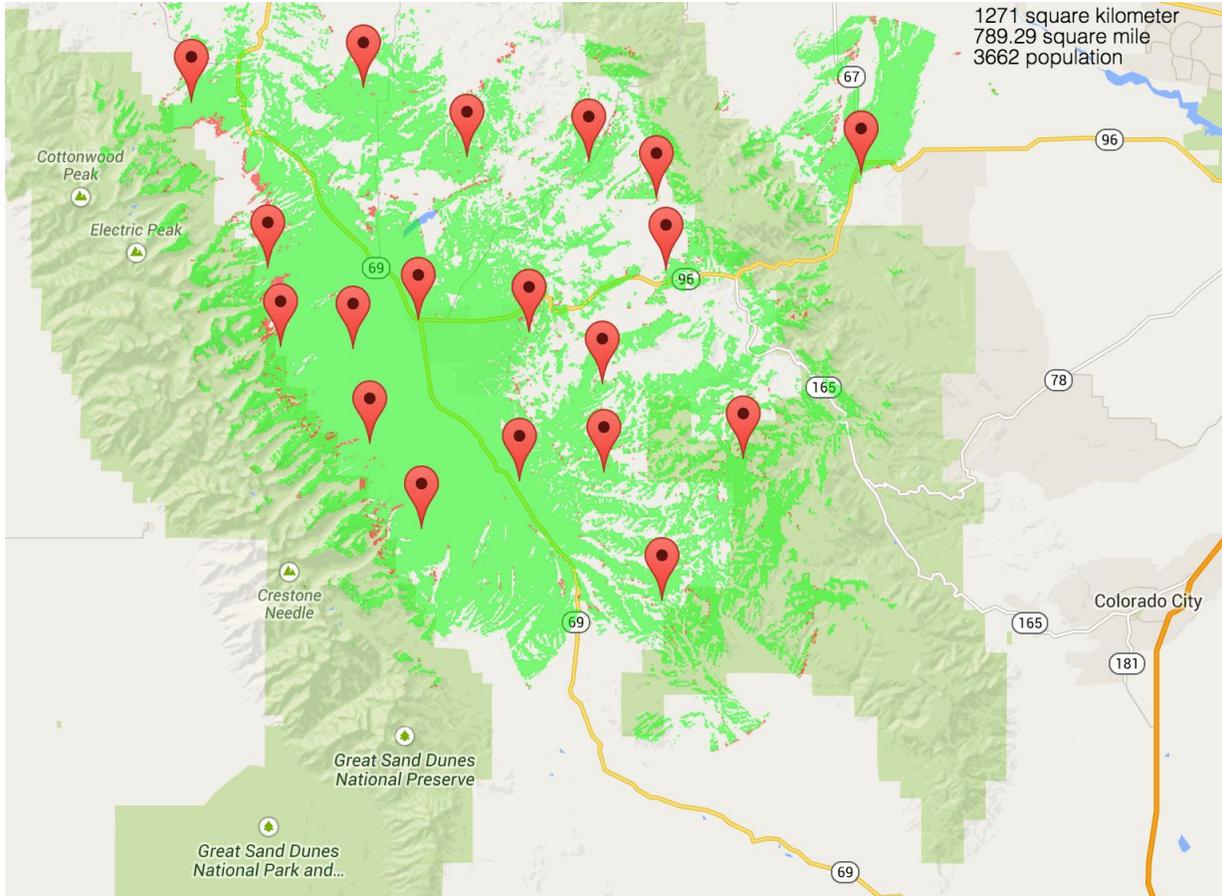
The wireless sites operated by the current wireless ISP's in Custer County (DD Wireless and Hiltop Wireless) are well distributed and provide theoretical service to over 70% of the County residents. This is based on a database of ground cover and the assumption that both the subscriber side and the provider side offer a minimum of 20ft placement of equipment above ground level. In addition the radius of each site was limited to 10km of coverage to ensure strong signals which allow for higher data rates. It also assumes well designed antenna systems and frequency selection since no attempt was made to model the precise equipment at each site. This assumption was made based on the fact that equipment evolves steadily over time, but the geography does not.

To achieve 85% coverage the County can assist the current providers by facilitating access to County property and antenna systems (specifically those currently used for Public Safety). With careful coordination of frequencies and equipment placement there is no reason to believe this would degrade the current County systems in any way. In addition there is a site currently used by DD Wireless called Wetmore that has special significance. This site or one nearby is located in a currently underserved area that greatly benefits from increased tower height. Using a process of adjusting tower heights at existing locations while determining the number of users gained from each 10ft of additional height the Wetmore site clearly stands out.

The incremental benefit of increasing the height of access points at each location was measured and composite maps created to establish which sites created the greatest gain in subscribers. The Wetmore site was unique in that adding height gained customers that could not easily be served from any of the other sites studied singly or in combination. There does not appear to be another area in Custer County that creates the same benefit.

The recommendation is that the County do what it can via land acquisition, permitting, construction assistance, financing, etc. to establish a tower on or near the current Wetmore site of at least 100 feet in height. Additional height gains additional homes served, but the cost benefit seems greatest between 100 and 120 feet in height. These recommendations lead to theoretical coverage greater than 85% of the County's population. Given that level of coverage and existing bandwidth available to the providers

there is no reason to believe that the existing providers cannot provide excellent broadband service to all but most remote residents of the County.



**Figure 7: Custer County Preliminary Wireless Propagation Survey**

## Model Open Trench Dig Once Ordinance<sup>27</sup>

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WHEREAS, obstructions and excavations in City/Town/County rights of way disrupt and interfere with public use of the Rights of Way; and

WHEREAS, obstructions and Excavations in City/Town/County Rights of Way result in loss of parking and loss of business to merchants and others whose places of business are in the vicinity of such obstructions and Excavations; and

WHEREAS, it is desirable to adopt policies and regulations which will enable the City/Town/County of \_\_\_\_\_ to gain greater control over the disruption and interference with the public use of public streets and Rights of Way, in order to provide for the health, safety and well-being of the City's/Town's/County's residents and users of City/Town/County Rights of Way; and

WHEREAS, significant public funds have been invested to acquire, build, maintain and repair the streets within the City/Town/County, and Excavations in the Rights of Way reduce the useful life of the pavement infrastructure; and

WHEREAS, significant public funds have been invested to place and maintain Landscaping within Rights of Way in the City/Town/County and Excavations in the Rights of Way cause damage to, and increase the costs of maintaining that Landscaping; and

WHEREAS, at the present time, the City's/Town's/County's Department of Public Works does not have [or desires to update, as appropriate] a detailed map or database indicating the location, nature, or extent of the system underground utility, communications and similar Facilities; and

WHEREAS, the various public and commercial utilities, broadband and communications providers and similar entities which install, maintain, and operate Facilities under the City's/Town's/County's Rights of Way are constrained, from time to time, to make excavation cuts which degrade the surfaces of these Rights of Way, thereby reducing their useful life; and

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<sup>27</sup> This Model Open Trench/Dig Once Ordinance is intended as a starting point to address issues that local governments might include in their own rights of way codes. It may be considered as a separate ordinance or for inclusion in a more comprehensive ordinance government rights of way management, permitting and construction. All provisions relate in some way to coordinating and attempting to minimize excavations, but all may not be appropriate in every jurisdiction. The provisions of this Model may also, where authorized, be modified and adopted as local policies or regulations.

WHEREAS, demand for access to broadband services is growing, and in order to fill such demand, more broadband network infrastructure is being installed in Rights of Way; and

WHEREAS, in other jurisdictions, the demand for access and the number of entities seeking to install Facilities has sometimes resulted in multiple, serial Excavations within the Rights of Way, which can and has resulted in traffic disruption, a weakening of pavement integrity, and a shortening of the useful life of paved surfaces; and

WHEREAS, while Colorado state statutes, particularly, C.R.S. 38-5.5-109, contains some procedures for addressing joint trenching in connection with broadband provider operations in the Rights of Way, at the present there is no comprehensive mechanism nor legal requirement that all public and commercial entities coordinate Excavation in the Rights of Way, and construct Facilities in newly developed areas to minimize future Excavations; and

WHEREAS, the [City/Town/County] of \_\_\_\_\_ intends to responsibly manage its Rights of Way by anticipating such demand and planning accordingly.

NOW, THEREFORE, be it enacted by the City/Town/County of \_\_\_\_\_ as follows:

I. PURPOSE AND OBJECTIVES

A. Purpose: to provide principles and procedures for the coordination of construction Excavation within any public Rights of Way, and to protect the integrity of the Rights of Way and road system.

B. Objectives. Public and private uses of Rights of Way for location of Facilities employed in the provision of public services should, in the interests of the general welfare, be accommodated; however, the City/Town/County must insure that the primary purpose of the Rights of Way, namely the safe and efficient passage of pedestrian and vehicular traffic, is maintained to the greatest extent possible. In addition, the value of other public and private installations, Facilities and properties should be protected, competing uses must be reconciled, and the public safety preserved. The use of the Rights of Way corridors for location of Facilities is secondary to these public objectives. This ordinance is intended to assist in striking a balance between the public need for efficient, safe transportation routes and the use of Rights of Way for location of Facilities by public and private entities. It thus has several objectives:

1. To insure that the public health, safety and welfare is maintained and that public inconvenience is minimized.
2. To facilitate work within the Rights of Way through the standardization of regulations.

3. To conserve and fairly apportion the limited physical capacity of the public Rights of Way held in public trust by the City/Town/County.

4. To promote cooperation among the Applicants and Permittees (as defined herein) and the City/Town/County in the occupation of the public Rights of Way, and work therein, in order to (i) eliminate duplication that is wasteful, unnecessary or unsightly, (ii) lower the Permittee's and the City's/Town's/County's costs of providing services to the public, and (iii) minimize Rights of Way Excavations.

## II. DEFINITIONS

For the purpose of this Chapter the following words shall have the following meanings:

A. "Applicant" means an owner or duly authorized agent of such owner, who has submitted an application for a Permit to Excavate in the Rights of Way.

B. "City"/"Town"/"County" means the City/Town/County of \_\_\_\_\_, Colorado.

C. "Conduit" means a single enclosed raceway for cables, fiber optics or other wires, or a pipe or canal used to convey fluids or gases.

D. "Department" means the Department of Public Works.

E. "Developer" means the person, partnership, corporation, or other legal entity who is improving property within the City/Town/County and who is legally responsible to the City/Town/County for the construction of improvements within a subdivision or as a condition of a building permit or other land use or development authorization.

F. "Director" means the Director of Public Works of the City/Town/County or his/her authorized representative.

G. "Emergency" means any event which may threaten public health or safety, or that results in an interruption in the provision of services, including, but not limited to, damaged or leaking water or gas conduit systems, damaged, plugged, or leaking sewer or storm drain conduit systems, damaged electrical and communications facilities, and advanced notice of needed repairs is impracticable under the circumstances.

H. "Excavate" or "Excavation" means any Work in the surface or subsurface of the Rights of Way, including, but not limited to opening the Rights of Way; installing, servicing, repairing or modifying any Facility(ies) in or under the surface or subsurface of the Rights of Way, and restoring the surface and subsurface of the Rights of Way.

I. "Facilities" means, including, without limitation, any pipes, conduits, wires, cables, amplifiers, transformers, fiber optic lines, antennae, poles, ducts, fixtures and appurtenances and other like equipment used in connection with transmitting, receiving, distributing, offering, and providing broadband, utility and other services.

J. "Landscaping" means materials, including without limitation, grass, ground cover, shrubs, vines, hedges, or trees and non living natural materials commonly used in landscape development, as well as attendant irrigation systems.

K. "Major Work" means any reasonably foreseeable Excavation that will affect the Rights of Way for more than five (5) consecutive calendar days.

L. "Owner" means any Person, including the City, who owns any Facilities that are or are proposed to be installed or maintained in the Rights of Way.

M. "Permit" means any authorization for use of the Rights of Way granted in accordance with the terms of this ordinance, and other applicable laws and policies of the City/Town/County.

N. "Permittee" means the holder of a valid Permit issued pursuant to this Chapter and other applicable provisions of applicable law for Excavation in the Rights of Way.

O. "Person" means any person, firm, partnership, special, metropolitan, or general district, association, corporation, company, or organization of any kind.

P. "Rights of Way" means any public street, road, way, place, alley, sidewalk or easement, that is owned, held or otherwise dedicated to the City/Town/County for public use.

Q. "Work" means any labor performed on, or any use or storage of equipment or materials, including but not limited to, construction of streets and all related appurtenances, fixtures, improvements, sidewalks, driveway openings, street lights, and traffic signal devices. It shall also mean construction, maintenance, and repair of all underground structures such as pipes, conduit, ducts, tunnels, manholes, vaults, buried cable, wire, or any other similar Facilities located below surface, and installation of overhead poles used for any purpose.

### III. POLICE POWERS

A Permittee's rights hereunder are subject to the police powers of the City/Town/County, which include the power to adopt and enforce ordinances, including amendments to this ordinance, and regulations necessary to the safety, health, and welfare of the public. A Permittee shall comply with all applicable ordinances and regulations enacted, or hereafter enacted, by the City/Town/County or any other legally constituted governmental unit having lawful jurisdiction over the subject matter hereof.

The City/Town/County reserves the right to exercise its police powers, notwithstanding anything in this ordinance or any Permit to the contrary. Any conflict between the provisions of the ordinance or a Permit and any other present or future lawful exercise of the City's/Town's/County's police powers shall be resolved in favor of the latter.

IV. JOINT PLANNING AND CONSTRUCTION; COORDINATION OF PLANNED EXCAVATIONS

A. Excavations in City/Town/County Rights of Way disrupt and interfere with the public use of those Rights of Ways and can damage the pavement and Landscaping. The purpose of this section is to reduce this disruption, interference and damage by promoting better coordination among Applicants and Permittees making excavations in City/Town/County Rights of Way and between these Persons and the City/Town/County. Better coordination will assist in minimizing the number of Excavations being made wherever feasible, and will ensure the Excavations in City/Town/County Rights of Way are, to the maximum extent possible, performed before, rather than after, the resurfacing of the Rights of Way by the City/Town/County.

B. Any Permittee owning, operating or installing facilities in City/Town/County Rights of Way, providing water, sewer, gas, electric, broadband, communication, video or other utility or utility-like services, shall meet annually with the Director, at the Director's request to discuss Permittee's excavation master plan. At such meeting, to the extent not already in possession of the City/Town/County, Permittee shall submit documentation, in a form required by the Director, showing a location of the Permittee's existing Facilities in the City/Town/County Rights of Way. Permittee shall discuss with the Director, its excavation master plan, and identify planned Major Work in the City/Town/County. The Director may make his own record on a map, drawing or other documentation, of each Permittee's planned Major Work in the City/Town/County; provided, however, that no such document prepared by the Director shall identify a particular entity, or the planned Major Work of that particular entity. An excavation master plan shall be submitted in both hard copy and digital format. As used in this subsection, the requirement to identify planned Major Work refers to any Major Work planned to occur more in the ensuing three (3) years after the date that the Permittee's master plan or update is discussed. Between the annual meetings to discuss planned Major Work, a Permittee shall use its best efforts to inform the Director of any substantial changes in the planned Major Work discussed at the annual meeting.

C. The Director shall review the major excavation plan and identify conflicts and opportunities for coordination of Excavations. The Director shall notify affected Owners and Permittees of such conflicts and opportunities to the extent necessary to maximize coordination of Excavation. Each Applicant for a Permit shall coordinate, to the extent practicable, with each potentially affected Owner and Permittee to minimize disruption in the Rights of Way.

D. The City/Town/County may disclose information contained in a Permittee's master excavation plan to any public or private entity planning on conducting Excavation activities in the Rights of Way only on a need-to-know basis in order to facilitate coordination among excavators and to avoid unnecessary Excavation in the Rights of Way. To the maximum extent permissible under the Colorado Open Records Act, as amended, the City/Town/County shall not otherwise disclose to the public any information contained in a master excavation plan submitted by a Permittee that is proprietary, trade secret or is otherwise protected from disclosure; provided, however that the City/Town/County shall have no duty to decline to disclose any information that the Permittee has not identified on its face as proprietary, trade secret or otherwise protected from disclosure. The City/Town/County shall notify a Permittee of any request for inspection of public records that calls for disclosure of any master excavation plan on which any information has been identified as proprietary, trade secret or otherwise protected from disclosure. The City/Town/County shall consult with its legal counsel regarding any such request and shall inform the affected Permittee either that the City/Town/County will refuse to disclose the protected information or, if there is no proper basis for such refusal, that the City/Town/County intends to disclose the requested information unless ordered otherwise by a court.

E. The Director shall prepare a Repaving Plan showing the Rights of Way resurfacing planned by the City/Town/County. For purposes of this section, the Repaving Plan shall include a Landscaping or other Rights of Way improvement plan. The Repaving Plan shall be revised and updated on an annual basis. The Director shall make the City's/Town's/County's Repaving Plan available for public inspection. In addition, after determining the City's/Town's/County's Rights of Way resurfacing Work that is proposed for each year, the Director shall send a notice of the proposed Work to all Permittees that have had an annual meeting with the Director, and those broadband providers that are identified on the list maintained by the Colorado Department of Transportation pursuant to C.R.S. 39-5.5-109 (1)(b).

F. Prior to applying for a Permit, any Person planning to Excavate in the City's/Town's/County's Rights of Way shall review the City's/Town's/County's Repaving Plan on file with the Director and shall coordinate, to the extent practicable, with the utility and street Work shown on such plans to minimize damage to, and avoid undue disruption and interference with the public use of the Rights of Way.

G. In performing location of Facilities in the Rights of Way in preparation for construction under a Permit, Permittee shall compile all information obtained regarding its or any other Facilities in the Rights of Way related to a particular Permit, and shall make that information available to the City/Town/County in a written and verified format acceptable to the Director. If the Permittee fails to provide the locate information requested by the City/Town/County, the City/Town/County may obtain this information and charge the Permittee the actual costs for obtaining the information.

V. JOINT EXCAVATION

A. Public Entity Excavators. Whenever two or more public entity excavators propose Major Work in the same block within a three-year period, such Work shall be performed by one public entity excavator. The participants to the excavation shall pay their pro rata share of the Work, or as otherwise agreed to by the affected public entities. For purposes of this subsection, the public entity excavators shall be treated as a single Permit Applicant and shall submit one application.

B. Private Entity Excavators. Whenever two or more private entity excavators propose Major Work in the same block within a three-year period, such Work shall be performed by one private entity excavator. For purposes of this subsection, the private entity excavators shall be treated as a single Permit applicant and shall submit one application.

C. Public Entity Excavator and Private Entity Excavator. Whenever a public entity excavator(s) and a private entity excavator(s) propose Major Work in the same block within a three-year period, the Department shall condition Permits for such Work in a manner that maximizes coordination and minimizes the total period of construction.

D. Excavations Not Identified on Major Excavation Plans. When an Applicant seeks a Permit for an Excavation, and such Excavation has not been identified on a major excavation plan so as to allow the City/Town/County to coordinate joint Excavation as set forth in subsections A through C of this section, an Applicant may, in the discretion of the Director, be required to circulate a description of its proposed Excavation to the Permittees and other parties described in Section IV.E above, to determine whether any Persons have requirements for installing Facilities along the proposed route.

1. The Persons notified should be provided with the Applicant's proposed route plan, the target commencement date and the estimated completion date.

2. Within ten (10) working days after the notification required by this subsection, any interested Person must notify the Applicant of their requirements so that the Applicant may incorporate these requirements, where reasonable, in its Permit application. The Applicant should summarize the responses it receives from other Persons in its Application.

3. If the Applicant believes that it is not reasonably feasible to entertain the requests made by another Person(s) for conditions of joint Excavation, it should notify City/Town/County and the other Person(s) within ten (10) working days from the date of receiving the requirements from the other Person(s) and provide reasons why it is considered not reasonable to do so. The parties are expected to endeavor to resolve any technical or commercial concerns among themselves, and the Applicant shall report the results of these efforts together with its application for a Permit.

E. Waiver of Joint Excavation Requirements. Permit Applicants may seek a waiver of the joint Excavation requirements with respect to a particular Excavation.

1. Except in cases of Emergencies, within thirty (30) calendar days of receipt of a written request for a waiver, the Director, in his or her discretion, may grant a waiver to the joint Excavation requirements for good cause. In making his or her decision on the request for waiver, the Director shall consider the impact of the proposed Excavation on the neighborhood, the applicant's need to provide services to a property or area, facilitating the deployment of new technology and improved services, and the public health, safety, welfare, and convenience. The Director shall indicate in written, electronic, or facsimile communication the basis for granting any waiver pursuant to this subsection.

2. The Director may waive the requirements for joint Excavation in cases where Emergency conditions exist.

3. The Director may place additional conditions on any Permit(s) subject to a waiver, including, without limitation, the charging of additional fees. The Director's decision regarding waivers of the joint Excavation requirements shall be final.

## VI. CONSTRUCTION OF NEW STREETS

A. Intent. The intent of this section is to provide for the construction of infrastructure sufficient to allow broadband communications entities desiring to deploy Facilities in the future to do so by pulling the same through the conduit and appurtenances installed pursuant to this section and without Excavating within the Rights of Way. This section is not intended to require Owners of broadband Facilities to install additional ducts or conduit in existing Rights of Way; rather, it is intended to require those constructing public streets, including the City/Town/County and Developers, to provide and install such conduit and appurtenances as may be necessary to accommodate future broadband needs within the Rights of Way without further Excavation.

B. Requirements—Adoption of Standards. Whenever any new public street is constructed, whether by the City/Town/County as a public works project or by a Developer or other private party in conjunction with development, the following shall be required:

1. In all new local streets serving or abutting residential development, a minimum of two 2" conduit with pull box every 1000' feet or less (and at every 90 degree turn) shall be installed by the party constructing the street.

2. In all new collector or arterial streets serving or abutting residential development, and in all new streets serving or abutting nonresidential development, a minimum of four 2" conduit with pull box every 1000' feet or less (and at every 90 degree turn) shall be installed by

the party constructing the street; provided however that at the discretion of the Director, the number and size of the conduit and spacing of pull box may be modified to address the reasonably known plans and/or demand for broadband capacity in these locations.

3. In addition to installing conduit, the party constructing the street will be required to install such vaults and other appurtenances as may be necessary to accommodate installation and connection of broadband Facilities within the conduit.

4. All construction and installation shall be accomplished according to construction standards adopted by the City/Town/County. The construction standards shall be adopted with due consideration given to existing and anticipated technologies and consistent with industry standards.

5. All Facilities installed by Developers or other private parties pursuant to this section shall be conveyed and dedicated to the City/Town/County with the dedication and conveyance of the public street and/or Rights of Way.

6. All installation costs shall be the responsibility of the party constructing the public street.

C. Use by Broadband Service Providers and Network Owners. Whenever conduit installed or to be installed under this section is available or will become available within a newly constructed public streets or Rights of Way upon dedication, all broadband service providers or network owners thereafter locating Facilities within such street or Rights of Way shall be required to locate their communications lines within such conduit unless it can be demonstrated to the reasonable satisfaction of the City/Town/County that such location is not technologically feasible or reasonably practicable. Conduit capacity shall be allocated to broadband service providers or network owners on a first-come, first-served basis; provided, that the City/Town/County may reserve capacity within such conduits for its own use; and provided further, that the Director may adopt additional rules for conduit allocation in order to ensure that all broadband service providers and network owners have reasonable access to the Rights of Way and that no barriers to entry or competition result from the allocation of conduit space.

D. Fees. The City/Town/County reserves the right to charge reasonable fees for the use of conduit installed pursuant to this section, to the extent consistent with and as limited by federal and state laws. Any such fees shall be established by resolution or ordinance.

This Ordinance shall take effect immediately upon [insert language appropriate for individual jurisdictions ...]

INTRODUCED, READ, ADOPTED ON FIRST READING AND ORDERED PUBLISHED, as provided by law, by the City Council/Town Board of Trustees/Board of County Commissioners of the City/Town/County of \_\_\_\_\_, at its regular meeting held on the \_\_ day of \_\_\_\_\_, 201\_.

\_\_\_\_\_

Name and Title

ATTEST:

\_\_\_\_\_

City/Town/County Clerk

READ, ADOPTED ON SECOND READING AND APPROVED this \_\_ day of \_\_\_\_\_, 201\_.

\_\_\_\_\_

Name and Title

ATTEST:

\_\_\_\_\_

City/Town/County Clerk