San Luis Valley

Regional Broadband Strategic Plan

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EXECUTIVE SUMMARY

We could spend a great deal of time talking about the current state of broadband, what the residents and businesses of the San Luis Valley (including Alamosa, Conejos, Costilla, Rio Grande, Mineral, and Saguache Counties) want it to be, and how to close the gaps between the current state and the desired state. In fact, in the body of this report we do.

But here we want to simply state our conclusion:

- First, broadband services in the valley are inadequate.
- Next, the low population density, economic factors, and geography of the region make achieving broadband development objectives difficult.
- Finally, collaboration between various broadband development efforts is required to overcome the barriers to development.

The first two points are pretty obvious. The proposed solution probably requires a little more explanation. Let's look at the who, what, where, when, why, and how of a collaborative approach to broadband development in the San Luis Valley.

- **WHO:** All private sector providers in the region should be encouraged to participate in a collaborative broadband development effort. To help encourage private providers, we recommend implementing certain public sector projects designed to support private sector participation. Any public sector projects should participate in any collaborative broadband development effort.

We do not want to diminish the importance of any member's participation. However, participation by San Luis Valley Rural Electric Cooperative, Jade Communications, and the City of Alamosa would lay an extraordinary foundation for a public sector and private sector collaboration.

- **WHAT:** Regional infrastructure owners should participate in a regional broadband development collaborative. The broadband development collaborative should be designed to combine the various participating network owners' regional broadband infrastructure into a single regional shared infrastructure network. All participants should have access to all other participants' infrastructure on a wholesale basis.
- **WHERE:** Each participant in the proposed collaborative should retain local control and local self-determination. For an organization like Jade or SLVREC, local control and local self-determination would reflect their service areas and their existing management structures. For public sector entities like Alamosa or Monte Vista, the locality may be constrained by incorporated boundaries. The various participants from the San Luis Valley region should combine in a regional collaborative structure. The region should encourage the state to develop a state authority designed to support the various regions.
- **WHEN:** With SLVREC's continuing expansion of broadband infrastructure throughout the Valley, now is a good time to establish a regional broadband development collaborative environment.
- **WHY:** Developing broadband in the very rural San Luis Valley is a capital intensive proposition. It is essential that capital spending inefficiencies be eliminated insofar as possible. Regular market forces tend to encourage multiple broadband capital expenditures along more profitable routes – thus we see multiple fiber routes between certain communities in the region.

  While market forces tend to encourage inefficiencies in capital spending, market forces also encourage entrepreneurial innovation.

  A regional broadband coalition that combines the physical network assets of multiple network owners throughout the region in a shared infrastructure model appears to be the best way to reduce competitive inefficiencies and increase the advantages of competition.

  A reduction of competitive inefficiencies should free broadband development capital to extend network assets into otherwise unserved and underserved areas. An increase in the advantages of competitions should ensure residents and businesses get optimal pricing for the largest variety of service offerings.
- **HOW:** Of course the "how" is the most difficult question. We will spend more time on the how in the body of the report.

Let us summarize some of the implications of the proposed regional broadband collaborative:

- The collaborative implies a **wholesale-retail** split in which network owners make their infrastructure assets available to competing providers on a wholesale basis. In telephony this structure is sometimes called unbundling.
  We believe the wholesale-retail split is appealing to network owners for three reasons:
  - *Inefficiencies in capital expenditures will be significantly reduced.*
    Currently for a provider to reach subscribers, the provider must build infrastructure to the subscriber. If two providers want to reach neighboring subscribers, both subscribers must build infrastructure. In a collaborative shared infrastructure model, the inefficiencies represented by the parallel infrastructure required for separate providers to serve neighboring addresses is eliminated.
  - *New market opportunities will be available to participating providers.*
    Sharing infrastructure on a wholesale-retail split model opens new market potential for each provider in the region. For example, providers like Colorado Central Telecom can provide service over fiber infrastructure in markets they cannot currently reach. Furthermore, they can extend fixed wireless services from more fiber end points. SLVREC can accelerate their goal to reach every address in the valley with fiber by taking advantage of public sector projects and other network owners' infrastructure. A provider like CenturyLink could extend services like prism TV that simply do not function on much of the infrastructure currently available to them in the Valley.
  - *New revenue opportunities will mature on existing networks.*
    New revenue opportunities will exist as subscribers who are uncomfortable with an incumbent network owner may subscribe to services from a competing provider offering retail services on the incumbent's network (paying wholesale fees to the incumbent network owner). Furthermore, marketing efforts from competing service providers will contribute to awareness and adoption and may drive more broadband adoption and greater demand for premium products.
- **Public sector investment** in broadband infrastructure is important to the collaborative effort. Public sector investment can provide a significant inducement for private sector participation in the proposed broadband development collaborative. Public sector investment also creates a lever the public sector can use to influence the satisfaction of policy objectives driving the need for broadband development.
- **Capital investment** in broadband infrastructure **must be coordinated**. We do not suggest the collaborative entity have any authority to dictate the capital spending of participating members. However, we see the collaborative entity serving as a

clearinghouse to help coordinate capital spending to minimize inefficiencies inherent in multiple providers building infrastructure to the same areas.

- **The collaborative entity must be funded**. Grant funding (from federal, state, or local foundation sources) may be available to start the collaborative entity but continuing funding will be required. We recommend the collaborative entity be funded by a small percentage of wholesale fees.

That represents the heart of our recommendations for San Luis Valley regional broadband development. Keep reading this executive summary for a more complete introduction. Read the full report for background and additional detail.

A MORE COMPLETE SUMMARY

A regional broadband strategic plan focuses on a specific region – in this case, the San Luis Valley to include Alamosa, Conejos, Costilla, Rio Grande, Mineral, and Saguache Counties. Its intent is to answer three questions:

What is the current state of broadband in the region?

What do we want broadband to look like?

How do we close the gaps?

Our team has conducted or is engaged in regional broadband strategic planning exercises for the Northwest Colorado Council of Governments, the Upper Arkansas Council of Governments, the Northeast Colorado Association of Local Governments, the East Central Council of Governments, and the South Central Council of Governments in addition to our efforts on behalf of the San Luis Valley. We have also worked with the Southwest Colorado Council of Governments on the Southwest Colorado Access Network project, with Rio Blanco County on the Rio Blanco Broadband project, with Park County on the Park County Broadband project, and

with Yuma County and the towns of Yuma and Wray on their broadband projects. We have also studied NEO Connect's efforts in Region 10, Teller County, and elsewhere in Colorado. Further, we have helped develop broadband strategies for communities in Utah, Washington, Oregon, California, Nevada, Connecticut, New York, and elsewhere.

In all these efforts, we have found that every community has unique broadband challenges and wildly differing broadband objectives; but we have also found that every community's unique broadband challenges have similar root causes and that each community can see similar benefits to improving their broadband environment. The real differentiating quality between the diverse communities within the San Luis Valley and throughout rural Colorado is not so much where the broadband starting point is nor what the objective is, but rather, how to get there.

So, what have we found?

What Is the State of Broadband?

We measure the quality of broadband along five characteristics:

Availability

Some parts of the Valley have multiple broadband options, others have none.

Affodability

Broadband is generally more expensive in the Valley than the national average.

Abundance

In most cases, broadband services are limited to at or below the current FCC definition of broadband (25/3 Mbps).

Reliability

Broadband service in the Valley is somewhat reliable but needs improvement .

Sustainability

The low population density, lower income levels, and other factors contributing to low adoption rates suggest broadband development may be unsustainable without subsidization.

Taken as a region, the current state of broadband in the San Luis Valley is not all that different from other rural areas of Colorado. It is inadequate to meet the economic development and quality of life objectives of the various communities and there is not a sustainable path for private sector providers to change that.

What Is the Desired State of Broadband?

The various communities express their end broadband goals in different ways. Nonetheless, the following goals represent a summary of the various community goals or a means by which they can be achieved:

Available

- Every address in the region should have access to at least two broadband providers.

Abundant

- Encourage a continual increase of average access speeds over time that will keep up with technological advances.
- Every address in the region should have access to at least one data package that meets or exceeds the current FCC definition of broadband.
- Provider packages will match national typical service offered over similar delivery technologies.

Affordable

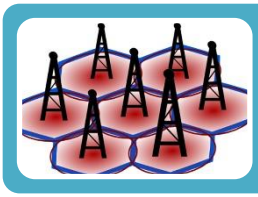
- Every address in the region should have access to at least one data package that meets or exceeds the US average cost per Mbps per month.
- Every address in the region should have access to at least one data package for less than $50 a month.
- Monthly prices and value should be equitable with national averages.

Reliable

- All service providers in the region should interconnect to one or more Tier 1 or Tier 2 POP(s) on path diverse redundant routes.

Sustainable

- Achieve availability, abundance, affordability, and reliability goals without putting significant tax dollars at risk and in such a way that participating private sector providers can maintain reasonable profits.



Other

- Broadband development should contribute to better cellular service and coverage.

How Do We Close the Gaps Between the Current State and the Desired State?

The answers to the first two questions turn out to be strikingly similar throughout rural Colorado. The current state of broadband is inadequate. Residents, businesses, and community anchor institutions want it to be better so they can more effectively participate in the economic development and quality of life opportunities of the 21st century.

The answer to the question of how to close the gaps between the current state and the desired state turns out to be very locality and regional specific.

We believe the San Luis Valley has one of the best opportunities of any rural area in the state to significantly improve broadband services. In Jade Communications/Blanca Telephone, Colorado Central, and the San Luis Valley Rural Electric Cooperative's Ciello, the region is endowed with a set of local providers who are fiercely dedicated to seeing the quality of broadband improve. Each of these companies has committed significant resources to improving middle mile services, driving fiber deeper into the last mile and to the home, and augmenting service with fixed wireless solutions to extend availability where none previously existed. Each of these providers is dedicated to continue capital spending to improve service – even at marginal returns on investment.

Most of the larger population centers and significant rural areas are served by CenturyLink. CenturyLink is currently planning on how to best spend $26.5 million in Connect America Funds (CAF) in each of the next six years (nearly $160 million). The federal funds will be matched by CenturyLink spending. This combined money can make a significant difference in the broadband environment throughout the state and in CenturyLink's San Luis Valley service areas.

With these great providers participating in broadband development throughout the Valley, the real question becomes how to most effectively support their efforts to ensure the Valley's broadband development objectives are met. Meeting the goals described above in the environment of the San Luis Valley encounters four key constraints:

1. DSL, the primary architecture used by CenturyLink, has limited viability for providing desired abundance. Fixed wireless can achieve some abundance objectives but may not keep pace with the exponential growth of bandwidth demand. Cable service providers can meet current abundance requirements but they are unlikely to expand networks – especially in rural areas. Fiber to the premises is the optimal methodology for providing abundant service but is extremely expensive to deploy.
2. Competition, or choice of service providers, drives innovation and helps control consumer costs. While competition is good for the consumer, the various service providers are unlikely to strive to expand competition in the fairly limited market the San Luis Valley represents.

3. Building separate infrastructure to enable choice of service providers is more costly and less efficient than providing choice via a shared infrastructure model.
4. The low density, lower incomes, and other factors contributing to lower adoption rates hamper broadband business models and make significant broadband development unlikely without public sector subsidization.

These constraints suggest the strategy for expanding broadband in the Valley should be one that targets shared fiber to the premises but reaches for that goal through a pragmatic path of improving wireless and DSL services and that augments private sector development with targeted public sector investment (in implementation, guaranteed returns, or other subsidization mechanisms).

First, CenturyLink has federal funding immediately available. CenturyLink is obligated to meet certain standards as they make improvements with company and federal funds. CenturyLink has a large service territory and cannot be expected to understand the individual needs of each community without input from residents, businesses, and, in particular, elected officials from within the community. As CenturyLink is primarily a DSL provider in the San Luis Valley, it is probable CenturyLink will focus on expanding its DSL service. Further, the federal funding does not require recipients to meet the current FCC definition of broadband (25/3 Mbps). Rather, the CAF funding requires recipients meet a lower 10/1 Mbps standard. CenturyLink will likely meet a higher standard in some areas. However, in order to benefit the most potential subscribers, it is likely that CenturyLink will meet the lower allowed standard in many cases.

The improvements CenturyLink makes with federal and company funds are not likely to extend fiber to the premises or to encourage significant competition. Nonetheless, CenturyLink's improvements can represent a significant pragmatic step towards meeting the Valley's broadband objectives. An important element of CenturyLink's improvements may be fiber to the node. This fiber to the node may be used not only to improve CenturyLink's DSL services, it may also enable improvements in fixed wireless services and may support improvements in cellular services.

Next, Jade, Colorado Central, and other fixed wireless providers should be encouraged to continue to expand their networks. Fixed wireless services are typically less expensive to deploy to rural areas than are wireline services. However, without sufficient subscribers, fixed wireless providers cannot support the implementation of tower, radios, and backhaul. Public sector entities may be able to support broader fixed wireless deployments by making existing vertical assets available to providers or by implementing new vertical assets required to support more isolated potential subscribers.

Expanding fixed wireless services will improve availability but will only have a minimal effect on abundance and affordability. Public sector vertical assets represent a step towards a shared infrastructure environment.

A ubiquitous fiber to the premises environment in the Valley is an ambitious but realistic objective. The San Luis Valley Rural Electric Cooperative has an 18-year plan to deploy fiber to the premises throughout the Valley. Jade also has plans to continue fiber development. The REC's and Jade's fiber to the premises objectives fully meet abundance objectives and may also meet affordability goals. However, they do not directly contribute to improving competition. If these organizations could be encouraged to share their expanding infrastructure assets in an open access (wholesale-retail split) model, all of the region's objectives could be met.

One potential mechanism to encourage the REC and Jade to share their infrastructure in an open access model may be to accelerate their build plans through public sector open access fiber builds. If, for example, the City of Alamosa were to deploy an open access fiber to the premises network, the REC's provider, Ciello, would have access to a significant market without the required capital expenditure of the REC building the network. This expanded market at lower capital expenditures could serve to offset any potential losses the REC may face by offering their infrastructure assets throughout the valley to competing service providers on a wholesale basis.

The proposed shared infrastructure model suggests public and private sector network owners will build network improvements and make those improvements available to competing service providers on a wholesale basis. In the end, network owners like the REC, the City of Alamosa and others would offer wholesale infrastructure to competing service providers like Ciello, jade, Colorado Central, and others. Through this proposed shared infrastructure model, potential subscribers would have a choice of multiple competing service providers without the region experiencing the inefficiencies associated with unneeded redundant infrastructure spending.

FINANCING THE GOALS

There are four items that need to be considered when determining realistic financial cost associated with improving broadband access: capital expenses, operations expenses, revenue, and schedule/time. Capital expenses are the upfront costs associate with building new infrastructure. Operations expenses encompass everything with running the business. Revenue is the money generated by the service and used towards capital and operating expenses. Schedule or time includes the amount of time to recover costs spent on improvements and time necessary to recover investments.

Funding Options

There are multiple funding sources to assist with improving broadband access. The US Department of Agriculture (USDA) farm bill has designed Rural Utility Service (RUS) funds that can be used for broadband access. The Federal Communications Commission (FCC) also provides funds through multiple sources including, Universal Service Funds (USF). Other federal programs may be used to improve broadband service.

The state of Colorado offers funding opportunities for improving broadband access. These include Colorado Department of Local Affairs (DOLA) grants and the new Broadband Infrastructure Grant program.

Local jurisdictions can use a few methods to raise funds to improve broadband access. Three of the most common methods are Special Districts (SD), Local Improvement Districts (LID), and Business Improvement Districts (BID). Of these mechanisms, LIDs are the most flexible since it allows homeowners to construct and finance public works projects over a pre-determined amount of time (such as 10 years) so the entire cost of the project does not have to be paid at once.

The body of this report provides details intended to support this summary. Some of the content can be found in other reports our team has written. We have spent an extensive amount of time validating these findings and considering various options for the Valley.

DOCUMENT HISTORY

Ver.	Date	Author	Notes
0.01	16 Aug 2016	Recanzone/Jaworski	First draft.
0.02	1 January 2017	Recanzone	• Rebranded to COG instead of DRG • Added DOLA branding • Formatting, images, and graphics • Update Contents • Update Colorado Central Summary in Appendix
0.03	16 March 2017	Recanzone	• Updated information about Jade/Blanca • Added pricing for Fairpoint and Charter
1.00	7 May 2017	Recanzone	• Remove draft marks • Add “Public Meeting Notes” appendix

Table 1: Document History

CONTENTS

TABLES

FIGURES

BROADBAND PRIMER (INTRODUCTION)

This regional broadband strategic plan covers the San Luis Valley Development Resources Group (SLVDRG) / San Luis Valley Council of Local Governments (SLVCOG) region, which includes Alamosa, Conejos, Costilla, Mineral, Rio Grande, and Saguache Counties. The San Luis Valley encompasses approximately 3,000 square miles and has breathtaking scenery including the San Juan Mountains, Sangre de Cristo Mountains, and the Continental Divide. Even though the Valley is arid, the lifeblood of the community is agriculture.

Traditional economic and geographic barriers have lessened over time and encourage user growth of the internet. What used to be considered a luxury item has become a vital staple of the professional and recreational landscape of the 21st century. Fast, efficient and reliable broadband access can have tremendous impacts to local economies and educational systems. Small rural school districts depend on fast and reliable broadband access in order to offer distance learning opportunities that give their students access to classes that would otherwise be unavailable. Data centers can locate anywhere and often prefer rural areas where property and facility costs are lower; but only if fast enough speeds are available and service is reliable.

Since a strong regional network provides the most opportunity for personal, business, and educational growth of

These sidebars will be located throughout this report and function as a summary of key points.

Broadband access improves the quality of life of residents and encourages the vitality of businesses. Improved access crosses all generations since it augments education, emergency services, healthcare, anchor businesses, and improved community cohesion.

Broadband access is divided into multiple layers of infrastructure. This report focuses primarily on middle mile and last mile infrastructure.

The purpose of this Regional Broadband Strategic plan is to answer the following questions:

- *What is the current state of broadband in the region?*
- *What do we want broadband to look like?*
- *How do we close the gaps?*

an area, this plan focuses on regional broadband access issues rather than service in specific areas.

The purpose of this Regional Broadband Strategic plan is to answer the following questions:

What is the current state of broadband in the region?

What do we want broadband to look like?

How do we close the gaps?

Recommendations will include short term (e.g. within one year), mid-term (e.g. three years), and long-term (e.g. five years) strategies. We will examine basic information about broadband services before diving into the specific needs of the SLVCOG region.

WHAT IS BROADBAND

Data communications has been around for a long time. The Bell System implemented a dedicated line Data-Phone service as early as 1958. This service allowed “high-speed” transmission of data over regular telephone circuits. The first “internet” was built in 1969 between University of California Los Angeles (UCLA), the Stanford Research Institute, University of California Santa Barbara (UCSB), and the University of Utah. Email came on the scene in 1972. Al Gore sponsored the pivotal Supercomputer Network Study Act in 1986 and began the transformation of the internet landscape from a defense and research tool to a commercial platform. In 1990, Tim Berners-Lee brought the first web server online and with it, the first website and web browser in history. Paul Kunz brought the first US web server online at the Stanford Linear Accelerator Center by December 1991.

Internet was in the “slow” lane during the early years. From the first data connections in the late 50s through the development of the commercial internet in the 90s, data was typically

passed on dedicated lines or using dial-up modems to connect at 56 Kbps (.056 Mbps). At 56 Kbps this report (about 23 MB) would take nearly 55 minutes to download. Broadband technologies started becoming widely available beginning around 2000. First, ISDN services offered data speeds of up to 128 Kbps (.128 Mbps), which shortened the amount of time to download this report to about 24 minutes. Shortly on the heels of ISDN came DSL with data speeds above 1 Mbps (at which speed you could start enjoying this report after about three minutes). Cable companies also started implementing DOCSIS standard technologies that allowed for two-way data transmissions on coaxial systems at multiple megabits per second.

Today, service providers deliver broadband speeds over a variety of technologies including: fixed and mobile wireless, a variety of DSL technology, cable companies' coaxial networks, and at the speed of light over fiber optic cabling.

The literal definition of broadband has to do with the range of frequencies across which data signals travel. But for most people, broadband consists of two primary characteristics:

1. It is faster than dial-up service and
2. It is always on and does not interfere with voice calls.

The definition of adequate broadband speed is constantly shifting and will continue to do so for the near-term. 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. The Federal Communications Commission (FCC) makes this point on their website (broadband.gov) when they say:

> *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.*[1]

We often jokingly say that broadband is internet access that is faster than whatever you have now. But like most humor, the joke is not too far from the truth. As we look at improving broadband in the San Luis Valley, we want to come to a strategic plan that has the potential to improve broadband for everyone. This may mean extending a one or two Mbps wireless link to those that have no broadband today, which is a pragmatic step in the right direction. However,

[1] Federal Communications Commission, 'What is Broadband?', Federal Communications Commission National Broadband Plan [Website], 23 June 2014, http://www.broadband.gov/about_broadband.html, accessed 9 May 2016

this step would not "provide access to the highest quality internet services," meaning subscribers would still be at a competitive disadvantage. To get the highest quality internet services available today, subscribers need access to data speeds more in the 20 or 30 Mbps range. Many businesses and some residences find 20 to 30 Mbps speeds to be inadequate. They struggle with their needed online services 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 wholly inadequate. Economic development may demand improving broadband to the 1 Gbps (1,000 Mbps) range or better. Even at these faster speeds, if the network is not reliable, if it does not have diverse paths, or if costs are too high, communities are at a disadvantage when trying to attract and retain 21st century businesses. While the economic development director and potential subscriber may appear to have different problems since one is trying to attract a call center and associated economic growth for their town, they both have vital broadband development needs necessary to compete in today's regional, national, and global market.

HOW IS BROADBAND DELIVERED

The internet has become known as the "information superhighway;" using a road analogy leads to an improved understanding of how it works. 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".

Naturally, surface streets and highways 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. Internet traffic can easily cross from one major network to another at these peering points. Thus, viewing a web page from South Africa is just as easy as watching a movie hosted on a server in South Carolina;

sending an email to your grandkids in Denver is just as easy as video conferencing with a client in Dusseldorf.

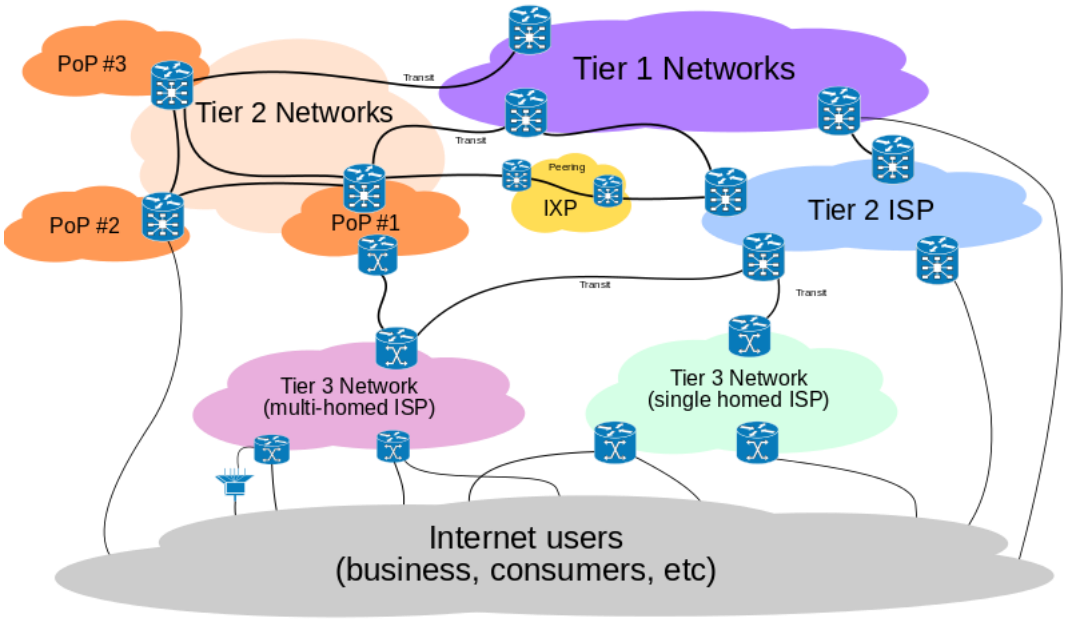


Figure 1: High Level internet Diagram

"Figure 1: High Level internet Diagram" illustrates 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 and the lines that connect population centers to each other, similar to the interstate system. 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). And this is not the end of the research. *The technology does not yet exist that will saturate a fiber pair!* The real limiting factor is not the fiber but rather the connecting technology.

The deployment of fiber infrastructure can expect to survive many connecting technology upgrades providing multiple generations of subscribers extraordinary connectivity and offering an extended return on investment.

Because of its phenomenal capacity, fiber is the preferred medium for middle mile infrastructure. Reasonable lower cost middle mile alternatives to more expensive fiber optic deployments are licensed microwave links. 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 interregional, 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 San Luis Valley has reasonably good middle mile options. Improvements like Jade's dual fiber and microwave paths are valuable assets as are the SkyWerx microwave network and the fiber Zayo, CenturyLink, EAGLE-Net and others have throughout the region.

LAST MILE

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

Distribution (the "collector" roads)

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, a point-of-presence (POP), or a data center.

Distribution paths are usually developed in a ring architecture out from the meet me point to provide path diversity and redundancy. Path diversity and redundancy are imperative to maintain service to an area because they provide an alternate pathway should the primary path be disrupted. Some intra-regional distribution paths may connect disparate communities and others may provide paths through a community itself.

Distribution architecture is fundamental to enabling demand aggregation to benefit the communities they serve. This level of architecture is seldom highlighted by those incumbent providers who work to disaggregate demand in order to maximize profit or for other business or technical reasons.

Sometimes distribution architecture is considered "middle mile" and other times it is considered a portion of the "last mile" network. We are considering it part of the "last mile" network in this report because on a regional scale, the last mile includes the entire path from the property address to the POP (colocation facility or data center).

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 engaging in broadband development focus on distribution architecture. It is a straightforward task to build distribution infrastructure to cohesively connect a community by joining disparate community anchor institutions such as universities, schools, libraries, job

employment centers, emergency services, and healthcare facilities. 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 reduced 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 (the neighborhood roads)

Access level architecture extends the network from the distribution 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 an expensive proposition in terms of upfront costs. However, without improved access level architecture, the benefits of any broadband development may be limited to very localized areas, which are generally not the areas that need access the most. The goal is to tap into areas that if provided access could provide exponential growth as new participants or provide a future workforce that is competitive and provides a boost to the region.

Drop Level (the driveways)

Drop level architecture extends access level infrastructure into the subscriber's premises (e.g. the physical address).

HOW DO WE MEASURE BROADBAND QUALITY

We describe the broadband environment in the region with five characteristics: availability, abundance, affordability, reliability, 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.

Abundant

Broadband capacity affects the user experience in the online world and is measured in kilobits, megabits or gigabits per second download and upload speeds. Targeting capacity bottlenecks is vital to increasing overall broadband capacity. If adequate backhaul (middle mile) capacity exists to support subscribers but their access level infrastructure (last mile) does not provide sufficient connectivity to capitalize on that backhaul, then increasing backhaul capacity will only have a marginal effect.

Affordable

The broadband environment improves when costs per Mbps go down. Users may see higher monthly bills but still benefit from lower per unit 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.

Reliable

Desired services must be available when needed in order to provide a satisfactory user experience and ensure an adequate platform for economic development.

Reliability typically improves 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 and/or qualitative measures to compare their state in the south central Colorado area with other areas, national averages, or ideal objectives.

BROADBAND INFRASTRUCTURE

A variety of transmission media can deliver last mile services. The most common are DSL, fixed wireless, cable and fiber. In many cases in south central Colorado, subscribers use mobile wireless as their only means of connecting to the internet while others use satellite services.

Broadband is delivered through various methods with the most common being:

- *DSL*
- *Fixed Wireless*
- *Cable*
- *Fiber*
- *Other (e.g. satellite, cellular, etc)*

DSL

DSL, or Digital Subscriber Line, transmits digital information on a twisted pair of copper wire – usually the very same twisted pair that delivers traditional telephone service to the home.

CenrturyLink is a primary provider of DSL service in the San Luis Valley. Federal regulation requires that incumbent local exchange carrier 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 an incumbent (owner) carrier's infrastructure. This unbundling concept is a foundational principle of the shared infrastructure model we are proposing in the Valley.

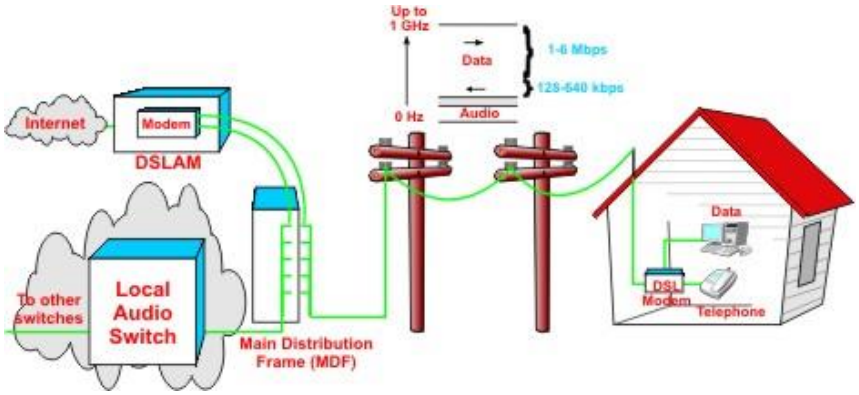


Figure 2: DSL

"Figure 2: DSL" represents a simplified DSL system.

There are many varieties of DSL. CenturyLink offers both Asymmetric Digital Subscriber Line (ADSL) or Very High Bit Rate Digital Subscriber Line (VDSL) in various parts of the Valley. ADSL has a maximum download speed of about 7 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.

DSL services aggregate at a Digital Subscriber Line Access Multiplexer (DSLAM). A DLS service loses its data signal as it travels along the twisted pair cable from the DSLAM to the customer premises. In general, the further the subscriber is from the DSLAM, the more service degrades as shown in "Figure 3: Typical DSL Loss Impact".

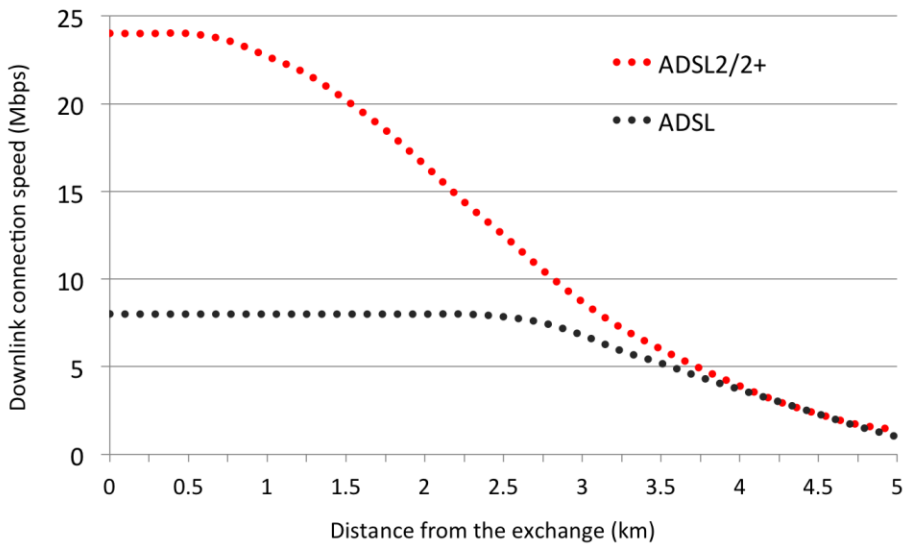


Figure 3: Typical DSL Loss Impact

In many areas, DSL providers deploy remote DSLAMs to extend the reach of their DSL service. The distribution network for these remote DSLAMs is customarily fiber resulting in a solution known as "fiber to the node."

Fixed Wireless

Fixed wireless services can physically 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 download speeds.

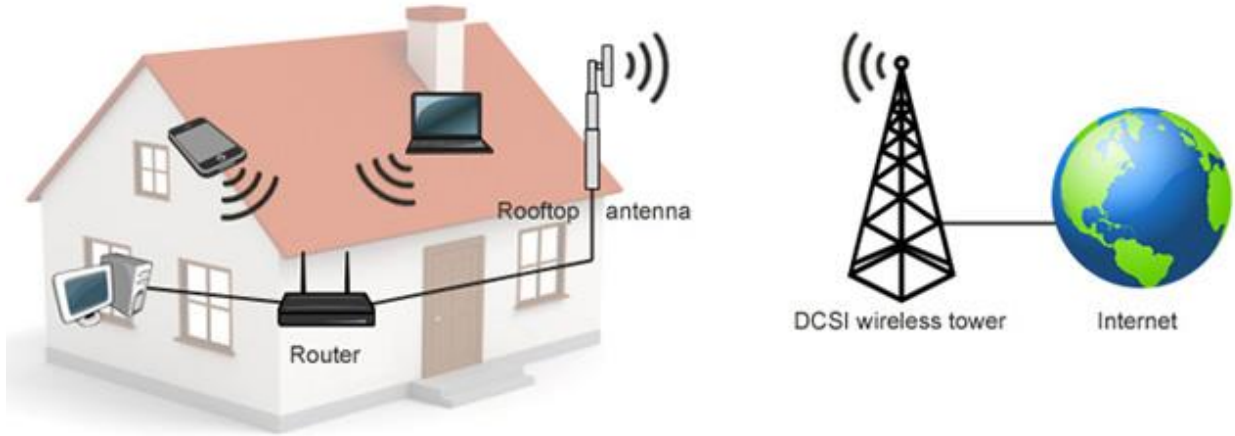


Figure 4: Fixed Wireless

“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, which results in lower quality service. Additionally, licensed and unlicensed systems face general terrain and atmospheric signal degradation. Licensed spectrum is scarce and can be expensive.

Cable

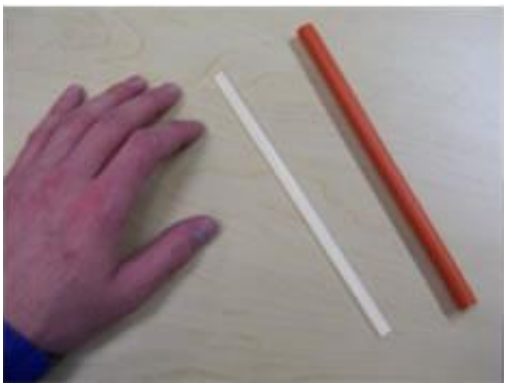
In the late 1990s and early 2000s, cable TV companies began providing data service on existing coaxial cable TV systems using a standard called Data Over Cable Service Interface Specifications (DOCSIS). Over time, DOCSIS has improved and providers have improved their network by upgrading their lines. This resulted in optical fiber feeder deployed deeper into the network. Thus, cable companies can offer speeds up to 150 Mbps (or faster in some cases).

Only limited communities in the San Luis Valley have access to cable internet service.

Fiber

A common component of the middle mile and last mile infrastructure is optical fiber because of its capacity and longevity. Most wired and many wireless providers use fiber in at least one segment of their distribution networks. CenturyLink and Jade/Blanca implement a fiber-based Metropolitan Optical Ethernet service throughout their access level infrastructure to some businesses in their service area. Jade/Blanca has implemented some fiber to the premises. The San Luis Valley Rural Electric Cooperative plans nearly ubiquitous fiber to the premises service throughout the Valley and has already begun deployment in communities like Creede and South Fork.

Consider the following illustration of the long-term scalability of fiber: if a standard drinking straw represent dial up speeds (56 Kbps), then a pipe about a foot in diameter equals a 100 Mbps connection (VDSL speeds). Using the same scale, a Gigabit connection would be represented by a pipe about 3 feet in diameter. A pipe about 115 feet in diameter would represent commercially available connections for a single fiber pair. 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 same pipe 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.

Other

Some subscribers use satellite service, cellular service, or other broadband technologies. These alternative technologies may be the only choice available to subscribers. Trees, terrain, and weather impede cellular and satellite services.

Summary

The table below compares the network options according to availability, abundance, reliability, affordability, and sustainability. As discussed in detail in Section 3.0, the goal is to get as close to an optical fiber network as possible. The table uses a subjective scale of very poor, poor, fair, good and excellent. The definitions for the subjective scale are as follows:

- Very Poor
  Does not exist, does not meet any quality standards or otherwise fails to meet "poor" standards.
- Poor
  Generally does not exist, generally does not meet quality standards or otherwise fails to meet "fair" standards.
- Fair
  Fairly average.
- Good
  Generally exists, generally meets exceeds "fair" quality standards or otherwise exceeds "fair" standards.
- Excellent
  Universally exists, greatly exceeds "fair" quality standards or otherwise greatly exceeds "fair" standards.

	Available	Abundant	Reliable	Affordable	Sustainable
DSL	**Good** 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.	**Fair** Generally reliable when DSLAM has path diverse and redundant connections.	**Fair to Poor** Monthly costs are generally good. Cost per Mbps is poor.	**Excellent** Uses existing twisted pair infrastructure.

	Available	Abundant	Reliable	Affordable	Sustainable
Fixed Wireless	**Good** Generally available. Availability limited by line of sight issues and distance from tower sites.	**Good**	**Poor** Reliability suffers from congestion on aggregation points and service degradation resultant from weather conditions.	**Fair** Monthly costs are generally good. Cost per Mbps is poor. Wireless services typically have the highest cost per Mbps of last mile solutions.	**Good** Relatively low cost deployment.
Cable	**Poor** Available in some more dense areas. Not usually available in rural areas.	**Good**	**Fair** Capacity is often degraded by over-subscription at hub sites. Reliability suffers from shortcomings in broadcast network design	**Good**	**Poor** New deployments are capital intensive and unlikely. Deployments on existing infrastructure are reasonably easy.
Fiber	**Poor**. Very little last mile fiber exists in the south central Colorado area.	**Excellent**	**Good** Only if designed for redundancy.	Where fiber to the premises has been deployed, monthly costs are **very good to excellent**. In particular, the cost per Mbps is excellent.	**Fair** High cost to deploy but once it is in place fiber has a long expected life cycle and low operating costs.
Other	**Fair** Satellite service is generally available. Cellular broadband is reasonably available. Some other technologies may also be available.	Other technologies are **poor to very poor** broadband solutions.	**Poor** Service is affected by weather, congestion, and other conditions.	**Poor** Other broadband solutions usually have high prices compared with traditional last mile technologies.	**Fair** Most other technologies are at constant risk of being superseded by more traditional solutions.

Table 2: Last Mile Technology Summary

WHERE ARE WE NOW AND WHERE DO WE WANT TO BE (NEEDS ASSESSMENT)

Let us first take a look at how broadband may be contribute to economic vitality and quality of life in the south central Colorado region. We will then look at the general state of broadband in the region. Later, when we look at development options, we will provide a little more detail regarding the state of broadband in each of the counties.

BROADBAND VALUE TO ECONOMIC VITALITY AND QUALITY OF LIFE

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

BROADBAND VALUE TO THE COMMUNITY/REGION

Many public safety functions depend on communications. While this Regional Broadband Strategic Plan does not directly address public safety, an unintended benefit of improved broadband is that it creates improved public safety opportunities. Police and private security companies can deploy high definition and heat sensitive security cameras for remote monitoring of sensitive areas because of broadband development. Police departments can more effectively use systems like Shot Spotter technology that identifies gunshots and alerts authorities to detect and deter violent crime. Fire departments can take advantage of data provided via intelligent alarm systems. These and other public safety benefits demonstrate the value of broadband development to the community and region.

Based on 2013 data, tourism is listed by the Colorado Office of Economic Development & International Trade as one of the top five industries in the San Luis Valley region[2]. Reliable broadband plays heavily for most when deciding where to vacation, especially when it is

[2] OECD, 'Region 8 Strategic Summary,' Regional Strategies 2.0 [website], Colorado Office of Economic Development & International Trade, http://www.advancecolorado.com/blueprint/regional-strategies-20/region-8, 2015.

common for employees to stay connected even when on vacation or traveling. Advance Colorado also list recreational opportunities as one of the Region's assets.

During the 2015 San Luis Valley Listening tour, "many communities expressed a desire for a community center as a means to promote community engagement, cultural heritage, and healthy recreational activities."[3]

More specifically, let us look at economic development and education benefits.

BROADBAND VALUE TO ECONOMIC DEVELOPMENT

Broadband development supports economic development. As the 21st century economy evolves, many "knowledge" jobs continue to develop and migrate towards areas with broadband access. Figure 5 below shows the southern Colorado economy by industry using 2014 data, which shows the largest employment sectors are government and healthcare.[4] Drilling down to the San Luis Valley region, the Colorado Office of Economic Development & International Trade lists the key industries as agriculture, healthcare, transportation/logistics, tourism/outdoor recreation, and construction. Broadband access would offer an opportunity to not only expand the current key industries but attract new "knowledge" jobs.

[3] San Luis Valley Rural Philanthropy Days, 'Listening Tour Report,' 2015 San Luis Valley Rural Philanthropy Days, http://crcamerica.org/wp-content/uploads/2015-San-Luis-Valley-Listening-Tour-Report.pdf.

[4] R. Baird, 'San Luis Valley: Energizing with Sunshine', *Colorado Business Review,* 81, 4, 2015, page 10, http://www.colorado.edu/business/sites/default/files/attached-files/cbr_november_2015.pdf, accessed 15 June 2016.

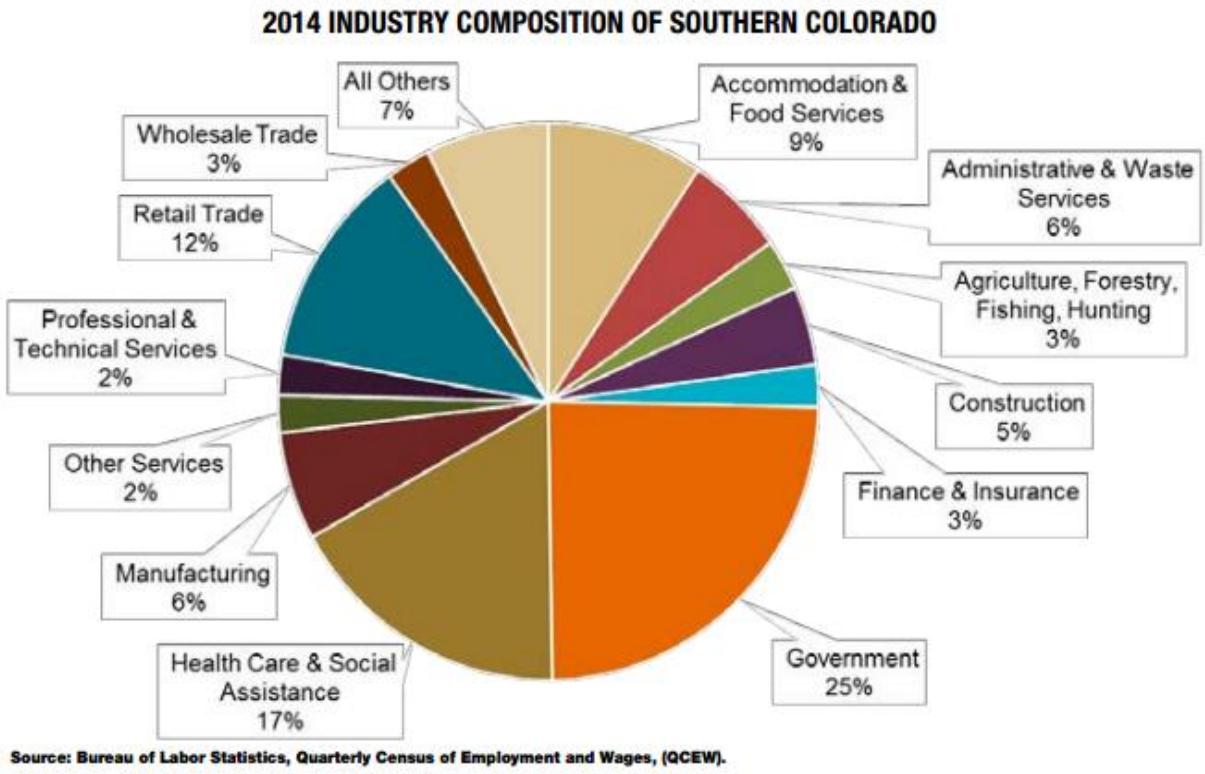


Figure 5. Southern Colorado industry composition as of 2014.

Many of these knowledge jobs are "location neutral" meaning the worker can be physically located anywhere and still contributing – 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. The largest private sector employers within the San Luis Valley region are City Market, Town and Country Car and Truck Center, SLV Health, Rio Grande Hospital, Mountain King Potatoes, and Monte Vista Co-op. All of these rely on internet access to function and their bandwidth needs will increase as their businesses grow. This sentiment was emphasized in the 2015 San Luis Valley listening tour report, specifically that "businesses throughout the region lack reliable access to high speed internet, which is considered critical to robust economic development." Broadband will become fundamentally ingrained as two general business trends accelerate:

1. 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 high definition (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 south central Colorado area.

2. Perhaps more importantly than enabling reductions in business travel, affordable and abundant broadband makes telecommuting and working from home a viable reality. High performing, reliable and affordable broadband services make it possible for workers with jobs on the Front Range and around the country to live and work anywhere. This is equally true for home based entrepreneurs and other location neutral workers.

Broadband development is a critical component of an economic development strategy but it is not a silver bullet. Broadband investment is one component tied to a wider set of community and economic development strategies that help make regions engaging and interesting places to operate businesses. It makes communities vibrant and safe places to live that will entice new residents and retain current ones.

Communities that have made broadband investments without adequately identifying a broader set of goals, complete with expected outcomes and metrics, have often been disappointed when their broadband investments have made insignificant impact. Broadband investments are critical for economic vitality as showcased by David Salway in May 2012 in an article examining how broadband can and should be used as an economic driver. He suggests, "There is little debate that increasing broadband access spurs economic development, but can this be quantified?"[5] 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[6] 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."[7]
- 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% per year.[8]

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[5] D. Salway, 'Broadband as an Economic Driver', About.Com, http://broadband.about.com/od/economicdevelopment/a/Broadband-As-An-Economic-Driver.htm, May 2012.
[6] http://www.itif.org/
[7] J. Tessler, 'Broadband Funding in Stimulus Plan Sparks Debate', *USA Today*, http://www.usatoday.com/tech/news/2009-02-06-broadband-funding_N.htm, 6 February 2009.
[8] R. W. Crandall, L. William, and L. Robert,'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.

- 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."[9]
- 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 substantial cumulative gain over the next 10 years compared to what could be expected under business as usual conditions."
- Hasset and Shapiro's study indicates broadband access resulted in "$1,019.2 billion in value added for the American economy, equal to 5.9 percent of U.S. GDP" in 2014."[10]
- **For every $1 million granted for broadband development, 15 jobs would be created**.

In order to accelerate the availability of broadband options within south central Colorado communities, community investments in infrastructure is vital. Similar communities have found if they collaborate with local private sector providers in order to provide "model" service levels, it will encourage private sector providers to offer subscriber packages similar to national averages. Thus, it will boost the region's competitiveness for vital mainstay economic sectors such as education, healthcare, business and agriculture.

BROADBAND VALUE TO EDUCATION

Technology has opened a world of possibilities to students in rural areas through the establishment of virtual schools and elite online summer courses such as those offered by

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http://www.brookings.edu/~/media/research/files/papers/2007/6/labor%20crandall/06labor_crandall.pdf, July 2007.

[9] N. Czernich, O.Falck, T. Kretschmer, and L. Woessman, 'Broadband Infrastructure and Economic Growth', CESIFO Working Paper, http://www.cesifo.de/pls/guestci/download/CESifo%20Working%20Papers%202009/CESifo%20Working%20Papers%20December%202009/cesifo1_wp2861.pdf, December 2009.

[10] K.A. Hassett and R.J.Shapiro, 'The Impact of Broadband and Related Information and Communications Technologies On the American Economy', Internet Innovation Alliance, http://internetinnovation.org/images/misc_content/Report_on_the_Economic_Impact_of_Broadband_-_Hassett-Shapiro_-_Rev_-_March_23_2016.pdf, accessed 20 May 2016.

Harvard and MIT. The amount of high school students that have taken some form of a distance education course doubled between 2003 and 2012 (16% to 32%). In fact, some estimates are as high as 25% of current high school students take at least one course online and 13% are enrolled in a virtual (online) school.[11] Even the traditional classroom structure with the powerful impact of a teacher interacting face-to-face with students – find augmented courses are the norm with online resources. For example, most textbooks come in a digital format and include additional assignments, tests and hands-on scenarios leading to overall greater preparation to succeed in the course. Teachers also leverage electronic communication methods to increase parent participation and boost student engagement.

The Education Commission of the States has explained "we are expected as students to utilize the internet for assignments and research...for those students that live in areas with very low access to these high speeds, they may not be able to do things like participate in online current chats or classroom discussions, or downloading videos or presentations or [deliver] presentations for that matter."[12]

Broadband enables educational applications for students, parents, and professionals. According to the March 2016 publication *Education Trends of the States*, a universal trend among states indicated two primary obstructions that hinder universal broadband access among the education sector: (1) lack of broadband infrastructure and (2) limited funds to either build the infrastructure or to connect to existing infrastructure. Unfortunately, the lack of access tends to be a rural issue since 53% of rural residents lack broadband access compared to 8% of their urban counterparts. Figure 6 reveals the results of a 2009 survey conducted in Colorado. The survey demonstrated the need for broadband for currently available educational services:

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[11] L. Sisneros and B. Sponslet, 'Broadband access and implications for efforts to address equity gaps in postsecondary attainment', *Education Trends of the States*, March 2016, http://www.ecs.org/ec-content/uploads/Broadband-access.pdf, accessed 15 June 2016.

[12] J. Brudin, 'High-Speed Internet Disparities Hurt College Chances Study Finds', Colorado Public Radio, 04 April 2016, https://www.cpr.org/news/newsbeat/high-speed-internet-disparities-hurt-college-chances-study-finds , accessed 15 June 2016.

K-12 Bandwidth Application and Software Analysis

Model Basis

250 Students; 12 Teacher/Admin; 260 Computers; 12 VoIP Phones; 10/100 Ethernet LAN

Dynamic Use - 260 Computer Users using one or more Applications simultaneously across LAN and Internet

Application *	Per User*	One T-1 (1.5 Mbps)	Two T-1s (3 Mbps)	Four T-1s (6 Mbps)	10 Mbps Ethernet	20 Mbps Ethernet
VoIP	50 kbps	Full Functionality	Full Functionality	Full Functionality	Full Functionality	Full Functionality
Email and Web Browsing	50 kbps	Full Functionality	Full Functionality	Full Functionality	Full Functionality	Full Functionality
Audio Streaming (MP3)	100 kbps	Problematic	Full Functionality	Full Functionality	Full Functionality	Full Functionality
School Portal	100 kbps	Problematic	Problematic	Full Functionality	Full Functionality	Full Functionality
Student Created Content	150 kbps	Unable to utilize with concurrent users	Problematic	Full Functionality	Full Functionality	Full Functionality
Online Learning	150 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Problematic	Full Functionality	Full Functionality
Virtual Field Trips	150 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Problematic	Full Functionality	Full Functionality
Web/School 2.0 Tools	250 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Full Functionality	Full Functionality
Online Assessment	250 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Full Functionality	Full Functionality
TV-Quality Streaming Video (320 x 240)	250 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Full Functionality	Full Functionality
Interactive Video at a Desktop Standard Definition Good Quality	250 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Problematic	Full Functionality
DVD Quality Streaming Video (640 x 480)	1040 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Problematic	Full Functionality
1/2 HD Quality Streaming Video (1024 x 720)	4977kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Full Functionality
H.264 HD (1080 P) Video Conference	6000 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Problematic
Full HD Quality - Streaming Video (1920 x 1080)	13998 kbps	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Unable to utilize with concurrent users	Problematic

KEY

- Full Functionality
- Problematic
- Unable to utilize with concurrent users

Figure 6: Broadband Use for Current K-12 Applications

As technology continues to develop, the need for broadband to support education becomes ever greater. Colorado's schools have moved to online core curriculum testing. The Partnership for Assessment of Readiness for College and Careers (PARCC) has released its "Technology Guidelines for PARCC Assessments: Version 3.0"[13] In the guidelines, PARCC recommends 100 Kbps per student or faster connections or about 1 Mbps per 10 students. Using the connection speeds defined in "Figure 6: Broadband Use for Current K-12 Applications", schools could simultaneously test as follows:

Speed	Simultaneous Tests
One T1 (1.5 Mbps)	15
Two T1s (3 Mbps)	30
Four T1s (6 Mbps)	60

[13] Partnership for Assessment of Readiness for College and Careers, 'Technology Guidelines for PARCC Assessments: Version 3.0', Partnership for Assessment of Readiness for College and Careers, September 2013, http://www.parcconline.org/sites/parcc/files/TechnologyGuidelinesforPARCCAssessmentsV3.0Sept2013.pdf, accessed 9 May 2016.

Speed	Simultaneous Tests
10 Mbps Ethernet	100
20 Mbps Ethernet	200

Table 3: Simultaneous School Assessment Tests by Bandwidth

The nation's schools suffer from inadequate internet access and IT training. While there has been a general growth in broadband access, approximately 13.6 million people in rural areas lack access to fixed broadband service and a whopping 41% of schools nationwide still do not meet the minimum bandwidth of 100 Mbps for every 1,000 students.[14] The good news is that 77% of school districts within the U.S. meet 100 kbps per student as of late 2015 compared to 30% in 2013.[15] For most, access is too slow with insufficient bandwidth to allow creative and expansive online learning, such as video conferencing or collaborative work. Schools with constrained bandwidth have limited options for classroom use of IT applications such as streaming video. The Benton Foundation explains:

Distance learning over broadband is a distant dream. Online curricula is offline. Teachers are insufficiently trained to use technology in their classrooms, so that whatever technology is available to them languishes. Students are taught the basic 3 Rs, as required by the No Child Left Behind Act, but not the digital skills that will enable them to translate those 3 Rs into success in today's Information Age.[16]

Many schools are using the internet to expand course offerings. For instance, in Greenville, South Carolina, students are enrolling in an online Latin course taught by a teacher at another district school. The Kahn Academy leverages internet access so every student has access to courses and educational material regardless of physical location. Elsewhere, students can use the internet to take higher level or better-quality courses than those available at their home schools. The internet helps break down the walls of the classroom, allowing students to participate in remote classes and in virtual field trips. Students are going online and "touring the Smithsonian National Air and Space Museum, experiencing a tribal dance in Africa, or scouring the depths of the Pacific Ocean in a submarine." Multiple colleges within the United States are offering free courses to anybody with computer and internet access. For the first time in history, U.S. students were able to hear firsthand (in real time) from those that

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[14] J. Eggerton, 'FCC: Fixed Broadband Still Falls Short', *Multichannel News*, 37:2, January 11, 2016, pp. 4.

[15] '77% of U.S. school districts', Investors Business Daily, November 20, 2015, pp. A02

[16] J. Rintels, "An Action Plan for America: Using Technology and Innovation to Address our Nation's Critical Challenges: A Report for the new Administration from the Benton Foundation', Benton Foundation, 2008, http://benton.org/sites/benton.org/files/Benton_Foundation_Action_Plan.pdf., accessed 9 May 2016.

experienced the Haiti earthquake rather than through news outlets or textbooks. Users are exploring the digital archives at the Library of Congress and collaborating with students, professors, and government officials in other states and around the world.[17]

According to the "America's Digital Schools 2008", 37% of school districts anticipate a problem obtaining sufficient bandwidth and the majority have implemented policies to conserve bandwidth by limiting student internet use.[18] Nonetheless, it is expected that students are already be proficient with using the internet by the time a student enters college, leaving many children at an educational disadvantage. Employer hubs look at technology proficiency of a workforce to aid in determining if skilled employees are available to meet their needs or if there is a labor shortage.

Schools in the San Luis Valley depend on distance education. Most school districts in the region share resources for language and advanced placement classes. Accelerated students depend on distance education access to college courses to meet their needs.

Furthermore, true broadband can enhance businesses because they can offer robust training and onboarding programs to their employees that, in turn, improve employee retention rates and satisfaction. More professional registrations and certifications are offered in "online only" or as "computer adapted" formats. Therefore, professionals without access to the variety of online practice tests are inherently at a disadvantage. Full-scale broadband brings critical training resources together with those in need of the training more often and in more ways than can be imagined.

Outside of traditional classroom environments, broadband enables adult continuing education and professional development by bringing instructors and students together without travel costs. The several "Closing the Digital Divide" projects implemented in south central Colorado demonstrate the importance of this alternative education. The "digital divide" would widen and create inequities if these projects do not move forward. Connecting traditionally underserved rural areas to broadband access will allow rural communities to become competitive with their urban counterparts.

BROADBAND VALUE TO HEALTHCARE

The US healthcare system is expensive, overburdened, and inefficient. In 2006, national healthcare costs grew 6.7% to $2.1 trillion, or $7,026 per person, and accounted for 16% of

[17] J. Rintels, 'An Action Plan for America: Using Technology and Innovation to Address our Nation's Critical Challenges: A Report for the new Administration from the Benton Foundation', Benton Foundation, 2008, http://benton.org/sites/benton.org/files/Benton_Foundation_Action_Plan.pdf, accessed 9 May 2016.
[18] T. Greavesand J. Hayes, 'America's Digital Schools 2008: The Six Trends to Watch', The Greaves Group, The Hayes Connection, 2008, http://www.schooldata.com/pdfs/ADS08_intro.pdf, accessed 9 May 2016

gross domestic product (GDP). Projections indicate similar growth will continue past 2017 at which point healthcare will account for nearly 20% of GDP. Inappropriate reliance on costly hospital emergency rooms, which are often sought after traditional office hours or in communities with a shortage of physicians, are attributed to some of this expense. In fact, over half (55%) 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.

The Colorado Office of Economic Development and International Trade report the two largest healthcare employment centers within the San Luis Valley are SLV Health and the Rio Grande Hospital. Internet access can improve sharing of patient information to form a holistic and comprehensive medical team regardless of where the patients and medical network are located. Broadband technology can dramatically reduce these expenses by providing the tools that remotely monitor patients, allow collaboration between healthcare professionals, facilitate the transfer of healthcare data (including images), and increase access to emergency services in remote areas. By one estimate, these services can lead to nationwide savings of $165 billion per year.[19] "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, instant access to medical personnel through video, and otherwise improving efficiencies in service. This was acknowledged during the San Luis Valley Listening tour held in 2015 and further elaborated that rural communities, such as the Valley, healthcare service providers struggle to meet the senior's desire to "age in place."

BROADBAND VALUE TO FARMING/RANCHING/AGRICULTURE

To start our look at broadband and agriculture, let us reference data from the USDA's Economic Research Report titled "Broadband internet's Value to Rural America".[20]

Agriculture is a business sector that benefits from the internet. For farm operators with internet access in 2000, 98% used it to gather information. Price tracking (82%) was the next most common application.[21] The Colorado Office of Economic Development & International Trade

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[19] Rand Health, "Extrapolating Evidence of Health Information Technology Savings", 2005, cited in Rand Health, 'Upgrade America's Health Care System: Pass Health IT Legislation Now', Business Roundtable, 2005, http://businessroundtable.org/sites/default/files/BRT_Hill_Event_Brochure_Split-10-13.pdf, accessed 9 May 2016....

[20] P. Stenberg et al.,'Broadband Internet's Value to Rural America', USDA, August 2009, http://www.ers.usda.gov/publications/err-economic-research-report/err78.aspx, accessed 9 May 2016.

[21] J. Hopkins and Mitch Morehart, 'Farms, the Internet, & E-Commerce: Adoption and Implications', *Agriculture Outlook*, Nov 2001, pp. 17-20.

lists agriculture and associated products as one of the top assets within the San Luis Valley. In fact, the San Luis Valley is known as the heart of potato country and ranked 5th in the United States for production. Approximately 92% of all the potatoes grown in Colorado come from the San Luis Valley.[22] That is enough potatoes to feed up to 19 million people each year. A whopping 90% of potatoes grown in the Valley are for the fresh market. There are more than 160 potato farmers in San Luis Valley as of 2014, with the largest employer being Mountain King Potatoes. J. Ehrlich further explains that "market prices fluctuate but the typical annual value of the potato crop ranges between $180 and $220 million, with the cumulative impact on the region estimated at three times this value." San Luis Valley's next largest crop is lettuce. San Luis Valley also has the claim to fame with the first successful quinoa crop produced in the United States. Quinoa has been a produced commercially since 1987 but the first crop was grown in 1982. The legalization of marijuana has opened the door for new agricultural operations in the Valley.

Horticulture and other specialty farm products are increasingly sold direct to households because of e-commerce growth. There are multiple farm food cooperatives within the San Luis Valley region where consumers partner with local farms. An example is the Valley Food Cooperative. E-commerce has increased efficiencies in existing relationships along the food marketing chain, reduced the cost of expanding market area, and brought about new services such as supermarket home delivery and direct-to-consumer sales.[23]

Not all types of agricultural production lend themselves readily toward direct sales from producer to consumer. Some crops must be packaged before they can be sold to the consumer. Potatoes are one of these crops and there are multiple packaging sheds located throughout the valley. Ehrlich estimated that 600 jobs were tied to the potato industry not including seasonal jobs associated with planting and harvesting. Internet adoption among the supply chain boosts productivity within the potato industry of the Valley. Wholesale and retail food industry has also enhanced its productivity with internet adoption.[24] San Luis Valley is a large producer of

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[22] J. Ehrlich, 'Hidden Treasure in the San Luis Valley', *Colorado Business Review,* 81, 4, 2015, pages 6-7, http://www.colorado.edu/business/sites/default/files/attached-files/cbr_november_2015.pdf, accessed 15 June 2016.

[23] J. Kinseyand B. Buhr, 'E-Commerce: A New Business Model for the Food Supply/Demand Chain', Working Paper 03-01, The Food Industry Center, University of Minnesota, February 2003.

[24] J.T. Akridge, 'E-Business in the Agricultural Input Industries', *Review of Agricultural Economics*, 25:1, 2003, pp. 3-13.

F. Beurskens, 'The Economics of Dot.coms and E-commerce in the Agrifood Sector', *Review of Agricultural Economics,* 25:1, 2003, pp. 22-28.

J. Henderson, F. Dooley, and J. Akridge, 'Adoption of E-Commerce strategies for agribusiness firms',2000, http://www.ebscohost.com, accessed 9 May 2016.

barley for the alcoholic beverage industry and feed (hay) for dairy cows.[25] These industries rely on the internet to manage their supply chain and quality control.

Respondents to the 2007 Agricultural Resources Management Survey (ARMS) were asked if they had internet access and if it was "high-speed." A majority of farms (63%) reported using the internet in their farm business (see "Figure 7: Distribution of Farms and Value of Farm Production by internet Use"). Among those using the internet, the predominant access method was broadband and this group of users accounted for over 60% of US farm production.

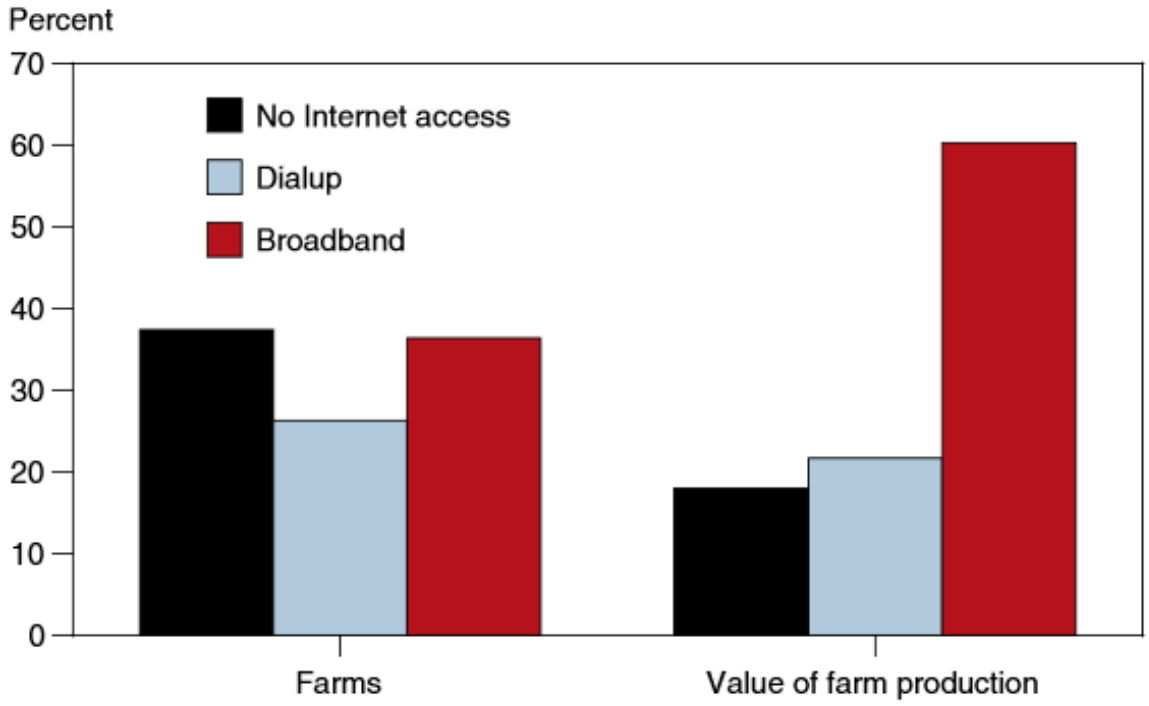

Figure 7: Distribution of Farms and Value of Farm Production by internet Use

On farms with no internet use, roughly a third of spouses reported working off-farm, compared to more than 50% of those that used the internet. On the one hand, off-farm employment may provide a diversified income stream and exposure to internet technologies, instigating home or

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S. Stricker, D.A. Sumner, and R.A.E. Mueller, 'Wine on the Web in a Global Market: A Comparison of E-Commerce Readiness and Use in Australia, California, and Germany'. Paper presented at the EFITA 2003 Conference,5-9 July 2003.
D. Zilberman, M. Metcalfe, and A. Heiman, 'Economics and Adoption of Information Technology with Evidence from California'. Paper for the Card E-Commerce research mini-conference, 9 February 2002.

[25] OECD, 'Region 8 Strategic Summary,' Regional Strategies 2.0 [website], Colorado Office of Economic Development & International Trade, http://www.advancecolorado.com/blueprint/regional-strategies-20/region-8, 2015.

farm adoption. The type of agricultural use of a property may also play a role in predicting off-farm employment. In some cases, a spouse who works off the farm may indicate financial stress and lesser wherewithal to invest in farm-specific internet use. Households with school-age children tend to have a higher awareness of the internet and more demand for bandwidth-intensive applications.[26] In keeping with this, the percentage of farms with school-age children was nearly two times higher in 2007 when internet use was reported than when it was not.

Reviewing agricultural adoption rates:

- Larger farm businesses, as indicated by more hired workers, have a higher probability of broadband internet access.
- Farm households with income above $50,000 have a higher probability of broadband internet access.
- The relative probability of broadband internet use does not increase as the number of providers in an area increases.
- Having school-age children in the household is associated with higher probability of broadband internet use.
- Operators with at least a college degree are more likely to use broadband.
- Farms located in mixed urban/rural areas are less likely to use broadband than those in urban areas.

In our interviews with agriculturalists in the San Luis Valley, we found significant data usage requirements met almost exclusively through cellular data packages. Interview data can be found in the appendix under Section 7.2 Survey Response. Telemetry data for farm implements and irrigation devices depend on cellular broadband packages. Field mapping depends on cellular data. As such, John Deere goes so far as to include an AT&T subscription with all of its equipment.

Broadband is a valuable utility that benefits the region including economic development, education, health care, emergency services, agriculture sectors. The individual resident benefits from broadband access with an improved quality of life.

CURRENT STATE OF BROADBAND IN THE SAN LUIS VALLEY

The current state of broadband in the San Luis Valley is a combination of what really exists and resident's perception of what exists.

[26] A. Grant, E. August., and J. H. Meadows, editors, Communication Technology Update, eighth edition, Woburn, MA: Elsevier Science, 2002.

EXISTING BROADBAND SERVICES

We will look at each broadband characteristic in some detail. “Table 4: San Luis Valley Current State Findings Overview” summarizes our findings.

Available	Availability is unequal through the SLVDRG region with multiple areas having no service and others having choices of multiple broadband options. The majority of addresses have either no fixed line broadband service or a single fixed line broadband choice. Some areas enjoy two or more solutions to choose from. CenturyLink provides wired service that covers at 60 percent (60%) of the SLVDRG area. We also find two smaller ILECs (Jade/Blanca and Fairpoint/Coumbine). Jade/Blanca provides some fiber to the premises and significant fixed wireless services. Fairpoint/Columbine does not offer wireline broadband service. San Luis Valley Rural Electric Cooperative is engaged in deploying fiber to the premises throughout the valley. In addition to the wireline services in the region, we find Jade/Blanca, Colorado Central, and others offering fixed wireless service. These fixed wireless providers offer service through much of the region with varying degrees of success. Some areas have access to two or more fixed wireless options but most only have one. However, there are some significant fixed wireless service gaps. **GOAL:** *Every address in the region should have access to at least two broadband providers.*
Abundant	In some areas, the local incumbent providers have chosen to deploy fiber to the premises providing an abundance of broadband capacity. Other areas are limited to DSL or fixed wireless services. While still other areas have no fixed line broadband service available at all. The needs of business are not being met in many of the population centers. **GOAL:** *Every address in the region should have access to at least one data package that meets or exceeds the current FCC definition of broadband.* **GOAL:** *Business zoned areas should have access to at least one data package that meets or exceeds 100 Mbps download speeds.*

Affordable	Packages in the range of $35 to $45 per month are available in most service areas. $/Mbps/month ranges from $0.75 to $23.33. On average, for a $35 to $45 per month residential package, subscribers will pay: • Wireless: $12/Mbps/month • DSL: $18/Mbps/month • Cable: $9/Mbps/month • Fiber: $6/Mbps/month Subscribers willing to buy more bandwidth (and pay higher monthly fees) usually pay less per Mbps. **GOAL:** *Every address in the region should have access to at least one data package that meets or beats the U.S. average price per Mbps per month.* **GOAL:** *Every address in the region should have access to at least one data package for less than $50 per month.*
Reliable	Multiple stakeholders stated that reliability is a key concern during their. **GOAL:** *Every service provider in the region should interconnect to a Tier 1 or Tier 2 POP on path diverse redundant routes.*
Sustainable	Sustainable broadband development depends on residential and business adoption. Throughout the region, business leaders and economic development teams expressed a need for more capacity, better pricing, and more reliability. In the residential marketplace, we found three prevailing attitudes towards adoption: 1. The internet does not offer enough value to justify the cost. Subscribers do not feel the need to obtain more than a fairly low-cost and low bandwidth package or they feel their cellular data package provides sufficient service at home. 2. Subscribers would love to have better bandwidth but they do not think service is available at their home. Sometimes this understanding, or misunderstanding, occurs in serviced areas. 3. Subscribers find the internet to be very important and will enroll for the fastest affordable package available. The prevalence of the first two attitudes towards adoption suggests broadband development will be difficult to sustain. **GOAL:** *Availability, abundance, affordability, and reliability goals should be achieved without putting significant tax dollars at risk and in such a way that participating private sector providers can maintain reasonable profits.*

Other	Many residents choose to access broadband services through cellular services (either using mobile devices or cellular sharing devices like MiFi). Agriculture – especially farm implements and irrigation systems – depend on cellular services. Because of this, improving cellular service should be considered in broadband development plans. **GOAL:** *Broadband development should contribute to better cellular service and coverage.*

Table 4: San Luis Valley Current State Findings Overview

AVAILABLE SERVICES

Alamosa County	**Pop: 16,496**	
Alamosa (Pop: 8,870)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet Verizon Viaero
Alamosa East (Pop: 1,458)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet Verizon Viaero
Hooper (Pop: 103)	Wireline Fixed Wireless Cellular	Fairpoint/Columbine Amigo Crestone/Colorado Central Jade AT&T Verizon
Conejos County	**Pop: 8,130**	
Antonito (Pop: 781)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet T-Mobile Viaero

La Jara (Pop: 818)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet Verizon Viaero
Manassa (Pop: 991)	Wireless Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet Viaero
Romeo (Pop: 404)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet T-Mobile Verizon Viaero
Sanford (Pop: 879)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Jade AT&T Comnet Verizon Viaero
Costilla County	**Pop: 3,584**	
Blanca (Pop: 385)	Wireline Fixed Wireless Cellular	Jade/Blanca (fiber) Amigo Jade AT&T Viaero
Chama (Pop: 63)	Wireline Fixed Wireless Cellular	 Jade AT&T Comnet Viaero
Fort Garland (Pop: 433)	Wireline Fixed Wireless Cellular	Jade/Blanca (fiber) Amigo Jade AT&T Viaero

San Luis (Pop: 629)	Wireline Fixed Wireless Cellular	CenturyLink Jade/Blanca (fiber) Jade AT&T Viaero
Rio Grande County	**Pop: 11,543**	
Center (Pop: 2,230)	Wireless Fixed Wireless Cellular	CenturyLink Amigo Colorado Central Jade AT&T Verizon Viaero
Del Norte (Pop: 1,705)	Wireline Fixed Wireless Cellular	CenturyLink Jade/Blanca (fiber) Amigo Colorado Central AT&T Verizon Viaero
Monte Vista (Pop: 4,444)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Colorado Central Jade AT&T Verizon Viaero
South Fork (Pop: 604)	Wireline Fixed Wireless Cellular	CenturyLink SLVREC – Ciello (fiber) USA Communications SkyWerx AT&T Comnet Verizon
Mineral County	**Pop: 726**	
Creede (Pop: 290)	Wireline Fixed Wireless Cellular	CenturyLink SLVREC – Ciello (fiber) Amigo Comnet
Saguache County	**Pop: 6,251**	
Bonanza (Pop: 16)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Comnet

Center (Pop: 2,230)	Wireline Fixed Wireless Cellular	CenturyLink Amigo Colorado Central Jade AT&T Verizon Viaero
Crestone (Pop: 127)	Wireline Fixed Wireless Cellular	Fairpoint/Columbine Amigo Fairpoint/Columbine Colorado Central AT&T Verizon Viaero
Moffat (Pop: 116)	Wireline Fixed Wireless Cellular	Fairpoint/Columbine Amigo Fairpoint/Columbine Colorado Central AT&T Verizon Viaero
Saguache (Pop: 493)	Wireline Fixed Wireless Cellular	CenturyLink USA Communications Amigo Colorado Central USA Communications AT&T Verizon Viaero

Table 5: Available Services by Community

ABUNDANT/AFFORDABLE

Where available, data packages range from 1.5 Mbps to 150 Mbps (and more in special circumstances). In most cases in the region, subscribers are limited to data packages with slower speeds than the current FCC target of 25/3 Mbps.

The U.S. average price for broadband is $55 per month for an average connection speed of just over 15 Mbps download. This results in an average cost of $3.50 per Mbps. San Luis Valley residents pay from $0.50 to $28.66 per Mbps. Most wireline subscribers in the region pay about the $55 national average for data packages of about 7 Mbps. This translates into an average cost of $7.86 per Mbps per month. Thus, even though regional subscribers are paying about the same price each month as the national average, they are getting about half the value. For those

who only have the opportunity to subscribe to fixed wireless service, the price per Mbps per month is closer to $10.

	Packages	$/Mbps/month
Amigo (Simply Broadband) Wireless	1.5: $30	**$20.00/Mbps/month**
	3: $45	**$15.00/Mbps/month**
	10: $60	**$ 6.00/Mbps/month**
CenturyLink DSL	DSL	
	1.5/.896: $42.99	**$28.66/Mbps/month**
	7/.896: $52.99	**$ 7.57/Mbps/month**
	12/.896: $62.99	**$ 5.25/Mbps/month**
	20/.896: $72.99	**$ 3.65/Mbps/month**
	20/5: $77.99	**$ 3.90/Mbps/month**
	40/5: $112.99	**$ 2.82/Mbps/month**
	40/20: $122.99	**$ 3.07/Mbps/month**
Charter	Cable	
	Up to 60 Mbps: $64.99	**$ 1.08/Mbps/month**
Colorado Central Wireless	Business	
	4/1: $54.95	**$11.24/Mbps/month**
	8/1.5: $79.95	**$ 9.99/Mbps/month**
	12/2: $99.95	**$ 8.33/Mbps/month**
	Residential	
	4/1: $44.95	**$13.33/Mbps/month**
	8/2: $69.95	**$ 8.74/Mbps/month**
	12/2: $89.95	**$ 7.50/Mbps/month**
Fairpoint	DSL	
	4 Mbps: $64	**$16.00/Mbps/month**
	7 Mbps: $69	**$ 9.86/Mbps/month**
	12 Mbps: $74	**$ 6.17/Mbps/month**
	15 Mbps: $79	**$ 5.27/Mbps/month**
Jade/Blanca Wireless Fiber DSL	Blanca DSL/Fiber Jade	
	Wireless/Fiber	**$ 8.00/Mbps/month**
	5/1: $39.99	**$ 5.00/Mbps/month**
	10/1: $49.99	**$ 3.00/Mbps/month**
	20/2: $59.99	**$ 1.00/Mbps/month**
	100: $99.99	
SLV REC/Ciello Fiber	Residential	
	10: $39.95	**$ 4.00/Mbps/month**
	50: $64.95	**$ 1.30/Mbps/month**
	100: $84.95	**$ 0.85/Mbps/month**
	1000: $129.95	**$ 0.13/Mbps/month**
	Business	
	25: $59.95	**$ 2.40/Mbps/month**
	100: $89.95	**$ 0.90/Mbps/month**
	1000: $499.95	**$ 0.50/Mbps/month**

Table 6: Data Package Pricing

The pricing in "Table 6: Data Package Pricing" generally does not reflect bundles or special pricing. In all cases, we tried to find standard data only pricing.

RELIABLE

A key factor driving reliability is path diversity and redundancy of the middle mile. The region has multiple middle mile carriers. Most providers in the region take advantage of path diversity and redundancy capabilities made possible by multiple middle mile paths.

PROJECTS COMPLETED IN SAN LUIS VALLEY

There have been multiple projects completed in an effort to improve reliability and performance of internet service within the San Luis Valley region. Additional project information is located in the appendix beginning on page lxv.

MULTI-USE NETWORK (MNT) AND THE NEXT MILE PROJECT

The Multi-Use Network (MNT) was initiated in the late 1990s to develop the foundation of a fiber optic broadband network so the state of Colorado could be connected. MNT was first piloted in the San Luis Valley and ushered in connected E911 services and GIS development services. This project was so successful that it allowed similar projects to be adopted and implemented statewide by the Colorado Rural Council. The goal of the "Next Mile" project was to connect all 64 county courthouses to the statehouse. It was recognized that sharing of information between governmental agencies would enhance the level of service they could provide citizens. As of 2002, the portion of the network connecting the telephone hubs with the individual courthouses was completed. The fiber network connecting the statehouse via a regional network was the missing remnant. DOLA came through in 2003 with funding and actively sought projects that would connect rural Colorado to broadband. The SLVDRG summarized the purpose of MNT and the Next Mile Project as "instantaneous and continuous access to information will maximize efficiencies and strengthen our decisions in both the public and private sectors."[27]

SAN LUIS VALLEY RURAL ELECTRIC COOPERATIVE

[27] SLVDRG. 'Data Set Infrastructure & Utilization – The Key To Success in the 21st Century', http://www.slvdrg.org/files/White_Paper.pdf, accessed 15 June 2016.

The San Luis Valley Rural Electric Cooperative (SLVREC) initiated a pilot project that constructed a fiber optic network towards the Plaza area and would offer 20 residences another broadband service option.[28] This pilot project spawned additional projects in South Fork and Creede.

EAGLE NET

Eagle Net is a local government partnership for the purpose of creating a reliable middle-mile network connecting public schools and community anchor institutions. The funding came from both federal grants and CenturyLink's CAF. Figure 31 in the appendix shows the existing and planned network for the San Luis Valley.[29]

EAGLE-Net is a local government co-operative designed to create a middle-mile fiber network connecting Colorado's 178 public school districts and other community anchor institutions like hospitals. Most of the San Luis Valley has been connected. The San Luis School District, Creede School District, North Conejos School District, Sanford School District, Costilla County Public Library, and Trinidad State Junior College are listed as future projects under development.

ALAMOSA COUNTY PROJECTS

The following broadband projects have been completed for Alamosa County:

- Fiber path from Alamosa to Salida also exists for E-911 and other emergency connections.
- CenturyLink has completed a redundant route over Poncha Pass, the north gate to the Valley, up through the Granite area, and out to the I-70 corridor. CenturyLink uses ROADM technology in the area that allows capacity to be doubled.
- SLVREC deployed a fiber optic base telecommunications network throughout the San Luis Valley from the central portion of the Valley west beyond Creede in Mineral County, north to Poncha Pass, south to the New Mexico state line, and east to Fort Garland in Costilla County. Dark fiber has also been laid in some areas.
- Blanca Telephone has completed a fiber optic route over La Veta Pass, the Valley's east gate, and is researching a southern route out of the Valley.
- Viaero Wireless has a radio shot into the Valley over La Veta Pass.
- A microwave radio shot by Skywerx deployed over Wolf Creek Pass, the Valley's west gate, that serves Crestone Telephone and Adams State University.

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[28] San Luis Valley Electric Cooperative, 'Telecom and Fiber Optics Update', *The Newsboy,* August 2014, page 2, http://www.slvrec.com/sites/slvrecslvrec/files/newsboy/AugustNewsboy2014.pdf , accessed 15 June 2016.

[29] Eagle Net,'EAGLE-Net Network Map', http://www.co-eaglenet.net/btop/map/ , 30 June 2014, accessed 15 June 2016.

- The CRTP project provided wireless T1 connections to San Luis and Antonito.
- The National Science Foundation provided wireless equipment to the Monte Vista School District.
- Free on-site technical assistance and workshops are also being provided to local libraries throughout the Southwest Regional Library Service System.
- SLVREC expanded services from Del Norte to South Fork in 2015.
- ChileRoute.com LLC,) built a mutually redundant physical path connection to the Internet.

COSTILLA COUNTY PROJECTS

The following broadband projects have been completed for Costilla County:

- Fiber path from Alamosa to Salida also exists for E-911 and other emergency connections.

RIO GRANDE COUNTY PROJECTS

The following broadband projects have been completed for Rio Grande County:

- Rio Grande county recently received a BTOP grant that will connect and improve internet services at the Monte Vista Carnegie Public Library and Carnegie Library South Fork Branch.[30]

SUSTAINABILITY

Sustainability is a key issue for broadband development in San Luis Valley for two reasons: population density and adoption patterns.

First, the population density is low. The business case for the capital expenditures required to significantly improve broadband in low population density areas is difficult.

Second, poor service and the associated "halo" effect in some areas diminish adoption in south central Colorado. In short, people hear that the internet service is bad or is not valuable. They

[30] Colorado Department of Education, 'Library Use of Grant Funds', https://www.cde.state.co.us/sites/default/files/documents/cdelib/btop/download/pdf/libraryuseofgrantfunds.pdf , accessed 15 June 2016.

then believe this message and choose either not to subscribe at all or to subscribe to a broadband alternative like a cellular data package.

The economic standing of much of the region further exacerbates broadband development sustainability. Sustainability will be out of reach unless public perception is changed and service is improved.

HOW DO WE CLOSE THE GAPS

There are many proactive actions a community can adopt to improve broadband access. Previous sections explained the need for broadband access, state of the existing infrastructure and overall goals. This section will address specific paths forward that culminate in recommendations for south central Colorado.

BROADBAND DEVELOPMENT PRINCIPLES (METRICS FOR ALTERNATIVE COMPARISON)

Generally, communities considering public broadband development should do so based on principles. Four key guiding principles many communities have used are:

- A public sector solution should be open access and offer wholesale services to all qualifying service providers; it must be **open and wholesale.**
- A public sector solution should offer **carrier-class** security, functionality and reliability.
- A public sector solution should offer **high scalable bandwidth.**
- A public sector solution should be based upon an **open and independent architecture.**

These principles may not all be adopted based ECCOG circumstances but they provide the foundation for evaluating possible broadband development options. Each of these principles will be discussed in more detail within the subsections below before we discuss specific alternatives to improve broadband access within the south central Colorado region.

OPEN AND WHOLESALE PRINCIPLE

Monopolization is detrimental to competition and consumers. Evidence suggests that monopoly and duopoly constraints have played a large role in creating the average broadband environment found in the U.S. today, including south central Colorado. If monopoly business models are responsible for the inadequate current state, it does not make sense for municipalities to trade one monopoly (the regulated private monopoly) for another (a public sector monopoly) by deploying a closed broadband infrastructure. Philosophically, cities should be averse to creating a monopoly system and should shun the idea of delivering services themselves. Rather, the focus should follow a traditional municipal role by providing infrastructure. The actual delivery of services would be left to competing private service providers without constraining the number of entrants that are qualified to serve the market. This model ensures that publicly owned infrastructure is available to a wide variety of competing private firms for the delivery of goods and services.

While this open and wholesale model seems to fit logically with the traditional role of governments, it can be difficult to adhere to this model in practice. Masha Zager, Editor of Broadband Communities Magazine, compiled a list of 135 municipal projects in the May/June 2013 issue.[31] In Zager's list, only 34 of the 135 projects are designed to support multiple competing service

An analogy may help illustrate the concept of an open and wholesale network: When cities realize the need to build a municipal airport, they often form an Airport Authority. That organization exists for the sole purpose of building and operating the municipal airport. The Authority builds runways and structures, but it does not fly the airplanes. Instead, private airlines use the infrastructure and compete for retail ticket sales. Because the high cost of the airport is spread over multiple airlines using the facility, the cost to use the airport becomes much lower than if each airline had to build its own airport.

When an airline sells tickets to passengers, the cost of the ticket covers runway fees, gate fees, and other Airport Authority assessment costs associated with airlines use of the airport. These fees operate the airport and pay the debt used to finance its construction. The Airport Authority does not charge customers any of the fees or sale tickets. Instead, the airlines are the Authority's first line customers. The arrangement allows the airlines to compete against each other, not against the Airport Authority. This competition helps airlines focus on things like value and services rather than on maintenance of the airport. This benefits customers because airlines become innovative in their approaches to win and keep customers.

Similarly, in the public open access network model, municipalities build and maintain the broadband infrastructure, but they do not engage in selling services to the end-user.

(continued)

[31] See http://www.bbpmag.com/2013mags/may-june/BBC_May13_MunicipalNetworks.pdf

providers. Arguments for pursuing a vertically integrated model usually revolve around the financial implications of a wholesale/retail split. As the argument goes, price differentiation opportunities are limited in a wholesale model so the network owner has little maneuvering capability to compensate for revenue shortfalls. Further, the argument continues, the inefficiencies associated with multiple organizations running the same business consume too much of the thin margins available. However, Anupam Banerjee and Marvin Sirbu of Carnegie Mellon University demonstrated these arguments are invalid. In their 2006 paper, "FTTP Industry Structure: Implications of a Wholesale Retail Split", they conclude:

In spite of interfering with a wholesaler's ability to price discriminately, a wholesale-retail split is economically feasible. A wholesaler can recover its cost and as long as a significant number of homes do not have a zero willingness to pay for broadband data service, a wholesaler is almost as profitable as a vertically integrated entity.[32]

Changing the broadband delivery model from one that favors current monopoly players to one that enables competition seems like an important policy objective. A core principle guiding municipal broadband selection is implementing a model that allows for a wholesale/retail split, a model that separates the natural monopoly element of broadband delivery from the competitive aspects of the services.

Rather, they open the infrastructure to private service providers. Ideally, multiple service providers compete with each other for market share. The broadband service providers are the first line customers of the municipal network owners. In this model, the private sector still owns the relationship with the end-user subscribers and is able to focus on their service offerings since they no longer have to worry about maintaining the infrastructure. This stimulates innovation as providers seek to differentiate themselves from one another and it helps ensure that prices remain at an appropriate market level driven by competition. Additionally, since government entities can secure lower interest rates and longer terms than private industry, the cost of debt service is lower than what it would be for private network infrastructure deployment. These cost savings benefit the service providers who end up paying lower access fees. Since their overhead is lower, service providers can price their services at lower retail rates or use free revenue for research and development that will benefit the end user.

When a community realizes they need an airport to stimulate economic development and improve quality of life, they do not call up the airline and ask them to "please build runways in their town." Rather, they build an airport. When a community recognizes the need for improved broadband to achieve the same objectives, they should not be forced to call the private network owners and try to get them to meet public policy objectives. Rather, they should be able to build a network.

CARRIER CLASS PRINCIPLE

[32] See http://repository.cmu.edu/tepper/447

"Carrier-class" is a vague term. The PC Magazine online encyclopedia defines it as "…hardware and software used in large, high-speed networks. It implies [the hardware and software are] extremely reliable, well tested and proven. Telephone companies, major ISPs, and large enterprises purchase carrier-class equipment."[33] In their 2007 article "Carrier-Grade: Five Nines, the Myth and the Reality", Wedge Greene and Barbara Lancaster conclude, "Carrier-grade is actually an intangible expectation and explicit promise that the equipment vendors will provide the best equipment possible and a clear, immediate communication of issues related to equipment. And that service providers will also provide the best network possible to their customers and keep a clear and immediate communication channel open concerning service impacting situations. And lastly that the supply chain communication is two-way, with feedback from the buyer going to the provider so they gauge and support continuous improvement."[34] Brocade Networks' 2009 article "What is Carrier Grade Ethernet"[35] helps refine the overall understanding of what a carrier grade network is by defining five attributes carrier-grade Ethernet must possess: (1) standardized services, (2) scalability, (3) reliability, (4) quality of service, and (5) service management. Brocade Networks' focus is on Ethernet, which proves to be relevant as 21st century networks tend to be packet based Ethernet or Ethernet-like networks.

In a 2001 white paper titled, "Carrier-Class Ethernet: A Services Definition",[36] Appian Communications defines carrier-class Ethernet around the services the network can deliver. Their definition included:

a. Granular, SLA-managed bandwidth guarantees.
b. Rapid service activation even on demand.
c. SONET/SDH resilience and manageability.
d. Services that span the metro and regional area.
e. High-speed migration for current data services.
f. Simple strategy to sell new services and expand subscriber services.
g. Integration with existing TDM services.
h. Greatly reduced operating and capital costs.

[33] http://www.pcmag.com/encyclopedia_term/0,1237,t=carrier+class&i=39298,00.asp
[34] Greene, Wedge and Barbara Lancaster (18 March 2007). "Carrier-Grade: Five Nines, the Myth and the Reality." LTC International – published in Pipeline Magazine in April 2007.
[35] Brocade Communications Services (2009). "What is Carrier Grade Ethernet?" Brocade Communications Systems.
[36] Appian Communications (2001). "Carrier-Class Ethernet: A Services Definition." Appian Communications White Paper.

The fundamental concept underlying each of Appian Communications' services is the ability of service providers to increase revenues by reliably offering new packet driven services to meet demand while simultaneously controlling costs.

Fundamentally, carrier-class suggests those attributes required to enable a service provider to offer customers reliable professional services. Carrier-class consists of attributes that Wedge and Lancaster call "intangible" and that Brocade Networks and Appian Communications try to enumerate. The purpose of these attributes are to focus on improving and maintaining reliability, capacity, security, flexibility, and other features that service providers rely on from the network to deliver services to subscribers. From the smallest start-up to global giants with international reputations, each is willing to entrust those reputations to the network only if they are confident the network meets carrier-class expectations. From the physical design to the operational model, the network must deliver exceptional performance and offer absolute security.

Therefore, while "carrier-class" may not be easily defined or readily measured, it is mandatory pre-requisite for municipal open access network projects.

Market research supports this seemingly obvious requirement as a guiding principle. Scientifically administered surveys (including SRI surveys) determined which specific characteristics were required in order for successful implementation of municipal networks. In nearly every case, the number one or two concern for businesses and residents alike is "reliability"; the other is "speed."

HIGH SCALABLE BANDWIDTH PRINCIPLE

Municipal networks must meet the carrier-class demands of multiple service providers simultaneously to sufficiently meet the first two principles. In other words, they have to be capable of reliably and securely delivering all the current services available as well as higher-bandwidth consuming future services from all service providers on the network. Thus, the system has to start out with tremendous bandwidth capacity and be able to grow larger still. In a way, this is a requirement to make the system "future proof," meaning that it is capable of adapting to new and emerging technologies that otherwise might make the investment obsolete.

Other sectors incorporated the value of this principle into their foundation. When the railroad was expanding, "whistle stop" communities had an advantage over those bypassed completely. Cities with the ability to support multiple current and future services will have economic, as well as quality-of-life, advantages over other communities. Further, this principle ensures that the investment made today will not become outdated. The system must be designed to scale in order to meet future demands.

Many incumbents argue that the bandwidth they provide is more than adequate and they will upgrade their services as soon as the market demands it. This argument is eerily similar to the one Henry Ford made when he said of the Model-T in 1909, “Any customer can have a car painted any color that he wants so long as it is black.” More germane to the current discussion is the flood of telephone styles that came to market after AT&T abandoned their telephone device monopoly. Prior to allowing competing handsets, AT&T claimed that the market did not demand anything other than the traditional black cradle phone. In the case of bandwidth, like with colors of automobiles and styles of phones, greater availability creates greater demand. As previously discussed, subscribers are already limiting their use due to lack of capability of the network rather than their preferences. The example discussed previously of schools limiting student access to websites, limiting integration of technology into the educational process and limiting educator access to tools available displays the reality of the current state of limited broadband access.

What allegorical black Model-T’s and cradle phones are today’s equivalents of Henry Ford and AT&T offering U.S. broadband customers in the 21st century?

The Organization for Economic Cooperation and Development (OECD) compares international advertised download speeds among 34 member countries. “Figure 8: Average Advertised Broadband Download Speed by Country” shows the OECD 2011 international broadband speed comparison places the US, with its average advertised download speeds of 27.6 Mbps, at a poor 19th place.

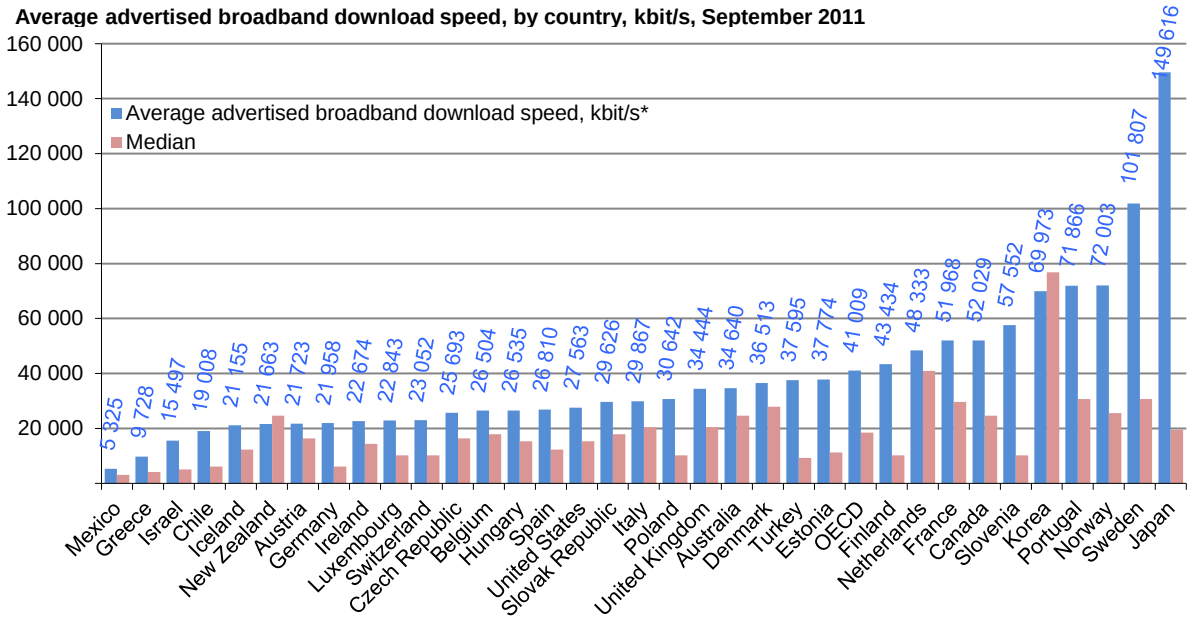

Figure 8: Average Advertised Broadband Download Speed by Country

While current DOCSIS technologies may seem adequate to meet the needs of today needs, the copper based technology limits future growth. Dial-up modems seemed adequate 20 years ago and DSL technologies sufficiently met most consumers' needs 10 years ago. Today's cable infrastructure will eventually reach its limit. The real future of broadband lies in fiber as discussed in Section 2.4 Broadband Infrastructure.

OPEN AND INDEPENDENT ARCHITECTURE PRINCIPLE

While many proprietary solutions could be selected to deliver the first three principles, this fourth principle aims to ensure the efficiencies of the system are always maximized. By requiring solutions to be standards-based and founded on open technologies, municipal open access network owners can "shop around" for the best deals and are not beholden to any one particular company or proprietary invention.

Sometimes proprietary solutions' benefits can outweigh the negatives of diminished choices. However, providers who are actively competing for business and responding to competition with efficient pricing and more innovative solutions offer greater benefits to their customers.

BROADBAND DEVELOPMENT OPTIONS

Four categories of potential action most commonly considered for a regional study such as this one are: continue with the status quo, provide incumbent providers incentives and/or penalties including implementing broadband friendly policies, municipal entry, and/or public-private partnerships. Of course, there are many varieties of each of these options.

COMPARE AND CONTRAST PATHS (ALTERNATIVES)

Status Quo

Status quo development essentially means the current system remains unchanged and may also be called the no-build alternative. Doing nothing means the incumbent private sector providers will continue to install and maintain the necessary infrastructure in order to reach the region's broadband policy objectives. As of today, the status quo has not met the region's objectives. Section 3 discusses the current state of the existing system and provides more details. Furthermore, dependence on the status quo minimizes and hinders the possibility of seeing the desired regional policy objective.

Nonetheless, to do nothing – or to maintain the status quo – is sometimes the most appropriate action if residents and business owners:

a. Are satisfied with broadband in the region.
b. They believe there are other more pressing issues.

c. They believe the existing service providers and the private marketplace will take care of the region's broadband needs without intervention.

However, respondents to surveys have very low desire to maintain the status quo. In fact, it ranked dead last out of the four alternatives. The only alternative that scored lower was "other." Fewer than one in five felt maintaining the status quo was the most appropriate or a somewhat appropriate action.

Does the Status Quo Satisfy the Four Defining Principles?

- **Is the status quo open and wholesale?**
  Not generally. Most incumbent providers protect the use of their infrastructure from use by competitors. Federal regulation requires some "unbundling."
- **Does the status quo result in carrier class deployments?**
  Mostly. Most providers in the region offer carrier class service. Those providers who do not take advantage of existing middle mile redundancy and path diversity suffer from more frequent and more extensive outages than can be considered carrier class.
- **Does the status quo offer high scalable bandwidth?**
  Only to specific target installation.
- **Is the status quo based on an open and independent architecture?**
  Depending on the network owner.

Does maintaining the status quo advance the five broadband quality measures established in Section Two of this report? As discussed in the evaluation of the current state, the status quo has largely failed to produce the broadband quality desired by the region. Some areas have very high quality broadband because of the efforts of the local cooperative. However, as a region, the status quo has not resulted in satisfactory results.

Incentives and/or penalties

Existing (incumbent) service providers can be encouraged to improve access to broadband in the region through incentives and penalties. Some incentives might include access to lucrative government or other community anchor institution contracts, tax breaks or fee reductions, easy access to public rights of way and so forth. The denial of incentives functions as penalties for incumbent providers.

Blair Levin was the program manager responsible for developing the National Broadband Plan. For the last several years, Levin has been arguing that we need to "change the equation" and make it more economical for private companies to develop advanced broadband solutions in our communities. In the Levin model, a community identifies assets it has available (including buying power). The community documents its assets and presents them to the marketplace. By providing assets, the community reduces the costs of broadband development and increases the likelihood that a private provider will build.

The Levin model suggests the community role is to own a small set of assets that are leased or deeded to a private provider, who will then use those assets to develop broadband solutions. The private provider owns other network assets, provides operation and management and offers retail services.

The online survey showed incentives and penalties to be a popular course of action. This alternative ranked second when combining the "most appropriate" and "somewhat most appropriate" responses to the best course of action questions – ahead of government owned infrastructure, maintaining the status quo and other. Incentives and penalties ranked third when looking at the "most appropriate" course of action responses – ahead of maintaining the status quo and other. More than half of respondents felt incentives would be either the most appropriate or a somewhat appropriate course of action.

Survey comments indicate that many respondents are unaware of the federal incentives already offered to existing service providers through federal, state, and local funding sources.

Does implementing incentive and penalty broadband policies improve the quality of the five broadband measures established in Section Two of this report?

- **Availability**
  Incentives may induce better development in certain areas. The incentive model relies on lowering costs or raising revenue to a sufficient degree to encourage development. It is difficult to imagine incentives that could define a business case for some parts of rural Colorado.
- **Abundance**
  Demand aggregation could be considered a type of incentive. Demand aggregation has supported expansion of abundance in some areas.
- **Affordability**
  Incentives can have some impact on affordability.
- **Reliability**
  In south central Colorado, the primary reliability issue lies with gaps in the infrastructure and lack of avaialble path diversity and middle mile redundancy. A strong set of

incentives/penalties that could be easily weilded by the jurisdictions throughout central Colorado is to extend CAI contracts only to carriers willing to improve path diversity and middle mile redundancy.

- **Sustainability**
  The MNT (Colorado Multi-Use Network) is based on a model of incentives. By most accounts, the MNT has proven unsustainable.

Incentives and penalties are generally not strong enough to induce action that would meet the goals and objectives of improving broadband access. However, they can be a useful tool coupled with other alternatives to reach the overall goals. Broadband friendly policies can influence private sector providers' behavior.

Broadband Friendly Policies

The Fiber to the Home Council has suggested communities can become "broadband friendly" through:

- Community and local government leadership and support.
  - Develop a clear broadband plan.
  - Ensure commitment of community stakeholders, including local government personnel.
- Favorable approval requirements and permitting.
  - Define an expeditious process for ongoing permitting and inspections.
  - Permit innovative construction techniques.
  - Relax community-wide build out requirements.
- Use of existing infrastructure.
  - Publish data about existing infrastructure.
  - Make all rights of way available on clearly defined, reasonable terms through a rapid approval process.
  - Ensure make-ready work is performed expeditiously.
  - Coordinate all pole maintenance and make-ready work with new providers to save cost.
  - Allow prospective attachers to perform all make-ready work themselves.
- Proactively improving existing infrastructure.
  - Provide space on all poles for new attachments.
  - Install fiber conduit.
  - Use building codes and community development plans to drive broadband deployment.

Some of these "broadband friendly" guidelines are part of offering incumbent providers incentives and penalties. However, becoming a "broadband friendly" community requires more work by community leaders than offering incentives and penalties.

Of all the options presented to our survey respondents, implementing broadband friendly policies was the most popular with the top ranking for those choosing the “most appropriate” course of action and remained the top choice with nearly two-thirds of respondents considering broadband friendly policies to be either the most appropriate or a somewhat appropriate action.

Do Broadband Friendly Policies Satisfy the Four Defining Principles?

- **Are broadband friendly policies open and wholesale?**
  Almost never. In fact, some of the policies suggest grant of monopoly.
- **Do broadband friendly policies result in carrier class deployments?**
  Rarely. Because many broadband friendly policies result in the granting of physical infrastructure to private incumbents, the incentives to upgrade and maintain those elements is low.
- **Do broadband friendly policies offer high scalable bandwidth?**
  Rarely. Usually broadband friendly policies will simply encourage continued incremental bandwidth improvements.
- **Are broadband friendly policies based on an open and independent architecture?**
  Most DSL deployments are based on open and independent architectures. Most DOCSIS (cable) services are less so. Private sector fiber deployments are typically PON designs and suffer significant interoperability shortcomings.

Does implementing broadband friendly policies improve the quality of the five broadband measures established in Section Two of this report?

- **Availability**
  Broadband friendly policies only increase availability as private sector providers choose to capitalize on the policies.
- **Abundance**

Broadband friendly policies seldom impact abundance unless they are coupled with other incentives.

- **Affordability**
  Broadband friendly policies can reduce capital expenditures for expansion and may reduce operating expenses. These savings may be passed on to subscribers in the form of better affordability.
- **Reliability**
  Broadband friendly policies can only lend to reliability if they incent path diversity and middle mile or distribution redundancy.
- **Sustainability**
  Broadband friendly policies may support sustainability.

Broadband friendly policies are a great tool as part of a comprehensive plan to provide greater broadband access. However, they rarely drive progress towards meeting broadband access goals on their own.

Municipal Entry (Publicly Owned Infrastructure)

Competition often spurs innovation and lower prices. The municipal entry development model has been most successful in communities that own and operate their own power utility like Lafayette, Louisiana or Chattanooga, Tennessee. These communities have used revenue bonds to borrow the money needed to build fiber networks. They then operate and manage these networks and provide retail services directly to the customer as an additional vertically integrated monopoly provider.

The towns in the south central Colorado region could build new broadband infrastructure and provide services to compete with the existing service providers or the towns could build new competing infrastructure and invite new service providers to use it to provide service. Unlike a limited build to close caps or enhance capabilities, this idea would put government owned infrastructure — and possibly services — in competition with existing providers.

This alternative was the second highest ranked as “the most appropriate” action by survey respondents. When the “most appropriate” and “somewhat appropriate” responses are combined, this alternative ranked third after broadband friendly policies and incentives/penalty policies. This translates to less than half of survey respondents felt building government owned infrastructure was the most appropriate or a somewhat appropriate action.

Does Municipal Entry Satisfy the Four Defining Principles?

- **Is municipal entry open and wholesale?**
  No. Open and wholesale municipal entry models are defined as public-private partnerships as discussed below.
- **Does municipal entry result in carrier class deployments?**
  Yes. It depends on the investment the municipality is willing to make. Most communities with public sector power companies have carrier class capabilities.
- **Does municipal entry offer high scalable bandwidth?**
  It can. However, this bandwidth has limited reach with targeted deployment models.
- **Is municipal entry based on an open and independent architecture?**
  It can be if the resources are available and the project is designed to meet this principle.

Does the municipal entry as a broadband service provider improve the quality of the five broadband measures established in Section Two of this report?

- **Availability**
  Municipal entry will increase availability in the areas served by the municipalitiy.
- **Abundance**
  Municipal entry should be a fiber or other advanced network implementation. This should increase abundance in the limited area of the municpal entry.
- **Affordability**
  Depending on the business model chosen by the municipal entrant, municipal entry can improve affordability for potential subscribers of the municipal entrant. Neighboring areas may also see greater affordability through a competitive response from neighboring providers. However, most municipal entrants have had no impact on affordability for near neighbors. Generally speaking, competing service providers understand the limits of the municipal entrants potential expansion and see no need for a competitive response outside those bounds.
- **Reliability**
  Municipal entry generally has no impact on reliability.
- **Sustainability**
  Municipal entry generally has no impact on sustainaiblity.

While municipal entry can meet the needs towards reaching the broadband access goals, most communities find the associated costs may prohibit following this model.

PUBLIC PRIVATE PARNTERSHIP

In a public-private partnership (PPP), government or quasi-government entities sponsor public networks for the public good and partner with private businesses who deliver the actual service to the public using the government owned infrastructure. The role of public owner is not to compete directly with private enterprise solutions.

Rather, public institutions identify and provide "natural monopoly" services, common or public good services, or market failure services. Since 21st century broadband infrastructure exhibits characteristics of all three of these areas, it typically calls for government intervention and action.

A public-private partnership network allows the government to provide the natural monopoly elements of broadband (the infrastructure itself), while opening the non-monopoly competitive aspect of providing services to multiple providers that enhances the overall market. A three-tiered public-private partnership is often the best organizational structure to accomplish the need to split physical assets from service provisioning as it provides shared policy leadership and direction, shared expertise, and shared financial responsibility and risk.

Public Private Partnership Roles

Depending on the project, the boundaries between the partners in a three-tiered public-private partnership can shift. Generally, they are as follows:

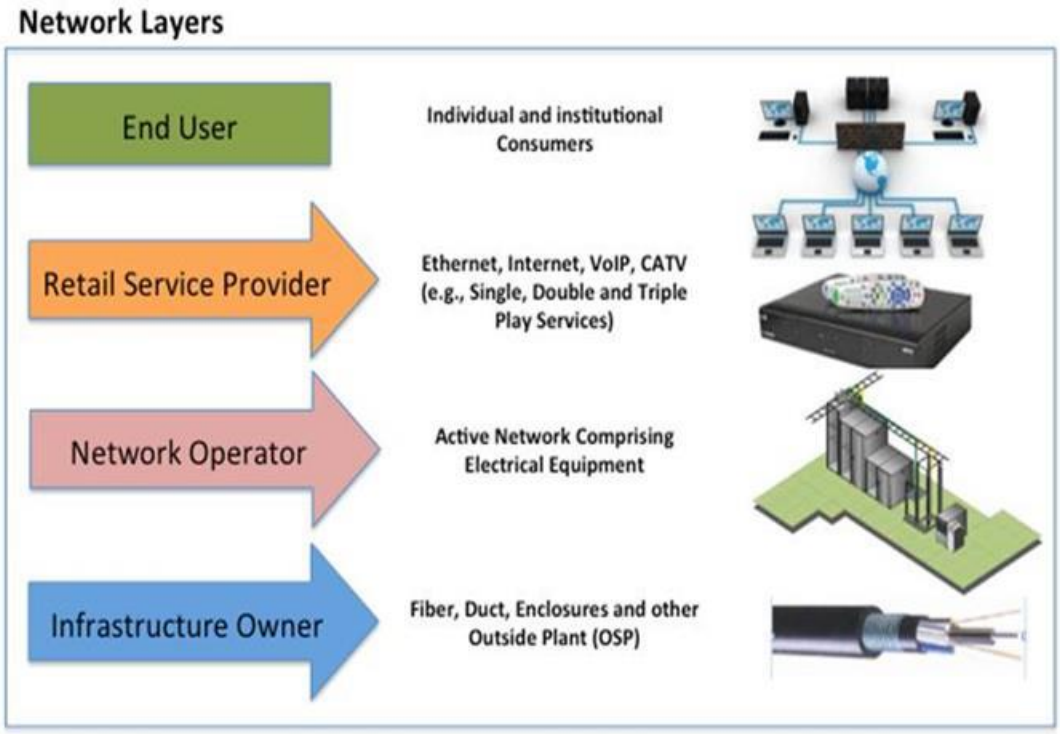

Figure 9: Three-Tiered Public-Private Partnership

As shown in Figure 16, the three-tiered public-private partnership broadband environment consists of:

1. **Infrastructure or Network Owner (or Owners).**
   This is the governmental organization (or multiple entities) that own the physical infrastructure. We usually recommend public ownership because it gives the City a tool to retain control of the public policy outcomes. Sometimes the network operator or service providers may own network infrastructure for use in the three-tiered public-private partnership environment.

2. **Network operator or Network Operator.**
   The network operator is responsible for bridging the gap between physical infrastructure and services. This could mean providing wholesale services to service providers; or offering services directly to anchor institutions and other select organizations.

   The network operator plays a critical role in developing the City's physical asset into a platform that can be effectively used by private enterprise service providers to reach and meet the needs and expectations of the end-user residential and business subscribers.

3. **Retail Service Providers.**
   Service providers offer customer-facing services to residents and businesses in the City. Service providers may own some infrastructure and may make some of that infrastructure available to the three-tiered public-private partnership environment.

   Some service providers will bring a full suite of products to the network environment. Others may be more interested in a "non-facilities" based model in which they simply repackage and sell the wholesale services made available by the Operator.

Public and private entities usually enter into broadband development public-private partnerships to accomplish three categories of objectives: 1) to share policy leadership and direction, 2) to share expertise, and 3) to spread financial responsibility and risk.

Shared Policy Leadership and Direction

A public-private partnership allows the public entity or entities involved to retain a valid voice in leadership and direction. A private entity is driven by profits and by law have a fiduciary responsibility to earn as much profit as possible for their shareholders. As such, cash is the true bottom line. Government entities are responsible for ensuring they provide the best services for the greater public good, rather than being profit driven. The municipality has a say in ensuring ubiquitous deployment helps reduce the digital divide, in ensuring community anchor institutions are served and in meeting other public objectives by keeping an active voice about the direction of the network through a PPP.

Shared Expertise

Professionals in the private and public sectors often have different skill sets and expertise. Execution of a public-private partnership means both parties can bring their expertise to bear to ensure the success of the project.

Shared Financial Responsibility and Risk

There are two general models for sharing access to capital and means of repayment. In both of them, we will consider cash flow between five entities: 1) the public entity or the City, 2) a lender, 3) the network operator or PPP entity, 4) the service providers and 5) the subscribers. In both models, the same organization may serve in multiple roles at various times.

Model 1 (City Capital PPP) starts with the public entity borrowing from the lender. The City uses the funds to build the network in conjunction with the network operator/PPP and the expertise the network operator/PPP can bring to bear. The subscribers pay the service providers for retail services. The service providers pay the public-private partnership for wholesale services. The

public-private partnership then pays the city a lease fee for the network. Finally, the City services its debt. In a City Capital PPP, the PPP's payments to the City can be set at a guaranteed level – sufficient to service the debt. The PPP is also responsible for operations expenses.

Model 2 (PPP Capital) starts with the lender providing funds to the PPP. The PPP builds the network and the City pays the PPP an "availability" fee. Subscribers pay service providers for retail services and service providers pay the PPP wholesale fees. The PPP leases the network from the City (cash flow arrow 5) and services the debt. In the PPP Capital model, the lender can provide funds to the PPP based on a contracted "availability" payment from the City. The City can make the "availability" payment based on the lease fee paid by the PPP.

A quick review of the description probably leaves one wondering, "Why is the City involved? The PPP seems to be paying the City, so the City can pay the PPP." The simple answer is that city involvement is required to make the PPP eligible for lender funds.

In both capital models, the City is the network owner – and thus retains control of the target public policy development. Our proposed special taxing districts in Colorado can accommodate either model.

Within the three-tiered public private partnership, we usually see financial risk shared through a variety of cash flow channels. Some potential cash flow opportunities include:

1. **Network owner to network operator.**
    a. ***Availability Fee.***
    An availability fee is paid when the network operator has provided capital for infrastructure development. The network operator may assess the network owner an availability fee to justify their capital expenditure.
    b. ***Asset Management Fee.***
    An asset management fee is assessed if the operating cost of the network is anticipated to be higher than the probable revenues generated by the network. The network owner may have economic development and quality of life public policy goals that justify subsidizing operations.
    c. ***Program Management Fee.***
    Program management fees are generally associated with implementation events. The network operator may implement program management fees to cover their costs associated with helping implement the network.
    d. ***Other Fees.***
    Other fees may be used to help support and sustain the network operator.

2. **Network operator to service providers.**
    Generally, the network operator will not transfer revenue to service providers unless a profit sharing mechanism is in place.

3. **Subscribers to service providers.**
   Service providers charge subscribers retail rates that align with their competitive advantages, cover their costs and maintain a profit for their shareholders.

4. **Service providers to network operator.**
   The network operator sets a fee policy for use of the network that aligns with the network owner's public policy objectives and allows service providers to retain enough revenue, so that they are sustainable.

5. **Network operator to network owner.**
   1. ***Lease Fee.***
      The network operator may pay the network owner a lease fee for access to the network owner's assets.
   2. ***Profit Share.***
      If a profit sharing mechanism is in place, the network operator may also pay the network owner their share of the profit.

Do Public-Private Partnerships Satisfy the Four Defining Principles?

- **Is a public-private partnership open and wholesale?**
  Yes, as long as the partners choose for it to be so.
- **Does a public-private partnership result in carrier class deployments?**
  Yes, as long as the partners choose for it to be so.
- **Does a public-private partnership offer high scalable bandwidth?**
  Yes, as long as the partners choose for it to do so.
- **Is a public-private partnership based on an open and independent architecture?**
  Yes, as long as the partners choose for it to be so.

While we only touched lightly on the shared vision and leadership aspect of a public-private partnership, this is actually its greatest strength. A public-private partnership can meet the objectives of the guiding principles if the partners choose for it to do so. More importantly, through a public-private partnership, the public entity can maintain control of public policy objectives while enhancing the private sector marketplace.

Does using a Public-Private Partnership (PPP) improve the quality of the five broadband measures established in Section Two of this report?

- **Availability**
  Using a regional PPP model can improve availability throughout the entire region.
- **Abundance**
  Using a regional PPP model can improve abundance throughout the entire region.
- **Affordability**
  Using a regional PPP model can extend competition to currently monopoly controlled areas and to new build areas. This competition should improve affordability.
- **Reliability**
  A regional PPP will have more influence over non-participating carriers who do not currently take advantage of avaialble path diversity and middle mile redundancy capabilities.
- **Sustainability**
  A regional PPP could achieve a sustainable business model.

The regional PPP alternative meets all four principals and allows for improvements across all broadband quality measures.

SUMMARY OF ALTERNATIVES

The following grid provides a summary of how each alternative meets the four principles.

	Open and Wholesale	Carrier Class	High scalability Bandwidth	Open and Independent Architecture
Status Quo				
Incentives and Penalties				
Broadband Friendly Policies				
Municipal Entry				
Public-Private Partnership				
Meets Needs =				

Somewhat Meets Needs =	
Does not Meet Needs =	

Table 7: General Broadband Development Paths and the Four Broadband Development Principles

The following matrix highlights how each alternative meets the overall broadband quality goals:

	Availability	Abundance	Affordability	Reliability	Sustainability
Status Quo					
Incentives and Penalties					
Broadband Friendly Policies					
Municipal Entry					
Public-Private Partnership					
Meets Needs =					
Somewhat Meets Needs =					
Does not Meet Needs =					

Table 8: General Broadband Development Paths and the Five Broadband Characteristics

GENERAL RECOMMENDATIONS

To meet the goals of improved broadband access and encourage adoption, we recommend the formation of a regional broadband development collaborative effort to:

1. Work with regional service providers to understand their broadband development plans and influence their behavior.
2. Strengthen and develop the middle mile network.
3. Implement a regional broadband awareness campaign to increase support that will drive higher demand.
4. Implement “model” projects to:

a. Drive development to areas that are under-served in comparison with the rest of the region and
b. Set the standard for regional private sector service providers.

Work with Regional Service Providers

The region's service providers are all engaged in capital improvement plans to varying degrees in order to maintain and deliver service to subscribers. The regional broadband development collaboration should work to ensure participating members coordinate their individual improvement efforts. Furthermore, participants should make their infrastructure available to each other on a wholesale basis. This shared infrastructure model can greatly improve capital expenditure efficiencies and may result in better broadband services for residents and businesses through the power of competition.

Implement a Regional Broadband Awareness Campaign

Public entities and other community anchor institutions are important broadband customers in the region. First, they function as "anchor tenants" for broadband providers. Next, they set the example in the region. If the patrons of public institutions and other community anchor institutions see that broadband is important to the institution, they may see its relevance in their own businesses and households.

As noted above, stakeholder interviews and the online survey suggest the need for a sustained education effort that may go beyond the political and jurisdictional boundaries of the local entities setting an example.

A sustained education effort should have three primary goals:

1. Develop an appreciation for the value of broadband services,
2. Provide information about available broadband options (and what can be done if the current options are inadequate), and
3. Ensure residents and business owners know their actions can make a difference in the region's broadband environment.

We recommend three primary education paths:

1. **Online Presence.** The region should develop a "broadband education and resource" web presence. Each jurisdiction within the region should link to the region's web presence. A social media presence can be difficult to maintain but it may represent a worthwhile effort.

The online presence should initially focus on the difference between merely adequate broadband (service that allows basic web browsing and access to email) and more abundant bandwidth (service that makes available the highest quality internet services).

2. **Event Presence.** It is difficult to get people to come to an online presence or real world events when they are not interested. To that end, the region's jurisdictions should participate in existing events like county fairs, back to school nights, and other public gatherings.
3. **Classroom Opportunities.** Relevant uses of online services represent a key driver for broadband adoption. To that end, the region should support classroom opportunities that drive broadband usage. Classes should focus on activities that may interest residents and businesses like genealogy and family history, using video conferencing for personal and business, using "cloud" services for your household or business, etc.

In order to be effective, this education effort should be sustained through time. The region should conduct periodic surveys to measure the effect of the education effort and to identify needed adjustments to the message. Public sector efforts should be designed to support and coordinate with private sector marketing and education efforts.

Of course a sustained education effort requires expending resources. Professional services are required to design an effective online presence; materials need to be printed; booths at fairs may cost; space for classes may need to be rented; course material needs to be developed. Much of the cost may be offset by contributions. The individual counties may donate booth space at their fairs; classes may be conducted in libraries or in other public spaces; students and instructors from high schools and the college may be recruited to prepare course material. The funding needed to support the effort could come from federal, state, or foundation grants or it may come from fees on wholesale services collected by the regional broadband collaborative.

Broadband Friendly Policies

Of the proposed broadband development options, implementing broadband friendly policies received the most favorable response. Broadband friendly policies are generally very low cost to implement but often have only limited utility towards improving the broadband environment. The most valuable result of implementing broadband friendly policies is how it demonstrates local policy makers' dedication to improving broadband in the region. This demonstration of dedication could be a very important element of the proposed sustained education effort.

Some broadband friendly policies may include:

- CRS Title 29 Article 27 (also known as "Senate Bill 152") places restrictions on municipal broadband development. Many Colorado communities are engaging in "opt out" initiatives designed to restore local control regardless of chosen broadband development paths. This indicates that regions such as SLVDRG are interested in local control of the broadband infrastructure.
- The various counties and communities should implement a "dig once" or "open trench" policy and other broadband friendly initiatives. A model "dig once" or "open trench" ordinance is included in the appendix.
- Require new developments to include conduit for future broadband infrastructure.
- Broadband mapping requires constant attention. Private companies are not required to disclose their infrastructure assets, service levels constantly change, old assets are retired, and other changes occur. Rather than trying to maintain its own broadband map, the region should work with Governor's Office of Information Technology (GOIT) to develop information sharing mechanisms where the region provides GOIT with information and GOIT responds to the region's broadband information needs.
  As the region feeds information to GOIT to improve GOIT's broadband map, the region should expect to be able to make recommendations to improve the utility of the map for the region. For example, the region may find that the 10-25 Mbps category identifying services is too broad. The region should be able to suggest to GOIT narrower broadband categories and GOIT should be able to implement them.
- Develop online services and otherwise encourage broadband utilization. It is important for public entities to demonstrate the value of broadband.
- Implement reasonable infrastructure (e.g. conduit placed with other utility projects) deployments.

Use Community Projects to Drive Development and Improve Last Mile Infrastructure

We recommend one or two significant public broadband infrastructure builds in order to create a compelling market to attract private sector providers into the regional broadband coalition.

Some mechanisms the communities may use to support private sector broadband development include:

- **Increased Public Entity Usage and Awareness**
  Public entities and other community anchor institutions are important broadband customers in the region. First, they function as "anchor tenants" for broadband providers. Next, they set the example in the region. If the patrons of public institutions and other community anchor institutions see that broadband is important to the institution, they may see its relevance in their own businesses and households.

- **Aggregate Purchasing**
  Typically, the more broadband capacity one buys, the lower the Mbps cost. Insofar as reasonable, communities should aggregate their community anchor institution broadband purchases. In many instances, this may require some linking infrastructure. The community or private service providers build necessary infrastructure linking.
- **Targeted Wi-Fi Implementations**
  Providing Wi-Fi in certain public areas increases the visibility of broadband adoption and helps spread the message of broadband relevance.
- **Targeted Infrastructure Builds**
  Communities need to invest in targeted infrastructure projects in order to support broadband purchasing aggregation and improve business cases that align private and public sector needs. These builds may connect disparate middle mile networks to improve reliability, to extend fiber to cell towers to increase capacity, to build towers to support extending fixed wireless services, or for other purposes.
  Funding for particular targeted builds is available through federal and state programs. For example, E-Rate funds are available to build fiber to schools and the Colorado Telehealth Network continues to work to bring Healthcare Connect funds to the state to connect health facilities to fiber.
- **General Infrastructure Builds**
  The types of infrastructure development described above, while valuable, does not create a significant base of public infrastructure. In order to make participation in the regional broadband development cooperative truly compelling to the region's private sector providers, more general infrastructure deployment may be required.
  We recommend Alamosa and other municipalities pursue general fiber to the premises builds. These builds can be undertaken by the individual communities or by a local broadband authority.

ALTERNATE PATH

If creating a regional broadband development coalition proves untenable, an alternate path is for the individual jurisdictions in the region to work independently to implement the objectives described above.

FINANCIAL MODELING AND SUSTAINABILITY

Broadband development would not be possible without financing the equipment costs (e.g. capital expenditures) or maintenance costs. Ongoing operational costs need to be sustainable in order to develop a robust long-term broadband accessibility for a region.

There are four items that need to be considered when determining realistic financial cost associated with improving broadband access: capital expenses, operations expenses, revenue, and schedule/time.

Capital expenses are the upfront costs associate with building new infrastructure. Operations expenses encompass everything with running the business. Revenue is the money generated by the service and used towards capital and operating expenses. Schedule or time includes the amount of time to recover costs spent on improvements and time necessary to see a positive profit margin.

The Federal Communications Commission (FCC) enacted methods to fund telephone infrastructure and increase accessibility across all demographics, including the impoverished. The most well-known method was the Universal Service Fund (USF) through the Telecommunications Act of 1996.

The purpose of the Act was to ensure access to reliable telephone service at a reasonable rate. This was a huge step because traditionally urban areas had a lower cost due to a higher population per area. Rural Communities were generally high cost, which resulted in lower system maintenance and upgrade opportunities. As the information age advanced, this difference would hinder growth and economic viability to remain competitive. Details about the USF fund are discussed in Section 5.2.

In addition to the USF funds, states and communities were able to implement tariffs to fund infrastructure to ensure reliability within their communities. The Internet Tax Freedom Act first enacted in 1998 and the Permanent Internet Tax Freedom Act recently passed the House in 2015 and is working its way through congress, removed the ability of states and communities to migrate the phone tariffs to broadband tariffs. This means the traditional funds do not migrate as people transition from internet services that use dedicated phone lines to broadband. As such, there is a small window of opportunity where the funds are still accessible to assist with implementing the largest cost items today.

This strategic plan does not provide a full financial analysis, but will touch on the costs so you can make informed decisions and be able to dig deeper when implementing the recommendations.

FINANCIAL MODELING

What are the costs associated with broadband service that will meet standards established in this report and be able to continue to meet these standards over time (e.g. sustainability)? In the simplest of terms, the budget process needs to take into account:

- Capital Expenses: This is the actual upfront costs associated with building new infrastructure. These are widely variable costs because it depends on the location, type of equipment used, size of the overall project, and previous experience with the technology used and/or built.
- Operations Expenses: This covers everything involved with running the business or department. It includes maintenance of the infrastructure built, customer support, billing (including debts), staff salaries, equipment costs (including maintenance), etc. Remember that equipment includes construction equipment, rentals, company cars, copy machines, computers, etc. These items collectively are sometimes called the "overhead" costs.
- Revenue: This is the source of money generated to feed both Operations and Capital expenses. Traditionally these have been fees or tariffs of some sort. Other revenue sources can be used for wholesale services, retail and lease fees to operate or expand the network.
- Schedule/ Time/Investment Rate of Return: This is the amount of time to recover the funds spent on the improvements. This includes determining the breakeven point and is used to project revenue and profit (if applicable). This financial modeling also takes into account debt so projects are planned accordingly. Projects encompass new infrastructure, retrofit upgrades and routine maintenance.

Capital Expenses

A variety of constraints will directly affect capital expenses. For example, construction timing for a project can have a huge cost variable depending on the availability of materials, limits to the construction season, number of projects planned, unanticipated or emergency repairs, various construction methodologies, etc.

Historically northeastern Colorado projects have not built new cable or DSL infrastructure. Historical projects generally fall into one of three categories:

1. **Tower Infrastructure**
   Tower infrastructure falls into two camps: the actual standard cell tower itself and the equipment used for microwave links, cellular service, and fixed wireless service. There are five primary types of cell towers: broadcast, monopole, guyed, lattice, and stealth (camouflaged). Broadcast towers are generally not built specifically for internet or cell

service but are used for radio and television frequencies. If broadcast towers are used, it is usually a retrofit of equipment on an existing tower.

The monopole and guyed towers look very similar with a single pole rising out of a foundation. The guyed tower uses guyed wires to assist in holding the tower in place. Lattice towers use a lattice framework rather than a single pole. Lattice towers are similar in appearance to traditional oil rigs.

Stealth towers tend to be the most expensive because they go above functionality and incorporate cosmetic design features so they blend into the environment. This could be a variety of trees, windmills, flagpoles, etc.

The cost varies considerably between these five types of cell towers. One of the largest cell tower consultants (Steel in the Air) was used to research the average cost of a cell tower, which is approximately $150,000. This is without any of the supporting equipment.

Larger towers that are used to support larger antenna arrays, microwave links/dishes, cellular service, and fixed wireless service average approximately $250,000.

There are other auxiliary costs such as the actual footprint of the tower, which includes a foundation/base, security fencing, base transmitter station (e.g. building that houses equipment), generator, sump pumps (if applicable), and utilities.

2. **Middle Mile Fiber**

   Costs associated with middle mile fiber vary wildly from $25,000 to greater than $400,000 per mile. If there are clean pole lines and construction is straightforward, the cost is closer to the low end at $25,000 per mile. If construction will be difficult or require extensive directional boring, the cost can skyrocket to over $400,000 per mile. For this reason, each project will need an individual cost estimate to provide a realistic range.

   A good rule of thumb for long term planning is to use historical project costs. When historic costs are not available, new fiber construction averages $70,000 per mile based on average terrain in south central Colorado.

3. **Last Mile Fiber**

   As you recall, last mile fiber connects broadband services to the customer (e.g. homes and businesses). Last mile fiber is the most expensive solution to implement because of the construction constraints associated with building in or around residential, business, or institutions. As previously discussed, fiber may be more expensive up front but generally has a longer lifecycle compared to other options (e.g. physically lasts longer and ability to keep up with technological advancements).

Typical last mile project capital cost estimates in urban or semi-urban areas are $1,100 per address passed plus another $1,100 per address connected to the network, for a total of $2,200 per address.
In rural areas, last mile fiber costs are better estimated at similar costs per mile for middle mile fiber deployment, plus another $1,100 per address connected. This means that an average cost of $70,000 for each mile of fiber plus $1,100 for each address to connect to the network. A five-mile stretch with 15 customer connections would be approximately $366,500.

Operational Expenditures

Operational expenses include items easily estimated such as staffing costs, building/office leases, equipment leases, equipment purchases and software/billing costs. Routine maintenance can become predictable based on standard modeling using lifecycle analyses. Staffing costs do not immediately need to be new full time employees (FTE), but can be an extension of work divided among existing staff or even a combination of part time employees (PTE), existing employees and new FTEs.

A contingency fund must be included in operational budgets to account for any unanticipated costs such as emergency repairs, legislative mandates, etc. Over time, the contingency budget becomes more predictable as historical data becomes available.

Operational expenses cost approximately $0.05 per month per foot of existing infrastructure being maintained plus $3.00 per month per customer or subscriber. This will need to be adjusted as more historical data become available to tailor the averages for your specific circumstances.

For example, if there were five miles of infrastructure serving 15 subscribers, the monthly cost would be $1,320 for the infrastructure plus $45 for the subscribers, which comes to a total of $1,365 per month.

Revenue

Revenue is comprised of fees including: wholesale, retail, lease, and other revenue opportunities. In the broadband and utility industry, revenue is reflected as the Average Revenue Per User (ARPU). To calculate the ARPU, divide the annual revenue by the number of subscribers (or number of units if calculating both internet and cellular access). If the ARPU is low, then generally one needs to have more subscribers to generate the break-even point. If the ARPU is high, then less subscribers are needed to break-even. In order to support development, a low ARPU may be the initial goal.

Time/Forecasting

Time plays a critical role in modeling financial performance for broadband investments. Typical broadband development efforts require significant capital expenditure upfront at the beginning of the project. From there it only slowly generates revenue through a ramp-up period before going into full production.

While time is a critical factor in financial modeling, factoring time into the model is beyond providing a one, three, and five-year strategic plan contained within this report. The region and individual jurisdictions must model time (e.g. schedule) for each of their potential projects while developing their program to execute the recommendations within this report. Forecasting will aid in determining the order and priority of projects, depending on their break-even points, anticipated revenue generation, and maintenance requirements.

POTENTIAL FUNDING SOURCES

Since this is a strategic report, the scope does not provide the detail necessary to identify funding sources for any particular project. However, this report will describe some potential public funding sources as a starting point when the implementation plan(s) are completed. This section is not inclusive of all the funding sources that could be available.

Federal Funding Sources

Principal federal funding used for previous broadband development in rural areas comes from the Rural Utilities Funds designated by the US Department of Agriculture (USDA) Farm Bill. USDA provides funding opportunities through loans, loan guarantees and grants. The overall purpose of the Rural Utilities Service (RUS) program is to assist rural communities so they can meet the needs of their residents, remain competitive and encourage positive economic growth. The focus is on improving the quality of life as envisioned by the community.

According to Pew Research from 2014, approximately 78% of people that live in rural areas rely on the internet compared to

FUNDING SOURCES

Fortunately, there are multiple funding sources to assist with improving broadband access, including federal, state, and local options.

The most common Federal funding opportunities include:

The most common USDA RUS funds fall into four programs: Community Connect Grants, Distance Learning and Telemedicine Grants, Farm Bill Broadband Loan and Loan Guarantee Program, and Community Facilities Direct Loan and Grant Program.

Universal Service Funds (USF) are offered through the Federal Communications Commission (FCC). USF is further divided into three primary funds used for improving broadband access: Healthcare Connect, E Rates, and FirstNet.

The state of Colorado offers funding opportunities including the Colorado Telehealth Network (CTN), Colorado Department of Local Affairs (DOLA) grants, and the new Broadband Infrastructure Grant.

Three of the most common methods that local jurisdictions use for funding broadband access projects are Special Districts (SD), Local Improvement Districts (LID), and Business Improvement Districts (BID). Of these mechanisms, LIDs are the most flexible since it allows homeowners to construct and finance public works projects over a pre-determined amount of time (such as 10 years) so the entire cost of the project does not have to be paid at once.

42% in 2000. This same study showed that from 2000 to 2014, there was a correlation to high income and higher education levels and higher internet usage. This study emphasizes the need to include broadband access as part of a solid economic strategy for long-term growth. Four primary broadband development programs currently offered by RUS in 2015 include:

- Rural Utilities Service Loan Program
    - Community Connect Grants
    - Distance Learning and Telemedicine Grants
    - Farm Bill Broadband Loan and Loan Guarantee Program
    - Community Facilities Direct Loan and Grant Program

The Federal Communications Commission (FCC) has provided funds through various sources as well. While these traditionally were used for telephone infrastructure, their use has been expanded to broadband deployment.

- FCC Universal Service Funds
    - Healthcare Connect
    - E Rates
    - FirstNet
        - Colorado Uses Funds for their Colorado Telehealth Network (CTN).
- Additional Federal funding sources can be found at grants.gov. They require some credentialing and online authentication procedures for the first time users. This may take several business days to complete.

Basic information about each funding source listed above is provided below and fact sheets are provided in the appendix. Please note the information listed below is subject to change.

Community Connect Grants

Community Connect Grants aim to help communities boost economic growth by providing much needed financial support. The goal is to provide broadband service to unserved, underserved, low income, and rural areas. There is a focus of ensuring community facilities are connected, such as education, healthcare, libraries, and other community centers. Community Connect Grants give priority to rural areas and new broadband services.

Who Can Apply:

- Incorporated organization
- Indian tribe or tribal organization
- State or local unit of government
- Cooperative (for-profit or not-for-profit)
- Private corporation (for-profit or not-for-profit)

- Limited liability company (for-profit or not-for-profit)

Grant Amounts Available:

- Minimum $100,000
- Maximum $3,000,000

Local Match Required:

- At least fifteen percent (15%) of the total amount of financial assistance requested.

Website for More Information:

www.rd.usda.gov/programs-services/community-connect-grants

Types of Projects Covered:

- Construction of facilities to deploy broadband services to all Critical Community Facilities (CCF) and subscribers within the Proposed Funded Service Area (PFSA).
- Acquisition of facilities to deploy broadband services to all CCF and subscribers within the PFSA.
- Leasing of facilities to deploy broadband services to all CCF and subscribers within the PFSA.

Caution:

- Individuals and partnerships are not eligible.
- Local match cannot be in-kind services.
- Local match cannot be from other federal sources.
- Addresses cannot be skipped within service area (e.g. offer service to all residential and business customers).
- Must provide free service to all Critical Community Facilities located within the Proposed Funded Service Area for at least two (2) years.
- Must provide free service to Community Centers with at least two (2) Computer Access Points and wireless access. There is a limit to the cost associated with providing this access.
- Propose a contiguous geographic area within an eligible Rural Area or eligible Rural Areas, in which Broadband Service does not currently exist.
- Service area must not overlap with the Service Areas of current RUS borrowers and grantees.
- Ineligible projects include duplication of any existing Broadband Service provided by another entity and operating expenses other than the cost of bandwidth for two (2) years to provide service at the Broadband Grand Speed eligibility requirements to the CCFs.

Distance Learning and Telemedicine Grants

The Distance Learning and Telemedicine (DLT) Grant provides a method to encourage rural areas to become connected through technology. It allows for medical facilities and practitioners to connect with patients regardless of remoteness of the area. Teachers and students are able to bridge the physical divide that can occur in a rural setting. Access to broadband allows a community to grow economically and opens academic channels to residents that may not have been there previously.

Who Can Apply:

- Incorporated organization or a partnership
- Indian tribe or tribal organization
- State or local unit of government
- Consortium
- Other legal entity, including a private corporation organized on a for-profit or not-for-profit basis

Grant Amounts Available:

- Minimum $50,000
- maximum $500,000

Local Match Required:

- Fifteen percent (15 %) of total amount requested
- Can be cash or in-kind

Website for More Information:

www.rd.usda.gov/programs-services/distance-learning-telemedicine-grants

Types of Projects Covered:

- Lease or purchase of new eligible DLT equipment and facilities
    - Audio, video and interactive video equipment
    - Terminal and data terminal equipment
    - Computer hardware, network components and software
    - Inside wiring and similar infrastructure that further DLT services
- Acquire new instructional programming that is a capital asset
- Telemedicine or distance learning equipment or facilities necessary to the project
- Up to 10% of grant for:
    - Technical assistance,

- Develop instructional material for the operation of the equipment; and/or
- Engineering or environmental studies in the implementation of the project.

Caution:

- In kind matches from vendors are not eligible, though they are eligible from grantee.
- End-user sites need to be in rural areas.
- Operations expenses are not eligible.
- Electric and telecommunications borrowers under the Rural Electrification Act of 1936 are ineligible.

Farm Bill Broadband Loan and Loan Guarantee Program

The Farm Bill Broadband Loan and Loan Guarantee Program was put into place to provide much needed funds to rural areas. The purpose is to provide broadband access to as many unserved and underserved populations as possible.

Who Can Apply:

- Corporation
- Limited liability company (LLC)
- Cooperative or mutual organization
- A state or local unit of government
- Indian tribe or tribal organization

Grant Amounts Available:

- Minimum $100,000
- Maximum $10,000,000

Local Match Required:

- Equity position equal to at least 10 percent (10%) of the amount of the loan requested

Website for More Information:

http://www.rd.usda.gov/programs-services/farm-bill-broadband-loans-loan-guarantees

Types of Projects Covered:

- Construction, improvement, and acquisition of facilities and equipment to provide service at the broadband lending speed for eligible rural areas.

- Cost of leasing facilities required to provide service at the broadband lending speed if such lease qualifies as a capital lease under generally accepted accounting principles.
- Acquisitions in limited circumstances
- Fund pre-loan expenses under certain circumstances up to five percent of the broadband loan

Caution:

- Non-contiguous areas are considered separate service areas and must be treated separately for the purpose of determining service area eligibility.
- At least 15 percent (15%) of the households in the proposed funded service area are unserved.
- None of the proposed funded service area has three or more "incumbent service providers."
- None of the proposed funded service area overlaps with the service area of current RUS borrowers or the service areas of grantees that were funded by RUS.
- Operating expenses are ineligible.
- Any costs associated with the project that were incurred prior to the date the application that was deemed complete are ineligible.
- Cannot purchase (or acquire) any facilities or equipment of an affiliate, unless approved by the agency in writing.
- Broadband facilities leased under the terms of an operating lease are ineligible.
- Merger or consolidation of entities are ineligible.
- Vehicles are ineligible regardless of purchase or lease.
- Applications are submitted online. Authentication to obtain credentials is required prior to gaining access to the system.
- There are multiple constraints regarding the loan terms. For example, loan terms are limited to the expected composite economic life of the assets that will be financed plus an additional 3 years.

Community Facilities Direct Loan and Grant Program

Community Facilities Direct Loan and Grant Program were put in place to assist rural communities with providing essential community facilities. This program has a broad range of eligible projects, which may make it difficult to compete for broadband deployment projects in their own right.

Who Can Apply for Loans:

- Public bodies
- Community-based non-profit corporations
- Federally recognized Indian tribes in a rural area

Who Can Apply for Grants:

- Public bodies
- Nonprofit corporations or associations must have significant ties with the local rural communities
- Federally recognized Indian tribes in a rural area

Grant Amounts Available:

- Varies. Uses a graduated scale depending on how rural the area is (e.g. unserved) and median household income.

- Grant assistance cannot exceed the lower of:
  - Qualifying percentage of eligible project cost determined in accordance with §3570.63(b),
  - Minimum amount sufficient to provide for economic feasibility,
  - Either 50 percent (50%) of the annual state allocation or $50,000, whichever is greater, unless an exception is made.
- Grants of up to 75 percent (75%) of the cost of developing essential community facilities may be used to supplement financial assistance if:
  - Located within a rural community having a population of 5,000 or less, and
  - Median household income of the population to be served by the proposed facility is below the higher of the poverty line or 60 percent (60%) of the State nonmetropolitan median household income.

Local Match Required:

- No specific mention of local match.
- Joint funding is permitted. For example, rural development may finance projects jointly with funds from other sources, such as, commercial/private lenders, federal agencies, state and local governments, etc.

Website for More Information:

http://www.rd.usda.gov/programs-services/community-facilities-direct-loan-grant-program

Types of Projects Covered for Loan:

- Purchase, construct, and / or improve essential community facilities, purchase equipment and pay related project expenses.

  - Health care facilities such as hospitals, medical clinics, dental clinics, nursing homes or assisted living facilities
  - Public facilities such as town halls, courthouses, airport hangars or street improvements

- Community support services such as child care centers, community centers, fairgrounds or transitional housing
- Public safety services such as fire departments, fire trucks, police stations, police vehicles, prisons, public works vehicles or equipment
- Educational services such as museums, libraries or private schools
- Utility services such as telemedicine or distance learning equipment
- Local food systems such as community gardens, food pantries, community kitchens, food banks, food hubs or greenhouses

Types of Projects Covered for Grant:

- Construct, enlarge, extend, or otherwise improve essential community facilities providing essential service primarily to rural residents and rural businesses. Rural businesses include facilities such as Community Anchor Institutions (CAI), educational and other publicly owned facilities.
- The purchase of major equipment (such as solid waste collection trucks, telecommunication equipment, necessary maintenance equipment, fire service equipment, X-ray machines, etc.) which will in themselves provide an essential service to rural residents.
- Purchase of existing facilities when it is necessary either to improve or to prevent a loss of service.
- Construct or relocate public buildings, roads, bridges, fences, or utilities and to make other public improvements necessary to the successful operation or protection of facilities.
- Relocate private buildings, roads, bridges, fences, or utilities, and other private improvements necessary to the successful operation or protection of facilities.
- Pay the following expenses, but only when such expenses are a necessary part of a project to finance facilities:
    - Reasonable fees and costs such as legal, engineering, architectural, fiscal advisory, recording, environmental impact analyses, archeological surveys and possible salvage or other mitigation measures, planning, establishing, or acquiring rights.
    - Costs of acquiring interest in land; rights such as water rights, leases, permits, and rights-of-way and other evidence of land or water control necessary for development of the facility.
    - Purchasing or renting equipment necessary to install, maintain, extend, protect, operate, or utilize facilities.

Caution:

- Ineligible Projects
    - Initial operating expenses or annual recurring costs.
    - Construct or repair electric generating plants, electric transmission lines, or gas distribution lines to provide services for commercial sale.

    - Refinance existing indebtedness
    - Pay interest
    - Pay for facilities located in non-rural areas
    - Pay any costs of a project when the median household income of the population to be served by the proposed facility is above the higher of the poverty line or eligible percent (60, 70, 80, or 90) of the state nonmetropolitan median household income.
    - Pay project costs when other loan funding for the project is not at reasonable rates and terms.
    - Pay an amount greater than 75 percent (75%) of the cost to develop the facility.
    - Pay costs to construct facilities to be used for commercial rental unless it is a minor part of the total facility.
    - Construct facilities primarily for the purpose of housing State, Federal, or quasi-federal agencies.
- Applicants must be unable to finance the project from their own resources and/or through commercial credit at reasonable rates and terms.
- Facilities must serve rural area where they are/will be located.
- Project must demonstrate substantial community support.
- Environmental review must be completed.

FCC Universal Service Funds

Compared to the much older telecommunication industry, FCC Universal Service Funds are relatively new considering they were established in 1996. Essentially, the Telecommunications Act of 1996 requires all service providers to contribute to the Universal Service Fund (USF). The goal of the USF is to encourage accessibility to traditionally unserved or underserved communities whether it is through improved educational, health care, emergency services, or global access. The Fund is further divided into four categories that target specific communities: Healthcare Connect (rural health care), E Rates (schools and libraries), High Cost Program, and Lifeline (low income, elderly, and disabled access).

Before going into the program details, there are some events on the horizon that need to be mentioned so local communities can prepare and plan accordingly. More people are shifting from landline telephone to cell phone usage. The Centers for Disease Control (CDC) has been performing studies since 2003 to track trends in cell phone use and landline use. In 2014, approximately 47% of the homes within the United States no longer use a landline phone and only use a cell phone[37]. Engadget referenced a CDC study that shows only 8% used a landline as

[37] M. Trujillo, 'Cellphone Only Homes Becoming the Norm, CDC Finds', The Hill, 1 December 2015, http://thehill.com/policy/technology/261657-cellphone-only-homes-become-the-norm-cdc-survey-finds, accessed 9 May 2016.

of 2015[38]. At the same time, more customers are migrating from cable and satellite services to internet services for their work and entertainment. Pew Research found that in 2015,

> Only 15% of the population surveyed did not use the internet.[39] This means that 85% used the internet as part of their daily life

Currently, the USF is funded by telephone service and not broadband service. In 2015, the FCC ruled that internet access has reached the same level as telephones and could be considered a necessity today. This opened the door for funds to migrate as people leave telephone services for broadband services. However, the Internet Tax Freedom Act was implemented in 1998 temporarily to encourage consumers to use the internet. The Internet Tax Freedom Act was made permanent in 2015. Part of this Act prohibits implementing taxes in such a way as to be discriminatory or could be perceived as discriminatory. It also prohibits state and local taxes on internet services. This means that as people migrate from phone services to internet only services, the state and local taxes collected will not migrate with them. It is unclear if the FCC will issue a ruling that USF fees can migrate with consumers to include internet access.

Since this report is focused on broadband access, the target of the remainder of USF funding discussion will be on Health Connect, First Net, and E Rates programs.

Healthcare Connect

Healthcare Connect focuses on bridging the gap in rural communities between patients, medical facilities, and medical providers.

Who Can Apply:

- Consortium, Individual Health Care Providers (HCP), and Service Providers
- Non-rural HCPs that are eligible as a member of a consortium made up of more than 50 percent (50%) rural HCP sites.
- Consortia of eligible rural and non-rural public/nonprofit health care providers (HCPs).
- Individual rural public/nonprofit HCPs
- Not-for-profit and public of one of the following entity types:
    - Post secondary educational institutions - covering health care instruction, teaching hospitals, or medical schools,
    - Community health centers or health centers providing health care to migrants,
    - Local health departments or agencies,

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[38] A. Tarantola, 'CDC: Nearly Half of American Homes No Longer Have Landlines', Engadget, 1 December 2015, http://www.engadget.com/2015/12/01/cdc-nearly-half-of-american-homes-no-longer-have-landlines/, accessed 9 May 2016.

[39] M. Anderson and A. Perrin, '15% of Americans Don't Use the Internet. Who Are They?', Pew Research, 28 July 2015, http://www.pewresearch.org/fact-tank/2015/07/28/15-of-americans-dont-use-the-internet-who-are-they/, accessed 9 May 2016.

- Community mental health centers,
- Not-for-profit hospitals,
- Rural health clinics including mobile clinics,
- Dedicated emergency rooms of for-profit hospitals.

Grant Amounts Available:

- $400 million a year cap for the entire program
- $150 million cap for upfront payments and multi-year commitments
- 65 percent (65%) flat-rate discount on all eligible expenses

Local Match Required:

- No specific match listed as mandatory.

Website for More Information:

http://www.usac.org/rhc/healthcare-connect/default.aspx

Types of Projects Covered:

- Telecommunications and broadband services/network equipment
- Consortium applicants: HCP-constructed and -owned network facilities
- Consortium applicants: Upfront payments
- Can include off-site services: Connections associated with offsite data centers and offsite administrative offices used by eligible HCPs for health care purposes are eligible for funding.
    - In addition, broadband connections associated with off-site data centers and off-site administrative offices that are used by eligible health care providers for their health care purposes are eligible for funding.
- Telecommunications service
- Broadband service
- Network equipment
- HCP-constructed and owned network facilities (consortia only)

Caution:

- Applicants are prohibited from submitting funding requests for the same service (circuit) in the Telecommunications Program and the Healthcare Connect Fund (HCF) Program.
- Price must be a primary factor. Then bandwidth, quality of transmission, reliability, and technical support.

E Rate

The E Rate program targets rural communities and initiates funds to provide affordable broadband access to schools and libraries so they are competitive and comparable to their urban counterparts.

Who Can Apply:

- Individually or Part of a Consortium
    - Eligible schools
    - School districts
    - Libraries

Grant Amounts Available:

- $3.9 billion per funding year and indexed to inflation.
- Additional Category One funding, up to 10 percent (10%), to match state funding for special construction charges for high-speed broadband connections.
- $1 billion annual target for Category Two support.
- Schools with Category Two services are eligible for up to $150 per student (pre-discount) over a five-year period.
- Discounts range from 20 percent (20%) to 90 percent (90%) of the costs of eligible services.
- Rural libraries remain eligible to request discounts on Category Two services of up to $2.30 per square foot.
- In some cases, E Rate will provide a 1:1 dollar match in extra Category One funding up to an additional ten percent (10%) discount.

Local Match Required:

- Yes. Varies depending on percentage of discount and funding categories.

Website for More Information:

https://www.fcc.gov/general/e-rate-schools-libraries-usf-program

Types of Projects Covered:

- Category One-Services to a School or Library.
    - Data transmission services and Internet access
    - Voice Services
    - Special construction charges beyond the applicant's property line and modulating electronics to light dark fiber.
    - Self-construction of their own high-speed broadband networks if most cost effective.
- Category Two-Deliver Services within a School or Library.
    - Internal connections
    - Managed internal broadband services

    - Basic maintenance of internal connections
- Miscellaneous

Caution:

- Dark fiber must also seek bids for lit fiber over a comparable time period.
- Include equipment and maintenance costs associated with lighting dark fiber in the same application with the dark fiber lease.
- Will not receive support for excess capacity
- Funding is allocated first to the highest poverty schools and libraries, then the next highest poverty applicants, and continues down the list of applicants.

FirstNet

FirstNet is a national program established to create a comprehensive public safety broadband network. Colorado receives funds through this program and offers additional funds through the Colorado Telehealth Network (CTN), discussed later in this section.

Who Can Apply:

- Public safety users
    - Law Enforcement
    - Fire
    - EMS
    - Emergency Management
    - Public Safety Answering Points (PSAP)/911)
- State, county, regional and municipal government
- Public works
- Transportation
- Public health
- Education
- Utilities
- Healthcare
- Corrections
- Parks and Wildlife
- Military and Veterans Affairs
- Tribal partners
- Federal partners

Grant Amounts Available:

- Up to $6.5 billion nationwide.

- Minimum distribution amounts are divided up over 25 years with increasing amounts from $80,000,000 to $430,000,000.

Local Match Required:

- Unknown.

Website for More Information:

http://www.firstnet.gov
https://www.youtube.com/watch?v=E-8ZUTaG0lA&feature=youtu.be

Types of Projects Covered:

- Construction of a core network and any Remote Area Network build-out.
- Towers
- Adequacy of hardening, security, reliability, and resiliency of the network.

Caution:

- Limited to specific deployment of FirstNet system.
- Colorado has received funds already and in turn offers funding opportunities to eligible entities within Colorado. See the CTN discussion later in this section.

Colorado State Fund Sources

Colorado is ahead of the curve compared to the remainder of the country. There are multiple funding opportunities within the state of Colorado. This includes established programs such as the Colorado Telehealth Network (CTN) and Colorado Department of Local Affairs (DOLA) grants, and the new Broadband Infrastructure grant.

Colorado Telehealth Network

Colorado Telehealth Network (CTN) was created with a $9.7 million grant in 2008 for connecting healthcare providers, facilities, first responders, and patients. Unfortunately, rural areas historically did not have the funds available to implement the latest technology to create a comprehensive network. The goal of CTN is to use technology to link the healthcare community with patients, educate healthcare workers and patients so they can use the new technology effectively, provide access to traditionally unserved areas, and leverage technology advances to improve healthcare in the area.

Who Can Apply:

- Hospitals
- Rural health clinics
- Local health departments
- Community health centers (community SafetyNet clinics and federally qualified health centers).
- Health centers providing health care to migrant workers
- Post-secondary educational institutions offering heath care instruction.
- Teaching hospitals
- Medical schools
- Other nonprofit HCPs in a consortium

Grant Amounts Available:

- Varies depending on year. In 2012, approximately $1 million was available.
- Funds received from national FirstNet funds

Local Match Required:

- Unknown

Website for More Information:

http://www.cotelehealth.com/
http://www.cotelehealth.com/Programs/Broadband.aspx

Types of Projects Covered:

- Low-cost, high-capacity digital bandwidth that enhances all aspects of grantees communications systems, including, but not limited to:
    - Use of electronic health records,
    - Televideo,
    - Telephone services using the Internet (VoIP), or
    - Transmission of high-resolution images in trauma situations
- Rural broadband infrastructure
- HCPs to:
    - Post their own data,
    - Interact with stored data,
    - Generate new data,
    - Communicate by:
        - Providing connectivity over private dedicated networks and
        - Public Internet for the provision of health information technology

Caution:

- Project parameters vary widely and are specified as RFPs are posted.

Colorado Department of Local Affairs (DOLA)

The Colorado Department of Local Affairs (DOLA) issues both planning and middle-mile infrastructure grants through the Energy/Mineral Impact Assistance Fund (EIAF). In 2015, DOLA earmarked $20 million for broadband development that will not compete with other EIAF applications.

The DOLA funds are designated for planning and infrastructure. Some of the DOLA planning grant money went to fund this report. The grants were implemented as a way to offer broadband access that will enhance economic growth, support communities' character, and encourage greater quality of life for residents.

Who Can Apply:

- Regional councils of governments (or similar collaborations)
- Communities that are economically or socially impacted by the development of energy and mineral resources.
- Directed to smaller and more rural communities
- Note: Public Private Partnerships are encouraged.

Grant Amounts Available:

- Total $20 million

Local Match Required:

- Dollar-for-dollar basis
- Minimum local match is 25 percent (25%) if applicant's financial status prevents a 50/50 split.
- Sub-regional (county) plans must contribute a minimum of 50 percent (50%) match.

Website for More Information:

https://www.colorado.gov/pacific/dola/broadband-program

Types of Projects Covered:

- Broadband Planning
    - Needs assessments
    - Regional plans identifying network gaps
    - Strategies, solutions
- Middle Mile Infrastructure
    - Investment in equipment and inputs
    - Manufacturing of equipment

- Drilling
- Construction
- Ductwork
- Maintenance
- Connectivity from backbone to community
- Local area networks - loop of CAIs (fire stations, law enforcement, schools, etc)
- Minimum geography: county-level
- Consistent with regional plan
- Conduit, fiber, towers, ROW, appurtenances, etc.
- Must have operations & maintenance plan (sustainable)

Caution:

- Private sector application counterpart under consideration by the Broadband Deployment Fund will be given special consideration in order to leverage State funds.
- Middle mile infrastructure will be considered to terminate at local fiber loops connecting CAIs.
- Fiber to publicly-owned towers or other critical public infrastructure will be considered middle mile.
- Infrastructure grant applications will be considered only after demonstration that the proposed project is consistent with a regional broadband plan and sub-regional (county) plans.
- Last mile connections are not eligible.
- Applicants that fall under SB 05-152 (CRS 29-27-101 et seq.) restrictions are limited to dark fiber only if it is intended to benefit non-governmental users (e.g., private citizens, businesses) will be limited to dark fiber.
- 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.
- Applicant will be required to allow use of any infrastructure for public safety purposes.
- Applicant must agree to share infrastructure location information (GIS) to assist the state in building an asset inventory.

Broadband Infrastructure Network

The Broadband Infrastructure Network was created to enhance unserved communities by increasing the number of residents with broadband access. This includes establishing a solid network that can be used for generations to come.

Who Can Apply:

- For-profit entities

- Nonprofit telephone cooperative or a nonprofit rural electric association that existed on May 10, 2014.

Grant Amounts Available:

- Up to $2.4 million beginning Jan 1, 2016
    - Up to 75 percent (75%) of infrastructure costs

Local Match Required:

- At least 25 percent (25%) of total project cost
- Certain in-kind matches allowed and requires appraisal for in-kind matches

Website for More Information:

https://www.colorado.gov/pacific/dora/broadband-fund-application-proces

Types of Projects Covered:

- New infrastructure only
- New project (e.g. not an existing project)
- Last mile service shall be included
- Can include middle mile service

Caution:

- In-kind matches cannot include planning, operation expenses, or consulting.
- Does not cover maintenance or operations expenses.
- Project does not duplicate or conflict with other funding sources.
- Meets industry reliability standards.
- Must show the ability to operate the proposed system for at least 5 years.
- Must supply GIS information.
- Must show reasonable cost per household.
- Must show reasonable service cost per end user.

Local Fund Sources

Two of the most common types of local funding mechanisms are Special Districts (SD) and Local Improvement Districts (LID). Special districts (CRS Title 32) have the distinction of enduring beyond the life of debt service. Thus, a SD can be organized to initially fund a program and function as a vehicle for enduring operations and maintenance. Local Improvement Districts (CRS 30-20-6) and Business Improvement Districts (CRS 31-21-12) (BID) exist only as long as a program or project needs to be funded and associated debt paid.

Broadband development is not one of the specified purposes allowed for SDs, LIDs, or BIDs. However, utility improvement districts may be an option in the future since the FCC has started down the path of establishing broadband as a utility. Of these mechanisms, LIDs are the most flexible.

A 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[40] seems to be common. See Figure 20 for a flow chart of this process.

[40] Lorimer County, 'Local Improvement District Customer Assistance Packet', Local Improvement District, April 2009, http://www.larimer.org/engineering/impdist/lidpackt.htm, accessed 25 May 2016.

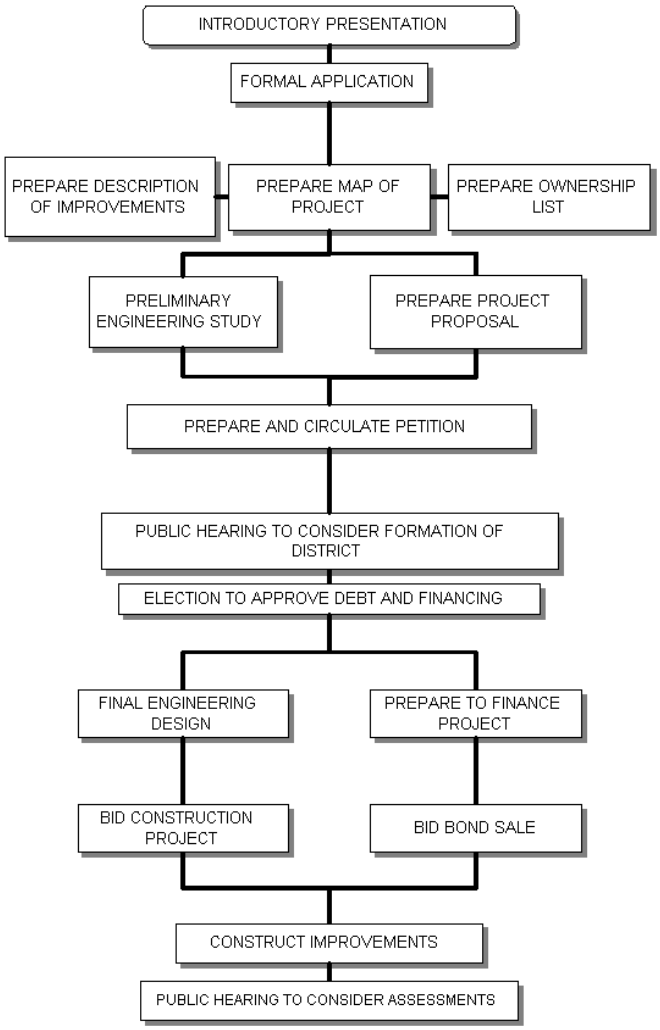

Figure 10: Local Improvement District Flowchart of Events

The table below offers an “at a glance” summary of the various funding mechanisms discussed and the most common projects they cover.

	Capital Expenses						Planning	Who?					Match		Location		
	Tower Infrastructure	Middle Mile	Last Mile	Operations Expenses	Maintenance Expenses	Education/Training	Feasibility/Strategic	Public	Non-Profit	Private	PPP	Consortium	Cash	In-Kind	Rural	Unserved	All
FEDERAL																	
Community Connect Grant	Y	Y	Y		Y			Y	Y			Y	Y		Y	Y	
Distance Learning and Telemedicine Grant	Y	Y	Y			Y	Y	Y	Y			Y	Y	Y	Y	Y	
Farm Bill Broadband Grant and Guarantee Loan Program	Y	Y	Y					Y		Y		Y	M	M	Y	Y	
Community Facilities Direct Loan and Grant Program			Y					Y	Y								
FCC Healthcare Connect	Y	Y	Y					M	M	M		Y					
FCC E Rate	M	M	Y					M				M	Y		Y	Y	
FCC First Net	Y		Y					Y				Y			Y		
STATE																	
Colorado Telehealth Network			Y					Y	Y			Y			Y	Y	
DOLA EIAF	Y	Y					Y	Y			Y		Y	Y	Y	Y	
Broadband Infrastructure Grant	Y	Y	Y						M	Y	M		Y	Y	Y		
LOCAL																	
Special District								Y									Y
Local Improvement District	M	M	M					Y									Y
Business Improvement District								Y									Y

APPENDIX

PULBIC MEETING NOTES

On 16 March 2017, we held a public meeting with the help of SLV DRG. N. Walowitz, regional broadband coordinator for the Northwest Colorado Council of Governments and P. Recanzone presented.

FROM THE N. WALOWITZ PRESENTATION:

Why do we need broadband?

- Economic Development issues/wishes
  - Industry - health and education are both looking for better connectivity
    - Education would like to extend into the entire valley
    - Telehealth would like to grow
      - The health care industry would like to extend telehealth to people's homes; not just clinic to hospital but clinic/hospital to the home
      - Governor's state innovation model is working to identify models that work and how does a payment model work for telehealth home visits?
      - Human services and others need access to peoples' homes - especially homes with young children - for speech therapy and other services. How do we extend broadband services to meet these needs?
    - The continuing expansion of cloud services and other hosted services demand both abundant and reliable broadband services.
    - What are the target industries for economic development?
      - Aeronautical and light manufacturing
      - Telecommuting industries
  - The valley's medical and professional services sectors can recruit because young professionals like to come for the low cost of living and eliminate their debt service. However, retention is another question.
- Government needs

    - City of Alamosa and Monte Vista partner and have an IGA. For Alamosa IT to support the two cities connectivity is required.
    - Broadband and public transit. Can broadband help eliminate some of the public transportation needs?
    - Jails can reduce transport needs through video arraignments and hearings
- Quality of Life issues
    - Crestone residents involved in spirituality would like to stream their events
    - Online services are becoming an integral part of people's lives
- Utilities and public infrastructure require a certain degree of telemetry
- Public Safety Needs
    - South Fork is moving to a remote/synchronized model because of lack of confidence in reliable connectivity.

What challenges do providers face?

- REC is struggling with materials and right of way acquisition
- Colorado Central is struggling with limitations of wireless

So, what does the future look like? What do we need to do to make it work?

- There will have to be a cooperative effort - local projects offer significant value
- More direction as to what has to happen
- Right of way and infrastructure materials
- Jade expressed (through a proxy) how incredibly expensive this is
- A fiber to the tower with a wireless solution might be the best model forward; maybe a hybrid model makes more sense to the region
- Let's all work together to develop a common infrastructure; maybe community owned and multi-service provider - or multiple operators/network owners…

What if we tried to pull together some model of common infrastructure?

- There is abundant broadband into the valley though reliability is suspect because most backhaul providers follow the Same path; Connections to Denver and other peering points is only going through La Veta Pass. Fiber redundancy in the backhaul is insufficient because of the dependency on microwave for path diversity.
- There is a weakness in the regional and last mile

What are some of the challenges of moving to a shared infrastructure model?

- Larger service providers want to be the end-to-end owner.
- Service providers worry about how to control the customer experience
- Would a shared infrastructure model interfere with the work Jade and the REC are already engaged in? Why don't we begin the conversation with Jade and get them together with the REC and see if we can continue their existing successful model?

What does REC need to get to market faster and is there an interesting cooperative model?

- Supply of materials
- Access to capital funds (in some cases) - grant money would be very helpful

If we all have to get on the same page, it is never going to happen. How can we be moving at different paces but still having the right kind of conversations? Will collective action on grants work better than the REC's individual work?

- Maybe the broadband steering committee can help create the universal model
- Everyone can have a plan and the committee help coordinate them
- Many grants require a public grantee own the infrastructure

The elephant in the room is how do we help everyone? Especially when not everyone is on the same page?

There may be some regional projects that we may be able to drive additional growth - for example, education and health and public safety?
Is there a basic level of service we can all agree upon and build to that?
Are Jade and the REC going to be able to create a working relationship?

Regional resource pooling is similar to the proposed shared infrastructure model

- Region 10 is planning on pooling resources and grant funding.
- Pooling purchase power across multiple buyers might work.
- Education development through e-rate: can we do a consortia bid?

NOTES FROM N. WALOWITZ

Notes from San Luis Valley Strategic Broadband Brainstorming Meeting

March 16, 2017

Network application usage:

Streaming video, banking, student use

Economic Development Opportunities and Challenges

Healthcare including Telehealth (care at patient's residence)

Education

Adams State University

K-12 – Brian Shepherd mentioned there are at least 3 schools that do not have fiber or broadband access. This needs to be verified, but there is an opportunity for improvement.

Cloud Hosted Service

Extended workdays and opportunities for telecommuting

Targeted Investments

Need broadband and infrastructure funding

GIS

Question about what can be done in Costilla County to meet their needs?

Conversation turned to opportunities for Fiber to the Premise and Fiber to the Tower and noted the capital intensive nature of these types of investments.

Access to capital funds –

Federal Grants – RUS – e-Rate – DOLA

e-Rate can fund fiber – leverage this funding vehicle to route fiber to mutual benefit of other entities as well.

Conversation about possibility of leveraging federal broadband funding for healthcare providers and facilities

Where are the challenges?

Last Mile, Regional Middle Mile, Middle Mile

Current middle mile providers are Zayo, CenturyLink, Skyworks, CDOT

Redundant middle mile would be beneficial

Last Mile –

Fiber from SLV REC and

Can there be a cooperative relationship created to procure deployment materials

REC has challenge procuring materials due to other worldwide providers placing large orders and REC orders being delayed significantly due to low priority.

Generating interest in a conversation about sharing infrastructure with multiple providers across the region was difficult.

POTENTIAL IMPLEMENTATION SCENARIO

This strategic plan lays out a high level shared infrastructure strategy to meet the regions broadband development goals through collaboration between public and private projects and amongst the region's various private sector providers. The tactical path, that is, the actual implementation, can take many forms.

MAJOR COMPONENTS

There are four major interrelated components to implement:

- Establish the Legal Framework for public sector projects

- Establish an organizational structure to manage the proposed shared infrastructure environment
- Design and implement shared infrastructure
- Operate and maintain shared infrastructure

Let's briefly examine each in turn.

LEGAL FRAMEWORK FOR PUBLIC SECTOR PROJECTS

CRS Title 29 Article 27 (also known as "Senate Bill 152") places restrictions on public sector broadband development. Public sector entities cannot engage in broadband development or service delivery for other than their own use without a vote of the relevant constituency. These votes are commonly called "SB 152 overrides". In another appendix, we have provided some of the language that has been used in successful SB 152 overrides elsewhere in Colorado.

In addition to an SB 152 override, public sector projects may require some sort of funding authorization. Funding authorization will depend on the selected funding model.

Finally, the organizational structure (discussed below) may require voter action to implement.

ORGANIZATIONAL STRUCTURE

In order to manage public and private sector infrastructure in a shared infrastructure model throughout the region, a governing organizational structure must be in place. Many organizational structures are possible. We have looked at four:

- Ad Hoc
  An ad hoc governing structure would establish network and performance standards and memorialize them with contracts between the various participants. Each project would remain largely autonomous from others.
- Permanent Governing Board
  More formally, a permanent governing board of participants and other key stake holders could be established. This board would help manage the contracts between the various participants and would resolve any conflicts or concerns as they arose.
- Broadband Authority
  The region could elect to establish a broadband authority to govern the interactions between the various network owners. A broadband authority would have the ability to influence (or even dictate) business objectives.

Each of these organizational structures represent increasing levels of centralized control of the broadband environment in the region. An ad hoc structure represents the least possible centralized control and leaves the bulk of authority and responsibility on the shoulders of each network owner. This ad hoc structure would strongly favor private sector participants and would likely result in their dominance in broadband development decisions.

Establishing a broadband authority represents the strongest centralized control model. The broadband authority would exercise greater control over where future construction happens and would control other broadband development decisions in the region. A broadband authority represents the best opportunity for public sector entities to maintain control of the future of broadband development in the region.

A permanent governing body is a reasonable compromise between an ad hoc structure and a broadband authority. A governing body could be carefully structured to balance power between public and private sector entities.

- Third Party Management

  A fourth option is the possibility of third party management of the regional shared infrastructure. Of course, each network owner would maintain control of their infrastructure and each service provider would maintain control of their subscribers. The third-party management entity would serve as a bridge between foreign network owners and service providers making all network owners look the same to the various service providers and making all service providers look the same to the various network owners.

Each organizational structure has its advantages and disadvantages. We believe the limited business case for broadband development in the region coupled with the existing efforts of Jade and San Luis Valley Rural Electric Cooperative (two private sector network owners) suggests the need for a broadband authority. However, implementing a broadband authority would represent a significant shift in control of the broadband environment in the region. This step would likely be perceived as a public sector overreach.

A reasonable alternative is to establish a permanent governing board supported by a third party management organization.

Before establishing any organizational structure, key participants must be consulted. As part of the efforts to complete this regional broadband strategic plan, we introduced the idea of a shared infrastructure model to San Luis Valley Rural Electric Association, Jade, Colorado Central Telecom, the City of Alamosa, and others. We did not experience outright rejection from any of

the potential participants. However, neither did we receive enthusiastic support from many of them.

SHARED INFRASTRUCTURE DESIGN AND IMPLEMENTATION

Design and implementation requires significant resources and skills. It is anticipated each network owner will continue to design and implement their individual networks. However, the organizing body should work with each network owner to establish reasonable design guidelines that will make it easier for the various networks to function together in a coordinated regional shared infrastructure.

Public sector development should be undertaken separate from the current private sector network owners. Public sector investment is an important enticement to encourage private sector network owners to make their networks available on a wholesale basis.

As described earlier, there are several funding mechanisms available to the public sector. It is likely a combination of funding mechanisms will be the best solution for the region. We developed a simple projection model based on our previous experience with similar projects. Assuming full debt funding of capital expenditures to include capitalized operational losses and capitalized debt service. Assuming both Alamosa and Monte Vista participate in public sector fiber to the premises projects, total borrowing would be $7,350,000. At no time would public funds be used in the project. The project would be cash flow positive after month 21 and would generate about $100,000 per year that could be used to continue to expand the network. Once debt service is complete, that amount increases to about $730,000 per year.

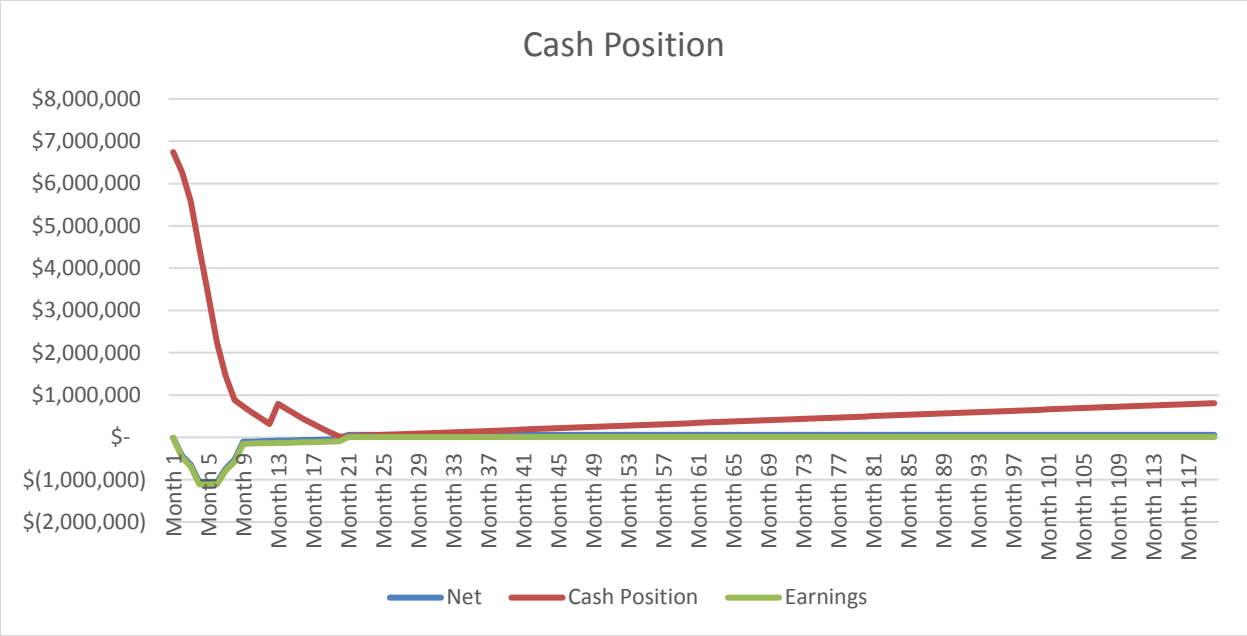

Figure 11: High Level Cash Position for Combined Alamosa and Monte Vista Fiber to the Premises[41]

Grant opportunities will likely improve this forecast.

SHARED INFRASTRUCTURE OPERATIONS AND MAINTENANCE

With shared infrastructure comes some degree of shared operations and maintenance. By and large, we anticipate each network owner will be responsible for the operations and maintenance of their individual networks. Public sector entities who implement networks but do not have operations and maintenance capabilities can contract with existing private sector network owners or with a third party operations and maintenance organization.

POSSIBLE MILESTONES

In the Next Year

To accomplish the proposed solution, we recommend that in the next year the region establish a team to move the strategy forward. This is likely the team that will be appointed by the COG in the first quarter of 2017. That team should immediately begin in depth consultations with the various network owners and potential network owners in the region. The purpose of these consultations is to establish the intended organizational structure.

With an organizational structure established negotiations for shared infrastructure usage should be possible. The next step is to formalize network standards and wholesale contracts.

[41] The model used to generate these data is found in a separate "SCCOG Simple Model.xlsx".

This should allow for the first wholesale-retail split subscribers. These will only be between private sector network owners in the first year as the public sector has yet to build infrastructure.

In time for the odd-year election cycle, the team should establish if the organizational structure needs to come to a vote. The team should also establish the scope of one or more SB 152 overrides.

Simultaneously to developing an organizational structure and preparing SB 152 overrides, the public sector participants must establish a financing plan. The plan may be dependent on the SB 152 overrides or it may require a publicly established organizational structure. Financing may require a vote.

Expediency may drive all required votes onto a single ballot or may force votes to separate ballots. The team should decide the best path to electoral success but should then be ready to e flexible.

In the first year, the following should be complete:

- Organizing team in place
- Final organizational structure defined and implemented
- Shared infrastructure standards and contracts agreed to
- First wholesale-retail split subscribers come on line
- Required SB 152 override vote(s) complete
- Financing plan developed

In the Second Year

With the organizational structure in place, SB 152 overrides done, and private sector network owners demonstrating good faith by implementing wholesale-retail split contracts, it is critical that in the second year the public sector make infrastructure investments.

The first investment should be a county led effort to identify important vertical asset locations and implement towers to allow extension of fixed wireless services to unserved and under served areas. Tower sites should be selected in consultation with all participating public and private sector members.

The second investment should be fiber to the premises design, engineering, and implementation in Alamosa and Monte Vista.

In the second year, the following should be complete:

- Initial shared tower sites implemented
- Design and engineering for Alamosa and Monte Vista complete and implementation under way.

In the Third Year and Beyond

By the third year, Alamosa and Monte Vista implementation should be complete. Jade and San Luis Valley Rural Electric Cooperative should be coordinating continued expansion of their fiber networks. Some shared tower assets should be in place.

The third year represents year 1 of the accompanying “SCCOG Simple Model.xlsx”. By year three of the model (the sixth year from plan start), public sector projects should be generating sufficient revenue to continue public sector network expansion.

SERVICE PROVIDER SUMMARIES

Each entity researched expressed a desire to expand broadband services throughout the San Luis Valley. 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.

CENTURYLINK

CenturyLink is very much interested in broadband development through private/public partnerships and we have been working with communities on a variety of initiatives across the state.

They welcome the opportunity to discuss in more detail the services they offer today and their plans in Colorado to deploy broadband in un-served and high cost areas over the next six (6) years through federal funding made available through the Connect America Fund (CAF) 2.

CenturyLink announced on August 27, 2015 that it will accept in Colorado $26.5 million annually for the next six (6) years and is committed to deploying broadband service as defined by the Federal Communications Commission (a minimum of 10 mbps down and 1 mbps up bandwidth speed) to more than 50,000 eligible households and businesses in Colorado.

CenturyLink is currently developing our year one (1) building plans and will be available to discuss them once they are finalized and they look forward to meeting with broadband stakeholders in the San Luis Valley.

CHARTER COMMUNICATIONS, INC.

Charter Communications, Inc., founded in 1993, created a customer service-oriented company that has grown and evolved on many levels over the past two decades. Charter's growth has been achieved through acquisitions of cable properties and the subsequent increase of customers in those communities, as well as the development and launch of new products and services. Charter became a publicly-traded company on NASDAQ in 1999 and has been a Fortune 500 company since 2001.

A leading broadband communications company and the fourth largest cable operator in the United States, Charter today employ approximately 23,000 and provide services to more than six million customers in 28 states. Headquartered in Stamford, Connecticut, the company is focused on integrating the highest-quality service with clearly superior entertainment and communications products.

Over the years, Charter has invested billions in the communities it serves through infrastructure upgrades, allowing the company to deliver industry leading video, high-speed Internet and phone service to homes and businesses. In 2014, Charter completed its transition to an all-digital network and launched the Charter Spectrum brand leveraging the power of the network to offer leading products and services to its customers.

Quality Products and Services:

Unleashing the unique power of our superior two-way, interactive digital cable plant, Charter provides a full range of communications and entertainment products and services. Our residential services include the following:

- Charter Spectrum TV offers more than 200 HD channels, DVR service and a choice of over 10,000 On Demand movies and shows. Customers can watch TV everywhere on tablets, smartphones and other portable devices with the Spectrum TV app, including over 170 live TV channels available throughout the home and more than 60 networks available on the go.
- Charter Spectrum Internet provides download speeds starting at 60 Mbps (100 Mbps in St. Louis) with no data caps; 20 times faster than DSL. Customers can stream video, play online games, download music, upload photos and more across multiple devices in their home without sacrificing performance. Charter also provides the fastest, most powerful in-home WiFi to do more across all devices.
- Charter Spectrum Voice is a fully featured voice service that includes unlimited local and long distance calling in the U.S., Canada and Puerto Rico and 18+ popular calling features, including free 411 and voicemail.

The Spectrum Business division of Charter Communications provides a broad range of services for business organizations with scalable, tailored, and cost-effective broadband communications solutions, including business-to-business Internet access, data networking, business telephone, video and music entertainment services and wireless backhaul.

Catering to the unique broadband needs of business customers, Spectrum Business offers competitively priced bundled products over its state-of-the-art, fiber based network, and helping businesses in a variety of industries maximize efficiency while continuing to grow. Spectrum Business is Metro Ethernet Forum Certified.

Spectrum Reach is the advertising sales division of Charter Communications. The division offers custom solutions for the modern media landscape utilizing national cable networks, internet advertising, and promotional events supported by marketing, research and award-winning creative services. Spectrum Reach applies insightful research to understand consumer behavior and build targeted, multi-screen media plans personalized for each customer.

With offices in twenty six (26) states, Spectrum Reach covers over three million households throughout the country. From traditional commercial advertising to exciting new possibilities in interactive media and multi-screen solutions, Spectrum Reach's consultative team brings advertisers effective, efficient ways to turn our audiences into their customers.

They are willing to discuss opportunities in the San Luis Valley Region to expand their network.

COLORADO CENTRAL TELECOM

Colorado Central Telecom was founded in 2011 through a grassroots effort to improve internet service in the Crestone area.

Colorado Central Telecom leverages a hybrid fiber/fixed wireless network with more than two dozen towers and repeater sites throughout its service area. The network uses multiple sources of redundant backhaul, including fiber and licensed microwave links.

The flexibility of Colorado Central Telecom's fixed wireless infrastructure has allowed it to connect underserved communities in Center, Crestone, Moffat, Saguache, Villa Grove, Maysville, Salida, Nathrop and Buena Vista.

Colorado Central Telecom now provides internet and VoIP phone service to 2,200 business and residential clients throughout the upper San Luis Valley and Chaffee County.

Colorado Central Telecom's first client came online April 4, 2012. After rapid growth in the northern San Luis Valley, the company expanded into the Upper Arkansas River Valley at the urging of the Chaffee County Economic Development Corporation. Monarch Mountain – the company's first client in Chaffee County – was connected on January 1, 2013.

Colorado Central Telecom acquired Matrix Internet Services and Mountain Computer Wizards in 2015, expanding its fiber footprint in the Buena Vista area. To better serve its local clients, Colorado Central Telecom has opened brick-and-mortar locations in Crestone and Buena Vista.

Colorado Central Telecom remains committed to bridging the digital divide in Central Colorado. It welcomes opportunities to expand its network through collaborative efforts and public private partnerships.

FAST TRACK

As a last-mile and middle-mile provider, they build the fiber optic infrastructure to connect communities internally and externally, spurring economic development. Partnerships with local ISPs serving residential communities extend their high speed Internet connections to homes throughout Colorado and New Mexico.

As if their fiber optic Internet connection wasn't already speedy, they've upgraded their IP network to 3.5 terabytes of throughput capacity. FastTrack's high speed network supplies Colorado and New Mexico businesses and public entities with data transport, high speed Internet, VDSL2, MPLS, voice, bundled solutions (voice and Internet) and customized solutions.

They are interested in discussing possible expansion of their network.

EAGLE-NET

EAGLE-Net started with a vision to bring high-speed Internet to every public school in Colorado through public/private partnerships to build a comprehensive, statewide network.

In 2007, the Centennial Board of Cooperative Educational Services (CBOCES) developed EAGLE-Net as a cost-sharing consortium for Colorado. After conducting a broadband survey of all of Colorado's K-12 school districts in 2008, CBOCES/EAGLE-Net determined that market forces weren't sufficient to drive technological investment in Colorado's most remote, rural and underserved areas. It found that Colorado ranked 42nd out of all 50 states in broadband connectivity. In response to these findings, CBOCES, as the operator of the EAGLE-Net network became an American Registry for Internet Numbering (ARIN) acknowledged Internet service provider with its own IP addressing capability.

In 2009, EAGLE-Net responded to 78 school district requests for Internet services and began to connect districts to the EAGLE-Net network. In coordination with the American Recovery and Reinvestment Act (ARRA) and Colorado's Recovery Act Broadband Framework, CBOCES determined that in order to expand its technology-rich broadband Internet services, it would respond to the Round-1 notice of funding availability offered via the U.S. Department of Commerce Broadband Technology Opportunities Program (BTOP), with the intent to create the EAGLE-Net Alliance as an independent intergovernmental entity to deploy and operate the statewide network.

The initial Round-1 BTOP application proposed using public/private partnerships to improve Colorado's technological infrastructure. Although the Round-1 application was not funded, another application for connecting Colorado's middle mile was submitted in Round-2 and was awarded a $100.6 million grant from BTOP in September 2010.

EAGLE-Net is moving forward to build new infrastructure and provide broadband services to community anchor institutions throughout Colorado. They are willing to explore opportunities as they become available.

FAIRPOINT COMMUNICATIONS/COLUMBINE

FairPoint Communications delivers a range of affordable data and voice communications services to businesses, including public and private institutions, as well as residential and wholesale customers in seventeen (17) states.

There's Strength in the Numbers.

- 100+ years of combined telecommunications service
- Operations in seventeen (17) states
- More than 21,000 fiber route miles
- Largest network in northern New England
- More than 17,000 fiber route miles and 90% percent of our central offices enabled for Carrier Ethernet Services in Maine, New Hampshire and Vermont.
- 95% network coverage of northern New England businesses
- More than $700 million invested in infrastructure and technology to reach new customers, upgrade its network and enable the next-generation of communications technology since 2008
- Approximately 2,700 employees as of Q4 2015
- More than $1 million in charitable and civic contributions in 2015

The FairPoint Difference:

Superior Network:

- Their customers can count on FairPoint to keep them connected. Their fiber-core, Ethernet network powers today is technology and tomorrow's possibilities through both traditional and cutting-edge IP-based services.

Local Support and Presence:

- FairPoint employees are neighbors to their customers. They are fellow investors and volunteers in their local communities. They are firmly dedicated to their customers and their satisfaction with their service.

Best-in-Class Customer Experience:

- Even as the way they connect continues to evolve, FairPoint's commitment to providing trusted, best in class service that their customers can count on is unwavering. FairPoint builds and inspires confidence in their team by being reliable, responsible, responsive, honest and caring.

Value for the customer:

- FairPoint believes their customers choose them because they deliver the overall best value. They believe value is in the eye of the beholder. Therefore, value is not necessarily the lowest price or the latest technology, but right-sized scalable services designed and supported by experienced local teams.

They are willing to discuss opportunities in the San Luis Valley to expand their services and offerings.

JADE COMMUNICATIONS/BLANCA TELEPHONE

Founded by William Tessler in 1926, Blanca Telephone Company was the first telephone company in the San Luis Valley. Blanca Telephone has always been a leader in innovation for rural Colorado Communications. As early as 1995 Blanca began implementing fiber into its network and providing broadband services. Over the last fifteen years, Blanca Telephone has been extending fiber services to the premises and now offers fiber to the premises in Blanca, Ft. Garland, Sangre de Cristo Ranches, Forbes Park, and Wagon Creek

Founded in 1990, Jade Communications began as a cable television provider, providing DirecTV and other television services to the residents of the San Luis Valley. Seeing the need to provide Internet to residents living in rural areas, they began offering satellite Internet in 2000. Shortly thereafter, in 2003, they started their hallmark service: Canopy Wireless Internet. Since its inauguration, they have expanded their network, constructing a total of eighteen (18) service towers, serving a total of twenty five (25) communities, and covering a total of 4157 square miles in Southern Colorado. That's more square mileage than Delaware and Rhode Island combined.

One of the many things they pride themselves in is their dedication to innovation. In 2010, they constructed a fiber optic route from Alamosa, over La Veta pass, to I-25. Simultaneously, they constructed two (2) additional backup routes out of the San Luis Valley – the first, a microwave route, runs from Alamosa, Colorado to Taos, New Mexico, and, the second, a fiber optic route, runs from the San Luis Valley to Northern New Mexico. These additional routes were constructed so that their customers always, regardless of environmental catastrophes, have service. Aside from all these advancements, they continued to build their wireless Internet network, serve their customers, and change the way Southern Colorado receives Internet.

Jade offers fiber to the premises services in San Luis and Del Norte.

Jade Communications is very interested in discussing opportunities to expand their networks.

SAN LUIS VALLEY RURAL ELECTRIC COOPERATIVE/CIELLO

CIELLO is the San Luis Valley's first fiber optic broadband Internet service provider. Their state-of-the-art network provides reliable connections to the Internet at high speed. San Luis Valley Rural Electric Cooperative (SLVREC) services Rio Grande, Costilla, Saguache, Alamosa, Conejos and Mineral Counties.

At present, They have an eighteen (18) year build-out of the network which started April 2015 with phases 1 and 2 (South Fork and Creede) being complete. When completed, the network will cover the six (6) counties stated above.

They are very interested in any opportunities where their current plan can be expanded and advanced to serve our San Luis Valley communities.

SECOM

SECOM is the broadband internet and telecommunications subsidiary of Southeast Colorado Power Association (SECPA), an electric power cooperative formed in 1937. SECOM has been providing competitive and innovative data transport solutions, based on high-speed fiber optic lines and equipment, since 1998. We own and maintain more than 1,300 miles of fiber throughout Southeastern Colorado, a number that is constantly growing as we expand in both area and penetration.

SECOM has pioneered a fully integrated "metro" ethernet platform, which provides access to subscribers on the same type of interface that a local area network uses and avoids extra WAN equipment.

In 2008, SECOM purchased Rural-Com and Plains Online, two local internet service providers, expanding our platform to include residential wireless broadband, as well as dial-up internet services. We now provide broadband internet and WAN services to thousands of customers including homes, schools, libraries, government entities, telecoms, and other businesses.

SECOM is interested in exploring ways to extend their network in rural Colorado.

SKYWERX

SkyWerx is a locally owned Wireless Internet Service Provider (WISP) based in Pagosa Springs, Colorado. Their continually expanding wireless infrastructure has been designed to effectively deploy high speed wireless Internet to the community and surrounding areas of Pagosa Springs, Bayfield, and Durango, Ignacio, and beyond. They are dedicated to bringing high speed Internet

access the community. SkyWerx is a service provider and their number one mission is to provide the highest quality Internet related service and technology to their customers.

SkyWerx has a minimal presence in the San Luis Valley. However, they are willing to explore other opportunities.

UNITE PRIVATE NETWORKS

Unite Private Networks (UPN) provides high-bandwidth; fiber-based communications networks and related services to schools, governments, carriers, data centers, hospitals, and enterprise business customers throughout the United States. Service offerings include dark and lit fiber, private line, optical Ethernet, Internet access, data center services, and other customized solutions.

UPN currently serves over 300 communities across 20 states, with over 6,000 metro fiber route miles, and 3,500 on-net buildings.

UPN has a proven history of successful completion of large and complex fiber-optic construction projects, on time and on budget. Customer relationships typically include long-term agreements (10-20 years) for fiber-optic connectivity between multiple facility locations. UPN manages all phases of the customer relationship, including RFP response, construction management, network reliability, technical assistance, and customer service, to facilitate a long-term partnership with the customer. UPN also has significant experience working with federal E-Rate program guidelines for K-12 school districts.

UPN is regulated by Public Service Commissions of each state in which UPN operates and also by the Federal Communication Commission, with periodic reporting requirements and service standards. UPN is a certified E-Rate service provider.

Headquartered in the Kansas City, MO metro area, UPN has been providing customer-focused communications solutions since 1998.

UPN is focused mainly in the Education Industry. However, they are willing to discuss opportunities.

ZAYO GROUP

The Zayo Group provides communications infrastructure services, including fiber and bandwidth connectivity, colocation and cloud services to the world's leading businesses. Customers include wireless and wireline carriers, media and content companies and finance, healthcare and other large enterprise networks.

Today's world runs on bandwidth. That's not an observation designed to impress you. It's a fact. There are more users, more devices and more advances in data-driven services than ever before. And what does that mean? The demand for bandwidth will continue to increase.

Their mission is simple. They accelerate capabilities to bring freedom and prosperity to the world by providing enormous high-quality bandwidth for the world's leading companies. These include wireless and wireline carriers, media and content providers, finance and healthcare organizations and other large enterprises. It has been our focus since our inception in 2007. Since then, Zayo has evolved into the leading global communications infrastructure services provider, with calling cards such as high-performance connectivity, secure colocation and flexible cloud services.

They own and operate an 110,000 mile network in the United States and Europe. This all-fiber backbone – 7.7 million miles of it includes connectivity to thousands of data centers, enterprise locations, carrier exchange points, wireless towers, media centers, entertainment venues, financial exchanges and cloud providers. They offer dark fiber services, which provide their customers with dedicated high-capacity, low latency bandwidth. In addition, their offerings encompass a range of managed bandwidth, lit fiber solutions, including wavelength, Ethernet, IP and video transport, and our expansive network footprint and extensive metro coverage deliver bandwidth that is flexible and scalable for enterprises, carriers and government.

They are willing to explore opportunities to expand their network in the San Luis Valley Region.

SB 152 OVERRIDE INFORMATION

The following is from a memo dated 31 July 2015 from Geoff Wilson, General Counsel for the Colorado Municipal League and Eric Bergman, Policy Director for Colorado Counties, Inc. The subject of the memo was Materials on SB 152 Elections.

Introduction

In order to compete in today's economy, communities across the state have become increasingly dependent on broad bandwidth Internet access ("broadband") for business development and operations. The availability of broadband also enhances the quality of life and desirability of a community by providing residents access to things like online education and distance learning opportunities, telemedicine and entertainment content (movies, music, etc.). Broadband has become so critical, in fact, that many now regard it as a basic infrastructure need - on par with roads, water systems and energy grids.

Unfortunately, numerous communities across Colorado still lack adequate broadband service. The reasons vary, but more often than not these areas are too sparsely populated, too remote or in regions where the topography (mountainous terrain, etc.) makes expanding service difficult and expensive for telecommunication providers. These communities are "upside down" from a business model standpoint, and providers are unable or unwilling to connect these areas, leaving them at an economic disadvantage from their more urbanized neighbors.

While local governments often play a direct role in economic development efforts, cities and counties historically have not been directly involved in the delivery of retail telecommunication services. However, the increasing demand for broadband service – often driven by economic development concerns - has forced many local government officials to reexamine their role in the provision of broadband services.

In the last few years, a growing number of local governments have started looking at investing public dollars in broadband infrastructure improvements (usually fiber optic cable lines or cell towers) in order to attract Internet providers and enhance economic development efforts in their region. The Department of Local Affairs has also heard these community concerns, and this year expanded its existing broadband planning grant program to include funds for local government investments in "middle mile" broadband infrastructure.

SB 152 and Statutory Prohibitions on Local Government Broadband Infrastructure

One of the biggest impediments to local governments enhancing broadband infrastructure is a law passed in 2005, which has since been commonly referred to as "Senate Bill (SB) 152" (…codified at sections 29-27-101-304, C.R.S.). SB 152 prohibits most uses of municipal or county money for infrastructure to improve local broadband service, without first going to a vote of the people. The hurdles put in place by this statute are not insurmountable; indeed, in the past few years ten municipalities and three counties [since this memo was written in 2015, the number has climbed significantly] have placed measures on the ballot to override the

prohibitions in SB 152. These measures have passed handily in virtually every jurisdiction - with the support of citizens who are frustrated and want timely action on broadband service in their communities.

Continued dissatisfaction over a lack of adequate broadband is resulting in more and more jurisdictions considering going to the ballot with SB 152 questions. Late in 2014, CML and CCI began meeting with local government officials, economic development professionals and telecommunication experts from jurisdictions whose voters had approved SB 152 questions at the ballot. One outcome of these conversations is the development of this memorandum and materials designed to help interested local government officials and staff to frame the issue and consider the impacts of preparing their own ballot questions.

SB 152 Frequently Asked Questions (FAQ's)

What does a SB 152 election accomplish?

SB 152 requires that an election be held before a local government may "engage or offer to engage in providing" various telecommunication services. The term "providing" is given an expansive definition in the statute, which restricts both the direct and "indirect" provision of service ("indirect", in turn, is given its own, broadly restrictive definition). Fortunately, through a successful SB 152 election, a local community can clear away this legal impediment to a wide variety of local broadband initiatives.

It is important to point out that the vast majority of local governments who have passed SB 152 questions (or are considering going to the ballot in the near future) are **not** interested in hooking up homes and businesses and providing actual broadband services themselves. By and large, these jurisdictions are working to enhance local broadband infrastructure in order to *attract* service providers who would otherwise be unwilling or unable to serve their communities. The local broadband initiatives in the jurisdictions passing SB 152 questions to date usually involve some form of public-private partnerships between local governments, economic development agencies and the industry.

Is referring a SB 152 question to the ballot expensive?

No more so than any other referred measure. Most jurisdictions have referred their questions when the municipality or county was *already* having an election. Accordingly, the addition of the SB 152 issue did not significantly increase costs. In a coordinated election, a particular jurisdiction's costs would be affected by the terms of the IGA regarding election cost allocation between the county and participating local governments.

Are there any restrictions on referring SB-152 ballot measures in odd-numbered year coordinated elections?

Apparently not. A wide number of locally-referred questions have been submitted to voters in coordinated elections conducted in odd-numbered years in Colorado. Local governments have regularly referred TABOR questions and home rule charter amendment ballot questions to the voters in odd-numbered years, and this practice is explicitly authorized in C.R.S. § 1-41-103. Additionally, the Attorney General issued an opinion in 1999 (No. 99-8 AG Alpha No. HE CS AGAWD) which concluded that local governments may refer ballot questions on term limits in odd-numbered years as well. Odd-year ballot questions dealing with issues outside of TABOR, charter amendments and term limits are less common, but have been referred fairly regularly by local elected officials over the years without challenge. The language in SB 152 (specifically C.R.S. § 29-27-201(1)) requires that "Before a local government may engage in providing…telecommunications service, or advanced service, an election shall be called on whether or not the local government shall provide the proposed…service." This authorizing language is broad in nature, and does not appear to limit the ballot question to the general election ballot. Again, local government officials are advised to consult with legal counsel in the development of these ballot questions.

What sort of election specifics does SB 152 require?

Not many. SB 152 specifies four requirements for ballot questions in a SB 152 election. (See: C.R.S. § 29-27-201(2))

The ballot:

(1) Shall pose the question as a "single subject",

(2) Shall include a description of the "nature of the proposed service,"

(3) Shall include a description of "the role that the local government will have in the provision of the service," and

(4) Shall include a description of the "intended subscribers of such service."

How have other jurisdictions addressed these requirements?

A review of the ballot questions put forth by local governments so far (included below) shows a clear preference for broad "anything and everything" type authority. Industry representatives have complained from time to time that such local ballot language has lacked the specificity required by the statute. This notion has never been tested in court. One might also argue that a "broad authority" question that describes the nature of the service proposed, along with potential future build-outs or applications, is not fatally flawed by its inclusion of the latter. Furthermore, courts have been traditionally hesitant to reverse the will of the voters, if evident.

Obviously, the development of local SB 152 ballot language should be done in close consultation with legal counsel.

What about the "single subject" requirement?

The term "single subject" is not defined in SB 152. Nonetheless, the ballot questions submitted by local governments thus far seem comfortably within the single subject standard applied to statewide *ballot initiatives,* in cases such as In the Matter Of The Ballot Title and Submission Clause for 2013-2014 #129, 333 P.3d 101 (Colo. 2014). Local government officials are urged to consult with legal counsel.

Are there any additional election requirements that distinguish a SB 152 question from other matters routinely referred to the ballot by a county or municipality?

No (but again, please confer with your legal counsel). As always, attention should be paid to the requirements of the Fair Campaign Practices Act (Section 1-45-117, C.R.S.), which forbids use of public funds for advocacy in elections. This restriction is a prudent consideration in planning any campaign for a successful SB 152 election.

Does voter approval of a county SB 152 ballot question have the effect of authorizing the provision of such services by municipalities within that county?

No. SB 152 requires voter approval by each jurisdiction participating in the provision of covered services.

Does a jurisdiction need to approve a SB 152 ballot question in order to qualify for broadband infrastructure grant funds from the Department of Local Affairs (DOLA)?

It depends. DOLA's broadband grant program provides funding for regional planning and "middle mile" infrastructure projects (i.e., projects that do not provide "last mile" connections to customers). The guidance in DOLA's broadband grant policies suggests that each jurisdiction must determine whether it is in compliance with the statutory restrictions set forth in SB 152. DOLA requires any grantee to be in compliance with any applicable laws and regulations. DOLA itself will not make that determination, nor does the awarding of a grant confer any certainty or acknowledgment of compliance on DOLA's part to the grantee. DOLA's broadband grant policy guidelines can be found at: http://dola.colorado.gov/demog-cms/content/dola-broadband-program.

Sample Local Government Ballot Language for SB 152 Elections

County Questions

Rio Blanco County (Passed Fall 2014)

“Without increasing taxes, shall the citizens of Rio Blanco County, Colorado, authorize the Board of County Commissioners of Rio Blanco County, Colorado, to provide to potential subscribers including telecommunications service providers, residential and commercial users within Rio Blanco County, all services restricted since 2005 by Title 29, article 27 of the Colorado Revised Statutes, including “telecommunication services,” “cable television services,” and “advanced services” which is defined as high speed internet access capability in excess of two hundred fifty six kilobits per second both upstream and downstream (known as “broadband”) including any new and improved bandwidth services based on future technologies, utilizing the existing community owned fiber optic network and/or developing additional infrastructure, either directly or indirectly with public or private sector partners?”

San Miguel County (Passed Fall 2014)

“Without increasing taxes, shall San Miguel County, Colorado, have the legal ability to provide any or all services currently restricted by Title 29, article 27, Part 1, of the Colorado Revised Statutes, specifically described as “advanced services,” “telecommunication services,” and “cable television services,” as defined by the statute, including, but not limited to, any new and improved high bandwidth services based on future technologies, utilizing community owned infrastructure including but not limited to any existing fiber optic network, either directly, or indirectly with public or private sector service providers, to potential subscribers that may include telecommunications service providers, and residential or commercial users within San Miguel County?”

Yuma County (Passed Fall 2014)

“Without increasing taxes, shall the citizens of Yuma County Colorado re-establish their counties’ right to provide all services and facilities restricted since 2005 by Title 29, Article 27 of the Colorado Revised Statutes, described as “Advanced Services,” “Telecommunication Services,” and “Cable Television Services,” including providing any new and improved broadband services and facilities based on future technologies, utilizing existing or new community owned infrastructure including but not limited to the existing fiber optic network, either directly or indirectly with public or private sector partners, to potential subscribers that may include telecommunications service providers, residential or commercial users within the boundaries of Yuma County?”

Municipal Questions

SPRING 2015

GRAND JUNCTION

PASS: 75%-22%

CITY OF GRAND JUNCTION REFERRED MEASURE 2A SHALL THE CITY OF GRAND JUNCTION, WITHOUT INCREASING TAXES BY THIS MEASURE, BE AUTHORIZED TO PROVIDE, EITHER

DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR PARTNER(S), HIGH-SPEED INTERNET SERVICES (ADVANCED SERVICE), TELECOMMUNICATIONS SERVICES AND/OR CABLE TELEVISION SERVICES AS DEFINED BY § 29-27-101 TO 304 OF THE COLORADO REVISED STATUTES, INCLUDING BUT NOT LIMITED TO ANY NEW AND IMPROVED HIGH BANDWIDTH SERVICE(S) BASED ON FUTURE TECHNOLOGIES, TO RESIDENTS, BUSINESSES, SCHOOLS, LIBRARIES, NONPROFIT ENTITIES AND OTHER USERS OF SUCH SERVICES, WITHOUT LIMITING ITS HOME RULE AUTHORITY?

ESTES PARK
PASS: YES: 1652 NO: 136
WITHOUT INCREASING TAXES, SHALL THE TOWN OF ESTES PARK REESTABLISH THE TOWN'S RIGHT TO PROVIDE ALL SERVICES RESTRICTED SINCE 2005 BY TITLE 29, ARTICLE 27 OF THE COLORADO REVISED STATUTES, DESCRIBED AS "ADVANCED SERVICES," ”TELECOMMUNICATIONS SERVICES" AND "CABLE TELEVISION SERVICES," INCLUDING ANY NEW AND IMPROVED HIGH BANDWIDTH SERVICES BASED ON FUTURE TECHNOLOGIES, UTILIZING COMMUNITY OWNED INFRASTRUCTURE INCLUDING, BUT NOT LIMITED TO THE EXISTING FIBER OPTIC NETWORK, EITHER DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR PARTNERS TO POTENTIAL SUBSCRIBERS THAT MAY INCLUDE TELECOMMUNICATIONS SERVICE PROVIDERS, RESIDENTIAL OR COMMERCIAL USERS WITHIN THE TOWN AND THE SERVICE AREA OF THE TOWN'S LIGHT AND POWER ENTERPRISE?

FALL 2014

BOULDER
PASS: 17512-3551
SHALL THE CITY OF BOULDER BE AUTHORIZED TO PROVIDE HIGH-SPEED INTERNET SERVICES (ADVANCED SERVICES), TELECOMMUNICATIONS SERVICES, AND/OR CABLE TELEVISION SERVICES TO RESIDENTS, BUSINESSES, SCHOOLS, LIBRARIES, NONPROFIT ENTITIES AND OTHER USERS OF SUCH SERVICES, EITHER DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR PARTNERS, AS EXPRESSLY PERMITTED BY §§ 29-27-101 TO 304, “COMPETITION IN UTILITY AND ENTERTAINMENT SERVICES,” OF THE COLORADO REVISED STATUTES, WITHOUT LIMITING ITS HOME RULE AUTHORITY?

CHERRY HILLS VILLAGE
PASS: 2362-613
SHALL THE CITY OF CHERRY HILLS VILLAGE, WITHOUT INCREASING TAXES BY THIS MEASURE, AND TO RESTORE LOCAL AUTHORITY THAT WAS DENIED TO LOCAL GOVERNMENTS BY THE COLORADO GENERAL ASSEMBLY AND FOSTER A MORE COMPETITIVE MARKETPLACE, BE AUTHORIZED TO PROVIDE HIGH-SPEED INTERNET, INCLUDING IMPROVED HIGH BANDWIDTH SERVICES BASED ON NEW TECHNOLOGIES, TELECOMMUNICATIONS SERVICES, AND/OR CABLE TELEVISION SERVICES TO RESIDENTS, BUSINESSES, SCHOOLS, LIBRARIES, NON-PROFIT ENTITIES AND OTHER USERS OF SUCH SERVICES EITHER DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR PARTNERS, AS EXPRESSLY PERMITTED BY ARTICLE 27, TITLE 29 OF THE COLORADO REVISED STATUTES?

RED CLIFF
PASS: 56-24
SHALL THE TOWN OF RED CLIFF BE AUTHORIZED TO PROVIDE CABLE TELEVISION, TELECOMMUNICATIONS AND/OR HI-SPEED INTERNET SERVICES TO RESIDENTS, BUSINESSES, SCHOOLS, LIBRARIES, NONPROFIT ENTITIES AND OTHER USERS OF SUCH SERVICES, EITHER DIRECTLY OR INDIRECTLY THROUGH PUBLIC OR PRIVATE SECTOR PARTNERS?

WRAY
PASS: 3167-2461
WITHOUT INCREASING TAXES, SHALL THE CITIZENS OF WRAY, COLORADO REESTABLISH THEIR CITY'S RIGHTS TO PROVIDE ALL SERVICES AND FACILITIES RESTRICTED SINCE 2005 BY TITLE 29, ARTICLE 27 OF THE COLORADO REVISED STATUTES, DESCRIBED AS "ADVANCED SERVICES,' TELECOMMUNICATIONS SERVICES' AND 'CABLE TELEVISION SERVICES,' INCLUIDNG PROVIDING ANY NEW AND IMPROVED BROADBAND SERVICES AND FACILITIES BASED ON FUTURE TECHONOLOGIES, UTILIZING EXISTING OR NEW COMMUNITIY OWNED INFRASTRUCTURE INCLUDING BUT NOT LIMITED TO THE EXISTING FIBER OPTIC NETWORK, EITHER DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR PARTNERS, TO POTENTIAL SUBSCRIBERS THAT MAY INCLUDE TELECOMMUNICATIONS SERVICE PROVIDERS, RESIDENTIAL OR COMMERICAL USERS WITHIN THE CITY?

YUMA
PASS: 71%-29%
WITHOUT INCREASING TAXES, SHALL THE CITIZENS OF YUMA, COLORADO REESTABLISH THEIR CITY'S RIGHTS TO PROVIDE ALL SERVICES AND FACILITIES RESTRICTED SINCE 2005 BY TITLE 29, ARTICLE 27 OF THE COLORADO REVISED STATUTES, DESCRIBED AS "ADVANCED SERVICES,' TELECOMMUNICATIONS SERVICES' AND 'CABLE TELEVISION SERVICES,' INCLUIDNG PROVIDING ANY NEW AND IMPROVED BROADBAND SERVICES AND FACILITIES BASED ON FUTURE TECHONOLOGIES, UTILIZING EXISTING OR NEW COMMUNITIY OWNED INFRASTRUCTURE INCLUDING BUT NOT LIMITED TO THE EXISTING FIBER OPTIC NETWORK, EITHER DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR PARTNERS, TO POTENTIAL SUBSCRIBERS THAT MAY INCLUDE TELECOMMUNICATIONS SERVICE PROVIDERS, RESIDENTIAL OR COMMERICAL USERS WITHIN THE CITY'S UTILITY SERVICE AREA?

SPRING 2014

MONTROSE
REFERRED MEASURE "A"
PASS: 3969-1396
WITHOUT INCREASING TAXES, SHALL THE CITIZENS OFTHE CITY OF MONTROSE, COLORADO, RE-ESTABLISH THEIR CITY'S RIGHT TO PROVIDE ALL SERVICES RESTRICTED SINCE 2005 BY TITLE 29, ARTICLE 27 OFTHE COLORADO REVISED STATUTES, DESCRIBED AS "ADVANCED SERVICES," "TELECOMMUNICATIONS SERVICES" AND "CABLE TELEVISION SERVICES," INCLUDING ANY NEW AND IMPROVED HIGH BANDWIDTH SERVICES BASED ON FUTURE TECHNOLOGIES, UTILIZING COMMUNITY OWNED INFRASTRUCTURE INCLUDING BUT NOT LIMITED TO THE EXISTING FIBER OPTIC NETWORK, EITHER DIRECTLY OR INDIRECTLY WITH PUBLIC OR PRIVATE SECTOR

PARTNERS, TO POTENTIAL SUBSCRIBERS THAT MAY INCLUDE TELECOMMUNICATIONS SERVICE PROVIDERS, RESIDENTIAL OR COMMERCIAL USERS WITHIN THE CITY?

FALL 2013

CENTENNIAL
BALLOT QUESTION 2G
PASS: 76%-24%
SHALL THE CITY OF CENTENNIAL, WITHOUT INCREASING TAXES, AND TO RESTORE LOCAL AUTHORITY THAT WAS DENIED TO ALL LOCAL GOVERNMENTS BY THE STATE LEGISLATURE, AND TO FOSTER A MORE COMPETITIVE MARKETPLACE, BE AUTHORIZED TO INDIRECTLY PROVIDE HIGHSPEED INTERNET (ADVANCED SERVICES), TELECOMMUNICATIONS SERVICES, AND/OR CABLE TELEVISION SERVICES TO RESIDENTS, BUSINESSES, SCHOOLS, LIBRARIES, NONPROFIT ENTITIES AND OTHER USERS OF SUCH SERVICES, THROUGH COMPETITIVE AND NON-EXCLUSIVE PARTNERSHIPS WITH PRIVATE BUSINESSES, AS EXPRESSLY PERMITTED BY ARTICLE 29, TITLE 27 OF THE COLORADO REVISED STATUTES?

MODEL OPEN TRENCH/DIG ONCE ORDINANCE[42]

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

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

[42] 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, 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

2G: In the world of cell phones, 2G signifies second-generation wireless digital technology. Fully digital 2G networks replaced analog 1G, which originated in the 1980s.

2G networks saw their first commercial light of day on the GSM standard. GSM stands for global system for mobile communications.

3G: Third generation of the mobile telephony standard. Analog cellular was the first generation and digital PCS the second.

4G: Abbreviation for fourth-generation wireless. Specifies a mobile broadband standard offering both mobility and very high bandwidth. Usually refers to LTE and WiMax technology.

Access Level Infrastructure: Infrastructure required to deliver services from the community cabinet or hub to the customer access point. Access level infrastructure ties to distribution rings at the community cabinet and to drop level infrastructure at the customer premises. Access level infrastructure is typically part of the local loop.

Access Portal (AP): The transceiver or media converter device that terminates a fiber network at the customer's premises. Other names for the AP include Optical Network Termination (ONT) or Ethernet Demarcation Device (EDD).

ADSL: See Asymmetric Digital Subscriber Line.

Advanced Mobile Phone Service (AMPS): A standard system for analog signal cellular telephone service in the United States and elsewhere. It is based on the initial electromagnetic radiation spectrum allocation for cellular service by the FCC in 1970 and first introduced by AT&T in 1983.

Aerial: Infrastructure placed in above ground installations.

Aggregation: See Demand Aggregation.

Aggregation Point: Aggregation point is used to describe a) a location where multiple fiber runs come together or b) a network location where multiple sites aggregate traffic.

AMPS: See Advanced Mobile Phone Service.

Analog: Relating to or using signals or information represented by a continuously variable physical quality such as spatial position or voltage.

Analog Reclamation: In a cable system, refers to repurposing spectrum previously used to carry analog channels for other uses for digital channels or high-speed data.

AP: See Access Portal.

ARPU: See Average Revenue per User.

Asymmetric Digital Subscriber Line (ADSL): A technology that transmits a data signal over twisted-pair copper, often over facilities deployed originally to provide voice telephony. Download rates are higher than upload rates - i.e., are asymmetric. ADSL technology enables data transmission over existing copper wiring at data rates several hundred times faster than analog modems using an ANSI standard.

Name	Download	Upload
ADSL	8.0 Mbps	1.0 Mbps
ADSL (G.DMT)	12.0 Mbps	1.3 Mbps
ADSL over POTS	12.0 Mbps	1.3 Mbps
ADSL over ISDN	12.0 Mbps	1.8 Mbps
ADSL Lite (G.Lite)	1.5 Mbps	0.5 Mbps
ADSL2	12.0 Mbps	3.5 Mbps
RE-ADSL2	5.0 Mbps	0.8 Mbps
Splitterless ADSL2	1.5 Mbps	0.5 Mbps
ADSL2+	20.0 Mbps	1.1 Mbps
ADSL2+M	24.0 Mbps	3.3 Mbps

Asymmetrical: internet connections have two components - a downstream and upstream. When the two speeds are not comparable, the connection is termed asymmetric. Typically, phone and cable companies offer much slower upload speeds than download, in part because the internet tended to be a download-centric system in the 90's and early 00's. However, users increasingly need faster upload connections to take full advantage of modern applications.

Asynchronous Transfer Mode (ATM): A means of digital communications that is capable of very high speeds; suitable for transmission of images or voice or video as well as data; ATM is used for both LAN and WAN.

AT&T U-Verse: An AT&T brand of triple-play telecommunications services delivered via fiber to the node.

ATM: See Asynchronous Transfer Mode.

Availability Gap: See Broadband Availability Gap or Investment Gap

Average Revenue per User (ARPU): "Average revenue per user is calculated by dividing revenues by the subscriber base. Non-service revenues, such as equipment or other sales, are included in the calculation." From http://www.yourdictionary.com/finance/arpu.

While the accurate calculation of ARPU requires inclusion of non-service revenues, many organizations exclude them when calculating ARPU .

Backhaul: A general term for the segment of a network connecting the network to an internet peering point.

Bandwidth: The rate at which the network can transmit information across it. Generally, higher bandwidth is desirable. The amount of bandwidth to you can determine whether you download a photo in two seconds or two minutes.

BHOL: See Busy Hour Offered Load.

BICC: See Bearer Independent Call Control.

Bit: The base unit of information in computing. For our purposes, also the base unit of measuring network speeds. 1 bit is a single piece of information – a one or zero, on or off, true or false. Network speeds tend to be measured by bits per second – using kilo (1,000), mega (1,000,000), and giga (1,000,000,000). A bit is a part of a byte – they are not synonyms. Bits are generally abbreviated with a lower case b (as in Mbps). Bits are used to measure network speeds. Bytes (abbreviated with an upper case B – as in MB) are used to measure storage space and file sizes.

That smash hit two hour long high definition movie you want to download is probably 8+ GB. If you want to download it on a standard DSL line, you better have about six hours (8 billion bytes * 8 bits = 64 billion bits / 3 million bits per second = 5.9 hours).

BPON: See Broadband Passive Optical Network.

Broadband: According to the FCC, 4 Mbps download and 1 Mbps upload. True broadband provides exponentially faster speeds and is often symmetrical.

Broadband Availability Gap: Either a) The amount of funding necessary to upgrade or extend existing infrastructure up to the level necessary to support the National Broadband Availability Target. Because this is a financial metric it is referred to as the Investment Gap. Or b) the difference in bandwidth and services available between two geographic areas, socio-economic strata, age generation, ethnic groups, or other groups.

Broadband Friendly: Policies designed to lower the costs and risks of deploying broadband in a community.

Broadband Passive Optical Network (BPON): A type of PON offering downstream capacities of up to 622 Mbps and upstream capacities of up to 155 Mbps shared among a limited number of end users.

Broadband Technology Opportunities Program (BTOP): The Department of Commerce broadband funding program.

Brownfield: Brownfield neighborhoods are neighborhoods that are already build out and typically have existing roads, sidewalks, landscaping, and other impediments to network deployment. Brownfield neighborhoods typically have existing networks requiring new entrants to overbuild unless the incumbent is required to unbundle.

BTOP: See Broadband Technology Opportunities Program.

Burst Rate: The maximum rate or "speed" which a network is capable of delivering within a short timeframe – typically seconds or minutes. This is usually expressed as a rate in Mbps. Many network providers report their burst rate as their maximum advertised speed.

Busy Hour Offered Load (BHOL): BHOL (per subscriber) is the network capacity required by each user, averaged across all subscribers on the network during the peak utilization hours of the network. Network capacity required is the data received/transmitted by a subscriber during and hour; this can be expressed as a data rate (like Kbps) when the volume of data received/transmitted is divided by the time duration.

Byte: The base unit for file storage comprised of 8 bits. A 1 MB (megabyte) file is made of 8 million bits. Bytes generally refer to the size of storage

whereas bits are used to discuss how rapidly files may be moved.

Cable Modem System: Cable television companies have offered internet access via their cable systems since 1997. The network architecture uses a loop that connects each subscriber in a given neighborhood, meaning they all share one cable to the internet. Because the cable network shares the last mile connection among potentially hundreds of subscribers, a few bandwidth hogs can slow everyone's experience.

Cable Television (CaTV): In its original incarnation the acronym was CATV standing for Community Antenna or Community Access Television. The CaTV acronym stands for Cable Television. In either case, cable television uses coaxial cable to deliver video signals from a single receiver to multiple homes. Cable television technologies almost always "broadcast" all available channels on the cable and rely on in home tuners to select a channel from the broadcast stream.

CAF: See Connect America Fund.

CAI: See Community Anchor Institution.

CAP: See Customer Access Point.

Capacity: Ability of telecommunications infrastructure to carry information. The measurement unit depends on the facility. A data line's capacity might be measured in bits per second while the capacity of a piece of equipment might be measured in numbers of ports.

CapEx: See Capital Expenditure.

Capital Expenditure (CapEx): Business expense to acquire or upgrade physical assets such as buildings, machinery, network infrastructure, etc. Also called capital spending or capital expense.

Carrier Neutral Location: A CNL is a local peering point location where multiple middle mile providers can meet and provide service to multiple last mile providers.

CATV: See Community Antenna Television.

CaTV: See Cable Television.

CDMA: See Code-Division Multiple Access.

Cellular: Denoting or relating to a mobile telephone system that uses a number of short-range radio stations to cover the area that it serves.

Census Block: The smallest level of geography designated by the US Census Bureau which may approximate actual city street blocks in urban areas. In rural districts census blocks may span larger geographical areas to cover a more dispersed population.

Center for Information Technology Leadership (CITL): See http://www.citl.org/.

Central Office (CO): A telephone company facility in a locality to which subscriber home and business lines are connected on what is called a local loop. The CO has switching equipment that can switch calls locally or to long-distance carrier phone offices.

Churn: The number of subscribers who leave a service provider over a given period of time, usually expressed as a percentage of total customers.

CITL: See Center for Information Technology Leadership.

CLEC: See Competitive Local Exchange Carrier.

Cloud: Some refer to the entire internet as a cloud – the idea being that all the information is just out there and it does not matter where. More commonly, cloud computing refers to services such as Amazon's S3 where users pay a fee to store information on Amazon's servers without ever really knowing the physical location. Cloud services may include storage, applications, and other services. As we gain access to faster internet connections (particularly upstream speeds) cloud services may offer a more efficient means of accomplishing tasks and more reliable backup solutions.

CNL: See Carrier Neutral Location.

CO: See Central Office.

Code-Division Multiple Access (CDMA): Any of several protocols used in so-called second-generation (2G) and third-generation (3G) wireless communications.

As the term implies, CDMA is a form of multiplexing which allows numerous signals to occupy a single transmission channel optimizing the use of available bandwidth. The technology is used in ultra-high-frequency (UHF) cellular telephone systems in the 800-MHz and 1.9-GHz bands.

Community Anchor Institution (CAI): non-profit and government organizations that provide essential services to the public. Universities, colleges, community colleges, K12 schools, libraries, health

care facilities, social service providers, government and municipal offices are all community anchor institutions.

Community Antenna Television (CATV): Early cable television systems were called community antenna television, or CATV, because by nature of their design they used a using antenna for multiple viewers. This was usually done to bring television signals into basins or other areas obstructed from receiving over the air signals. A single antenna would be placed on a hill or other area where signals could be received and cable would be used to distribute the signal to the homes where access was obstructed.

Community Cabinet: A remote switch location designed to support a single service area or footprint.

Community Connect Grant: The Community Connect program serves rural communities where broadband service is least likely to be available, but where it can make a tremendous difference in the quality of life for citizens. The projects funded by these grants will help rural residents tap into the enormous potential of the internet.

Competitive Local Exchange Carrier (CLEC): The term and concept coined by the Telecommunication Act of 1996 for any new local phone company that was formed to compete with the ILEC.

Conduit: A reinforced tube through which cabling runs. Conduit is useful both to protect cables in the ground and because one can place conduit underground when convenient (like when other utility work is underway) and later blow or pull cable through the conduit.

Connect America Fund (CAF): A federal broadband development resource developed by the reformation of the USF to support broadband deployment.

Core: See Network Core.

Coverage: Refers to the geographic area in which one can obtain service. Sometimes referred to as a service area.

CPE: See Customer Premises Equipment.

CTN: See Colorado Telehealth Network.

Customer Access Point (CAP): The splice location where a subscriber's drop level infrastructure enters the network. May also be called a subscriber Splice Box (SSB).

Customer Drop: See Drop Level Infrastructure.

Customer Premises Equipment: The family of devices used at the customer's location to access network services. Some CPE – like the AP or cable modem – are provided by the network owner or service provider. Other CPE – like telephones and computers – are usually provided by the customer.

DAS: See Distributed Antenna System.

Data Over Cable Service Interface Specifications (DOCSIS): An international telecommunications standard that permits the addition of high-speed data transfer to an existing cable TV (CaTV) system. It is employed by many cable television operators to provide internet access over their existing infrastructure.

Demand Aggregation: The process of combining several clients' broadband demand into a single purchase.

Dense Wave Division Multiplexing (DWDM): DWDM is a method of using a single fiber strand for multiple logical data paths.

Dig Once Policies: Broadband friendly policies that dictate communications conduit be added to any underground construction effort.

Digital Subscriber Line (DSL): A family of technologies that provide digital data transmission over the traditional copper wires of a telephone network. The common DSL technologies used in the US are Asymmetric Digital Subscriber Line (ADSL) and Very High Speed Digital Subscriber Line (VDSL).

Digital Subscriber Line Access Multiplexer (DSLAM): Technology that concentrates or aggregates traffic in DSL networks. Located in the central office or in a remote terminal.

Distributed Antenna System (DAS): A network of spatially separated antenna nodes connected to a common source via a transport medium that provides wireless service within a geographic area or structure.

DOCSIS: See Data Over Cable Service Interface Specifications.

Distribution Level Infrastructure: Telecommunications infrastructure intended to distribute signal to community cabinets.

Distribution Ring: An element of distribution level infrastructure connecting multiple community cabinets.

Download: Internet connections have two components – a downstream and upstream. Download refers to the rate at which the user's computer can receive data from the internet.

Downstream: Generic term referring to data traffic going from the network core to the subscriber location.

Drop: See Drop Level Infrastructure.

Drop Level Infrastructure: Drop level infrastructure – often referred to as a "drop" or "customer drop" is the infrastructure that connects the subscriber's premises to the access level infrastructure. Drop level architecture is part of the local loop.

DS1: A digital signal 1 or DS1 (also known as a T1). A T-carrier signaling scheme devised by Bell Labs. DS1 is a widely used standard in telecommunications in North America and Japan to transmit voice and data between devices. DS1 is the logical bit pattern used over a physical T1 line; however, the terms DS1 and T1 are often used interchangeable. Carries approximately 1.544 Mbps.

DS3: A copper digital signal transport with 44.736 Mbps capacity – or 28 T1 lines – or 672 voice lines.

DSL: See Digital Subscriber Line.

DSLAM: See Digital Subscriber Line Access Multiplexer.

Duopoly: A situation in which two companies own all or nearly all of the market for a given type of product or service – that is, a two company monopoly.

DWDM: See Dense Wave Division Multiplexing.

EAGLE-Net: See https://www.co-eaglenet.net/.

Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA): An approximate measure of a company's operating cash flow based on data from the company's income statement. Calculated by looking at earnings, which are calculated by subtracting OpEx and SG&A from net revenues, before the deduction of interest expense, taxes, depreciation, and amortization. This earnings measure is of particular interest in cases where companies have large amounts of fixed assets which are subjected to large depreciation.

EBITDA: See Earnings Before Interest, Taxes, Depreciation, and Amortization.

EDD: See Ethernet Demarcation Device.

EPON: See Ethernet Passive Optical Network.

ESRI: ESRI (www.esri.com) is the global leader in geographic information systems.

Ethernet Demarcation Device (EDD): The transceiver device that terminates the optical network at the customer premises in an active Ethernet or EPON design. May also be called an access portal (AP) or optical network terminator (ONT).

Ethernet Passive Optical Network (EPON): One of the family of PON offering downstream capacities of up to 1.25 Gbps and upstream capacities of up to 1.25 Gbps shared among a limited number of end users.

EV-DO: See Evolution-Data Optimized.

Evolution-Data Optimized (EV-DO): A 3G wireless radio broadband data standard that enables faster speeds than are available in existing CDMA networks or other services such as GPRS or EDGE.

Fast Ethernet: A network transmission standard that provides a data rate of 100 Mbps.

FCC: See Federal Communications Commission.

FDMA: See Frequency Division Multiple Access.

Federal Communications Commission (FCC): Federal agency responsible for telecommunications regulation. See http://www.fcc.gov/.

Fiber Optic Splice Case (FOSC): A protective case at a fiber splicing point.

Fiber to the Building (FTTB): One of the families of fiber networks characterized by fiber delivery to a demarcation on or in the building with distribution to multiple tenants within the building through copper or wireless technologies.

Fiber to the Curb (FTTC): One of the families of fiber networks characterized by fiber delivery to the curb. Sometimes FTTC hands the curb to home connection to a copper or wireless technology. Other times, FTTC is simply a place holder with fiber continuing to the address once the address subscribes to service.

Fiber to the Home (FTTH): One of the families of fiber networks characterized by fiber delivery to the home. FTTH is sometimes used synonymously with FTTP.

Fiber to the Node (FTTN): A high-capacity bandwidth approach that uses both fiber and copper wires. Optical fiber is used for the distribution rings from the core of the telco or CaTV network to an

intelligent node in the neighborhood where copper wire is used for the local loop connection to the end user.

Fiber to the Premises (FTTP): A fiber deployment/architecture in which optical fiber extends all the way to the customer's premises. Also known as fiber to the home (FTTH) or fiber to the building (FTTB).

Fiber to the "Whatever" (FTTx): A generic term used to encompass the entire family of fiber networks.

FiOS: See Verizon Fiber Optic System.

FirstNet: The First Responder Network Authority (FirstNet) is an independent authority within NTIA chartered to provide emergency responders with the first high-speed, nationwide network dedicated to public safety.

Fisher-Pry Model: A mathematical model used to forecast technology adoption when substitution is driven by superior technology where the new product or service presents some technological advantage over the old one.

Fixed Wireless: Wireless service that uses fixed CPE in addition to (or instead of) mobile portable devices to deliver data services. Fixed wireless solutions have been deployed as a substitute for wired access technologies. For example, it is being used commercially in the US by Clearwire with WiMax and Stelera with HSPA.

FOSC: See Fiber Optic Splice Case.

Franchise: A cable company wishing to provide television service in a community historically signed a franchise agreement with the municipal government. The agreement would specify what the community would receive from the cable company in return for access to public rights of way.

FTTB: See Fiber to the Building.

FTTC: See Fiber to the Curb.

FTTH: See Fiber to the Home.

FTTN: See Fiber to the Node.

FTTP: See Fiber to the Premises.

FTTx: See Fiber to the "Whatever".

Gbps: See Gigabit per Second.

Geographic Information System: Geographic information systems are databases of spatial data. GIS systems are used to map traffic flows, contagion patterns, flood plains, and many other geography dependent features – like telecommunications outside plant.

Gig-E: See Gigabit Ethernet.

Gigabit Ethernet: A network transmission standard that provides a data rate of 1,000 megabits per second.

Gigabit Passive Optical Network (GPON): A type of PON offering downstream capacities of up to 2.5 Gbps and upstream capacities of up to 1.25 Gbps shared among a limited number of end users.

Gigabit per Second (Gbps or Gb/s): One billion bits per second. Gbps > Mbps > Kbps.

As a comparison, a high definition movie with surround sound is about 8.3 GB in size. To download this size file with different technology transmission speeds:

	Days	Or Hours	Or Minutes	Or Seconds	
Standard Dial-Up	13.72	329.3	19,761.90	1,185,714	**56 Kbps**
Fast Dial-Up	12.00	288.1	17,291.67	1,037,500	**64 Kbps**
T-1	0.51	12.2	737.78	44,266	**1.55 Mbps**
Standard DSL	0.25	6.1	368.89	22,133	**3 Mbps**
Fast DSL	0.05	1.2	73.78	4,426	**15 Mbps**
Fast Cable	0.03	0.9	55.33	3,320	**20 Mbps**
100 Mbps Fiber	0.007	0.18	11.07	664	**100 Mbps**
1 Gbps Fiber	0.0008	0.018	1.11	66	**1 Gbps**

GIS: See Geographic Information System.

Global System for Mobile Communication (GSM): A second-generation digital mobile cellular technology using a combination of frequency division multiple access (FDMA) and time division multiple access (TDMA). GSM operates in several frequency bands. The standard was jointly developed between European administrations. GSM provides a high degree of security by using subscriber identity module (SIM) cards and GSM encryption.

Gompertz Model: A mathematical model used to forecast technology adoption when substitution is

driven by superior technology but purchase depends on consumer choice.

GPON: See Gigabit Passive Optical Network.

Grand Slam: A triple play with cell phone service. Sometimes called a quadruple play.

Greenfield: A plot of land that will soon become a residential or business development. Building a broadband network is cheaper in greenfield developments because roads, sidewalks, lawns, and buildings are not yet impediments to running the necessary wires and the network can be deployed in conjunction with the other utilities.

GSM: See Global System for Mobile Communication.

HFC: See Hybrid Fiber Coaxial.

High Speed Packet Access (HSPA): A family of 3G digital data services provided by cellular carriers worldwide that uses the GSM technology. HSPA service works with HSPA cell phones as well as laptops and portable devices with HSPA modems. The two established standards of HSPA are HSDPA (downlink) and HSUPA (uplink).

HSPA: See High Speed Packet Access.

ICT: See Information Communication Technologies.

ILEC: See Incumbent Local Exchange Carrier.

Incumbent: An existing network owner or service provider.

Incumbent Local Exchange Carrier (ILEC): The dominant local phone carrier within a geographical area. Section 252 of the Telecommunications Act of 1996 defines Incumbent Local Exchange Carrier as a carrier that, as of the date of enactment of the Act, provided local exchange service to a specific area. In contrast, competitive access providers and competitive local exchange carriers (CLECS) are companies that compete against the ILECs in local service areas.

Information Communication Technologies (ICT): Information and communication based technologies.

Inside Plant (ISP): Electronics, wiring, and other accouterments associated with telecommunications networks located within community cabinets, central offices, or other shelters.

Integrated Services Digital Network (ISDN): A set of CCITT/ITU standards for digital transmission over ordinary telephone copper wire as well as over other media. Home and business users who install an ISDN adapter (in place of a telephone modem) receive Web pages at up to 128 Kbps compared with the maximum 56 Kbps rate of a modem connection.

Interconnect: The term interconnect is used in two different ways: a) to describe the connection between a service provider and the internet – also known as backhaul and b) the logical and physical infrastructure used to connect two non-congruous service areas. In either case, interconnect is usually part of the middle mile infrastructure.

Interexchange Carrier (IXC): A telecommunications service provider authorized by the FCC to provide interstate, long distance communications services and authorized by the state to provide long distance intrastate communications services. Also known as an Interexchange Common Carrier.

Interexchange Common Carrier: See Interexchange Carrier.

International Standards Organization (ISO): The body charged with developing and advertising international standards.

internet Exchange Point (IXP): See Peering Point.

internet Protocol Television (IPTV): A method of delivering television services using the internet Protocol.

internet Service Provider (ISP): A company or organization that provides a connection to the public internet, often owning and operating the last mile connection to the end user locations.

Investment Gap: The amount of funding necessary to upgrade or extend existing infrastructure up to the level necessary to support the National Broadband Availability Target. The investment gap is sometimes referred to as the broadband availability gap.

IP: See internet Protocol.

IPTV: See internet Protocol Television.

Irrevocable Right of Use (IRU): A method of leasing fiber or other existing telecommunications assets that gives the lease an irrevocable right of use for some period of time. IRU's are typically counted as capital expenses but under some circumstances can be operational expenses.

IRU: See Irrevocable Right of Use.

ISDN: See Integrated Services Digital Network.

ISO: See International Standards Organization.

ISP: See internet Service Provider or Inside Plant.

IXC: See Interexchange Carrier.

IXP: See internet Exchange Point.

Kbps: See Kilobits per Second.

Kilobits per Second (Kbps): A measure of transmission speed. Kbps < Mbps < Gbps.
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100 Mbps Fiber	0.007	0.18	11.07	664	**100 Mbps**
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Last Mile: Describes the final leg of a connection between a service provider and the customer and is often synonymous with the local loop. In DSL and cable systems, this is the most common bandwidth bottleneck.

LATA: See Local Access and Transport Area.

Latency: The amount of time it takes for a bit to get from point A to point B.

LEC: See Local Exchange Carrier.

Levelized: A method, often used in regulatory proceedings, to calculate the annuitized equivalent – i.e., the effective annual value of cash flows – of the costs and revenues associated with building and operating a network. A "levelized" calculation provides a steady cash-flow stream rather than trying to model or guess the timing of largely unpredictable yet sizeable real-world payouts like those for upgrading and repairing equipment. The present value of a levelized cash flow is equal to the present value of actual cash flows.

Line of Sight: Requiring an unimpeded view from one site to another.

Link Budget: A calculation involving the gain and loss factors associated with the antennas, transmitters, transmission lines and propagation environment used to determine the maximum distance at which a transmitter and receiver can successfully operate along a link.

Local Access and Transport Area (LATA): One of 196 local geographical areas in the US created by the Modified Final Judgment in which a divested Regional Bell Operating Company (RBOC) was permitted to offer local exchange telecommunications and local exchange access services.

Local Exchange Carrier (LEC): A regulatory term in telecommunications for a local telephone company.

Long Term Evolution (LTE): A high performance air interface for cellular mobile communication systems. LTE technology increases the capacity and speed of wireless networks relative to 3G deployments.

LTE: See Long Term Evolution.

Mbps: See Megabit per Second.

MDU: See Multiple Dwelling Unit.

Megabit per Second (Mbps): A measurement of data connectivity speed. Kbps < Mbps < Gbps.

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Metropolitan Optical Ethernet (MOE): CenturyLink's branding for fiber to the premises.

Microwave: Microwave transmission refers to the technique of transmitting information over microwave frequencies using various integrated wireless technologies. Microwaves are short wavelength high frequency signals that occupy the electromagnetic spectrum 1 GHz to roughly 300 GHz. This is above the radio frequency range and below the infrared range. Microwave transmissions can travel a long distance but must be line of sight.

Middle Mile: Middle mile is a term most often referring to the network connection between the last mile and the greater internet. Middle mile infrastructure is sometimes referred to as backhaul.

MiFi: MiFi is a brand name used to describe a wireless router that acts as a cellular data Wi-Fi hotspot. A MiFI device can provide internet access for up to ten devices through a single cellular connection.

MIMO: See Multiple Input Multiple Output.

Mobile Switching Center (MSC): The mobile switching center connects the landline public switched telephone network (PSTN) system to the wireless communications system. The MSC is typically split into a mobile switching center server and a media gateway and incorporates the bearer independent call control.

Mobile Wireless: Data connectivity from a cellular network.

MOE: See Metropolitan Optical Ethernet.

MPLS: See Multiprotocol Label Switching.

MSC: See Mobile Switching Center.

MSO: See Multi-System Operator.

MTFB: See Mean Time Between Failures.

MTU: See Multiple Tenant Unit.

Multi-System Operator (MSO): Typically refers to a firm that owns more than one cable television network infrastructure.

Multiple Dwelling Unit (MDU): A building or property with multiple individual residential addresses like an apartment building.

Multiple Input Multiple Output (MIMO): An antenna technology for wireless communications in which multiple antennas are used at both the source (transmitter) and the destination (receiver). The antennas at each end of the communications circuit are combined to minimize errors and optimize data speed.

Multiple Tenant Unit (MTU): A building or property with multiple individual business addresses like a strip mall or office building.

Multiprotocol Label Switching (MPLS): A mechanism in high-performance telecommunications networks which directs and carries data from one network node to the next. MPLS makes it easy to create "virtual links" between distant nodes. It can encapsulate packets of various network protocols.

National Association of Telecommunications Officers and Advisors (NATOA): NATOA is comprised of local government officials and employees that work on cable and broadband issues – from public access television to managing the community's rights of way.

National Broadband Availability Target: The level of service set in the National Broadband Plan that should be available to every household and business location in the U.S. The initial target is an actual download speed of at least 4 Mbps and an upload speed of at least 1 Mbps, with a proposed review and update every four years.

National Broadband Plan: A Federal Communications Commission plan to improve internet access in the United States.

National Telecommunications and Information Administration (NTIA): A division of the Department of Commerce.

NATOA: See National Association of Telecommunications Officers and Advisors.

Natural Monopoly: A monopoly in an industry in which it is most efficient (involving the lowest long-run average cost) for production to be concentrated in a single firm.

Network Management System (NMS): A combination of hardware and software used to monitor and administer a computer network or networks. Individual network elements in a

network are managed by an element management system.

Network Operations and Dispatch Center (NODC): When a network operations center also has crew dispatch functions it is sometimes called a network operations and dispatch center.

Network Operations Center (NOC): The centralized location where the network is monitored and restoration, maintenance, and operations are coordinated.

Network Owner: An organization owning (and possibly operating) telecommunications infrastructure.

NMS: See Network Management System.

NOC: See Network Operations Center.

NODC: See Network Operations and Dispatch Center.

Node: An active or passive element in a cable or telephone system where neighborhood distribution (or access level infrastructure) begins. Often a node is where fiber transitions to copper local loop infrastructure.

Node Splitting: In a cable system, adding infrastructure so that subscribers previously served by a single node are moved to multiple nodes reducing the number of subscribers per node.

NTIA: See National Telecommunications and Information Administration.

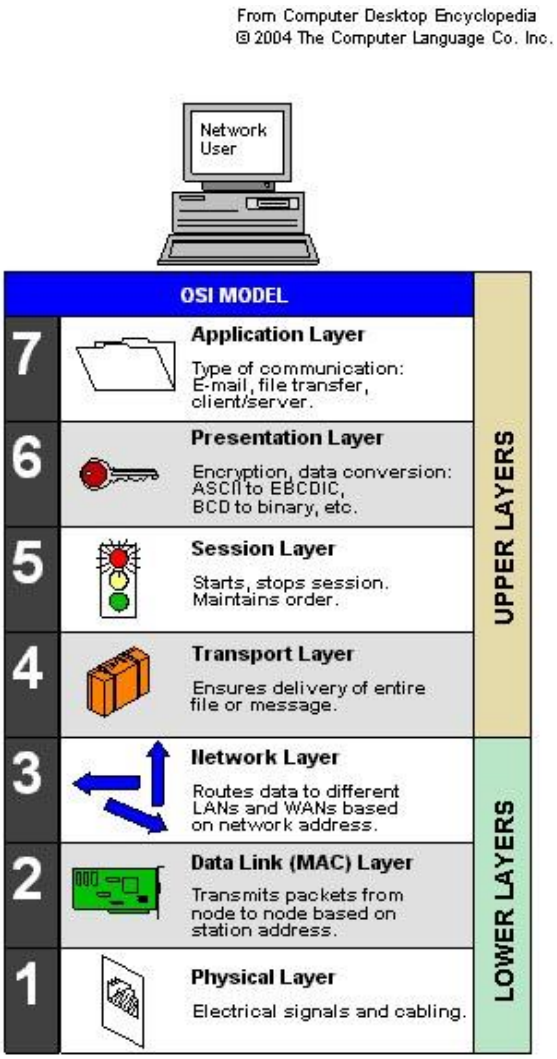
OECD: See Organization for Economic Cooperation and Development.

OFAP: See Optimal Fiber Allocation Plan.

ONT: See Optical Network Termination.

Open Access Network: A network designed and operated on the principal of a wholesale/retail split in which the network owner makes wholesale infrastructure and services available to competing service providers who provide retail services to end customers.

Open Systems Interconnect (OSI): The ISO model that defines the seven layers of activity in a data communication network.



Operational Expense (OpEx): An expense a business incurs over the course of its normal operations. Examples include product overhead, employee salaries and electric bill payments. Importantly, operating expenses on a balance sheet reflect only ordinary expenses rather than unexpected, one-time expenses. One subtracts the operating expense from operating revenue to determine the operating profit.

OpEx: See Operational Expense.

Optical Network Termination (ONT): The device in a PON architecture that terminates the optical network at the customer's premises. In many active architectures the parallel device is called an AP or EDD}.

Optimal Fiber Allocation Plan (OFAP): In designing a fiber network, engineers must take into

consideration the cost of aggregation points vs. the cost of the fiber plant itself. The OFAP describes the balance point where the greatest efficiency in both aggregation and fiber plant is achieved.

Organization for Economic Cooperation and Development (OECD): The mission of the OECD is to promote policies that will improve the economic and social well-being of people around the world.

The 30 member countries are: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Japan, Korea, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States.

OSI: See Open Systems Interconnect.

OSP: See Outside Plant.

OTT: See Over the Top.

Outside Plant (OSP): The outside plant is that portion of the physical network that delivers services to the subscribers' homes that lies between the CO or node and the premises demarcation. Outside plant consists of conduit, fiber, cable, handholes, communications shelters, and other elements.

Outside Plant System of Record: The outside plant system of record is any system used as the definitive record of the outside plant.

Over Subscription Rate: The ratio of retail bandwidth to wholesale bandwidth used by and ISP to manage bandwidth costs.

Over the Top: Services carried over an internet connection. For example, OTT video would include video delivered by Hulu or YouTube.

Overbuild: The process of deploying a network in an already developed area – usually where existing telecommunications networks already exist.

Overlash: The process of adding additional cable to an existing aerial route.

P2P: See Peer to Peer.

PARCC: See Partnership for Assessment of Readiness for College and Careers.

Partnership for Assessment of Readiness for College and Careers (PARCC): An organization that creates a standard set of K-12 assessments in math and English.

Passive Optical Network (PON): A fiber architecture that shares bandwidth with multiple subscribers through passive splitters.

PBX: See Private Branch Exchange.

PCS: See Personal Communications Service.

Peer to Peer: A type of network or service that allows computers to connect directly to each other rather than organizing them via hierarchical connections.

Peering: A relationship between two or more ISPs in which the ISPs create a direct link between each other and agree to forward each other's packets directly across this link.

Peering Point: A physical location where peering occurs.

PEG: See Public Access, Education, and Government.

Personal Communications Service (PCS): The FCC term used to describe a set of 2G mobile communications digital cellular technologies working over CDMA, GSM, and TDMA air interfaces.

Plain Old Telephone Service (POTS): The basic single line switched access service offered by local exchange carriers to residential and business end users, using loop-start signaling.

Point of Presence (PoP): A physical location where one network hands off to another.

PON: See Passive Optical Network.

PoP: See Point of Presence.

POTS: See Plain Old Telephone Service.

Primary Revenue: Revenue created from direct charges.

Private Branch Exchange (PBX): A telephone system within an enterprise that switches calls between enterprise users on local lines while allowing all users to share a certain number of external phone lines.

PSTN: See Public Switched Telephone Network.

Public Access, Education, and Government (PEG): These are commonly programming options made available to the community by the cable company as part of its franchise agreement.

Public Switched Telephone Network (PSTN): The worldwide collection of interconnected public telephone networks that was designed primarily

for voice traffic. The PSTN is a circuit-switched network, in which a dedicated circuit (also referred to as a channel) is established for the duration of a transmission, such as a telephone call. This contrasts with packet switching networks, in which messages are divided into small segments called packets and each packet is sent individually. Packet switching networks were initially designed primarily for data traffic.

QOS: See Quality of Service.

Quadruple Play: A triple play with cell phone service. Sometimes called a "Grand Slam".

Quality of Service (QOS): The ability to provide different priority to different applications, users, or data flows, or to guarantee a certain level of performance to a data flow in a data network.

Radio Frequency Over Glass (RFoG): An evolutionary technology that allows cable companies to offer an all-fiber architecture (not hybrid-fiber coax) without changing modulation schemes. RFoG is a standard in development for Point to Multipoint (P2MP) operations that has a proposed wavelength plan compatible with data PON solutions including EPON and 10G-EPON.

RBOC: See Regional Bell Operating Company.

Regional Bell Operating Company (RBOC): Local exchange carriers formed after the breakup of AT&T in 1984. The seven regional holding companies (RHCs) of roughly equal size were formed as a result of the 1982 Consent Decree AT&T signed with the US Department of Justice, stipulating that it would divest itself of its 22 wholly owned telephone operating companies. The seven RHCs were Ameritech, Bell Atlantic, BellSouth, NYNEX, Pacific Telesis, Southwestern Bell and US West. After a series of acquisitions, mergers and name changes (including one in which a combination of several RHCs reclaimed the original AT&T name), only three of the original seven remain. They are AT&T, CenturyLink, and Verizon.

Regional Tandem: A tandem switch is an intermediate switch or connection between an originating telephone call or location and the final destination of the call. These are hub facilities that interconnect telephone central office exchanges and are deployed by geographical region within a telco LATA or exchange.

RFoG: See Radio Frequency Over Glass.

Right of Way (ROW): The legal right, established by usage or grant, to pass along a specific route through grounds or property belonging to another.

ROW: See Right of Way.

Rural Utilities Service (RUS): A division of the US Department of Agriculture. RUS has a division responsible for providing low interest loans to telecommunications network owners to deploy broadband technologies in rural areas.

RUS: See Rural Utilities Service.

San Luis Valley Rural Electric Cooperative (SLVREC): The San Luis Valley Rural Electric Cooperative has embarked on an effort to deploy fiber in their service territory and beyond. The SLVREC sells broadband services through their subsidiary, Ciello.

SDV: See Switched Digital Video.

Second Mile: Generally refers to the transport and transmission of data communications from the first point of aggregation to the greater internet or the peering point. Sometimes called middle mile or backhaul.

Secondary Revenue: Revenue generated through taxes or fees unrelated to the primary purpose of the assets.

Selling, General and Administrative Expense (SG&A): Corporate overhead costs, including expenses such as marketing, advertising, salaries and rent. SG&A is found on a corporate income statement as a deduction from revenues in calculating operating income.

Service Area: An area served by a community cabinet.

Service Provider: An organization providing telecommunications or broadband services.

Set Top Box (STB): The device used to translate IPTV or other digital television signals to useful information to the customer's television.

SG&A: See Selling, General and Administrative Expense.

Signal to Interface plus Noise Ration (SINR): For a wireless communications device, the ratio of the received strength of the desired signal to the received strength of undesirable signals (noise and interference).

SIM: See Subscriber Identity Module.

SINR: See Signal to Interface plus Noise Ratio.

SLVREC: See San Luis Valley Rural Electric Cooperative.

SLIGP: See State and Local Implementation Grant Program.

Spectrum Allocation: The amount of spectrum dedicated (or allocated) to a specific use. In wireless, spectrum allocation is typically made in paired bands with one band for upstream and the other for downstream.

SSB: See Subscriber Splice Box.

State and Local Implementation Grant Program (SLIGP): The Middle Class Tax Relief and Job Creation Act of 2012 authorized the creation of the first nationwide broadband network for public safety, the First Responder Network Authority (FirstNet). The law also directed NTIA to develop a grant program for states to support planning, education and outreach as they consult with FirstNet on the deployment of the broadband network, which will enable first responders to better communicate during emergencies and save lives. NTIA's State and Local Implementation Grant Program gives states the resources needed to consult with FirstNet on deployment of a nationwide public safety broadband network.

STB: See Set Top Box.

Subscriber Splice Box (SSB): The splice location where a subscriber's drop level infrastructure enters the network. May also be called a customer access point (CAP).

Switched Digital Video (SDV): A network scheme for distributing digital video via a cable more efficiently to free up bandwidth for other uses. Only channels being watched by end users in a given node are transmitted to that node.

Symmetrical: internet connections have two components - a downstream and upstream. When the two speeds are comparable, the connection is termed symmetric. Fiber-optic networks more readily offer symmetrical connections than DSL and cable, which are inherently asymmetrical. Ultimately, purely symmetrical connections are less important than connections which offer robust connections in both directions. However, many asymmetrical connections via DSL and cable networks offer upload speeds that are too slow to take advantage of modern applications.

T1: A mode of frequency division multiplexing that provides 1.544 Mbps or 24 voice channels. Sometimes called DS1.

TA: See Terminal Adapter.

Take Rate: Represents the number of subscribers divided by the number of potential subscribers. There are several different models for defining both subscribers and potential subscribers.

TCP/IP: See Transmission Control Protocol/internet Protocol.

TDM: See Time Division Multiplexing.

TDMA: See Time Division Multiple Access.

Telco: *Tel*ephone *Co*mpany. A provider of telecommunications services such as voice and data services. Also called common carriers or Local Exchange Carriers.

Telecommunication Act of 1996: Current US federal law governing telecommunications regulation.

Telepresence: Refers to a variety of methods to use technology to make it seem like a person in a remote location is present. The more bandwidth available, the more realistic the telepresence.

Terminal Adapter (TA): The CPE device used to convert VOIP signals to traditional telephone signals so customers do not require specialized telephones.

Tier 1 Network: An internet Protocol network that participates in the internet solely via settlement-free interconnection, also known as settlement-free peering.

Tier 2 Network: An internet service provider who engages in the practice of peering with other networks, but who still purchases IP transit to reach some portion of the internet.

Tier 3 Network: Used to describe networks who solely purchase IP transit from other networks (typically Tier 2 networks) to reach the internet.

Time Division Multiple Access (TDMA): Technology used in digital cellular telephone communication that divides each cellular channel into three time slots in order to increase the amount of data that can be carried. TDMA is used by Digital-American Mobile Phone Service (D-AMPS), Global System for Mobile communications (GSM), and Personal Digital Cellular (PDC). Each of these systems implements TDMA in somewhat different and potentially incompatible ways. An alternative multiplexing scheme to FDMA with TDMA is

CDMA (code division multiple access), which takes the entire allocated frequency range for a given service and multiplexes information for all users across the spectrum range at the same time.

Triple Play: The three main services offered over modern broadband networks - television, phone services, and internet access - comprise the triple play. Many consumers like to get all three from the same service provider on the same bill. Service providers frequently offer deals that will lower the cost on these packages.

UMTS: See Universal Mobile Telecommunications System.

Unbundling: Making elements of the network available to competitors at wholesale prices.

Uninterruptable Power Supply (UPS): A batter device that continues to deliver power to connected electronics when other power fails.

United States Department of Agriculture (USDA): See http://www.usda.gov/wps/portal/usda/usdahome.

Universal Mobile Telecommunications Service (UMTS): Third-generation (3G) broadband, packet-based transmission of text, digitized voice, video and multimedia at data rates up to and possibly higher than 2 Mbps, offering a consistent set of services to mobile computer and phone users. Based on the Global System for Mobile (GSM) communication standard.

Universal Service Fund (USF): A federal program funded by telecommunications surcharges with four programs: high cost (subsidizes the high cost of services in rural areas), low income (includes Lifeline and Link Up discounts to those in poverty), rural health care (reduced rates to rural health care providers to ensure they have access to similar services as urban counterparts), and schools and libraries (E-Rate subsidizes telecommunication services to schools and libraries).

Unserved: Those addresses without access to a broadband network capable of offering service that meets the National Broadband Availability Target.

Upload: internet connections have two components - a download and upload. Upload refers to the rate at which the user's computer can send data to the internet. DSL and cable networks frequently offer upload speeds at only 1/10 of the download speeds. This is one of the main reasons DSL and cable networks are insufficient for the modern internet.

UPS: See Uninterruptable Power Supply.

Upstream: Generic term referring to traffic going from the subscriber location towards the network core.

USDA: See United States Department of Agriculture.

USF: See Universal Service Fund.

Unbundle: The process of making network elements available to competing service providers.

U-Verse: see AT&T U-Verse.

Verizon Fiber Optic System (FiOS): FiOS (Fiber Optic Service) is a "fiber to the home" (FTTH), implementation undertaken by Verizon. A typical FiOS package includes high-speed internet access along with cable TV and basic telephone service. For consumer use, FiOS internet access is available at downstream speeds between 15 and 300 megabits per second (Mbps) and upstream speeds between 5 and 65 Mbps.

Verizon has built its FiOS network in most of the states where it offers landline communications services.

Virtual Local Area Network (VLAN): A method of using common carrier networks to include disparate devices on the same broadcast domain.

Virtual Private Network (VPN): A set of protocols used to build and secure a private connection through a public network.

VLAN: See Virtual Local Area Network.

Voice Over internet Protocol (VOIP): A method of delivering voice services over an IP (packet switched) network.

VOIP: See Voice Over internet Protocol.

VPN: See Virtual Private Network.

Wholesale Retail Split: One description of the telecommunications business model wherein the network owner and the retail service provider are not the same entity.

Wi-Fi: Wi-Fi is a suite of protocols that allow wireless devices to exchange information using unlicensed frequencies. Equipment carrying the Wi-Fi brand is interoperable. Recently, a number of cities and some private companies attempted to blanket

their cities with Wi-Fi but the technology is not well suited to such large scale efforts. Wi-Fi has proved tremendously successful in homes and businesses.

WiMax: Worldwide Interoperability for Microwave Access (WiMAX) is a telecommunications technology that uses radio spectrum to transmit bandwidth between digital devices. Similar to WiFi, WiMAX brings with it the ability to transmit over far greater distances and to handle much more data.

Wireless: Unwired telecommunications; either fixed wireless or mobile wireless.

Wireless internet Service Provider (WISP): An internet service provider that provides fixed or mobile wireless services to its customers. Using Wi-Fi or proprietary wireless methods, WISPs provide last mile access, often in rural areas and areas in and around smaller cities and towns.

WISP: See Wireless internet Service Provider.