South Central Council of Governments

Regional Broadband Strategic Plan

Version 1: 21 Jun 2017
We could spend a great deal of time talking about the current state of broadband, what the residents and businesses of the South Central Region (including southern Pueblo, Huerfano, and Las Animas Counties, and Raton, New Mexico) 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 region are inadequate – especially outside of population centers.
- Next, the low population density, economic factors, and geography of the region make achieving broadband development objectives difficult.
- Finally, public sector investment and public sector led collaboration between various broadband development efforts is the best way to overcome 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 South Central Region.

- **WHO:** Private sector providers in the region should be encouraged to participate. In particular, SECOM has a strong and growing presence in the region. Rye Telephone may also contribute significantly to successful broadband development. Comcast and CenturyLink may provide valuable broadband development but it is unlikely they will
participate in significant shared infrastructure development. From the public sector, we are recommending significant collaborative efforts. The recommended strategy is to use fiber projects in the population centers and fixed wireless projects in certain rural areas to create funding to expand more aggressively into more rural areas.

- **WHAT:** Walsenburg, Trinidad, and Raton should consider open access municipal fiber to the premises projects. Las Animas and Huerfano Counties should consider tower builds in cooperation with SECOM. All infrastructure should be “open access” or available to multiple competing service providers on a wholesale basis. Wholesale fees should cover debt service, operations, and generate some revenue to continue to expand the network and extend services deeper into more rural areas.

- **WHERE:** Each participant should retain local control and local self-determination.

- **WHEN:** Detailed planning should begin immediately. The recommended actions will require ballot initiatives.

- **WHY:** Developing broadband in the region is important to the continued economic relevance of the region. However, broadband development is a capital intensive proposition. Regular market forces discourage adequate broadband development because of the capital cost. Nonetheless, while market forces discourage capital spending, they also encourage entrepreneurialism and innovation. Thus a solution that creates a marketplace for entrepreneurial and innovative broadband solutions without the penalty of long-term high-cost capital improvements is optimum to economic development. “Shared” or “open access” infrastructure with public sector involvement creates just such a marketplace.

- **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 recommended solution:

- To maximize regional benefit and reduce capital spending inefficiencies, a **wholesale-retail** split (in which network owners make their infrastructure assets available to competing providers on a wholesale basis) is important. In telephony this structure is sometimes called unbundling.

- **Public sector investment** in broadband infrastructure is important to lead regional broadband development efforts. Public sector investment can provide a significant inducement for private sector participation. 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.
That represents the heart of our recommendations. Keep reading this executive summary for a more complete introduction. Read the full report for background and additional detail.

1.1 A MORE COMPLETE SUMMARY

A regional broadband strategic plan focuses on a specific region – in this case, South Central Colorado to include southern Pueblo, Huerfano, and Las Animas Counties, and Raton, New Mexico. 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 San Luis Valley in addition to our efforts on behalf of South Central Colorado. 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 studied NEO Connect’s efforts in Region 10, Teller County, and elsewhere in Colorado. We have also 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 in south central Colorado 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 region have multiple broadband options, others have none.
- **Affordability**: Broadband is generally more expensive in the region 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 region 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 south central region is not all that different from other rural areas of Colorado. With few exceptions, it is inadequate to meet the
economic development and quality of life objectives of the various communities and there no apparent 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 broadband
  - We should work towards choice of broadband service providers for every address in the region.

- **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 peering points 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.

Some of these goals are more important than others to various communities.
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.

Some private sector development is making a difference in the south central Colorado region.

SECOM has invested in significant fixed wireless last mile infrastructure and some fiber (mostly in the middle mile).

Comcast has a fairly robust last mile network in Trinidad.

Most of the population centers and significant rural areas are served by CenturyLink. CenturyLink is in the process of spending $26.5 million in Connect America Funds (CAF) in each of the next five years (for a total of nearly $160 million). The federal funds will be matched by CenturyLink spending meaning potential broadband development investment in Colorado of up to $320 million. This combined money can make a significant difference in the broadband environment throughout the state and in CenturyLink’s south central Colorado service areas. Unfortunately, the speed standard set for CAF funds does not meet the FCC’s definition of broadband.

In spite of good efforts in south central Colorado, this private sector development has failed to adequately address broadband needs in the region. In particular:

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 region’s fairly small market.

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 region 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 new construction, 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 region, it is probable they will focus on expanding this technology. 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 only a lower 10/1 Mbps standard. CenturyLink will likely surpass the 10/1 Mbps standard in some areas. However, in order to spread spending in order to benefit the most potential subscribers, it is likely that CenturyLink will target 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 broadband development 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, but may also enable improvements in fixed wireless services and may support cellular service improvements. In some cases, CenturyLink may be willing to use fiber to the node routes to support individual fiber subscribers.

Next, SECOM 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 public sector led broadband development.

A ubiquitous fiber to the premises environment in the region is an ambitious objective and may be unrealistic. Nonetheless, local jurisdictions can take the lead in making it happen. We do not believe that any community in the region can create a financially sustainable wholesale-retail split fiber to the premises network on their own. However, if Walsenburg, Trinidad, and Raton combine efforts to maximize economies of scale, we believe a project could be developed that would generate sufficient revenue to provide for future expansion into more rural areas.

**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 region.

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<td>A comparison matrix of broadband development paths; this document is also in the appendix</td>
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This regional broadband strategic plan covers the South Central Council of Governments (SCCOG) region, which includes Huerfano and Las Animas Counties in Colorado. For the purposes of this report, the study area includes parts of Pueblo County and includes considerations for Colfax County in New Mexico. The SCCOG study area covered by this report encompasses approximately 12,508 square miles and has a rich history dating back millennia. The area was once a steel meal and coalmine mecca that gradually transitioned to an agricultural paradise. Breathtaking scenery defines the region which has something for every outdoor enthusiast from mountains to plains to rivers. Internet access provides a pathway to attract ecotourism, strengthen the economy, and improve education and quality of life for residents.

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 21\textsuperscript{st} century. Fast, efficient and reliable broadband access can have tremendous impacts to local economies and education 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 prefer rural areas where property and facility costs are lower; but only if fast enough speeds are available and service is reliable. In the 21st century economy, fast reliable broadband is not a luxury item but rather an economic vitality and quality of life requirement.

Since a strong regional network provides the most opportunity for personal, business, and educational growth of 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 for the region. We will examine basic information about broadband services before diving into the specific needs of the SCCOG region.

3.1 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 using a variety of methods including: fixed and mobile wireless, DSL technologies, cable companies’ coaxial networks, and at the speed of light over fiber optic cabling.

The literal definition of broadband focuses on 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.*

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We often jokingly say that broadband is internet access that is faster than whatever you have now. But in many senses, the joke is close to reality. As we look at improving broadband in south central Colorado, 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 step in the right direction; however, this scenario 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 closer to the 20 or 30 Mbps range. Even at 20 to 30 Mbps, many businesses and some residences find their broadband speeds to be inadequate. They struggle with their connectivity and hope for improvements that will lift them to above 100 Mbps. To attract data centers, call centers, and other data intensive businesses, 100 Mbps service is 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.

3.2 HOW TO DELIVER BROADBAND

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

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“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.

### 3.2.1 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 (10,000,000 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 south central Colorado area has a fairly robust middle mile environment. Several providers have middle mile fiber assets running north and south along Interstate 25 from Pueblo to Raton. Multiple paths also exist on the east-west path from Walsenburg to Alamosa where microwave connections are available to Durango which connects north and
south to Grand Junction and Albuquerque. Middle mile is largely missing east on Highway 160 to connect the region to southeast Colorado, along Highway 350 to serve the communities along the highway/railroad, and along Highway 69 from Walsenburg into Custer County.

Often it is difficult for a community – or even a region – to develop middle mile infrastructure because of its extra-regional nature. The region can work with other areas or regional carriers to try to improve middle mile infrastructure. For example, Custer County is currently working with SECOM to try to find a solution to bring middle mile fiber from Walsenburg along Highway 69 to Westcliffe and on to Canon City. South central Colorado counties and communities may be able to contribute to that effort.

3.2.2 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 (that is, the point of presence, the colocation facility or data center). DOLA considers distribution architecture to be part of the middle mile environment and therefore it is eligible for DOLA grant funding.
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. This is one of the significant upgrades CenturyLink is making in many areas with their Connect America Fund federal subsidies. 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.

Colorado projects that have focused on distribution architecture include the original fiber collaboration in Meeker, the SCAN network in southwest Colorado, and the initial ring project in Fort Morgan. In Meeker and Fort Morgan, the communities both realized that distribution architecture was insufficient to meet their needs. Both communities have moved forward with Access level projects.

**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 usually not the areas with the greatest need.

**Drop Level (the driveways)**
Drop level architecture extends access level infrastructure into the subscriber’s premises (e.g. the physical address).

### 3.3 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.

#### 3.3.1 DSL

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

Because it uses traditional twisted pair copper, many Incumbent Local Exchange Carriers (ILECs) provide DSL service. In south central Colorado, CenturyLink and Pine Drive Telephone company are DSL providers in their respective territories. Federal regulation requires that owners of telephone infrastructure make elements of that infrastructure available to competing providers at fair rates. This “unbundling” means that other providers can offer DSL service across an incumbent (owner) carrier’s infrastructure.

![Figure 2: DSL](image)

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

There are many varieties of DSL. Most DSL providers offer either Asymmetric Digital Subscriber Line (ADSL) or Very High Bit Rate Digital Subscriber Line (VDSL). ADSL has a maximum download speed of about seven Mbps. VDSL can perform up to about 45 Mbps. Both ADSL and VDSL are asymmetrical services offering faster downloads than uploads. ADSL usually has upload speeds below one Mbps. VDSL can have upload speeds up to 10 Mbps.
DSL services are created and aggregate at a Digital Subscriber Line Access Multiplexer (DSLAM). DSL loses data signal strength 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.

Figure 3: Typical DSL Loss Impact

In many areas, DSL providers deploy remote DSLAMs to extend the reach of their DSL service. CenturyLink is using Connect America funds to extend the reach of their DSL service by placing remote DSLAMs and by extending fiber to the node.

3.3.2 FIXED WIRELESS

The technologies used to deploy services are different between fixed wireless and mobile wireless (or cellular broadband). 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” 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.

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

Unlicensed systems can suffer degradation 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 which explains why most providers adopt unlicensed systems first.

### 3.3.3 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 Trinidad in the south central Colorado area has access to cable internet service through Comcast.

### 3.3.4 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 implements a fiber-based Metropolitan Optical Ethernet service throughout their access level infrastructure to some businesses in south central Colorado communities. SECOM and Baca Valley Telephone company also offer some fiber to deliver services for limited business and residential addresses in the areas they serve. Rye Telephone has implemented fiber to the premises throughout their service area.
Consider the following illustration of the long-term scalability of fiber: if a standard drinking straw represents 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.
3.3.5 OTHER

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

In the south central Colorado region, significant numbers of subscribers use cellular broadband service out of choice (they feel it is the best option) or necessity (they understand it to be their only option).

3.3.6 EMERGING TECHNOLOGIES

As we look at broadband delivery, it is important to take a moment to discuss some emerging technologies and to make a reasonable assessment of their impact on broadband deployment.

First, some “emerging technologies” are more less likely than others to actually emerge. For example, Google and Facebook have created some speculation about balloons or drones being used to create flying access points for remote areas. Neither of these options have proven viable and do not appear they will mature to be so. AOptix was able to complete some flying bandwidth work for military applications. Christina Richards wrote about their experience for Wired Magazine.\(^2\) Richards concludes, “The wireless systems used to transmit data will need to be shrunk down in both size and cost, and although there are still many technical hurdles to address, from a technology standpoint such networks are entirely possible today. However, it remains to be seen if these organizations will be able to break through political and social barriers within specific regions. In the end, those forces may prove much harder to counter and will take sheer, sustained determination to resolve.” Without sufficient market demand, it will be very difficult to shrink down both size and cost.

Broadband over powerlines is another “emerging technology” that sometimes gets attention – especially in rural areas with existing power infrastructure but little or no broadband infrastructure. Unfortunately, as Jamie Yap paraphrases Ian Keene of Gartner Research for ZDNet, “…the hype never made it to reality: Products were delayed into the market due to technical issues, prices were high, and field performance often did not match up to laboratory performance.”\(^3\)

A final “emerging technology” that deserves some skepticism is the use of television white space to deliver broadband. Peter Rysavy’s GigaOM article\(^4\) does a pretty good job of describing


\(^4\) [https://gigaom.com/2013/03/17/white-spaces-networks-are-not-super-nor-even-wi-fi/](https://gigaom.com/2013/03/17/white-spaces-networks-are-not-super-nor-even-wi-fi/)
the promise and the problem of using TV white space for broadband deployment. In sum, significant investment is required to develop equipment and set regulatory policy for a fairly small opportunity.

Emerging technologies that are more likely to develop follow more traditional paths – in particular fixed wireless and cellular services continue to advance. Fixed wireless and cellular solutions enjoy significant markets and a business case that encourages continuing development. In some conditions, wireless solutions are able to deliver truly abundant bandwidth. There are three disadvantages to next generation fixed and cellular services:

1. As bandwidth increases, distance usually decreases.
2. Bigger bandwidth solutions typically rely more heavily on unobstructed line of sight. In some cases, line of sight can be obstructed by something as innocuous as high humidity.
3. A fundamental premise of wireless solutions for last mile access is point-to-multipoint where multiple end subscribers use a single “access point”. A shared access model is prone to congestion.

In spite of these disadvantages, new advances in cellular and fixed wireless solutions may prove invaluable to the region.

3.4 HOW TO 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.

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.

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

**Table 3: Last Mile Technology Summary**
4 NEEDS ASSESSMENT

Let’s take a look at some of the ways broadband contributes to economic vitality and quality of life and see if the current state of broadband is meeting the needs of the public and businesses in the area.

4.1 BROADBAND VALUE

Broadband services offer benefit to the community/region and to industries in the region.

4.1.1 TO THE COMMUNITY/REGION

General Value

Based on 2013 data agriculture, tourism, and healthcare are listed by the Colorado Office of Economic Development & International Trade as three of the top five industries in the South Central Council of Governments region\(^5\). Healthcare, manufacturing, and transportation/logistics are listed as the top three industries in the Pueblo County region\(^6\). Reliable broadband plays heavily into having the best healthcare technology available, constructing and sourcing materials, and developing a nimble logistic network. Most tourists factor internet connectivity and reliability when deciding where to vacation, especially when it


is common for employees to stay connected even when on vacation or traveling. Advance Colorado also lists the local college system, natural resources, and skilled workforce as a few of the Region’s many assets.

The unique history and location of the area has attracted people to choose Huerfano, Las Animas, Pueblo, and Colfax counties. Quality of life is an important component of choosing a community and broadband access is an integral component of quality of life. The population declined between 2010 and 2015 for most of the area according to the census bureau. However, the population grew for Pueblo County by 2.8%. See Table 3 for a breakdown by county. While internet access is not a silver bullet, it would allow the region to attract and retain residents.

<table>
<thead>
<tr>
<th></th>
<th>Colfax County</th>
<th>Huerfano County</th>
<th>Las Animas County</th>
<th>Pueblo County</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010 Population</td>
<td>13,750</td>
<td>6,711</td>
<td>15,507</td>
<td>15,9063</td>
</tr>
<tr>
<td>2015 Population</td>
<td>12,414</td>
<td>6,492</td>
<td>14,058</td>
<td>16,3591</td>
</tr>
<tr>
<td>Change</td>
<td>-9.7%</td>
<td>-3.3%</td>
<td>-9.3%</td>
<td>2.8%</td>
</tr>
</tbody>
</table>

Table 4: SCCOG Population Change 2010 to 2015

Public Safety

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.

4.1.1.1 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: Southern Colorado industry composition as of 2014” shows the
largest employment sectors in the region are government and healthcare. Drilling further down in the south central Colorado region, the Colorado Office of Economic Development & International Trade lists the key industries in Huerfano and Las Animas counties as healthcare, tourism/outdoor recreation, agriculture, infrastructure, and financial services. The key industries for Pueblo County are listed as healthcare, manufacturing, transportation/logistics, infrastructure, and financial services. Improved broadband access offers an opportunity to not only expand the current key industries but attract new “knowledge” jobs.

![2014 Industry Composition of Southern Colorado](image)

*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. Broadband access becomes a more vital asset to location neutral and traditional work as two business trends continue to 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

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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 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?”

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 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.”
- 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.
- 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.”

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9 http://www.itif.org/
• 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.”

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

Improving broadband access meets goals established by the planning regions covering this study area including helping to enhance communication, cooperation that results in economic vitality and supports the Stronger Economies Together (SET) initiative, Las Animas County Rural Jump Start Program, cultivate innovation, and technology. Reliable internet access will also help meet the core goals established by the Pueblo Area Council of Governments including creating a business friendly environment, recruit, retrain, and grow businesses.

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 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.

4.1.1.2 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 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.\textsuperscript{14} 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.

Broadband enables educational applications for students, parents, and professionals. According to the March 2016 publication \textit{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:

As technology continues to develop, the need for broadband to support education becomes ever greater. Broadband access will help to meet the Raton Basin Regional Economic Plan’s goal of raising the average educational level by 2.50 years before the year 2020 since it can expand educational opportunities for residents.\textsuperscript{15} 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”\textsuperscript{16} 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:

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure6}
\caption{Broadband Use for Current K-12 Applications}
\end{figure}

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.\textsuperscript{17} 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. \textsuperscript{18} 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:

\textit{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.}\textsuperscript{19}

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

\begin{table}[h]
\centering
\begin{tabular}{|l|l|}
\hline
\textbf{Speed} & \textbf{Simultaneous Tests} \\
\hline
One T1 (1.5 Mbps) & 15 \\
Two T1s (3 Mbps) & 30 \\
Four T1s (6 Mbps) & 60 \\
10 Mbps Ethernet & 100 \\
20 Mbps Ethernet & 200 \\
\hline
\end{tabular}
\caption{Simultaneous School Assessment Tests by Bandwidth}
\end{table}


\textsuperscript{18} ‘77% of U.S. school districts’, Investors Business Daily, November 20, 2015, pp. A02

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 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.²⁰

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.²¹ 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.

South central Colorado’s schools 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 Morgan Community College courses to meet their needs. In many cases, schools participate with the South Central BOCES for connectivity to broadband and access to distance education technology and support.

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

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rural areas to broadband access will allow rural communities to become competitive with their urban counterparts.

### 4.1.1.3 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 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 largest healthcare employers within the region are Spanish Peaks Regional Health Center, Mount San Rafael Hospital, Trinidad Inn Nursing Home, Las Animas County Rehabilitation Center, Parkview Medical Center, Centura: St. May-Corwin Medical Center, and Colorado Mental Health Institute at Pueblo. 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. 22 “Always-on broadband” is “essential” for some of these applications and greatly improves others that “depend on uninterrupted real-time transmission.” Care services are an important priority for the region and includes both healthcare, resident facilities, in-home care, and meal delivery. At least 400 residents receive care services with the intent to extend the ability to remain in their own home as long as possible. Over 25,500 meals were delivered to residents receiving care services.

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. In fact, broadband access will support the new state of the art

cancer center and new training facility (complete with simulation programs) at Saint Mary Corwin Hospital. The Raton Basin Regional Economic Development Plan list multiple goals to strengthen the regions healthcare opportunities. An effort has been in place to recruit healthcare staff and broadband access would supplement this goal by improving not only successful recruiting but retention of highly skilled medical staff. Another goal from the 2013 plan is the development of a regional coding center. Broadband access directly supports the functions of such a center and attracts long term, highly paid careers.

4.1.2 BROADBAND VALUE TO 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”.23

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.24 The Colorado Office of Economic Development & International Trade lists agriculture and associated products as one of the top assets within the region.

Horticulture and other specialty farm products are increasingly sold direct to households because of e-commerce growth. 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.25

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. Other sectors of farming, such as ranching, inherently prove more difficult to direct market. Internet adoption among the supply chain boosts productivity. Wholesale and retail food industry has also enhanced its productivity with internet adoption.26


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](image)

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 farm adoption. The type of agricultural use of a property may also play a role in predicting off-

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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. 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 south central Colorado area, 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.

4.1.3 BROADBAND VALUE TO OTHER REGIONAL INDUSTRIAL CENTERS

The Colorado Office of Economic Development and International Trade and Pueblo Economic Development Board list other large employers within the region as:

• Peak View Wind Energy
• Huerfano River Wind Farm
• Evraz, Inc.
• Express Scripts
• Colorado State University

Reliable broadband access will support these community employment anchors whether it’s through more efficient payroll, greater inventory control, or improved predictability of business to business commerce.

4.2 CURRENTLY AVAILABLE SERVICES IN THE REGION

We will look at existing services and public and private projects already underway.

4.2.1 EXISTING SERVICES

This regional broadband strategic plan focuses on broadband (or high speed internet services). We also looked at some other services.

4.2.1.1 HIGH SPEED INTERNET SERVICES

We find the following providers in the region:

<table>
<thead>
<tr>
<th>County</th>
<th>Community</th>
<th>Pop.</th>
<th>Wireline</th>
<th>Wireless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pueblo</td>
<td>Avondale</td>
<td>674</td>
<td>CenturyLink</td>
<td>DD Wireless (SECOM), Pueblo Wireless</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 1.9/xx Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pueblo</td>
<td>Beulah Valley</td>
<td>556</td>
<td>Pine Drive Telephone Company</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 1.5/0.562 Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pueblo</td>
<td>Boone</td>
<td>339</td>
<td>CenturyLink</td>
<td>DD Wireless (SECOM), Pueblo Wireless</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: xx/xx Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pueblo</td>
<td>Colorado City</td>
<td>2,193</td>
<td>Rye</td>
<td>DD Wireless (SECOM)</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: xx/xx Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pueblo</td>
<td>Rye</td>
<td>202</td>
<td>Rye</td>
<td></td>
</tr>
<tr>
<td>Huerfano</td>
<td>La Veta</td>
<td>800</td>
<td>CenturyLink</td>
<td>DD Wireless (SECOM), Amigo.net (Zero Error)</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 4.4/0.483 Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Huerfano</td>
<td>Walsenburg</td>
<td>3,068</td>
<td>CenturyLink, SECOM</td>
<td>DD Wireless (SECOM), Amigo.net (Zero Error)</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 12.5/2.2 Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Las Animas</td>
<td>Aguilar</td>
<td>538</td>
<td>SECOM</td>
<td>SECOM</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 7.4/6.5 Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>Community</td>
<td>Pop.</td>
<td>Wireline</td>
<td>Wireless</td>
</tr>
<tr>
<td>------------</td>
<td>-----------------</td>
<td>------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Las Animas</td>
<td>Cokedale</td>
<td>129</td>
<td>CenturyLink</td>
<td>SECOM</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: xx/xx Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Las Animas</td>
<td>Trinidad</td>
<td>8,771</td>
<td>CenturyLink, Comcast, SECOM</td>
<td>SECOM</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 15.8/2.9 Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colfax</td>
<td>Raton</td>
<td>6,885</td>
<td>Baca Valley Telephone, CenturyLink</td>
<td>Sierra Communications (Baca Valley Telephone)</td>
</tr>
<tr>
<td></td>
<td>Average Connection Speed: 5.3/1.7 Mbps</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6: Last Mile Service Providers

These data indicate that in most cases, population centers have a choice of a single wireline service provider and one or more fixed wireless providers. In some areas served only by the incumbent telephone company using DSL, competing service providers can take advantage of federally mandated unbundling requirements to offer service provider competition. Baca Valley Telephone offers DSL over CenturyLink’s network in much of Colfax County. However, since the imposition of unbundling requirements in the Telecommunications Act of 1996, unbundling requirements have been regularly weakened. Most prominently in 2015 when the FCC formalized its previous history of enforcement forbearance on fiber circuits feeding remote nodes. These relaxed unbundling requirements usually mean that as a regulated telephone company improves their network by implementing fiber to the node, they also relieve themselves of competition as competing service providers no longer have regulated access to transport to the improved node.

These data also indicate that average connection speeds in the region are far below the US average of between 28 and 55 Mbps (depending on the data source).

Each provider in the region offers service in different areas and at a variety of price points.

<table>
<thead>
<tr>
<th>Serving</th>
<th>Tech</th>
<th>Pricing28</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amigo.Net (Zero Error)</td>
<td>Some areas of Huerfano County</td>
<td>Fixed wireless</td>
</tr>
<tr>
<td>Baca Valley Telephone</td>
<td>Some fixed wireless and fiber service in Raton and other parts of Colfax County</td>
<td>Fixed wireless Some fiber</td>
</tr>
</tbody>
</table>

28 All speeds represent “up to” speeds. Pricing is generally non-promotional internet only pricing.
Table 7: Last Mile Internet Pricing

These data suggest most of the region’s providers offers at least one option near to or below the $47 per month US average. However, service at or below the $1 per Mbps range exists only in the limited areas served by Rye Telephone and Comcast.

In order to ensure market forces influence service provider behavior, every address in the region should have access to at least two broadband service providers. Every address should

29 Prices are non-promotional prices for Internet only. CenturyLink offers higher speed packages but they are not generally available in the region.
30 Comcast’s non-promotional prices are difficult to ascertain. Comcast typically offers a six-month promotion followed by an increase to another promotional price for the second six months followed by an increase to standard rates. Comcast representatives indicate they cannot determine standard pricing as it varies by time and location. Therefore, standard rates are usually expressed in a range. We have used the mid-point of the range for pricing in this report.
have access to at least one provider offering the FCC’s minimum definition of broadband (currently 25/3 Mbps), every address should have access to at least one service package at or below the US average monthly cost (currently about $47 per month), and every address should have access to at least package at or below the US average cost per Mbps (currently about $1).

### 4.2.1.2 MIDDLE MILE INFRASTRUCTURE

The region enjoys significant middle mile resources – especially on the north-south axis from Pueblo through Walsenburg and Trinidad and on to Raton and continuing to Santa Fe.

![FiberLocator Fiber Map](image)

**Figure 8: FiberLocator Fiber Map**

The FiberLocator service indicates fiber from CenturyLink, Level 3, SECOM, Sprint, Verizon, Windstream, and Zayo on this north-south axis. Some organization’s fiber is not included in the FiberLocator data. For example, EAGLE-Net has completed fiber on the east-west axis in the region as well as fiber parallel to other north-south providers’ routes.
Figure 9: EAGLE-Net Network

4.2.1.3 OTHER SERVICES

Potential subscribers in the region have access to other broadband services in addition to wireline and fixed wireless services.

Satellite broadband is available throughout most of the region. Satellite broadband has significant weaknesses when compared to fixed wireless and wireline services. Nonetheless, satellite broadband is an option in unserved and underserved areas.

Mobile wireless or cellular providers also provide service in the region.
Using a combination of publicly available data and a proprietary cellular survey, we found good cellular service along the I-25 corridor from Pueblo to Trinidad. Service was less reliable off of the I-25 corridor and crossing the Raton pass.

Verizon and AT&T both have significant capabilities in the region. Viaero has begun significant development in the region. Viaero takes a very different approach to network development. Verizon and AT&T are voice networks with data capability. They tend to place their antennas high on tower structures to maximize the geography covered with each site. This development method creates a large blanket of coverage but comes at the sacrifice of good data service in much of the covered area. Viaero pursues a model of being a data network that provides voice service. To accomplish this, Viaero builds their network with significantly higher tower density.
and shorter towers than the other cellular carriers. This shorter tower model enables a much better data network but comes at the cost of each tower having a smaller coverage area.

4.3 DEMAND

Let us look both at current and projected demand and adoption.

4.3.1 ADOPTION AND USAGE/CURRENT DEMAND

We used two tools to look at current demand. First, we make the assumption that current demand in the region should be similar to demand in the state and we compare regional service levels to state-wide service levels. Secondly, we use interviews to gauge satisfaction with current service levels.

The good news is that regional broadband speeds have kept pace with or generally beat statewide development:

![Average Download Speeds](image)

**Figure 11: Statewide Average Download vs. Regional Average Download**

However, the sample sizes undermine the accuracy of this comparison. Statewide, we have 162,815 speed tests from 20,617 unique devices. Of these, 2,733 tests from 236 unique devices are from the south central region. An unrepresentative number of the tests from the south central region are from Trinidad (63%) and from Comcast (51%).
When we review comments from interviews, we find general dissatisfaction with broadband in the region. Asked to rate their opinion of broadband, 74 regional interviewees were roughly split between poor, adequate, and good. Only one respondent (a Comcast subscriber) had an excellent impression of their broadband.

![Reported Broadband Impressions](image)

**Figure 12: Broadband Impressions**

4.3.2 PROJECTED NEAR TERM AND FUTURE DEMAND

Nielsen’s Law of Internet Bandwidth, postulated in 1998, suggests individual bandwidth demand will increase by 50% per year. In the nearly 20 years since its origin, the law has remained remarkable prescient. Expanding streaming video quality, increasing numbers of devices participating on the “internet of things”, growing “cloud” computing requirements, and other forces promise to continue the trend.

The average US connection speed is currently about 40 Mbps in 2016. At a 50% growth-rate per year, by 2020, the average US connection speed will be over 200 Mbps and will surpass 1 Gbps before 2025.
Unfortunately, distribution technology limits bandwidth growth. In “Figure 13: Growth in Technology Innovation” created by Google, we see that computing power and storage capacity are far outpacing internet speed growth.

![Growth in Technology Innovation](image)

**Figure 13: Growth in Technology Innovation**

The figure also suggests there is a cap on internet speed growth. This cap is a result of the limited transmission speed capability of many of the fixed wireless and wireline technologies used to deploy bandwidth. Simply put, DSL cannot meet projected broadband demand growth.

### 4.4 DEVELOPMENT NEEDED TO OPTIMIZE SERVICES TO MEET DEMAND

Some public and private projects have recently been completed or are currently under way that may help improve broadband in the region. However, it is unlikely these projects will sufficiently close the gap between services currently available and broadband development goals.

#### 4.4.1 PUBLIC AND PRIVATE PROJECTS ALREADY UNDERWAY

In the last several years, four initiatives have driven public and private broadband development in the region:

- The 2009 stimulus
- The Connect America Fund
• FCC Capital Projects
• Unsubsidized and Other Private Sector Development

4.4.1.1 THE 2009 STIMULUS

Three 2009 broadband stimulus projects had a significant impact on Colorado’s broadband environment:

• Bridging Colorado’s Digital Divide
• EAGLE-Net
• Broadband Initiatives Program

4.4.1.1.1 BRIDGING COLORADO’S DIGITAL DIVIDE

In 2010, the Colorado State Library received federal stimulus money and matching funds from the Bill and Melinda Gates Foundation to install or upgrade Public Computer Centers in libraries and community centers throughout the state. Local libraries provided 10% match, purchased equipment, offered public training, and promoted broadband adoption and digital literacy.

The grant was completed early and the final numbers for two years are significantly higher than projected in the initial application.

• Installed or upgraded 88 public computer centers in Colorado – 16% more centers than projected
  Of these, two were in the South Central Region:
  o Spanish Peaks Library District – Spanish Peaks Library in Walsenburg
  o Trinidad Carnegie Public Library in Trinidad
• Purchased 26% more computers than projected – in total over 1,500 desktops, laptops, tablets, and assistive tech machines
• Had 28% more uses of the computers – in total over 3.46 million computer uses
• The centers offered training to over 400,000 resident learners including 383,935 individual tutoring sessions and nearly 5,000 formal classes to 31,873 attendees. Surpassing the goal of 10,000 computer trainings projected in the grant application.

4.4.1.1.2 EAGLE-Net

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.

Through leased lines and new construction, EAGLE-Net has connected facilities in Walsenburg, La Veta, Aguilar, Hoehne, and Branson.
Several rural service providers throughout the state took advantage of broadband stimulus funds to build fiber to the premises. None of them are in the south central Colorado area.

The Connect America Fund (CAF) — also known as the universal service High-Cost program — is the FCC’s program to expand access to voice and broadband services for areas where they are unavailable. Through one component of the program, called CAF Phase II, the FCC provides funding to local telephone companies to subsidize the cost of building new network infrastructure or performing network upgrades to provide voice and broadband service in areas where it is lacking.

CenturyLink is the only CAF II recipient in Colorado. Some significant areas of the South Central area and Colfax County are eligible for CenturyLink CAF II spending.
CenturyLink has some leeway in the way they will spend funds associated with CAF II upgrades.

### 4.4.1.3 FCC CAPITAL PROJECTS

Funds are available from the FCC to provide schools and medical facilities grants to reduce the cost of implementing fiber to their facility. These projects are undertaken by the individual schools or medical facilities in cooperation with regional providers.

### 4.4.1.4 UNSUBSIDIZED AND OTHER PRIVATE SECTOR DEVELOPMENT

Private sector companies continue to make broadband improvements in the region.
SECOM has been expanding its fiber backhaul and fixed wireless network services throughout the region.

Comcast has conducted significant network upgrades on its Trinidad facilities.

Viaero continues to expand its cellular wireless network in the region. As described above, the Viaero wireless network is a reasonable broadband alternative.

Rye Telephone Company has implemented fiber to the premises through much of its service area.

4.5 BROADBAND QUALITY GOALS SUMMARY

The following are the empirical metrics associated with each of the overall broadband quality goals:

- **Availability**
  - Every address should have access to at least one broadband provider.
  - Development should expand until every address in the region should have access to at least two broadband options.

- **Abundance**
  - Every address in the region should have access to at least one broadband service that offers the FCC minimum definition of broadband (currently 25/3 Mbps).
  - Business zoned areas should have access to at least one data package that meets or exceeds 100 Mbps download speeds.

- **Affordability**
  - Every address in the region should have access to at least one data package that meets or beats the US average price per Mbps month (currently about $1).
  - Every address in the region should have access to at least one data package for less than the US average monthly broadband cost (currently $47 per month).

- **Reliability**
  - All service providers in the region should have path diverse redundant middle mile connections.

- **Sustainability**
  - 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**
  - Broadband development should contribute to better cellular service and coverage.
5 POTENTIAL DEVELOPMENT PATHS

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 potential paths forward.

5.1 INTRODUCE POTENTIAL PATHS

Before introducing potential broadband development paths, let’s take a moment to identify a set of guiding principles. We can then use the guiding principles in conjunction with the broadband quality measures defined above and the region’s broadband development objectives to evaluate each of the general broadband development paths.

5.1.1 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 SCCOG circumstances but they provide the foundation for evaluating possible broadband development options.

### 5.1.1.1 OPEN AND WHOLESALE

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 (like the project in Longmont). Philosophically, public sector entities 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 should 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.

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.
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. In Zager’s list, only 34 of the 135 projects are designed to support multiple competing service 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.*

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, 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.

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32 See [http://repository.cmu.edu/tepper/447](http://repository.cmu.edu/tepper/447)
a model that separates the natural monopoly element of broadband delivery from the competitive aspects of the services.

5.1.1.2 CARRIER CLASS

“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.” 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.”

Brocade Networks’ 2009 article “What is Carrier Grade Ethernet” 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”, 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.

33 http://www.pcmag.com/encyclopedia_term/0,1237,t=carrier-class&i=39298,00.asp
g. Integration with existing TDM services.

h. Greatly reduced operating and capital costs.

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 have 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.” Our own interviews found this to be the case in the south central Colorado region as well.

5.1.1.3 HIGH SCALABLE BANDWIDTH

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 16: 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.
While current DOCSIS technologies may seem adequate to meet the needs of today, 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.

5.1.1.4 OPEN AND INDEPENDENT ARCHITECTURE

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.

5.1.2 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
• Public-private partnerships.

Of course, there are many varieties of each of these options. Representatives of the general public completed a survey to aid in determining regional perspectives and leanings towards these four alternatives. Respondents were asked to use a 5-point scale ranging from choosing the alternative as the “least appropriate action” to the “most appropriate action.” The top alternatives chosen as the “most appropriate action” are broadband friendly policies, government and infrastructure, and use incentives/penalties to influence provider behavior.

![Survey Results - Broadband Development Actions](image)

**Figure 15: Survey Results - Broadband Development Actions**

### 5.2 COMPARE AND CONTRAST PATHS (SWOT ANALYSIS)

The following narrative describes each of the four general broadband development paths and compares their relative strengths and weaknesses based on broadband quality measures and guiding principles.
5.2.1 STATUS QUO

Status quo development essentially means the current system remains unchanged – the public sector will do little or nothing to change the current course of broadband development. Public sector restraint means the incumbent private sector providers will continue to install and maintain the necessary infrastructure in order to reach their business objectives. Private sector business objectives often align with the region’s broadband development policy objectives but sometimes do not. As of today, the status quo has not met the region’s objectives.

Nonetheless, 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

Interviewees and survey respondents had very low desire to maintain the status quo. In fact, it ranked dead last out of potential development options. 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 installations.

- **Is the status quo based on an open and independent architecture?**
  Depending on the network owner.

Does maintaining the status quo advance the five characteristics of quality broadband? To date, 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 providers. However, as a region, the status quo has not resulted in satisfactory results.

<table>
<thead>
<tr>
<th>Internal STRENGTHS</th>
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</thead>
<tbody>
<tr>
<td>• Transfers broadband development risk to the private sector.</td>
</tr>
<tr>
<td>• Broadband development can be complex and resource intensive. The status quo shields local public sector entities from these demands.</td>
</tr>
<tr>
<td>• Broadband is currently a private sector responsibility. There is some wisdom to avoiding public sector entry into private sector functions.</td>
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</table>

<table>
<thead>
<tr>
<th>Internal WEAKNESSES</th>
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<tbody>
<tr>
<td>• Cedes control of broadband development – and meeting the objectives thereof – to the private sector.</td>
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<thead>
<tr>
<th>External OPPORTUNITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Market forces may drive additional private sector investment as can already be seen in the Viaero and SECOM expansions.</td>
</tr>
<tr>
<td>• Some state and federal funds are more readily available to private sector firms.</td>
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</tbody>
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<thead>
<tr>
<th>External THREATS</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Broadband development will be driven by market forces and other external factors. These external factors favor development in more populous areas.</td>
</tr>
<tr>
<td>• Some state funds are more readily available to public sector entities.</td>
</tr>
</tbody>
</table>

Table 8: Status Quo SWOT

The status quo has left south central Colorado with generally inadequate broadband service.

5.2.2 INCENTIVES AND/OR PENALTIES

Existing (incumbent) service providers can be encouraged to improve 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 purchasing 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 improve broadband.

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 public sector lowers barriers and buys service.

Another incentive regimen is 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.

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.

Broadband friendly policies were a separate option in the online survey. Broadband friendly policies were the highest ranked option in the survey. Nearly two-thirds of respondents
considering broadband friendly policies to be either the most appropriate or a somewhat appropriate action.

Survey comments indicate that many respondents are unaware of the federal incentives already offered to existing service providers and the broadband friendly policies already in place.

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**Do Incentives and Penalties Satisfy the Four Defining Principles?**

- **Do incentives and penalties encourage open and wholesale networks?**
  Not generally. Typical incentive and penalty programs – like making public assets available to incumbent providers or consolidating purchasing power – benefit a single provider to the exclusion of others in the marketplace.

- **Do incentives and penalties encourage carrier class deployments?**
  There is significant risk that improperly crafted incentives and penalties will undermine carrier class network quality. The fundamental philosophy of incentive programs is to lower the cost of broadband development. Implementing carrier class quality generally requires higher investments. Thus, a carrier enticed by incentives that lower costs may be inclined to reduce costs in other areas as well.

- **Do incentives and penalties encourage high scalable bandwidth?**
  Unless they are well crafted, incentives and penalties will typically encourage a continuance of constrained bandwidth development.

- **Is the status quo based on an open and independent architecture?**
  Depending on the network owner.

---

Does implementing incentive and penalty broadband policies advance five characteristics of broadband quality?

- **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 available path diversity and middle mile redundancy. A strong set of incentives/penalties that could be easily wielded 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.

<table>
<thead>
<tr>
<th>Helpful</th>
<th>Harmful</th>
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<tbody>
<tr>
<td><strong>STRENGTHS</strong></td>
<td></td>
</tr>
<tr>
<td>Transfers broadband development risk to the private sector.</td>
<td></td>
</tr>
<tr>
<td>Broadband development can be complex and resource intensive. Incentive and penalty programs are a relatively easy step into the process.</td>
<td></td>
</tr>
<tr>
<td>Broadband is currently a private sector responsibility. There is some wisdom to avoiding public sector entry into private sector functions. Even so, the public sector frequently uses incentives and penalties to shape private sector behavior.</td>
<td></td>
</tr>
<tr>
<td><strong>WEAKNESSES</strong></td>
<td></td>
</tr>
<tr>
<td>Typically favors a small set of private sector providers over others.</td>
<td></td>
</tr>
</tbody>
</table>

| **OPPORTUNITIES** |
| Incentives and penalties subsidize market forces to drive additional private sector investment. |

| **THREATS** |
| Private sector firms excluded may pursue redress. |
| The private sector firms selected for incentives may monopolize the incentives and still fail to deliver sufficient development. |

Table 9: Incentives and Penalties SWOT

Incentives and penalties are generally not a strong enough mechanism 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.

5.2.3 **Municipal Entry**

Competition often spurs innovation and lower prices. A municipality (or public sector entity) can enter the broadband market to increase competition and provide alternative solutions.
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 general bonds and other funding sources to secure the capital 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.

Municipal entry comes in two basic models: targeted builds and general builds.

Targeted builds focus on deploying infrastructure to specific parts of the community or region. A fiber build to a business park may enhance economic development to that park. A fiber ring connecting multiple community anchor institutions can improve education and healthcare services. A publicly owned fiber fed tower can be offered to fixed wireless and cellular providers to extend service to underserved and unserved areas. In all cases, targeted build infrastructure can be used as part of an incentive program.

Other municipal entry projects are more general in nature. The City of Longmont elected to build and operate a ubiquitous fiber network. 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 gaps or enhance capabilities, this idea would put government owned infrastructure — and possibly services — in competition with existing providers.

Public sector infrastructure was the second highest ranked as “the most appropriate” action by survey respondents. When the “most appropriate” and “somehow 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 believing building government owned infrastructure was the most appropriate or a somewhat appropriate action.
Does the municipal entry as a broadband service provider advance the five broadband quality characteristics?

- **Availability**
  Municipal entry will increase availability in the areas served by the municipality.

- **Abundance**
  Municipal entry should be a fiber or other advanced network implementation. This should increase abundance in the limited area of the municipal 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**
  Some municipal entry projects in the U.S. have failed.

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**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?**
  Maybe; 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.
While municipal entry can help achieve broadband development goals, most communities find the associated costs prohibit following this model.

### 5.2.4 PUBLIC-PRIVATE PARTNERSHIP

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 but rather to make broadband roads available to multiple private sector providers. The public sector partner identifies and provides “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 calls for government intervention and action. However, the services market is robust and vibrant. There is no call for direct government action in this area.

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:

<table>
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<th>Helpful</th>
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<tbody>
<tr>
<td><strong>STRENGTHS</strong></td>
<td><strong>WEAKNESSES</strong></td>
</tr>
<tr>
<td>• Creates great control of broadband development objectives.</td>
<td>• Comes with significant capital requirements and risk.</td>
</tr>
<tr>
<td>• A successful project may generate positive cash flow that can be used to supplement other programs or to lower prices.</td>
<td>• Represents a public sector entry into private sector business.</td>
</tr>
<tr>
<td><strong>OPPORTUNITIES</strong></td>
<td><strong>THREATS</strong></td>
</tr>
<tr>
<td>• May drive other providers to offer improved services or pricing.</td>
<td>• Private sector firms are likely to respond competitively.</td>
</tr>
<tr>
<td>• Offers an opportunity to respond to consumer demands.</td>
<td>• Private sector firms may take legal action to stop public sector projects.</td>
</tr>
</tbody>
</table>

Table 10: Municipal Entry SWOT
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**
   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.

---

**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.

Additionally, a public-private partnership creates an environment with shared vision and leadership. 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

---

Does using a Public-Private Partnership (PPP) advance the quality of the five broadband characteristics?

- **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 available path diversity and middle mile redundancy capabilities.

- **Sustainability**
  A regional PPP could achieve a sustainable business model.

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<tbody>
<tr>
<td><strong>Internal</strong></td>
<td><strong>WEAKNESSES</strong></td>
</tr>
<tr>
<td>STRENGTHS</td>
<td>Can be complex and difficult to manage – especially in multi-jurisdictional models.</td>
</tr>
<tr>
<td>- Creates shared control of broadband development objectives.</td>
<td></td>
</tr>
<tr>
<td>- Shares risk with private sector partners</td>
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</table>

| **External** | **OPPORTUNITIES** |
| THREATS | |
| - Creates a flexible model to respond to market forces. | |
| - Some private sector providers may refuse to participate on the shared infrastructure. | |
| - Individual communities may be too small to sustain a wholesale retail split. | |

**Table 11: Public-Private Partnership SWOT**

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

### 5.3 IDENTIFY PRIMARY AND ALTERNATE PATHS

The following grid provides a summary of how each of the broadband development alternatives described above meets the four guiding principles.

<table>
<thead>
<tr>
<th></th>
<th>Open and Wholesale</th>
<th>Carrier Class</th>
<th>High Scalability</th>
<th>Open and Independent Architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Status Quo</td>
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Meets Needs =
The following matrix highlights how each broadband development alternatives helps advance the overall broadband quality goals.

<table>
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<tr>
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<th>Availability</th>
<th>Abundance</th>
<th>Affordability</th>
<th>Reliability</th>
<th>Sustainability</th>
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<td>Status Quo</td>
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5.3.1 PRIMARY PATH

To affect the greatest broadband development, the region should engage in a regional public-private partnership involving multiple jurisdictions and multiple private providers. At a strategic level, the recommendation is for multiple public and private network owners to join together to share infrastructure in a wholesale retail split model. These network owners would allow multiple private sector service providers to offer services to customers across the shared infrastructure throughout the region. While fiber is the preferred development model, fiber can be quite expensive to deploy. Therefore, a pragmatic approach that combines existing networks, new fixed wireless expansion, and new fiber expansion is the most prudent approach.
The network would lie down throughout the region combining existing fiber to the premises (especially in the Rye Telephone area) and existing fixed wireless (especially in the SECOM coverage areas).

<table>
<thead>
<tr>
<th>Existing Fiber</th>
<th>Existing Fixed Wireless</th>
<th>Existing DSL</th>
<th>Underserved and Unserved</th>
</tr>
</thead>
</table>

Emphasizing Rye Telephone and SECOM areas is not targeting Rye Telephone and SECOM. Rather it suggests they are critical partners in the proposed partnership.

Through various funding mechanisms, public and private sector projects (fiber to the premises – particularly in Walsenburg, Trinidad, and Raton, targeted fiber – particularly fiber to the tower and perhaps supporting fiber along Highway 69 between Walsenburg and Westcliffe, and tower/wireless expansion – especially along Highway 350 between Trinidad and La Junta and along Highway 160 between Trinidad and Highway 109) would then expand the shared service area.

<table>
<thead>
<tr>
<th>Existing Fiber</th>
<th>New Fiber</th>
<th>Existing Fixed Wireless</th>
<th>New Fixed Wireless</th>
<th>Reduced DSL</th>
<th>Reduced Underserved and Unserved</th>
</tr>
</thead>
</table>

Expanding the shared service area is a critical incentive to draw the attention of the private providers in the region. Furthermore, future revenue from public projects can be used to continue fiber expansion. For that reason, we strongly encourage Walsenburg, Trinidad, and Raton to consider fiber to the premises solutions.

Partners in the broadband development should continue to seek new funding and should set aside a portion of revenues to continue fiber expansion to eliminate all unserved and underserved and eventually extend fiber ubiquitously through the region.

<table>
<thead>
<tr>
<th>Existing Fiber</th>
<th>New Fiber</th>
<th>Existing Fixed Wireless</th>
<th>Reduced DSL</th>
</tr>
</thead>
</table>

Because the proposed model suggests multiple network owners, the public-private partnership should be a three-tiered model placing a network operator between the multiple network owners and the multiple service providers. The network operator would act as a buffer between the service providers’ business processes and the network owners’ business processes making all network owners look the same to the service providers and all service providers look the same to the network owners.
A regional public private partnership has several distinct advantages over other potential broadband development models.

- **Open and Wholesale**
  The very nature of the concept is that the infrastructure in the region will be open and wholesale. In addition to providing the benefits of competition and the innovation and entrepreneurial spirit that involves, a coalition of network owners can work together to reduce inefficiencies in broadband construction. Instead of four or five fiber paths along Interstate 25, if the region had a coordinating broadband body, some of the funds used to build those parallel middle mile paths could have been used for distribution and other last mile infrastructure.

- **Carrier Class**
  The various network providers will be encouraged to build carrier class infrastructure in order to support the needs of the various service providers.

- **High Scalable Bandwidth**
  The objective is to build as much fiber as possible. Fiber supports the most scalable of all broadband delivery mechanisms.

- **Open and Independent Architecture**
  The need to ensure interoperability with other network owners and with multiple service providers will drive network owners towards choosing open and independent architectures.

- **Available**
  Combining multiple networks into a single regional network will enhance the reliability of all participating networks.

- **Affordable**
  Competition among multiple service providers should result in the most affordable sustainable pricing.

- **Abundant**
  By deploying fiber, the partnership of private and public network owners will enable the most abundant services available. Competition among service providers should then drive providers to offer bigger and better packages.

- **Reliable**
  Combining the regions networks through a partnership will create new path diversity and redundancy.
• **Sustainable**  
  Larger broadband markets help offset the fixed costs each provider must meet. By combining the whole of the south central region into a single marketplace, all providers will have a larger potential market and better economies of scale to offset their fixed costs.

• **Other Advantages**  
  A regional partnership helps create local broadband development self-determination. A partnership that includes public and private entities has access to grants and loans available to either the public sector or the private sector.

While a regional partnership model has significant potential advantages, it does not come without risk.

• Private sector network owners may have no interest in participating. Without private sector network owners participating, the whole capital risk of developing broadband falls on the public sector. Furthermore, loan and grant funds that favor private sector entities may not be available to the partnership. Finally, the expertise and community good-will some of the region’s private sector providers enjoy will compete with the partnership instead of contributing to it.

• The partnership structure may prove to be too complex and unwieldy to effectively implement broadband solutions.

• The financial model may simply not work.

Concurrently to development of fiber assets in population centers, the region’s local jurisdictions should work with wireless providers (most likely SECOM) to expand wireless service in the region by placing additional vertical assets.

Already, some reasonable wireless coverage exists. SECOM (through their own development and through their acquisition of DD Wireless has antennas at more than 20 locations in the region.
There are other tower assets and vertical structures throughout the region. In particular, Industrial Tower and Wireless manages at least 11 sites in the region.
Figure 19: Approximated Viewsheds from SECOM and Industrial Tower and Wireless Tower Sites

Negotiating a single agreement with Industrial Tower and Wireless could significantly increase covered areas.

Additionally, new tower sites can be added. Selecting new towers sites should be a collaborative effort between private sector wireless providers and public sector infrastructure owners. The public-private collaboration opens maximum opportunities for grant and loan funds.

Custer County has been able to establish an effective partnership with SECOM where SECOM is helping select tower sites to expand wireless access.

5.3.2 ALTERNATE PATHS

A regional broadband development partnership represents a bold and progressive model for broadband development. If the risk is too great, the next best alternative is a combination of broadband friendly incentives coupled with targeted builds – especially vertical assets for wireless deployments – designed to enhance the business case of potential private sector providers.
6 FINANCIAL MODELING AND SUSTAINABILITY

6.1 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**
  Capital expenses are the actual upfront costs associated with building new infrastructure. Potential capital expenditures vary widely because they depend on location, type of infrastructure, size of the overall project, previous experience with the technology used and/or built, and other factors.

- **Operations Expenses**
  Operations expenses cover everything involved with running the business or department. They include infrastructure maintenance, customer support, billing (including debts), staff salaries, equipment costs (including maintenance), etc. These items collectively are sometimes called the “overhead” costs.

- **Revenue**
  Revenue is the source of money generated to feed both operations and capital expenses. Traditionally revenue includes fees or tariffs of some sort (for service or for use of infrastructure). Revenue may also come from grants or loans.

- **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.

Recent south central Colorado projects have not built new cable or DSL infrastructure. Recent projects generally fall into one of three categories:

1. **Tower Infrastructure**
   Tower infrastructure falls into two camps: the actual standard communications tower itself and the equipment used for microwave links, cellular service, and fixed wireless service.
   
   There are five primary types of cell towers:
   
   - **Broadcast**
     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.
   
   - **Monopole**
     The monopole and guyed towers look very similar with a single pole rising out of a foundation.
   
   - **Guyed**
     The guyed tower uses guyed wires to assist in holding the tower in place.
   
   - **Lattice**
     Lattice towers use a lattice framework rather than a single pole. Lattice towers are similar in appearance to traditional oil rigs.
     
     Much of the recent Viaero expansion in the region is on new lattice towers.
   
   - **Stealth (Camouflaged)**
     Stealth towers tend to be the most expensive because they go above functionality and incorporate aesthetic design features to help them blend into the environment. This could be a variety of trees, windmills, flagpoles, etc.
The cost varies considerably between these five types of communications towers. One of the largest communications tower consultants (Steel in the Air) identified typical tower construction costs at about $150,000. This is without land acquisition or 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 requires individual cost estimates to provide realistic cost ranges.

   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 typical 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 if the project anticipates 100% of passed addresses to subscribe to service.

   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 Expenses**

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 should 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 average approximately $250 per year per mile of existing infrastructure being maintained plus $3.00 per month per customer or subscriber. These values can be adjusted as more historical data become available to tailor the averages to a project’s 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 revenue by the number of subscribers (or number of units if calculating services separately). 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 user adoption or certain public policy objectives, 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.

6.2 POTENTIAL FUNDING SOURCES

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

All programs listed are subject to change. Before pursuing a particular funding mechanism, the current state of the program should be carefully reviewed.

While a number of federal and state funding sources exist, communities should carefully consider the restrictions placed on those funds. It may be in the community’s best interest to forego state or federal funds in order to retain local control and self-determination.

6.2.1 FEDERAL FUNDING SOURCES

Federal funding for broadband development is currently available from the USDA Rural Utilities Service, from Federal Communications Commission programs, and from other federal sources.

6.2.1.1 USDA RUS

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

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.
Four primary broadband development programs currently offered by RUS in 2015 include:

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

6.2.1.1.1 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.

6.2.1.1.2 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
  o Audio, video and interactive video equipment
  o Terminal and data terminal equipment
  o Computer hardware, network components and software
  o 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:
  o Technical assistance,
  o Develop instructional material for the operation of the equipment; and/or
  o 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.

6.2.1.1.3 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.

6.2.1.1.4 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:

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

Who Can Apply for Grants:

o Public bodies
  o Nonprofit corporations or associations must have significant ties with the local rural communities
  o 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:
o Qualifying percentage of eligible project cost determined in accordance with §3570.63(b),
o Minimum amount sufficient to provide for economic feasibility,
o 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:
  o Located within a rural community having a population of 5,000 or less, and
  o 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.
  o Health care facilities such as hospitals, medical clinics, dental clinics, nursing homes or assisted living facilities
  o Public facilities such as town halls, courthouses, airport hangars or street improvements
  o Community support services such as child care centers, community centers, fairgrounds or transitional housing
  o Public safety services such as fire departments, fire trucks, police stations, police vehicles, prisons, public works vehicles or equipment
  o Educational services such as museums, libraries or private schools
  o Utility services such as telemedicine or distance learning equipment
  o 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:
  o 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.
  o 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.
  o Purchasing or renting equipment necessary to install, maintain, extend, protect, operate, or utilize facilities.

Caution:

• Ineligible Projects
  o Initial operating expenses or annual recurring costs.
  o Construct or repair electric generating plants, electric transmission lines, or gas distribution lines to provide services for commercial sale.
  o Refinance existing indebtedness
  o Pay interest
  o Pay for facilities located in non-rural areas
  o 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.
  o Pay project costs when other loan funding for the project is not at reasonable rates and terms.
  o 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.

6.2.1.2 FCC

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

- FCC Universal Service Funds
  - Healthcare Connect
    - Colorado Uses Funds for their Colorado Telehealth Network (CTN).
  - E Rates
  - FirstNet

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 summaries, 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\textsuperscript{37}. Engadget referenced a CDC study that shows only 8% used a landline as of 2015\textsuperscript{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.\textsuperscript{39} This means that 85% used the internet as part of their daily life.

Currently, the USF is funded by telephone service (including cell phone 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 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 on internet access (similar to the USF fees currently paid on telephone service). Thus, while the FCC has created programs that enable the use of USF funds for broadband development, it appears to be unsustainable to assume we can continue to expand broadband access on funds based on declining voice line revenues.

\subsection*{6.2.1.2.1 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,
- 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.
6.2.1.2.2  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.

### 6.2.1.3 OTHER FEDERAL SOURCES

The National Telecommunications and Information Administration (NTIA), the Economic Development Administration, and other federal agencies also sometimes have programs that support broadband development. Additional Federal funding sources can be found at grants.gov. The site requires some credentialing and online authentication procedures for the first time users. This may take several business days to complete.

### 6.2.2 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.

#### 6.2.2.1 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 health 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.
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 from the set-aside funds; beyond the set-aside, broadband projects will compete with other DOLA projects

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.

6.2.2.3 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-process

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.

6.2.3 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 following process outlined by Larimer County⁴⁰ seems to be fairly common.

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6.2.4 FUNDING SOURCE SUMMARY

The table on the next page offers an “at a glance” summary of the various funding mechanisms discussed and the most common projects they cover.
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<tr>
<th></th>
<th>Capital Expenses</th>
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**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
- 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
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</table>

Note: 'Y' indicates availability, 'M' indicates a specific condition or requirement.
7 COMMUNICATION ("MARKETING") PLAN

7.1 DEFINE THE MARKET AND "COMPETITION"

Investopedia provides “The Industry Handbook: The Telecommunications Industry.” The following industry overview relies heavily on the Investopedia article but has been modified to be more relevant to south central Colorado.

Think of telecommunications as the world’s biggest machine. Strung together by complex networks, telephones, mobile phones, and Internet-linked PCs, the global system touches nearly all of us – some more effectively than others. It allows us to speak, share thoughts and do business with nearly anyone regardless of where in the world they might be. Telecom operating companies make all this happen.

In spite of deregulation, beginning in earnest in the early 1980’s, the telecommunications industry is still dominated by a club of big national and regional operators. On the cable television side of telecommunications, Comcast and Time Warner Cable claim 55% of all wireline cable subscribers. The third largest player in the wireline cable service industry, Cox Communications, only has 7.5% of the market share. In broadband, Comcast, AT&T, and Time Warner Cable combine for more than 58% of the market share. The fourth largest broadband provider, Verizon, claims 11% of broadband subscribers and no one else even breaks double digits. In cell phones, Verizon and AT&T both have over 108 million subscribers. The third through eighth largest providers (Sprint Nextel, T-Mobile, TracFone Wireless, MetroPCS, US Cellular, and Cricket Wireless) have a combined subscribership of 129 million subscribers – only 60% of the two big carriers’ combined market share. Traditional landline business is dominated by what remains of the Bell operating companies after divestiture separated them and mergers.

41 http://www.investopedia.com/features/industryhandbook/telecom.asp#axzz25hKTRpTw
and acquisitions brought them back together. AT&T, Verizon, and CenturyLink account for 89% of all landline telephone service in the U.S.

Southern Colorado lies in the shadow of much of this market concentration. CenturyLink has significant assets throughout the region, Comcast provides service in Trinidad, and AT&T and Verizon are available through most of the region. The rest of the area is served by a group of smaller companies struggling to meet their customers’ needs.

Telecom has become less about voice more about text, images, and tele-presence. In most areas, high-speed internet access has become the staple of the industry replacing the long standing dominance of voice services. Fiber optics provides the best capacity and, with adequate redundancy, reliability for this 21st century tool of commerce, education, entertainment, and communication.

Of all the customer markets, residential and small business markets are arguably the toughest. Competitors rely heavily on price to slog it out for households’ monthly checks; success rests largely on brand name strength and heavy investment in efficient billing and customer support systems. The corporate market remains fairly lucrative; though competition is eroding historic margins for big business services.

Telecom operators also make money by providing network connectivity to other telecom companies that need it, and by wholesaling circuits to heavy network users like Internet service providers and large corporations.

It is hard to avoid the conclusion that size matters in telecom. It is an expensive business; contenders need to be large enough and produce sufficient cash flow to absorb the costs of expanding networks and services that become obsolete seemingly overnight. Transmission systems need to be replaced as frequently as every two years. Big companies that own extensive networks – especially local networks that stretch directly into customers’ homes and businesses – are less reliant on interconnecting with other companies to get calls and data to their final destinations. By contrast, smaller players must pay for interconnection more often in order to finish the job. For little operators hoping to grow big some day, the financial challenges of keeping up with rapid technological change and depreciation can be monumental.

7.1.1 PORTER’S FIVE FORCES ANALYSIS

1. Threat of New Entrants. It comes as no surprise that in the capital-intensive telecom industry the biggest barrier to entry is access to finance. To cover high fixed costs, serious contenders typically require a lot of cash. When capital markets are generous, the threat of competitive entrants escalates. When financing opportunities are less readily available, the pace of entry slows. In addition, it is important to remember that
solid operating skills and management experience is fairly scarce, making entry even more difficult.

2. **Power of Suppliers.** At first glance, it might look like telecom equipment suppliers have considerable bargaining power over telecom operators. Indeed, without high-tech broadband switching equipment, fiber-optic cables, and billing software, telecom operators would not be able to do the job of transmitting voice and data from place to place. But there are actually a number of large equipment makers around. There are enough vendors, arguably, to dilute bargaining power. The limited pool of talented managers and engineers, especially those well versed in the latest technologies, places companies in a weak position in terms of hiring and salaries.

3. **Power of Buyers.** With increased choice of near replacement telecom products and services, the bargaining power of buyers is rising. Let’s face it; telephone and data services do not vary much, regardless of which companies are selling them. For the most part, basic services are treated as a commodity. This translates into customers seeking low prices from companies that offer reliable service. At the same time, buyer power can vary somewhat between market segments and geographic areas. In much of the US telecom services are provided by predominant multi-state corporations for whom the loss of a small market is not a significant threat. Furthermore, while switching costs are relatively low for residential telecom customers, they can get higher for larger business customers – especially those that rely on more customized products and services. Southern Colorado communities have had little success exercising their buying power to influence the behavior of multi-state providers like CenturyLink and Comcast. Some of the regional providers are fairly responsive to the power of buyers. A primary example is the continued expansion of Viaero.

4. **Availability of Substitutes.** Products and services from non-traditional telecom industries pose serious substitution threats. Cable TV, satellite operators, wireless and cellular companies all compete for buyers. Railways and energy utility companies are laying miles of high-capacity telecom networks alongside their own track and pipeline assets.

5. **Competitive Rivalry.** Competition is “cut throat”. The wave of industry deregulation together with the receptive capital markets of the late 1990’s paved the way for a rush of new entrants. New technology is prompting a raft of substitute services. Nearly everybody already pays for phone services, so all competitors now must lure customers with lower prices and more exciting services. This tends to drive industry profitability down. In addition to low profits, the telecom industry suffers from high exit barriers, mainly due to its specialized equipment. Networks and billing systems cannot really be used for much else, and their swift obsolescence makes liquidation pretty difficult. The industry has reacted to “cut throat” competition by establishing service areas protected by regulatory regimes or “gentlemen’s agreements” precluding competitive entry and by consolidating creating very high market concentration.

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7.2 **MARKETING OBJECTIVES**
In order for any broadband development in the region to be successful, the value of broadband must be understood by potential subscribers and potential public sector supporters. The region’s public jurisdictions should not be in the business of closing sales but they should be in the business of increasing broadband awareness and adoption.

7.3 MARKETING AND COMMUNICATION PLAN

The “marketing” campaign might better be called an awareness and adoption education campaign. A sustained education effort is required to ensure residents and businesses understand the value of broadband and then pursue purchase options. Awareness and adoption efforts will grow the broadband market and will contribute to the sustainability of any broadband development efforts.

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 four 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 – that is service that allows basic web browsing and access to email – and more abundant bandwidth – that is service that makes available the highest quality Internet services. If the partnership path is pursued, the online presence should make a clear presentation of what the partnership is and how it benefits local businesses and residents. The online presence can also be used to provide information about public actions that may or may not need to be taken (like potential SB152 overrides).

2. **Event Presence.** It is difficult to get people to come to an online presence or real world events that they are not already interested in. 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.

4. **Online Government Services.** By placing services online, local jurisdictions can demonstrate to their constituents the importance of broadband.

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 Trinidad State Junior College may be recruited to prepare course material.
8 RISK MANAGEMENT PLAN

8.1 THE LEGAL ENVIRONMENT

The biggest risk in the legal environment is Colorado’s prohibition on public entry into broadband services. This prohibition can be overcome through a vote. Huerfano County has already passed a prohibition override.

As we recommend projects in Walsenburg and Trinidad, it may be prudent for these two communities to pass separate overrides.

If the organizational structure of the proposed broadband development cooperative effort is not carefully crafted, it could lead to future litigation.

It may be prudent to establish a separate broadband authority to protect the individual jurisdictions from legal challenges. If a separate broadband authority is created, the broadband authority will need to pass a separate broadband development prohibition override.

8.2 FINANCIAL RISK MANAGEMENT

Broadband development is a very capital intensive proposition. Some communities engaged in broadband development have found their general funds under stress due to their broadband development efforts.

Separating the broadband project from the individual jurisdictions by creating a separate broadband authority will protect the individual jurisdictions from financial risks. In order to ensure the broadband district has access to the widest range of financial options, the district should incorporate public and private sector entities.
9 PRELIMINARY ACTION PLANS

9.1 OVERALL STRATEGY FOR ONE-, THREE-, AND FIVE-YEAR ACTION PLANS

SECOM, Viaero, and Rye Telephone are making significant improvements in the region and CAF II funding may bring additional investment from CenturyLink. Regional jurisdictions could depend on these companies to continue their development. However:

- SECOM’s primary development in the region is through fixed wireless solutions with some fiber to support tower sites. Fixed wireless is a great solution for rapid deployment and for extending service into difficult or expensive to build areas – including very rural areas. But the limitations of fixed wireless technologies prevent it from meeting projected growth in bandwidth demand. Also, no fixed wireless packages in the region offer target cost per Mbps.
- Viaero has an innovative and aggressive data deployment model across their cellular network. Viaero will continue to expand fiber to its cell towers and will continue to improve its coverage. Nonetheless, cellular wireless services are constrained by some of the same limitations as fixed wireless.
- Rye Telephone has implemented significant fiber through their service area but their service area is limited to a tightly constrained geographic area.
- CenturyLink may invest significant capital in improving their DSL network in the region but DSL cannot meet continuing bandwidth growth.
For these reasons and others, a strategy of depending on existing network owners to meet the region’s broadband development goals (either in the status quo or through offering incentives) does not seem promising. If a status quo or incentive model is to be the primary focus of the region, broadband development goals should be adjusted to be more realistic in these development models.

Rather than adjusting goals, we believe an aggressive program of incenting existing providers and building public infrastructure can achieve and exceed the region’s broadband development goals. We do not recommend pursuing a full public entry model similar to Longmont. While financially a full public entry model is easier to manage, a full public entry model tends to diminish consumer choice instead of increasing it. Furthermore, a full public entry model forces the public sector to react to market forces with innovation and flexibility – two characteristics the public sector is not well known for. Rather, we recommend a public wholesale-private retail model similar to Rio Blanco County.

First, public infrastructure in a public wholesale-private retail model can be used to spur competition and incent service providers. By providing public infrastructure (much like the public sector provides roads or airports), the public sector can greatly reduce private sector capital costs and lower barriers to entry and innovation.

Next, public infrastructure investment can be designed to meet the regions broadband objectives. By taking control of physical infrastructure, the public sector takes control of the broadband environment and can use that control to meet policy objectives.

Finally, a public wholesale-private retail model creates a vibrant marketplace in which private sector providers can innovate.

We recommend Walsenburg, Trinidad, and Raton pursue open access fiber to the premises builds using grant funds and borrowing based on the strength of a broadband district with taxing authority. Each project alone has a reasonable chance of success but by working together, the three communities can have a more significant impact on the whole of the region and have a much better chance.

A combined project requires about $16.5 million and can reach cashflow positive after about 25 months.
Figure 21: Combined Cashflow Model

Individual projects are included in the individual county discussions below.

While the strategy initially focuses on the population centers of Walsenburg, Trinidad and Colfax, the positive revenues generated after the second year should be used to continue to expand the fiber to the premises network.

9.2 HUERFANO COUNTY AND COMMUNITIES

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<td></td>
<td></td>
<td></td>
<td>Average Connection</td>
<td>Speed: 4.4/0.483 Mbps</td>
</tr>
<tr>
<td>Huerfano</td>
<td>Walsenburg</td>
<td>3,068</td>
<td>CenturyLink, SECOM</td>
<td>DD Wireless (SECOM), Amigo.net (Zero Error)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Average Connection</td>
<td>Speed: 12.5/2.2 Mbps</td>
</tr>
</tbody>
</table>

Table 12: Huerfano County Services

CenturyLink and SECOM provide DSL and fixed wireless services respectively throughout most of Huerfano County. Unfortunately, the technologies used by these companies results in average connection speeds of less than 12 Mbps.

To significantly improve service in Huerfano County, we recommend Walsenburg participate in a regional effort to deploy fiber to the premises. A Walsenburg project would cost about $3.1 million and could achieve cashflow breakeven in the first year.
Table 13: Walsenburg Cashflow Model

A Walsenburg fiber to the premises model does not generate sufficient revenue to redirect revenue to subsidizing continuing construction.

9.3 PUEBLO COUNTY AND COMMUNITIES

<table>
<thead>
<tr>
<th>County</th>
<th>Community</th>
<th>Pop.</th>
<th>Wireline</th>
<th>Wireless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pueblo</td>
<td>Avondale</td>
<td>674</td>
<td>CenturyLink</td>
<td>DD Wireless (SECOM), Pueblo Wireless</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Pine Drive Telephone Company</td>
</tr>
<tr>
<td></td>
<td>Beulah Valley</td>
<td>556</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Boone</td>
<td>339</td>
<td>CenturyLink</td>
<td>DD Wireless (SECOM), Pueblo Wireless</td>
</tr>
<tr>
<td></td>
<td>Colorado City</td>
<td>2,193</td>
<td>Rye</td>
<td>DD Wireless (SECOM)</td>
</tr>
<tr>
<td></td>
<td>Rye</td>
<td>202</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 14: Pueblo County Providers

Northern Pueblo County is not included in our analysis.

In southern Pueblo County, Rye Telephone offers fiber to the premises through much of the Buelah Valley. Outside of the Rye territory, average connection speeds are very poor.
Southern Pueblo County should participate in a regional effort led by municipal projects in Walsenburg, Trinidad, and Raton. These three projects together can generate sufficient revenue to support additional expansion into more rural areas like most of southern Pueblo County.

9.4 LAS ANIMAS COUNTY AND COMMUNITIES

<table>
<thead>
<tr>
<th>County</th>
<th>Community</th>
<th>Pop.</th>
<th>Wireline</th>
<th>Wireless</th>
</tr>
</thead>
<tbody>
<tr>
<td>Las Animas</td>
<td>Aguilar</td>
<td>538</td>
<td>SECOM</td>
<td>SECOM</td>
</tr>
<tr>
<td>Las Animas</td>
<td>Cokedale</td>
<td>129</td>
<td>CenturyLink</td>
<td>SECOM</td>
</tr>
<tr>
<td>Las Animas</td>
<td>Trinidad</td>
<td>8,771</td>
<td>CenturyLink, Comcast, SECOM</td>
<td>SECOM</td>
</tr>
</tbody>
</table>

Table 15: Las Animas County Services

Most of Las Animas County has average to poor DSL service from CenturyLink or no service whatsoever. Trinidad is well served by a combination of CenturyLink and Comcast. While Trinidad is well served, Trinidad functions as a central element of the regional public wholesale-private retail strategy.

Figure 22: Trinidad Cashflow
Trinidad alone has sufficient scope to suggest a successful project. However, by working together with Walsenburg and Raton, the project can contribute significantly more to expanding broadband in the region by participating with the region.

9.5 COLFAX COUNTY AND RATON

Raton represents a third leg of the regional broadband development stool.

![Cash Position Graph](Figure 23: Raton Cashflow)

Raton represents a sufficiently large enough project to suggest a successful municipal project. However, by working together with the region, Raton can contribute to a larger expansion of services in the region.
10 CONCLUSIONS AND RECOMMENDATIONS

Broadband services in the South Central Region generally do not meet current or future demand. Regional service providers are improving services but improvements generally lag behind more urbanized areas and behind national averages.

To overcome this lagging development, we recommend the region engage in an aggressive public infrastructure model wherein the public provides infrastructure for private sector use. To start this process, we recommend Walsenburg, Trinidad, and Raton engage in municipal fiber to the premises projects where they deploy fiber to every address and make that fiber available to multiple private sector service providers. Rather than engaging in independent projects, we recommend the three communities work together in a regional broadband authority to maximize efficiencies and to build a strong financial foundation for expanding services into more rural areas.
11 APPENDIX

11.1 SURVEY SUMMARY
<table>
<thead>
<tr>
<th><strong>Huerfeno</strong></th>
<th><strong>Las Animas</strong></th>
<th><strong>Pueblo</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Could be better... It is what it is..</td>
<td>Tried to solve our own problems – worked with DDwireless... still in progress but need to do more to solve our problem. CenturyLink speeds are a fraction of speeds that are advertised or purchased...</td>
<td>Appreciate the work of commissioners. We have to explore new opportunities for companies that want to come to Trinidad. Better broadband will bring more people into Trinidad. I think the commissioners is doing a good job and they know what needs to be done.</td>
</tr>
<tr>
<td>Marginal</td>
<td>T1 is pretty fast</td>
<td>CenturyLink pushes you to purchase higher speeds that are not available. Wireless doorbells with camera doesn’t work with CenturyLink routers. Lose internet with storms... Need infrastructure in mountain areas – emergency services and businesses depend on internet.</td>
</tr>
<tr>
<td>CenturyLink</td>
<td>To attract young people to community and stay home businesses, need robust internet like 1 gig service. We are dead if we don’t. Don’t have Cable – satellite doesn’t work well so the internet is our life’s blood. Internet needed for everyday living – it’s like needing water.... You cannot run a business from here without high speed internet.</td>
<td>No Broadband, unserviceable to carriers that have high speed internet</td>
</tr>
<tr>
<td>Eaglenet in town, but don’t know if anyone is connected. Only DDWireless you have to have line of sight. Frustrated that Gov. put in fiber, but has been wasted.</td>
<td>Works ok with 1 person...</td>
<td></td>
</tr>
<tr>
<td>Huerfeno</td>
<td>Las Animas</td>
<td>Pueblo</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Inadequate for today's needs</td>
<td>Totally inadequate, businesses limited, effecting economy. Online learning not possible. Biggest drawback to living in this area. System goes down so credit card systems in stores/restaurants.</td>
<td>Not always working - very frustrating. It is slow, but it is what it is.</td>
</tr>
<tr>
<td>Federal Gov. has allowed larger communities to take everything...</td>
<td>Poorest service I’ve ever had. Would do anything to get rid of Centurytel</td>
<td>Sufficient for Bank</td>
</tr>
<tr>
<td>Terrible, had home in CO Springs.... Comparing that flawless and super speeds, it's like a 3rd world country here.</td>
<td></td>
<td>Sufficient for what we use</td>
</tr>
<tr>
<td></td>
<td>System shuts down, loose service a few times a day.</td>
<td></td>
</tr>
<tr>
<td>Huerfeno</td>
<td>Las Animas</td>
<td>Pueblo</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Pretty Satisfied</td>
<td>using 2 bonded DSL lines, single line is not fast</td>
<td>Providers try sell you what’s not available here! It’s just not right. If they can’t deliver don’t sell it!</td>
</tr>
<tr>
<td>Sufficient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Works ok, but pricy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pretty Poor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good, sometimes goes down.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Good</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10 Scale, I give it a 7.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fine</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comcast</td>
<td>Pretty Good, but should have fiber.</td>
<td>Need at least one more competitor to have another option and to help with pricing. Like to see investment in a solution like google fiber or someone that</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Great</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Need to get broadband to south end of town and county areas.</td>
</tr>
<tr>
<td>Huerfeno</td>
<td>Las Animas</td>
<td>Pueblo</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>brings fiber to communities.</td>
<td></td>
</tr>
<tr>
<td>Pretty Good, but should have fiber.</td>
<td>Paying for service we can’t get. Keep upgrading but not improving... Need to upgrade infrastructure.</td>
<td></td>
</tr>
<tr>
<td>Reasonable most of time, phone system is digital.</td>
<td>Where I live is good in city. Don’t know about rural areas.</td>
<td></td>
</tr>
<tr>
<td>Scale of 1-10 is probably 7. Does lose service</td>
<td>Vital for rural areas; especially for online courses or online businesses.</td>
<td></td>
</tr>
<tr>
<td>Ours is sufficient for what we do.</td>
<td></td>
<td>We have considered moving into county away from Trinidad - would if internet was available. Need broadband further out from cities.</td>
</tr>
<tr>
<td>Huerfeno</td>
<td>Las Animas</td>
<td>Pueblo</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>Satisfied</td>
<td>It is a shame that parts have terrible internet service. Places from heart of town have no internet, it would be great to get good internet to them. I am for all we can get because of speed of change in technology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>I think it's pretty good</td>
<td>Parts of town get terrible speeds because of older technology. It is a shame that one business has good internet speed and just 7 minutes away it's terrible...</td>
</tr>
<tr>
<td></td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not to bad - could be better</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Could be better</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretty good in Town</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td>Huerfeno</td>
<td>Las Animas</td>
<td>Pueblo</td>
</tr>
<tr>
<td>----------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>Ok, but a little pricy for all they provide. Not many options</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Needs to be upgraded, terrible</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor, disconnects</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Poor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Substandard... To much money for what you get... Service drops out intermittently, lose connectivity to printers and devices.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissatisfied with cost and well below what you can get in other areas. Connectivity and consistency ok</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ok, not fastest. Sufficient but could be faster</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Good</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fine</td>
<td></td>
</tr>
<tr>
<td>DD Wireless</td>
<td>Huerfeno</td>
<td>Las Animas</td>
</tr>
<tr>
<td>------------</td>
<td>----------</td>
<td>------------</td>
</tr>
<tr>
<td>17mbps</td>
<td>Business owners need high speed internet and many people in county areas do not have access at all. Need to fix this!</td>
<td></td>
</tr>
<tr>
<td>Pretty pleased with current service</td>
<td>Vast majority do not have line of site to utilize DD wireless. Cable/fiber infrastructure maybe difficult because of geography. I’m a realist... Definitely could be more towers for wireless so all have internet access.</td>
<td></td>
</tr>
<tr>
<td>Slower than Business</td>
<td>Don’t believe they will ever get better internet – very frustrating!</td>
<td>Pretty good</td>
</tr>
<tr>
<td>Worse ever had. Unacceptable</td>
<td>Wish explore other companies to bring us into 20th century. To attract new business, it is vital for the success of our communities.</td>
<td>Not good, terrible</td>
</tr>
<tr>
<td>Nothing really available. Can’t even do DirectTV Movies</td>
<td>If we can get FAST broadband that would be great!</td>
<td></td>
</tr>
</tbody>
</table>

Satellite

- Slower than Business
- Worse ever had. Unacceptable
- Nothing really available. Can’t even do DirectTV Movies
<table>
<thead>
<tr>
<th>SECOM</th>
<th>Huerfeno</th>
<th>Las Animas</th>
<th>Pueblo</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Moderately happy</td>
<td>Would be great if had something locally....</td>
<td>I think it’s pretty good</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unknown or No Service</td>
<td>Huerfeno</td>
<td>Las Animas</td>
<td>Pueblo</td>
</tr>
<tr>
<td>-----------------------</td>
<td>----------</td>
<td>------------</td>
<td>--------</td>
</tr>
<tr>
<td>If available, would use to run part of business from Home</td>
<td>Fine, not the best</td>
<td>To confusing; don’t know who to get service from, how to get it, or if it works in area. Could do better with access in county areas!</td>
<td>Before we found SeCom - horrible</td>
</tr>
<tr>
<td>Non existent</td>
<td>No service or to slow, it would be good to fix that.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Doesn’t work</td>
<td>Nice to get service for entire county area – more towers for internet and cellular.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Would like access to broadband</td>
<td>Definitely need to get broadband – whole county needs it! Need something more stable! People here deserve it just as everybody else</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know if better in Trinidad, but lousy here.</td>
<td>To slow not worth the cost.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Don’t know anything about broadband, don’t have or use.</td>
<td>Don’t know if better</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
11.2 RECOMMENDATION DECISION MATRIX

11.2.1 OVERVIEW

We review broadband development options in four broad categories along the spectrum of public sector engagement in broadband development.

The four broad categories include:

- **Laisse Faire** in which public sector engagement is limited or non-existent
- **Broadband Friendly Policies** in which public sector engagement is focused on policies and procedures that encourage private sector broadband development
- **Public-Private Models** in which the public sector and the private sector work together in coordinated ways to improve broadband; because public-private models are the primary recommendation of the regional broadband strategic plan, we find it valuable to further clarify the spectrum of public-private models to include:
  - **Public Grants** in which the public sector uses restrictions on use of public funds to steer private sector investment
  - **Limited Public Infrastructure Development** in which the public sector builds limited broadband infrastructure and makes it available to private sector entities or builds limited broadband infrastructure to support purchasing aggregation
  - **Extensive but Targeted Infrastructure Development** in which the public sector builds significant infrastructure but to a specific purpose like middle mile development, regional distribution, to support business development, etc.
  - **Extensive and General Infrastructure Development** in which the public sector builds significant infrastructure for shared private sector use
- **Public Entry** in which the public sector builds and operates a broadband network providing retail services

These categories are not rigidly defined; rather, they define points along the spectrum of public sector engagement in broadband development.

11.2.2 RECOMMENDATIONS

We **DO NOT** recommend either extreme of the spectrum (that is, laisse faire and public entry). Our recommendations can be seen as a primary path, a secondary path, and a tertiary path.

11.2.2.1 PRIMARY PATH
Local jurisdictions in the region should band together to form a regional broadband development consortium. The regional broadband consortium should take on three primary tasks:

1. Create common easement, right of way, open trench, dig once and other ordinances for all participating jurisdictions. Also, working as a region, conduct “SB152 override” initiatives.
   Common policies will lower barriers of entry to private sector broadband development.
   Use the creation of common policies and other actions, like the development of online services, as tools to expand awareness and adoption. Continue awareness and adoption efforts through the other tasks.

2. Working in coordination with SECOM and other fixed wireless providers, invest in vertical infrastructure designed specifically to support private sector expansion of fixed wireless.
   Fixed wireless is a good step towards expanding broadband and can be used effectively to reach currently unserved areas. Fixed wireless areas should be targeted for future fiber to the premises builds.
   Public sector entities can use grants, private sector match funds, and other funds to build vertical assets and regional connectivity to extra-regional backhaul points of interconnection.
   The consortium could use expensive wireless propagation studies to determine where to place vertical assets to serve the most subscribers. However, simply asking the fixed wireless providers in the region usually provides better results.
   Some revenue can be generated by leasing space on vertical assets to private sector providers or from providing shared fixed wireless infrastructure. However, revenue from these assets will not be sufficient to expand the network.

3. Build open access (that is available to multiple providers) fiber to the premises (that is past every address) in Walsenburg, Trinidad, and Raton. Use a private sector network operator to manage the assets and to manage multiple private service providers offering service on the network(s).
   This final task is packed with significant weight and should be somewhat deconstructed:
   a. None of the three cities has sufficient market to build a financially sustainable network on their own. By combining the markets of all three cities, the consortium can create sufficient scale to not only develop a financially sustainable network but one that can generate revenue for continued expansion outside of population centers.
   b. These population centers (especially Trinidad) have better broadband than more rural areas. Building fiber networks will significantly improve abundance but do little
to extend availability. However, revenue from the fiber networks can be set aside for
continued broadband expansion in underserved and unserved areas.

c. Creating a shared infrastructure model lays the foundation for robust competition
among private sector retail service providers taking advantage of the shared
network. This competition should spur innovation and creative pricing.

d. The recommendation assumes public sector entities have expertise in infrastructure
projects but not in broadband network operations and maintenance or retail service
provisioning and support. A private sector network operator functions as a bridge
between the multiple jurisdictions in the consortium, the broadband technology,
and the multiple private sector service providers.

e. Regional private sector providers should be encouraged to share infrastructure with
other providers and otherwise participate in the consortium.

f. Funding can come from grants, federal loans, and public sector guaranteed private
funding. Fiber Community and its Colorado subsidiary Colorado Fiber Community,
Ting, SiFi Networks, and Macquarie are some private sector entities who have
financing models based on some form of private sector guarantee.

11.2.2.1 PRIMARY PATH PROJECT OVERVIEW

Some notes regarding the primary path project...

11.2.2.1.1 SCOPE

As described above, the primary path project has three primary work products:

1. Regional Cooperative Model
   The regional cooperative model must create an organizational structure in which
   multiple public sector and private sector entities can work together. The most successful
   regional cooperative model in Colorado is Northwest Colorado Broadband (NCB), a non-
   profit organization with public and private sector members. Other potential models
   include a lead entity (like one of the Counties or Cities) with contractual agreements
   with other member entities, an interlocal agreement with private sector entities allowed
   to participate or to enter into contractual agreements to be involved, creation of a new
   arm of the COG, or other options.
   Because of the success of NCB, we recommend looking at the non-profit model.
   When the regional cooperative is in place, it should be used to manage the project and
to complete the scope tasks of managing SB152 override votes, developing common
broadband friendly policies, and advancing economic development and quality of life
objectives achieved through expanded broadband.

2. Fixed Wireless Expansion and Augmentation
The fixed wireless expansion and augmentation should be done in careful coordination with existing fixed wireless providers and in consideration of existing and needed vertical infrastructure.

3. **Fiber to the Premises**
   The fiber to the premises model is only feasible under the conditions of a larger scope than any single community in the region (therefore, the need for a regional cooperative model) and low interest long term federal loans available from the Rural Utilities Service.

### 11.2.1.1.2 SCHEDULE

There is a reasonable path to start the project in 2017. From start to finish, the project will probably take three years.

Much of the project can be done from any starting point. However, RUS loans have limited windows for application (the remaining 2017 window is in September). Also, SB152 override votes are best done in conjunction with a regular ballot (to save costs).

A compressed schedule would parallel track the three primary work products. It would start by selecting a lead agency that could manage the work until the regional structure was in place. The lead agency would need to develop grant and loan applications or contract an entity to do so. The lead agency would need to establish coordination with regional fixed wireless providers and vertical asset owners or contract an entity to do so.

If the 2017 RUS loan window is a target, work must begin no later than mid-June of 2017.

### 11.2.1.1.3 BUDGET

The total projected budget $20,600,000 divided between:

- $1.5 million for expanding and enhancing fixed wireless opportunities
- $17.7 million for fiber to the premises
- $1.4 million for capitalized operations and interest

Proposed sources of funds include:

- $2 million in federal (EDA, E-Rate, and telehealth) and foundation grants and private sector contributions
- $17 million in low interest long term RUS loans
- $1.6 million in publicly guaranteed private sector borrowing
11.2.2.1.4 OTHER NOTES

If Fiber Community were to engage in this project with the region, we would require a public sector loan guarantee and a revenue share agreement. Details of our engagement would be similar to those documented in our Rio Blanco County project.

11.2.2.1.2 SECONDARY PATH

The primary path recommendation is difficult. Regional cooperation in a consortium of multiple jurisdictions and private sector providers requires delicate political balance. Capital infrastructure investment in vertical assets and, in particular, in fiber to the premises comes with some financial risk.

If it is not possible to build a regional consortium or if any of the three primary cities (that is Walsenburg, Trinidad, and Raton) cannot participate in a joint fiber to the premises project, this secondary path should be pursued.

The secondary path consists of individual jurisdictions pursuing the first two tasks of the primary path as independent entities.

If the region follows this secondary path, we recommend that no jurisdiction pursue a general build. Our projections suggest any individual general network build will not be financially sustainable without subsidization.

11.2.2.1.3 TERTIARY PATH

If funding for vertical assets cannot be secured or if regional fixed wireless providers are not interested in using publicly provided vertical assets the region should pursue the first task.
<table>
<thead>
<tr>
<th>Basic Description</th>
<th>Allow market forces to drive broadband development.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>Most of the state is dependent on market forces to drive broadband development.</td>
</tr>
<tr>
<td>Overview</td>
<td>Wireless</td>
</tr>
<tr>
<td></td>
<td>SECOM is investing wireless development in the region.</td>
</tr>
<tr>
<td></td>
<td>Viaero’s mobile wireless products are having a positive impact on “broadband” availability.</td>
</tr>
<tr>
<td>Copper</td>
<td>Little investment in copper should be expected in a laisse Faire model. Providers are likely to continue fiber to the node projects that will improve copper capabilities. Some new cable infrastructure may be implemented in new housing areas in or near Charter’s service area in Trinidad.</td>
</tr>
<tr>
<td>Fiber</td>
<td>Most fiber development will be in regional distribution. Charter and CenturyLink are likely to continue improving service through fiber to the node improvements. SECOM may bring additional middle mile into the region but that is unlikely as they already reach Walsenburg and connect to other carriers there. Without public assistance, additional last mile fiber development is unlikely.</td>
</tr>
<tr>
<td>Strategic Plan</td>
<td>Laisse faire broadband development has created the current broadband environment in south central Colorado. Residents and businesses generally find the current state unsatisfactory. The Regional Broadband Strategic plan <strong>DOES NOT</strong> recommend continuing laisse faire broadband development in the region.</td>
</tr>
<tr>
<td>Specific Actions</td>
<td>Public officials and interested citizens should let private sector providers know they are interested in continuing development and system improvement. Public entities can participate in improving broadband awareness and adoption. Higher levels of awareness and adoption will drive higher demand which, in turn, makes private sector investment more appealing. East Central Colorado is considering an awareness campaign to improve broadband adoption - better adoption may spur faster market development. Awareness and adoption can be improved by making more government services available online and by advertising the online availability of information and services. Local governments and community anchor institutions can encourage adoptions and awareness by having an official presence on social media and other online platforms.</td>
</tr>
<tr>
<td>Cost Models</td>
<td>No significant public costs associated with laisse faire broadband development. Some small costs may come from publicly sponsored broadband awareness and adoption programs.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Broadband Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available</td>
</tr>
<tr>
<td>Affordable</td>
</tr>
<tr>
<td>Abundant</td>
</tr>
<tr>
<td>Reliable</td>
</tr>
<tr>
<td><strong>Sustainable</strong></td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td><strong>Internal Origin</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>External Origin</strong></td>
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</tbody>
</table>
### Broadband Friendly Policies

<table>
<thead>
<tr>
<th>Basic Description</th>
<th>Implement broadband friendly policies to spur market forces. Broadband friendly policies can include easing permit requirements, offering long-term contracts for government services, easing access to government-owned vertical assets, etc. The intent of broadband friendly policies is to lower barriers to private sector investment.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples</td>
<td>Yuma County has adopted dig once/open trench policies and taken other broadband positive actions.</td>
</tr>
</tbody>
</table>
| Overview          | Generally  
Broadband friendly policies should be designed to limit bureaucratic hurdles and lower implementation and maintenance costs for private providers.  
**Wireless**  
Making public vertical assets (e.g. water towers, publicly owned communications towers, etc.) available to wireless carriers can make a significant difference. Counties can make access to tower sites easier for wireless providers through easements and road improvements.  
**Copper**  
DSL and DOCSIS networks depend on cabinet sites, underground easements, and access to aerial support infrastructure. Easing easement requirements and making public land available to help meet these requirements can lower barriers to copper network improvements.  
Open trench or dig once policies can lower construction costs.  
**Fiber**  
Fiber deployments (in the middle mile, regional distribution, and last mile) depend on buried and aerial infrastructure as well as cabinets for access and regeneration. Like copper improvements, local governments can reduce administrative barriers and lower costs of entry and maintenance by creating open trench and dig once policies, streamlining permitting requirements, assisting with easement acquisition, making certain public properties available for broadband development, and taking other actions. |
| Strategic Plan Recommendation | Local jurisdiction **SHOULD IMPLEMENT** broadband friendly policies as a minimum broadband development activity or as a component of a public-private model. |
Some public-private models may reduce the value of broadband friendly policies and certain jurisdictions may find they are not worth the effort in context of their larger broadband development activities.

<table>
<thead>
<tr>
<th>Specific Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Speak with regional service providers and identify policies they would like to see changed</td>
</tr>
<tr>
<td>• Review open trench and dig once policies; identify if regional service providers are interested in using shared trenches; develop and implement a policy that meets their needs</td>
</tr>
<tr>
<td>• Review permitting requirements and work towards a common regional permitting process</td>
</tr>
<tr>
<td>• Review public easement policies and work towards a common regional easement process</td>
</tr>
<tr>
<td>• Work towards common usage policies for public assets</td>
</tr>
<tr>
<td>• Prepare inventories of public assets available for private sector</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>No significant public costs associated with implementing most broadband friendly policies. Primary costs are associated with lost revenue from lowering costs to use public facilities and lowering costs of permits and other administrative fees. Some staff costs may be incurred devising broadband friendly policies for adoption.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Broadband Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available</td>
</tr>
<tr>
<td>A broadband friendly policy regime may help extend availability if broadband friendly policies serve to sufficiently reduce capital and operational cost barriers.</td>
</tr>
<tr>
<td>There is little likelihood of broadband friendly policies significantly changing the competitive landscape.</td>
</tr>
<tr>
<td>Affordable</td>
</tr>
<tr>
<td>Broadband friendly policies typically only have a secondary impact on broadband affordability. That is, if private sector entities are able to reduce capital and operational expenses, they may share those savings with subscribers and improve affordability.</td>
</tr>
<tr>
<td>Abundant</td>
</tr>
<tr>
<td>Dig once or open trench policies help extend fiber footprints. This, in turn, usually has a positive impact on abundance.</td>
</tr>
<tr>
<td>Reliable</td>
</tr>
<tr>
<td>Broadband friendly policies have little impact on reliability.</td>
</tr>
<tr>
<td>Sustainable</td>
</tr>
<tr>
<td>Broadband friendly policies support private provider economic sustainability.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Helpful</th>
<th>Harmful</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Origin</td>
<td>Strengths</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------</td>
</tr>
<tr>
<td></td>
<td>• Comes with little financial cost</td>
</tr>
<tr>
<td></td>
<td>• Gives local governments the opportunity to demonstrate their support of broadband development</td>
</tr>
<tr>
<td></td>
<td>• Gives local governments the opportunity to use specific policies as leverage with regional private sector providers</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>External Origin</th>
<th>Opportunities</th>
<th>Threats</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Reserves the very difficult task of broadband development for regional and/or national organizations with significant resources and expertise</td>
<td>• South central Colorado represents a very small market to large organizations like CenturyLink and Charter</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Other regions with more aggressive public sector engagement in broadband development may realize greater benefits and may draw businesses and residents from south central Colorado</td>
</tr>
<tr>
<td><strong>Public-Private Models</strong></td>
<td></td>
<td></td>
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<tr>
<td>--------------------------</td>
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</tr>
<tr>
<td><strong>Basic Description</strong></td>
<td>Public-private models cover a vast spectrum of solutions ranging from government grants for private companies to build infrastructure to government owned infrastructure with private sector financing or other involvement.</td>
<td></td>
</tr>
<tr>
<td><strong>Examples</strong></td>
<td><strong>Federal or State Grants</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>CenturyLink considers the Connect America Fund (CAF) program to be a public-private model.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Carrier Neutral Facility/Purchase Aggregation</strong></td>
<td></td>
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<tr>
<td></td>
<td>Community anchor institutions in Steamboat Springs worked together to create a non-profit entity that then built a &quot;carrier neutral location&quot; where they aggregate their purchase of middle mile services. The hope is that this will encourage more middle mile providers to provide service and drive costs down - creating better reliability and affordability.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Middle Mile Development</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Region 10 is using public projects to expand middle mile infrastructure in the hopes that lower cost more reliable middle mile infrastructure will spur stronger last mile development.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Regional Distribution Development</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Centennial built a fiber ring and then made it available to a variety of service providers. Service providers (like Ting) can build last mile infrastructure off of the City's distribution architecture.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Public Infrastructure – Private Service Providers</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rio Blanco County built a fiber and wireless network and uses a third party operator to light it and maintain it on a wholesale basis with multiple private sector service providers offering retail services.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The County, with the aid of a DOLA grant, funded regional distribution, main running lines, and wireless infrastructure. A private sector network operator is using a County financial guarantee to build drop level infrastructure and to procure customer premises equipment.</td>
<td></td>
</tr>
<tr>
<td><strong>Overview</strong></td>
<td>Public private models fall on a spectrum ranging from public sector entities providing grants to private sector providers to significant investment in broadband infrastructure. The following represent a set of broad categories along the public private model spectrum:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• <strong>Public Grants</strong></td>
<td></td>
</tr>
<tr>
<td>Strategic Plan Recommendation</td>
<td>We have developed a three track plan in which the lowest level of public sector involvement calls for broadband friendly policies. The second level calls for limited infrastructure development focused primarily on vertical infrastructure planned and executed in close cooperation with regional fixed wireless providers. The most extensive public sector role would see a regional broadband consortium pursuing the first two levels and developing fiber to the premises in population centers and then using revenue generated by those projects to continue extending availability, affordability, and abundance.</td>
<td></td>
</tr>
</tbody>
</table>
| Specific Actions | • Determine the feasibility of establishing a regional consortium of local jurisdictions and private sector providers  
  o If a coalition is formed, determine funding for and plan and build shared infrastructure  
• Determine funding for vertical assets and coordinate with regional fixed wireless providers to place new vertical assets where they will best extend service to the most residents and businesses  
• Either as a coalition or as individual jurisdictions, establish common broadband friendly policies throughout the region |
| Cost Models | Rough rule of thumb cost estimates place tower construction at about $180,000 per site and fiber construction at about $1,100 per address passed plus another $1,100 per subscriber connected.  
Implementing common regional broadband friendly policies involves little cost.  
Funding can be secured through grants and loans. Some private sector network operators (like Colorado Fiber Community, Macquarie, Ting, and SiFi Networks) have mechanisms to secure private funding for public projects with a public sector guarantee. |
<table>
<thead>
<tr>
<th>Broadband Characteristics</th>
<th>Available</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>At Broadband Friendly Policy Level</td>
<td>See Broadband Friendly Policy discussion above.</td>
<td></td>
</tr>
<tr>
<td>At Vertical Asset Level</td>
<td>Availability can be extended to significant currently unserved areas. Competition will not be significantly enhanced.</td>
<td></td>
</tr>
<tr>
<td>At Consortium General Build Level</td>
<td>Availability can be extended to significant currently unserved areas. Competition will be enhanced in public sector fixed wireless and fiber project areas.</td>
<td></td>
</tr>
<tr>
<td>Affordable</td>
<td>At Broadband Friendly Policy Level</td>
<td>See Broadband Friendly Policy discussion above.</td>
</tr>
<tr>
<td>At Vertical Asset Level</td>
<td>Public sector vertical assets are not likely to have a significant impact on affordability. Fixed wireless providers are likely to use public sector infrastructure to extend service areas where it would otherwise be financially unsustainable to do so.</td>
<td></td>
</tr>
<tr>
<td>At Consortium General Build Level</td>
<td>Affordability is usually significantly better on public sector provided infrastructure.</td>
<td></td>
</tr>
<tr>
<td>Abundant</td>
<td>At Broadband Friendly Policy Level</td>
<td>See Broadband Friendly Policy discussion above.</td>
</tr>
<tr>
<td>At Vertical Asset Level</td>
<td>Will not improve abundance.</td>
<td></td>
</tr>
<tr>
<td>At Consortium General Build Level</td>
<td>Public sector fiber to the premises will significantly improve abundance in served areas.</td>
<td></td>
</tr>
<tr>
<td>Reliable</td>
<td>At Broadband Friendly Policy Level</td>
<td>See Broadband Friendly Policy discussion above.</td>
</tr>
<tr>
<td>At Vertical Asset Level</td>
<td>Will not improve reliability.</td>
<td></td>
</tr>
</tbody>
</table>
### At Consortium General Build Level

Will only have a secondary impact on reliability. That is, the public sector network may cause middle mile providers to implement path redundancy as is the case in Rio Blanco County where the County’s project has caused Mammoth to identify and implement a northern route to supplement the County’s primary southern route.

### Sustainable

**At Broadband Friendly Policy Level**

See Broadband Friendly Policy discussion above.

**At Vertical Asset Level**

Public sector vertical assets allow private sector fixed wireless providers to enter service areas that would otherwise be financially unsustainable.

**At Consortium General Build Level**

Unless all three major population centers (Walsenburg, Trinidad, and Raton) participate, a general public sector build is not reasonably financially sustainable.

<table>
<thead>
<tr>
<th></th>
<th>Helpful</th>
<th>Harmful</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Internal Origin</strong></td>
<td><strong>Strengths</strong>&lt;br&gt;• Public sector entities retain significant control of broadband supported public policy objectives&lt;br&gt;• Public sector entities retain significant control over the pace and type of broadband development&lt;br&gt;• Treats broadband infrastructure like any other shared infrastructure (e.g. roads, airports, wastewater facilities, etc.)</td>
<td><strong>Weaknesses</strong>&lt;br&gt;• Some public-private models are unduly complex making them unwieldy&lt;br&gt;• Finding competent and dedicated private partners may be challenging&lt;br&gt;• Infrastructure is capital intensive</td>
</tr>
<tr>
<td><strong>External Origin</strong></td>
<td><strong>Opportunities</strong>&lt;br&gt;• Allows for multiple service provider options and may result in a vibrant marketplace for broadband&lt;br&gt;• Splits capital intensive infrastructure from services allowing service providers to focus on services&lt;br&gt;• Competition and focus may drive innovation</td>
<td><strong>Threats</strong>&lt;br&gt;• Well established regional service providers with extensive infrastructure are unlikely to participate in public infrastructure models&lt;br&gt;• Private sector network owners may strongly resist the development of shared infrastructure (through lobbying or competitive measures)</td>
</tr>
</tbody>
</table>
### Public Entry

<table>
<thead>
<tr>
<th><strong>Basic Description</strong></th>
<th>Public sector entity builds infrastructure (usually fiber or fixed wireless) and provides services in competition with private sector network owners.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Examples</strong></td>
<td>Longmont has built a fiber network and operates and maintains it as a government competitor in the broadband space.</td>
</tr>
<tr>
<td><strong>Overview</strong></td>
<td><strong>Generally</strong></td>
</tr>
<tr>
<td></td>
<td>Public entry into broadband generally offers significant improvement in broadband within the limited jurisdiction of the public sector entity.</td>
</tr>
<tr>
<td></td>
<td><strong>Wireless</strong></td>
</tr>
<tr>
<td></td>
<td>Several communities throughout the U.S. have tried various iterations of fixed wireless. Most of them are no longer in service.</td>
</tr>
<tr>
<td></td>
<td><strong>Copper</strong></td>
</tr>
<tr>
<td></td>
<td>Some communities have engaged in coaxial network deployment. Most communities build fiber if they are going to go to the expense of new construction.</td>
</tr>
<tr>
<td></td>
<td><strong>Fiber</strong></td>
</tr>
<tr>
<td></td>
<td>Communities build targeted infrastructure or more general infrastructure and provide service.</td>
</tr>
<tr>
<td><strong>Strategic Plan</strong></td>
<td>Local entities <strong>SHOULD NOT</strong> engage in public entry broadband development.</td>
</tr>
<tr>
<td><strong>Recommendation</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Specific Actions</strong></td>
<td>If public entry into the broadband market is contemplated, the first step is a feasibility study.</td>
</tr>
<tr>
<td><strong>Cost Models</strong></td>
<td>Rough estimate of pricing is about $1,100 per address passed and about $1,100 per subscriber connected</td>
</tr>
<tr>
<td><strong>Broadband Characteristics</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Available</strong></td>
<td>Public entry improves availability within the footprint of the public network. Public entry usually undercuts competition and eventually weakens the competitive marketplace.</td>
</tr>
<tr>
<td><strong>Affordable</strong></td>
<td>Public entry can improve affordability for those locations served by the public network.</td>
</tr>
<tr>
<td>Abundant</td>
<td>Public entry significantly improves abundance for those location where the network is available.</td>
</tr>
<tr>
<td>-------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Reliable</td>
<td>Public entry can have some positive impact on reliability if the public entity targets improved reliability.</td>
</tr>
<tr>
<td>Sustainable</td>
<td>Public entry in the south central Colorado market is not reasonably financially sustainable.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th><strong>Helpful</strong></th>
<th><strong>Harmful</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal Origin</td>
<td></td>
</tr>
<tr>
<td><strong>Strengths</strong></td>
<td><strong>Weaknesses</strong></td>
</tr>
<tr>
<td>• Public sector entities retain full control of broadband development public policy objectives</td>
<td>• Requires significant broadband technical and marketing skills not typically native to public sector entities</td>
</tr>
<tr>
<td>External Origin</td>
<td></td>
</tr>
<tr>
<td><strong>Opportunities</strong></td>
<td><strong>Threats</strong></td>
</tr>
<tr>
<td>• May create a revenue stream from a new enterprise account</td>
<td>• Private sector network owners may compete aggressively undermining the success of the public sector network or may abandon the market undermining competition in the market</td>
</tr>
</tbody>
</table>
### 11.3 SERVICE PROVIDERS

<table>
<thead>
<tr>
<th>Last Mile Technology</th>
<th>Pricing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Amigo.Net</strong></td>
<td>Fixed Wireless</td>
</tr>
<tr>
<td></td>
<td>1.5 Mbps: $30 ($20/Mbps)</td>
</tr>
<tr>
<td></td>
<td>5 Mbps: $45 ($9/Mbps)</td>
</tr>
<tr>
<td></td>
<td>10 Mbps: $60 ($6/Mbps)</td>
</tr>
<tr>
<td><strong>Baca Valley Telephone</strong></td>
<td>DSL and Fixed Wireless</td>
</tr>
<tr>
<td></td>
<td>DSL</td>
</tr>
<tr>
<td></td>
<td>4 Mbps: $39.95 ($9.99/Mbps)</td>
</tr>
<tr>
<td></td>
<td>Fixed Wireless</td>
</tr>
<tr>
<td></td>
<td>1.5 Mbps $44.95 ($29.97/Mbps)</td>
</tr>
<tr>
<td></td>
<td>5 Mbps $59.95 ($11.99/Mbps)</td>
</tr>
<tr>
<td></td>
<td>8.5 Mbps $79.95 ($9.41/Mbps)</td>
</tr>
<tr>
<td><strong>CenturyLink</strong></td>
<td>DSL (some fiber)</td>
</tr>
<tr>
<td></td>
<td>1.5/.896 Mbps: $42.99 ($28.66/Mbps)</td>
</tr>
<tr>
<td></td>
<td>7/.896 Mbps: $52.99 ($7.57/Mbps)</td>
</tr>
<tr>
<td></td>
<td>7/5 Mbps: $57.99 ($8.28/Mbps)</td>
</tr>
<tr>
<td></td>
<td>12/.896: $62.99 ($5.25/Mbps)</td>
</tr>
<tr>
<td></td>
<td>12/5 Mbps: $67.99 ($5.67/Mbps)</td>
</tr>
<tr>
<td></td>
<td>20/.896 Mbps: $72.99 ($3.65/Mbps)</td>
</tr>
<tr>
<td></td>
<td>20/5 Mbps: $77.99 ($3.90/Mbps)</td>
</tr>
<tr>
<td></td>
<td>40/5 Mbps: $112.99 ($2.82/Mbps)</td>
</tr>
<tr>
<td></td>
<td>40/20 Mbps: $122.99 ($3.07/Mbps)</td>
</tr>
<tr>
<td><strong>Comcast</strong></td>
<td>DOCSIS</td>
</tr>
<tr>
<td></td>
<td>10 Mbps: $49.95 ($5/Mbps)</td>
</tr>
<tr>
<td></td>
<td>25 Mbps: $64.95 ($2.60/Mbps)</td>
</tr>
<tr>
<td></td>
<td>100 Mbps: $79.95 ($0.80/Mbps)</td>
</tr>
<tr>
<td></td>
<td>200 Mbps: $88.95 ($0.44/Mbps)</td>
</tr>
<tr>
<td><strong>Rye Telephone</strong></td>
<td>Fiber</td>
</tr>
<tr>
<td></td>
<td>5 Mbps: $59.95 ($11.99/Mbps)</td>
</tr>
<tr>
<td></td>
<td>10 Mbps: $79.95 ($8/Mbps)</td>
</tr>
<tr>
<td></td>
<td>55/10 Mbps: $89.95 ($1.64/Mbps)</td>
</tr>
<tr>
<td></td>
<td>100/25 Mbps: $115.95 ($1.60/Mbps)</td>
</tr>
<tr>
<td></td>
<td>1000/100 Mbps: $199.95 ($0.20/Mbps)</td>
</tr>
<tr>
<td><strong>SECOM</strong></td>
<td>Fixed Wireless (some fiber)</td>
</tr>
<tr>
<td></td>
<td>3/1 Mbps: $29.95 ($9.98/Mbps)</td>
</tr>
<tr>
<td></td>
<td>10/2 Mbps: $44.95 ($4.50/Mbps)</td>
</tr>
<tr>
<td></td>
<td>15/3 Mbps: $52.95 ($3.53/Mbps)</td>
</tr>
</tbody>
</table>

### 11.3.1 AMIGO.NET/ZERO ERROR NETWORKS

Amigo.net is a fixed wireless provider with some coverage in the Walsenburg area.
11.3.2 BACA VALLEY TELEPHONE/SIERRA COMMUNICATIONS

Baca Valley Telephone is an incumbent local exchange carrier serving northeast New Mexico including Raton.

11.3.3 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.

### 11.3.4 CHARTER

Charter provides cable broadband service in Walsenburg. Charter is unlikely to expand service in the region.

### 11.3.5 COMCAST

Comcast provides cable broadband service in Trinidad. Comcast is unlikely to expand service in the region.

### 11.3.6 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.

11.3.7 PINE DRIVE TELEPHONE COMPANY/BUELALAND COMMUNICATIONS

Pine Drive Telephone Company serves an area of over 200 square miles in Western Pueblo and Southeastern Custer counties. 95% of their nearly 750 customers have access to high-speed Internet connections using DSL technology. Pine Drive Telephone Company is considering fiber to the home deployments.

11.3.8 RYE TELEPHONE /GHVALLEY.NET

Rye Telephone provides fiber to the home in and around Rye and Colorado City.

11.3.9 SECOM/DD WIRELESS
Figure 25: SECOM Tower Locations
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.
11.4 SB152 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](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,' INCLUDNG 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 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,' INCLUDNG 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 CITY'S UTILITY SERVICE AREA?

SPRING 2014
MONTROSE
REFERRED MEASURE "A"
PASS: 3969-1396
"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?
11.5 MODEL DIG ONCE ORDINANCE

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 _______, 20__.

____________________________
Name and Title

ATTEST:

___________________________
City/Town/County Clerk

READ, ADOPTED ON SECOND READING AND APPROVED this __ day of _______, 20__.
Name and Title

ATTEST:

__________________________

City/Town/County Clerk
11.6 TERMS AND ACRONYMS

**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.

<table>
<thead>
<tr>
<th>Name</th>
<th>Download</th>
<th>Upload</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADSL</td>
<td>8.0 Mbps</td>
<td>1.0 Mbps</td>
</tr>
<tr>
<td>ADSL (G.DMT)</td>
<td>12.0 Mbps</td>
<td>1.3 Mbps</td>
</tr>
<tr>
<td>ADSL over POTS</td>
<td>12.0 Mbps</td>
<td>1.3 Mbps</td>
</tr>
<tr>
<td>ADSL over ISDN</td>
<td>12.0 Mbps</td>
<td>1.8 Mbps</td>
</tr>
<tr>
<td>ADSL Lite (G.Lite)</td>
<td>1.5 Mbps</td>
<td>0.5 Mbps</td>
</tr>
<tr>
<td>ADSL2</td>
<td>12.0 Mbps</td>
<td>3.5 Mbps</td>
</tr>
<tr>
<td>RE-ADSL2</td>
<td>5.0 Mbps</td>
<td>0.8 Mbps</td>
</tr>
<tr>
<td>Splitterless ADSL2</td>
<td>1.5 Mbps</td>
<td>0.5 Mbps</td>
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<tr>
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<td>20.0 Mbps</td>
<td>1.1 Mbps</td>
</tr>
<tr>
<td>ADSL2+M</td>
<td>24.0 Mbps</td>
<td>3.3 Mbps</td>
</tr>
</tbody>
</table>

**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.


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/](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](http://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.


**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:

<table>
<thead>
<tr>
<th>Speed</th>
<th>Days</th>
<th>Hours</th>
<th>Minutes</th>
<th>Seconds</th>
<th>Kbps</th>
</tr>
</thead>
<tbody>
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<td>1 Gbps</td>
</tr>
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**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.

**Interconnection:** 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 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.


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. 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:

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</table>

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.


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:
Standard Dial-Up | 13.72 | 329.3 | 19,761.90 | 1,185,714 | 56 Kbps
---|---|---|---|---|---
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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 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.

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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 Ratio (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:** Telephone Company. 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 battery device that continues to deliver power to connected electronics when other power fails.


**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.