Colorado Southeast Region Broadband Strategic Plan

Submitted to:

SEBREA

(Southeast Business Retention Expansion Attraction)

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Table of Contents

1 Executive Summary

1.1 Study Background and Goals

The Southeast Business Retention Expansion Attraction organization (SEBREA), which represents a six county area of Southeast Colorado – Baca, Bent, Crowley, Kiowa, Otero and Prowers Counties – engaged Tilson to conduct a broadband strategic plan (Broadband Plan) for the Southeast Region. The goal of the Broadband Plan is to support the Southeast Region's economic development objectives by defining the region's broadband needs, identifying gaps in broadband service and proposing strategies to meet the gaps.

This plan was made possible by a grant from Colorado's Energy and Mineral Impact Assistance Fund (EIAF) awarded through the Colorado Department of Local Affairs (DOLA). Otero County administered the contract with Tilson. A steering committee made up of one representative from each county helped oversee and direct the project. Tilson would like to thank Danelle Berg, Otero County's Economic Development Coordinator, for her work leading the project on behalf of Otero County and the Southeast Colorado Broadband Steering Committee.

1.2 Findings and Recommendations

As the Southeast Region is aware, the increasing movement of both work and education to the home has turned what was a 'luxury' into a necessity. For businesses, internet access is no longer a matter of email capability. Collaborative tools and techniques make it possible to locate business in less expensive areas, but only where reliable, high-speed access is available. Rural areas where low population density weakens the business case for broadband expansion are at a significant disadvantage when seeking to attract new business and residents.

The Southeast Region's broadband gaps can be distilled into four categories:

1. Broadband reliability in municipal areas where speeds meet the FCC's broadband threshold of 25Mbps upload/3 Mbps download;
2. Speed offerings significantly exceeding 25Mbps upload/3 Mbps download in municipal areas;
3. Broadband coverage in rural areas outside of municipal boundaries; and
4. Affordability.

The fact that better broadband coverage is needed in the Southeast Region is no surprise. With the exception of a few municipal areas, federal and state mapping data show that the six counties of the Southeast Region are either underserved or unserved by high-speed broadband services. However, what did come as a surprise is that the broadband offerings in served municipal areas are inadequate: they were widely reported as unsatisfactorily unreliable, and in some cases not fast enough for the demands of today's location-neutral workforce. Lastly, affordability of an internet connection is an impediment to students achieving their full potential, and to the Southeast Region's ability to educate and develop its workforce.

Section 2 Broadband Service Gaps provides an expanded discussion of these gaps and the data and community feedback that supports them.

Tilson's recommendations lead with focusing on leveraging current service providers and pursuing a

privately owned and privately operated business model rather than government-owned models. The primary reasons for this approach are:

1. The low population density would not support additional government-owned providers, in addition to the two cooperatively owned providers (SECOM'S parent company SECPA and Eastern Slope) whose mission is not unlike government in that they both operate for the benefit of their members/constituents ; and

2. Based on regional demographics, it would be challenging to find sufficient IT and telecommunications expertise in the region to operate or administer a government-owned network in addition to those that already exist in the region.

First and foremost, the Southeast Region should maximize federal and state subsidies that are available and required to make to service commercially viable in low population areas. While the Southeast Region doesn't have set aside funds of its own to subsidize service to unserved and underserved areas, the Region can provide indirect support for these efforts by partnering with providers and funding agencies. Examples of partnership activities include providing access to public assets like attachment points and rights of way that would help providers reach new areas; providing support to providers to encourage their successful participation in Colorado Broadband Fund grants; and to work with COIT to improve the Colorado Broadband Map that is relied upon in the grant making process.

Secondly, the Southeast Region should pursue targeted wireline investments in densely settled municipal areas. For the most part, these areas are ineligible for large federal and state grant programs due to reported service speeds of at least 25 Mbps up/3 Mbps down. However, infrastructure investment is needed in many parts of the region to address the reliability and speed gaps in town. In order to offset the risk of the large capital investment required for wireline upgrades, the Southeast Region should administer a demand aggregation tool that allows residents and businesses to demonstrate interest in upgraded service, thus enabling service providers to match supply with demand and lower their financial risk.[1]

Lastly, the Region should promote and develop providers' low income offerings. This could be done on a broad scale, or as part of a pilot program in a school district where student access to school-provided devices is curtailed due to affordability (i.e. in districts with high rates of free and reduced lunch).

Section 4 Recommended Strategies provides an expanded discussion of recommended strategic initiatives.

1.3   Approach and Methodology

Tilson's collected information on regional broadband infrastructure and service, community goals, and unmet broadband needs to serve as key inputs for defining broadband gaps. Tilson's data collection methods included database searches, interviews, community meetings and an online survey. The proposed strategies to meet broadband gaps were developed based on the objective-defining inputs plus additional information including a review of existing broadband service models, discussions with public

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[1] While conducting research for this study, Tilson learned that SECOM was considering adoption of a demand aggregation tool for its fiber build-out. However, if a regional entity were to administer a demand aggregation tool, SECOM said they would be pleased to work with that entity in measuring demand. The tradeoff for any service provider administering a demand aggregation tool vs using a publicly controlled one is control and the ability to use the full feature set (like signup/ordering) versus not having to pay for and administer the tools themselves.

institutions and private service providers, Tilson's sample network designs, and discussions with Steering Committee members.

Tilson excluded mobile phone connectivity from the Broadband Plan for two reasons: 1) mobile data connectivity is very expensive; and 2) mobile-oriented companies don't design their networks to support the larger data consumption common with home and business users, and their rate plans reflect that.

Components of the study included:

- Analysis of federal and state mapping databases containing information about broadband infrastructure and service;
- Interviews with broadband service providers about service offerings, infrastructure, upgrade and expansion process, and participation in public programs;[2]
- Community meetings in each county to assess needs and goals related to broadband; [3]
- An online survey designed to assess broadband use and unmet needs;
- Sample designs and capital cost estimates for wireless broadband improvements;
- Discussions with the Colorado Office of Information Technology (COIT);

Tilson's high-level designs are for sample sites selected in consultation with the study steering committee as representative sample of the under-served or unserved areas – those lacking minimum broadband service of 25 Mbps down and 3 Mbps up. These underserved areas are eligible for subsidies, and are extensively rural where wireless technology is the most cost efficient technical solution.

1.4   Document organization

The following report provides a regional overview, summarizes the findings of the survey, outlines detailed discussions of carrier involvement in the region, presents county level specifics, provides high-level wireless designs for several sample sites, and presents a roadmap of strategic initiatives the Southeast Region can use to advance broadband service. The appendices provide an explanation of key broadband terms and technology, the full result set from the survey and general reference material related to findings and recommendations.

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[2] Tilson contacted all ten known service providers in the region and interviewed all six that responded.
[3] In addition to soliciting feedback from the community, these meetings had the additional objectives of informing and engaging the community on broadband issues.

2 Broadband Service Gaps

Feedback from the online survey and community meetings identified three major gaps in broadband service offerings.

2.1 In-Town Reliability

Although speed issues were identified by the steering committee, community feedback also identified significant gaps in service reliability. Further, the reliability gap is most pronounced in areas that have reported access to broadband speeds in excess of 25/3 Mbps. Reliability was the most frequently listed improvement in the online survey; it was selected more often than speed or price improvements.

Survey results and community feedback indicate that the reliability gap is concentrated in in-town areas that are served by national wireline providers. Respondents in the least rural counties, Otero and Prowers, plus Baca County, listed reliability as their top desired improvement.[4] For Kiowa County, which is 100% rural and served by different incumbent wireline providers from the rest of the region, not a single respondent listed reliability as a desired improvement.[5]

In Otero County, the open comments from the online survey and the feedback at the community meeting indicate deep dissatisfaction with Spectrum and its predecessor Charter (see Appendix C for survey comments by county). Specifically, Spectrum customers complain of frequent outages. Spectrum serves in-town premises in the municipalities of Fowler, Manzanola, Rocky Ford, Swink and La Junta in Otero County.

In Prowers County, fewer survey respondents called out Spectrum for reliability issues (see Appendix B). At the community meeting, an IT professional reported that part of Lamar, which includes the area near the community college, has good service from Spectrum. Another part of town is known to have reliability problems. Two wireless ISPs at the meeting said that their largest source of customer growth was picking up disaffected in-town customers, which was a shift from their typical customer base in out-lying areas.

In Baca County, community members with CenturyLink service at the Two Buttes US Post Office and in Walsh complained of outages with their CenturyLink service.[6]

Most in-town areas that are not well served are ineligible for subsidies, based on the incumbents reported advertised speeds. Fortunately, the economics of providing service in a densely populated area are good, and unsubsidized competitors are more likely to have a viable business in-town than in surrounding rural areas.

2.1.1 In-Town Speed Above 25/3 Mbps

In order for the Southeast region to reverse the projected population exodus and economic decline, it must attract new residents and retrain existing residents. The largest potential population for this needed increase is location-neutral professionals (LNPs). LNPs are heavily dependent on internet connectivity for

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[4] According to emailed data from COIT, 40% of Otero County households and 33% of Prowers households are classified as rural. 100% of Baca, Bent, Crowley and Kiowa county households are rural. Email 4/25/17.

[5] Kiowa County is served by Eastern Slope and Fairpoint. CenturyLink and Spectrum do not have service there. Tilson limited its study of desired improvements to counties with more than 10 responses.

[6] This feedback was obtained through an impromptu discussion at the local post office. Community members attending the Baca County community meeting were all SECOM customers, and quite happy with their service.

work execution and need speeds at and above 25/3 Mbps. Many LNPs need speeds of >3Mbps to upload content to the Internet, and several cited the need for symmetrical speeds of 50/50 Mbps and higher. However, these faster speeds are either not available or inadequately provided in the Southeast region.

In community meetings, several examples of inadequate provision of speed were provided. Among the examples:

- Spectrum service in excess of 25/3 Mbps slowed unacceptably during the evening;
- A community member was unable to afford the $5,000 cost to build a fiber connection to SECOM that would enable him to do the video editing work he had done in Denver; and
- A school waited 18 months for a quote for fiber-based service from CenturyLink before giving up.

Tilson's experience at national hotel chains in La Junta and Lamar provided evidence that the region's in-town areas can benefit from high-speed competition. The two national hotel chains Tilson visited were being served by a CenturyLink DSL connection that had been procured through their national office. In both instances, the guest wi-fi capability was inadequate with below 1 Mbps download speeds and immeasurably slow upload speeds. Both hotels however, were in the process of ordering a fiber-based SECOM connection, and expected to offer faster speeds to guests as a result.

2.1.2 Adequate Coverage Outside of Town

According to high-level estimates by the Colorado Office of Information Technology (COIT), about 47% of rural households in Region 6 have access to broadband internet access (speeds of at least 25/3 Mbps).[7] COIT's stated goal is for 80% of rural Colorado households to have broadband-speed access by 2018, and 100% by 2020.[8] COIT estimates that today 77% of rural households statewide have broadband access. Therefore, Region 6 is significantly behind Colorado's stated goals.[9]

Rural businesses and households with inadequate coverage fall into two categories: those without any non-mobile, non-satellite internet access; and those with sub-broadband internet speeds (speeds of less than 25/3 Mbps). Due to the limitations of the mapping data, Tilson was not able to ascertain how many premises fall into the former category of no internet access outside of satellite or mobile phone service. Tilson did speak to two people in this category – one came to a community meeting, and the other was a business manager that was introduced to Tilson by phone. It may be the case that this subset of unserved businesses and households was unrepresented due to travel distances and the inherent isolation in not having a good connection.

The category of rural users with inadequate broadband speed was not well represented in community meetings, but they did respond to the survey. Most of the community meeting participants subscribed to sub-broadband internet access, and were satisfied with their speeds.[10] However, speed was the second-most desired improvement overall, after reliability. More than 30% of respondents in Baca and Kiowa counties selected speed as a desired improvement. Survey comments indicated a need for more speed in outlying areas.

Fortunately for the region, these areas are most likely to be eligible for state and federal subsidies, since

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[7] Source: Colorado Office of Information Technology, Broadband Office. Via email to Tilson on 4/25/17.
[8] Ibid
[9] Ibid
[10] A common refrain was "if it's fast enough for Netflix, I'm happy."

reported available speeds are below 25/3 Mbps.

2.1.3 Affordability

Online survey data yielded price as the third-most desired improvement, and community meeting feedback indicated that affordability was an impediment to internet access adoption for school families. The fact that affordability is an issue in the region is supported by the state's statistics on free and reduced lunch participation. Compared to the rest of Colorado, Region 6 has a significantly higher percentage of students on free and reduced lunch. The state average is 42%, and the region's weighted average is approximately 68%.[11] (See Appendix F for free-reduced data by school district.)

Community feedback suggests that the lack of home internet access has limited the benefits of the state's Chromebook 1:1 Initiative, since at least two schools have decided that there is insufficient uptake to allow students to bring the devices home. Without closing the affordability gap, it will be very difficult for the region to meet its core objective of educating and training its future workforce.[12] Educational resources are increasingly online, and participation in the future workplace will require digital skills.

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[11] Source: Colorado Department of Education. Weighted average computed by Tilson by factoring-in all schools for which there was pupil-count information.
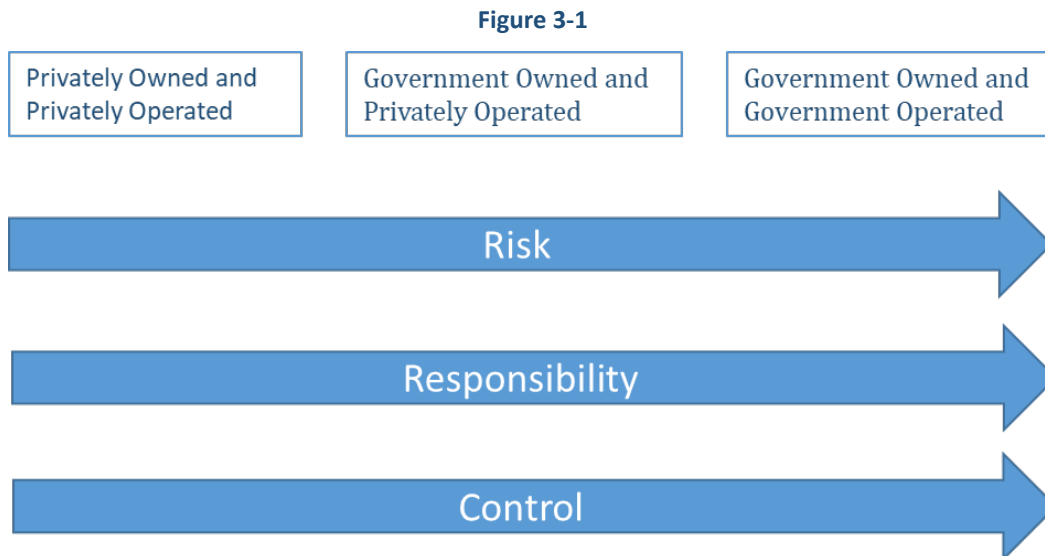
[12] Region 6. "Colorado Blueprint: A bottom-up approach to economic development," Colorado Office of Economic Development and International Trade.

3 Industry Alternatives

3.1 Owner/Operating Model Overview

Regional and municipal governments throughout the United States are grappling with the challenge of inconsistent internet access. There are State and Federal government programs that provide support and subsidies for service improvements to less populated areas, but they are fragmented and sometimes structured around outdated definitions of 'high-speed' thresholds. As a result, some municipal governments are becoming directly involved in providing broadband service. Direct involvement can range from subsidizing private providers to expand or upgrade service to government ownership and operation of broadband networks.

There are three basic owner/operating models for government involvement in broadband service provision. The section below describes these models and some of their variations. While there are myriad variations on the structure within these models, the high-level tradeoffs of risk, responsibility and control remain unchanged. Figure 3-1 illustrates these tradeoffs.

Figure 3-1

| Privately Owned and Privately Operated | Government Owned and Privately Operated | Government Owned and Government Operated |

Risk

Responsibility

Control

3.1.1 Privately Owned and Privately Operated

Under this model, a private network provider retains the ownership and operation of the network. Government involvement typically comes in the form of cash subsidies for capital or operating expenses. Sometimes government entities subsidize private providers with in-kind donations like real estate, access to wireless attachment points, and fiber or rights of way. These donations are typically made in exchange for a service provider's commitment to expand their service area.

This model places the least financial risk on the enabling government entity beyond the initial cash outlay. If a project does not generate positive cash-flow after subsidy, the private provider is responsible. Corresponding to the minimized risk for this model is minimized government responsibility control. The private entity is responsible for building and operating the network. They are fully accountable for the build schedule, ongoing network performance, technology upgrades, billing, customer service, etc. Except for minimum speeds and coverage areas, the service provider typically keeps control over their network and terms of service. This includes control over network design, vendors, service offerings and pricing structure.

Most private providers prefer this model because it gives them full control over their business. Providers do a business case on whether they can generate a profit with a government subsidy, and then have maximum control over decisions that determine profitability. In addition, this model minimizes the future risk of competitors operating over the same network when compared to open access government-owned networks.

Examples of government support of this model include the Colorado Broadband Fund and the FCC's Connect America Fund. New York State's New NY Broadband Program is another example of this model. The providers in the Southeast Region have used this model to improve their service: Viaero was recently awarded a $395,492 subsidy to improve service in eastern Kiowa County, and CenturyLink accepted a six-year capital and operating subsidy of $26.5 million to upgrade DSL service throughout rural Colorado.

3.1.2   Government Owned and Privately Operated

Under this model, a government entity, such as a municipality or county, owns the physical network and contracts with private partners to operate it. Governments typically fund the network build through bonds backed by future tax revenues. This model gives them the advantage of a lower cost of capital than most private providers, but does not obligate them to undertake the complex task of running a network. By owning the network, municipalities dictate the last mile technology and coverage area.

Risk, responsibility and control of the network is split between the government owner and its private partner. They are typically allocated via structured agreements that may stipulate terms of service, financial guarantees, and sometimes even standard operating procedures.

A Colorado example of this model is Rio Blanco County's broadband network. Rio Blanco owns the fiber network infrastructure and private partners operate the network.[13] In Ammon, Idaho the municipality owns and operates a dark-fiber network that is available to service providers, businesses, and residents as a virtual or physical infrastructure (http://b.ci.ammon.id.us/fiber-optic/).

This operating model has perhaps the greatest number of variations. Variations include what network elements are municipally owned, which services are outsourced, and how many private partners operate over the same network. Further, some governments lease their network from a private provider and operate a network themselves.[14]

3.1.3   Government Owned and Government Operated

In this model, a government entity such as a municipally owned utility, both owns and operates the network. Government entities benefit from their lower cost of capital, and are endowed with full responsibility and control of their network that comes from operating it themselves. The financial risk is wholly borne by the government entity, and minimizing this risk means making sound strategic decisions and being a proficient network operator. Strategic decisions include network design, product offering and pricing structure. Operating responsibilities include billing, provisioning, customer service, and local network configurations. A government entity operating its own network would likely purchase wholesale Internet access from an upstream provider.

Examples of this model in Colorado are the communities of Longmont and Glenwood Springs. In both

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[13] In Rio Blanco County's case, they have three tiers of private operators: a network operator, service providers and value added resellers.

[14] This is typically done to serve a municipality's own IT needs.

cases, the cities' municipally-owned electric utilities added a broadband offering. Both cities operate their FTTP networks and employ skilled technical labor that is highly valued in the IT marketplace. Because these governments run both wireline electrical utilities and broadband services, they have the benefit of operating synergies of shared line crews, billing and in-house customer support.

3.2   Indirect Government Support of Privately Owned and Operated Networks

Rather than directly fund internet service through direct investment, local and regional governments can facilitate private investment by assisting local providers apply for grants and subsidies from existing funding sources, documenting demand in underserved or unserved areas, or managing licensing agreements for cable TV providers that provide internet access.

3.2.1   Grant Application Support

As an alternative to direct investment, local and regional governments can play an important role in applying for grants. Governments can assist by becoming a clearinghouse for grant and loan programs that match providers with available funds; providing demographic information; convening stakeholders; application writing; or simply submitting letters of support.

Municipal and regional governments can also support the grant application process by holding the grant-making organization accountable to their stated goals. For example, the Southeast Region's current rural broadband coverage of 47% is wholly inadequate in the context of COIT's stated goal of 100% coverage by 2020. The Southeast Region could play an important role of highlighting the current shortfall of broadband coverage and the need to start planning upgrades now to achieve the state's goal in two and a half years.

3.2.2   Market Demand Aggregation

Governments can play a role in documenting demand in underserved or unserved areas. They can do this by surveying local businesses and residents to understand what service they currently have access to, and whether they would be interested in a particular service in the future. Governments can operate demand consolidation tools to facilitate civic and community engagement. Features like integrated social media and email sharing, custom web portals, FCC map validation, service ordering/sign-up, and real-time measurement of progress towards targeted community take rates are available across the various tools. Governments can build their own demand measuring tools, or use one of the several on the market. While slightly different, they all document unmet broadband demand for the purpose of facilitating targeted investments. Examples of possible tools are presented in Appendix G.

3.2.3   Municipal licensing agreements

Cable TV companies operate under franchise agreements that are negotiated with the municipalities in which they serve. These agreements grant the cable TV company access to the municipality's rights of way in exchange for meeting certain conditions. These conditions include service area stipulations, collection of a customer franchise fee, and procedures for customer grievances related to TV service. Government's management of these franchise agreements can have an indirect effect on internet access, since most cable TV providers offer internet access and phone service in addition to TV programing.[15]

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[15] In a call on 4/11/17 Spectrum said that they had recently completed 20 year renewals of all the Southeast Region's cable franchise agreements.

4 Recommended Strategies

Tilson's recommended strategies combine region-specific inputs with broadband operating models to make recommendations that address the Southeast Region's broadband gaps. It's important to note that all Tilson's strategies presume a privately owned and privately-operated business model.

Tilson recommends that the Southeast Region pursue this model over a government-owned model for several reasons: The first is that the Region is endowed with two cooperatively owned providers (SECOM'S parent company SECPA and Eastern Slope) whose mission is not unlike government in that they both operate for the benefit of their members/constituents. The second reason Tilson recommends this model is that there is insufficient IT and telecommunications expertise in the region to support a government owned and operated broadband service provider. The lack of expertise is both a function of the small population of the region and the fact that the economy is not technology-based like other regions of the state.

4.1 Partner with Providers and Funding Agencies

As seen in the mapping data in sections 6-12, large swaths of the region are underserved. Some populated areas are unserved. There are several ways that the Southeast Region could provide indirect support for these efforts.

4.1.1 Leverage Public Assets Where Possible to Reach New Areas

County governments should perform an inventory of towers, rights of way, and planned construction projects that would provide assets that could help providers upgrade or establish service in new areas.

An example of a planned construction project is the Arkansas Valley Conduit Project that when complete will include construction of new water supply likes to deliver municipal and industrial water to 40 water providers in the Southeast Region.

4.1.2 Develop a COIT/Provider Initiative to Ensure Participation in Future Colorado Broadband Fund Rounds

Last year's round of the Colorado Broadband Fund had only one applicant from the Southeast Region. That project was funded. The Region's Broadband Steering Committee should develop an initiative aimed at working with COIT and internet service providers to facilitate increased participation in future rounds.

Elements of this initiative should include:

- Ensuring that providers have a familiarity with the program and the resources required to apply;
- Identification of any impediments to providers for submitting applications; COIT addressing impediments where practicable;[16]
- Twice-yearly reporting on the Southeast's Region's progress towards COIT's stated goal of 100% rural broadband coverage by 2020;

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[16] For example, one issue that was highlighted during the study was inaccurate or incomplete reporting. Some providers do not report their coverage to COIT. Others exaggerate their service area. If there are reporting inaccuracies that lead to inefficient outcomes, they should be highlighted and addressed.

4.1.3 Work with COIT, Providers and Community to Improve CO Broadband Map

Accurate broadband mapping ensure that public subsidy goes to areas that need it most. COIT maps are generally better than the FCC's due to more frequent data capture, the higher granularity of the service area, and its process for correcting mistakes.

The Southeast Region can encourage COIT to improve its maps by asking it to compel all Broadband Fund applicants to submit internet access coverage data. In addition, COIT is in the process of acquiring spatial E-911 data that plots the locations of all potential broadband end-users. Once COIT has completed this initiative, the Southeast Region and private providers should use this data to prioritize upgrades and expansions.

Lastly, the Southeast Region should develop a campaign whereby users test their service and submit inaccuracies to COIT. This user testing could result in areas currently showing as "served" to be "underserved," and thus eligible for subsidies.

4.2 Facilitate Targeted Wireline Investments with a Demand Aggregation Tool

Because many of the region's downtown areas have reported service speeds of 25/3 Mbps and above, they are ineligible for large federal and state grant programs. The cities of Lamar and La Junta are examples: areas inside the city limits have reported speeds of 25 Mbps/3 Mbps or higher from at least one wireline carrier, yet members of the community say the existing service offers inadequate reliability and speed. Fiber-based broadband service would offer the promise of increased reliability and the certainty of increased speeds.

These in-town areas have dense settlement patterns that make wireline technologies like fiber more practical. In fact, some underserved customers in these communities have had fiber service provisioned to their home or business. However, if a premise is not close to a fiber distribution terminal, it can be very expensive to provision. Tilson's recommended strategy would enable multiple end users in close proximity to each other to pool their demand and lower the cost per-user of extending fiber to them. Appendix __ provides an illustrative example of the cost advantages of pooled demand.

If a regional entity were to administer a demand aggregation tool (e.g. SEBREA, a county government), that entity would be able to facilitate civic and business engagement in the process by providing an interface where users input their location, request for specific service attributes (internet, voice, phone), and potentially a host of other inputs. Service providers would use the information to make informed implementation decisions that match supply to demand, lowering the financial risk associated with their capital investment.[17]

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[17] While conducting research for this study, Tilson learned that SECOM was considering adoption of a demand aggregation tool for its fiber build-out. However, if a regional entity were to administer a demand aggregation tool, SECOM said they would be pleased to work with that entity in measuring demand. The tradeoff for any service provider administering a demand aggregation tool vs using a publicly controlled one is control and the ability to use the full feature set (like signup/ordering) versus not having to pay for and administer the tools themselves.

4.3 Promote and Develop Providers' Low-Income Offerings

Affordability is and will likely remain a barrier to broadband adoption. Anecdotal evidence from the community meetings suggests that there are significant numbers of families that don't have the disposable income to pay for a fixed home internet connection of any speed. For example, in Rocky Ford, the town in which the community member said that the 1:1 Chromebook Initiative devices weren't being sent home due to low broadband adoption, 73% of students receive free or reduced lunch. [18]

Without significant broadband adoption, the Region will not be able to meet its economic development goal of educating and training the future workforce.[19] Internet service providers recognize that an internet connection is critical for economic welfare; as such, some of them have offerings for low income families. Spectrum's Internet Assist program, outlined in section 13.5, is a good example of a low income offering.[20]

The Southeast Region should promote existing Low-Income offerings and work with providers to develop new ones. Because this is a large initiative, Tilson believes the Region should pick a pilot school district. Rocky Ford School District is a good candidate: the school has a knowledgeable and engaged IT staff member; it has Chromebooks for every child that are currently being underutilized; it has an existing provider with an excellent low income offering;[21] and it has a large low-income population.

Elements of this program would include developing a second low income offering for providers serving areas outside of Spectrum's in-town service territory (e.g. Viaero and SECOM); working with school and social services staff to promote the program and provide enrollment support; working with educators on extending the in-school online curriculum to home based activities; and measuring outcomes (e.g. change in broadband adoption rates and test scores).

If the program proved successful, it would pave the way for expansion into other areas of the Region.

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[18] Statistic for Rocky Ford Junior/Senior High School. https://high-schools.com/directory/co/cities/rocky-ford/rocky-ford-junior-senior-high-school/80627001103/

[19] "Region 6 Colorado Blueprint: A bottom-up approach to economic development," Colorado Office of Economic Development % International Trade. Rev 7-28-14

[20] CenturyLink's Internet Basics program offers speeds of only 1.5 Mbps, and therefore is much less useful. This offering was not discussed with Tilson, but it is published online.

[21] Spectrum Internet Assist with 30/4 Mbps for $14.99/month; wi-fi router rental $5/month

5 High Level Technical Design

The intent of the high-level design was to illustrate a representative solution that delivers broadband to underserved areas while using existing telecommunications infrastructure.

5.1 Site Selection and Technical Approach

Tilson created sample network designs for broadband infrastructure in areas that lacked reported broadband service meeting the speed threshold of 25/3 Mbps, and are thus eligible for state and federal subsidies. The sample designs covered one area in each county, plus one remote ranch in Otero County that was developed as a case study for a single-premise solution. The service areas were selected in consultation with the Southeast Region Broadband Steering Committee based on community feedback and broadband mapping.

Tilson's technical approach was to develop a hybrid fiber and wireless solution that leverages the existing fiber backbone in the region and uses wireless technology to reach end users. With this approach, data is transmitted via fiber to the nearest tower to the end users. Wireless technology is used for the last mile to reach the end users. In most cases, the wireless signal is a point-to-multipoint solution (PTMP) where several end users are served from one tower. In the case of the remote ranch in Otero County, Tilson designed a point-to-point (PTP) solution where only one customer is served from the nearest tower from a microwave link. This technical approach is the most cost effective to serve sparsely populated areas at broadband speed thresholds. It has the additional benefit of being quick to deploy.

The table below lists the set of sample sites selected by Tilson, the source suggesting the site, and the technical solution type.

Table 5-1

ID	Name	Description	County	Source	Comment	Solution
1	Higbee	Canyon area	Otero	SECOM	County-owned tower with avail space just north of Higbee on map.	Fiber, Wireless PTMP
2	Remote Ranch	Mail address: 1255 County Road E, La Junta, CO 81050. House east of 109 in Bent County	Bent	Homeowner @ Otero community meeting	Use as proof of concept for PTP.	Fiber, Wireless PTP and PTMP
3	Timpas	Small settlement area along 350 in Southern Otero Co	Otero	SECOM		Fiber, Wireless PTMP
4	Haswell	Town of Haswell and surrounding area	Kiowa	Tilson	No coverage on FCC and CO maps	Fiber, Wireless PTMP
5	Utleyville	Area in western Baca along Hwy 160.	Baca	Tilson	No coverage on FCC and CO maps	Fiber, Wireless PTMP
6	Southeast Prowers	Along HW 89 in southeast corner	Prowers	Tilson	No coverage on FCC and CO maps	Fiber, Wireless PTMP
7	Upper Crowley	Flat open area north of Ordway	Crowley	Tilson	No coverage on FCC and CO maps	Fiber, Wireless PTMP

5.2 Design Assumptions

- Attain customer speeds at least 25 Mbps download and 3Mbps upload with a latency below 50 milliseconds.

- Known fiber routes to the towers have capacity available for lease.[22]

- Existing fiber between towers is available for lease and use.

- Towers listed in the FCC database are available and have leasable space.

- Tower height used in the RF modeling are the actual heights of the towers.[23]

- Planning bandwidth is for illustrative purposes. Actual speeds may not always reach planning speeds due to many factors, some of which can be mitigated with proper planning and design as related network modeling. Appropriate planning and design parameters are provided under Network Design Guiding Principles

5.3 Methodology

Tilson design methodology included the following elements:

- Only FCC listed towers were used as attachment structures to reach the service area. The FCC lists all towers over 100 feet, and they are readily available in a database. In practice, other attachment structures such as windmills, water tanks, tall buildings and towers less than 100 feet may be available for use in wireless designs.

- Fiber was used whenever possible. Known fiber routes were used to get to the closest tower to the service area whenever possible. When a tower serving as a wireless access point was not served by fiber, a wireless connection (Distribution Layer) was used to reach a fiber-served tower (Core Layer). See Figure 5-1 below.

- Tilson's goal was to minimize radio hops wherever possible. Hops are defined either as one PTP or one PTMP link.

- For the PTMP Access Layer design, Ubiquiti airMax technology operating in the 5Ghz unlicensed spectrum was used.[24]

- Ubiquiti airFiber technology operating in the unlicensed spectrum was used for PTP wireless Distribution Layer and Access Layer connectivity.[25]

- Tilson utilized EDX Signal Pro for all wireless network planning and modeling. EDX SignalPro is a comprehensive and fully featured RF planning software suite offering all the study types needed to design wireless networks, including; area studies, link/point-to-point studies, point-to-multipoint and route studies. The output of this software is received signal strength indication (RSSI), which estimates

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[22] Tilson used SECOM's fiber routes.Tilson asked all facilities-based providers for middle-mile fiber route maps for use in this design, and only SECOM furnished its routes.
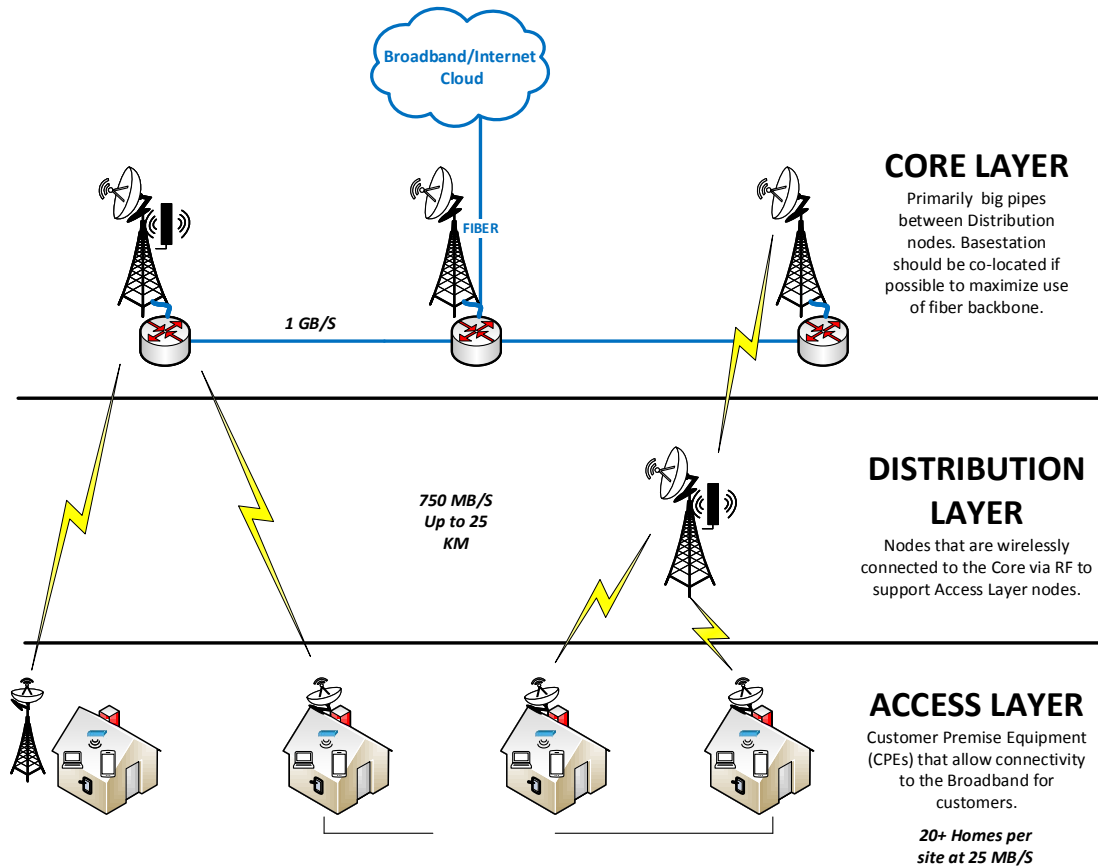
[23] This is a norm for high level planning when there are not resources available to ascertain actual availability of space on the tower. In reality space may not be available at or near the top of the tower, which could mean lower performance on wireless links.

[24] Tilson selected unlicensed PTP and PTMP technology since it is a lower cost (both CapEx and OpEx) than licensed, and the selected equipment works within the stated operating parameters. However, a provider may choose to operate in licensed frequency to avoid interference from other wireless users or to operate for longer distances or at higher capacities. Using licensed spectrum carriers higher equipment costs and operating costs than unlicensed spectrum.

[25] Ibid.

the signal strength that determines the likely service area.

Figure 5-1

CORE LAYER

Primarily big pipes between Distribution nodes. Basestation should be co-located if possible to maximize use of fiber backbone.

DISTRIBUTION LAYER

Nodes that are wirelessly connected to the Core via RF to support Access Layer nodes.

ACCESS LAYER

Customer Premise Equipment (CPEs) that allow connectivity to the Broadband for customers.

20+ Homes per site at 25 MB/S

5.4 Sample Designs

To illustrate the potential of the hybrid fiber/wireless design, seven rural locations were identified. Green lines on the designs indicate a modeled PTP connection (typically used for the Distribution Layer, with the exception of site 2). The yellow pushpins and green/blue signal propagation path profiles indicate the PTMP Access Layer.

The EDX software modeled RSSI of the PTMP Access Layer. Areas in green have an RSSI of -85.0 dbm, which means they are likely to receive a suitable signal for service. The blue areas are below -85.0 dbm and would likely not have sufficient signal for coverage.

5.4.1 Sample Site 1 Higbee, Otero County

Broadband coverage to this area proved difficult because of the elevation variation. Coverage shown in the graphic below is accomplished using a Core tower to Distribution tower model (1 hop), plus an additional hop to the premise (2 hops total). Coverage for this area would be provided by using existing FCC towers.
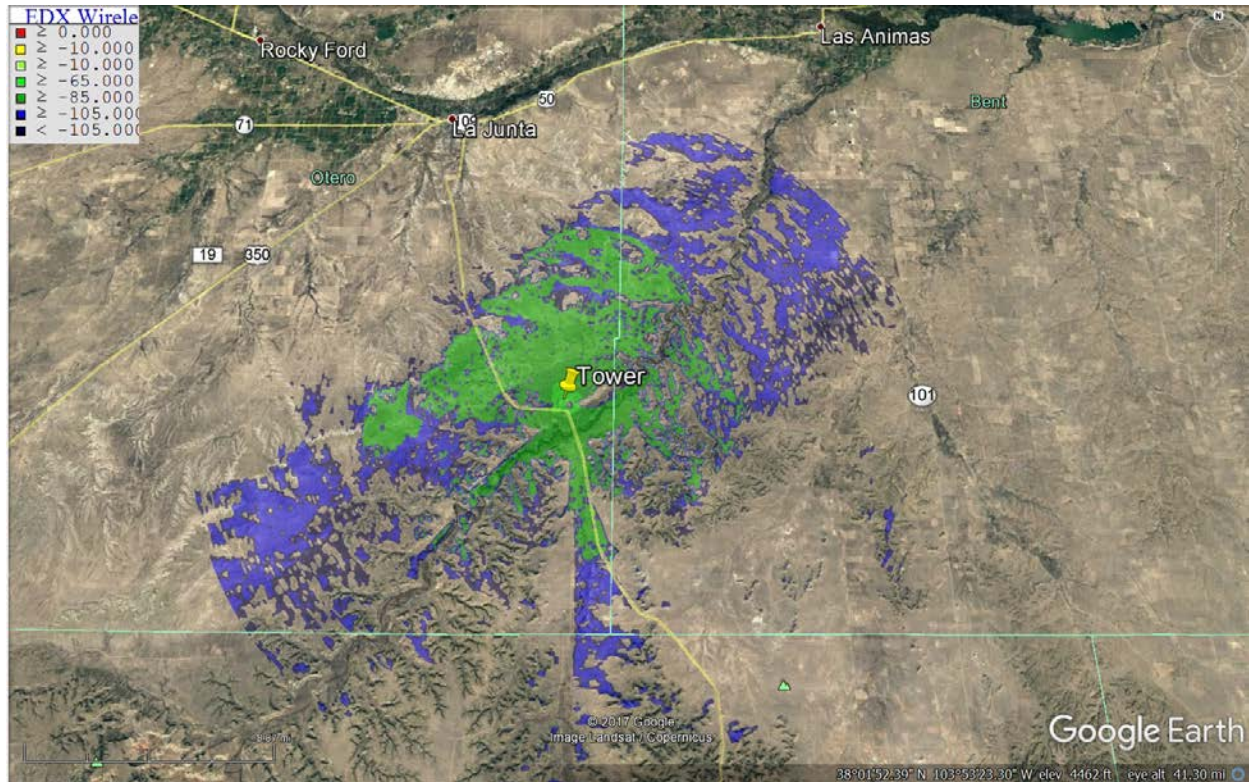
5.4.2 Sample Site 2 Remote Ranch, Bent County along the Eastern Otero County Border

Due to geographical constraints that necessitated multiple PTP hops with a final PTMP distribution for a particularly isolated ranch, Tilson created two high level designs for the location. One design uses 3 hops total, and the other uses only 1 hop, but necessitates the construction of a tower on the customer premises.

5.4.2.1 Sample Site 2, Remote Ranch Option A: Three Hop Design

Coverage shown in the graphic below is accomplished using a Core tower to Distribution tower model (1 hop), plus an additional hop to another Distribution tower (2nd hop) and another to the premise (3 hops total). Tilson's EDX RF modeling software indicates a marginal but potentially useable signal for the 2nd PTP hop. If this design is pursued, Tilson recommends a spectrum analysis and field testing the link to determine the viability.

RF modeling on Option A indicates that if the PTP connections strong enough, there is ample PTMP coverage for the house in question along with potentially 2-3 other aerially visible buildings in the coverage area.
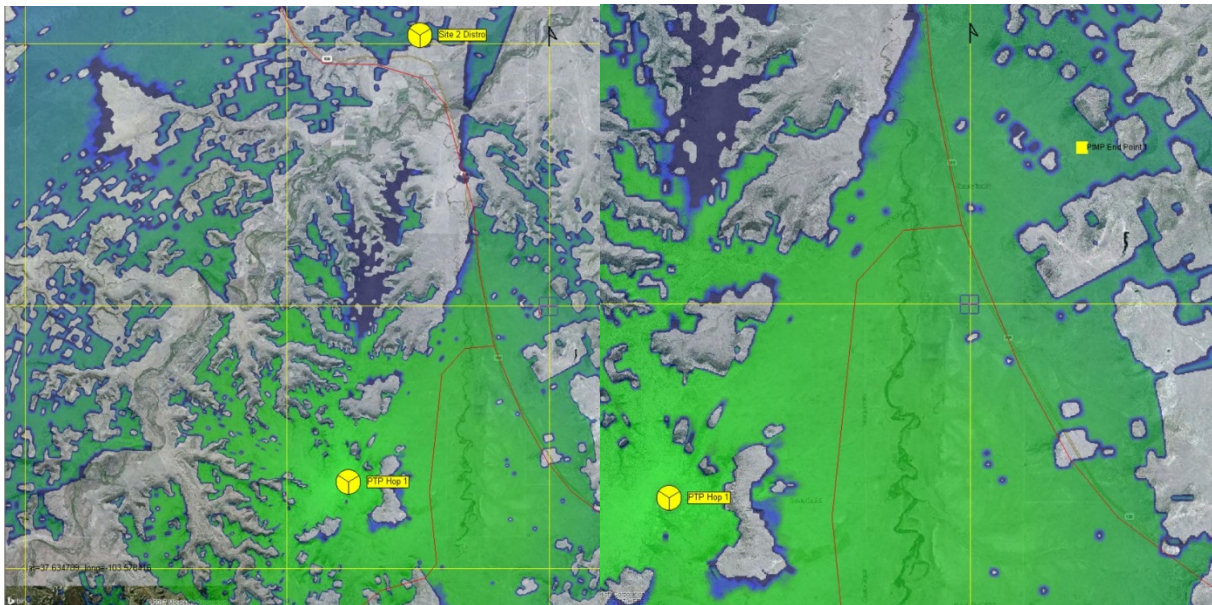
5.4.2.2   Sample Site 2, Remote Ranch Option B: One Hop Design

The ranch could be reached with a 1 hop design if a medium sized tower is built on a nearby ridge. The tower would be 150-200' tall, and a PTP connection would be made between the newly-constructed Access tower and a fiber-fed Distribution tower to the north. Broadband could be extended to the ranch via cabling.
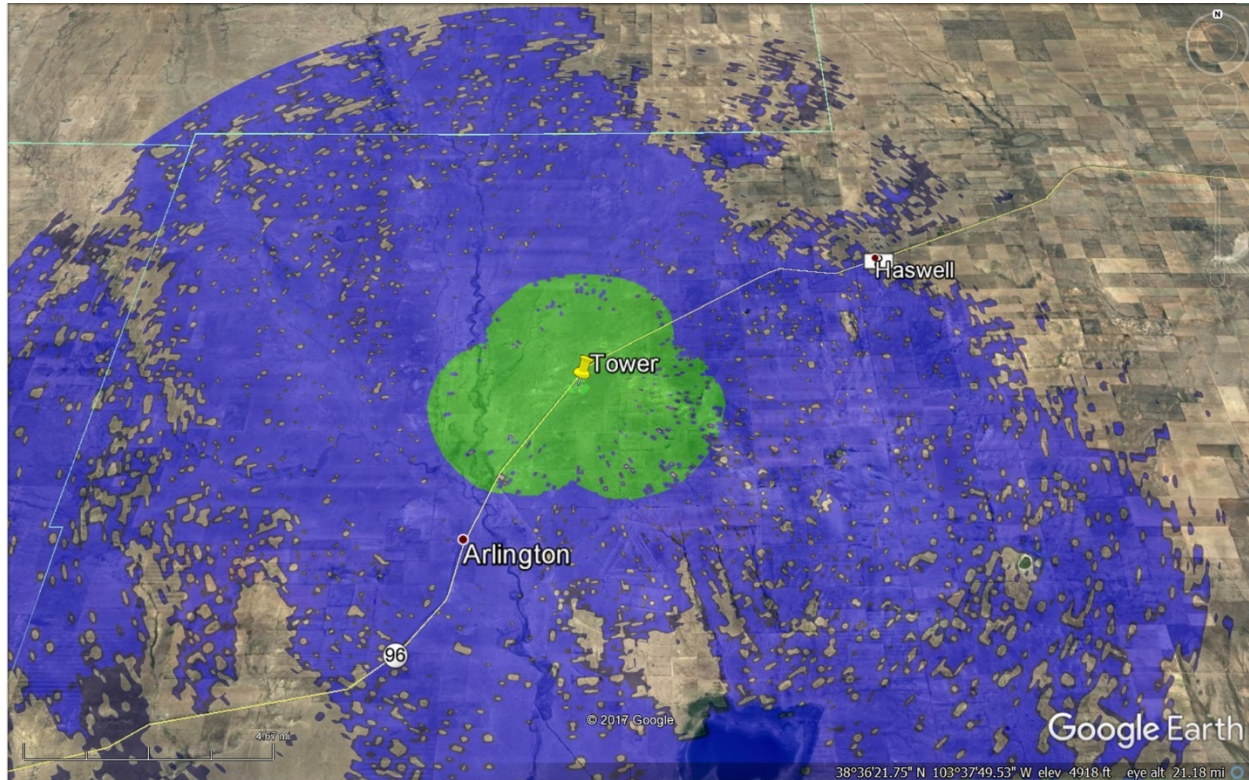
5.4.3 Sample Site 3 Timpas, Otero County

Broadband coverage shown in the graphic below is accomplished using a Core tower to Distribution tower model (1 hop).
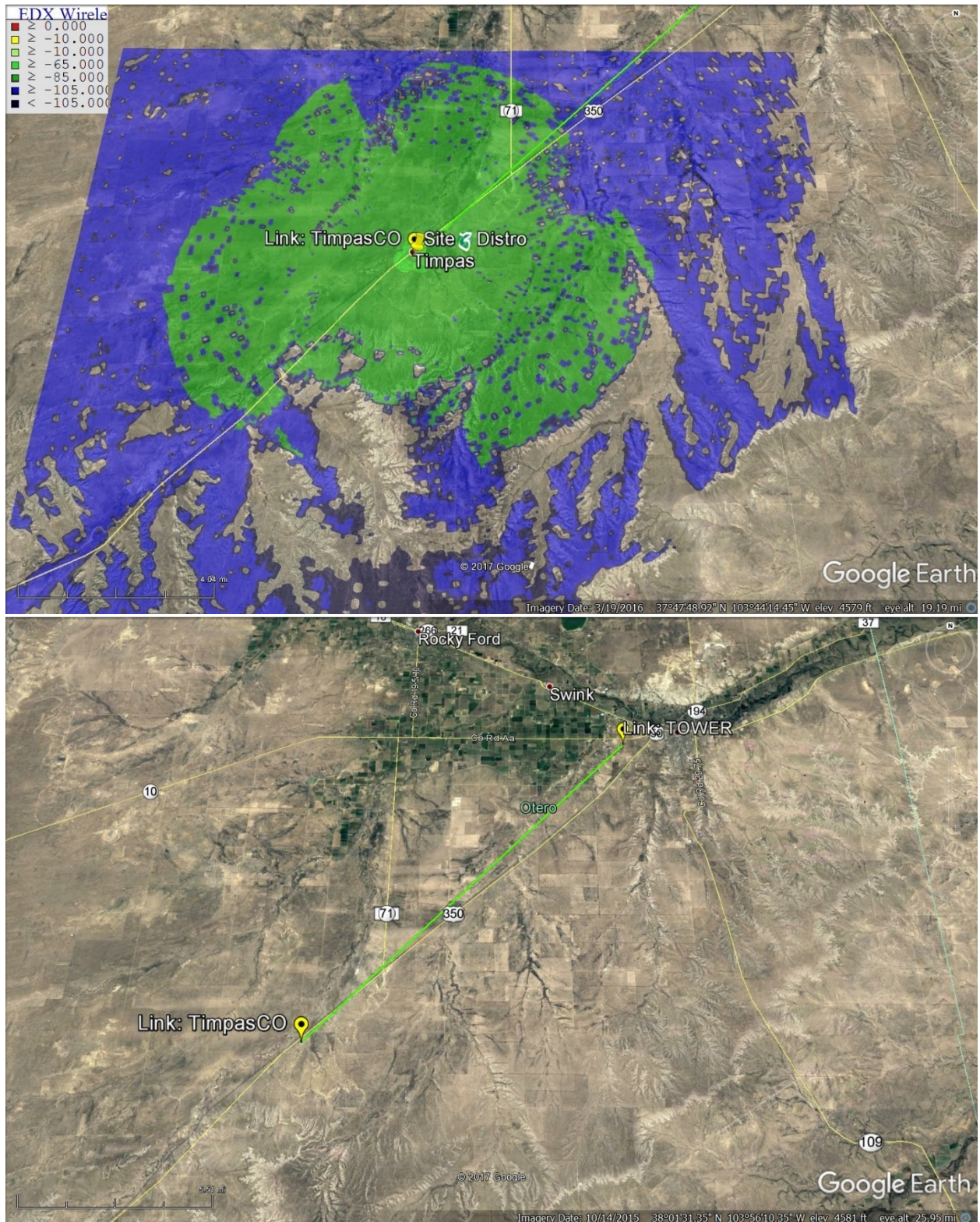
5.4.4 Sample Site 4 Haswell, Kiowa County

Broadband coverage is a challenge to this sample site. Because of its remoteness from existing fiber and Core tower sites, and its elevation variation it cannot be reached via the Core to Distribution model. A second Distribution to Distribution tower PTP connection would be required (2nd hop) to reach the sample area with 3 hops total.
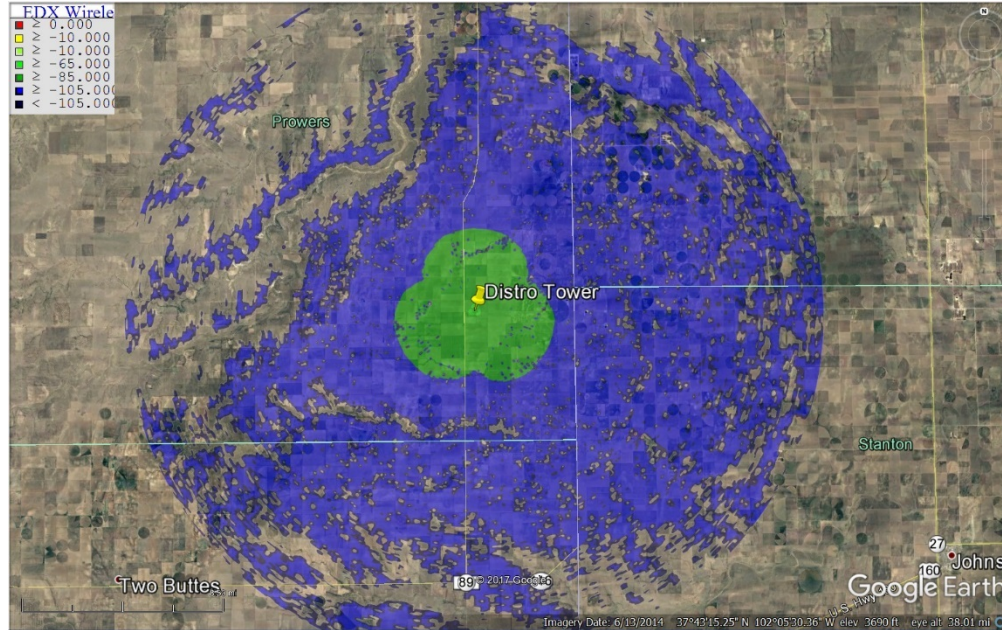
5.4.5 Sample Site 5 Utleyville, Baca County

Broadband coverage shown in the graphic below is accomplished using a Core tower to Distribution tower model (1 hop) for a total of 2 hops before reaching the customer premises.
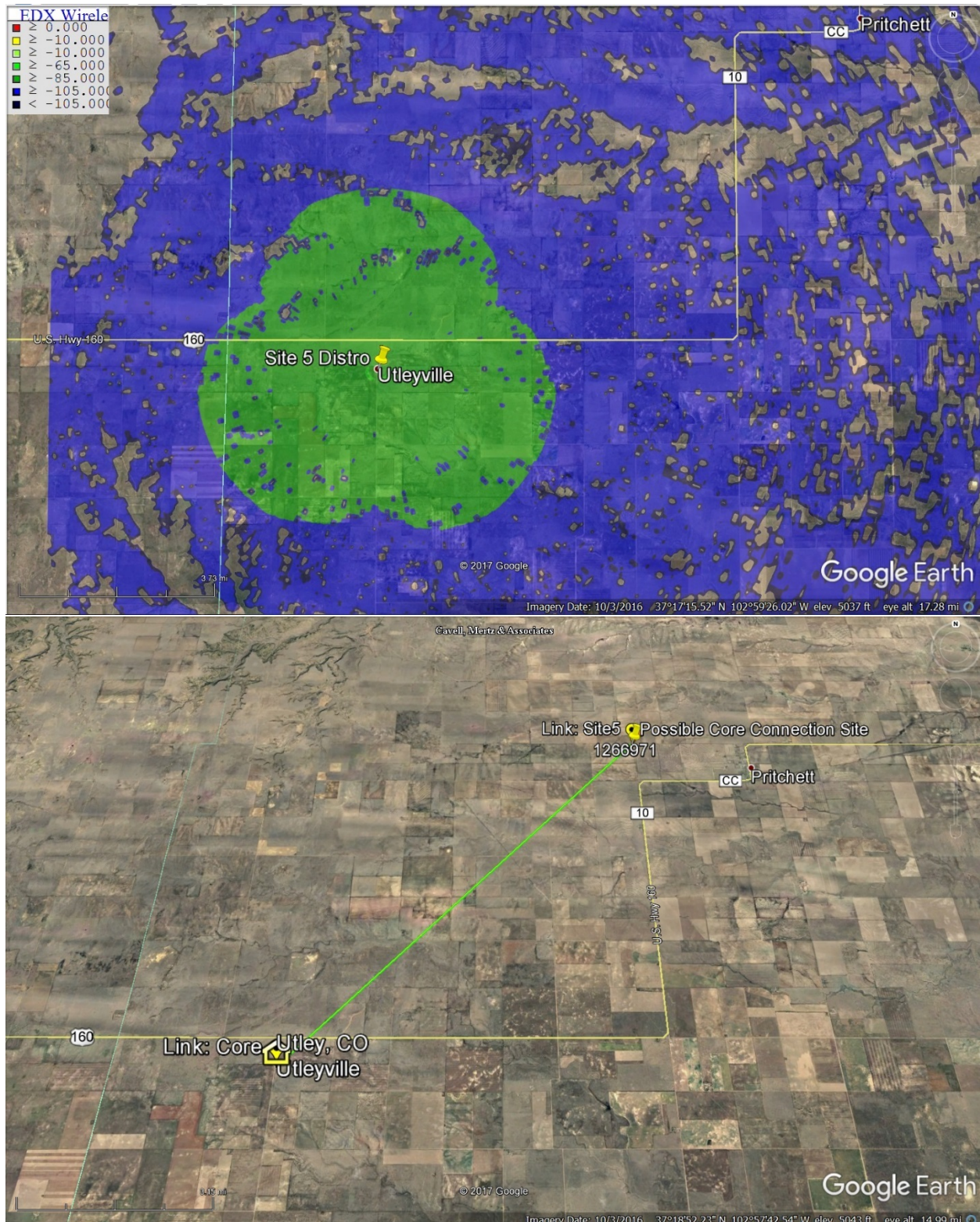
5.4.6 Sample Site 6, Southeast Prowers County

Broadband coverage to this area proved difficult because of the elevation variation. Coverage shown in the graphic below is accomplished using a Core tower to Distribution tower model for a total of two hops before reaching the customer premises. Additional coverage would require additional Distribution Layer towers.

5.4.7 Sample Site 7 Upper Crowley County Area

Broadband coverage shown in the graphic below is accomplished using a Core tower to Distribution tower model (1 hop). There is not an existing FCC tower in the area of the sample area to provide the required coverage, so if there isn't an available attachment site in the area, a medium size tower would need to be erected.
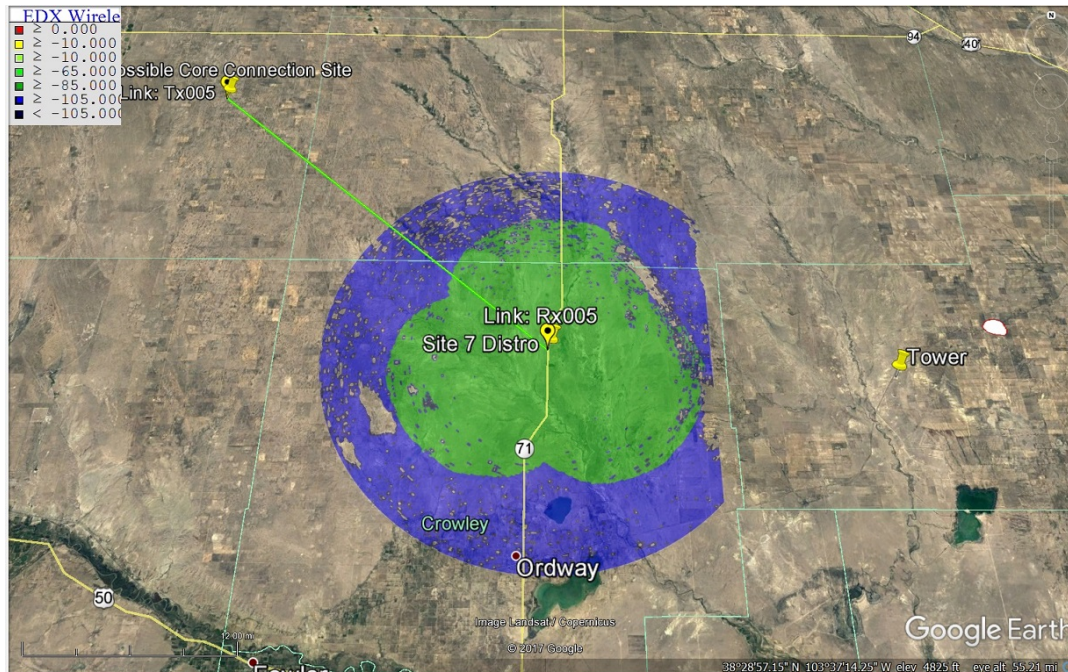
5.5 Representative Costing of Sample Designs

Tilson developed its costs based on prevailing prices at the time of this analysis. Using the area where the projected signal is adequate (green areas where the signal strength is >= -85.000), Tilson identified the census blocks covered. Using the census block data, Tilson totaled the households that would benefit from the installation to derive a per household cost. Based on the sample, the per household cost to expand service into the unserved/underserved areas of the region would range from $351.79 per household to $3,078.13. These calculations are biased to the best case as 1) some of the census blocks are only partially covered by the adequate signal so households may be over counted; and 2) the analysis assumes all households will subscribe.

These numbers exclude the remote ranch sample since that is a unique situation, although the analysis does provide an order-of-magnitude assessment of between $36,625 and $63,500. The higher number for the ranch sample reflects the cost of tower construction if an existing tower is not accessible.

High Level Two Hop Design Costs (Higbee, Timpas, Utleyville, Southeast Prowers, Upper Crowley)		
Component	**Count**	**CapEx**
Core Tower Site		
PTP Link	1	$3,500
Installation and Testing	1	$7,500
Permitting and Structural Analysis	1	$3,500
Distribution Tower Site		
PTMP Equipment	1	$125
Permitting and Structural Analysis	1	$2,500
Installation and Testing	1	$7,500
Total[2]		**$24,625**
Per-Premise Customer Equipment[1]		
Radio		$100
Licensed Spectrum Upgrade (Optional)		
PTP Core Equipment Premium	*1*	*$5,000*
FCC Lease (good for 10 years)	*1*	*$2,000*
Total Licensed Spectrum Upgrade		*$7,000*
[1] Likely paid for by customer [2] CapEx only. Excludes operating costs like fiber leases and tower leases (2) associated with adding a new site. Also excludes CapEx and OpEx associated with installing backup power at the site (if not available and included in lease).		

Estimated Capital Expense for Sample Sites: Remote Ranch Option B, Haswell (Three Hop Design)		
Component	**Count**	**CapEx**
Core Tower Site		
PTP Link	2	$7,000
Installation and Testing	2	$15,000
Permitting and Structural Analysis	2	$3,500
Distribution Tower Site		
PTMP Equipment	1	$125
Permitting and Structural Analysis	2	$3,500
Installation and Testing	1	$7,500
Total[2]		**$36,625**
Per-Premise Customer Equipment*		
Radio		**$100**
Licensed Spectrum Upgrade (Optional)		
PTP Core Equipment Premium	*2*	*$10,000*
FCC Lease (good for 10 years)	*1*	*$2,000*
Total Licensed Spectrum Upgrade		*$12,000*

[1] Likely paid for by customer
[2] CapEx only. Excludes operating costs like fiber leases and tower leases (3) associated with adding a new site. Also excludes CapEx and OpEx associated with installing backup power at the site (if not available and included in lease).

Estimated Capital Expense for Remote Ranch Option B Design		
Component	**Count**	**CapEx**
Core Tower Site		
PTP Link	1	$3,500
Installation and Testing	1	$7,500
Permitting and Structural Analysis	1	$3,500
Ranch Tower Site		
Tower Build	1	$40,000
Permitting and Design	1	$7,000
Cabling to Reach House	1	$2,000
Total[1]		**$63,500**
Per-Premise Customer Equipment		**$350**
Licensed Spectrum Upgrade (Optional)		
PTP Core Equipment Premium	*1*	*$5,000*
FCC Lease (good for 10 years)	*1*	*$2,000*
Total Licensed Spectrum Upgrade		*$7,000*

[1] CapEx only. Excludes operating costs like fiber leases and tower leases (1) associated with adding a new site. Also excludes CapEx and OpEx associated with installing backup power at the site (if not available and included in lease).

Estimated Capital Expense Per Household Based on Census		
Site	# Households	Per household Cost[1]
1 - Higbee	70	$351.79
3 - Timpas	8	$3,078.13
4 - Haswell	24	$1,026.04
5 - Utleyville	11	$2,238.65
6 - Southeast Prowers	38	$648.03
7 - Upper Crowley	35	$703.57
[1] Net of Premise equipment		

5.6 Network Design Guiding Principles

As the Southeast Region moves forward with expanding broadband in rural areas, the service residents receive will benefit if guiding principles are adhered to in wireless designs. These principles include:

- Use fiber when and wherever possible. Fiber offers the greatest performance (up to 10GB) and distance. This medium should be used across the core backbone of any network deployment. It also offers the most future growth potential as requirements grow in the future.
- Minimize wireless hops because bandwidth available bandwidth decreases with each hop.
- A scalable solution built on latest generation equipment is key. It should be scalable as evidenced by the ability to add new users in these areas at targeted speeds and increase speeds without significant additional capital investment over three to five years.
- It's important to consider link lengths, spectrum congestion, atmospheric conditions, required reliability, and initial and recurring costs, when deciding whether to use unlicensed or licensed spectrum.[26]
- Site acquisition and real estate needs to be part of the early planning process.
- Proper RF modeling and design should be done before spectrum analysis and field testing.

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[26] Unlicensed radio equipment can often be purchased for significantly less than licensed hardware. Licensed hardware also requires leasing the spectrum space to reserve its use for a given provider. In extremely rural, arid areas with plenty of available spectrum and limited interference issues, unlicensed spectrum can be a viable solution with greatly reduced capital expenditures and reduced recurring expenses. With current technologies, unlicensed spectrum can provide exceptional performance and throughput for smaller numbers of users – some manufacturers advertise as much as gigabit throughput in optimal situations. Real-world examples provide speeds far exceeding the 25/3Mbps definition of broadband. In more densely populated areas where spectrum can be congested and hotly contested by multiple providers, licensed spectrum may be required to provide the desired link stability and reliability in a challenging RF landscape.

6 Regional Mapping Overview

The Federal Communications Commission (FCC) and the Colorado Office of Information Technology (COIT) collect spatial information from internet service providers that can be mapped to display upload and download speed, technology type, and carrier. Tilson used this data to create high-level maps of Region 6 presenting served, underserved and unserved areas according the 25 Mbps download/3 Mbps upload[27] definition of broadband used by the State of Colorado and the FCC. This view is important to determining eligibility for broadband state and federal broadband subsidies.[28]

In addition, Tilson segregated the maps by technology type following the COIT guidelines of wireline service (CATV, Fiber, and DSL) and fixed wireless (non-mobile wireless). Due to inherent differences in technology, the fixed wireless coverage data is less precise than the wireline coverage. This section provides a regional overview of available service per the FCC and COIT data. County-specific data sets are provided in the county-specific sections of the report.

6.1 FCC DATA

Tilson imported the most recent data set, which contains fixed (i.e. non-mobile) internet access deployment data as of December 2015. The FCC Form 477 data contains internet service speed and technology by provider and census block. While the Form 477 data provides an excellent spatial overview of service, it has some limitations:

1. The low level of granularity. A census block is considered served if a given speed and technology is available at one or more addresses within the block. The entire block does not necessarily have service;

2. The aging of the published data. The most recent data set available is for December 2015 service. December 2016 service data isn't expected until about September 2017; and

3. The data is based entirely on provider submissions and is not validated for accuracy by the FCC.

6.2 COIT

Colorado Broadband Data and Development Program (CBDDP) data provided by COIT uses 40 acre quarter section blocks for a more granular depiction of service areas. The data is also more recent, containing submissions from 2016 as opposed to the FCC's 2015 data. The 'unserved' data can be misleading:

1. Data submission is voluntary. One local provider stated they refused to supply the data in protest over a disagreement with data mapping and validation techniques that allowed competitors to overstate service

2. The data excludes quarters where aerial surveys did not reveal structures. This is useful since lack of structures indicates a lack of a population that requires service. However, the dataset that COIT is willing to provide to the public does not distinguish between unserved quarters where there are structures but no service, and excluded areas where there are no structures.

While this data does not override the FCC data for applying for federal grants, it will be useful for strategy development and application for state grants.

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[27] Only download speeds were mapped. Most providers offering 25 Mbps download offer at least 3 Mbps upload.

[28] The State of Colorado uses data collected under its broadband mapping program to aid in determining its Broadband Fund eligibility. The FCC uses its Form 477 Data for determining eligibility under most federally administered broadband grants, e.g. the upcoming FCC's CAF 2 auction, and the USDA Community Connect Grants use Form 477 data.

6.3   Regional Maps

Figure 4-1 depicts areas where existing infrastructure provides broadband service of 25 Mbps down and 3 Mbps up (or better) per the FCC Form 477 data. Also reflected are critical infrastructure components for expansion, regional tower locations and known middle mile fiber routes. Existing infrastructure and service is clustered along major roads in the municipal areas. As shown in the key, orange areas are supported by optical carrier (fiber), light purple marks CATV service (cable TV); and blue is supported by DSL. Red lines are SECOM's aerial fiber and blue are SECOM's underground fiber.[29] The triangles are tower locations imported from the FCC's Antenna Structure Registration database.

Figure 6-1: 6 County Infrastructure
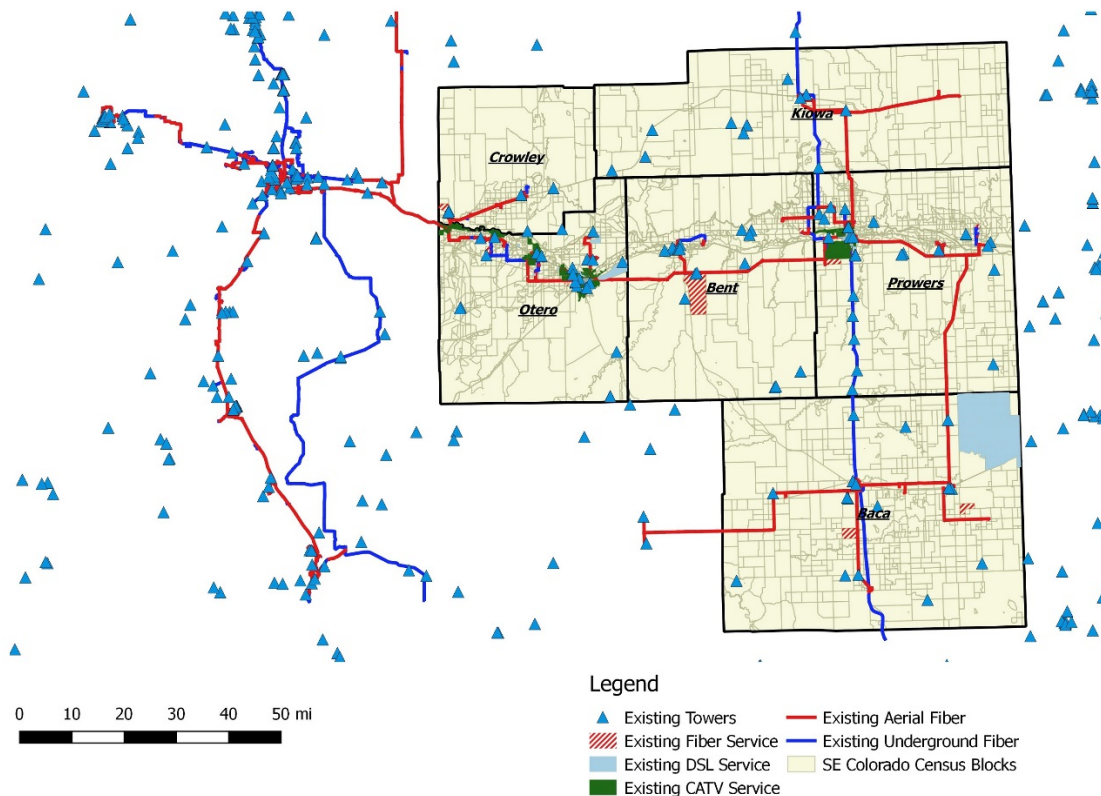
Figures 6-2 through 6-5 depict internet access coverage across the region as reported to the FCC and COIT. "Served" areas on the map are reported to have internet access speeds greater than or equal 25 Mbps download and 3 Mbps upload. "Underserved" areas reportedly have internet access, but at speeds below the 25/3 Mbps threshold. "Unserved" areas have no internet access available.[30]

As shown, most the region is served by internet access at speeds below the broadband threshold. Wireless is more predominant than wired, although pockets of service meet the broadband standard of 25/3 Mbps.

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[29] To date, Tilson has requested and received middle mile infrastructure from all the carriers, and received route information from SECOM and Eastern Slope Rural Telephone Association. Eastern Slope's map was of middle-mile fiber owned by a consortium, of which they are a member. However, the consortium fiber is north of the region and does not extend into the study area.

[30] Per COIT reporting convention, "unserved" areas might have wireless coverage, but have not have people living in them.

The reporting discrepancy between the FCC and the COIT maps is the greatest for wireline service, due to the distortion created by a single address in FCC data defining the census block. However, reported wireless coverage is predicted by wireless propagation models, and actual coverage is likely to degrade as a function of physical obstructions and interference by other wireless signals.

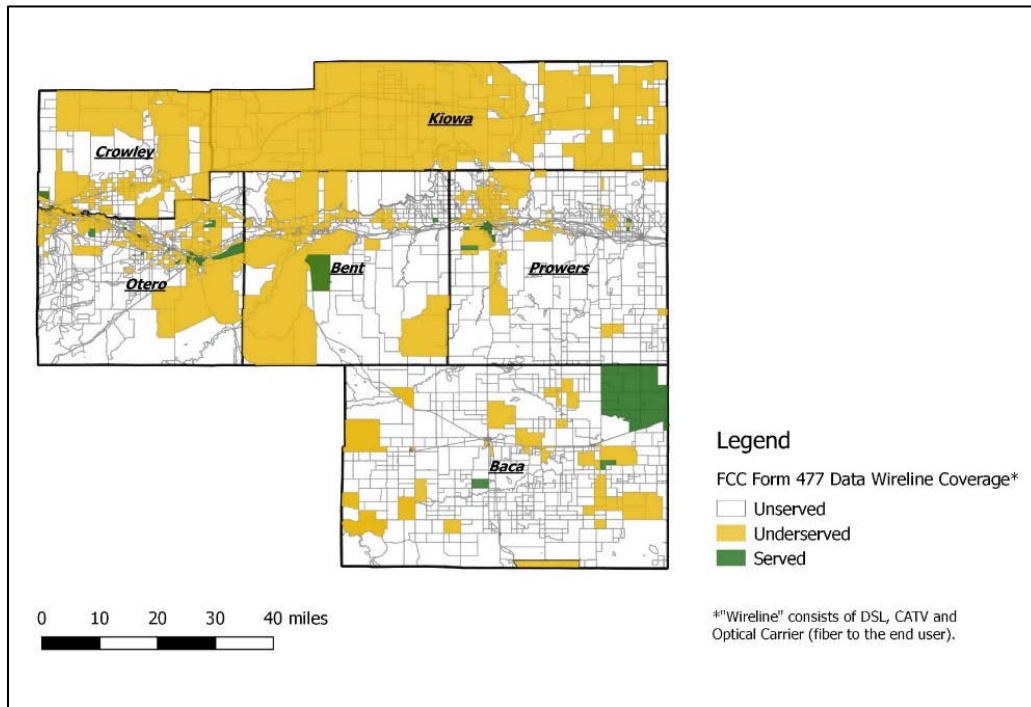**Figure 6-2: FCC Form 477 - Wireline Coverage (12/2015)**

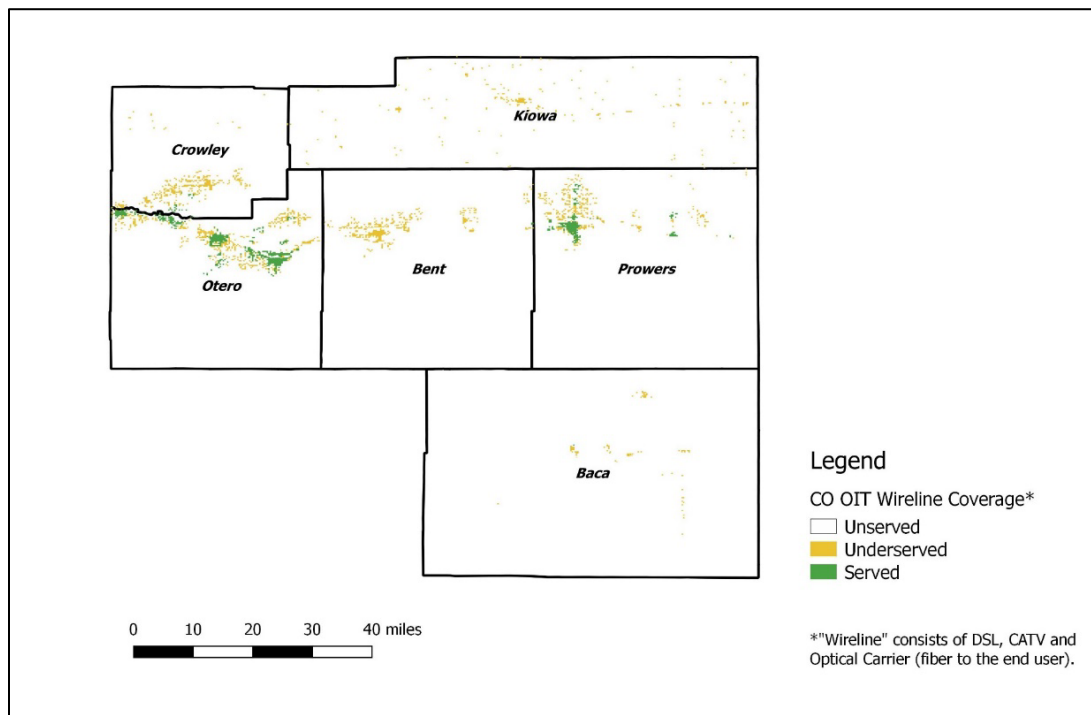**Figure 6-3: CO OIT CBDDP - Wireline Coverage (10/2016)**

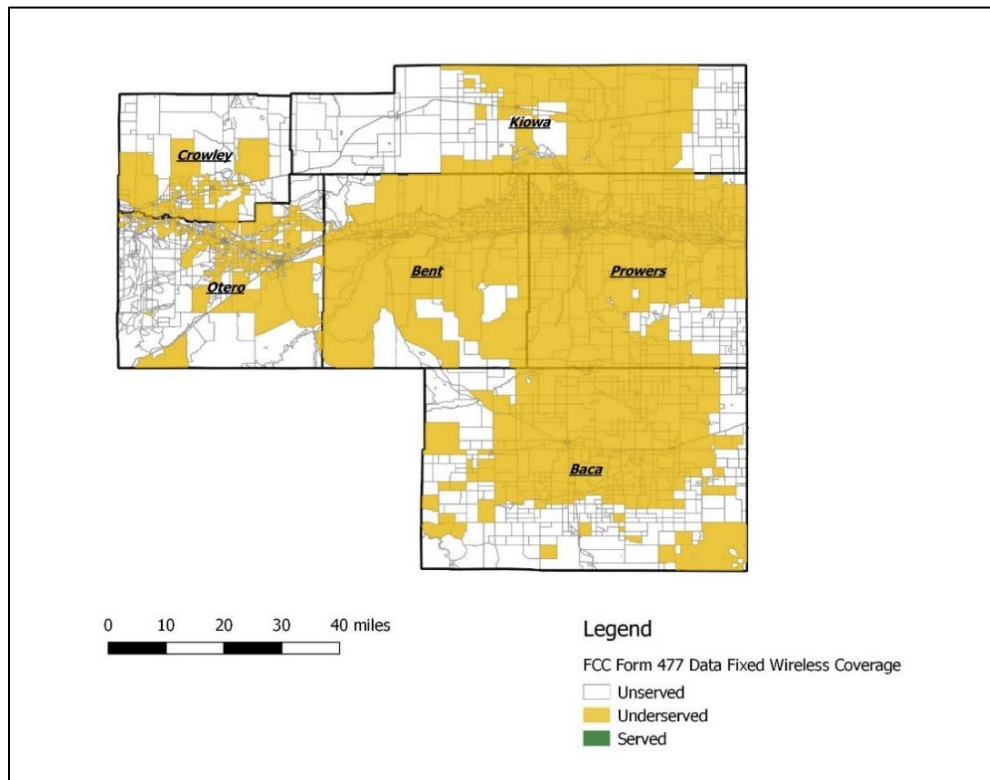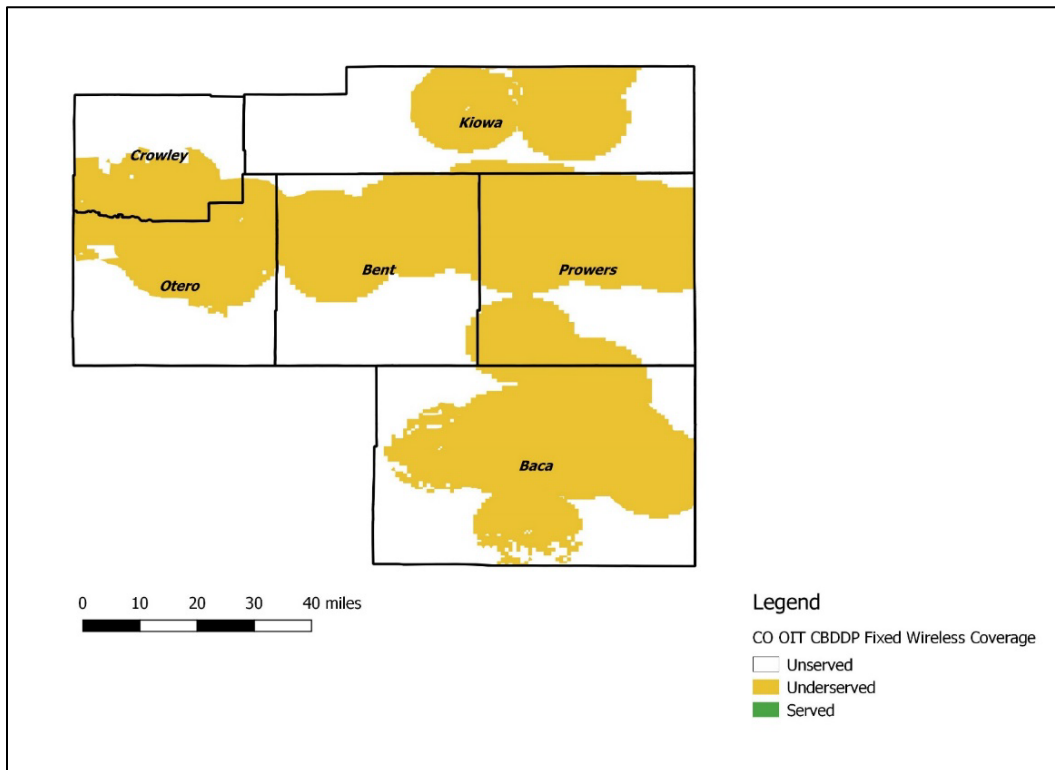**Figure 6-4: FCC Form 477- Fixed Wireless Coverage (12/2015)**

Figure 6-5: CO OIT CBDDP - Fixed Wireless (10/2016)

7 Baca County

7.1 Existing Broadband Offerings

Baca County has five known internet service providers, however only three of them report to both the FCC and COIT databases.[31] Pioneer, which only reports to the FCC, is a Kansas-based ILEC that serves the northeast portion on the county. According to a Viaero reseller in the area, the company covers most of Baca County with wireless coverage that is delivered from 9-10 towers in the county. The FCC Maximum Download and Maximum Upload speeds are the highest advertised speeds in the county as reported to the FCC in December 2015. While the COIT data is more recent, speed data by carrier is not available in downloadable format.

Table 7-1: Baca County Existing Broadband Offerings

Provider	Technology	FCC Max Download	FCC Max Upload	Database Participation	
				FCC	COIT
SECOM	Fiber	1 Gbps	1 Gbps	x	x
SECOM	Fixed Wireless	15 Mbps	7 Mbps	x	x
CenturyLink	DSL	11 Mbps	1 Mbps	x	x
Rebeltec	Fixed Wireless	15 Mbps	15 Mbps	x	x
Pioneer	DSL	80 Mbps	20 Mbps	x	
Viaero	Fixed Wireless				

7.2 Mapping Data

The following graphics depict the FCC and COIT reported coverage for Baca County. Viaero's coverage, which is significant, is excluded.[32] The discrepancies between the FCC and COIT maps are discussed in Section 4 Regional Mapping Overview.

Based on Tilson's outreach efforts, Tilson believes the FCC's gigabit service maps understate the penetration of this service in the region. In the last several years SECOM has been extending its fiber network to customers throughout the region that order it through a custom build process.

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[31] The FCC database lists the Rye Telephone Company as providing service in Baca, but Tilson confirmed that they provide service in Kim Colorado in neighboring Las Animas County, and not in Baca.
[32] It's likely that during the 2015 FCC reporting window that Viaero was reporting its service as a mobile provider, and therefore they do not show up as a fixed wireless provider in the FCC data set.

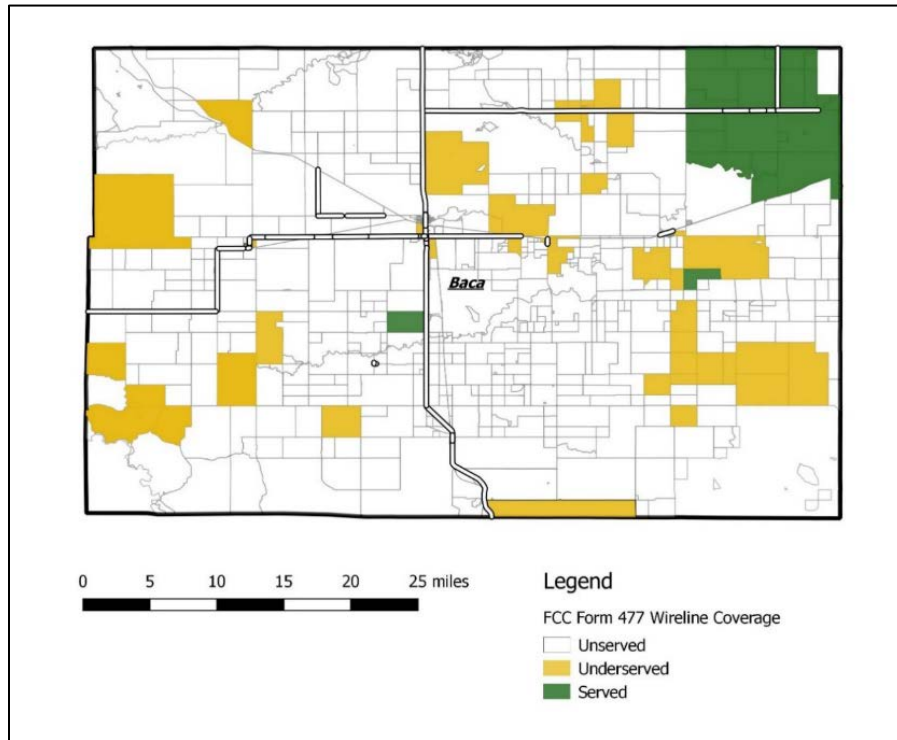**Figure 7-1: Baca County FCC Form 477- Wireline (12/2015)**

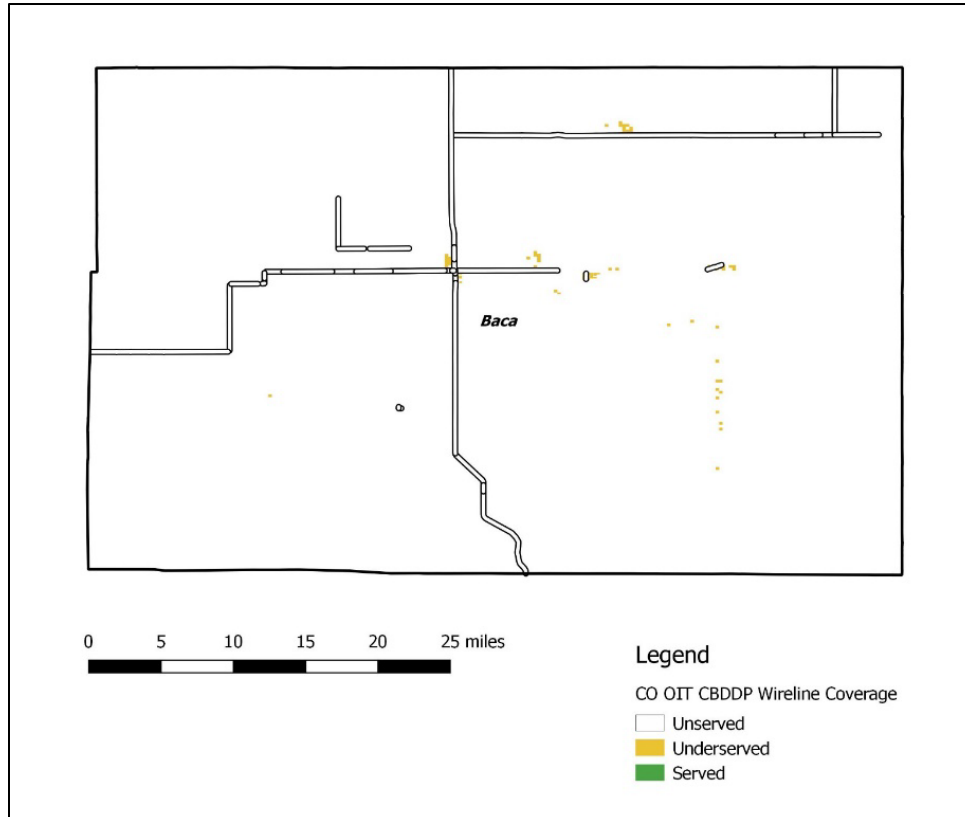**Figure 7-2:Baca County CO OIT CBDDP Data – Wireline (10/2016)**

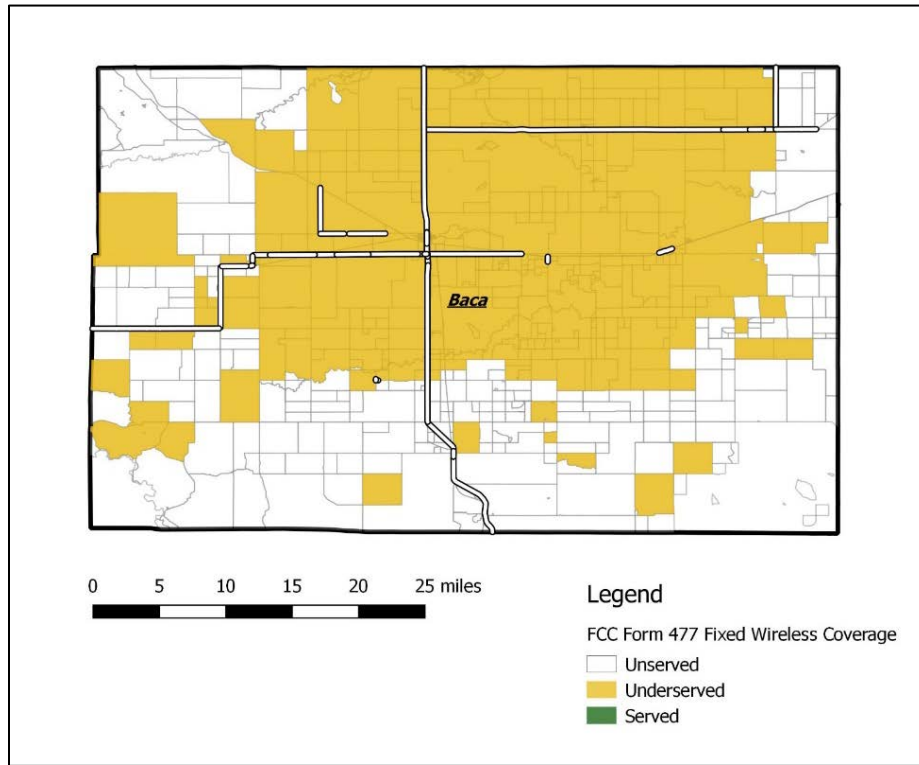**Figure 7-3: Baca County FCC Form 477 Data – Fixed Wireless (12/2015)**

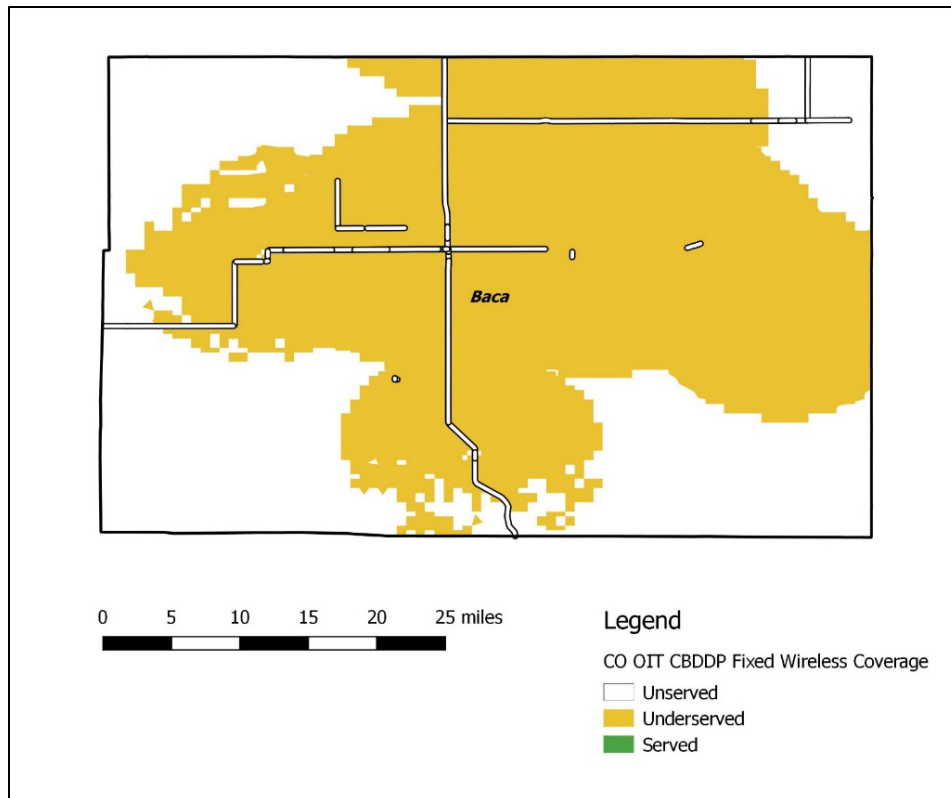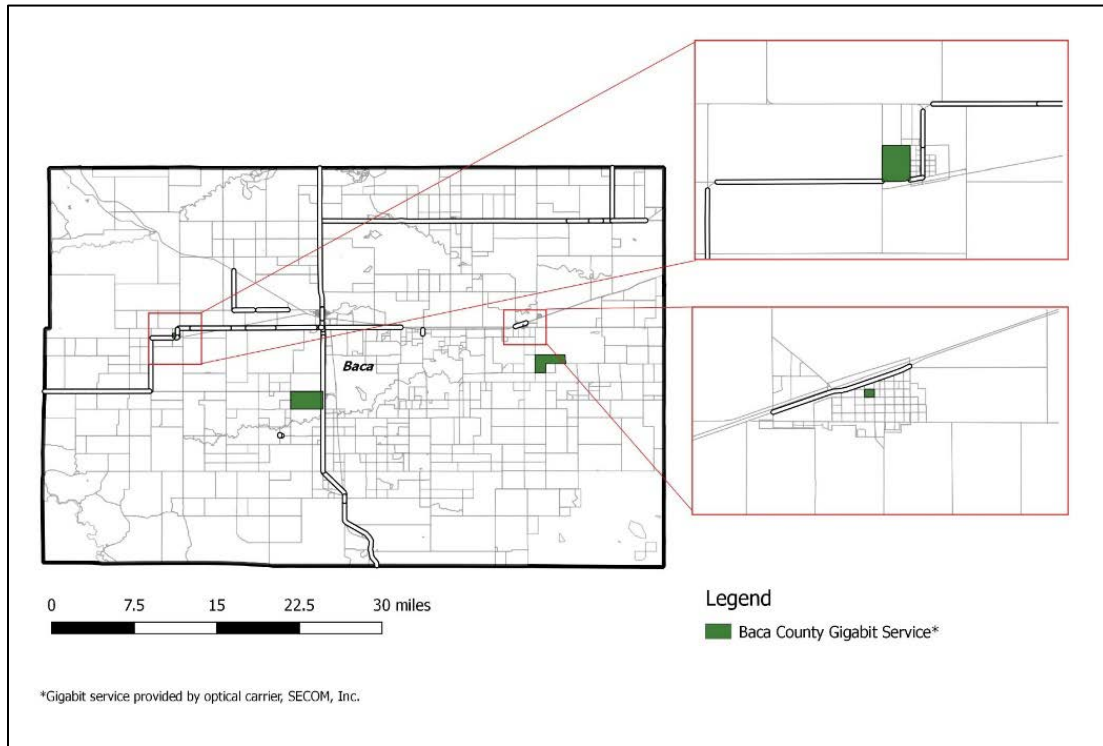**Figure 7-4: Baca County CO OIT CBDDP Data – Fixed Wireless (10/2016)**

7.3 Current Upgrade/Expansion Efforts

As part of its outreach process, Tilson asked providers about their current upgrade and expansion efforts. In addition to the specific CenturyLink and SECOM projects below, Viaero Wireless stated that they are making numerous upgrades by building out their ProConnect network, which has maximum download speeds of 25 Mbps. However, Viaero declined to provide a list of recent or planned upgrades.

Provider	Municipalities	Technology	Notes
CenturyLink	**Springfield**	**DSL**	In 2015, the FCC awarded $2.4 M for CenturyLink to upgrade its DSL network to 3,987 premises across five counties by 2020.[33] Upgrades must provide a minimum of 10/1 Mbps. By Year End 2017, roughly 40% of the premises must be upgraded. CenturyLink will share a list of areas upgraded in July 2017, when they report that information to FCC. Upgraded areas will be a subset of areas depicted on the FCC's "Accepted Areas Map"[34]
SECOM	**Springfield**	**Fiber**	Build out designed and in long range capital budget. Current residential FTTP speeds in other markets 200/200 Mbps.

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[33] $2.4M per year for six years. This was part of a larger annual award of $26.5 million (for six years) in Colorado.
[34] https://www.fcc.gov/reports-research/maps/caf-2-accepted-map/

7.4 Community Feedback

On May 23, 2017 Tilson held a community meeting at the Springfield Fairgrounds. The meeting was lightly attended (about 10 people) and included an IT professional, a rancher living outside of town, and various in-town community members.

After providing an overview of broadband technologies, economics and county mapping data, Tilson solicited feedback on the unmet needs and goals of the community. The key points of the discussion are highlighted below.

Wireless service adequate, despite sub-broadband speeds. Several community members were happy with their wireless service, despite having speeds less than 25/3 Mbps. One person stated that she could subscribe to a faster wireless speed, but did not because her current speed was adequate to stream Netflix. Another community member stated that her visiting daughter told her she needed faster speed, so she came to find out why that was.

SECOM's custom fiber drop fees vary widely. Several attendees said that SECOM very good fiber-based service, and that the monthly fees were very reasonable, even for businesses. However, the fiber drop price varies widely, and are typically a function of the customer's distance from SECOM's nearest service terminal. Install prices can range from several hundred dollars to $15,000. The diverging experiences of customers can be off-putting, especially since there is no perceived high-speed alternative.[35]

Example: 6/7/2017 discussion with Matt Schwaigert of RMH Holdings. RMH has a facility located 2.3 miles out of town that requires internet access for security, remote control and administrative functions. SECOM quoted $14,000 to extend a fiber connection, which was much higher than prices paid by other businesses. RMH was looking for other potential customers along the planned fiber route to see if there was an opportunity to share costs.

Pioneer service in northeast corner likely overstated by FCC data. Attendees questioned the data related to Pioneer's service speeds higher than 25/3 Mbps in the northeast corner of the state, since it is very sparsely populated.

Local wireless options better than DSL. Informal conversations in the Two Buttes post office on 5/24/17 revealed subscribers were universally happy with their wireless service from Viaero and SECOM. The post office subscribes to CenturyLink DSL through the federal government, and it is slow and unreliable compared to a Post Office employee's Viaero hotspot and SECOM home service. Similarly, a patron who cannot get a wireless signal at her in-town home in Walsh subscribes to CenturyLink DSL there, and is very unhappy. Her husband uses SECOM at their ranch and is very happy with the service.

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[35] CenturyLink would provide a similar service on a case-by-case basis, but prices for fiber-based internet access via custom builds are not advertised.

8 Bent County

8.1 Existing Broadband Offerings

Bent County has four known internet service providers. Three of these providers report to the FCC and COIT databases. Viaero is known to have coverage in the county. The FCC Maximum Download and Upload Speeds are the highest advertised speeds in the county as reported to the FCC in December 2015. While the COIT data is more recent, speed data by carrier is not available in downloadable format.

Table 8-1: Baca County Existing Broadband Offerings

Provider	Technology	FCC Max Download	FCC Max Upload	Database Participation	
				FCC	COIT
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SECOM	Fixed Wireless	15 Mbps	7 Mbps	x	x
CenturyLink	DSL	11 Mbps	1 Mbps	x	x
Rebeltec	Fixed Wireless	15 Mbps	15 Mbps	x	x
Viaero	Fixed Wireless				

8.2 Mapping Data

The following graphics depict the FCC and COIT reported coverage for Bent County. Viaero's coverage, which is significant, is excluded. The discrepancies between the FCC and COIT maps are discussed in Section 4 Regional Mapping Overview. Based on Tilson's outreach efforts, Tilson believes the FCC's gigabit service maps understate the penetration of this service in the region. In the last several years SECOM has been extending its fiber network to customers throughout the region that order it through a custom build process.

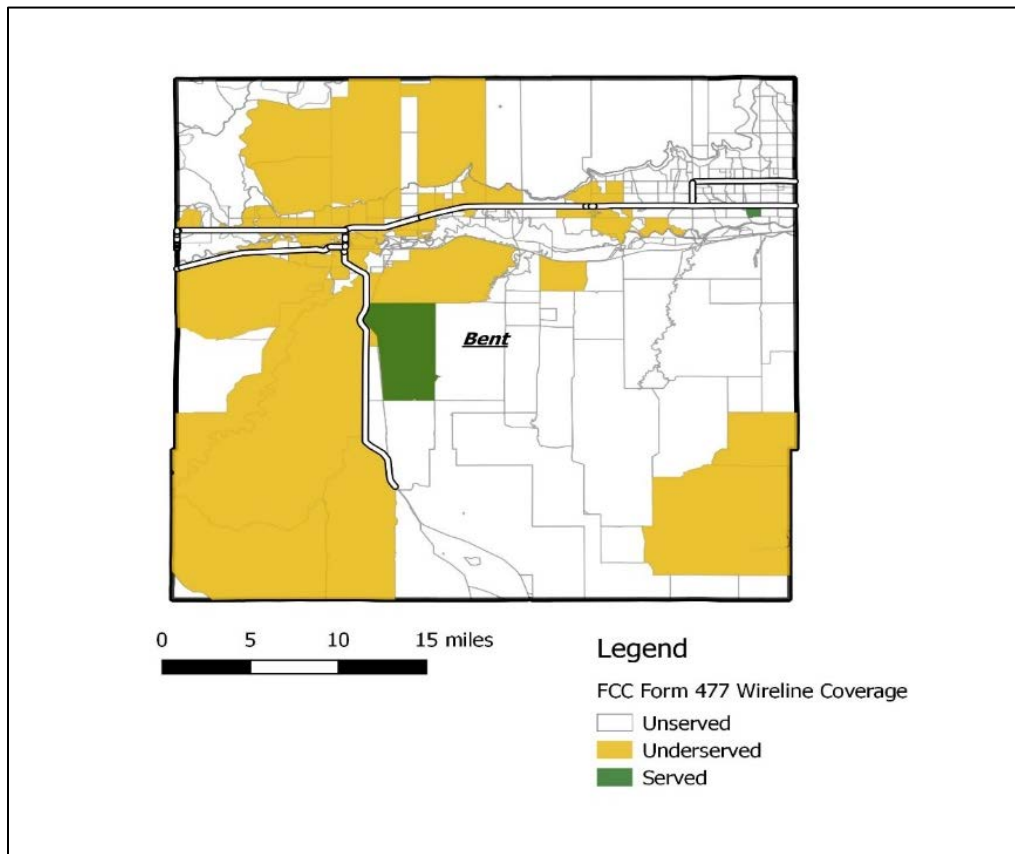**Figure 8-1: Bent County FCC Form 477 – Wireline (12/2015)**

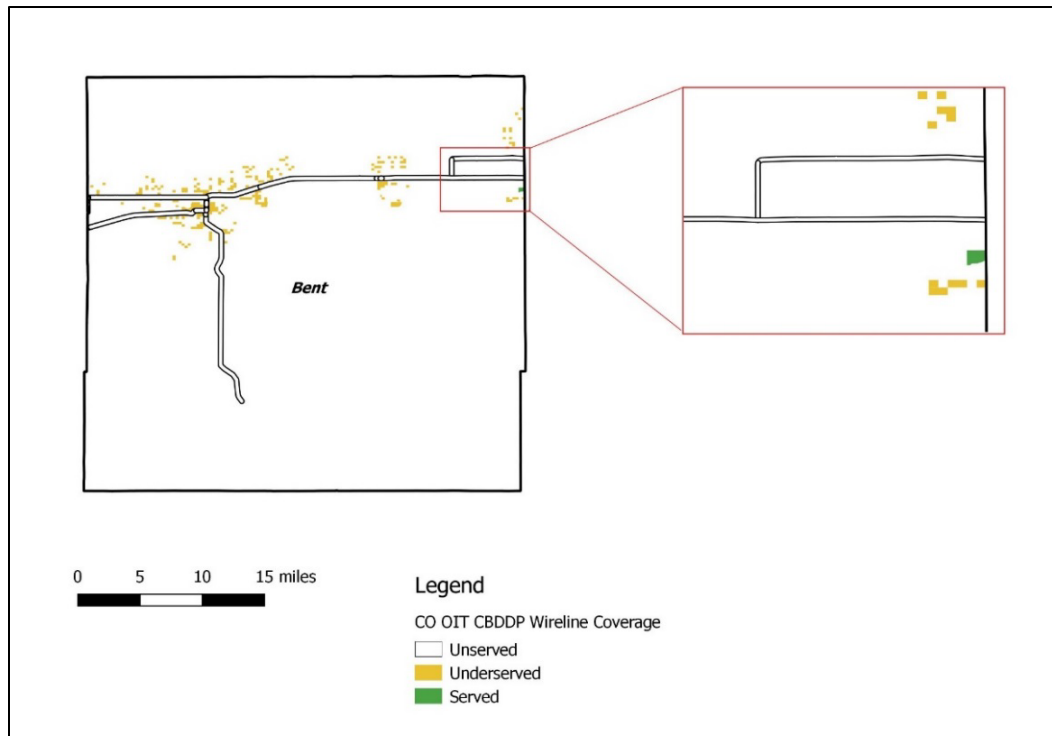**Figure 8-2: Bent County CO OIT CBDDP – Wireline (10/2016)**

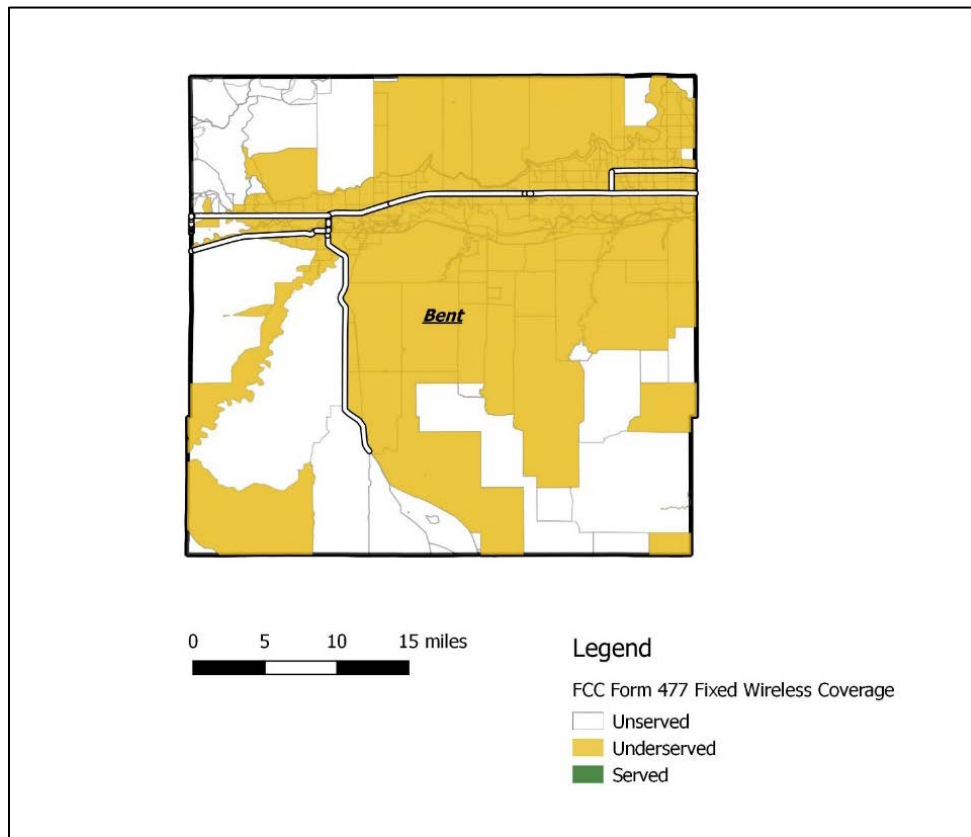**Figure 8-3: Bent County FCC Form 477 – Fixed Wireless (12/2015)**

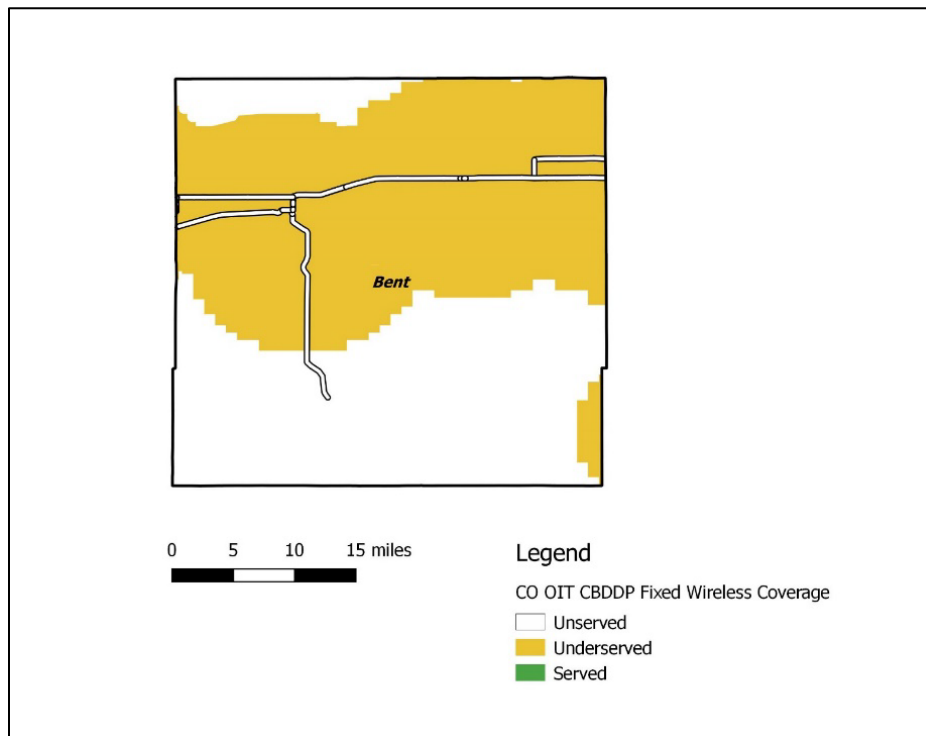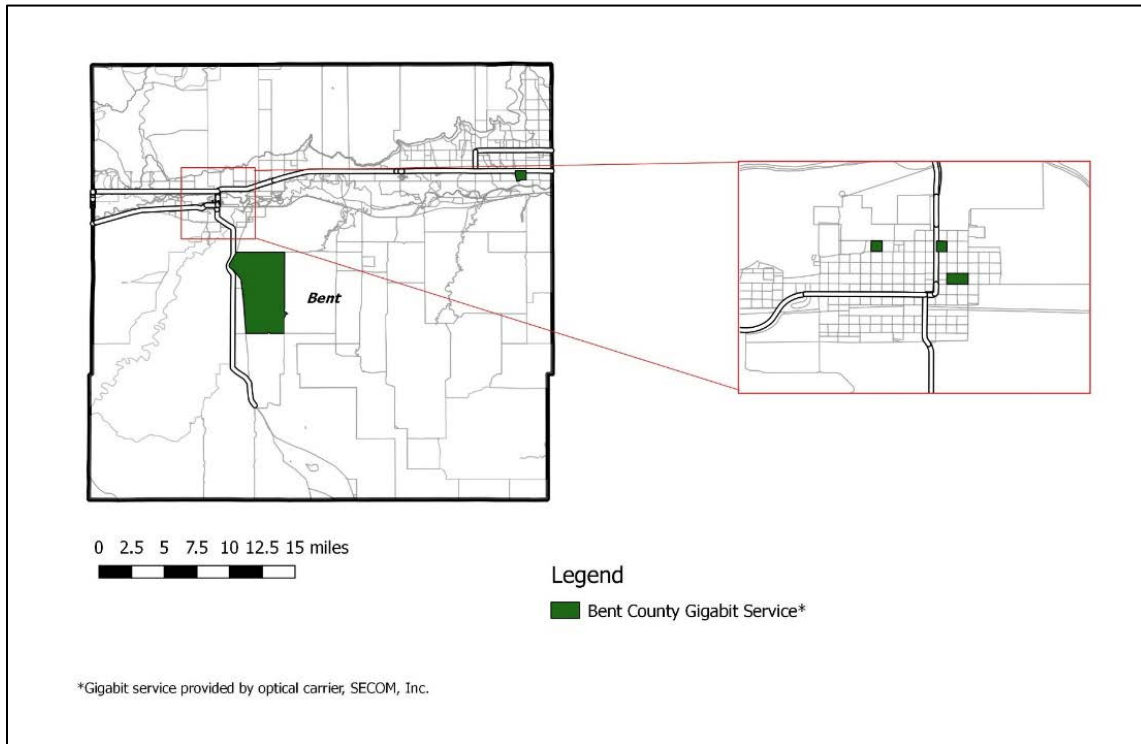**Figure 8-4: Bent County CO OIT CBDDP – Fixed Wireless (10/2016)**

Figure 8-5: Bent County FCC Form 477 Gigabit Service by Census Block

8.3   Current Upgrade/Expansion Efforts

The providers with whom Tilson spoke as part of its outreach efforts did not list any upgrade/expansion efforts in Bent County.

8.4   Community Feedback

On May 3, 2017 Tilson held a community meeting at the Las Animas Health Center. The meeting was attended by a county commissioner and a representative from the Bent County Development Foundation. No other members of the community participated.

There was some discussion about the current service offerings in the county. It was mentioned that SECOM has long had fiber to the county courthouse in Las Animas with 100/100 Mbps service, and that CenturyLink recently added a 10/10 Mbps fiber connection to the state court offices in the same building through a contract with the state. In addition, CenturyLink was thought to have extended a fiber connection to an IT professional's Las Animas home office.

9 Crowley County

9.1 Existing Broadband Offerings

Crowley County has four known internet service providers. Three of these providers report to the FCC and COIT databases. Viaero is known to have coverage in the county. The FCC Maximum Download and Upload Speeds are the highest advertised speeds in the county as reported to the FCC in December 2015. While the COIT data is more recent, speed data by carrier is not available in downloadable format.

Table 9-1: Crowley County Existing Broadband Offerings

Provider	Technology	FCC Max Download	FCC Max Upload	Database Participation	
				FCC	COIT
SECOM	Fiber	1 Gbps	1 Gbps	x	x
SECOM	Fixed Wireless	15 Mbps	7 Mbps	x	x
CenturyLink	DSL	11 Mbps	1 Mbps	x	x
Eastern Slope	DSL	10 Mbps	1 Mbps	x	x
Viaero	Fixed Wireless				

9.2 Mapping Data

The following graphics depict the FCC and COIT reported coverage for Crowley County. Viaero's coverage, which is significant, is excluded. The discrepancies between the FCC and COIT maps are discussed in Section 4 Regional Mapping Overview.

Based on Tilson's outreach efforts, Tilson believes the FCC's gigabit service maps understate the penetration of this service in the region. In the last several years SECOM has been extending its fiber network to customers throughout the region that order it through a custom build process.

Figure 9-1: Crowley County FCC Form 477 – Wireline (12/2015)
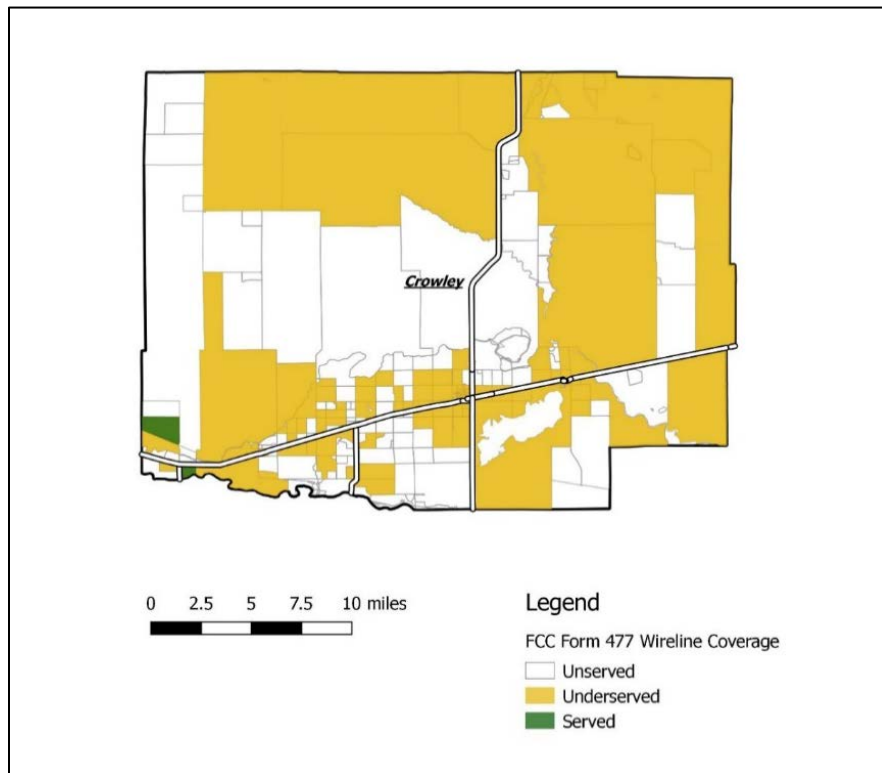
Figure 9-2: Crowley County CO OIT CBDDP – Wireline (10/2016)
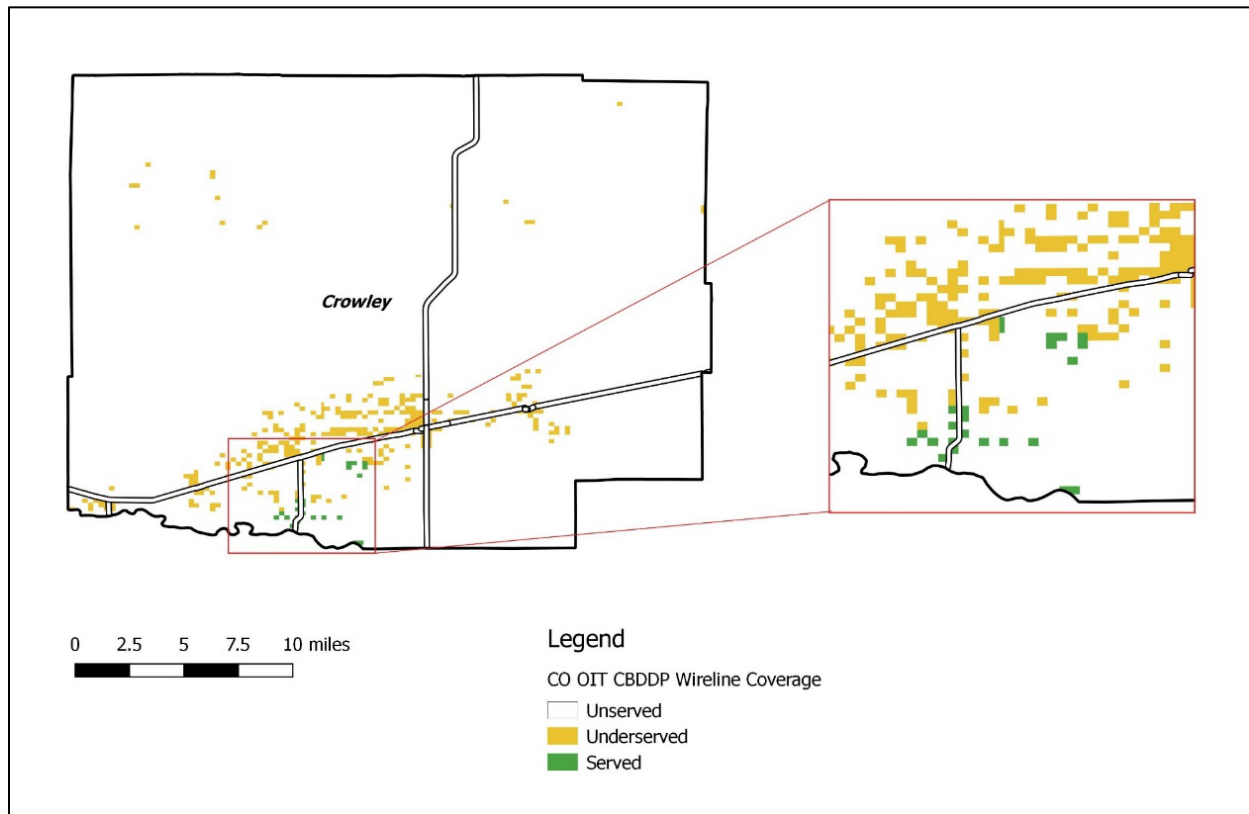
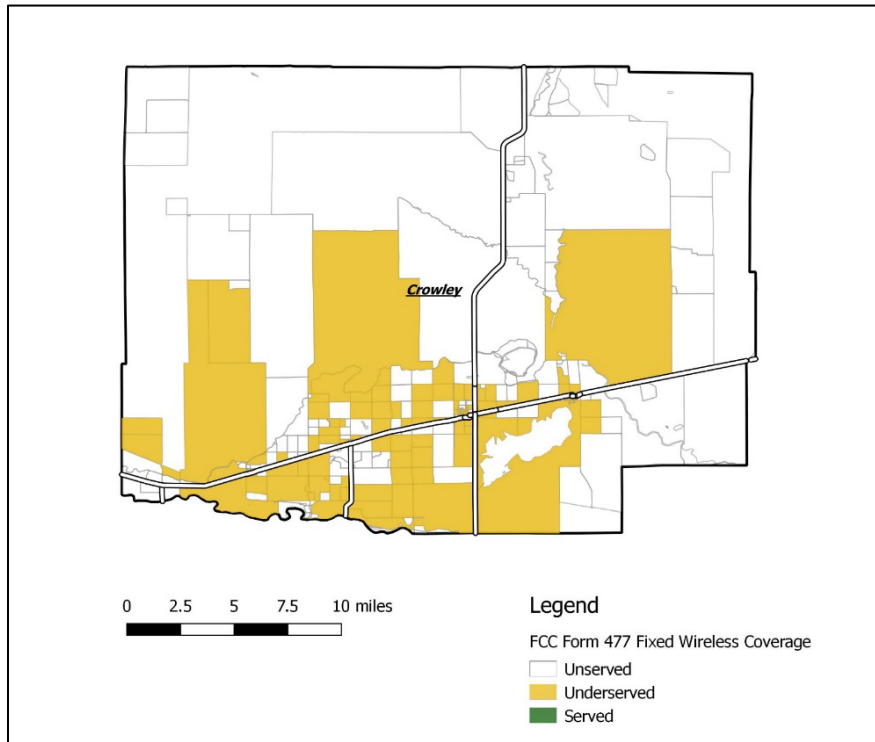**Figure 9-3: Crowley County FCC Form 477 – Fixed Wireless (12/2015)**

Figure 9-4: Crowley County CO OIT CBDDP – Fixed Wireless (10/2016)
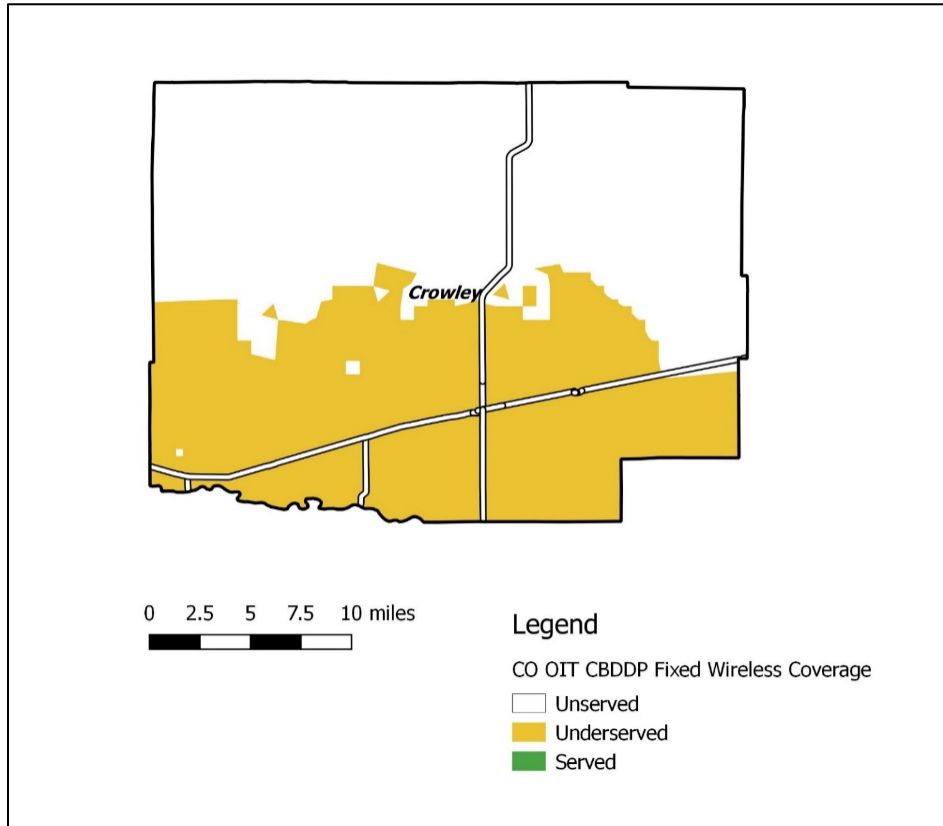
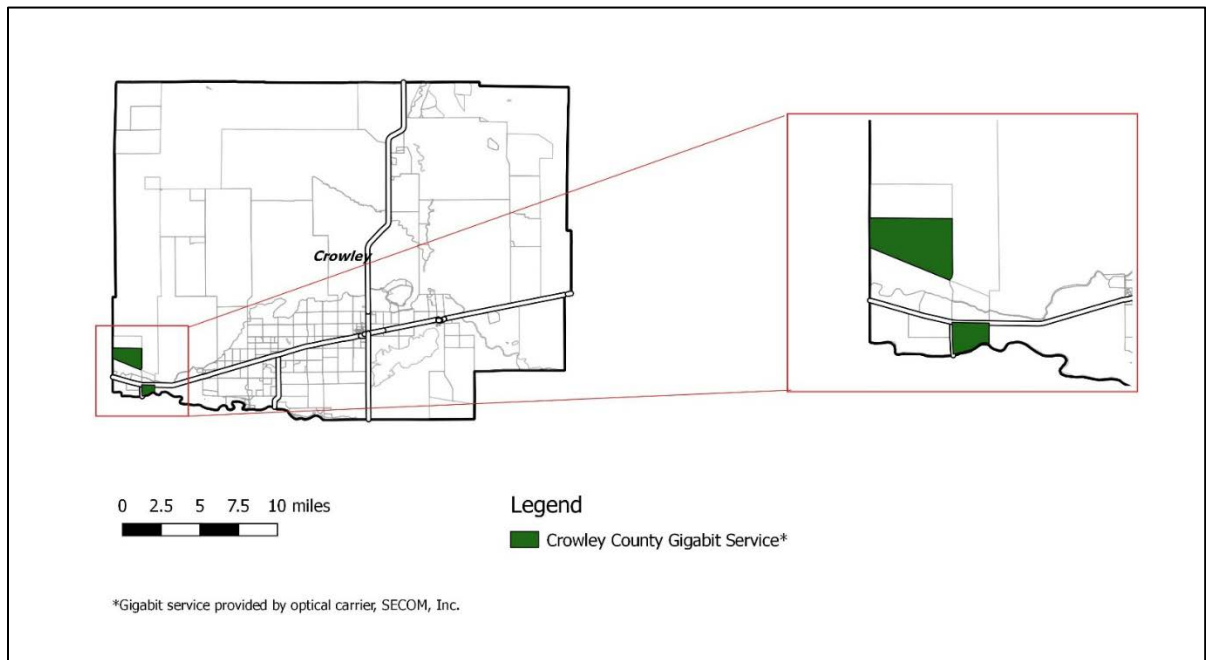**Figure 9-5: Crowley County FCC Form 477 Data Gigabit Service by Census Block**

Legend
- Crowley County Gigabit Service*

*Gigabit service provided by optical carrier, SECOM, Inc.

0   2.5   5   7.5   10 miles

Crowley

9.3 Current Upgrade/Expansion Efforts

The providers with whom Tilson spoke as part of its outreach efforts did not list any upgrade/expansion efforts in Crowley County.

9.4 Community Feedback

On May 4, 2017 Tilson held a community meeting at the Ordway Business Center. The meeting was attended by two county commissioners from Crowley and Otero Counties, but no other members of the community.

There was not significant discussion on the region's broadband-related needs and priorities. The Crowley County Commissioner in attendance felt he had adequate internet access, despite only having access to speeds below the broadband threshold.

The Ordway Business Center's role in the community was discussed. The business center was intended as a connected office space for local entrepreneurs to use. Despite the availability of good internet access and wi-fi (a speed test came in at 10/10 Mbps), very few small businesses have taken advantage of the Ordway Business Center. The underlying reason is not known, but may be due to inadequate promotion, difficulty gaining entry, or the availability of faster speeds at the local library.

Discussion included background on the Arkansas Valley Conduit Project to extend drinking water throughout the area; and contact information for the Southeast Colorado Water Conservation District.

10 Kiowa County

10.1 Existing Broadband Offerings

Kiowa County has five known internet service providers. Four of these providers report to the FCC and COIT databases. Viaero is known to have coverage in the county; Colorado AirNet is thought to provide service to remote ranches. Two of the providers –Eastern Slope and FairPoint are ILECs with unique (non-competing territories). Viaero, RebelTec and SECOM compete with the ILECs and possibly with each other.

The FCC Maximum Download and Upload Speeds are the highest advertised speeds in the county as reported to the FCC in December 2015. While the COIT data is more recent, speed data by carrier is not available in downloadable format and cannot be included in the table below

Table 10-1: Kiowa County Existing Broadband Offerings

Provider	Technology	FCC Max Download	FCC Max Upload	Database Participation	
				FCC	COIT
SECOM	Fixed Wireless	15 Mbps	7 Mbps	x	x
Rebeltec	Fixed Wireless	15 Mbps	15 Mbps	x	x
Eastern Slope	DSL	10 Mbps	1 Mbps	x	x
FairPoint	DSL	10 Mbps	1 Mbps	x	x
Viaero	Fixed Wireless				
Colorado AirNet	Fixed Wireless				

10.2 Mapping Data

The following graphics depict the FCC and COIT reported coverage for Kiowa County. Viaero's coverage, which is significant, is excluded. The discrepancies between the FCC and COIT maps are discussed in Section 4 Regional Mapping Overview. Based on Tilson's outreach efforts, Tilson believes the FCC's gigabit service maps understate the penetration of this service in the region. In the last several years SECOM and Eastern Slope have been extending their fiber network to customers through a custom build process.

Figure 10-1: Kiowa County FCC Form 477 – Wireline (12/2015)
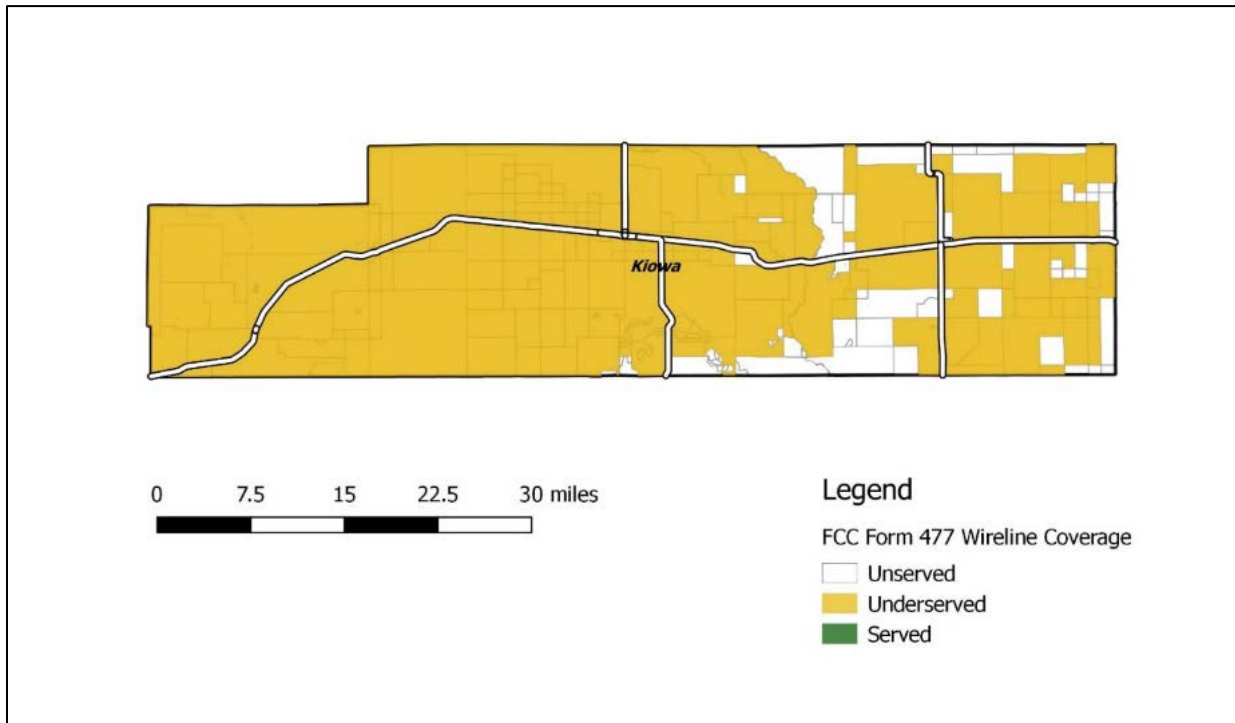
Figure 10-2: Kiowa County CO OIT CBDDP – Wireline (10/2016)
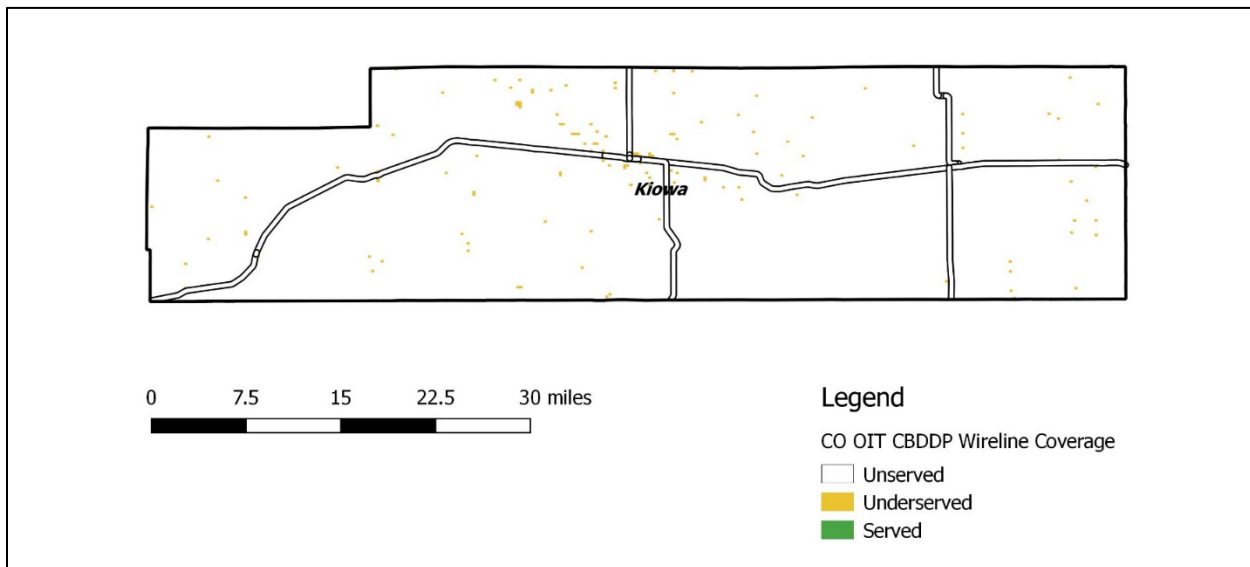
Figure 10-3: Kiowa County FCC Form 477 – Fixed Wireless (12/2015)
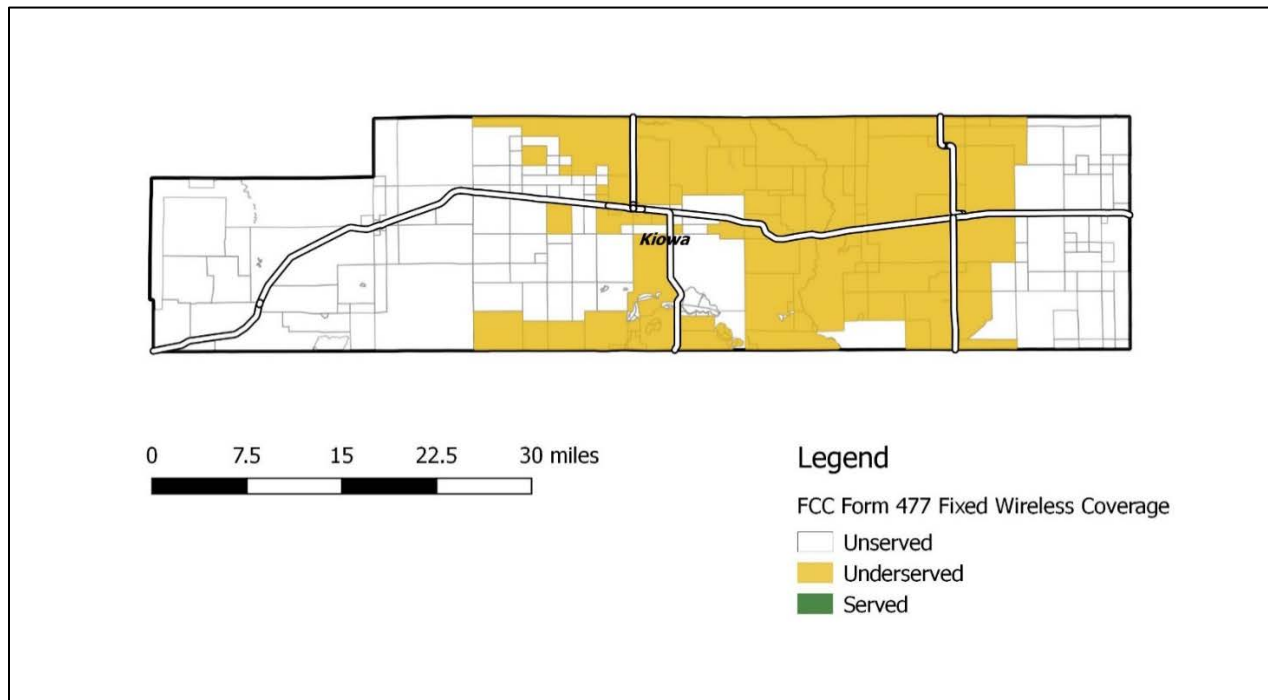
Figure 10-4: Kiowa County CO OIT CBDDP – Fixed Wireless (10/2016)

10.3 Current Upgrade/Expansion Efforts

As part of its outreach process, Tilson asked providers about their current upgrade and expansion efforts. In addition to the specific CenturyLink and FairPoint projects below, Viaero Wireless stated that they are making numerous upgrades by building out their ProConnect network, which has maximum download

speeds of 25 Mbps. However, Viaero declined to provide a list of recent or planed upgrades.

Provider	Municipalities	Technology	Notes
Viaero	**Sheridan Lake**	**Fixed Wireless**	Two new towers near Sheridan Lake, funded in part by a $395,492 Colorado Broadband Fund grant, will offer speeds of 25/3 within 5-7 miles' towers. Coverage area will extend into parts of Prowers and Cheyenne Counties, too. Extending fiber west into Eads for backhaul.
FairPoint	• Towner • Sheridan Lake • Brandon • Chivington	**DSL, Ethernet over Copper**	• Towner and Sheridan Lake recently upgraded with speeds up to 50/10 Mbps. • Brandon and Chivington to be upgraded summer 2017.

10.4 Community Feedback

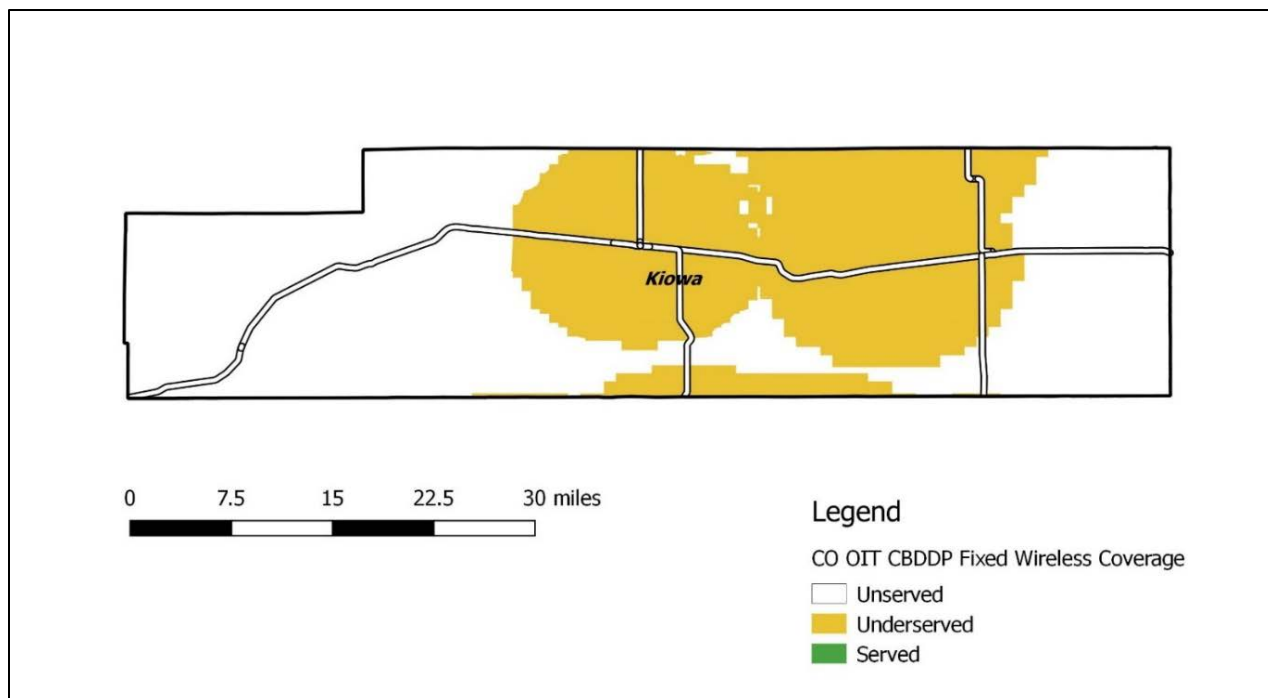On May 25, 2017 Tilson held a community meeting at the Cobblestone Inn in Eads. The meeting was attended by 10 people, including two Kiowa county commissioners, non-native Eads residents that moved from Dallas and Denver, one person closely involved with the schools, and Eastern Slope Telecom staff.

High levels of satisfaction with current service. Attendees were generally happy with their service, despite only a minority having access to broadband speeds. Most people had DSL via Eastern Slope or wireless via SECOM. Eastern Slope customers look forward to their annual coop dividend, and appreciate the triple play internet/phone/IPTV offering. One attendee who moved from Denver had a broadband fiber connection through SECOM. All were happy with service. The SECOM fiber customer uploads video for his job, and didn't have to pay very much to connect because, his house was nearby existing fiber.

No known gaps in internet access. No one in attendance knew of anyone in or outside of town who could not get internet access of some speed.

Complacency Warning. On May 28th, Tilson received a call from a resident that was displeased with the community's complacency about broadband. She said that the community's future depended on its ability to attract residents from urban corridors. Because farming and ranching requires less labor than it used to, without in-migration of people who work remotely, the population of Eads will shrink. Broadband is needed to attract location-neutral professionals, and to unleash the untapped talent of existing residents. Long-term residents of the town do not know what they are missing.

11 Otero County

11.1 Existing Broadband Offerings

Otero County has four known internet service providers. Three of these providers report to the FCC and COIT databases. Viaero is known to have coverage in the county. Several of the county's towns have multiple providers competing for service. For example, all four providers are believed to compete for service in the towns of Fowler, Manzanola, Rocky Ford, Swink and La Junta.

The FCC Maximum Download and Upload Speeds are the highest advertised speeds in the county as reported to the FCC in December 2015. While the COIT data is more recent, speed data by carrier is not available in downloadable format.

Table 11-1: Otero County Existing Broadband Offerings

Provider	Technology	FCC Max Download	FCC Max Upload	Database Participation	
				FCC	COIT
SECOM	Fiber	1 Gbps	1 Gbps	x	x
SECOM	Fixed Wireless	15 Mbps	7 Mbps	x	x
Spectrum	CATV	100 Mbps	5 Mbps	x	x
CenturyLink	DSL	11 Mbps	1 Mbps	x	x
Viaero	Fixed Wireless				

11.2 Mapping Data

The following graphics depict the FCC and COIT reported coverage for Otero County. Viaero's coverage, which is significant, is excluded. The discrepancies between the FCC and COIT maps are discussed in Section 4 Regional Mapping Overview.

Based on Tilson's outreach efforts, Tilson believes the FCC's gigabit service maps understate the penetration of this service in the region. In the last several years SECOM has been extending its fiber network to customers in its territory through a custom build process.

Figure 11-1: Otero County FCC Form 477 – Wireline (12/2015)

Legend

FCC Form 477 Wireline Coverage
- Unserved
- Underserved
- Served
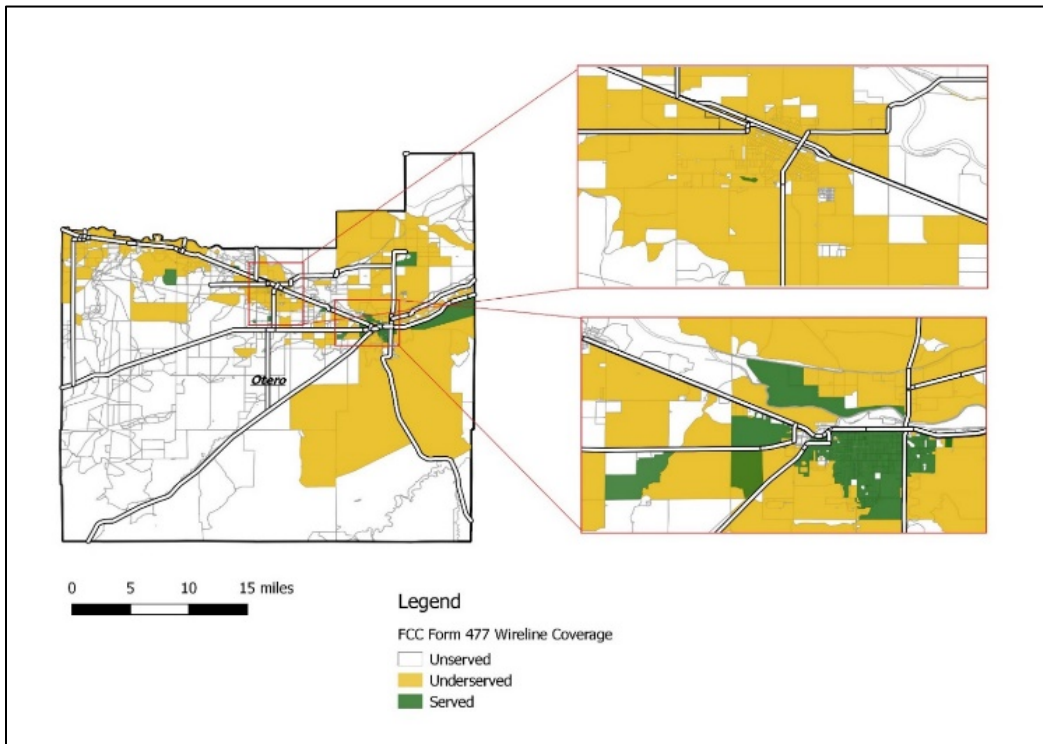
Figure 11-2: Otero County CO OIT CBDDP – Wireline (10/2016)

Legend

CO OIT CBDDP Wireline Coverage
- Unserved
- Underserved
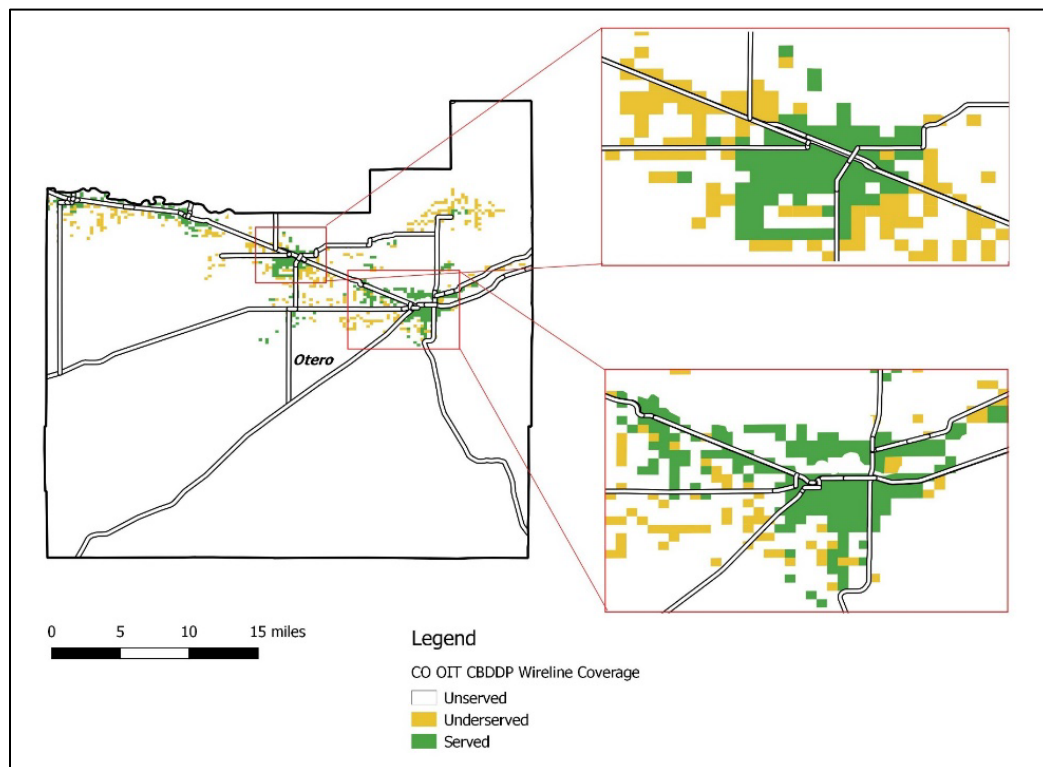- Served

Figure 11-3: Otero County FCC Form 477 – Fixed Wireless (12/2015)
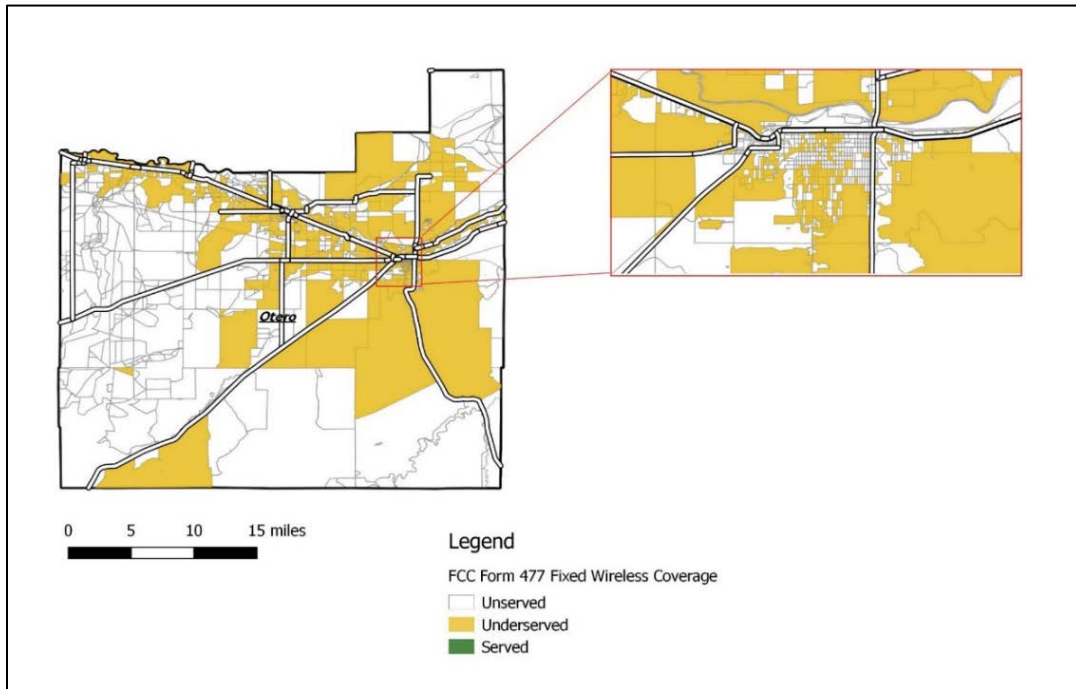
Figure 11-4: Otero County CO OIT CBDDP – Fixed Wireless (10/2016)
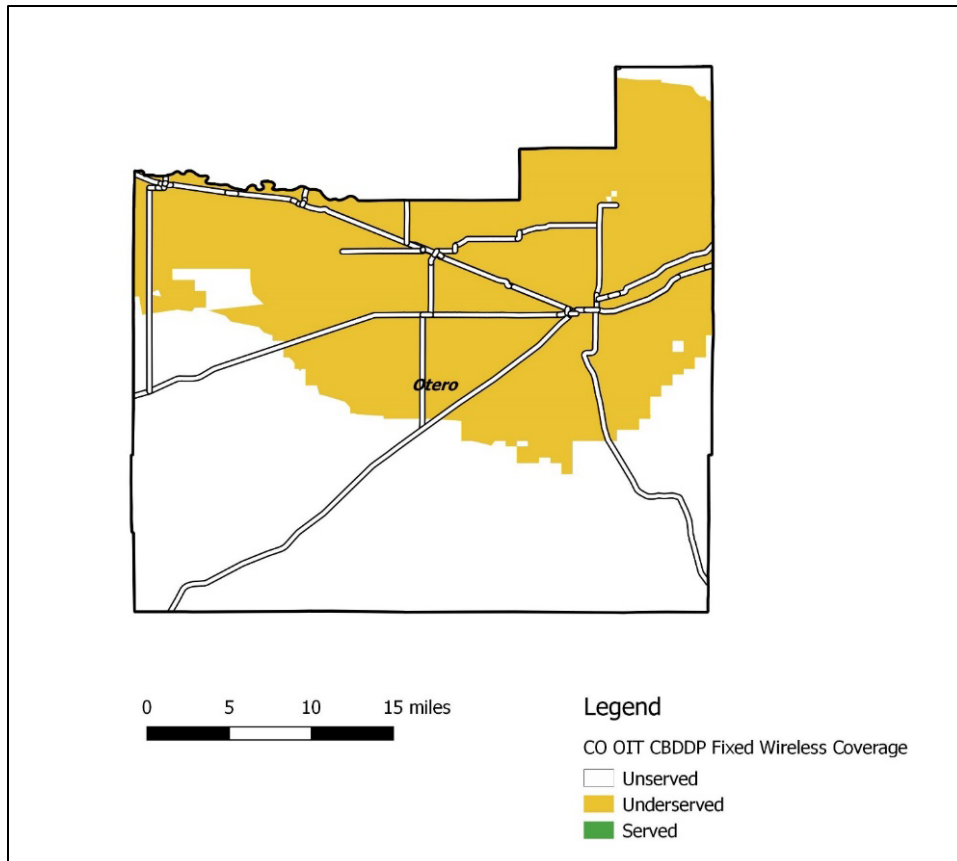
Figure 11-5: Otero County FCC Form 477 Data Gigabit Service by Census Block

11.3 Current Upgrade/Expansion Efforts

As part of its outreach process, Tilson asked providers about their current upgrade and expansion efforts. In addition to the specific CenturyLink and SECOM projects below, Viaero Wireless stated that they are making numerous upgrades by building out their ProConnect network, which has maximum download speeds of 25 Mbps. However, Viaero declined to provide a list of recent or planed upgrades.

Provider	Municipalities	Technology	Notes
CenturyLink	Rocky Ford	DSL	In 2015, the FCC awarded $2.4 M for CenturyLink to upgrade its DSL network to 3987 premises across five counties by 2020.[36] Upgrades must provide a minimum of 10/1 Mbps. By Year End 2017, roughly 40% of the premises must be upgraded. CenturyLink will share a list of areas in July 2017.
SECOM	La Junta	FTTP	SECOM recently installed a Fiberhood in a 12-block region of La Junta. It is bounded between 4th and 10th Streets to the south and north and Colorado and Raton Avenues to the west and east. Residents in the Fiberhood have access to the full suite of residential fiber-based services, including 200/200 Mbps broadband.

11.4 Community Feedback

On May 2, 2017 Tilson held two community meetings at Otero Junior College. There were about 10 people in attendance at each meeting. Attendees included a mix of service providers, government

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[36] This was part of a larger award of $26.5 million in Colorado.

representatives, and community members.

After providing an overview of broadband technologies, economics and county mapping data, Tilson solicited feedback on the unmet needs and goals of the community. Key points of the discussion are highlighted below.

Inadequate uptake among K-12 students. **Affordability part of the problem.** A community member that works for the Rocky Ford Schools District said that while all students in the school have a dedicated Chromebook via the 1:1 Chromebook Initiative, the school does not send the Chromebooks home with the students. This is because too many of the students do not have internet access at home. This lack of access is usually due to affordability, but also to coverage. More community wi-fi access would help, but not solve, the problem.

In-town Broadband speeds inadequate. La Junta is experiencing in-migration by location neutral professionals. For some of those people, 25/3 Mbps is not fast enough. In town locations should ideally gave access that is much faster and symmetrical (e.g. 100/100 Mbps). These speeds are commonly used by creative people and other location-neutral professionals. In-town shared office facilities may be a way to fulfill this need when a broader build-out is cost prohibitive.

Satellite service is insufficient, yet the only option for some. One attendee, whose home is in the southeast corner of the county, could only get satellite internet access. The satellite is slow, unreliable and expensive. Without a broadband solution, he community member's young children will not have adequate internet access for their educational needs, and the family may be forced to move.

Future broadband offerings should be reliable and long-lived. When asked what a future broadband offering looked like, attendees said they wanted reliable service that did not go down and delivered advertised speeds. Several in-town customers were disappointed with the performance of national providers' service, and that realized speeds slowed significantly during peak usage times (e.g. evenings).

A related point was that any company receiving a subsidy to improve area broadband service should have a sustainable business plan to serve the area in the long run. Several people remember the Eagle Net initiative whereby several millions of dollars of federal stimulus money funded a network intended to reach rural areas, but instead merely competed with existing providers to serve the "low hanging fruit" of easy-to-reach, large customers.

There was concern that both CenturyLink and Spectrum had recently closed offices that were open to consumers. Today there isn't an office where customers can walk in and speak to a representative of the company.

Troubleshooting skills largest digital literacy gap. Several attendees expressed frustration with frequent service outages, and the time it takes to work with customer service, particularly the customer service of national providers. One community member said that many fellow users don't know to automatically reboot their modem after a service outage, or how to run a speed test that measures delivered internet speeds. These types of skills could save consumers time and in the case of speed tests, highlight the need for network upgrades. Creating an IT team of young (potentially student) volunteers to help people in their homes was mentioned.

12 Prowers County

12.1 Existing Broadband Offerings

Prowers County has seven known internet service providers. Five of these providers report to both the FCC and COIT databases. Tilson learned of the other two, Viaero and Southeast Wireless, through various community outreach efforts. The FCC Maximum Download and Upload Speeds are the highest advertised speeds in the county as reported to the FCC in December 2015. While the COIT data is more recent, speed data by carrier is not available in downloadable format and is not reflected in the table below.

Table 12-1: Prowers County Existing Broadband Offerings

Provider	Technology	FCC Max Download	FCC Max Upload	Database Participation FCC	COIT
SECOM	Fiber	1 Gbps	1 Gbps	x	x
SECOM	Fixed Wireless	15 Mbps	7 Mbps	x	x
Spectrum	CATV	100 Mbps	5 Mbps	x	x
CenturyLink	DSL	30 Mbps	2 Mbps	x	x
Rebeltec	Fixed Wireless	15 Mbps	15 Mbps	x	x
FairPoint	DSL	15 Mbps	1 Mbps	x	x
Viaero	Fixed Wireless				
Southeast Network	Fixed Wireless				

12.2 Mapping Data

The following graphics depict the FCC and COIT reported coverage for Prowers County. Southeast Network and Viaero's coverage is excluded. The discrepancies between the FCC and COIT maps are discussed in Section 4 Regional Mapping Overview.

Based on Tilson's outreach efforts, Tilson believes the FCC's gigabit service maps understate the penetration of this service in the region. In the last several years SECOM has been extending its fiber network to customers in its territory through a custom build process.

Figure 12-1: Prowers County FCC Form 477 – Wireline (12/2015)
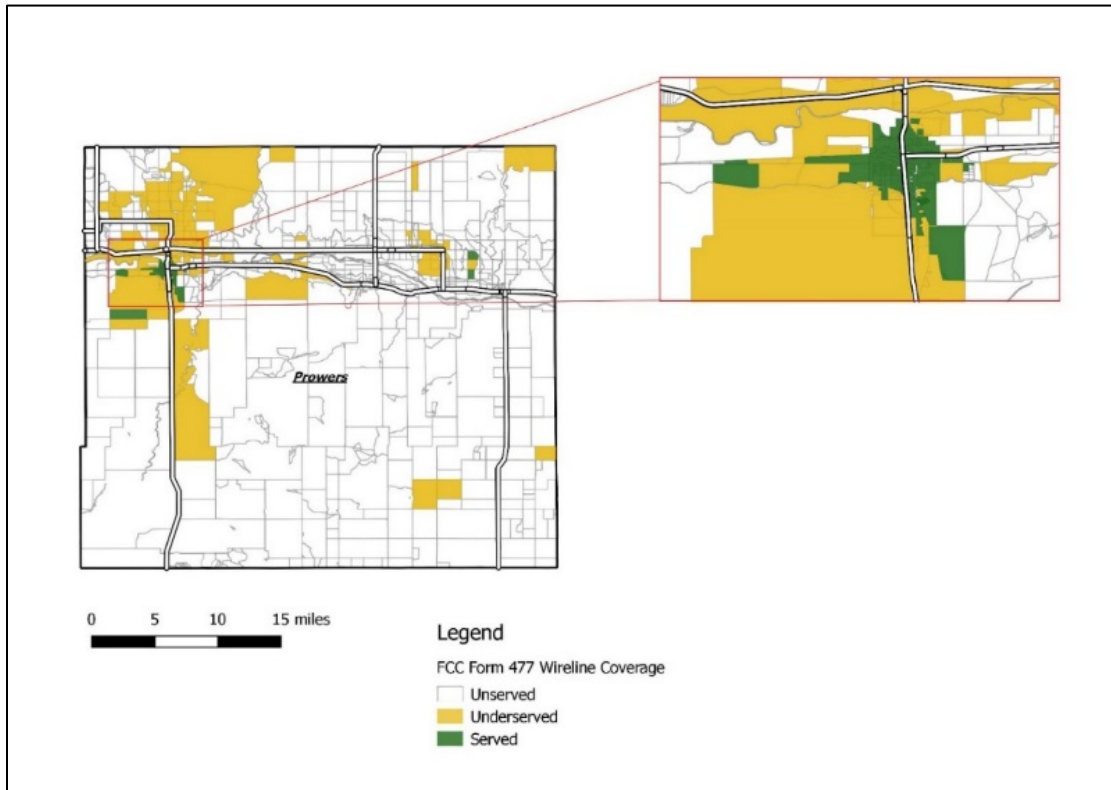

Figure 12-2: Prowers County CO OIT CBDDP – Wireline (10/2016)
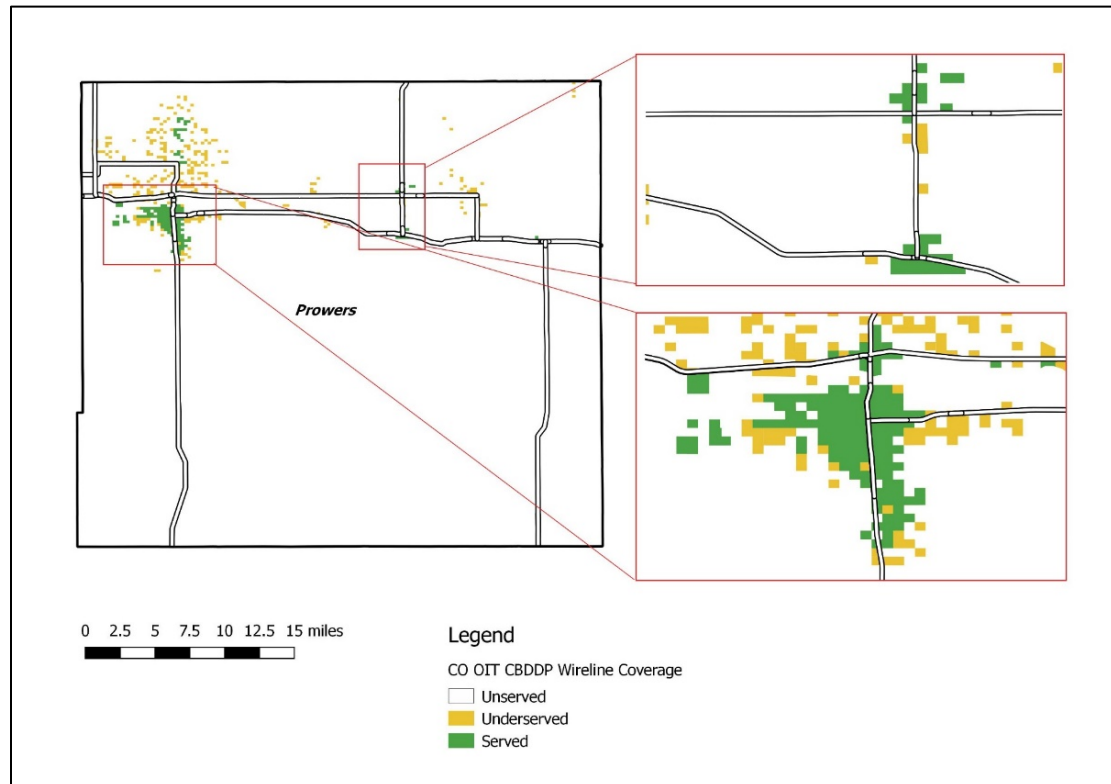
Figure 12-3: Prowers County FCC Form 477 – Fixed Wireless (12/2015)
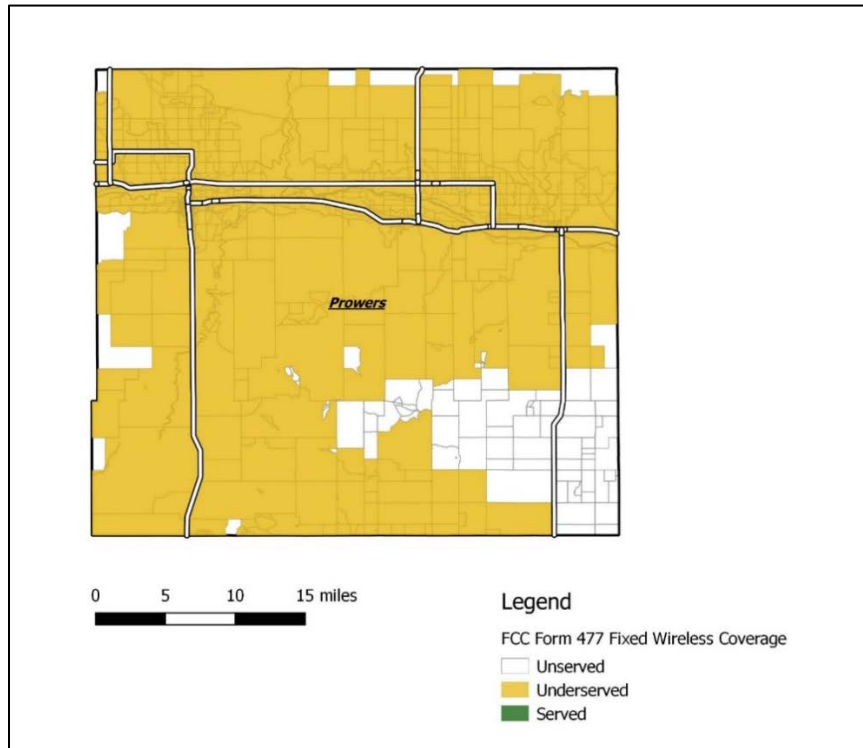
Figure 12-4: Prowers County CO OIT CBDDP – Fixed Wireless (10/2016)
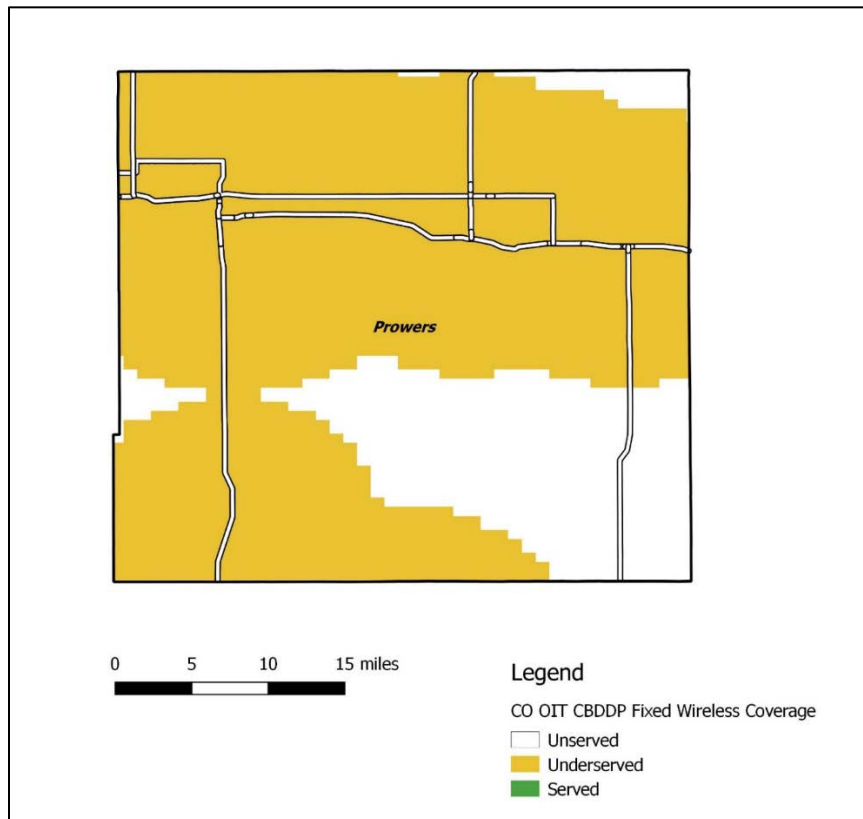
Figure 12-5: Prowers County FCC Form 477 Data Gigabit Service by Census Block

12.3 Current Upgrade/Expansion Efforts

As part of its outreach process, Tilson asked providers about their current upgrade and expansion efforts. In addition to the specific CenturyLink and FairPoint projects below, Viaero Wireless stated that they are making numerous upgrades by building out their ProConnect network, which has maximum download speeds of 25 Mbps. However, Viaero declined to provide a list of recent or planed upgrades.

Provider	Municipalities	Technology	Notes
CenturyLink	• Granada • Lamar • Others TBA	DSL	In 2015, the FCC awarded $2.4 M for CenturyLink to upgrade its DSL network to 3987 premises across five counties by 2020.[37] Upgrades must provide a minimum of 10/1 Mbps. By Year End 2017, roughly 40% of the premises must be upgraded. CenturyLink will share a list of areas upgraded in July 2017, when they report that information to FCC. Upgraded areas will be a subset of areas depicted on the FCC's "Accepted Areas Map"[38]
FairPoint	Hartman	DSL, Ethernet over Copper	Upgrade with speeds up to 50/10 Mbps planned for summer 2017.

12.4 Community Feedback

On May 24, 2017 Tilson held a community meeting at Lamar Community College. The meeting was attended by 8 people and included members from the community college administration, municipal

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[37] $2.4M per year for six years. This was part of a larger annual award of $26.5 million (for six years) in Colorado.
[38] https://www.fcc.gov/reports-research/maps/caf-2-accepted-map/

government, internet service providers, and the K-12 school system.

After providing an overview of broadband technologies, economics and county mapping data, Tilson solicited feedback on the unmet needs and goals of the community. The key points of the discussion are highlighted below.

Service needs improving in outlying areas. An IT consultant for the school system said that even though all the students in his school have use of a Chromebook for the year, the students do not bring them home, since they cannot assume that all students have internet access at home.[39] Community college president Linda Lujan said that she has a Vice President that doesn't check her email at home because she cannot get internet access there. Further, location neutral professionals will require high speeds, and some of them may want to live outside of town.

Affordability is an issue. Low income community college and K-12 students are known not to have internet access at home due to affordability.

Large incumbent providers struggle with consumer satisfaction. Dissatisfaction with Spectrum and CenturyLink is driving in-town customer to wireless providers. Two local wireless providers in attendance used to focus on the outlying areas, but lately most of their customer growth is in-town where consumers have access to faster wireline speeds. Spectrum service is purportedly good in some parts of town, and poor in others. Consumers report having trouble getting help troubleshooting network problems. The IT consultant for the school said the school needed to upgrade its 20 Mbps connection to comply with the federal guidance of 1 Mbps per student. One and a half years ago the consultant tried to get a quote for a fiber connection from CenturyLink, whose central office facility is less than 2 blocks away. After repeated requests he was not able to obtain a quote and has given up.

Small internet service providers lack resources to apply for federal grants. Small, local service providers are often the leaders in innovation for getting access to rural customers. For example, one put a Wireless Access Point (WAP) on a rancher's building in order to broadcast a signal to three nearby homes. However, both small local providers present at the meeting said they didn't have the resources to file the paperwork required to apply for and comply with a federal grant.

Cooperation in the business community could accelerate a fiber buildout. Businesses in the north end of Lamar do not currently have fiber access, although several of them want it. Prowers Economic Prosperity moved near the north end and received a SECOM quote of $5,000 to establish a fiber connection. In another example, the Holiday Inn Express in Lamar's north end was switching from CenturyLink DSL to SECOM fiber after a long planning process. This trend suggests there are opportunities for business to cooperate and lower their average cost of connection.

SECOM is increasingly competing with its customers. As SECOM has expanded its service territory through acquisitions and organic growth, it is increasingly competing with wireless ISPs that are its wholesale customers. The local WISPs in attendance felt that SECOM had a virtual monopoly on backhaul,[40] and that its prices have gone up, despite a downward market price trend for backhaul bandwidth. CenturyLink was offering good backhaul prices from its Central Office, but it was difficult and

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[39] Chromebooks are devices that look like laptops, but require an internet connection to perform most functions.
[40] CenturyLink is not aggressive with pricing and commercial terms for this service. However, there is a perception that they are very accommodating to Verizon's mobile business by extending fiber to their towers.

costly to meet the company at their buildings. CenturyLink does provide fiber backhaul to Verizon wireless mobile towers. The WISPs found it puzzling CenturyLink is not more aggressive with other wholesale customers.

Infrastructure investment should be part of a bigger plan. The community needs a plan on how to use improved infrastructure. An observation was made that many of the businesses in the area do not have a good online presence, and perhaps business owners need help with how to leverage connected technology.

13 Carrier Summaries

Tilson developed a list of all the known fixed internet access providers in the area, and contacted each one by phone and/or email[41]. This list was developed by Danelle Berg, and cross-checked against the names of providers submitting service data to the FCC via the Form 477.

Not all providers responded to Tilson's request for an interview. For the ones that did, Tilson had a standard list of questions it asked all providers; however not all providers answered all questions. Some carriers submitted supplemental information. This section summarizes Tilson's conversations with carriers and does not include input from Tilson's community outreach efforts.

Carrier	ILEC	In-State HQ	Interview Granted	Coverage Area	Primary Last Mile Tech
CenturyLink	x		x	Baca, Bent, Crowley, Otero, Prowers Counties	DSL
Eastern Slope	x	x	x	Western Kiowa	DSL
FairPoint	x		x	Eastern Kiowa	DSL
SECOM		x	x	All six Southeast Region counties	Wireless, Fiber
Spectrum			x	Cities of Fowler, Manzanola, Rocky Ford, Swink, La Junta and Lamar	DOCSIS (Cable TV)
Viaero			x	All six Southeast Region counties	Wireless
Colorado AirNet		x		n/a	n/a
Pioneer	x	x		All six Southeast Region counties	DSL
Southeast Network		x		n/a	n/a
RebelTec		x		n/a	Wireless

13.1 CenturyLink

CenturyLink is a publicly held telecommunications company based in Monroe, LA that operates in 33 states. The company is the predominant Incumbent Local Exchange Carrier (ILEC) in Colorado; in the Southeast region, the CenturyLink's ILEC territory covers most of Baca, Bent, Crowley, Otero and Prowers counties. (See Appendix E for Colorado's ILEC coverage map). As an ILEC, CenturyLink and its predecessors were the regulated telephone monopoly. As a result, CenturyLink owns and maintains an extensive amount of wireline infrastructure, including utility poles, copper and fiber optic cabling and wire centers. Today portions of the company's voice network is still regulated, while it competes in the long-distance voice, video and internet markets.

13.1.1 Service Offerings

CenturyLink offers DSL and fiber-based voice and internet access to residential, business and government customers in Region 6. DSL coverage is largely offered in town, and the service speeds vary by location.[42] Fiber is extended to some customers in the Southeast Region, for example CenturyLink provides a fiber connection to the state courthouses and the hospitals in its service territory. Typically, these fiber connections are part of a larger procurement program.[43]

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[41] Initial contact was made by email. If the email was not returned, Tilson called the service provider.
[42] Available speed is a function of both the DSL equipment deployed by the provider and the distance between the customer and the provider's DSL equipment.
[43] For example, the Colorado Telehealth Network, which connects rural health care organizations via two FCC grants.

13.1.2 Recent Investments

 In 2015, CenturyLink accepted $159 million of funding from the FCC as part of the Phase 2 Connect America Fund (CAF 2).[44] As a condition to accepting CAF 2 money, CenturyLink agreed to expand internet access coverage of minimum speeds of 10/1 Mbps to 50,000 Colorado premises by 2020. While CenturyLink declined to share which locations in the region it plans to upgrade, representatives mentioned that locations benefiting from the grant will include Granada, Lamar, La Junta, Springfield, Rocky Ford and Wiley. Some upgraded areas will receive up to 40 Mbps download.[45]

Many of CenturyLink's past investments in internet infrastructure in the area were funded by public subsidy via various public private partnerships (PPP's). These PPP's include the FCC's Phase 1 Connect America Fund, the Colorado Telehealth Network, and a program to connect Colorado's 64 county seats. In other regions of the state, CenturyLink has participated in PPP's with the Colorado Broadband Fund in Ridgeway, CO and Weld County Colorado. In Denver, CenturyLink has a partnership with the Sterling Ranch homeowner's association (HOA), whereby the HOA owns an FTTP network and CenturyLink operates it.

13.1.3 Investment Criteria

The company sees several obstacles to expansion, the most critical is the fact that the Southeast Region is not growing, which makes the business case of independent investment challenging. CenturyLink actively pursues state- and nation-wide opportunities, but sees the lack of coordination between COIT, DOLA and CDOT in infrastructure spending as an issue in Colorado.

13.1.4 Working with Communities

CenturyLink is open to PPPs that focus on the last mile and have a demonstrated end user demand. The company is opposed to "overbuild" networks that use public subsidies to compete with currently offered service. They are open to creative structures, and mentioned government contributions like property tax abatements or use of conduit and trenches in lieu of direct funding.

13.1.5 Looking Forward

CenturyLink is in the process of acquiring Level 3 Communications, which is a wholesale provider of unregulated telecommunications services. Level 3 owns an extensive network of domestic and international long-haul fiber that carries voice and data traffic to cities worldwide. This may affect its strategy and product offerings going forward.

13.2 Eastern Slope Rural Telephone Association (Eastern Slope)

Eastern Slope is a cooperative telecommunications company based in Hugo, Colorado. As a cooperative, Eastern Slope is owned by its customers, and profits are reinvested or distributed to customers. The company is the predominant Incumbent Local Exchange Carrier (ILEC) in western Kiowa County and operates in parts of nine other counties. (See Appendix E for Colorado's ILEC coverage map). As an ILEC, Eastern Slope owns and maintains an extensive amount of wireline infrastructure, including utility poles, copper and fiber optic cabling and wire centers. Today portions of the company's voice network are still

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[44] $26.5 million for six years

[45] On 6/26/17, CenturyLink advertised download speeds of up to 40 Mbps in Springfield, CO. CenturyLink's customer website does not provide information on DSL upload speeds, and representatives were not able to comment on planned upload speeds.

regulated, and it competes in the long-distance voice, video and internet markets through its Eastern Slope Technologies subsidiary.

13.2.1 Service Offerings

Eastern Slope offers voice, video and internet service via last mile DSL and fiber technologies. All customers within five miles of the nodes get access to 4/.512 Mbps or 15/3 Mbps internet speeds, IPTV and VOIP. Eastern Slope offers faster internet service to businesses via custom pricing. These services include 45-75 Mbps VDSL and up to 1 Gbps over fiber.[46]

13.2.2 Recent Investments

In 2013, the company completed network upgrades that fed all DSL nodes with fiber and placed additional fiber to allow for FTTP upgrades. Eastern Slope's fiber plant is buried. The buried infrastructure offers increased reliability; and the fiber to the DSL node offers better performance and faster upgradeability than copper-fed nodes.

13.2.3 Investment Criteria

Eastern Slope's internet infrastructure has largely been self-funded; its current 15/3 Mbps offering rendered it ineligible for the FCC's most recent CAF 2 funding.[47]   As a cooperative, the company must either distribute its profits to customers or reinvest them. Historically, the company has reinvested within its territory to meet customer needs, and distributed the remaining profits to customers via an annual patronage fee. Typically, customers receive 40-50% return on the dollar amount of their services (or patronage). This year Eastern Slope made a large profit from selling wireless spectrum; as a result, customers received 115% of their patronage dollars in their annual check.

13.2.4 Working with Communities

Eastern Slope is open to PPPs that utilize public infrastructure, which includes shared conduit, trenching and fiber. However, they have "[h]ave concerns about how EAGLE-Net overbuilt and cherry picked CAI customers in their service area," [48] and believe that it's necessary to demonstrate customer need as a requisite to public funding.

13.3 FairPoint Communications, Inc.

FairPoint Communication's is the Incumbent Local Exchange Carrier (ILEC) for the towns of Towner, Sheridan Lake, Brandon and Chivington in Kiowa County and the town of Hartman in Prowers County. (See Appendix E, FairPoint's territory is denoted as predecessor Sunflower Telecommunications).

13.3.1 Service Offerings

FairPoint offers voice and internet access customers in the region. Today the company uses DSL technology to provide internet access over its copper wire infrastructure. The company's voice and data

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[46] Eastern Slope declined to share geographies of the faster services.

[47] CAF 2 was available only to providers serving areas with access to speeds less than 4/1 Mbps.

[48] Email from Patricia White, General Manager and CEO of Eastern Slope Rural Telephone Association. 3/14/17. Cherry picking alludes to a phenomenon whereby a service provider only serves a small subset of users (usually the large ones) in a geography. Cherry picking harms the business case of any other provider to serve customers in that geography. More background on EAGLE-Net's federally subsidized overbuild can be found at: http://www.nytimes.com/2013/02/12/technology/waste-is-seen-in-program-to-give-internet-access-to-rural-us.html

traffic is backhauled east to Kansas, where it interconnects with other networks in Dodge City.

13.3.2 Recent Investments

Recently FairPoint upgraded its DSL infrastructure in Towner and Sheridan Lake; the company expects to upgrade service in Brandon, Chivington and Hartman in the summer of 2017. Once an upgrade in the region is complete, FairPoint can offer speeds of up to 50/10 Mbps within a mile of the DSL node and 15/2 Mbps within 3 miles. FairPoint is funding these upgrades without federal CAF 2 funding.

13.3.3 Investment Criteria

FairPoint names the very small number of people in the region as the largest obstacle to upgrading its internet.[49] It is currently focusing its capital expenditures in other states with more growth opportunity, and cited an Oklahoma network connecting Google data centers.

13.3.4 Working with Communities

FairPoint has not participated in PPPs in Colorado, although it has done so elsewhere in its service territory. An example is its ownership stake in Blue Bird Networks, a middle mile fiber consortium to connect small ILECs in Missouri. The company was eligible for CAF 2 funds for parts of its Kiowa and Prowers county service territory, but declined the funds.

13.3.5 Looking Forward

FairPoint is in the process of being acquired by Consolidated Communications, a telecommunications company with multiple ILEC holdings across several states. FairPoint's current strategy and outlook will likely change under new management.

13.4 SECOM

SECOM is a wholly owned subsidiary of Southeast Colorado Power Association (SECPA). SEPCA is a cooperative, and SECOM is organized as a for-profit subsidiary. Any profits that are not reinvested in SECOM get repatriated to SECPA.

13.4.1 Service Offerings

SECOM provides voice and internet access over wireless and fiber last mile technology; the company also provides wholesale services over its middle mile network that extends over 600 miles. SECOM offers speeds of up to 15/3 Mbps over its wireless network and a 200/200 Mbps over its fiber network.

13.4.2 Recent Investments

SECOM has been investing heavily in expansion and upgrades. Much of the company's expansion has been via acquisition: it has acquired three wireless ISPs in 18 months. Its acquisition targets are typically wholesale customers that do not have the capital to grow and meet customer needs. SECOM's economies of scale enable the company to recover its costs on network improvement investments.

SECOM's upgrades include a "Fiberhood" in La Junta that brought fiber-ready infrastructure to a 12 block area. In addition, Tilson talked to several residential and business customers in the six county region that paid SECOM a fee for extending a last mile fiber connection to their premise. SECOM has performed a cost estimate of a FTTP network in Springfield, and is weighing the investment.

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[49] FairPoint estimates that it serves 200 telephone lines in its entire Kiowa and Prowers service territory.

13.4.3 Investment Criteria

Obstacles to expansion include capital for last mile and middle mile fiber, tower rents and the availability of licensed spectrum required to serve more dense areas wirelessly. With current technology, SECOM can provide broadband speeds of 25/3 Mbps to a small number of customers from one antenna. However, an optimal wireless network that serves a high number of customers in a denser in-town setting requires wireless spectrum.

The FCC is expected to auction wireless spectrum that could be used to deliver higher capacity broadband in the next couple of years.

13.4.4 Working with Communities

SECOM has participated in PPP's in the past. These include Colorado's Beanpole Project that helped fund connections to regional schools, hospitals and libraries and USDA's Community Connect program. SECOM is open to participating in future PPP's via established programs like the Colorado Broadband Fund and in-kind contributions like access to towers. SECOM's participation in the USDA's Community Connect program that targets underserved rural communities is limited by unreliable FCC data, on which the USDA relies. Like Viaero, SECOM feels that incumbent providers tend to overstate service coverage, and the USDA process to contest the data is too expensive to justify.

13.5 Spectrum

Spectrum is a national provider of cable TV, internet and voice services that operates in the municipalities of Fowler, Manzanola, Rocky Ford, Swink, La Junta and Lamar. Spectrum was known as Charter Communications until its 2016 recent merger with Time Warner Cable; it is publicly held

13.5.1 Service Offerings

The company offers broadband internet access across its entire footprint in the southeast region. Using its DOCSIS 3.0 last mile technology, consumers can subscribe to speeds from 30/4 Mbps to 100/5 Mbps; 300/7 Mbps are available to businesses. The company will provision FTTP based services up to 10 Gbps on a custom-price bases.

13.5.2 Recent Investments and Investment Criteria

The company has steadily upgraded its speeds within its service territory since the 1980's, although it has not appreciably grown its service territory since then, and has no plans to expand service area unless the density requirements in its municipal franchise agreements are met. [50]

13.5.3 Working with Communities

Spectrum and its predecessors have not participated in PPP's in the area, although they would evaluate future ones on a case-by-case basis. The company would be interested in public contribution of middle mile fiber, real estate, cash subsidy, reduced permit fees, assistance with private easements, and aggregate demand for services. Without these potential contributions, the largest obstacle to Spectrum's expansion is customer density.

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[50] Typical cable TV franchise agreements specify a density of 20 houses per mile before a provider is obligated to extend its cable TV wireline network that also delivers internet and voice service. On a 4/11/17 call with Tilson, Charter claimed that their newly renegotiated franchise agreements in the area specified a density of 50 houses per mile. The current agreements extend into the mid 2020's.

Spectrum offers a nationwide program called Spectrum Internet Assist that provides low cost broadband to households that have a recipient member of one of the following programs: the National School Lunch Program (NSLP) free or reduced lunch; free school breakfast and lunch through the Community Eligibility Provision (CEP) of the NSLP; or Supplemental Security Income (SSI) for people ≥ age 65. Eligible households receive 30/4 Mbps internet access, a modem, unlimited data, and no contract requirement for $14.99/month. A wireless router can be rented for an additional $5/month.

13.6 Viaero

Viaero is a provider of wireless voice and internet service. The company provides both mobile and fixed services, and uses licensed spectrum. Viaero is based in Nebraska, is privately held, and focuses on rural markets. The company owns most of its network – including towers – and operates retail stores in its service area. Retail stores are often co-located with wireless towers.

13.6.1 Service Offerings

There are two distinct Viaero internet offerings that are delivered over two technologies: HomeConnect is delivered over Viaero's legacy 2G mobile phone network, offers download speeds of 8 Mbps maximum, and has data limits. ProConnect uses the most recent generation wireless LTE technology, offers download speeds of up to 25 Mbps, and does not have data caps. Viaero's website shows that the company covers a large swath of the Southeast Region, but the company does not specify the coverage of each offering type.[51]

Viaero would consider serving customers over its fiber network – both selling wholesale middle mile transport, and using a last mile FTTP connection for a large user along its route.

13.6.2 Recent Investments

Viaero is in the process of upgrading various elements of its network. It is replacing microwave connections that backhaul traffic from its towers with trenched fiber; and it is upgrading 2G sites to LTE. When Viaero upgrades its voice network from 2G to LTE, it often, but not always, upgrades the data, or internet network to LTE also.

13.6.3 Investment Criteria

When Viaero upgrades its voice network from 2G to LTE, it often, but not always, upgrades the data, or internet network to LTE also. Viaero typically needs 15-20 committed customers to justify the incremental expense. It gathers this information at its retail stores.

13.6.4 Working with Communities

Viaero has the only Colorado Broadband Fund project in Region 6. The company applied for and received $395,492 to construct two new towers and install equipment to provide HomeConnect service to a 334 square mile coverage area in Kiowa, Prowers and Cheyenne Counties. The company is open to PPPs, as long as Viaero retains ownership and control over the network. Viaero does not participate in DOLA's middle mile program, in part because it requires recipients to provide open access to competitors. Like SECOM, Viaero sees little opportunity in the federal USDA Community Connect program because it relies on inaccurate FCC Form 477 data, and the USDA process for contesting the FCC data is too expensive.

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[51] Viaero does not report coverage data to COIT, and did not provide a coverage map to Tilson after repeated requests. Customers are qualified for service by visiting a retail store, calling customer support, or filling out an online form.

Viaero would be open to future PPPs that are funded by grants (like the Colorado Broadband Fund), and joint trenching with a municipality. They try to stay away from turf battles, or to invest in contesting what they view as the exaggerated coverage data of large ISPs.

13.7 Other Providers

Tilson did not receive responses to its outreach from four internet service providers in the region: RebelTec, Pioneer, Colorado AirNet, and Southeast Network. Tilson did have the opportunity to talk to employees of Rebeltech and Southeast at the Prowers County community meeting, but was not able to ask the in-depth questions covered with the other providers.

Appendices

A: Broadband Overview

Broadband is a general term that applies to any communications technology that carries *data* at speeds in excess of a defined threshold (measured in bits per second). The Colorado Office of Information Technology (COIT) and the Federal Communications Commission (FCC) currently define the broadband as speeds at or above 25 Mbps download and 3 Mbps upload. Internet access at 25 Mbps download and 3 Mbps upload is currently referred to as broadband. Internet access below those speeds is not broadband. Areas without access to broadband are typically referred to as underserved. Areas with no internet access other than satellite service are referred to as unserved.

A.1   Network Terminology

In defining internet access, there are three main metrics that can be used to describe a connection: upload bandwidth, download bandwidth, and latency. These are defined as follows:

- Upload bandwidth is the capacity of a network connection to push data from the local network to the wide area network to which it is connected. In other words, upload bandwidth is a measurement of the capacity of the data "pipe" *from* the local network to the internet. Bandwidth is typically measured in megabits or gigabits per second, abbreviated Mbps and Gbps, respectively. The FCC definition of broadband requires a minimum upload speed of 3 Mbps.

- Download bandwidth is the capacity of the local network to receive data from the wide area network. Typically, the wide area network will be the Internet. While many people focus on a connection's download bandwidth, it is important to note that all bandwidth measurements are maximums in an ideal environment. Actual *throughput,* the data transfer rate achieved in the real world, is often significantly lower than advertised bandwidth due to factors on the local network and the broader Internet. The FCC definition of broadband requires a minimum download speed of 25 Mbps.

- Latency is a measurement of the time it takes for information to travel to its destination on the network. Generally, network latency measures the round-trip time – that is, the time it takes for a *packet* of information to travel from its origin to its destination and back. Latency has a significant impact on a user's perception of connection speed. High latency connections, where for example there is a significant delay between clicking on a link and the page beginning to load, will feel very slow compared to low latency connections, where the response to clicking is immediate, even if the page then takes a few seconds to load. Latency is of paramount importance for "real time" network applications like phone or video conferencing. Typically measured in milliseconds (ms), latency below 50ms is considered acceptable for home broadband connections.

A.2   Broadband Technologies Overview

There are many competing technologies available for broadband networks. Each represents a balance between installation cost, operation cost, geographic range, and the five network characteristics discussed above. This section will discuss the four most common technologies: DOCSIS, DSL, LTE, and fiber.

A.2.1   DOCSIS

Data Over Cable Service Interface Specification, usually called DOCSIS, is the standard used by cable internet providers. There are multiple versions of DOCSIS; the current specification is version 3.0. Most US cable companies will begin to implement DOCSIS 3.1 on a wide scale in 2017.

All versions of DOCSIS use existing cable TV wiring to provide data connectivity. Each cable internet

connection uses a *cable modem* to transmit and receive data, and convert between the cable company's infrastructure and a local networking interface, usually Ethernet.

Cable modems transmit and receive using the similar types of signals to those of cable TV. Cable providers can add or remove bandwidth by assigning more or fewer channels to the data network. The DOCSIS standard, among other things, defines ways for cable modems to take advantage of more channels for data. Since bandwidth on the cable companies' networks is a finite resource, as internet bandwidth needs grow, cable companies may be faced with removing less-watched TV channels from their lineups to free bandwidth for internet customers.

DOCSIS 3.0 is the current standard in US cable internet. While it can technically support up to 1Gbps, no cable provider offers such a service tier because it would use too many channels. In addition, gigabit speeds under DOCSIS 3.0 would require prohibitively expensive upgrades in the cable providers' head-end systems.

Instead, most operators plan to make head-end upgrades as part of the overall upgrade to DOCSIS 3.1. The newer standard is more efficient, and is designed to compete with FTTP offerings from Verizon, AT&T, Google, and others. Table 4 shows a comparison of the maximum bandwidth for each DOCSIS standard that can be typically realized. While DOCSIS 3.1 can theoretically support up to 10Gbps download, cable providers are only planning to implement a maximum of 5Gbps initially.

One important drawback to cable internet is that connection bandwidth is shared with other users in the area. If the network is not well-engineered, throughput will suffer during periods of high usage.

Table A-1 — DOCSIS 3.0 vs 3.1

	DOCSIS 3.0	DOCSIS 3.1
Year Released	2006	2015
Download Bandwidth (Theoretical)	Up to 1Gbps	Up to 10Gbps
Upload Bandwidth (Theoretical)	Up to 100Mbps	Up to 1Gbps
Download Bandwidth (Typical)	50-200Mbps	Up to 5Gbps
Upload Bandwidth (Typical)	1-20Mbps	Up to 100Mbps

A.2.2   DSL

Digital Subscriber Line, or DSL, is a family of technologies that allows high speed internet using old-fashioned copper phone lines. While a proven technology, DSL has significant technical limitations that drive up the cost of deploying higher-speed DSL networks.

The two main DSL technologies in use in the United States are ADSL and VDSL.

ADSL, Asymmetric Digital Subscriber Line, is the more common technology. The "asymmetric" refers to the fact that ADSL lines have different upload and download bandwidths. When the technology was first introduced in the late 1990s, ADSL had a maximum download bandwidth of 1.5Mbps. Nowadays, DSL networks can achieve 24Mbps download under ideal conditions using an updated version of the technology called ADSL2+. ADSL2+ is the most common DSL technology in the United States.

VDSL, Very-high-bit-rate Digital Subscriber Line, is an improved version of DSL technology that can provide bandwidth rivalling the fastest DOCSIS 3.0 connections under ideal circumstances. VDSL is generally used for DSL speeds in excess of 24Mbps. Achieving speeds comparable to fast cable connections with VDSL is costly and technically demanding in real world conditions. VDSL is less widespread in the United States, than ADSL but deployments do exist.

The core weakness of all DSL technologies is that speed decreases quickly as the customer moves farther from the phone company's DSL hub, called a DSLAM. While an ADSL connection might be able to attain 24Mbps, customers would have to be located within one third of a mile of the DSLAM to realize such speeds. Customers more than 2.5 miles from the DSLAM are limited to approximately 3Mbps, while DSL is generally not usable for customers more than about 3 miles from the DSLAM. Table 5 shows the theoretical maximum bandwidths for DSL technologies, under optimal conditions. VDSL can achieve speeds higher than below by using multiple physical pairs of wire and bonding them programmatically at the DSLAM into one connection, but this imposes a significant capital and operational cost in addition to requiring customers be near the DSLAM.

Table A-2 — DSL Technologies Comparison

	ADSL	ADSL2+	VDSL
Download Bandwidth	Up to 8Mbps	Up to 24Mbps	Up to 52Mbps
Upload Bandwidth	Up to 0.448Mbps	Up to 1.4Mbps	Up to 16Mbps

A.2.3   Fixed Wireless

Fixed wireless technology can provide a flexible way to provide a broadband connection to points over a wide area without the expense of deploying long lines either underground or in poles. In the right circumstances, it can have a lower up-front capital cost to deploy than comparable wireline technology. However, it is important to note that wireless technologies often require frequent equipment replacement--every three to five years is common. Also, wireless networks often struggle to achieve ubiquitous coverage over wide areas without increasing the density of sites, which reduces their up-front cost advantage. Wireless networks can vary enormously in their cost and performance depending on the type of wireless equipment used and its air interface, the spectrum, and the engineering standards used in the design of the network. There is not a single "typical" wireless network.

Fixed wireless technologies can be broadly broken down into two broad categories describing how the technology is deployed: point-to-point and point-to-multipoint. In Point-to-point (PTP) networks, radios are deployed in pairs, sending focused, directed energy between sites. PTP is typically used in the middle mile, or access layer of a network. In cases where long distances need to be spanned, or very high bandwidth is required, PTP can also be used for last mile service. While PTP provides excellent theoretical maximum speed and distance coverage, each link must be designed and tuned to the local operating conditions. The ultimate performance of a PTP link is dependent on parameters such as radio frequency band, height, climate, terrain and interference from other wireless signals. In addition, systems need to be designed to maximize the inherent tradeoffs between throughput (speed), availability and distance.

Point-to-multi-point technology (PTMP) is typical in the last mile, or distribution layer of the network. In these networks, multiple end users have an antenna that transmits and receives wireless signals to a single

wireless access point. PTMP networks have a lower cost per site covered because many users can share a single access point, and because end user radios are typically lower cost to purchase than access point radios or the paired radios in a PTP system. Like PTP technologies, PTMP can reach impressive theoretical throughput speeds, but ultimate performance is subject to factors such as distance from the base station, the spectrum bands used to carry the signal, and physical and radio frequency interference.). In addition, PTMP performance is influenced by the number of concurrent users on the base station. These local conditions sometimes make it difficult to pre-qualify a customer for a given level of service (i.e. provisioning and testing the service on-site is required.

Both PTP and PTMP technologies can operate on either licensed or unlicensed spectrum. Licensed spectrum provides a performance advantage. In more areas where spectrum can be congested and hotly contested by multiple providers, licensed spectrum protects against radio frequency interference and enables desired link stability and reliability. However, licensed spectrum hardware is typically more expensive and requires leasing the spectrum.

Mobile phones run on licensed spectrum PTMP networks, but today's mobile networks are not designed to handle the profile of a fixed broadband user that requires high availability and throughput and low latency.

A.2.4   Fiber

Fiber optics use glass (or, in some cases, plastic) strands to carry data signals in the form of pulses of laser light. Each strand is significantly thinner than a human hair but has no theoretical maximum bandwidth. Fiber connections of 400Gbps have been demonstrated, but most FTTP networks have a bandwidth of 1Gbps per connection. As new technologies become available, FTTP networks can be upgraded by installing new equipment at each end of the fiber.

Fiber to the premises is generally considered the "gold standard" in speed, reliability, and latency. One important differentiator of FTTP networks compared to other technologies is that FTTP is symmetric. That is, FTTP networks offer the same upload and download bandwidth. As people use the internet more and more for applications, like video chat, that require significant upstream bandwidth, this can become an important consideration.

Broadly speaking, there are two main types of FTTP network: passive and active. In a passive network, multiple customers share the bandwidth from a common fiber strand. Conversely, customers in active networks each have their own dedicated fiber strand to the head end. Passive networks tend to have lower capital and equipment costs while active ones are generally perceived as "future-proof". Both types of networks can still provide gigabit bandwidth to end users.

A.2.5   Summary of Network Technologies

The below table summarizes all the broadband technologies along the three characteristics of upload/download bandwidth and latency.

Table A-3 — Comparison of Broadband Technologies

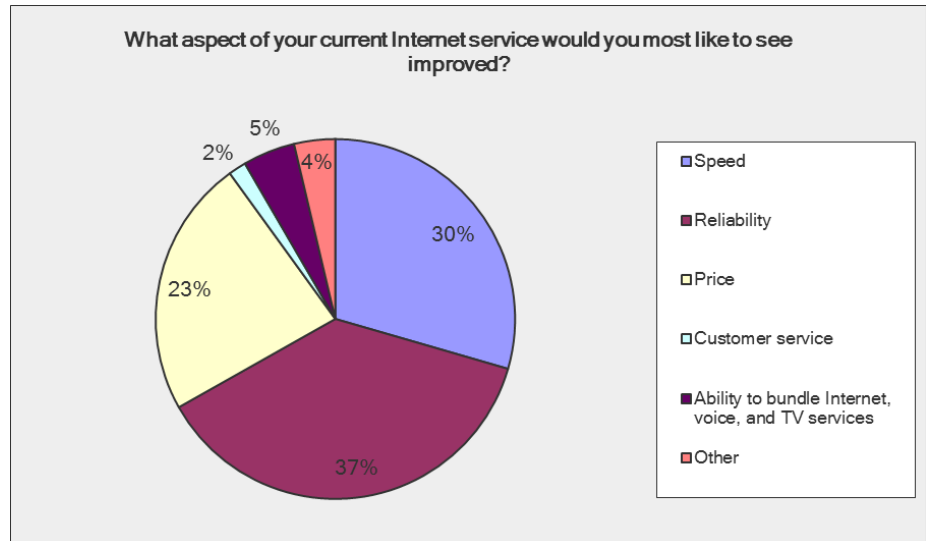|	Typical Download Bandwidth	Typical Upload Bandwidth	Typical Latency	Theoretical Max Download Bandwidth	Theoretical Max Upload Bandwidth
Cable/ DOCSIS	10-150Mbps	1-20Mbps	15-30ms	3.0: 1Gbps 3.1: 10Gbps	3.0: 100Mbps 3.1: 1Gbps
ADSL2+	3-18Mbps	0.768-1.4Mbps	40-60ms	24Mbps	1.4Mbps
Fixed Wireless (PTMP)	5-60Mbps	5-30Mbps	20-80ms	300Mbps	75Mbps
Fixed Wireless PTP	100-1000Mbps	100-1000Mbps	5-20 ms	10 Gbps	10 Gbps
FTTP	1Gbps	1Gbps	15-25ms	Effectively unlimited	Effectively unlimited

B: Broadband Survey

B.1 Summary Results

Although the broadband study and strategy focused on improving speed and access throughout the Southeast region, the survey respondents identified reliability as the major concern of subscribers, with speed and price second and third. Availability did not register as a major concern, but the nature of the survey skewed to those with existing access.

With the average price for internet or bundled internet and phone $51 - 100/monthly, most subscribers were willing to pay more for fast service, but not more than an additional $20/month.

At the county level there were some deviations, but overall the message was consistent.

What aspect of your current Internet service would you most like to see improved?

- Speed — 30%
- Reliability — 37%
- Price — 23%
- Customer service — 2%
- Ability to bundle Internet, voice, and TV services — 5%
- Other — 4%

B.2 Survey Structure

Tilson designed a fourteen question online survey to gather data on broadband usage patterns and unmet needs. County economic development officials promoted the survey via social media, email campaigns and newspaper coverage to gather opinions and information from residents unable to attend the community outreach workshops. The web-based survey tool was selected due to cost efficiency, ease of data collection and analysis, and ability to align the survey window with the overall study. Because respondents self-selected, it does not represent a random sample of users and is therefore not statistically significant. Nevertheless, Tilson believes the results are useful in understanding underlying attitudes towards broadband in the region as the results were consistent with discussions in the community meetings and a March 2017 Per Research Center study. Specifically, responses to Question 8, 'What broadband download speed do you subscribe to?' indicated that 46.3% of the respondents did not know their subscription speed which is consistent with the Pew findings that that 47% of Americans don't know their subscription speed. [52]

The survey included links to a speed test and an open comment field. Full details included all comments are listed in section *B.5 Survey Comments*.

B.3   Findings of Note

78% of the responses were for residential service, 14% business, and 8% home business. The focus on

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[52] Pew Research Center, March 13-27 2017, http://www.pewresearch.org/fact-tank/2017/04/10/americans-have-mixed-views-on-policies-encouraging-broadband-adoption/ft_17-04-07_homebroadband_4/

reliability over speed or price was consistent in all three categories. There were some differences in priority based on county. Reliability was the largest issue in Otero and in Powers counties (50% and 38% of the counties' responses, respectively); and speed was the largest issue in Kiowa (53%). Interestingly, none of Kiowa's 20 respondents listed reliability as an issue. Baca's top reported priorities were roughly split between speed and reliability.
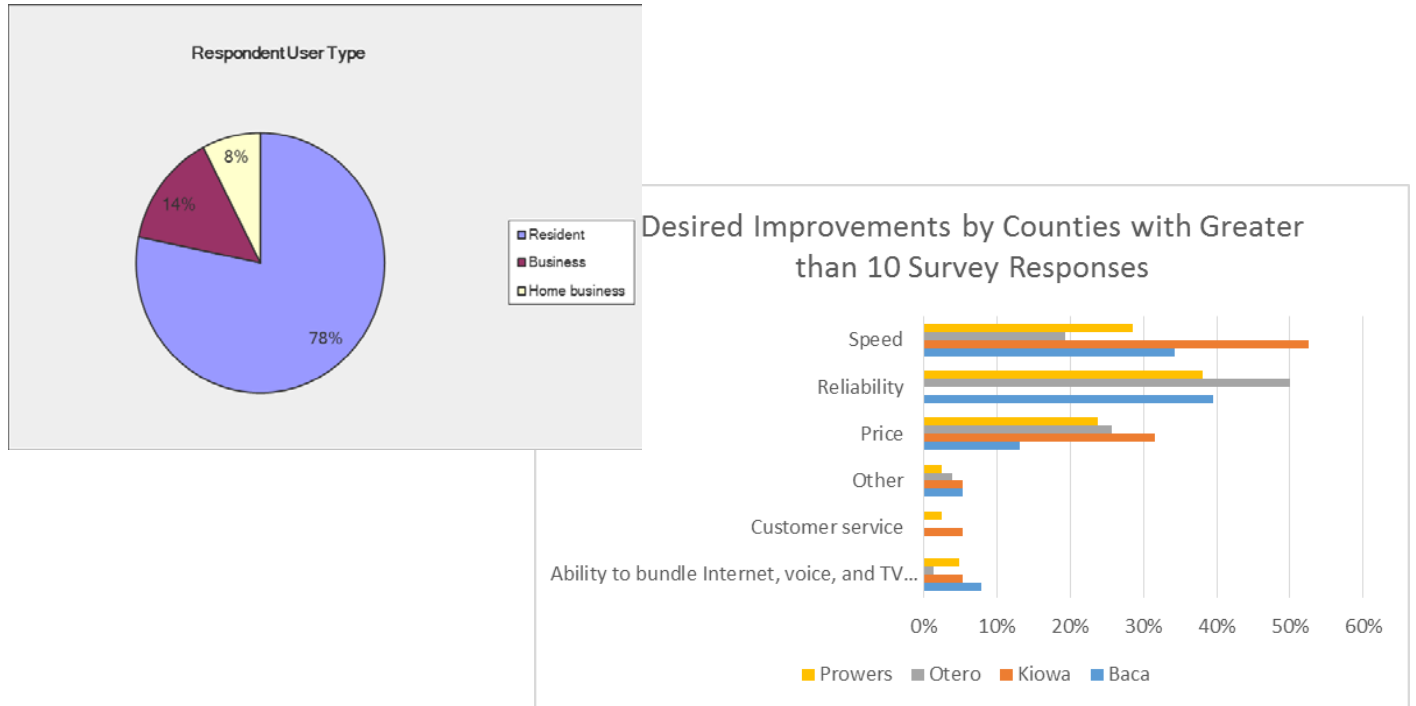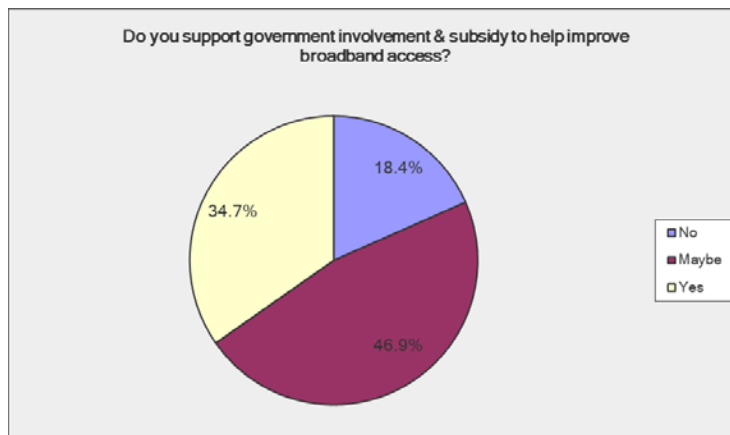

Respondents also indicated willingness to entertain government subsidies of broadband with thirty five percent of respondents supported government involvement and subsidy to improve broadband access. The largest percentage of respondents answered "maybe," which likely indicates that support would be contingent on the specific policy proposal.

B.4 Survey Results Detail

B.4.1 Respondent Profile

Tilson received 196 responses, which correlates roughly to a 1% response rate for the region.[53]   The geographic distribution of respondents was skewed towards Otero, Prowers and Baca Counties.
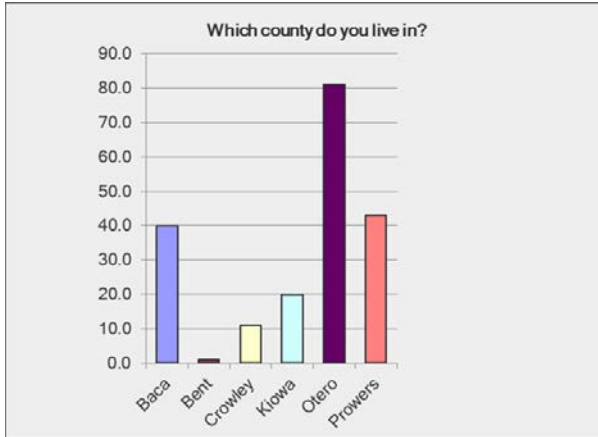
B.4.2 Reported Internet Use

As expected for an online survey, an overwhelming majority of respondents (95%) reported that they subscribed to Internet service at their residence or business. Tilson expects that if a random survey of households were to be conducted (e.g. a random door-to-door survey), the subscription rate might be lower. A "yes" answer to this question was meant to exclude users that rely on their mobile phones for internet connectivity.

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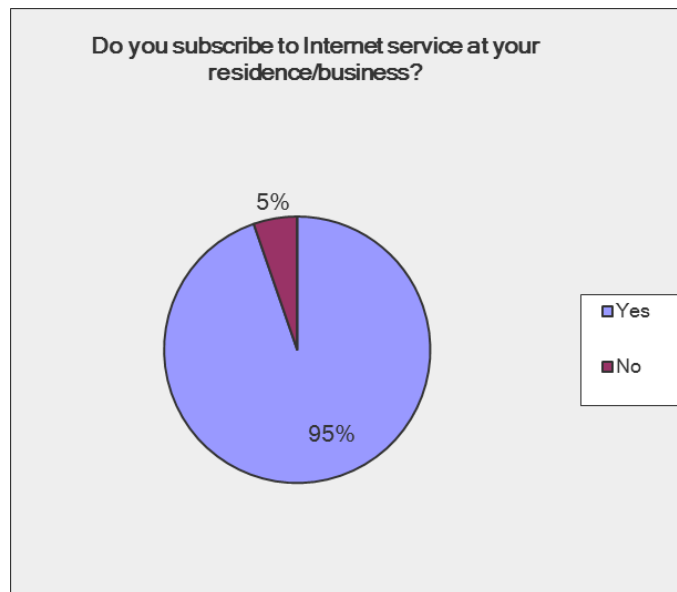
[53] Based on an estimate of 16,000 households, and an assumption of 1 survey per household, the response rate for 196 surveys would be 1.2%. Because there were likely multiple responses from some households, Tilson revised its estimate downwards to 1.0%.

The reasons stated by the 12 reported non-subscribers were skewed towards price. Only two respondents cited non-availability, and they were in Kiowa and Otero Counties.
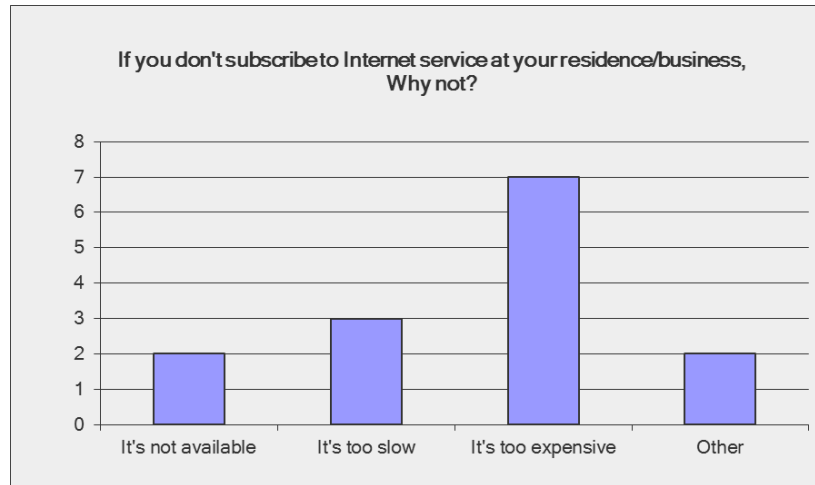
B.4.3   Service Bundles

The majority of respondents (73%) reported purchasing internet service as part of a bundle. Phone service was the most popular bundle. Tilson believes the 28% rate of combined internet, phone and cable TV bundles reflect the large proportion of Otero and Prowers respondents that have access to Spectrum's triple play package.
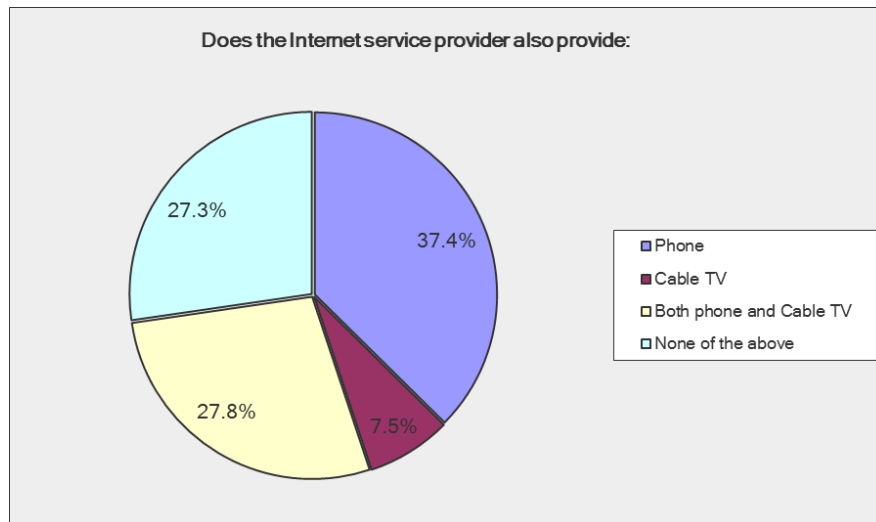
The most common reported monthly cost for internet only and combined phone and internet service was $51-$100. Monthly prices greater than $100 were not uncommon for any cable TV bundle. One half of the users reporting monthly bills over $200 were businesses.

Reported Monthly Cost by Bundle
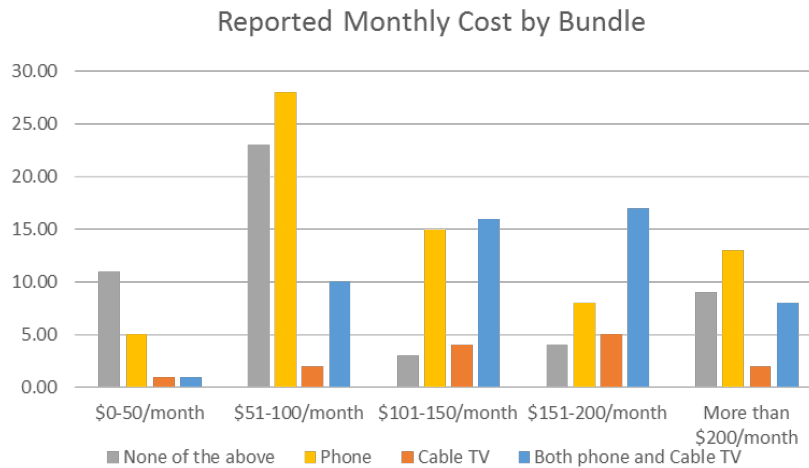
B.4.4 Desired Improvements

Reliability of internet service was the largest issue for respondents. Speed and price were secondary. Customer service and the ability to bundle more services were not much of a factor.
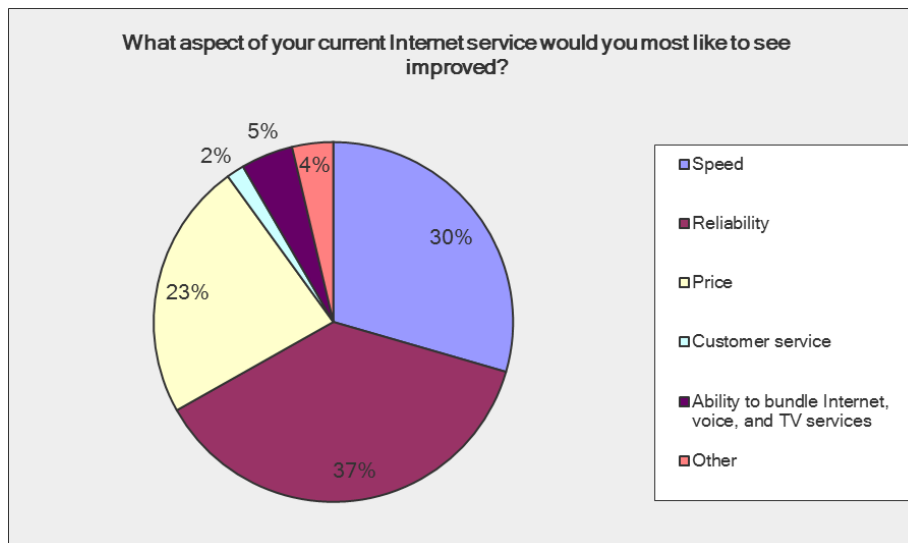
B.5.5   Reported Subscription Speeds

Many respondents didn't know what internet speeds they subscribed to. Of the respondents that did know, download speeds were concentrated at low levels (<10 Mbps) and very high speeds (>50 Mbps).

What broadband DOWNLOAD speed do you subscribe to at your residence/business? (In megabits per second. This is different than your actual or realized speed that is measured in a speed test.)
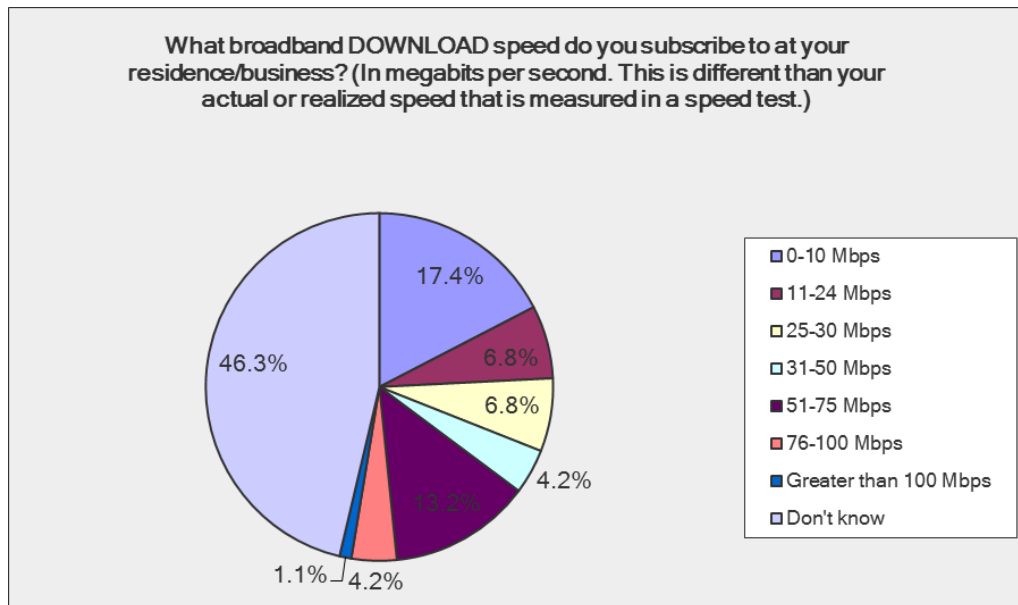
After eliminating the 46% of responses that did know their download speeds, 55% of respondents subscribed to broadband download speeds (25 Mbps); 45% subscribed to speeds slower than the broadband threshold.

Known Download Subscription Speeds by Broadband Threshold
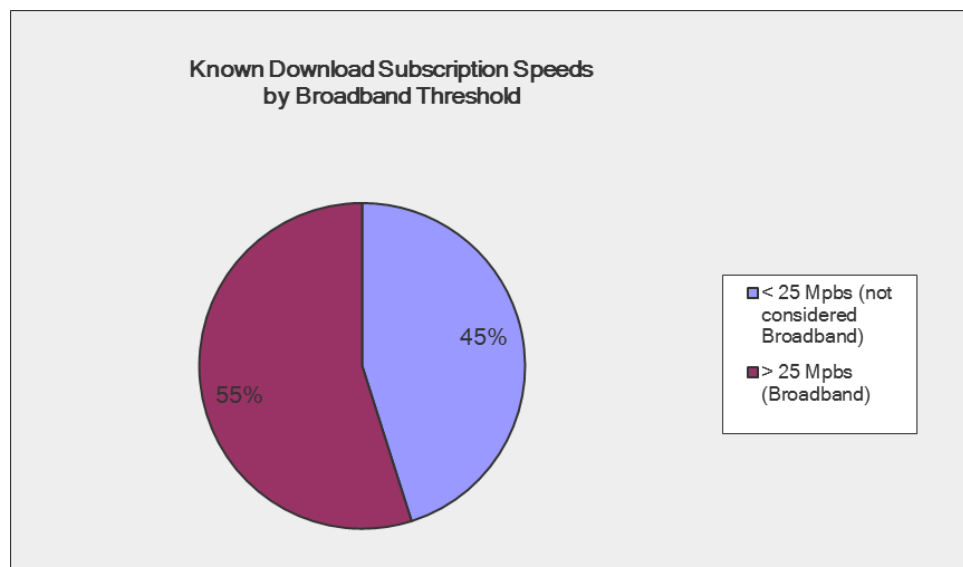
Slightly more respondents did not know their upload speeds (53%).

What broadband UPLOAD speed do you subscribe to at your
residence/business? (In megabits per second. This is different than your
actual or realized speed that is measured in a speed test.)

- <1 Mbps (<1,000 Kbps)
- 1-2 Mbps
- 3-10 Mbps
- 11-50 Mbps
- 51-75 Mbps
- 76-100 Mbps
- Greater than 100 Mbps
- Don't know

4.2%
6.3%
18.5%
52.9%
12.2%
3.7%
0.5%
1.6%
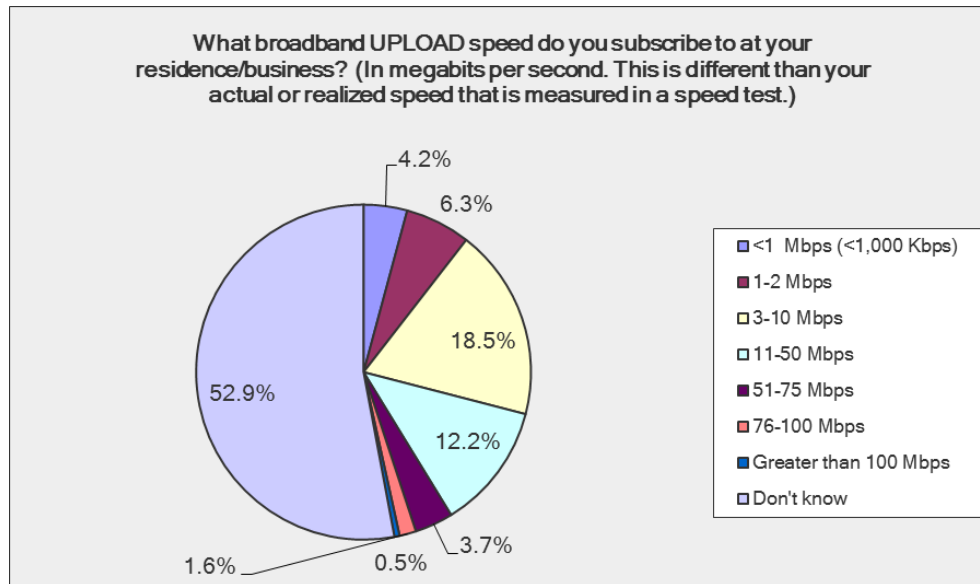
Of those that did know, 78% subscribed to speeds that met the broadband threshold. When compared to the download responses above, it's likely that many providers offer packages that with upload speeds in excess of 3 Mbps and upload speeds below 25 Mbps.

Known Upload Subscription Speeds
by Broadband Threshold

- < 3 Mpbs (not considered Broadband)
- > 3 Mpbs (Broadband)

22%
78%
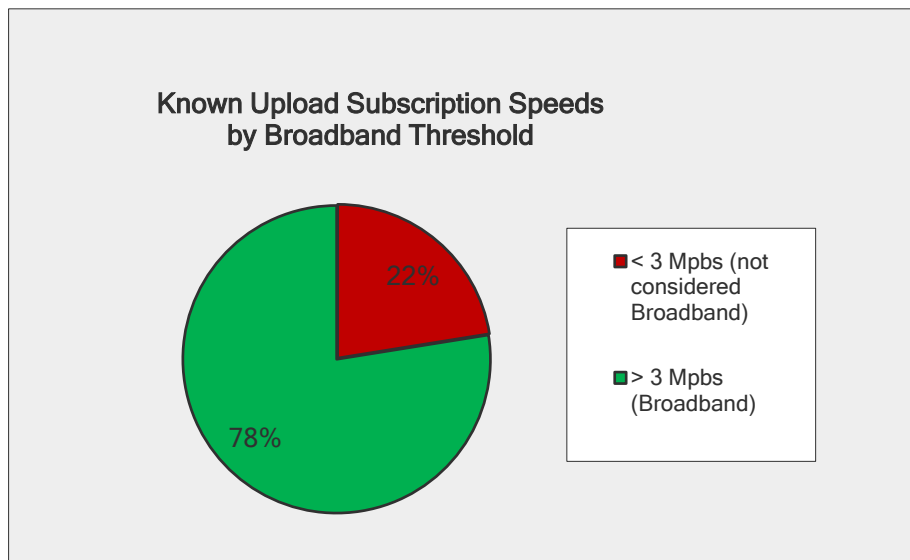
B.4.6   Speed Test Results

Twenty-four respondents completed and reported speed test results. The average speed test result was 30 Mbps download, and 12 Mbps upload. Subscribers of faster speeds disproportionately completed speed test results. Tilson performed an analysis of reported subscription ranges (e.g. 0-10 Mbps, 11-24 Mbps, etc.) compared to reported speed tests. In that analysis, Tilson found that most respondents

reported test results within their subscription range (72%); just less than a third had speed results slower than their subscription range (29%).

Comparison of Download Speed Test Results to Reported Subscription Rates

- Download within Reported Subscription Range
- Download Under Subscription Range
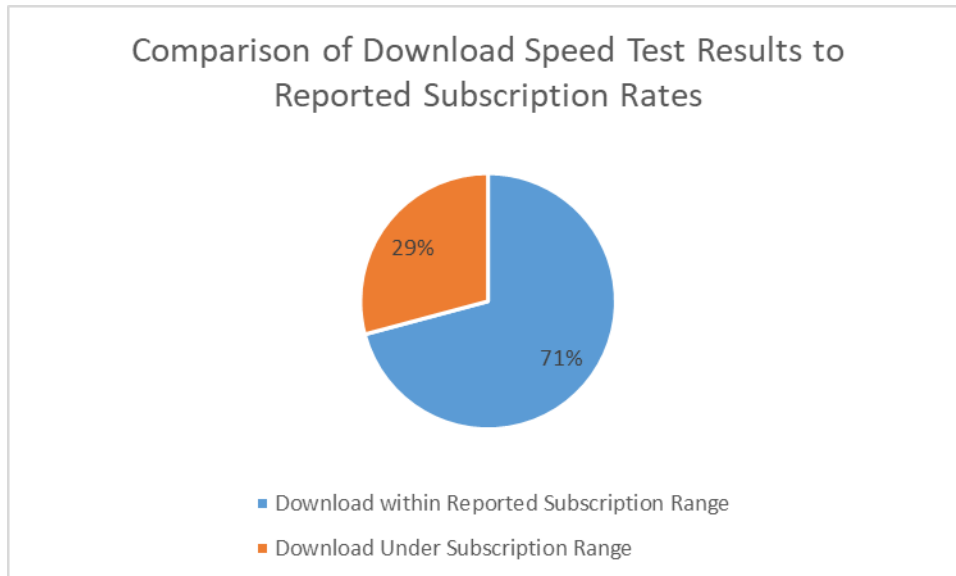
B.4.7 Stated Willingness to Pay

Tilson asked two questions about respondents' willingness to pay for service. The first question asked about a willingness to pay for doubled speeds. The answer to that question yielded that the majority of users was willing to pay more, although not many were willing to pay more than $20/month (just 17%).

If service at twice your current speed were available, how much of an increase would you be willing to pay per month?

- $0
- $1-$20
- $21-$50
- $51-$75
- $76-$100
- $101+
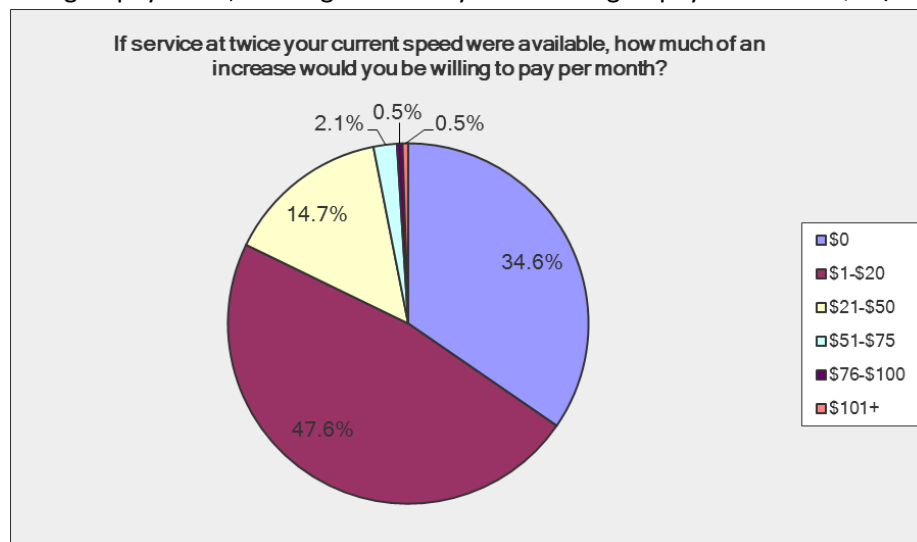
The second question asked respondents what they would be willing to pay to get broadband speeds of 25 Mbps download, 3 Mbps upload. Only 28% of respondents stated they'd be willing to pay more than $50 per month; however, in Question 6, 46% of respondents subscribing to internet only services currently pay greater than $50/month. A possible explanation for this seeming disconnect may be that the high

proportion of bundle subscribers pay less than $50 for the internet portion of their service, or that respondents didn't have a good sense for what level of improvement broadband speeds would offer. Interestingly, the two respondents that don't currently have access to non-satellite provided internet reported a willingness to pay of $51-$60 and $61-$70 per month.
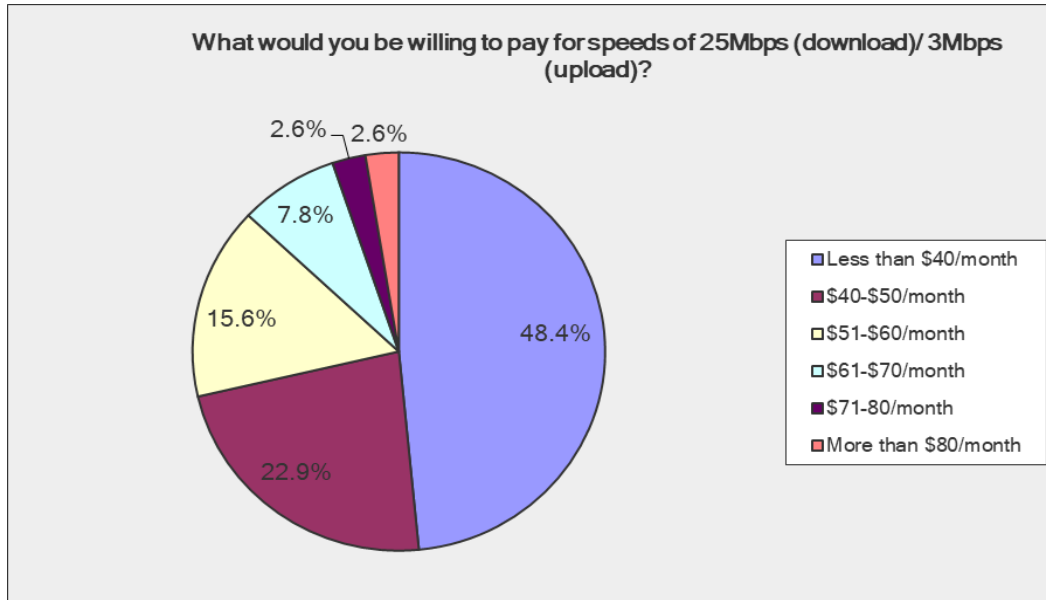
B.4. 8 Support for Government Involvement and Subsidy

Thirty five percent of respondents supported government involvement and subsidy to improve broadband access. The largest percentage of respondents answered "maybe," which likely indicates that support would be contingent on the specific policy proposal.
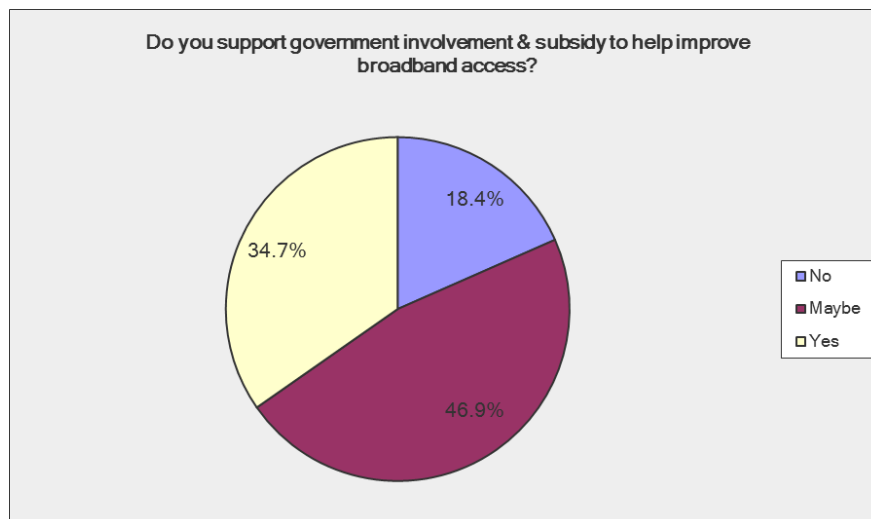
Tilson looked at the data to see if attitudes towards government involvement varied by whether respondents currently had broadband service.[54] Interestingly, unequivocal support for subsidy did not vary by subscribed speed (respondents answering "yes"). However, opposition to government involvement and subsidy did vary by whether respondents subscribed to broadband speeds. Twenty nine percent of broadband subscribers answered "no," while just 13% of non-subscribers opposed government involvement and subsidy.

Attitudes Towards Government Support by Subscribed Speed:
"Do you support government involvement and subsidy. . ."

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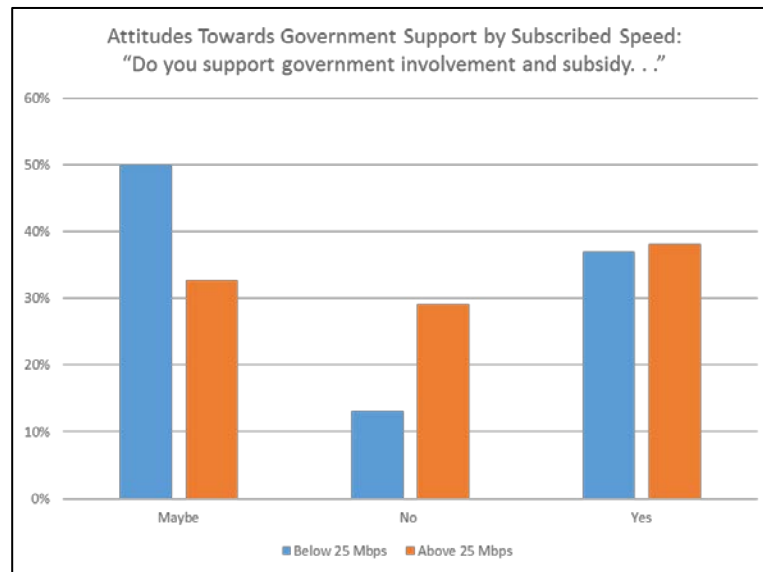
[54] Tilson used download speeds in excess of 25 Mbps as a proxy for broadband service.

C: Survey Comments

Comments are provided as entered in the survey tool, including typographical errors.

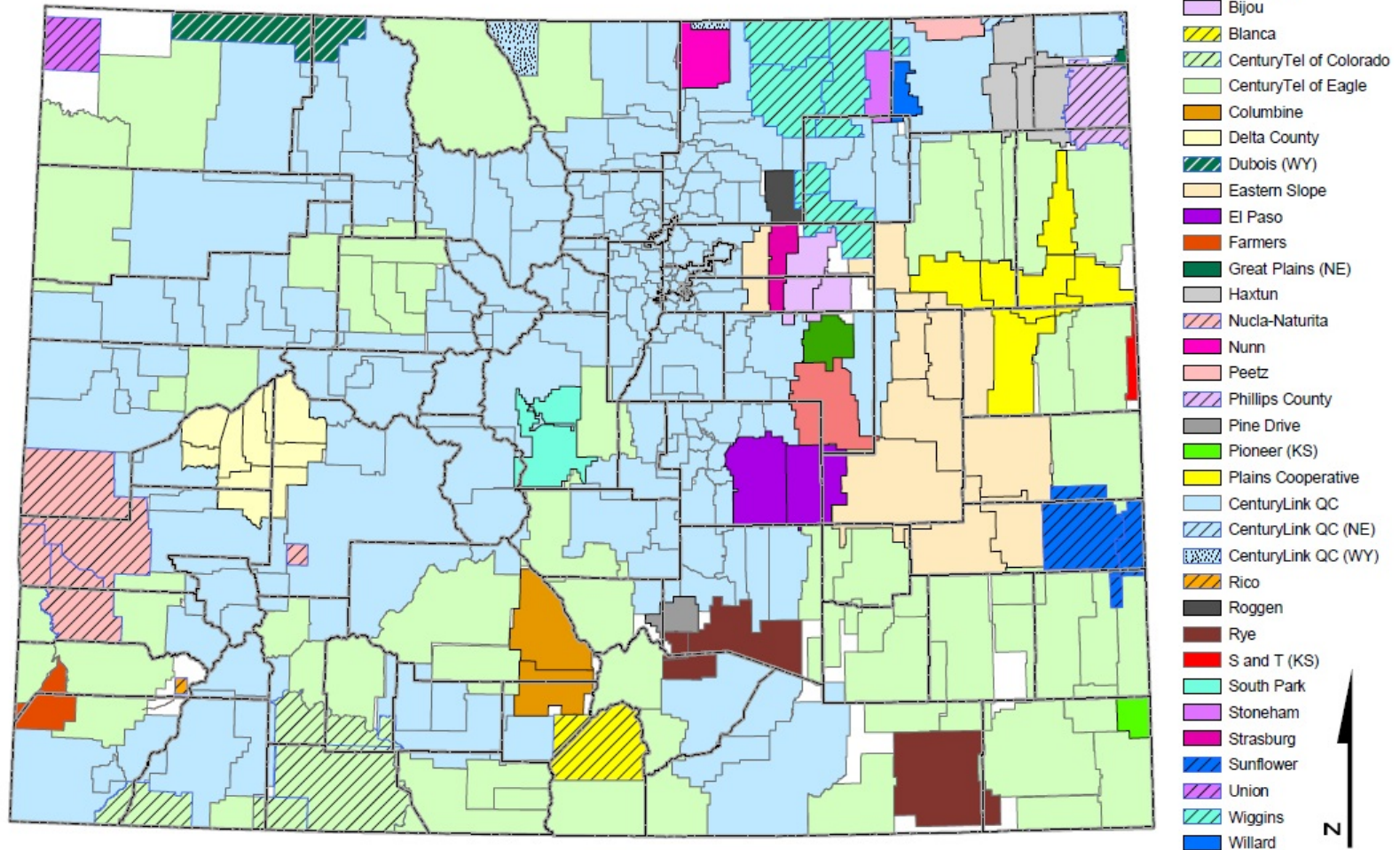| County	Comment
Baca	we're in sooutheast Colorado and desperate for better service.
Baca	The people who live outside city limits are the ones most in need of service. Our options are currently very very limited.
Baca	tried to take the test but couldn't get it to load?
Baca	We have no hard line service and we operate 2 miles outside of town
Baca	Int
Baca	service better now after called company multiple times to fix
Crowley	secom is doing a real good job
Crowley	My current provider has no absolute set of standards and regulations for their business practices which can greatly affect their customers. I feel that they take advantage of their near-monopoly stake in the industry in this area, always making decisions regarding billing whenever they see fit and do no other reason but to charge their customers more money via late fees and reconnect fees. Competition for my business would be greatly appreciated!
Crowley	I am currently paying $238 per month for internet, phone and directv. I would not have a home phone at all except that I am required to in order to get internet. At that price, i should have the fastest possible internet service and all possible TV channels.
Crowley	I have Centurylink. It use to be much faster. The last year has seen a dramatic decrease in overall speed.
Kiowa	We need higher service for industry!
Kiowa	MY ACTUAL UPLOAD SPEED: 498 kbps People in rural Southeastern Colorado don't understand what's needed in order to have internet capability that's competitive with other areas. It's VERY necessary to have broadband in this region, for a number of reasons...not the least is which economic development. I'm concerned about what the results might be of this survey for this area of the state, simply because people here don't know any better. But...if we somehow brought this to the area, I think the potential benefits are enormous.
Kiowa	I think it would be good for people that don't have access to high speed internet but for those that do I don't see a big advantage.
Kiowa	I am very happy with my service and do not desire anything faster, therefore my answers are skewed.
Kiowa	I pay low amount for DSL slowest speed and provides most of my needs, having higher speed is possible but not to 25 Mbps. Overall these speeds are available to all residents within 5 miles of service provider system. Had some issues with speed test as did not download flash video so guessing did not gather data either, so completed survey without but paying for 4 Mbps down and .512 upload.
Kiowa	Actual test results were 0.16 download and 0.08 upload.
Kiowa	It needs to be available in the county/rural areas
Otero	Broadband is necessary for business - it is needed to attract business. Broadband plays a role in families deciding where to live also.
Otero	No link to take speed test.
Otero	We pay $140 a month for slow wifi, our cable doesn't work half of the time and there is never nothing to watch. We have the cheapest bundle and it's a waste of money.
Otero	It seems they are always out, and when you call their excuse is we don't have their router. If the service they provide can't provide us with service with a router we can afford what is the point. Also don't understand why it costs us more to pay just for internet with charter and new comers get the deal of $29.99 for a bundle.

Otero	I wish we had more options for cable TV, I have no issues with internet right now
Otero	its not so much the internet service thats aproblem its the cable side of it
Otero	Horrible reliability in la Junta with internet.
Otero	The internet cable and phone through Charter Spectrum is usually goes off about 4 to 5 times a month getting ridiculous for the price that werepaying
Otero	Charter is outrages prices and outages too often.
Otero	Charter sucks. It's always out...
Otero	i left Charter because their service was worthless and unreliable. something needs to be done about reliability.. if i am paying $150 a month for service it needs to work all the time
Otero	So tired of Charter/Spectrum being down. My husband works from home. When the internet is down he cannot work.
Otero	Charter Communications is the bottom of the barrel of providers and yet it is the one most of us can afford. We definitely do not get what we pay for. I will not switch to Century Link because they are just as bad. Please get us a provider that actually works.
Otero	The only high speed internet service available to us is wireless broadband. We are about two miles from the nearest tower, and lose our service with regularity whenever there is a storm.
Otero	Secom has been pretty good, but the last couple weeks it's been pretty slow.
Otero	Charter sucks but can't afford secom
Otero	we need fiber optic
Otero	For what I pay charter now, I got 200Mbps in Austin, TX. This is ridiculous.
Otero	I use fiber optic cable through secom and pay $80 for 80mb.
Otero	Available speed on Centurylink insufficient for streaming.
Otero	Using an iPad on Ookla site results were download 14.33, upload 3.22. Secom provides wireless internet. I live four blocks from Otero Junior College.
Prowers	too much down time and too many outages - bogs down at certain times of day
Prowers	Internet service is a must and must be improved in Lamar.
Prowers	Cable and internet are always cutting out. Not happy with service that costs over $200/ month.
Prowers	I am unable to complete the speed test at this time because the internet is down.
Prowers	We have it through Dish, it is very slow
Prowers	Would like to see broadband that is a lot more reliable. Not something that has issues every time the weather changes. As in dropped service and slower speeds when "any" weather change happens
Prowers	Tethering my cell on a 3G network is ALWAYS a faster than broadband in this area
Prowers	Need more options
Prowers	We need a better quality internet in our area please!!
Prowers	I currently do not have an internet service provider. I use my phone as a hotspot to have internet to my laptop.
Prowers	We need another broadband service in our area. Our area providers are very overated and overpriced for the services we recieve. Since the internet is must for those us with children in school or are in school ourselves. In paticular Charter Communications has fallen extemely short of our expectations and needs. Since the interenet and cable are consistenetly out and not working properly with no ramifications. A survey of our area needs to be done to show how many times a year our services are completely down or one or the other is not working. Thank you

D: Carrier Contacts

Carrier	Name	Title	Email/Phone
CenturyLink	Stephanie Morales	Manager Region Operations	Stephanie.Morales@CenturyLink.com 719-940-0886
	Abel Chavez	Director State and Local Government Affairs	Abel.Chavez@CenturyLink.com 719-428-8084
Eastern Slope Technologies	Patricia White	CEO	patw@esrta.coop 719-743-2460
FairPoint	Ken Carter	Director of Enterprise Business	kcarter@fairpoint.com 704-227-3650
SECOM	Jon Saunders	COO	jons@secom.net 719-383-1319
Spectrum	John Lee	Senior Manager, Local Government Affairs	John.l.lee@charter.com 720-482-9086
Viaero	Jeff Brown	VP of Roaming and Data Services	jeff.brown@viaero.com 970-467-3114
	Jorge Carrasco	CO District Manager	Jorge.Carrasco@viaero.com
	Oliver Lei	Region Director - Colorado	Oliver.Lei@viaero.com 970-467-7000
Tilson contacted several providers via the contact information below, but did receive a response			
ColoradoAirNet	Tony Hagans		tony.hagans@gmail.com 719-330-9143
Pioneer	Catherine Moyer		(620) 356-3211
South East Network	Ryan Sneller		ryansneller@gmail.com 719-931-9334
RebelTech	B. J. Mahan		bj@rebeltec.net

Colorado Telephone Service Providers

Incumbent Local Exchange Service Providers

- Uncertified
- Agate
- Big Sandy
- Bijou
- Blanca
- CenturyTel of Colorado
- CenturyTel of Eagle
- Columbine
- Delta County
- Dubois (WY)
- Eastern Slope
- El Paso
- Farmers
- Great Plains (NE)
- Haxtun
- Nucla-Naturita
- Nunn
- Peetz
- Phillips County
- Pine Drive
- Pioneer (KS)
- Plains Cooperative
- CenturyLink QC
- CenturyLink QC (NE)
- CenturyLink QC (WY)
- Rico
- Roggen
- Rye
- S and T (KS)
- South Park
- Stoneham
- Strasburg
- Sunflower
- Union
- Wiggins
- Willard

Updated 10/22/2003

F: Free and Reduced Lunch Statistics by School

COUNTY CODE	COUNTY NAME	DISTRICT CODE	DISTRICT NAME	SCHOOL CODE	SCHOOL NAME	K-12 COUNT	FREE AND REDUCED COUNT	% FREE AND REDUCED	% FRL Range
05	BACA	0230	WALSH RE-1	9222	WALSH ELEMENTARY SCHOOL	78	54	69.2%	50%-75%
05	BACA	0230	WALSH RE-1	9226	WALSH HIGH SCHOOL	56	21	37.5%	25%-50%
05	BACA	0240	PRITCHETT RE-3	7174	PRITCHETT ELEMENTARY SCHOOL	15	N/A	N/A	75%-100%
05	BACA	0240	PRITCHETT RE-3	7176	PRITCHETT MIDDLE SCHOOL	8	N/A	N/A	50%-75%
05	BACA	0240	PRITCHETT RE-3	7180	PRITCHETT HIGH SCHOOL	15	N/A	N/A	25%-50%
05	BACA	0250	SPRINGFIELD RE-4	8160	SPRINGFIELD ELEMENTARY SCHOOL	164	121	73.8%	50%-75%
05	BACA	0250	SPRINGFIELD RE-4	8168	SPRINGFIELD JUNIOR/SENIOR HIGH SCHOOL	112	62	55.4%	50%-75%
05	BACA	0260	VILAS RE-5	9090	VILAS ELEMENTARY SCHOOL	19	N/A	N/A	50%-75%
05	BACA	0260	VILAS RE-5	9100	VILAS UNDIVIDED HIGH SCHOOL	20	N/A	N/A	50%-75%
05	BACA	0270	CAMPO RE-6	1248	CAMPO ELEMENTARY SCHOOL	13	N/A	N/A	75%-100%
05	BACA	0270	CAMPO RE-6	1252	CAMPO UNDIVIDED HIGH SCHOOL	19	N/A	N/A	50%-75%
06	BENT	0290	LAS ANIMAS RE-1	0443	AIM GLOBAL	533	474	88.9%	75%-100%
06	BENT	0290	LAS ANIMAS RE-1	1812	LAS ANIMAS ELEMENTARY SCHOOL	277	246	88.8%	75%-100%
06	BENT	0290	LAS ANIMAS RE-1	4279	IMMERSION SCHOOLS SCIENCE TECHNOLOGY ARTS	118	43	36.4%	25%-50%
06	BENT	0290	LAS ANIMAS RE-1	4986	LAS ANIMAS JUNIOR HIGH SCHOOL	88	76	86.4%	75%-100%
06	BENT	0290	LAS ANIMAS RE-1	4990	LAS ANIMAS HIGH SCHOOL	131	107	81.7%	75%-100%
06	BENT	0310	MC CLAVE RE-2	5666	MC CLAVE ELEMENTARY SCHOOL	134	58	43.3%	25%-50%
06	BENT	0310	MC CLAVE RE-2	5670	MC CLAVE UNDIVIDED HIGH SCHOOL	108	42	38.9%	25%-50%
13	CROWLEY	0770	CROWLEY COUNTY RE-1-J	2050	CROWLEY COUNTY PRIMARY	130	92	70.8%	50%-75%
13	CROWLEY	0770	CROWLEY COUNTY RE-1-J	2054	CROWLEY COUNTY WARD INTERMEDIATE	105	84	80.0%	75%-100%
13	CROWLEY	0770	CROWLEY COUNTY RE-1-J	2058	CROWLEY COUNTY JUNIOR AND SENIOR HIGH SCHOOL	202	143	70.8%	50%-75%
31	KIOWA	1430	EADS RE-1	2328	EADS ELEMENTARY SCHOOL	80	33	41.3%	25%-50%
31	KIOWA	1430	EADS RE-1	2332	EADS MIDDLE SCHOOL	46	N/A	N/A	25%-50%
31	KIOWA	1430	EADS RE-1	2336	EADS HIGH SCHOOL	50	19	38.0%	25%-50%
31	KIOWA	1440	PLAINVIEW RE-2	6992	PLAINVIEW ELEMENTARY SCHOOL	29	18	62.1%	50%-75%
31	KIOWA	1440	PLAINVIEW RE-2	7009	PLAINVIEW JUNIOR-SENIOR HIGH SCHOOL	29	17	58.6%	50%-75%
45	OTERO	2520	EAST OTERO R-1	4841	LA JUNTA INTERMEDIATE SCHOOL	459	378	82.4%	75%-100%
45	OTERO	2520	EAST OTERO R-1	4843	LA JUNTA PRIMARY SCHOOL	313	249	79.6%	75%-100%
45	OTERO	2520	EAST OTERO R-1	5015	LA JUNTA JR/SR HIGH SCHOOL	583	397	68.1%	50%-75%
45	OTERO	2530	ROCKY FORD R-2	5114	JEFFERSON INTERMEDIATE SCHOOL	239	190	79.5%	75%-100%

2016-2017 K-12 Pupil Membership by School and Free and Reduced Lunch Eligibility									***Revised 2/14/2017***
COUNTY CODE	**COUNTY NAME**	**DISTRICT CODE**	**DISTRICT NAME**	**SCHOOL CODE**	**SCHOOL NAME**	**K-12 COUNT**	**FREE AND REDUCED COUNT**	**% FREE AND REDUCED**	**% FRL Range**
45	OTERO	2530	ROCKY FORD R-2	7442	ROCKY FORD JUNIOR/SENIOR HIGH SCHOOL	372	275	73.9%	50%-75%
45	OTERO	2530	ROCKY FORD R-2	9264	WASHINGTON PRIMARY SCHOOL	194	162	83.5%	75%-100%
45	OTERO	2535	MANZANOLA 3J	5498	MANZANOLA ELEMENTARY SCHOOL	54	39	72.2%	50%-75%
45	OTERO	2535	MANZANOLA 3J	5506	MANZANOLA JUNIOR-SENIOR HIGH SCHOOL	73	50	68.5%	50%-75%
45	OTERO	2540	FOWLER R-4J	0056	FOWLER ELEMENTARY SCHOOL	204	127	62.3%	50%-75%
45	OTERO	2540	FOWLER R-4J	3130	FOWLER JUNIOR HIGH SCHOOL	65	38	58.5%	50%-75%
45	OTERO	2540	FOWLER R-4J	3134	FOWLER HIGH SCHOOL	127	49	38.6%	25%-50%
45	OTERO	2560	CHERAW 31	1546	CHERAW SCHOOL	202	127	62.9%	50%-75%
45	OTERO	2570	SWINK 33	8452	SWINK ELEMENTARY SCHOOL	196	82	41.8%	25%-50%
45	OTERO	2570	SWINK 33	8456	SWINK JUNIOR-SENIOR HIGH SCHOOL	170	75	44.1%	25%-50%
50	PROWERS	2650	GRANADA RE-1	3542	GRANADA ELEMENTARY SCHOOL	116	83	71.6%	50%-75%
50	PROWERS	2650	GRANADA RE-1	3546	GRANADA UNDIVIDED HIGH SCHOOL	81	45	55.6%	50%-75%
50	PROWERS	2660	LAMAR RE-2	0200	ALTA VISTA CHARTER SCHOOL	126	48	38.1%	25%-50%
50	PROWERS	2660	LAMAR RE-2	4956	LAMAR MIDDLE SCHOOL	339	247	72.9%	50%-75%
50	PROWERS	2660	LAMAR RE-2	4960	LAMAR HIGH SCHOOL	421	231	54.9%	50%-75%
50	PROWERS	2660	LAMAR RE-2	6794	PARKVIEW ELEMENTARY SCHOOL	294	226	76.9%	75%-100%
50	PROWERS	2660	LAMAR RE-2	9268	WASHINGTON ELEMENTARY SCHOOL	266	209	78.6%	75%-100%
50	PROWERS	2670	HOLLY RE-3	4058	HOLLY HIGH SCHOOL	92	61	66.3%	50%-75%
50	PROWERS	2670	HOLLY RE-3	4069	HOLLY JUNIOR HIGH SCHOOL	48	36	75.0%	75%-100%
50	PROWERS	2670	HOLLY RE-3	7794	HOLLY ELEMENTARY SCHOOL	145	103	71.0%	50%-75%
50	PROWERS	2680	WILEY RE-13 JT	9604	WILEY ELEMENTARY SCHOOL	110	49	44.5%	25%-50%
50	PROWERS	2680	WILEY RE-13 JT	9608	WILEY JUNIOR-SENIOR HIGH SCHOOL	137	61	44.5%	25%-50%

G: Demand Aggregation Tools

Examples of three demand aggregation tools, and some of their features are below.

1. In this illustration, a geographic area is segmented into fiber hoods. Users in each fiber hood area commit to future service, and can get real time feedback on progress versus a competing fiber hood service territory.
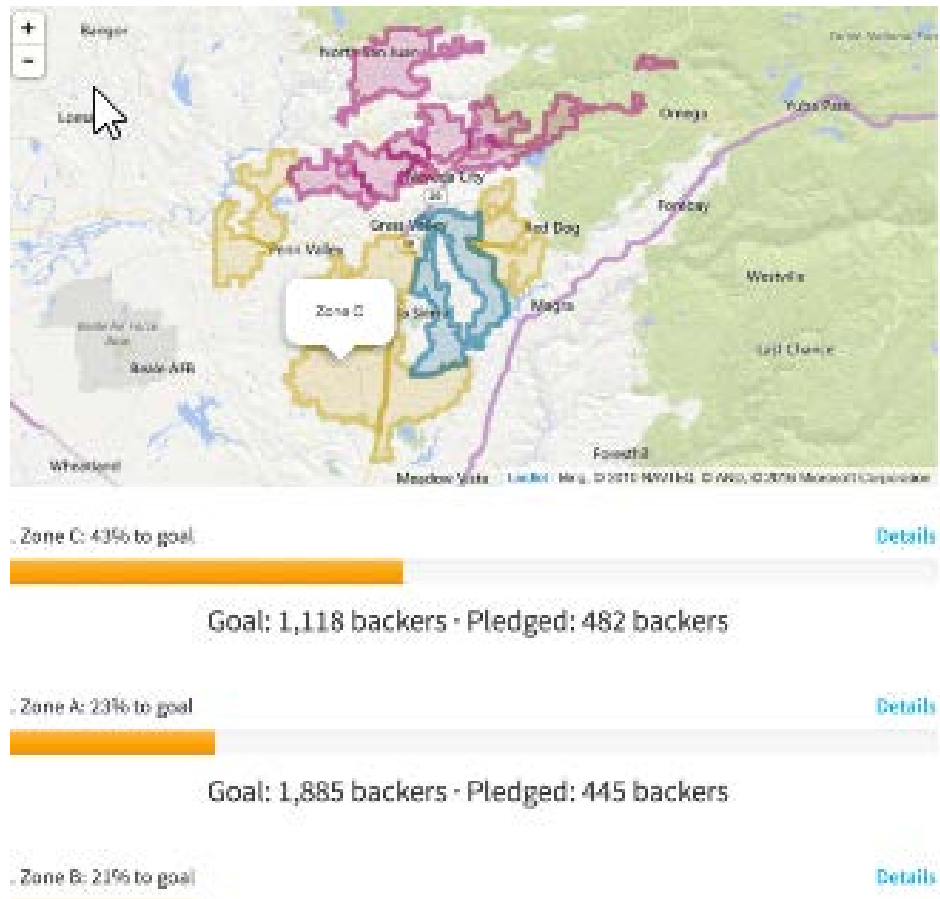
Figure G-1: COS Service Zones
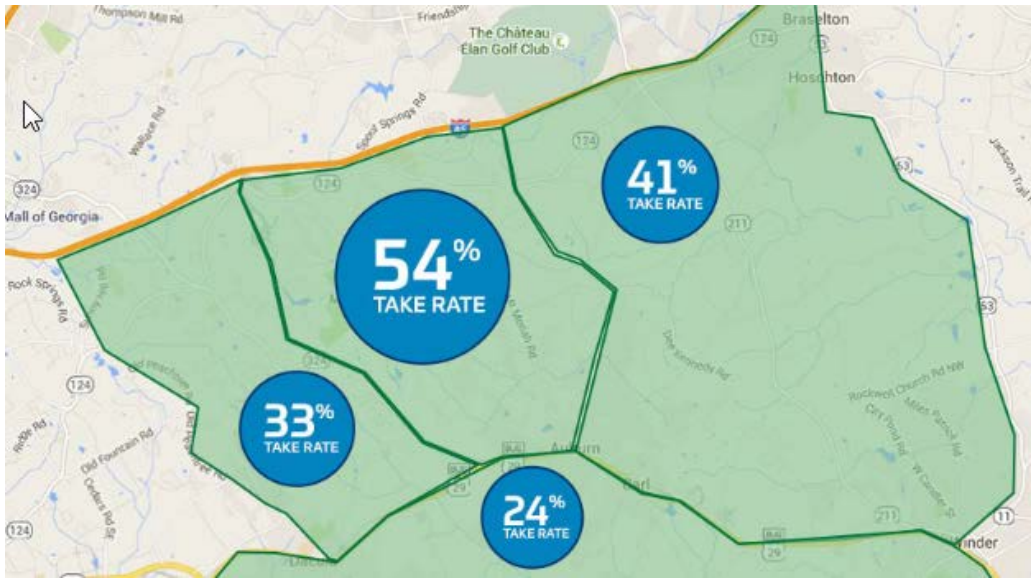
2. This illustration shows the Vetro tool's ability to take deposits that will generate commitments for future fiber builds

Figure G-2: Vetro Fiber Map

3. This tool can segment areas into fiber hoods that must achieve a minimum target take rate to justify a fiber build.

Figure G-3: CrowdFiber

Zone C: 43% to goal   Details

Goal: 1,118 backers · Pledged: 482 backers

Zone A: 23% to goal   Details

Goal: 1,885 backers · Pledged: 445 backers

Zone B: 21% to goal   Details

H: Fiberhood Economics

SECOM provided Tilson with a high-level overview of its capital costs for developing a Fiber to the Premise network (FTTP network, or Fiberhood), that would cover 85% of the premises in Springfield. SECOM's fiber build costs are split into two buckets: Fixed Costs, which are the costs of building aerial fiber and customer taps along they alley; and Variable Connection Costs, which are the costs of the customer premise electronics (CPE), materials to get from tap to inside the building, and labor. All costs are based on aerial construction. [55]

As Figure H-1 shows, the greater the uptake (represented as % participation rate), the lower the cost per user. If 100% of the premises of Springfield subscribe to the fiber service, the projected capital cost per users is $ 1375 ($625 fixed cost amortized over all premises plus $750 variable cost per subscriber). If 50% of the premises subscribe, the project capital cost per user is $2,000 ($625 fixed cost amortized over ½ of premises plus $750 variable cost per subscriber). While these may sound high, they are often lower on a cost per user basis than wireless deployments in very low density areas.

Figure H-1: Capital Expense of In-Town Fiber Build as a Function of Participation Rate

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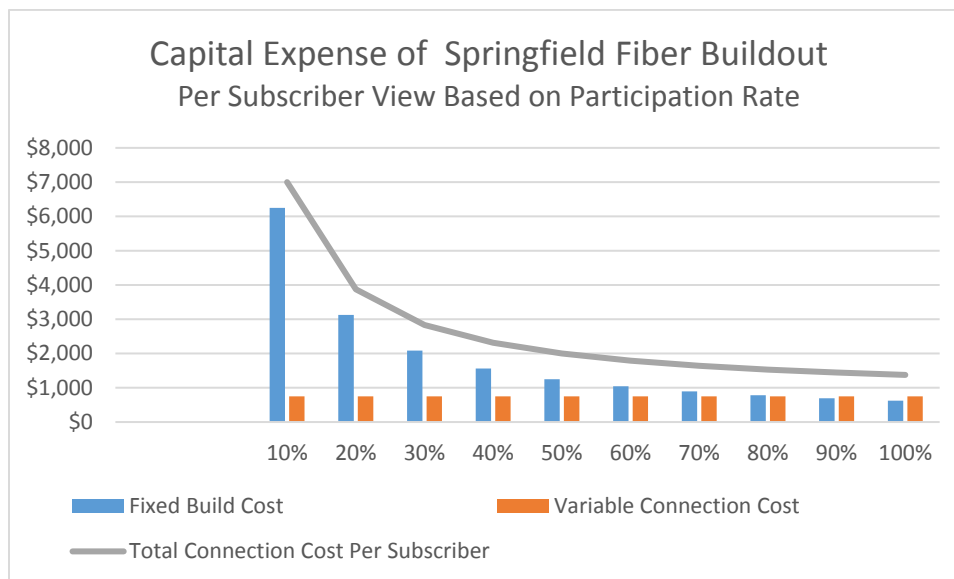
[55] Source: Jon Saunders, SECOM via email 8/1/17 and phone 8/2/17.