

I'll Vote for You

IF You Make

My Netflix Work

The 5A's of Community Broadband in Colorado

Frank Ohrtman

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DEDICATION

This book is dedicated to the volunteer community broadband activists everywhere who seek to make their communities better places to live. Without their selfless dedication in struggling against difficult odds, many communities would fail.

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PREFACE: I'LL VOTE FOR YOU IF YOU MAKE MY NETFLIX WORK

Although the author is a long time subscriber to and fan of Netflix, this book is not about Netflix. Rather, it is a study in what internet speeds are needed to enjoy a positive Netflix experience (something Netflix has little control over). The speed required to enjoy high definition streaming from Netflix align somewhat with the Federal Communications Commission's (FCC) definition of broadband at 4 megabits per second (Mbps) downstream and 1 Mbps upstream.

The author has traveled at least 15,000 miles around the state of Colorado establishing 17 Local Broadband Planning Teams covering 42 of the state's 64 counties for the purposes of improving the local broadband environment of the state's rural and remote communities. An unscientific approach to determining the speed of the internet infrastructure for a given community is to pose the question "Can you stream Netflix?" If not, then the simple assumption is that broadband, as defined by the FCC, is not available in that community. In addition, the author has collected thousands of speed test surveys from across the state and, very simply put, determined that broadband is not available for some majority of the state's rural and remote communities.

What is a community to do if broadband is not available to them? It is important for community leaders to realize that, without taking action themselves, they may be dependent on Wall Street or Washington for a solution that may not come. Those communities that realize that broadband is a utility just like power, water, roads, etc., and establish control over their broadband environment will succeed in enjoying access to 21st century healthcare, education, public safety and economic development, and, of course, a positive Netflix HD (and like services) streaming experience.

This book explains a five-step process (the "5 A's") for communities that seek to gain control of their broadband environment. Breaking a generations-long cycle of dependence on outside entities to plan, fund

and build telecommunications infrastructure is not easy. In Colorado, a number of rural and remote communities have embraced “the 5 A’s” described in this book and have either succeeded or are in the process of gaining control over their broadband environment.

It is hoped that this book can guide communities around the world in gaining control of their broadband environment and enjoy all that 21st century broadband has to offer. By applying the “5A’s” and adhering to a three-part mantra of a) all solutions are local b) no one size fits all and c) it does NOT cost millions of dollars to bring broadband to rural or remote communities any community can succeed in gaining control of their broadband environment.



Figure 1 Microwave middle mile near Crestone, CO. Photo by Justin Davis

From Whence Cometh Thy Help: Wall Street? Washington? Denver? Your Community?

I will lift up mine eyes unto the hills, from whence cometh my help.

Psalm 121:1

To enjoy Netflix streaming video service in high definition (HD), the subscriber must have an internet speed of approximately 4 Mbps downstream. For some majority of households in rural and remote

communities of Colorado, that is not possible due to inadequate telecommunications infrastructure. How will Colorado achieve ubiquitous broadband? What is the change agent?

Broadband is a utility just like water, electricity and roads. Most utilities in Colorado are operated in close coordination with the communities they serve either via the local government (roads, water, waste water) or a cooperative of subscribers (Example: rural electric and telephone cooperatives). The record for success and sustainability for community control of utilities is undeniable. Given the high cost of infrastructure and slow rate of return, few investors are interested in utilities.

The situation for some majority of communities in rural and remote communities of Colorado is that there exist one or more internet service providers (ISP, cable and telephone duopoly in most but not all communities). It is important to note the difference between internet service providers and broadband service providers. The Federal Communications Commission defines broadband as 4 megabits (Mbps) downstream and 1 Mbps upstream. Not all ISPs, telephone companies or cable TV providers are broadband service providers.

Why Wall Street-backed Providers Won't Help Your Community

Cable providers are largely in the mode of “harvesting” their investments in cable modem infrastructure. That is, there is little investment, upgrading or expansion of the existing network to meet current or future demands. In addition to “harvesting”, national corporate telephone companies pursue a strategy of “farming” subsidies from Universal Service Fund, Connect America Fund, High Cost Funds and a smorgasbord of other “support” from ratepayers.

The other half of the telecommunications duopoly is the incumbent telephone company of which 3 providers cover most of the United States. In Colorado, for the majority of communities, that provider is CenturyLink. Much of their network serving rural and remote communities is based on 1980's Asynchronous Transfer Mode (ATM) technologies which are not “redundant, abundant or affordable”. In short, the “pipe” that feeds communities outside metro areas is limited, outdated and prone to frequent, daylong outages.

Despite all the hype around 4G cellular data systems, those services do not exist beyond most metro areas of the nation. Outside metro areas cable modem and cellular providers rely on the incumbent telephone

company's middle mile for internet bandwidth.

Why Washington-backed Programs Won't Help Your Community

Federal programs such as those from the US Department of Agriculture's Rural Utilities Services (RUS) and the National Telecommunications and Information Administration (NTIA) are helpful where they can be applied but barely scratch the surface of the need in terms of funding ubiquitous broadband availability in rural and remote communities of Colorado. In short, communities should not plan on federal programs alone to improve their broadband environments.

Why State Government Won't Help Your Community

No state government has made any significant (as a percentage of the general fund) investment in broadband. Of note, 19 states, including Colorado, have expressly forbidden local governments from investing in their broadband environments. These laws do nothing but bar communities and local governments from helping themselves in building their broadband environment.

I'll Vote for You If You Make My Netflix Work!

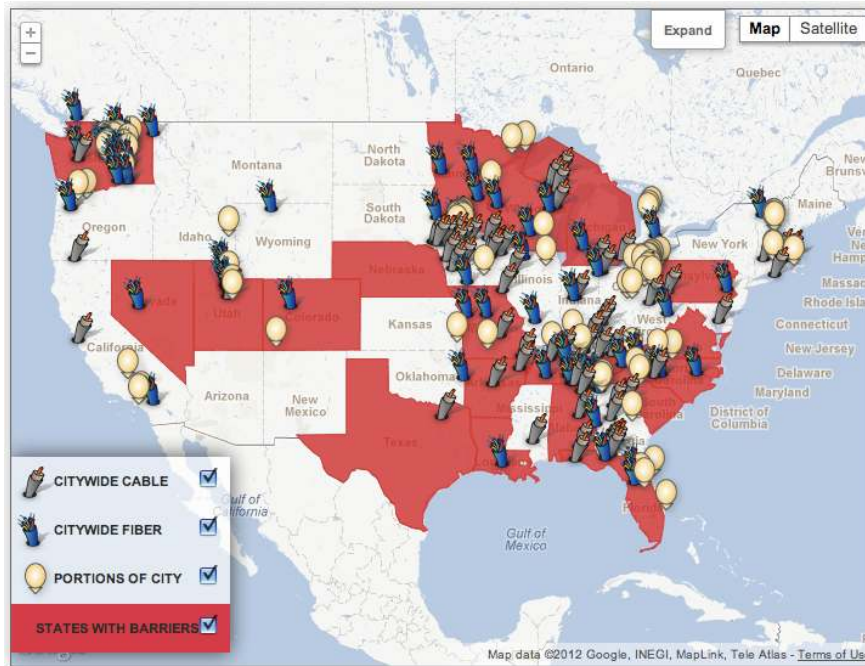


Figure 2 Nineteen states have banned municipally owned broadband networks forcing a dependence on corporate-owned networks which may not deliver broadband

Source: <http://www.muninetworks.org/communitymap>

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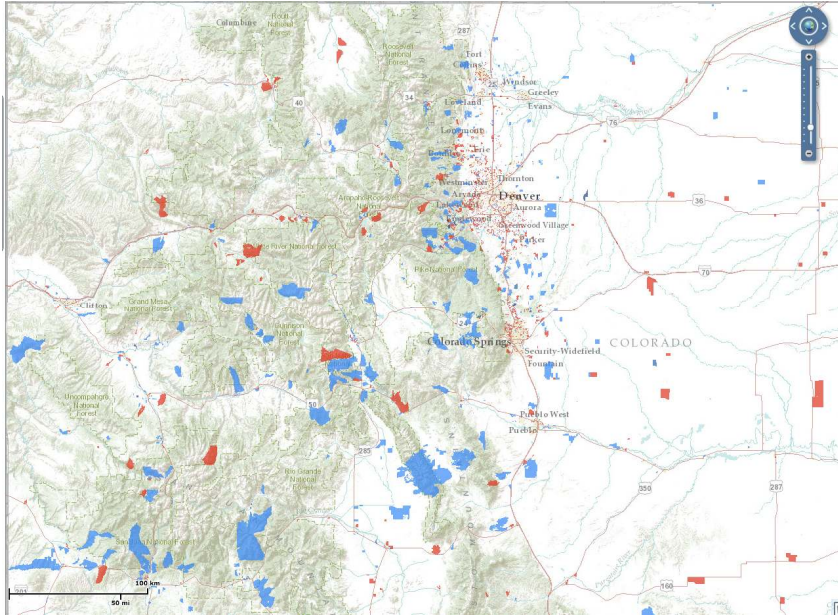


Figure 3 Problem: actual (not advertised) wireline (cable and telephone) broadband speeds for Colorado by census block. Red indicates presence of broadband, blue indicates a lack of broadband based on thousands of speed tests. Congress, in section 706 of the Telecommunications Act of 1996 requires the FCC to report annually on whether broadband “is being deployed to all American in a reasonable and timely fashion.”.

Source: State of Colorado <http://maps.co.gov/coloradobroadband>

Figure 3 above illustrates broadband availability in Colorado based on thousands of speed tests (actual not advertised speeds). Very simply put, broadband may not be available in communities outside of the state’s metro areas pointing to a market failure on the part of national service providers.

Solution

In the past, water, roads, and electric needs were met by local volunteers working in partnership with their elected officials to form the respective utility or government entity (department of transportation, rural electric cooperative, water department, etc.), communities must now work together to establish broadband utilities.

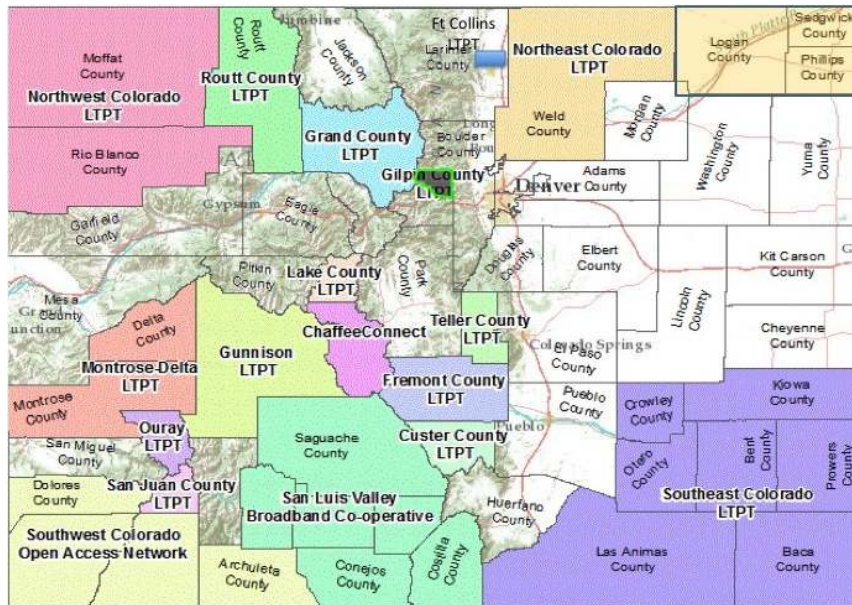


Figure 4 Colorado's Local Broadband Planning Teams cover about two-thirds of the state's landmass.

Source: State of Colorado <http://maps.co.gov/coloradobroadband>

Imagine the burden of organizing a rural electric or telephone cooperative in the 1930's or 1940's. It wasn't done in a day and

obtaining capital investment at the tail end of the Great Depression was no mean feat. In the pre-social media or even broadcast email era, this took enormous effort on the part of community organizers of those times and places. Today is no different.

The initial solution to ensuring all American communities have access to competitive broadband services is a Local Broadband Planning Team. The following chapters provide a step-by-step organizing guide for those community organizers seeking to improve their broadband environments.

The 5 A's

Broadband is a utility just like water, electricity and roads. In most communities, utilities are, in some ways, community owned and controlled. As in the past in building other utilities, communities are now faced with building their broadband utilities. There are three lessons to be learned regarding that process: 1) all solutions are local, 2) no one size fits all, and 3) it does not cost millions of dollars to bring 21st century broadband speeds to your community. This 3-part mantra then drives a methodology known as “the 5 A's” for building Local Broadband Planning Teams and community broadband utilities.

Aggregate Local Experience

There is no step in this process more important than recruiting a strong Local Broadband Planning Team. Team members are best recruited based on a) experience with previous or on-going efforts to improve broadband environments in targeted communities b) positions as elected officials or similar status c) technical expertise (Information Technology or telecommunications professionals) and d) the local service providers.

Assess Broadband Environment

What are the immediate shortfalls of the broadband environment (or lack thereof)? Market failures on the parts of incumbent service providers are often noted in the form of network outages lasting days. This can indicate outdated infrastructure and a dire need for the LBPTs to take control of their local broadband environment.

Assess and Aggregate Demand

What is meant by "Our internet stinks?" Is it too slow? Are there frequent outages? What are community anchors currently subscribing to? What speeds are they getting? What are they paying for? How much bandwidth do community anchors need to accomplish their mission? What is the total demand for a community? Does the current infrastructure (supply?) support that level of demand?

Competition drives improved broadband environments. In many communities, there is no forum for consumers of large quantities of bandwidth to compare pricing and bundle their aggregate buying power for mutual benefit. An LBPT, by virtue of team members' status as consumers of large quantities of bandwidth, represents a buyer's co-op for bandwidth.

Adopt Existing Resources and Solutions

A frequent excuse for low broadband speeds is the assumption that the capital expense necessary to bring improved broadband to a community is prohibitively high. That assumption is based on the notion that the incumbent or any new market entrant would need to spend millions of dollars to trench fiber from a tier one internet service provider's urban location to the rural community. Communities have resources (towers, existing fiber assets, power transmission lines, rooftops, etc) that can reduce that capital expense (CAPEX). In aggregating resources, capital expenses are cut and broadband environments can improve.

Disruptive technologies in broadband infrastructure deliver comparable if not superior value at a fraction of the cost. Examples include carrier neutral locations (CNL), Gigabit Ethernet (GigE), microwave and fixed

wireless.

Adapt for Sustainability

Assuming a community is successful in the previous steps, how is the community network sustained over generations to come? What is its legal status? What is the symbiotic relationship between it and the community? How is it funded? How does it pay for network upgrades? How does it counter competition?

The following pages will expand on the 5 A's. As the case studies in the appendices indicate, this process has been repeated throughout Colorado and can be duplicated just about anywhere. The 5 A's serve as a template for any community to control their broadband destiny and compete in a 21st century economy.



Figure 5 Crestone team (left to right) Kevin Pesenecker, Dennis Heuhaus, Ralph Abrams, Chester White and Cheryl Rowe

A # 1: Aggregate Local Experience: All Solutions Are Local

Local Broadband Planning Teams are gatherings of skilled community volunteers. Division of labor is key to success in getting necessary tasks completed sooner rather than later. Broadband activists, those with previous experience with similar ventures, elected officials, IT people from public and private sectors as well as local service providers make excellent team members. The figure below details a successful mix of talents for a Local Broadband Planning Team.

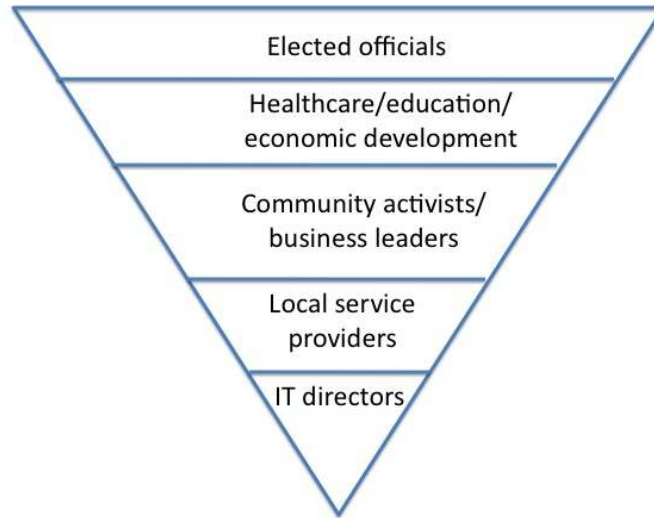


Figure 6 Matrix of involvement in growing a Local Broadband Planning Team

"5 A's"	Team(s)	Task
Aggregate Experience	Recruitment Team	Ensures appropriate talent is on the team.
Assess Broadband Environment	Technology Team	Determine what technologies are currently in place; speeds of service, extent of outages, pricing compared to Denver market.
Assess and Aggregate Demand	Survey and Marketing Team	<ol style="list-style-type: none"> 1. Gathers info on what products are currently being purchased, amounts and pricing; 2. Simultaneously gathers info on what subscribers need for their businesses and what they are prepared to pay for bandwidth 3. Obtain pre-sales contracts from those businesses, i.e. commitments to buy 4. Determine best estimate of take rates in business, public and residential markets 5. Determine range of products and pricing that will ensure best take rate
Adopt Resources and Solutions	Technology Team	<ol style="list-style-type: none"> 1. What is already in place that could be applied to a new network thus minimizing CAPEX for new network? 2. What technology and vendor mix will deliver the best solution for the community? 3. Technology partners that can

		contribute to aggregate demand?
	Business Team	1.Drive financing
Adapt for Sustainability	Legal Team	Determine legal entity that plans, funds, builds, operates the network vis-à-vis SB-152 and other laws
	Policy Team	Ensure elected officials are aware of community benefits of new network
	Business Team	1.Compile business plan 2.Determine numbers necessary to sustain entity 3.Ensure financing is readily available

Table 1 The "5 A's", Local Broadband Planning Sub-Teams and short list of tasks

Sub-Team	Tasks	Skill Sets/Background
Technology	Identify resources and solutions	Engineering/information technology/telecommunications; city and/or county infrastructure staff, local service provider staff
Survey and Marketing	Assess and aggregate demand	Consumer marketing, statistics, sales,
Legal	Determine form of business to avoid SB152 conflicts; ensure sustainability via early legal planning	Member of CO bar, well-versed in telecom law, especially SB-152
Business	Adapt for sustainability	Experienced entrepreneurs, chamber of commerce members, accountants
Recruitment	Aggregate Experience	Drive recruitment for team as a whole with focus on sub-teams
Political	Adapt for sustainability	Educates elected officials on importance of the network for the sustainability of the community, ensures Ft Collins has a "strategic bandwidth advantage"

Table 2 Functions of sub-teams

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Figure 7 Spring 2012: fiber optic cable (black line above fence line) allegedly owned by telephone company with market cap of \$26 billion along US 50 between Montrose and Gunnison, CO exposed by landslide. Note how rancher has installed new fence where the telephone company leaves fiber optic cable (and livelihoods of Gunnison county residents) open to elements. Cattle are more valuable than cable? Photo by Corey Bryndal



Figure 8 Central office in Silverton, CO. 100 Mbps+ middle miles serves upwards of thousands of users with slow speeds and outages (no redundancy)

A #2: Assess Broadband Environment: Is It Redundant, Abundant, and Affordable?

Some rural Coloradoans report that if they want to download a movie for Saturday night viewing, they need to start the download on Thursday night. Why? What is the state of the local broadband environment? How “bad” is it? How slow is it? Why is it “bad” or “slow”? Do a number of the symptoms tie back to a single 1980’s ATM

middle mile (the “pipe” coming into town)? Does that lack of competition in the middle mile further hinder competition in the last mile? Is the copper wire infrastructure decades old? Is there a single provider who faces no competition and as a result sees no business case or incentive to upgrade the infrastructure?

While extensive engineering studies mapping outside plant (telephone speak describing the copper wire infrastructure) are helpful, a discussion by local information technology (IT) and telecommunications professionals can quickly point to the weakest links in broadband (or lack thereof) infrastructure.

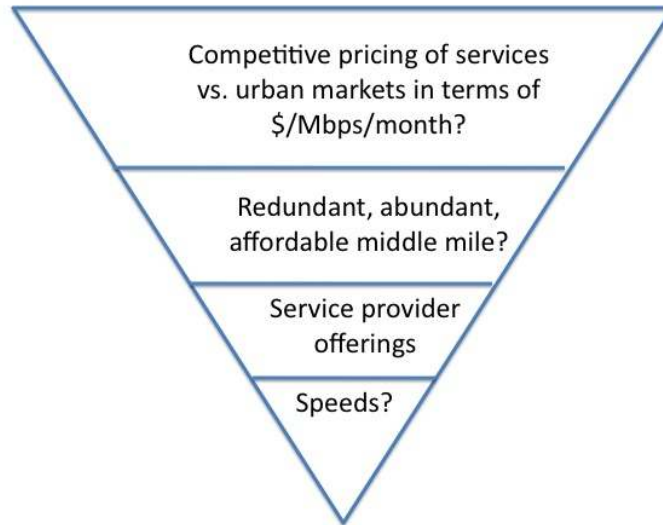


Figure 9 Elements to be assessed in the existing broadband environment. "You gotta count it before you can cure it."

Element	Current state	Desired state
Maximum actual (as opposed to advertised) internet speeds available to residential or small business subscriber?	2 Mbps from cable or DSL providers?	Potential for gigabit per second for residential and small business markets
Approximate average cost per megabit per second per month for residential or small business services?	\$50	\$2
Technology type(s)	Cable modem, DSL, fixed and mobile wireless	Anything that delivers faster speeds at less cost
Potential for gigabit per second service generally available from private sector in the next 24 months?	Zero	Best case: Gigabit per second speeds via FTTH/B; Near term fix: 50 Mbps via fixed wireless
Number of Internet outages lasting more than one hour in 12 months over last 3 years?	Multiple?	Zero or 99.999% availability for residential and small business markets
Number of middle mile options?	1	2 or more

Quality of cell phone data services, i.e. got 4G?	3G available, with data caps	Ubiquitous 4G minus data caps
Data caps on wired and wireless services?	Yes	No data caps. What is justification?

Table 3 Criteria for assessing broadband environment

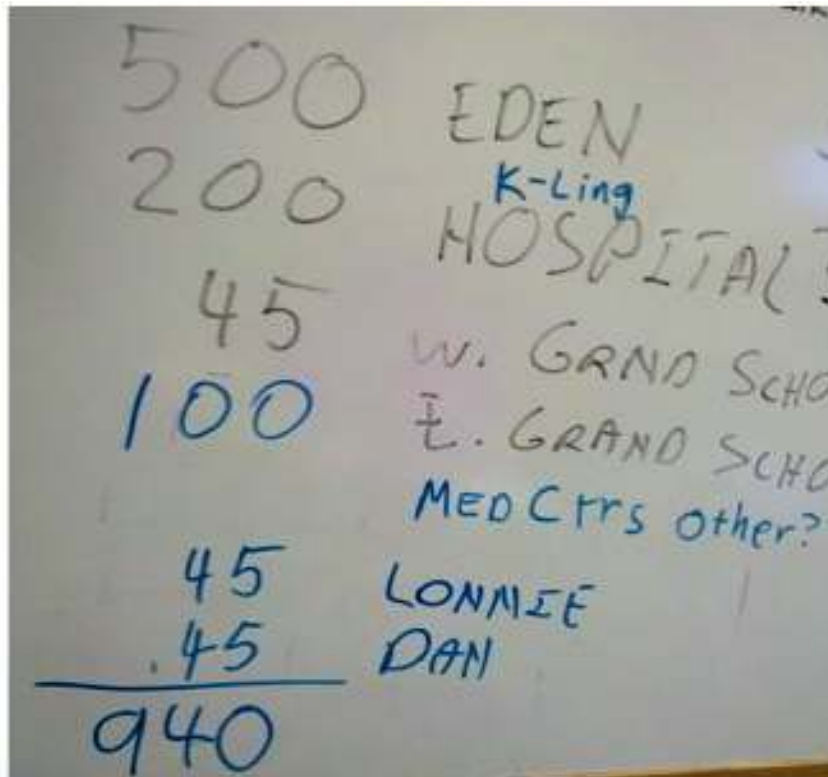


Figure 10 Results of an "auction" to determine aggregate demand for service providers and community anchor institutions in Grand County, CO. Total: about 1 Gbps for 6 buyers of big broadband

A #3: Assess and Aggregate Demand: No One Size Fits All

How many consumers want High Definition (HD) streaming video

(Netflix, for example) and what are they willing to pay for it? How many community anchors demand 100 Mbps+ service in order to accomplish their missions (schools, hospitals, etc)?

Community leaders seeking to improve their broadband environments often send letters to the national corporate service provider seeking investment in their community's infrastructure by the service provider.

They are frequently met with a letter politely replying that there appears to be no business case to support further investment in the broadband (or lack thereof) infrastructure of that community at this time. What is missing from the discourse is accurate market research by either party (in most market economies, service providers do this) in the form of a survey that essentially asks "What do you really need to do your mission (school, library, hospital, ISP, small business, etc) and what are you willing to pay for that?"

In the experience of some Colorado Local Broadband Planning Teams, some surprising results have emerged indicating demand in towns of 15,000 residents might have an aggregate demand in the multiple gigabits per second (Gbps). While some might focus on community anchors institutions (CAIs; public sector entities such as schools,

hospitals, county governments, etc), public sector demand might be only 10% of total community demand. Ergo, government strategies of building to public sector entities only are badly flawed. Planning must include the community as a whole.

Finally, demand is not real until a subscriber pays for it. To meet that end, service providers scouting a community for demand should quantify that demand in the form of presale contracts that bind a subscriber on a "If we build it, you will come or we will see you in court" basis.

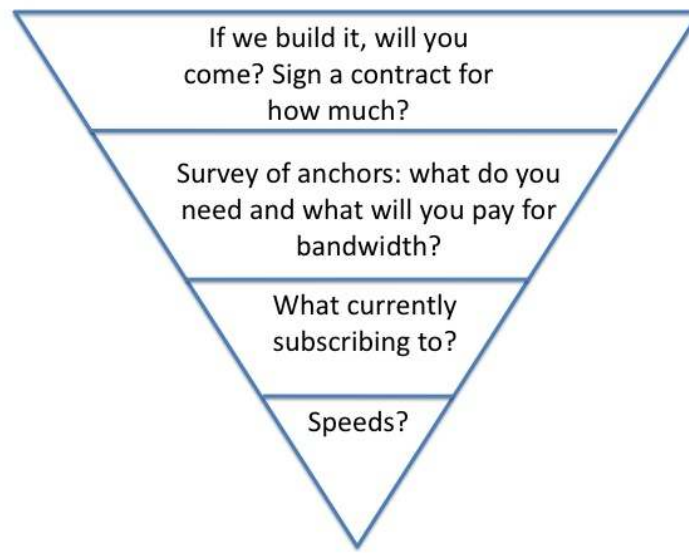


Figure 11 Matrix for assessing and aggregating demand.

Element	"if" ...	"then" ...
Speed test: what do subscribers currently enjoy in terms of speed?	If subscribers receive less than 4 Mbps down and 1 Mbps up (definition of broadband)...	They should review their options for broadband service.
Do subscribers receive the speeds they contract for?	If subscribers receive slower speeds than they contracted for...	They should consider changing providers or joining a Local Broadband Planning Team (LBPT) to plan/fund/build their broadband environment.
What do subscribers pay for the services they subscribe to, especially community anchor institutions and businesses?	If ATM-based (T-1, DS-3, OC-3, etc) technologies are only solutions and are very expensive in terms of \$/Mbps/month compared to urban pricing...	They should <ol style="list-style-type: none"> 1. Work to assess an estimate of the total demand for their community 2. Invite other service providers or models to consider entering their market
What would one subscribe to if price were no object, i.e. what do they need to be as effective and efficient as possible?	It is considerably more than what we are buying now...	It supports business case for significantly more demand than current supply in the market.

What is extrapolated total demand for the community?	1 Gbps/1000 people?	It communicates this figure to the market to entice private sector investment in the local broadband environment and/or build business case for new market entity to build new capacity (supply) into this market.
Does supply satisfy aggregate demand or are there artificial barriers to greater supply in place?	The cost of bandwidth in \$/Mbps/month exceeds Denver pricing...	It is time to introduce more supply by whatever means necessary to meet demand.
If a much faster service was available for only slightly more money than what you are currently paying would you contract to buy that service?	Yes	The aggregate contracts support business case for new investment in local broadband infrastructure.
If that service were available, at what price point would you sign a contract for it?	It is the same as we are paying for incumbent's over-priced services	It is time to aggregate contracts support business case for new investment in local broadband infrastructure

Table 4 Decision matrix for assessing and aggregating demand



Figure 12 Justin and Jason Davis of Skywerx installing microwave near Crestone, CO. Photo by Skywerx

A #4: Adopt Existing Resources and Solutions: It Doesn't Cost Millions of Dollars to Bring Broadband to Your Community

Per the polite letters from incumbent service providers mentioned earlier, the chief barrier for those providers or communities seeking to improve the local broadband environment is the perceived high cost of infrastructure or capital expenditure (CAPEX). An inventory of resources that might already be present in the market may negate the need for many expensive aspects of broadband infrastructure thus reducing the

CAPEX necessary to upgrade the community's broadband environment.

Examples might include tall buildings or towers that can be used for microwave or fixed wireless, fiber optic cable in the local electric grid, overhead electric wire infrastructure that might support fiber optic cable, master rights of way plans from local governments, etc.

Technology Resources and Solutions

In terms of solutions, technology marches on. Disruptive technology refers to those technologies that “cheaper, simpler, smaller and more convenient to use”.¹ One example is the use of fixed wireless as a last mile solution. New subscriber devices cost about \$50 each. The radios that transmit to them and support dozens of subscribers cost about \$250. Contrast that with an industry figure for fiber-to-the-home (FTTH) for urban or suburban communities at \$2,000 per home passed. Another example is the Gbps microwave middle mile over Wolf Creek Pass in Colorado that cost about \$300,000 in contrast to a “rural legend” that put a fiber path over that pass in excess of \$30 million. The microwave CAPEX is about 1% the cost of the fiber optic cable solution.

A low-cost and potentially disruptive physical solution to a market

¹ Christensen, Clayton M., Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, Harvard Business School Press, 1997

problem is the carrier neutral location (CNL). In many rural markets, there is one middle mile provider (often the incumbent telephone company), which often results in a lack of competition in the last mile. The City of Cortez, Colorado solved this issue by establishing a CNL in their City Services Building. This has resulted in enabling 3 middle mile providers and 4 last mile providers to operate competitively in this town of 9,000.

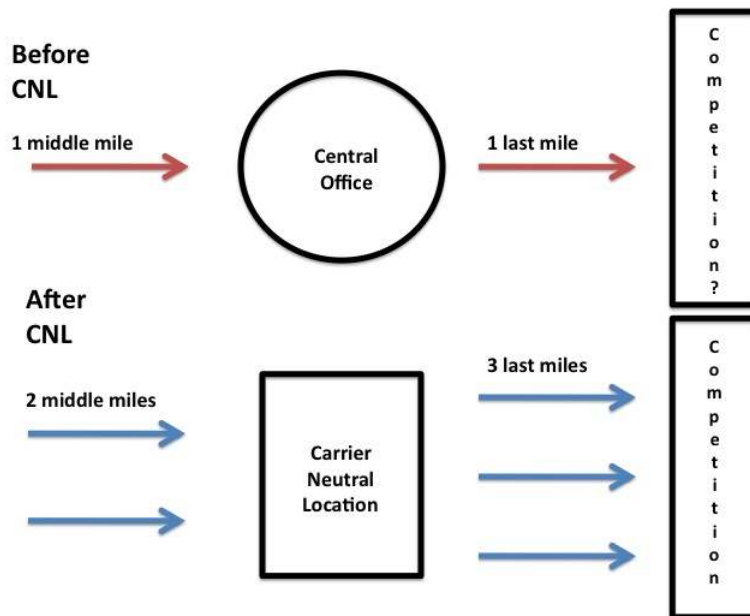


Figure 13 Before and after of a carrier neutral location in terms of introducing competition in middle and last mile markets



Figure 14 Carrier neutral location for City of Cortez, CO which as a result enjoys 3 middle mile providers and 4 last mile providers. Photo by Corey Bryndal

Dumb Pipe

Internet services have been delivered largely from a duopoly of telephone and cable TV providers who insist on selling telephone and/or video services as part of a “triple play” of services (voice, video, data). This worked fine for a while but now seems to be have run its course. Netflix, for example, is known as an “over the top” service which means it is not tied to any one service provider and is accessible to any one with internet access (preferably at broadband speeds).

The same is true of voice over internet protocol (VoIP) telephone services from providers such as Vonage or MajicJack. Some fixed wireless and fiber to the home services allow subscribers to buy only the internet service (data) and let the customer determine which mix of video and voice services they want. This is known in the industry as “dumb pipe”, meaning there is no predetermined service (cable TV or telephone) that must be included in any service offering.

Open Access

Open access, when used in relationship to community broadband, refers to a network that does not discriminate in terms of service providers, content or applications. A local government or cooperative might own and operate the physical assets (physical layer) of fiber optic or wireless network elements, perhaps the switching and even the routing functions. Beyond that, third party service providers have access to the network. An analogy might be city streets where the local government owns and maintains the network of streets and service providers such as FEDEX, J.B. Hunt Trucking and others operate on that network.

Business Model Solutions

The term “solutions” refers not only to technologies but service providers and business models as well. An excellent case study is Crestone, Colorado. Mayor Ralph Abrams took the lead in improving his community’s broadband environment. Given a state law that prohibited his town government from investing in their broadband environment, Mayor Abrams took it upon himself and community activists to launch Crestone Telecom, Limited Liability Company (LLC), a wireless internet service provider (WISP) which took advantage of the microwave middle mile over Wolf Creek Pass and fixed wireless last mile technologies (\$50 subscriber devices, \$250 transmitter radios).

Alternative legal entities, such as cooperatives, also serve as a solution in bringing broadband to a community. Since its founding in the spring of 2011, the San Luis Valley Broadband Co-operative has succeeded in encouraging at least 3 new middle mile entrants in the San Luis Valley market. The spring of 2011 also saw the introduction of a new form of cooperative in Colorado, the Limited Cooperative Association (LCA), a hybrid of patron cooperative and limited liability company or

corporation (can sell equity shares in the venture).

Financial Resources and Solutions

The inevitable question regarding the construction of community broadband is: "where does the money come from?" For a sustainable network the answer should be: "From the community." Start-up capital for Crestone Telecom came from some 50 local investors pledging a total of \$100,000, which was matched by an \$116,000 loan from the local economic development district. At the launch of construction of the network, Crestone Telecom had some 200 pre-sale contracts and was cash-flow neutral within 6 months of that launch. Crestone Telecom emphasizes local funding and control as a model for flexibility in contrast to the incumbent telephone company's out-of-state ownership and control. It should be noted that Crestone is located in Saguache County, Colorado, one of Colorado's 4 persistent poverty counties (20% of the population lives below the poverty line). The other 3 persistent poverty counties in Colorado lie within 100 miles of Crestone in the San Luis Valley. If Crestone could fund its own broadband network, so can almost any other community in America.

What Is Crowdfunding?

Crowdfunding is a means of raising money through an internet platform from a wide audience of small investors or charitable donors.

Crowdfunding is codified in the JOBS Act, which was signed into law by President Obama on April 5, 2012. It is expected that many communities could use crowdfunding mechanisms to a) sell equity shares in local broadband ventures, especially to members of the community who expect to benefit from the introduction of broadband services b) use the crowdfunding platform as a means of taking pre-sale contracts and/or payments which then raise funds for building the necessary infrastructure to deliver broadband service to a community.

We Could Learn a Lot From Arizona: Aggregating Highway Rights of Way for Middle Mile Fiber Optic Cable

Arizona provides a shining example of how Colorado could adopt existing resources to improve the broadband environment for rural and remote communities across the state. As the demand for digital Internet speed increases exponentially, many of Arizona's rural residents and businesses found they either did not have high capacity digital services available at all, or the available services did not provide sufficient capacity to support new video intensive Internet services such as eLearning, Tele-Health, Telework and IPTV, etc. These shortcomings

have been limiting factors in the availability of jobs, educational opportunities, public safety and healthcare services in such areas. The passing of Senate Bill 1402 in 2012 allows for the spread of significantly higher-speed broadband access to citizens statewide, accelerating economic growth, education, public safety, healthcare, and digital government in Arizona.

Specifically, the bill expands existing rules governing Arizona Department of Transportation's (ADOT) management of state rights of way (ROW) to include transportation-of-information as well as vehicles. When funding is provided to ADOT, from a fund to be managed by the Digital Arizona Project, ADOT will be requested to bury multiple empty fiber-optic conduits along specified state highways-using existing ROW wherever possible. These multiple separate conduits will be leased to broadband providers by the Project on a cost recovery basis. Providers must contract to install fiber before conduits are constructed. The outcome of the Project will be streamlined access to the ROW at significantly lower costs to providers for constructing long distance digital capacity to reach rural communities. These lowered costs are expected to encourage new investments by provider's thereby

accelerating and improving availability of high-capacity digital services in poorly served areas of Arizona. It is expected to take a number of years to fully implement this program throughout the rural areas of the state.²

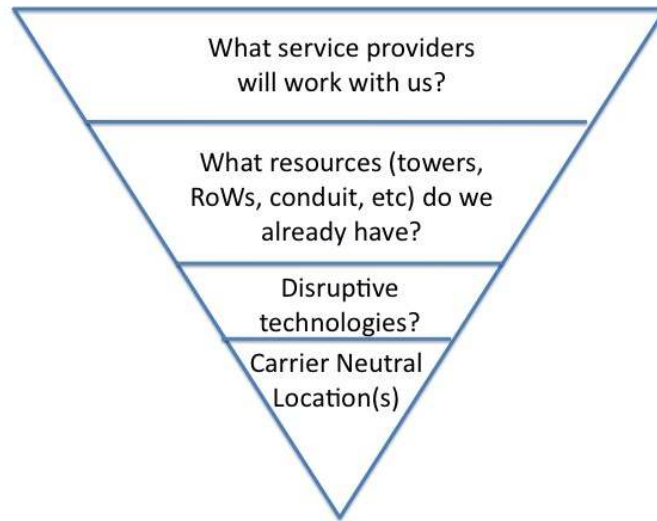


Figure 15 Matrix for adopting existing resources and solutions

² <http://aset.azdoa.gov/node/128>

Element	Action
<p>What does the community already have that can support improved broadband infrastructure?</p>	<ol style="list-style-type: none"> 1. Existing fiber or conduit for fiber? 2. Policy for universal Rights of Way (RoW)? 3. Municipally- or cooperative-owned electric utility with overhead wires?
<p>What resources contribute to what solutions?</p>	<p>What local innovations can we devise to support this network build? Private sector contributions? Crowdfunding? Bonds?</p>
<p>Carrier Neutral Location(s)</p>	<p>Where is it most advantageous to deploy these? How do they contribute to open access network approach while driving down costs, inspiring competition?</p>
<p>Middle Mile that is “redundant, abundant and affordable”</p>	<p>How many middle mile connections are possible for the network to ensure high availability, low cost and high bandwidth for all?</p>
<p>Leverage disruptive technology (“cheaper, simpler, smaller, more convenient to use”) where possible</p>	<p>What can we learn from the Google Kansas City project? Longmont? Discussion of GPON v. Active Ethernet? Gigabit microwave and 100 Mbps point to multipoint technologies where necessary?</p>

Table 5 What are the resources and solutions that will make the deployment as inexpensive as possible

A #5: Adapt for Sustainability

Assuming a community is successful in building a state-of-the-art broadband network, how will that network be sustained over the years? How will it keep up with the march of technology? How will it defend itself from competition? How will it stay in the good favor of its subscribers in the community? How will it fund maintenance and upgrades?

The answers are not necessarily technological or financial but more legal in nature. What is the legal entity that can sustain the network? Given that broadband is a utility; the answer lies in the lessons of utilities, such as electric cooperatives, formed in the past. Across rural and remote Colorado, there are a number of success stories in rural electric cooperatives (and municipally-owned utilities such as Longmont Power and Communications, Longmont, Colorado) dating back to the 1930's and beyond (1912 for Longmont) that offer lessons in sustainability. It can be argued that where the profit motive or Wall Street's quarter-to-quarter, price-per-share mentality is removed from the equation, sustainability becomes easier.

Where communities have focused on simple models that support open access broadband infrastructure models such as in Cortez or Longmont, Colorado, those communities enjoy high levels of broadband at very affordable prices.

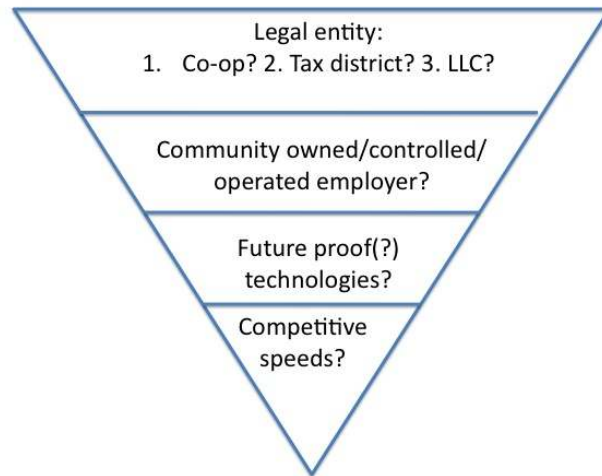


Figure 16 Matrix of elements for adapting for sustainability

Element	Action
Determine legal form for long-term ownership/operation of network: local government? LLC? LCA? Co-op?	Must determine this now. What does network do? Lease dark fiber to last mile providers? Operating entity is anything but a local government? Exclusive lease to a local cooperative to operate in best interests of the community?
Does a public entity need to take the lead? If so, prepare for a ballot initiative per SB-152 (forbids public entity retailing telecommunications services) allows city or county to own and operate network or network elements?	Follow Longmont's example? If so, start promoting ballot initiative now for the next election.
How to provide for community ownership or control to ensure sustainability and satisfaction of community customer base i.e. ensure long-term independence of the community's broadband environment from whims of Wall Street or Washington DC?	Community funding via crowdfunding? Sales to community anchor institutions at competitive pricing? Pre-sale contracts/deposits? Build as subscribers/neighborhoods buy/commit to buy service?

Table 6 Decision matrix for ensuring sustainability of the project

Broadband is a Utility: Find Something That Works For Your Community

It doesn't matter if a cat is black or white, so long as it catches mice.

Deng Xiaoping on Chinese market reforms, 1961

What consumer, in the developed world, upon rising in the morning, agonizes over where the electricity or water comes from for their morning rituals? Does the electricity come from a privately held company? Or, one that is publicly traded? Or, is it operated by the local government? Is it a cooperative owned by the consumers of that utility? Did they shop around for the best solution for their water or wastewater needs? What about the road to the office: private toll way or public highway?

If they are to remain competitive in a 21st century global economy, communities large and small must take control of their broadband environments and futures. No one cares more about the quality of a utility service than the consumer. Ergo, it is always in the best interest of consumers to have a say in how a service is deployed and operated. Broadband is no different. The history of roads, electricity, and water services provide a blueprint going forward for communities in planning

for ubiquitous broadband services.

Many Shades of Gray?

The challenge for communities in the 21st century is embracing broadband as a utility as well as a strategy to ensure their broadband infrastructure is redundant, abundant and affordable. The last couple of generations were well served by existing utilities (power, water, roads, etc) and needed only to maintain them. In addition to crumbling existing infrastructure, communities of the 21st century America must now determine how their communities will acquire competitive broadband infrastructure. Will they wait for a Wall Street-backed entity to bring it to their communities? Will they pursue some form of federal or state assistance? Will they devise public-private partnerships? Or, will they take on some other innovative and pragmatic approach to securing their broadband future? Relative to past generations of community administrators (mayors, county commissioners, etc), this entails risk. Risk nothing, gain nothing.

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Figure 17 Electric power for most of the Rocky Mountain West is provided by electric cooperatives. why not do the same for broadband?

Source: Tri-State Generation and Transmission Association

All Solutions Are Local

Without some form of local control of their broadband environment, communities can expect little responsiveness to their broadband needs

both now and in the future. The case studies in the appendices that follow show a wide diversity of success stories. No two cases are the same in terms of business models, legal entities involved, technologies applied, network architectures, etc. The evidence clearly indicates that the most efficient and effective services in Colorado's rural and remote communities are supplied by local entities (Example: SECOM's 100 Mbps service to rural schools for \$125/month or \$1.25/Mbps/month, a figure not seen in the Denver area) .

No One Size Fits All

Despite arguments for efficiency made possible by scalability of telephone company DSL or cable TV company cable modem services made by national service providers, no national service provider is offering the business and residential internet speeds as seen by some local providers. It does not appear that the national providers can tune a "one size fits all" business model to keep up with local demand. Many communities in southern Colorado can take advantage of 50+ Mbps download speeds from local service providers offering fiber-to-the-home or fixed wireless.

It Does NOT Cost Millions of Dollars to Bring Broadband To Your Community

When Colorado's rural and remote communities reach out to national

service providers to provide broadband to their communities, they are met with objections that claim upgrading the local network to offer broadband services would cost millions of dollars and thus presents no good business case for the provider. Given “one size fits all” models geared for dense urban and suburban markets and especially if the technology involved is based on 1980’s ATM technology, the argument may be correct. Communities that coordinate the use of existing resources and 21st century disruptive technologies are finding that it does NOT cost millions of dollars to bring broadband to their communities. Case studies outlined in the following pages prove this.

Stop Waiting for Godot

This book provides a framework for communities to take control of their broadband environment. Use it!

Appendix A Case Study: Crestone Telecom, LLC



“What”	“How”
Aggregate Experience	Founding team comprised of: <ol style="list-style-type: none"> 1. Then Crestone mayor, Ralph Abrams 2. Retired IT professionals Dennis Neuhaus, Chester White 3. Wireless experts Justin and Jered Davis of Skywerx 4. Sales and marketing expert: Cheryl Rowe
Assess broadband environment	100+ speed tests indicated: <ol style="list-style-type: none"> 1. 500 Kbps down, 200 Kbps up from single provider; 2. Single middle mile NOT “redundant, abundant, affordable”
Assess and aggregate demand	<ol style="list-style-type: none"> 1. Comments from speed test survey indicate what people are subscribing to and: 2. What they would pay for better service? 3. Obtained 200+ presale contracts
Adopt existing resources and solutions	<ol style="list-style-type: none"> 1. Crowdfunding: raised \$100,000 from 50 local investors 2. \$116,000 loan from Region 8 Economic Development District 3. Partnered with WISP Skywerx for 4 Gbps microwave middle mile at <1% cost of fiber 4. Fixed wireless last mile: \$50 subscriber device, \$250 radios
Adapt for sustainability	<ol style="list-style-type: none"> 1. Legal entity: Limited Liability Company 2. Locally funded 3. Locally operated employing local labor 4. Revenues stay in community 5. Revenues fund upgrades 6. Service to community anchors not previously available

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	<ol style="list-style-type: none"><li data-bbox="553 317 1206 384">7. In \$/Mbps/month, great savings for businesses and residences alike<li data-bbox="553 384 1206 451">8. Redundant, abundant, affordable middle mile ensures state-of-the-art competitive edge
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Appendix B Case Study: Southwest Colorado Access Network (SCAN)



“What”	“How”
Aggregate Experience	Team founded by members of Southwest Colorado Council of Governments (county commissioners and town mayors) and Region 9 Economic Development District to form Southwest Colorado Access Network (SCAN) catering to needs of community anchor institutions and economic development
Assess broadband environment	Extensive inventory of telecommunications infrastructure performed by Mid-States Consulting: <ol style="list-style-type: none"> 1. Central office locations 2. Middle mile assets 3. Existing fiber assets and capacities 4. Existing and potential carrier neutral locations
Assess and aggregate demand	Survey of businesses and community anchor institutions detailing: <ol style="list-style-type: none"> 1. Speeds of services currently subscribed to 2. Cost of services in \$/Mbps/month and compared to urban \$/Mbps/month 3. Desired speeds to accomplish mission. 4. Number of phone lines and prices paid for telephone service as measure of demand for VoIP services

<p>Adopt existing resources and solutions</p>	<p>Makes use of a number of resources and solutions</p> <ol style="list-style-type: none">1. Funded via \$3 million grant from State of Colorado Department of Local Affairs; \$1 million local match2. Leveraged existing fiber assets and carrier neutral locations in member communities
<p>Adapt for sustainability</p>	<p>Sustainability ensured by:</p> <ol style="list-style-type: none">1. Legal entity: local government2. Community anchor support3. Partnerships with regional service providers4. Strong community involvement (SWCOG) and volunteers on Telecommunications Committee

Appendix C Case Study: ChaffeeConnect

CHAFFEECONNECT

"What"	"How"
Aggregate Experience	Team anchored on Chaffee County Economic Development Corporation with active participation by local service providers, business community and community anchor institutions
Assess broadband environment	Assessment includes: <ol style="list-style-type: none"> 1. Extensive survey by the team determined single middle mile which is not "redundant, abundant or affordable" 2. Slow internet speeds 3. Reluctance of incumbent corporate service providers to expand capacity
Assess and aggregate demand	Multiple surveys of existing and desired speeds/pricing including: <ol style="list-style-type: none"> 1. Residential 2. Business 3. Community anchor institutions 4. Satisfaction survey re: "Are you getting what you pay for?" with overwhelming response being: "No!" 5. Tally of aggregate demand both present and at future points where existing contracts expire balanced with what new market entrants require for successful business plan

<p>Adopt existing resources and solutions</p>	<p>Process of:</p> <ol style="list-style-type: none">1. Inviting multiple service providers to the county (including Cablevision, CenturyLink, EagleNet and others)2. Identified public and private assets that could be applied to building “redundant, abundant and affordable” infrastructure3. Adoption of disruptive technology in the form of gigabit per second microwave as “redundant, abundant and affordable” middle mile solution followed by fixed wireless as last mile solution that serves subscribers in towns as well as outside of towns4. Ultimate solution: Skywerx microwave middle mile with fixed wireless last mile from Chaffee Telecommunications, LLC
<p>Adapt for sustainability</p>	<p>Regional service providers are in process of entering this market using local capital and labor to serve community anchors and local residential and business market. Legal entity: subset of Chaffee County Economic Development Corporation</p>

Appendix D Case Study: FremontConnect

"What"	"How"
Aggregate Experience	Team anchored on Upper Arkansas Council of Governments (UACOG) with active participation by: <ol style="list-style-type: none"> 1. Local service providers, 2. Business community 3. Community anchor institutions including Canon City School District, Fremont Sanitation District, Fremont County
Assess broadband environment	Assessment includes: <ol style="list-style-type: none"> 1. Extensive survey by the team determined single middle mile which is not "redundant, abundant or affordable" 2. Slow internet speeds/high \$/Mbps/month relative to urban pricing 3. Reluctance of incumbent corporate service providers to expand capacity
Assess and aggregate demand	Multiple surveys of existing and desired speeds/pricing including: <ol style="list-style-type: none"> 1. Residential 2. Business 3. Community anchor institutions
Adopt existing resources and solutions	Process of: <ol style="list-style-type: none"> 1. Regional service provider will provide a middle mile that is "redundant, abundant and affordable" 2. Existing fiber ring serving school district can be leveraged to provide fiber services to business and residential markets 3. Identification of a carrier neutral location on the existing fiber ring
Adapt for sustainability	Regional service providers are in process of entering this market using local capital and labor to serve community anchors and local residential and business market. Legal entity: subset of UACOG: a local government

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Appendix E Case Study: Northwest Colorado Regional Broadband Cooperative

"What"	"How"
Aggregate Experience	Team anchored on active participation by: <ol style="list-style-type: none"> 1. Routt County Board of Commissioners 2. Moffat County Board of Commissioners 3. Town of Steamboat Springs 4. Steamboat Springs School District 5. Moffat County School District 6. Zirkel Wireless 7. Resort Broadband
Assess broadband environment	Assessment includes: <ol style="list-style-type: none"> 1. Extensive survey by the team determined single middle mile which is not "redundant, abundant or affordable" 2. Slow internet speeds/high \$/Mbps/month relative to urban pricing 3. Reluctance of incumbent corporate service providers to expand capacity
Assess and aggregate demand	Multiple surveys of existing and desired speeds/pricing fro residential, business and community anchors.
Adopt existing resources and solutions	Process of: <ol style="list-style-type: none"> 1. Regional service provider will provide a middle mile that is "redundant, abundant and affordable" 2. Existing fiber ring serving school district can be leveraged to provide fiber services to business and residential markets 3. Identification of a carrier neutral location on the existing fiber ring
Adapt for sustainability	Regional service providers are in process of entering this market using local capital and labor to serve community anchors and local residential and business market. Legal entity: 501c3 non-profit

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Appendix F Case Study: San Luis Valley Broadband Cooperative

“What”	“How”
Aggregate Experience	Team comprised of Region 8 Economic Development District aka San Luis Valley Development and Resource Group, San Luis Valley Board of Cooperative Educational Services, Adams State College, Crestone Telecom, LLC, San Luis Valley Regional Medical Center
Assess broadband environment	Multiple daylong outages by CenturyLink point to single CenturyLink middle mile i.e., not “redundant, abundant or affordable”.
Assess and aggregate demand	Speed tests, surveys, discussions between anchor institutions and regional service providers point to multiple gigabit per second demand in Alamosa and surrounding communities.
Adopt existing resources and solutions	<p>New middle mile construction since formation of non-profit cooperative (“Es milagro!”):</p> <ol style="list-style-type: none"> 1. Viaero: 400 Mbps microwave via La Veta Pass 2. Skywerx: 4 Gbps microwave via Wolf Creek Pass 3. GoJade Communications: fiber optic cable via La Veta Pass 4. EagleNet Alliance: fiber optic cable via La Veta Pass 5. CenturyLink (proposed): fiber optic cable via Poncha Pass

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Adapt for sustainability	Legal entity: 501c3 non-profit cooperative
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Appendix G Case Study: Longmont Power and Communications



"What"	"How"
Aggregate Experience	<p>Citizens of Longmont who support ballot initiative to over ride SB-152 provisions banning public entities from retailing telecom services.</p> <p>Vince Jordan, Telecom Manager - Longmont Power and Communications, City of Longmont: 30 years experience in telecommunications.</p>
Assess broadband environment	<p>Longmont Power installed a fiber optic ring in the city in 1995. Given state forbidding municipal networks, city was unable to make this asset available for broadband use until after two ballot initiatives (first attempt unsuccessful) made it possible. Existing infrastructure provided by telephone and cable TV company does not compare favorably with fiber to the home speeds especially in terms of supporting community anchors and high tech industries.</p>

Assess and aggregate demand	Ballot initiative processes plus a very active effort to court Google fiber (made it to final 5 contenders nation-wide) mobilized citizens, community anchors and businesses to participate in multiple surveys that painted a strong picture of potential demand for fiber optic-scale services.
Adopt existing resources and solutions	Multi-strand fiber ring equates to 4,300 fiber miles circling Longmont. Platte River Power Authority is an active partner in expanding service from that ring.
Adapt sustainability	Legal entity: utility owned and operated by a local government for 100 years.

Appendix H Case Study: Southeast Colorado Local Broadband Planning Team



“What”	“How”
Aggregate Experience	Team comprised of SECOM, a division of Southeast Colorado Power Association (SECPA), county commissioners and economic development staff
Assess broadband environment	Determined in late 1990’s that bandwidth needs for community anchors was not being met. Middle mile services to towns in service area was not “redundant, abundant, nor affordable”.
Assess and aggregate demand	As a community-based electric cooperative, Southeast Colorado Power Association listened to community concerns regarding slow internet speeds and the high cost of internet bandwidth in their service area.
Aggregate resources and solutions	Utilized existing power transmission and distribution lines to bring fiber optic cable services to community anchors, businesses and residents throughout Southeast Colorado

	Power Association's service area and beyond.
Aggregate sustainability	<p>Legal entity: sponsored by Southeast Colorado Power Association, a 501c12 utility cooperative. SECOM has been serving almost all schools (almost 15% of all public schools in Colorado) in their service area with low cost, high bandwidth internet services, and building to building connectivity in each district (\$125/100 Mbps/month). Support to community anchor institutions ensures on-going community support. CAls served by SECOM include:</p> <p>K-12 Schools (27) by community</p> <p>Aguilar</p> <p>Campo</p> <p>Cheraw</p> <p>Eads</p> <p>Edison</p> <p>Fowler - multiple locations</p> <p>Granada</p> <p>Holly</p> <p>Kim</p> <p>La Junta - multiple locations</p> <p>Lamar - multiple locations</p> <p>Las Animas - multiple locations</p> <p>Manzanola - multiple locations</p>

	<p>Mc Clave</p> <p>OJC – Child Development Services (preschool) – multiple locations</p> <p>Ordway - multiple locations</p> <p>Pritchett</p> <p>Pueblo District 70 – multiple locations</p> <p>Rocky Ford - multiple locations</p> <p>Sheridan Lake (Plainview)</p> <p>Springfield - multiple locations</p> <p>Swink</p> <p>Trinidad – multiple locations</p> <p>Vilas</p> <p>Walsenburg</p> <p>Walsh</p> <p>Wiley</p> <p>BOCES (2)</p> <p>La Junta</p> <p>Lamar (They provide a state of the art distance learning solution to their member schools. This has been in place since 2000)</p> <p>Community Colleges (4)</p> <p>Lamar Community College</p> <p>Otero Jr College – (Multiple locations)</p> <p>Pueblo Community College</p>
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	Trinidad State Jr College
	Higher Ed (1)
	Colorado State University – Pueblo
	List of Community Anchor Institutions (CAI) – Page 2
	Libraries (11)
	Aguilar
	Eads
	Holly
	La Junta
	Lamar
	Las Animas
	Pueblo
	Rocky Ford
	Trinidad
	Walsenburg
	Walsh
	Hospitals (7)
	Eads
	La Junta
	Lamar
	Pueblo and Pueblo West (multiple locations)

	Springfield
	Trinidad
	Walsenburg
	Mental Health Clinics
	Eads
	La Junta
	Lamar – multiple sites
	Ordway
	Rocky Ford
	Springfield
	Trinidad
	Walsenburg
	Towns/Cities (14 - some have multiple sites connected with fiber)
	Aguilar
	Cheraw
	Fowler
	Granada
	Holly
	La Junta – Multiple locations
	Lamar - multiple locations
	Las Animas
	Manzanola
	List of Community Anchor Institutions

	<p>(CAI) – Page 3</p> <p>Towns/Cities – continued</p> <p>Rocky Ford</p> <p>Springfield</p> <p>Swink</p> <p>Trinidad – Multiple locations</p> <p>Walsh</p> <p>County Offices (8)</p> <p>Baca – Multiple locations</p> <p>Bent – Multiple locations</p> <p>Crowley – Multiple locations</p> <p>Heurfano</p> <p>Kiowa</p> <p>Otero – Multiple locations</p> <p>Prowers – Multiple locations</p> <p>Pueblo – Multiple locations</p> <p>Law Enforcement/Fire Departments (29)</p> <p>Aguilar Police</p> <p>Fowler Police</p> <p>Granada Police</p> <p>Holly Police</p> <p>Lamar Police</p>
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	Las Animas Police
	Manzanola Police
	Ordway Police
	Rocky Ford Police
	Springfield Police
	Swink Marshall
	Trinidad Police
	Walsh Police
	Baca Sheriff
	Bent Sheriff
	Heurfano Sheriff
	Kiowa Sheriff
	Las Animas Sheriff
	Otero Sheriff
	Prowers Sheriff
	Pueblo Sheriff – Multiple locations
	List of Community Anchor Institutions (CAI) – Page 3
	Law Enforcement/Fire Departments – continued
	Cheraw Fire
	Granada Fire
	La Junta Fire
	Lamar Fire

	Las Animas Fire
	Rocky Ford Fire
	Sheridan Lake Fire
	Springfield Fire
	USDA – Colorado State University Extension Offices (4)
	Eads
	Lamar
	Rocky Ford (two sites)
	Springfield

ABOUT THE AUTHOR

Frank Ohrtman has almost 20 years experience in telecommunications. Some of his “firsts” include: a) sold some of the world’s first VoIP switches for Netrix Corporation, b) deployed the first WiMAX network in Colorado c) established some of the nation’s first Local Broadband Planning Teams (a total of 17) covering 42 of Colorado’s 64 counties d) compiled Colorado’s first comprehensive database of community anchor institutions and their respective internet speeds and e) facilitated the founding of Colorado’s first rural broadband co-operatives.

As President of WMX Systems, Mr. Ohrtman wrote 3 American Recovery and Reinvestment Act grant applications; all 3 applications recommended by respective state governors for funding. He has served as a consultant on projects for Government of Canada, Tricom (Dominican Republic), WorldNet, (Puerto Rico), Hatifcom (Abu Dhabi), and San Isabel Telecom. Frank has been a guest speaker at 4G World, WiMAX World, InterOp, Voice on the Net (US and Mexico) as well as Schools, Health, Libraries Broadband Coalition (SHLB) conference.

Mr. Ohrtman has an extensive publications list including McGraw-Hill publications: WiMAX Handbook, Wi-Fi Handbook and Softswitch: Architecture for VoIP. He may be best known for his self-published work I'll Vote for You If You Make My iPhone Work.

Frank is a former Naval Intelligence Officer who specialized in electronic warfare. He holds a Master of Science degree in Interdisciplinary Telecommunications from University of Colorado, a Master of Arts degree in International Relations from Boston University, and a bachelor’s degree in Political Science from University of Iowa.

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