

How well is EAGLE-Net aligned with the National Broadband Plan?

by

Chris Ballantine

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How well is EAGLE-Net aligned with the National Broadband Plan?
written by Chris Ballantine
has been approved for the Interdisciplinary Telecommunications Program

David Reed, chair

Ken Fellman

Doug Sicker

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How well is EAGLE-Net aligned with the National Broadband Plan?
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Broadband data networks are becoming increasingly capable of delivering enhanced services and speeds well beyond the capabilities of traditional dial-up. A 2010 federal government report titled the National Broadband Plan includes guidelines and objectives for broadband development. This study will analyze EAGLE-Net Alliance in Colorado to determine the extent to which its broadband project is aligned with the relevant goals in the National Broadband Plan. EAGLE-Net Alliance is a statewide public sector broadband project. This includes the original government network, known as “EAGLE-Net,” which was owned by a regional organization of school districts known as the Centennial Board of Cooperative Educational Services. A federal grant from the 2009 American Recovery and Reinvestment Act helped expand the EAGLE-Net vision to a statewide level. The Centennial Board of Cooperative Educational Services played a leadership role in creating a statewide intergovernmental entity, known as EAGLE-Net Alliance, in order to deploy and manage the EAGLE-Net network statewide. This paper is a case study analyzing a publicly funded broadband project to determine the extent to which it is aligned with the National Broadband Plan.

This study is important because the success of the National Broadband Plan lies, in part, on periodically checking the progress of its stated goals. The study will attempt to interpret data from the federal grant period to determine the extent to which National Broadband Plan goals are aligned with the objectives and results of the EAGLE-Net Alliance project. Also, in the National Broadband Plan and elsewhere, there is support for designating broadband technology as a universal service, or at least a much more valuable technology than dial-up internet access. This relates to a transition in public policy away from telephone to focus on broadband. EAGLE-Net Alliance is perhaps an important early example of frontier broadband policy to promote broadband deployment and indirectly contribute to designating broadband as a universal service.

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Glossary of Terms

BTOP: Broadband Technology Opportunities Program

CAF: Connect America Fund

CAIs: Community Anchor Institutions

CBOCES: Centennial Board of Cooperative Educational Services

CCI: Comprehensive Community Infrastructure

CDOT: Colorado Department of Transportation

CTA: Colorado Telecommunications Association

CU-Boulder: University of Colorado at Boulder

EA SAC: Environmental Assessment special award condition

EAGLE-Net: Educational Access Gateway Learning Environment Network

ENA: EAGLE-Net Alliance

ESA: 1973 Endangered Species Act

E-Rate: aka Schools and Libraries Program, part of the Universal Service Fund

FCC: Federal Communications Commission

FONSI: Finding of No Significant Impact

FRGP: Front Range GigaPop

FWS: Fish and Wildlife Service, part of the Department of the Interior

IGA: Intergovernmental Agreement

ISP: Internet Service Provider

NBP: National Broadband Plan

NEPA: 1969 National Environmental Policy Act

NHPA: 1966 National Historic Preservation Act

NLR: National LambdaRail

NOAA: National Oceanic and Atmospheric Administration, part of the Department of Commerce

NTIA: National Telecommunications and Information Agency, part of the Department of Commerce

Recovery Act: 2009 American Recovery and Reinvestment Act

RSAs: Regional Service Areas

RUS: Rural Utilities Service, part of the Department of Agriculture

SHPO: State Historic Preservation Office

USF: Universal Service Fund

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CHAPTER 1

INTRODUCTION

Government intervention has been common in the telecommunications industry since at least the Bell Telephone monopoly in the early 20th century. However, the telecommunications world is different in the early 21st century. Unlike the early 20th century where one type of communications technology could only deliver one service, 21st century technology is increasingly capable of delivering multiple kinds of services. Broadband data networks are becoming increasingly capable of delivering enhanced services and speeds well beyond the capabilities of traditional dial-up. A recent federal government report titled the National Broadband Plan (NBP or the plan) includes guidelines and objectives for broadband development.¹ This study will analyze EAGLE-Net Alliance (ENA)² in Colorado to determine the extent to which its broadband project is aligned with the relevant goals in the National Broadband Plan. ENA is a public sector broadband project. The original government network was owned by a regional organization of school districts known as the Centennial Board of Cooperative Educational Services (Centennial BOCES or CBOCES). CBOCES called its network “EAGLE-Net.” A federal grant from the 2009 American Recovery and Reinvestment Act (Recovery Act) helped expand the EAGLE-Net vision to a statewide level. CBOCES played a leadership role in creating a statewide intergovernmental entity known as ENA, in order to

¹ The NBP clarifies that although the private sector is very important for broadband development, there is still a role for government.

² EAGLE-Net stands for Educational Access Gateway Learning Environment Network. In this paper, “EAGLE-Net” generally refers to the network itself, “CBOCES EAGLE-Net” refers to the broadband network operated as a regional network before the Recovery Act grant was awarded, while “ENA” refers to the intergovernmental entity that was created after the grant was awarded in order to implement the network through the spendspending of the grant funds.

deploy and manage the EAGLE-Net network statewide. This paper is a case study analyzing a publicly funded broadband project to determine the extent to which it is aligned with the NBP.

This study is important because the success of the NBP lies, in part, in periodically checking the progress of its stated goals. The study will attempt to interpret data from the federal grant period³ to determine the extent to which NBP goals are aligned with the objectives and results of the ENA project. Also, in the NBP and elsewhere, there is support for designating broadband technology as a universal service, or at least a much more valuable technology than dial-up internet access. This relates to a transition in public policy away from telephone to focus on broadband. ENA is perhaps an important early example of frontier broadband policy to promote broadband deployment and indirectly contribute to designating broadband as a universal service.

Across the literature, broadband technology is considered to have numerous positive effects on any society that chooses to embrace it. Further, according to an increasing number of scholars over the past decade, broadband is good for the economy [1] [2] [3] [4]. For example, broadband service is a “necessary precondition for economic growth and competitiveness,” as it was estimated to account for approximately one-third of the increase in productivity in Germany, France, and the UK from 2001- 2011 [2]. Further, the literature reports that the economic impact of broadband technology is an important factor for public policy that specifically targets broadband [4].

It is perhaps useful to consider public policy that aims to promote broadband development in simple economic terms. Policies can target demand-side areas, such as attempting to promote broadband adoption. Policies also can target supply-side areas, such as providing

³ The grant period is September 2010 to December 2014 (revised from an earlier completion date of August 2013).

funding for building broadband infrastructure. At least one scholar argues that successful policies target both demand and supply [5]. However, there is some academic debate about if and how much government support is needed on the demand-side, and whether policy is more effective on the supply-side [6] [7]. For the purpose of this study, ENA is considered a supply-side project, which, largely through a public policy grant, received funding to focus on the deployment of broadband infrastructure.

Universal service is perhaps an indirect or secondary policy goal for ENA. This is significant because broadband policies and some of the literature have increasingly made connections to universal service over the past few years. This attention to broadband possibly reflects a shift in the focus of universal service policy away from targeting telephone. There was less support for targeting dial-up internet access as a universal service, but broadband has made internet access much more attractive and valuable. However, universal service for broadband is different, and perhaps more challenging compared to the 20th century telephone experience.

Access to broadband services is a challenge shaped by many factors, and numerous actors play a role in offering potential solutions. A key component to offering a broadband service is the infrastructure, which can vary based on the type of network. A large initial cost is incurred to build network infrastructure, but some of this cost can be reduced if government funding is obtained. Government institutions themselves seek access to broadband services, and sometimes own the networks they utilize. Further, to build government networks, sometimes another government provides funding, typically in the form of a grant. A common reason given to support funding is to replace high-cost, low-performance services currently offered with cheaper⁴ and better performing services. Further, proponents of government intervention often argue that

⁴ Cheaper refers to a lower cost of service compared to before a grant period, but the infrastructure costs are significant nonetheless.

existing market forces are insufficient to provide broadband in geographically challenging areas. The costs are usually greatest, in relative terms, in rural and mountainous areas due to typically low population densities. Regions with challenging geography provide a significant obstacle to improving broadband availability, which is particularly true for Colorado.

The first section will discuss the EAGLE-Net Alliance and its broadband project, including summaries of the project itself, the expected benefits, the project implementation, and the results. The second section will discuss the NBP, focusing on availability, education, government performance, and benchmarking to provide context for a suggested framework of how well ENA is aligned with the plan. The third section will discuss an unscientific survey given to some ENA subscribers. Finally, a conclusion will suggest the extent to which ENA is aligned with the NBP, and possible areas of further research.

CHAPTER 2

EAGLE-NET ALLIANCE

This section will provide an overview of the story of EAGLE-Net Alliance. Abstractly, ENA's predecessor planted its seeds with a smaller, regional EAGLE-Net network before the Recovery Act, and now is attempting to grow and evolve as a statewide intergovernmental entity after the Recovery Act. First, a brief summary will provide some context of ENA by examining the environment leading up to the federal grant award. Next, a brief summary of the federal grant will help illuminate the change in the focus from Centennial BOCES to ENA, with an expanded statewide broadband vision. Third, a summary of the proposed benefits of ENA will show the potential opportunities that would help achieve this statewide vision. Fourth, a brief analysis of the implementation of the federal grant will highlight some of the important issues during the grant period. Finally, a brief section will suggest a basic framework to measure the performance of ENA in the context of the federal grant.

2.1 Brief history and context

Broadband development in Colorado is affected by unique geographic characteristics. Mountainous terrain and rural areas, along with urban centers reflect the significant diversity of Colorado's physical and human geography. However, even with the various and numerous inherent challenges that exist due to geographic diversity, public policy has attempted to overcome these challenges in a variety of ways. One recent example is ENA. ENA began developing a statewide middle mile broadband network in September 2010 when the Recovery Act grant was awarded. An important ENA objective is to be financially sustainable by the end

of the grant period, December 2014. However, it is helpful to briefly consider EAGLE-Net leading up to the federal grant award.

CBOCES was originally an internet service provider (ISP) serving school districts on a regional level in parts of northern Colorado. However, the Recovery Act provided an opportunity for CBOCES members⁵ to consider an expanded EAGLE-Net vision. Thus, CBOCES applied⁶ for a Recovery Act grant with the intent to offer internet access to all Colorado school districts and other so-called community anchor institutions.

The \$100 million Recovery Act grant was an important factor in allowing CBOCES to expand its vision to build a statewide fiber network connecting all school districts and other government institutions known as Community Anchor Institutions (CAIs). Consequently, when the grant was awarded, an intergovernmental entity was created named EAGLE-Net Alliance. In 2010 ENA officially took over the grant and the operation of the Eagle-Net network from CBOCES [8]. The grant was administered through the National Telecommunications and Information Administration (NTIA) and supervised by the grants office at the National Oceanic and Atmospheric Administration⁷ (NOAA).

2.2 Overview of the EAGLE-Net Alliance federal grant

This section will provide an overview of the federal grant awarded to CBOCES and the impetus for the transition from a regional network to a statewide network. In 2007 EAGLE-Net

⁵ As of April 2014, CBOCES members total 14 school districts [70].

⁶ The official organization to apply was the Centennial Board of Cooperative Educational Services (CBOCES), a.k.a. Colorado Community Anchors Broadband Consortium (CCABC).

⁷ More specifically, this was done by the Acquisition and Grants Office at NOAA.

was developed as a network serving the members of CBOCES [9].⁸ By 2010 when the grant was received, the vision was expanded with the creation of ENA to focus on a comprehensive statewide network to enable high-speed internet to every Colorado public school [9]. The new EAGLE-Net Alliance planned to operate as a cost-sharing organization for its members in Colorado. The statewide expansion of the CBOCES EAGLE-Net network was necessary, in part, because of poor broadband characteristics in Colorado. For example, a 2009 report cited that the bandwidth supplied to Colorado school districts was well below the national average⁹ [10]. Further, in some Colorado K-12 school districts, “market forces weren’t sufficient to drive technological investment in Colorado’s most remote, rural, and underserved areas” [11] [9].¹⁰

The mission of ENA initially focused on “[e]nabling access for technology-rich, quality education to every student in all 178 Colorado public school districts via broadband network services, advanced applications and Internet2 connectivity” [12]. The application CBOCES submitted for the first round of the grant process outlines the objectives and proposed benefits.¹¹ The main priority for the projected benefits was to provide broadband services to 234 community anchor institutions,¹² including 178 K-12 school districts, 15 community colleges, 26 libraries, and 3 higher education institutions. Next in priority level was a commitment to offer third party middle mile and backhaul services, which were required to comply with federal open access

⁸ More public organizations would join over time, including local governments and school districts [9].

⁹ This is according to a January 2009 America’s Digital Schools report.

¹⁰ Members of Colorado’s congressional delegation hoped the expanded EAGLE-Net would address areas “where market forces have failed to attract affordable broadband infrastructure and investment” [59].

¹¹ For this study, the grant application will be considered the initial plan for EAGLE-Net Alliance and thus will be used to compare against the results. Numerous proposed benefits are not mentioned here in the interest of time.

¹² According to the federal grant application, Community Anchor Institutions are public entities including schools, libraries, medical and healthcare providers, public safety, community colleges, public housing, higher education, and other government facilities [17].

guidelines. In other words, the main focus of ENA is educational institutions and CAIs, and the secondary focus is providing excess capacity to third parties for their middle mile network connectivity. However, middle mile access is mostly limited to members¹³ who purchase network services [13].

The 2009 Recovery Act specifically allocated \$7.2 billion to fund two broadband development programs in the federal Departments of Agriculture and Commerce, and thus provided a rare opportunity for CBOCES to apply for large-scale infrastructure development funding. The Broadband Technology Opportunities Program (BTOP) administered by the NTIA received about \$4.7 billion to distribute.¹⁴ The main objective¹⁵ of BTOP was to provide “grants for deploying broadband infrastructure in unserved and underserved areas of the United States, enhancing broadband capacity at public computer centers, and promoting sustainable broadband adoption projects” [14].¹⁶ In September 2010 the grant was awarded to CBOCES, totaling¹⁷ approximately \$100.6 million.

This BTOP grant fell under the Recovery Act category of Comprehensive Community Infrastructure (CCI), which focused “on Middle Mile broadband infrastructure projects that offer new or substantially upgraded connections to community anchor institutions, especially community colleges” [14]. Thus, obligations and priorities of the BTOP program are informed

¹³ Members can only be government or quasi-government entities and must sign ENA’s inter-governmental agreement (IGA) before purchasing services [13].

¹⁴ About \$2.5 billion was allocated to the Broadband Initiatives Program (BIP) administered by the Rural Utilities Service in the Department of Agriculture.

¹⁵ In addition, BTOP aims to advance the objectives of the 2009 Act “to spur job creation and stimulate long-term economic growth and opportunity” [14].

¹⁶ This indicates the project is mostly supply-side focused, but with some demand side attention.

¹⁷ In addition to the grant award, ENA received commitments for matching and other funds, which totaled approximately \$34 million.

by the CCI projects structure.¹⁸ Amidst distributing the grant funds, the NTIA put significant focus of middle mile infrastructure, particularly projects “that connect a significant number of community anchor institutions... [thus] facilitating the development of Last Mile broadband services in unserved and underserved areas, and promoting economic growth” [14]. Other priorities the NTIA focused on included a desire for public-private partnerships,¹⁹ the ability to serve public safety entities, last mile infrastructure components, and non-federal cost matching opportunities [14]. Perhaps the most telling reason why middle mile projects are so emphasized in the BTOP program is the belief that,

“like the interstate highways that link together the nation’s roads and streets, ... [these] broadband facilities play a critical role in the healthy functioning of the nation’s broadband infrastructure and are a necessary foundation for the ultimate provision of affordable end-user broadband services in unserved and underserved communities” [14].

2.3 Proposed EAGLE-Net Alliance Benefits

The purpose of ENA is to provide its members internet access and other network services by deploying broadband networks that connect community anchor institutions²⁰ across Colorado [15]. This section will provide an overview of some of the ENA goals and potential benefits to provide a baseline to eventually compare the results to. The first section briefly summarizes the proposed benefits that relate to the middle mile and last mile components of the EAGLE-Net

¹⁸ See five core purposes under Section 6001 of the 2009 Act.

¹⁹ According to the NTIA, public-private partnerships include “government, non-profit, and for-profit entities, and other key community stakeholders” [14].

²⁰ The ENA bylaws define ‘community anchor institutions’ as “schools, libraries, medical and healthcare providers, public safety entities, governmental institutions, community colleges and other institutions of higher education, and other community support organizations and agencies that provide outreach, access, equipment and support service to facilitate greater use of broadband service by vulnerable populations, including low-income, unemployed, and the aged” [15].

network. The next section examines the proposed benefits to education. The third section briefly examines the link between geography and the economic feasibility of ENA.

The EAGLE-Net Alliance outlines four areas that support its purpose, including to:

“(1) create a mechanism to deploy and offer a variety of broadband connectivity and affordable services to Colorado schools, libraries and other community anchors, (2) leverage a broadband middle mile network through partnerships with private sector service providers to expand broadband throughout Colorado; (3) share information pertaining to broadband services, and (4) create a structure to coordinate and cooperate in the administration, monitoring and deployment of broadband services to schools, libraries, and other community anchor locations, and to explore new means of achieving common objectives pertaining to broadband services within Colorado so as to increase broadband opportunities for Colorado...” [8].²¹

In addition, ENA has longer-term goals such as ensuring that network services and benefits are sustainable [16].

2.3.1 Middle mile and last mile

EAGLE-Net Alliance initially planned to supply middle mile network connections to all 12 of the Regional Service Areas (RSA) and 64 counties in Colorado once the grant period ended (see Fig. 1) [9]. The network design included a fully meshed “Core Network” with six major nodes, including two in Denver and one in Fort Collins, Grand Junction, Durango, and Pueblo (see Fig. 2) [17]. The ENA network is based on a hybrid fiber microwave architecture, with fiber the main component, although earlier designs emphasized the microwave component. The network build has focused on using existing and new fiber infrastructure, along with IP-based/Ethernet microwave equipment [17]. ENA seemingly has standard procurement rules²² for purchasing the necessary supplies for construction [18]. Thus, the project encompasses building

²¹ Similar language is found in the ENA bylaws [15].

²² Two interesting federal requirements in the procurement rules include the “Buy American Requirement” and an obligation to display the “BTOP Recovery logo” to the maximum extent possible on all project signage [18].

new infrastructure and improving existing infrastructure when possible to offer 20 Mbps – 1 Gbps speeds to its members. In addition, the project was intended to be sustainable after the federal grant period expired [9].²³

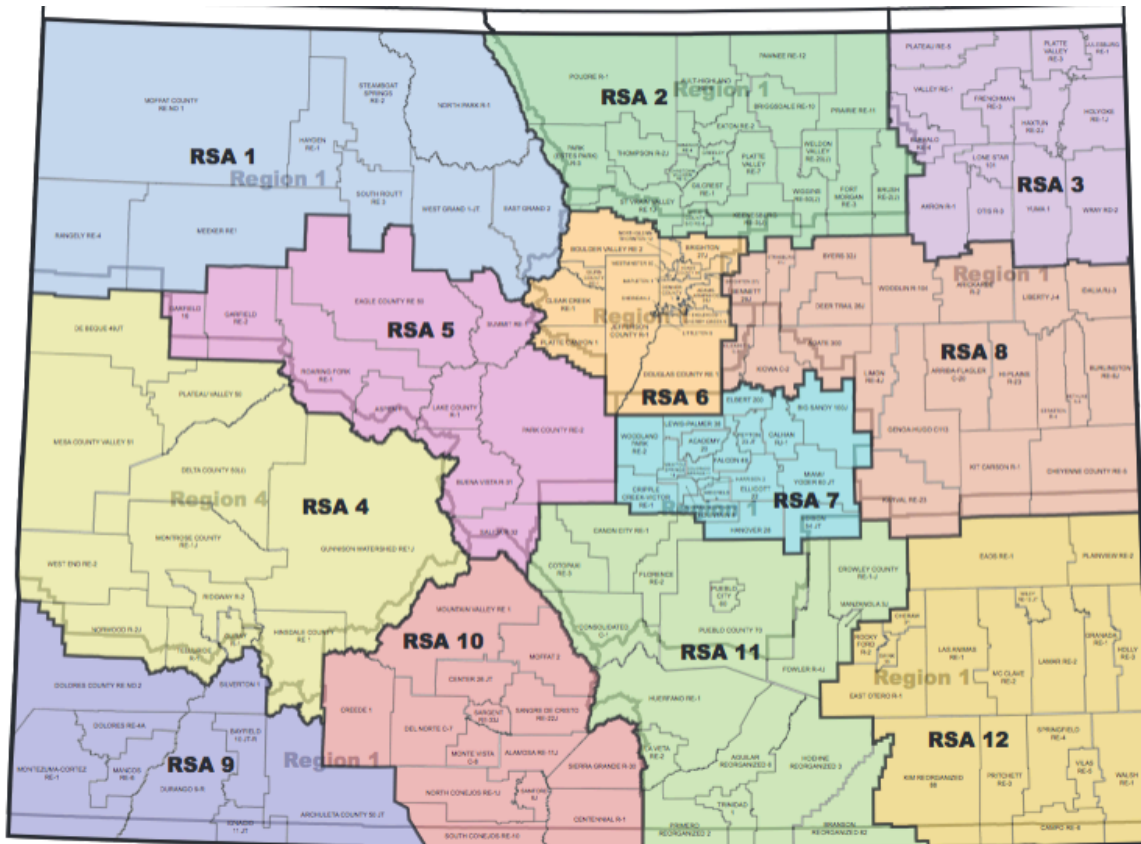


Fig. 1 This map shows the twelve Regional Service Areas (RSAs), as defined by the Colorado Department of Education [10].

²³ Sustainability from ENA’s perspective focuses on revenue from the services offered to their members.

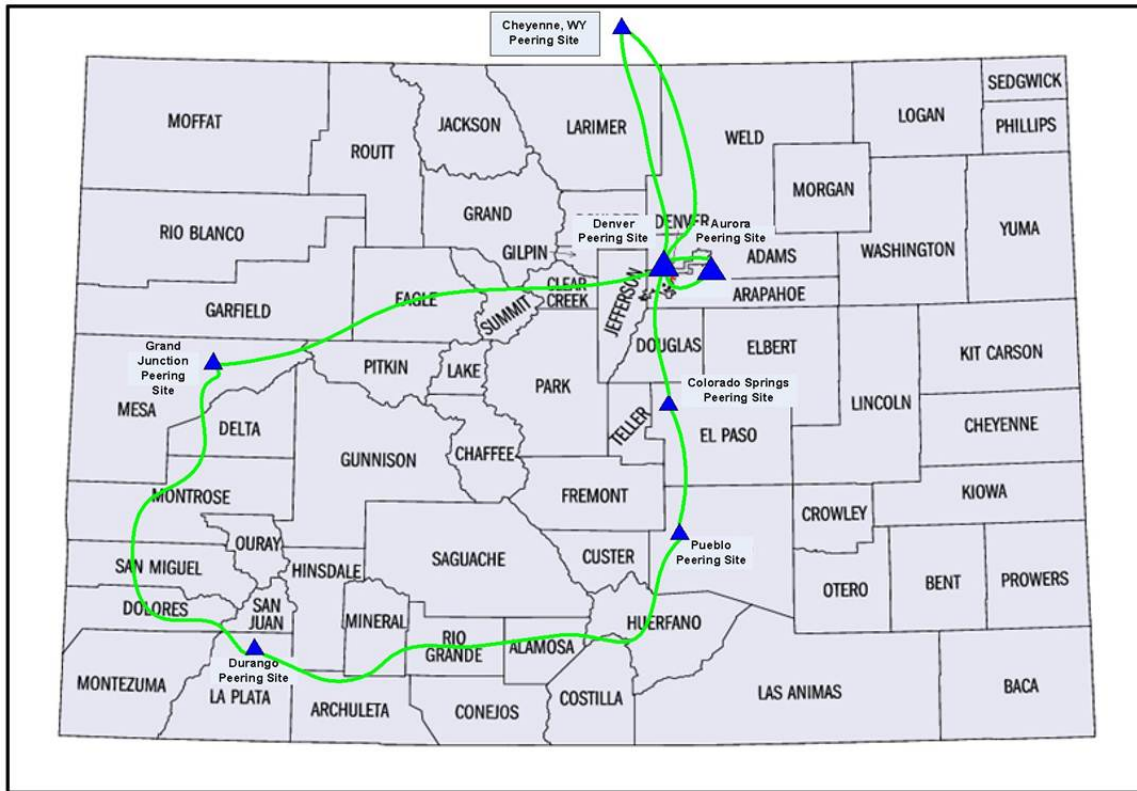


Fig. 2 This map of the counties in Colorado shows the core of the planned ENA network, including seven peering sites (triangles) that aggregate middle mile connections [9].

Further, ENA planned to partner with local service providers and communities for last mile connections based on grant requirements of open access policies for third parties [9]. This was “expected to stimulate the offering of affordable broadband access for more than 1.6 million households and more than 50,000 businesses” [17]. This stems from having a federally required open access policy for third party access and would “allow all private sector broadband providers access to bandwidth to provide their ender users greater capacity at cost sharing rates” [17]. Other cited opportunities include wholesale services for interstate carriers and government collaborators.

2.3.2 Education

The focus of ENA is improving broadband for schools, libraries, and other government entities, but public schools in particular receive the majority of attention. ENA was designed as an intergovernmental broadband network to include local, state, and federal entities, and thus increase their ability to provide access to advanced services in education and research [9]. For example, ENA supporters have cited the education benefits from increasing access to Internet2, which is a growing partnership between universities, industry, and government to “develop and deploy advanced network applications and technologies” [19]. According to ENA’s own analysis, Internet2 enhances the learning environment for teachers and students by utilizing technology in the classroom and for distance learning [19].

Other educational issues to be addressed include decreasing the cost of broadband service to Colorado schools. One concern was the higher price school districts pay in comparison to consumers. ENA cited in a 2009 report that the average DSL home use costs \$1.44 per 100 kbps, while the cost K-12 schools in Colorado is \$18 per 100 kbps [19]. In a 2008 report, Colorado schools averaged 3.5Kbps per student, which was well below the national average of 6.4Kbps per student. ENA planned to provide 40Kbps per student [17]. In the BTOP application, CBOCES cited that Colorado schools districts paid up to \$800 per month for 1Mbps, which worked out to be \$7.50 per student per year [17].²⁴ Thus, ENA planned to make improvements in these areas by providing better internet speeds and lower cost service for schools.²⁵ Thus, a main ENA objective is to provide schools with improved broadband speeds at affordable rates more closely aligned with residential and business consumers.

²⁴ Also, see the “Colorado K-12 Broadband White Paper” [69].

²⁵ This would only include schools that choose to contract for ENA services.

ENA offers services in two general categories: public sector services and carrier open access services.²⁶ Public sector services include internet access for government or quasi-government members, Layer 2 MPLS Virtual Private Wire Service, Layer 2 MPLS Virtual Private LAN Service, and Layer 3 Virtual Private Network [9]. In particular, government member internet includes

“access to the Front Range GigaPoP (“FRGP”) aggregation network. The FRGP is a consortium of Universities, non-profit corporations, and government agencies that cooperate in an aggregation point called the FRGP in order to enable research and education by sharing wide area networking services, access to the commodity Internet, access to the Internet2 research network, and access to the National LambdaRail (NLR)” [9].

For example, ENA reports that it offers network services, such as transport of ‘Commodity Internet’ and ‘Internet2’ with 20-100Mbps for each institution initially, with future scalable network growth capacity up to 10Gbps [17].

2.3.3 Geography and financial sustainability

The BTOP application also outlines the economic feasibility of ENA amidst the challenging geography of Colorado. Sustainability is an important component as “the organization will be fully sustainable by the end of the 36 month grant application period” [17]. ENA explained that a significant factor is the “State’s physical geography [which] is the most demanding physical geography in the lower 48 states; unusually diverse, encompassing both rugged mountains and vast plains” [17]. Further,

“Because of the out-of-market broadband construction costs in Colorado (1 linear mile of distance could equate to 3-6 miles over rugged terrain), the fiber optics networks built by various utility companies serve only the major cities resulting in the creation of rural underserved broadband islands throughout Colorado with no

²⁶ Carrier open access services include Layer 2 Virtual Private Wire Service, Layer 2 Virtual Private LAN Service, and Layer 3 Virtual Private Network [9].

competitive middle mile high bandwidth connectivity. The middle mile build out will not be completed by the private sector because the costs are too great to reach too few customers” [17].

ENA has focused on issues related to geographical challenges. For example, in early 2009, interim EAGLE-Net CEO Mike Ryan conducted a trip to Silverton, which has continuously tried unsuccessfully to get a fiber optic connection to the town [20].²⁷

Letters to the NTIA in support of the ENA network reflected concerns about Colorado’s unique geographic challenges. For example, Governor Bill Ritter explained that “our expansive geography has left many of our rural communities disconnected and subject to technological platforms which are out-of-date and incapable of meeting current broadband needs” [21].

Further, the project “would have an immediate impact on the educational standard and economic vitality of Colorado’s rural and agrarian communities” [21]. As such, at the outset optimism was based on the assumption that this project would be good for Colorado, but especially good for underserved rural areas.²⁸

In September of 2010 when Colorado was awarded the BTOP grant Governor Ritter marked the occasion with a press release. The governor announced, “this project has the potential to provide a modern, 21st century link for every school, library and community that has been underserved because of rural location and challenging geography” [22].

²⁷ In a previous statewide initiative, Qwest was contracted to connect all the county seats in Colorado with a fiber optic connection. However, because of the rugged mountainous terrain around Silverton, Qwest established a microwave connection instead of fiber. This resulted in court challenges, which ruled in favor of Qwest, leaving Silverton as the only county seat in Colorado without fiber connectivity to the internet backbone.

²⁸ Other letters of support to L. Strickling were sent from the Colorado Department of Education [60] [64], Colorado Department of Transportation [61], Colorado Department of Labor and Employment [62], and Colorado Department of Public Safety [63].

2.4 Implementation of EAGLE-Net Alliance

Numerous factors affected the implementation of the federal grant by ENA, but perhaps the most influential were those that related to federal regulations, delays, confusion, and criticisms of the project implementation. The first section will briefly summarize the process that BTOP grant recipients are required to complete in order comply with federal environmental laws and regulations, which is necessary to receive the grant funding [23]. Second, a brief summary of some of the delays and confusion surrounding the implementation will help provide context for the project's performance during the grant period. Third, a brief discussion of some of the criticisms of the ENA during the grant period will help illustrate the volatile political environment, which posed additional challenges to the project implementation.

2.4.1 Federal environmental policy compliance

There are three public policy tenets that serve as the foundation for federal requirements of federal grants that may affect the physical environment in one form or another. These are the 1969 National Environmental Policy Act (NEPA), 1966 National Historic Preservation Act (NHPA), and 1973 Endangered Species Act (ESA).

NEPA requires, in part, that the federal government consider the possible impacts of an action and consider reasonable alternative actions. In particular, the recipient of a grant is required to submit an environmental assessment (EA) to the NTIA. The NTIA then issues a 'Finding of No Significant Impact' (FONSI) if the EA is in compliance [23]. Further, the law prohibits segmentation²⁹ and thus requires a comprehensive EA, which aims to address the cumulative impacts of an action.

²⁹ This is when a federal project (or 'action') is broken into smaller actions, and each is analyzed separately [23].

The NHPA includes Section 106, which covers the potential impact on historic, cultural, and tribal resources, and requires consultation with the State Historic Preservation Office (SHPO) [23]. The ESA includes Section 7, which requires consultation with the Fish and Wildlife Service (FWS) to check the potential impact on endangered³⁰ and threatened species [23]. Other requirements include obtaining the various permits from government agencies. Further, a grant recipient is required to submit modifications of the project scope to the NTIA for approval [24].

2.4.2 Delays and Confusion

As ENA was being implemented once the federal grant was awarded, the project was delayed due to a variety of factors. One of the earliest examples relates to some confusion about the plan by CBOCES to transfer the grant to EAGLE-Net Alliance. The NTIA initially resisted allowing the transfer from CBOCES, which caused some delay. The reason to transfer was that CBOCES as a regional organization was not equipped to handle a statewide initiative. Once the NTIA recognized the need to transfer the grant to the newly created ENA, it was not certain how to get all of the federal approvals for that action. This delayed the start of the project about three months because until the grant was transferred, no funds could be approved to do the initial environmental work.

Also, there was some confusion relating to the restrictions on how ENA could use the federal grant money. For example, some companies desired to sell services to ENA to include as part of its statewide network, but ENA was prohibited by the grant award conditions, which required that grant funds be used for capital expenditures [24]. Further, some small

³⁰ The ESA prohibits “taking” endangered species, which includes to “harass, pursue, hunt, shoot, wound, kill, trap, capture, or collect...” [23].

telecommunications companies viewed ENA as a threat to their business. A negative effect was that these businesses might lose some customers, but a positive effect was that they gained new, affordable middle mile access through the third party open access grant requirements if certain conditions were met. In addition, sometimes the complaints about ENA were communicated to political figures, and their subsequent involvement caused further delays.

Perhaps the most impactful delay occurred in December 2012 with the temporary suspension of the federal grant. The main reason for the suspension was to “ensure that [ENA] completed necessary environmental and historic preservation (EHP)³¹ work related to certain route changes [ENA] has made in the project” [25]. Specifically, the Department of Commerce cited ENA with non-compliance with the Environmental Assessment special award condition (EA SAC), which required NTIA approval to make project modifications [24]. The grant office at NOAA cited “concerns regarding certain programmatic and financial issues surrounding [ENA’s] award,” and focused on ENA’s “failure to consult with NTIA on its new network design” [26]. Concerns that focused on the design change cited possible violations of federal environmental laws, thus officially suspending the award until certain conditions were met, including submitting a revised project map and schedule to return to compliance [26].

The alleged violation of federal environmental laws was the heart of the suspension. Preceding the suspension, ENA had changed some of its network architecture focus from microwave to fiber in order to improve reliability [24]. Further, some route changes were constructed without prior NTIA approval. In the suspension’s ‘corrective action plan,’ NOAA cites concerns about possible violations of NEPA due to an insufficient EA and violations of section 7 of ESA because of insufficient consultation with the FWS. Further, NOAA cited

³¹ The EHP requirements were briefly outlined above, in section 1.4.1.

insufficient consultation with SHPO under 106 of the NHPA and required demonstration that all required government permits had been obtained [26]. Ultimately, the NTIA would issue a FONSI and approve the network modifications after ENA had complied with the suspension terms [24].

A contributing factor to the suspension was a sometimes lack of communication between ENA and the network design and build contractor, G4S. For example, sometimes G4S changed its plans without getting approval. An earlier ‘corrective action plan’³² by NOAA cited concerns about and requested information of the G4S relationship with ENA [27]. NOAA ultimately lifted³³ the suspension in May 2013 [24].

The grant suspension had obvious negative effects on the progress of the ENA project. One way that was used to measure progress was a progress report submitted to the NTIA periodically. However, under the grant rules, the basis for measuring project completion was the percentage of grant funds spent, rather than measuring the percentage of network miles built. Thus, the methods that the federal government used to measure the progress of the ENA project and the other BTOP grants should merit some reconsideration.

Leading up to the suspension, ENA reported gradual, but consistent overall project progress. Yet, progress during the suspension was unsurprisingly slower. For example, at the end of March 2011, the project was 8 percent complete; by September 2012, it was 67 percent complete. ENA reported a lower 57 percent over the next few quarters, but through June 2013,

³² This September 2012 corrective action plan centered on the method of payment for ENA, which was changed from advance to reimbursement only status. Particularly, agency review was required for all withdrawals [65]. The conditions of the plan imposed corrective action, including various financial controls and documentation for correcting unallowable costs, questions on certain public and private partners, and other issues [27].

³³ On the other hand, the grant could have been terminated as a result of the suspension [24].

the project was 90 percent complete [28]. There were other factors for the delay in the project progress, but the grant suspension is perhaps the major reason. As ENA explained,

“The 57% is behind the baseline projection of 98% complete. A major part of the lag in the completion percentage is due to the temporary suspension put on construction spending in the last quarter. Not only was [ENA] required to stop all design and constructions activities, but also there was previously completed work that we were unable to pay for due to the federal funds being frozen during the suspension. With these accrued expenses, we would actually be close to 77% complete” [29].

ENA reported good progress in the next quarter of 2013 after the suspension was lifted with 90 percent project completion. Again, ENA explained,

“Although we are behind [the baseline] estimate, there was a large increase in our percentage complete from last quarter to this one. This was due to the lifting of the temporary suspension giving us the ability to pay our contractors the amounts owed for previously completed work, and the approval to use CDOT rights of way as in-kind match for all construction started along those rights of way” [28].

ENA was in a somewhat similar situation to some other BTOP recipients. For example, by February 2013, “among the 233 NTIA grants four have been closed out and 30 are in the closeout process... [Further] the NTIA has received more than 35 deadline extension requests, and approved more than 20, with the others still pending” [30].

After the grant suspension was lifted it was apparent that the project’s planned completion date would not be achieved and so ENA applied successfully for an extension of the grant award to December 2014.

2.4.3 Critics and overbuilding

Various issues during implementation fueled criticism of ENA. One common concern revolves around overbuilding, which generally refers to building new facilities near existing facilities. For example, the Department of Commerce reported that “several broadband service

providers alerted us to potential overbuild of their facilities by the [ENA] project” [25]. Proponents of this argument claimed not only would this lead to inefficient allocation of resources, but also may harm existing businesses by introducing a new competitor into the market subsidized with federal broadband dollars. From ENA’s perspective, ENA was sometimes forced to build new infrastructure because existing facilities were not made available by the facilities’ owners upon conditions that would satisfy open access and other grant requirements. Perhaps an over-dramatized story in *The New York Times* about ENA overbuilding a fiber connection to a small elementary school reflects the source for some of the criticism [30].³⁴

However, one report concluded that ENA followed best practices and that the overbuild accusations were false [31]. Further, ENA was successful in negotiating some agreements with owners of existing facilities. For example, ENA signed a 20-year contract with Tri-State Electric to use a fiber trunk line between Durango and Grand Junction. This would allow ENA to use approximately 412 miles of fiber in southwest Colorado without having to construct new facilities [32].

The ENA perspective emphasizes that overbuilding should be viewed through the conditions imposed by the federal grant requirements. For example, the grant was to be used for limited purposes, namely capital expenditures (versus operational). Thus, grant guidelines required ENA to leverage existing facilities if they met the capital expenditure requirements and were offered at reasonable rates [33]. Existing facilities sometimes did not meet the federal

³⁴ Another example of accusations of overbuilding includes a September 2012 letter to an Assistant Secretary in the NTIA where four Colorado congresspersons cited concerns about the project’s progress. In particular, their letter cautioned, “[ENA] has engaged in overbuilding existing networks at the expense of Colorado’s longstanding rural telecommunications providers” [56].

requirements, or sometimes owners of those facilities did not communicate with ENA by failing to respond to ENA's requests for proposals to use existing fiber facilities.

Additionally, numerous associations have taken part in the debate about the overbuilding claims. One example is the Colorado Telecommunications Association (CTA), which mainly represents small rural communications companies and has members that include local exchange service providers, inter-exchange carriers, and wireless providers [34].³⁵ In February 2013, for example, a CTA Executive Vice President appeared before the Subcommittee on Communications and Technology³⁶ regarding concerns about ENA's grant suspension. The CTA had previously supported the ENA project, but

“It appears to CTA members that this project was never intended just for unserved or underserved areas but rather to build a government owned and operated duplicate network to serve as many government entities as possible. [ENA] is primarily overbuilding networks on the Eastern Plains, South Central Colorado and in the Denver Metro Area while largely ignoring Western Slope Communities” [35].³⁷

Further, the testimony describes the lack of attention to isolated areas of Colorado by stating, “[ENA] has done just the opposite of what the legislature intended by primarily overbuilding ... while largely ignoring Western Slope Communities (i.e., Silverton and Routt County) where broadband facilities are desperately needed and would be welcomed by those

³⁵ The mission of the CTA is “to promote the availability of resources and enhance the opportunity of its members to provide the most advanced and highest quality communications networks and services to customers in rural Colorado and link residents of the state to the global network” [35].

³⁶ This subcommittee is part of the Committee on Energy and Commerce in the U.S. House of Representatives.

³⁷ The inspector general at NTIA addresses and dismisses some of these concerns in a January 2014 letter under a category titled “Three Major Areas where ENA's Market Presence was Disputed” [24].

communities” [35]. Ultimately, the NTIA inspector general considered the overbuilding claims, but concluded there were no violations [24].

Also, there were some concerns that ENA unfairly competes with established businesses. For example, a Colorado state senator attempted to get his governor’s support to change the direction of the project because “[ENA] has clearly veered off course and is threatening the livelihood of small rural companies” [36].

An example of the debate about the economic effect of ENA on existing businesses occurred in Steamboat Springs. Part of a *Denver Post* account explains the issue as,

“For years, CenturyLink has charged the city’s school district \$100 for each megabit per second of Internet connectivity, at least 10 times the price that Denver-area schools pay... The mere threat of an additional fiber-optic backbone reaching the mountain community helped the city negotiate lower fees with CenturyLink, said Tim Miles, technology director for the Steamboat Springs School District. ‘Because of [ENA] coming into town, bringing the competition, CenturyLink has come down on price.’ Problem is, [ENA] isn’t there yet. It is months behind schedule and facing mounting criticism about its spending and network build-out” [37].

CenturyLink responded that their decrease in price was due to ongoing investment and network efficiencies [37]. The various criticisms weighed against ENA certainly did not help the implementation of the project, but perhaps it is fair to say that ENA deserves only part of the blame.

2.5 EAGLE-Net Alliance Performance: Benefits and Results

The post-suspension ENA project is slightly smaller in scope than what was planned in the BTOP application. This is due, in part, to avoid duplication in some areas where other broadband services are already available for a variety of reasons, including some areas where the

BIP program was involved. However, as the scope of the project was being revised, ENA commenced a deal with a private sector entity called Affiniti³⁸ to manage the operations of the network. Thus, as ENA evolves from the federal grant experience, it is seeking creative ways to continue network deployment and achieve a level of sustainability.

The proposed ENA benefits outlined above will be used to measure against relevant results below.³⁹ The first measurement is to what extent ENA reached goals to connect 234 community anchor institutions. Also, this refers to how many members ENA has compared to the number of institutions that have access but choose not to subscribe. The second measurement is the extent to which ENA is offering service to wholesalers or last mile providers. The third measurement refers to the services offered by ENA and whether ENA is economically sustainable in terms of revenue from offering these services. The fourth measurement refers to the extent to which ENA has improved broadband access to public schools in terms of bandwidth and relative cost. Finally, the last measurement refers to the extent to which ENA has improved access for unserved and underserved areas?⁴⁰

First, the following results are based on the most recent available ENA BTOP progress report [38].⁴¹ The report cites that ENA has 109 subscribers, of which 97 receive new access and 12 receive improved existing access [38].⁴² Further, of 37 schools district customers and 2 BOCES customers, there are four tiers of service offered, ranging from 10 Mbps to 1 Gbps

³⁸ Affiniti is a company based in Austin, TX.

³⁹ The following five areas to measure performance were outlined in section 1.2.

⁴⁰ There are certainly other benefits and results to consider, but are not done so here in the interest of time.

⁴¹ Since the project is near completion, it is assumed most of this data can be relied on. The report indicates that overall the project is 94 percent complete, while the 'network build' is 74 percent complete [38].

⁴² This can be compared to numbers from July 2013 where ENA had about 102 institutions with access, of which 56 subscribed [24].

[38].⁴³ The 109 subscribers are out of a potential of 223 community anchor institutions.⁴⁴ It is not clear how many anchor institutions have access to the ENA network.

Second, according to the ENA BTOP progress report, there are seven signed agreements with wholesale and last mile providers who are receiving new access with 3 tiers of service

[38].⁴⁵ Further, 19 agreements are being negotiated.

Third, as noted above, ENA reports offering public sector services and carrier open access services. In the ENA BTOP progress report, revenue numbers are not reported.

Fourth, ENA reports that it offers up to 1 Gbps speeds, with potential scalability up to 10 Gbps [9]. The cost model for ENA is a cost-sharing consortium, thus subscribers pay equal costs, instead of the same level of service being more expensive in rural compared to urban areas.

Finally, it is difficult to ascertain the extent to which ENA has improved access to underserved and unserved areas. However, according to an ENA network map (see Fig. 3), numerous mountainous areas that could seemingly be considered underserved or unserved now have access to ENA, or network construction is planned for the future [9].

⁴³ Tier 1 (10-49 Mbps) has 15 customers. Tier 2 (50-99 Mbps) has 7 customers. Tier 3 (100-499 Mbps) has 13 customers. Tier 4 (500 Mbps-1 Gbps) has 4 customers.

⁴⁴ ENA plans to continue expanding service to more community anchor institutions after the grant period with the help of Affiniti.

⁴⁵ Tier 1 (100 Mbps) has 2 providers. Tier 2 (300 Mbps) has 3 providers. Tier 3 (600 Mbps) has 2 providers. The report indicates that service tiers up to 1 Gbps are available.

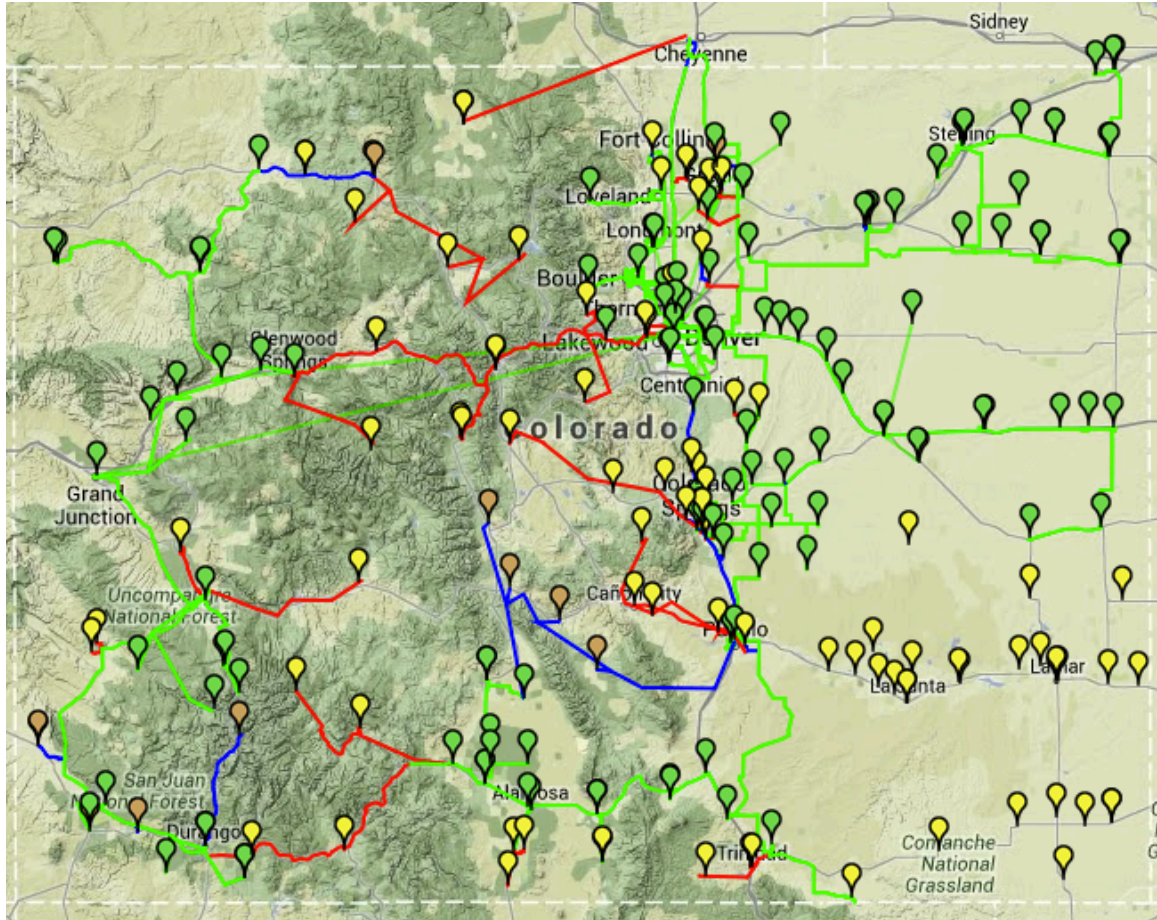


Fig. 3 This map shows the ENA network status as of Nov. 15, 2013. Green means the network is complete, blue means the network is under development, and red means future network development is planned [9].

Other data can provide further information about the results. For example, as of December 31, 2013 according to EAGLE-Net, 3019 total network miles have been completed [9]. The initial total length was proposed to be 4,954 miles [39].⁴⁶ This includes 1,947 miles of existing leased facilities and 1,072 miles of newly deployed facilities [9].

⁴⁶ The ENA website reports that the total planned network miles is now 3,206. The reduction in network miles is due to a number of factors.

CHAPTER 3

NATIONAL BROADBAND PLAN

The National Broadband Plan covers many areas, thus only portions of the NBP are relevant to ENA. The sections of the NBP that will be emphasized here in varying degrees are availability, education, government performance, and benchmarking. A key assumption in the National Broadband Plan is that greater broadband access can help improve economic performance and is good when adopted by a society:

“Broadband is a platform for social and economic opportunity. It can lower the geographic barriers and help minimize socioeconomic disparities-connecting people from otherwise disconnected communities to job opportunities, avenues for educational advancement and channels for communication” [40].

In 2009 Congress directed the Federal Communications Commission (FCC) to create a National Broadband Plan.⁴⁷ The NBP recommends to gradually shift public policy focus away from telephony to broadband. The main goal is to reach widespread deployment and adoption of broadband, but in particular there is a focus on deployment in areas with insufficient infrastructure, which often have low population densities.

3.1 Availability

The NBP argues there is a “broadband availability gap” in the United States, and the gap is worse in areas of low population density that lack sufficient private sector investment.⁴⁸

“Because service providers in these areas cannot earn enough revenue to cover the costs of deploying and operating broadband networks, including expected returns

⁴⁷ The FCC published the NBP in 2010.

⁴⁸ The total cost to fill this gap is estimated at \$33.4 billion, with \$15.2 billion for initial capital expenditure and \$18.2 billion for ongoing costs, which includes projected revenue.

on capital, there is no business case to offer broadband services in these areas. As a result, it is unlikely that private investment alone will fill the broadband availability gap. The question, then, is how much public support will be required to fill the gap” [41].

The NBP argument in favor of government support has potentially flawed logic. It starts with companies not being able to obtain enough revenue to cover the high costs, so there is no business case. However, this misses the point, which should address why the costs are so high to begin with. The high costs are at least partially due to government intervention and regulation. A potent example is the requirement that ENA had to follow federal environmental laws in order to obtain the grant money.

The broadband availability gap is relative based on network performance characteristics, namely minimum available upload and download speeds for *households*. In contrast, the focus of ENA is connectivity for *public institutions*. However, there is some common ground, for example, where ENA offers excess access to its middle mile network to private entities. The parallels with ENA are also evident in that the NBP proposes a “targeted level of service to everyone in the United States... [which] covers new networks and upgrades of existing networks” [41].⁴⁹ In similar fashion, ENA has minimum targets for offering broadband access to most of the public school districts in Colorado.

Further, the NBP suggests how subsidies targeting broadband should be administered. For example, subsidies should be awarded with market-based mechanisms “whenever possible,” but support from local, state, and federal governments is required [41]. Also, there are suggestions for targeting government support in order to help close the broadband availability gap more effectively. The NBP calculates government support as annual federal spending of \$10

⁴⁹ The target is 4 Mbps download and 1 Mbps upload.

billion on subsidy programs in 2008. Government support also includes the \$7.2 billion from the Recovery Act. According to the NBP, the Recovery Act funding “has improved broadband infrastructure in the U.S., [but] federal efforts have not been coordinated to meet the universal broadband goals of Congress” [41]. ENA certainly has improved broadband infrastructure in Colorado (and thus the U.S.), but ENA considers universal service⁵⁰ a secondary objective, at best.

The NBP offers cautious optimism about the Recovery Act programs, because “it is impossible to know with precision how much [they] will contribute to closing the gap before all of the funds are awarded” [41]. However, the plan concludes that this federal funding “alone will not be sufficient to close the broadband availability gap” [41]. Further,

“[c]losing the broadband availability gap and connecting the nation will require a substantial commitment by states and federal governments alike. This commitment must include initial support to cover the capital costs of building new networks in areas that are unserved today, as well as ongoing support for the operation of newly built networks in areas where revenues will be insufficient to cover ongoing costs” [41].

3.2 Universal Service

Universal service for broadband is a relatively recent phenomenon. However, universal service for communications technology in one form or another has been a public policy goal arguably since the 1934 Telecommunications Act (1934 Act). Of particular importance in this law is the phrase that Congress wanted to “make available, so far as possible, to all the people of the United States... a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges” [41].⁵¹ Even though the NBP supports universal service for broadband, there is still some academic debate occurring. For

⁵⁰ In this sense, universal service has a similar meaning to availability.

⁵¹ Telecommunications Act of 1996, Pub. LA. No. 104-104, 110 Stat. 56 (1996).

example, one scholar argues if broadband is not considered essential by society, then broadband should not be considered a universal service [42].

The plan further argues that universal service programs are insufficient for broadband because of some of the policies created from the 1996 Telecommunications Act (1996 Act) when few people had internet access and even fewer had access to broadband. Thus, the NBP argues that the result of these particular policies is an unbalanced emphasis on targeting traditional telephone service and reform is needed [41]. The NBP outlines this unbalanced emphasis by arguing that,

“While the federal USF⁵² and earlier programs have played a critical role in the universalization of voice service in the last century, the current USF was not designed to support broadband directly, other than for schools, libraries, and rural health care providers” [43].

In other words, universal service policy and the 1996 Act have failed to keep up with the rapidly evolving world of communications technology. For example, the four programs in the USF were projected to spend \$8.7 billion in 2010, but the plan outlines various reforms to modernize⁵³ the program to support broadband availability [41]. Perhaps it is fair to assume the Recovery Act has helped evolve federal funding by targeting universal service for broadband, instead of targeting telephone. The USF is an example of what one scholar refers to as an untargeted subsidy program, where negative consequences of this program stem from the subsidy going to certain companies instead of households [44]. The plan thus proposes

⁵² The Universal Service Fund (USF) has funded four programs aimed at helping broadband development in high-cost areas.

⁵³ The Connect America Fund (CAF) was created by the FCC in 2011 to support rural areas for private investment. Goals focused on eliminating waste and inefficiency, changing the focus to broadband and IP-based networks instead of telephone, and modernizing the USF and Inter-carrier Compensation [58].

realignment towards broadband platforms and developing a framework for new funding mechanisms [43].

The plan continues by proposing various methods to solve the high-cost problem of developing broadband in rural areas [41]. The NBP supports “one-time deployment or upgrades,” which presumably includes many of the broadband grants from the 2009 Recovery Act, including the grant for ENA [43]. However, public policy changes are needed because “the current regulatory framework will not close the broadband availability gap” [43].

3.3 Education

The National Broadband Plan has general goals of universal broadband access, but this includes a focus on public education institutions and other government entities. In particular, the NBP proposes that by 2020 “every American community should have access to at least 1 gigabit per second broadband service to anchor institutions such as schools, hospitals, and government buildings” [45].

The NBP emphasizes the potential of broadband to increase the quality and performance of students, but cites that some changes are needed in public policy. Poor public school graduation rates, among other problems, could be improved with broadband because “broadband-enabled solutions hold tremendous promise to help reverse patterns of low achievement” [46].

One important theme in the NBP is the desire to shift away from the traditional E-rate program [46].⁵⁴ This cautious approach to E-rate is echoed in the literature. According to one academic study, the E-rate program inhibits flexibility of schools’ choices for broadband

⁵⁴ The E-rate program was initiated in the 1996 Telecommunications Act.

services, does not always meet schools' expectations, and is oversubscribed [46]. Another study⁵⁵ concludes that E-rate was a success in terms of more classrooms being connected to the internet, but overall it was a failure because there was no significant impact on student performance [47]. This thinking in the literature and the NBP reflects a common objective that public policy needs to be more effective in encouraging affordable and quality broadband services for schools.

3.4 Government Performance

An important factor in successful broadband public policy is efficiency. According to the NBP, the federal government spends billions of dollars every year, but does not “leverage that spending in a coordinated way to improve broadband connectivity and access within local communities” [48]. However, the NBP says that government can help with broadband deployment

“by serving as an anchor tenant in unserved and underserved communities, by leveraging the purchasing power of the federal government to provide lower prices for broadband communications services for state and local governments and by coordinating federal grants with a broadband connectivity requirement” [48].

3.5 Benchmarking

The NBP suggests an approach to measuring the effects of the plan over time, which include five areas to consider: “how many people and businesses have access to broadband, how many subscribe, what speeds they get, how much they pay and what they do with it” [49].

3.6 EAGLE-Net Alliance alignment with the National Broadband Plan

⁵⁵ This study analyzed public schools in California.

The sections above are used to generate questions in order to shed light on the extent to which ENA is aligned with the NBP.⁵⁶ The first refers to availability, including the extent to which ENA improved broadband access (availability) for community anchor institutions.⁵⁷ Availability also refers to the extent to which ENA has helped close the broadband availability gap (e.g. by offering excess capacity to last mile providers and other third parties). The second question considers the extent to which ENA has built new networks in unserved areas.⁵⁸ The third question considers the extent to which ENA has helped modernize broadband policy by supporting universal service for broadband, such as shifting the focus away from telephone. The fourth question considers the extent to which ENA has helped achieve the NBP 2020 goal of 1 Gbps to every community in terms of the middle mile network capacity and available bandwidth to customers.⁵⁹ The fifth question refers to the extent to which the ENA funding was leveraged in a coordinated way in terms of cost and connectivity.⁶⁰ Finally, the sixth question refers to the NBP suggested benchmarking. Below are suggested answers to these questions, although future researchers may find more effective ways to answer the questions, or may even ask better questions. The purpose of this is to propose a starting point.

First, the question of whether ENA has improved availability can be answered by examining the number of community anchor institutions that have access and the number of last mile providers ENA has contracted to provide middle mile access. First, as noted above in the ENA section, according to the most recent public progress report, it is not clear how many community anchor institutions have access, but ENA has at least 109 subscribers [38]. Thus, it is

⁵⁶ Not surprisingly, similar themes and objectives are found in the NBP and ENA, which suggests at least some alignment.

⁵⁷ From section 3.1.

⁵⁸ From section 3.1.

⁵⁹ From section 3.2.

⁶⁰ From section 3.4.

fair to conclude that ENA improved broadband access simply because more institutions have access to ENA than compared with the pre-grant availability.⁶¹ Second, according to the most recent public information, ENA has agreements with 7 wholesale and last mile providers, and 19 agreements are being negotiated [38]. Thus, it is fair to conclude that in an indirect way ENA has helped improve broadband availability in the traditional sense of businesses and households.

Second, the question of whether ENA has built new networks in unserved areas can be addressed by examining two sources of data. First, according to the most recent ENA BTOP progress report, 97 subscribers receive new access while 12 receive improved access [38]. Second, ENA has deployed 813 new construction miles out of 3,023 total network miles [9].⁶² These two sets of data do not suggest a concrete answer, but perhaps it is fair to conclude that some parts of the ENA network serve areas that were previously unserved. Some of the lack of clarity of this answer is due to the federal third party open access requirements that sometimes caused ENA to conduct new network construction in areas that had existing facilities.

Third, the question of whether ENA has helped shift the public policy focus away from telephone to broadband can be answered by examining the general nature of the project in terms of the technological focus. A brief examination of ENA clearly suggests a primary focus on broadband technology, thus it is fair to conclude ENA has helped shift the public policy focus away from telephone. However, the degree to which ENA has influenced public policy remains to be seen.

Fourth, the question of whether ENA has contributed to the NBP 2020 bandwidth goal can be answered by examining the network characteristics of ENA in terms of middle mile capacity. As noted above, due to the middle mile network capacity, ENA has reported to offer up

⁶¹ See Fig. 3 for a network map.

⁶² As of 3/31/2014.

to 1 Gbps to subscribers, with scalable options up to 10 Gbps. Thus, it is fair to conclude that ENA has positively contributed to the NBP 2020 bandwidth goal. Again, however, the degree to which ENA has contributed to the NBP bandwidth goals remains to be seen.

Fifth, the question of whether the ENA grant was leveraged in a coordinated way in terms of cost and connectivity can be addressed by considering the project as a whole. The cost of the ENA project is somewhat contentious and probably higher than necessary because of the various delays during implementation mentioned above. ENA has improved connectivity by improving access to its targeted community anchor institutions and providing greater bandwidth. It is difficult to ascertain whether the grant was leveraged in a coordinated way. However, when these two areas of cost and connectivity are combined, there is certainly room for improvement.

Finally, the NBP suggested metrics for benchmarking can be interpreted for ENA to include the number of community anchor institutions that have access and the number that subscribe, the speeds offered, the cost of service, and what subscribers do with the service.⁶³ First, as noted above, according to the most recent available public information (Nov. 2013), the number of community anchor institutions that have access to ENA is unclear, but 109 have chosen to subscribe. Next, as noted above, the speeds offered include network service up to 1 Gbps, and potentially 10 Gbps [9] [17]. The cost model for ENA is a cost-sharing consortium, thus subscribers pay equal costs.⁶⁴ This model arguably improves parity between rural and metropolitan regions [31]. Lastly, it is difficult to consider how ENA subscribers are using the service from a general level. Perhaps it can be assumed that the service is sometimes being used for educational purposes by students and teachers, and is used for other purposes through

⁶³ From section 3.5. Three of these metrics will be addressed on an individual subscriber level in the survey section (speeds, cost for subscriber, and what they do with it).

⁶⁴ For example, this is in contrast to more market-based models where the same level of service is more expensive in rural compared to urban areas.

increased broadband adoption. So, it is certainly fair to conclude that ENA has some positive results based on the NBP benchmarking framework.⁶⁵

⁶⁵ Positive results here means that ENA made some progress, compared to doing nothing at all or failing completely.

CHAPTER 4

SURVEY RESEARCH

4.1 Methodology and Limitations

The targeted respondents for the survey were limited to public educational institutions that are ENA subscribers. So, a respondent had to be a community anchor institution that is a paying customer of ENA. Further, surveys were targeted specifically at public school institutions, which included Boards of Cooperative Educational Services (BOCES) and school districts.

The methods above to choose the targeted respondents for the survey certainly limit the coverage of the many community anchor institutions that receive ENA services. For example, libraries and other community anchor institutions are not included. Thus, this is not an attempt to make concrete conclusions about the total impact of ENA. Rather, the survey attempts to offer a first glance at some of the potential impacts of ENA on broadband so far. Of course, more rigorous and perhaps quantitative studies should be conducted to provide more definite conclusions about the extent to which ENA as a whole is aligned the NBP. The survey is just one aspect of my attempt to address this problem.

4.2 Survey Results

I initially planned to obtain five to ten responses for the survey, however, for possibly a variety of factors, it was difficult reach this goal. The survey was conducted in an informal and unscientific manner, roughly as follows. I made phone calls to school districts and BOCES offices to attempt to obtain the data. In order to choose who to call, I used a list of community

anchor institutions on the EAGLE-Net Alliance website which indicates if CAIs have access to ENA, but does not indicate who is a customer. Typically, I asked to speak with someone in the technology department and then briefly introduced myself to that person, including my graduate studies at CU-Boulder and the topic of this research paper. Otherwise I called a director, manager, or chief information officer directly if the relevant information was available. Then I asked whether this person's institution is a subscriber to ENA. If the answer was no, I then briefly explained about my survey, but indicated I was seeking responses only from ENA subscribers. If the answer was yes, I summarized the survey and asked if they would like to participate. Subsequently, the rest of the phone call roughly followed the survey questions (see Appendix B).

Often I left voice messages for someone in an institution's technology department, typically for an IT director or chief information officer. The voice message was roughly as follows: *Hi, my name is Chris Ballantine and I am a graduate student at CU-Boulder conducting some research for my thesis project, which is on EAGLE-Net. I was wondering if you are a subscriber of EAGLE-Net, and if so, I have six brief survey questions to ask. These are simple questions about things like cost and bandwidth. So, if you are a subscriber of EAGLE-Net and would like to participate, please call [my phone number] when it is convenient. Thank you.* Also, I sent two email messages, which were not replied to.

4.2.1 Survey Responses

I called most of the CAIs which have access to the EAGLE-Net network according to the ENA website and ultimately obtained five responses. Many of these calls were voice messages, which were not responded to. Thus, it can be assumed some were not ENA subscribers and some were ENA subscribers, but chose not to participate. The low response rate also could be due to

the timing of the phone calls (e.g. at the end of the school year or after it is over). One technology employee seemed to not believe I am a student at CU-Boulder, and voiced concerns that I was conducting some sort of sales call.

The following briefly outlines the responses of the CAIs that responded to the survey. The subsections (a. – f.) mostly relate to suggested benchmarking from the NBP. Subsection ‘g.’ attempts to interpret the data as it relates to cost, which was briefly discussed in section 1.3.2.

1. Widefield School District 3 (Colorado Springs): 8,963 students [50].
 - a. Became subscriber July 2013
 - b. Services: Broadband internet access
 - c. Bandwidth: unknown
 - d. Cost: \$1,936 per month
 - e. Most common uses: classroom educational purposes.
 - f. Anything else: none
 - g. Interpretation: The cost is about \$4.62 per student per month, which is lower than the maximum threshold of \$7.50 cited in the BTOP application. Note that the bandwidth is not available.

2. Huerfano School District RE-1 (Walsenburg): 575 students [51].
 - a. Became subscriber Oct. 2013
 - b. Services: Broadband internet access (only one connection for one school)
 - c. Bandwidth: 30 Mbps
 - d. Cost: unknown (87% discount rate under E-rate program)

- e. Most common uses: Participate in online educational services, such as video programs with the Museum of Natural History.
- f. Anything else: none
- g. Interpretation: It is important to note that this school district only has ENA services for one connection, and the cost is unknown. However, this connection provides about 52 kbps per student, which is much better than the 3.5 kbps per student cited in section 2.3.2.

3. Littleton Public Schools 6: 15,733 students [52].

- a. Became subscriber May 2014
- b. Services: Broadband internet access and Internet2
- c. Bandwidth: 500 Mbps
- d. Cost: \$2,853 per month
- e. Most common uses: Cloud services, file sharing, online curriculum, research, email, and others.
- f. Anything else: The decision to subscribe was partly based on talking to current subscribers, who reported reasonable prices and good reliability.
- g. Interpretation: The cost is about \$5.51 per student per month, which is lower than the maximum threshold of \$7.50 cited in the BTOP application. The bandwidth is about 31.8 kbps per student, which is much better than the 3.5 kbps per student cited in section 2.3.2. The cost can also be calculated as \$.57 per 100 Kbps, lower than the \$18 in section 2.3.2.

4. East Central BOCES: 21 member school districts [53].
 - a. Became subscriber in 2013
 - b. Services: Broadband internet access
 - c. Bandwidth: 100 Mbps connections each to Burlington and Limon
 - d. Cost: unknown
 - e. Most common uses: IP-based video conferencing for long-distance education and curriculum.
 - f. Anything else: The respondent reported the opinion that EAGLE-Net service has provided much needed additional competition, and thus has helped to lower the cost of internet services.
 - g. Interpretation: Given the known data, the East Central BOCES shows that ENA is supporting the NBP 2020 bandwidth goals to schools and communities.

5. Platte Valley School District RE-7 (Kersey): 1,057 students [54].
 - a. Became subscriber 2010
 - b. Services: Broadband internet access
 - c. Bandwidth: 100 Mbps
 - d. Cost: Approximately \$1,000 per month
 - e. Most common uses: Online curriculum
 - f. Anything else: The respondent reported to be very supportive of EAGLE-Net.
 - g. Interpretation: The cost is approximately \$.95 per student per month, which is lower than the maximum threshold of \$7.50 cited in the BTOP application.

The bandwidth is 94.6 Kbps per student, which is much better than the 3.5 kbps per student cited in section 2.3.2. The cost can also be calculated as \$1 per 100 Kbps, lower than the \$18 in section 2.3.2.

4.2.2 Survey Implications

Perhaps the most significant results from the survey are that the cost is lower than the threshold of various measurements, such as \$7.50 per student, and the reported bandwidth is at least 100 Mbps or greater in three cases. Note that the bandwidth numbers reported were for actual service levels, not the largest potential bandwidth available. This reflects customers choosing appropriate levels of service based their network characteristics. The Widefield school district bandwidth is probably at least 100 Mbps, given the cost and number of students. Further, the bandwidth per student is consistently much greater than the previous average of 3.5 Kbps per student in Colorado (6.4 Kbps per student nationally). Thus, considering these results within themselves, ENA has at least helped these particular institutions to be more aligned with the NBP compared to what was available previously.

So, given that it seems that ENA is able to offer broadband internet access at more reasonable prices suggests considerable alignment with the NBP. However, what remains to be seen is the extent to which the ENA business model is sustainable. It is yet to be determined whether ENA can attract enough customers and cover their future costs without any more taxpayer funding. The less than perfect implementation of the federal grant only adds to this uncertainty. However, the survey results certainly show some progress towards alignment with the NBP.

CHAPTER 5

CONCLUSION

EAGLE-Net Alliance as a middle-mile broadband project with support from federal grant money is significant because it represents a shift in the focus of public policy away from telephone to broadband. ENA has helped to shape future broadband access policies, but the extent to which remains to be seen. The ENA experience represents many challenges and lessons for reaching future broadband development goals. This project highlights important insights into early attempts of new methods for broadband universal service attempted in the post-telephone policy world. However, numerous factors influence the broadband policy environment and will continue to affect the rules of the road for the future.

Amidst the somewhat unstable implementation of the federal grant, ENA is remarkably aligned with the NBP. However when considering particular parts of the NBP, ENA is aligned in varying degrees. In some areas, ENA is less aligned, such as improving availability mainly for public entities rather than households and considering universal service a secondary objective. Other areas of the NBP, though, seems strongly aligned, such as improving broadband access for public schools and positively contributing to the 2020 bandwidth goal. Further research could perhaps be a quantitative analysis that dives deeper into the NBP questions about ENA in order to more specifically address the extent to which ENA is aligned with the NBP.

Perhaps the most contentious issue about ENA is the cost of implementation. To be sure, ENA has created value, and thus has benefited some parts of society. However, the cost to achieving this value seems rather high considering the various inefficiencies and problems during implementation, which only adds to the uncertainty for the future. The most significant

factor that affected the higher cost of the value of ENA was the federal government, due to the myriad regulations and a failed approach to managing the federal grant. The cost of implementing the ENA grant can be seen as the opportunity to use the resources in alternative ways because scarce resources have alternative uses. The mismanagement by the federal government, more than any other factor, helped to ensure that more resources than necessary were used to implement the ENA grant, thus decreasing the amount of resources that could have been used in alternative ways.

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Appendix A. Figures

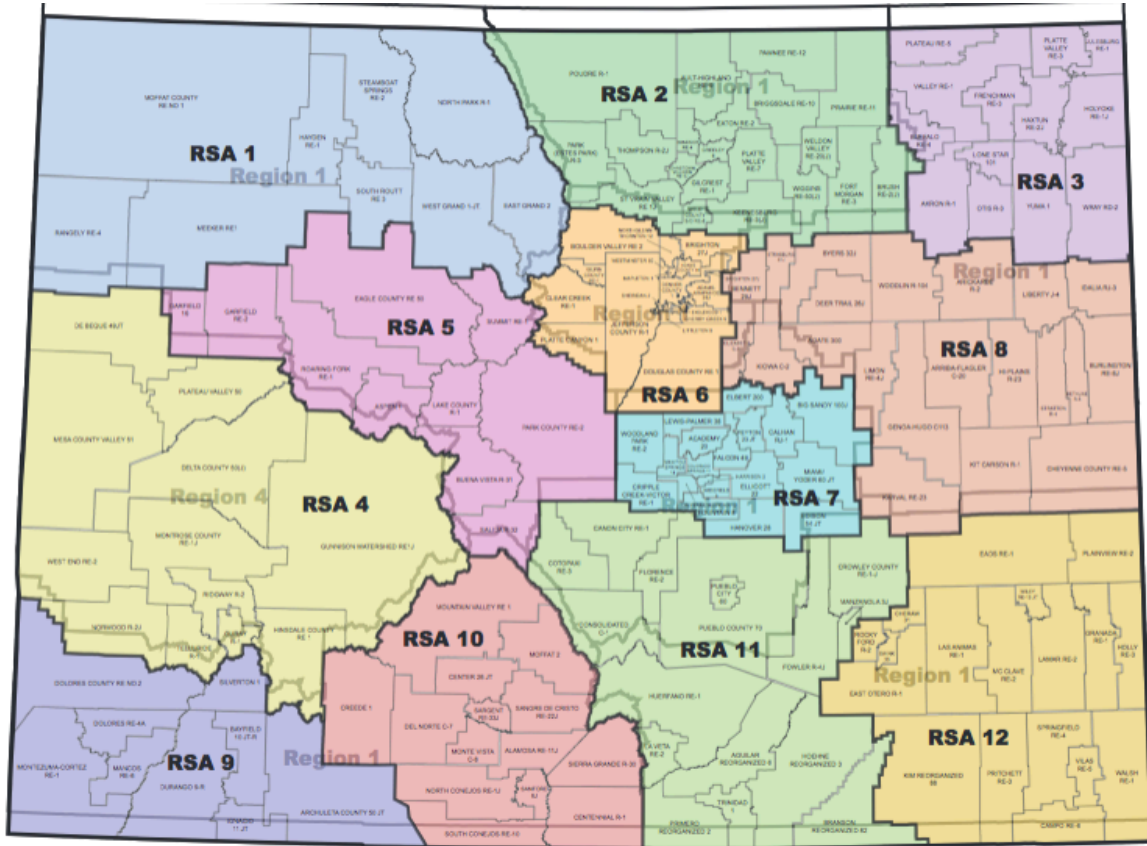


Fig. 1 This map shows the twelve Regional Service Areas (RSAs), as defined by the Colorado Department of Education [10].

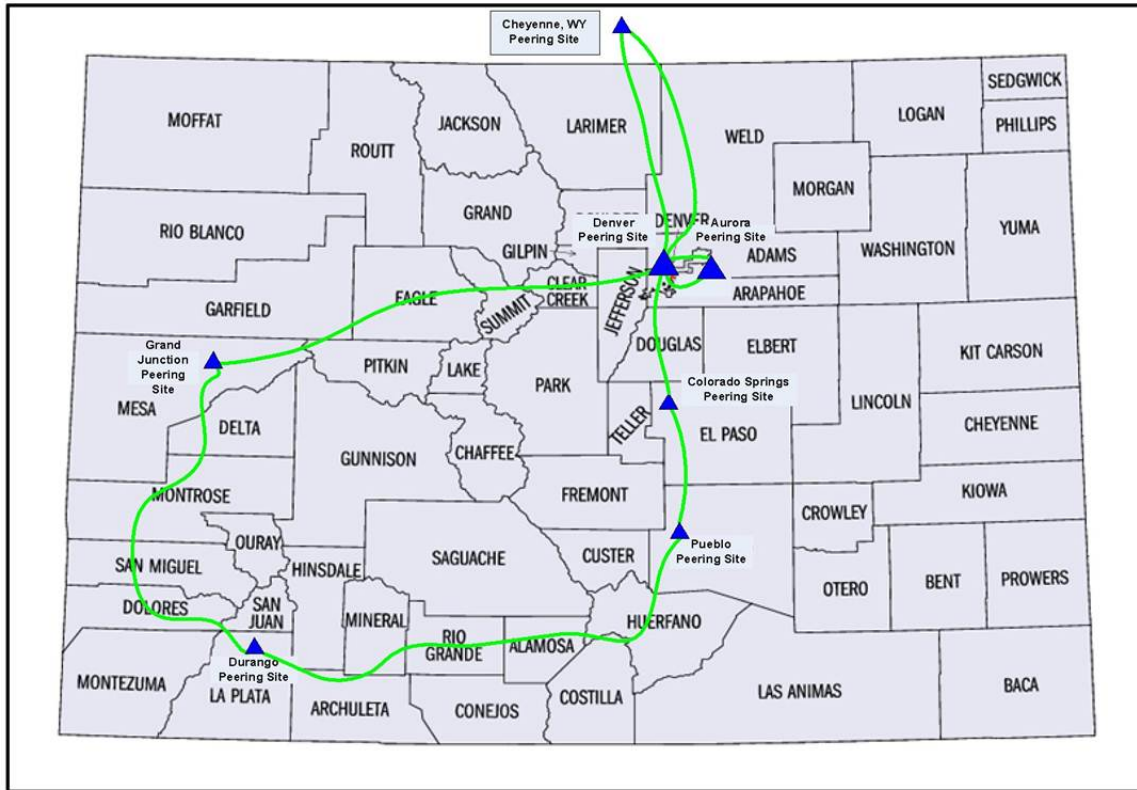


Fig. 2 This map of the counties in Colorado shows the core of the planned ENA network, including seven peering sites (triangles) that aggregate middle mile connections [9].

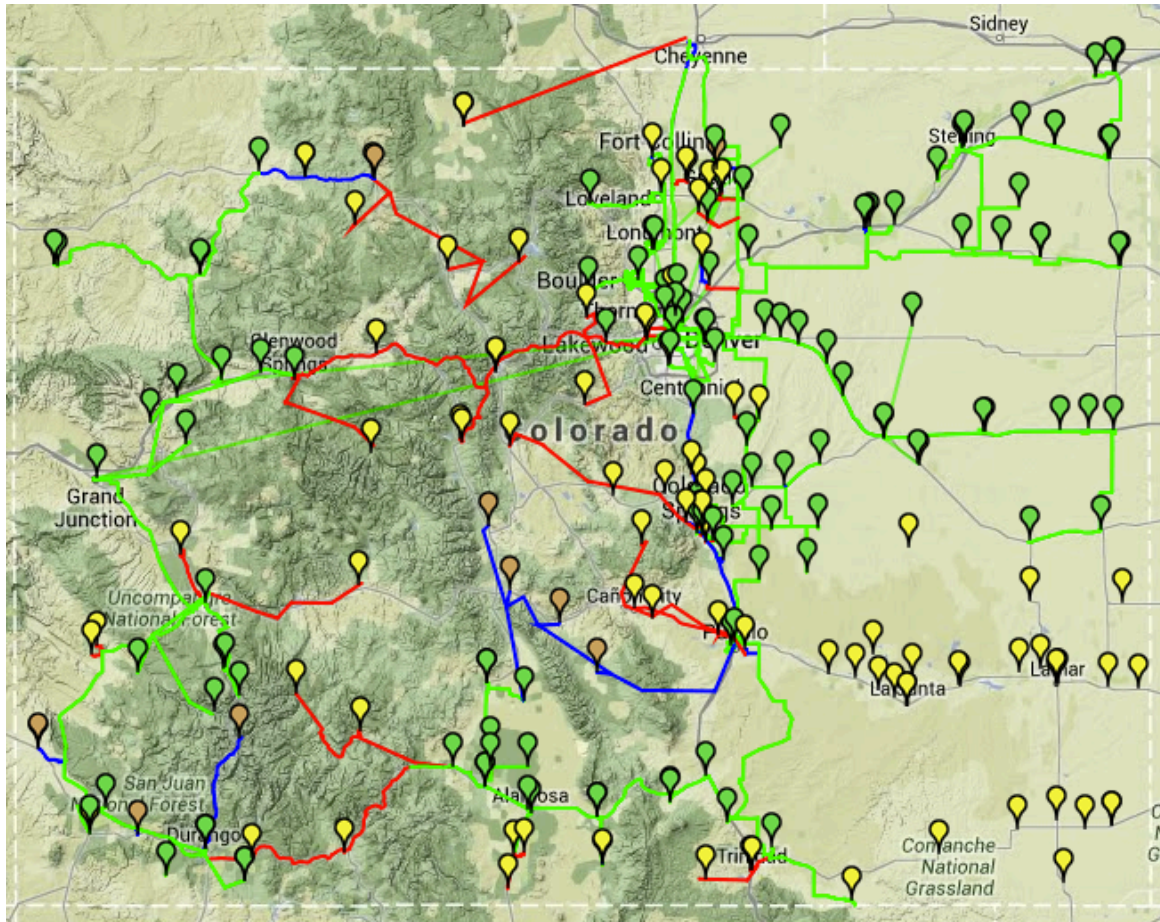


Fig. 3 This map shows the ENA network status as of Nov. 15, 2013. Green means the network is complete, blue means the network is under development, and red means future network development is planned [9].

Appendix B. Survey

1. Survey

The survey was conducted informally over the phone. I briefly summarized my thesis topic and graduate school status before asking the survey questions.

The survey questions are mainly from chapter 17 of the NBP titled “Implementation and Benchmarking” [49]. However, there are numerous commonalities found from the NBP and ENA sections.

1. When did you become a member of EAGLE-Net?⁶⁶
2. Which EAGLE-Net services do you subscribe to?⁶⁷

⁶⁶ From sections 2.2 and 3.5.

⁶⁷ From sections 2.2 and 3.5.

3. What kind bandwidth do you have access to?⁶⁸
4. What is the cost for the available bandwidth?⁶⁹
5. What is the most common use of the internet?⁷⁰
6. Is there anything else you would like to share about your experience with EAGLE-Net?

Afterwards, I offered to send the respondent a copy of my paper upon completion. All of the respondents requested a copy via email.

⁶⁸ From sections 2.2, 3.2, and 3.5

⁶⁹ From sections 2.2, 3.3, and 3.5.

⁷⁰ From section 3.5.