State of New Mexico
LEGISLATIVE FINANCE COMMITTEE

325 Don Gaspar, Suite 101 • Santa Fe, NM 87501
Phone (505) 986-4550 • Fax: (505) 986-4545

David Abbey
Director

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MEMORANDUM

TO: Senator John Arthur Smith, Chairman, Legislative Finance Committee
Representative Jimmie C. Hall, Vice-Chairman, Legislative Finance Committee
Legislative Finance Committee Members

THROUGH: David Abbey, LFC Director
Charles Sallee, LFC Deputy Director

FROM: Travis McIntyre, Ph.D., Program Evaluator, LFC

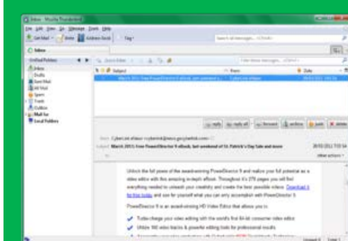
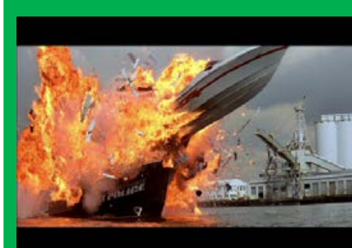
SUBJECT: Broadband Deployment in New Mexico

Summary. In New Mexico, access to the World Wide Web largely occurs at whole sale prices in Albuquerque and is distributed at retail prices throughout the state. There is a robust fiber backbone throughout the state but not to the "last mile" to homes and businesses, and the expensive electronics required to drive data content have not largely been invested in outside Albuquerque. The reason why is because there is not enough demand to attract investment in the last mile or in electronics in rural areas. The state can solve this problem by aggregating demand among public institutions, which currently procure internet independent of each other. If multiple institutions in a geographical region agree to purchase internet at one location, they can get access at significantly higher speeds and share the costs by sharing the access across a wide area network, similar to how coworkers in an office share one internet connection. To compete for the procurement of much higher speeds, providers will need to install the expensive electronics in the region to deliver the content and can then more cost effectively deliver higher speeds to other customers in the area as well. The evidence of the effectiveness of this in states that have aggregated demand among their institutions is clear, as is the evidence that no improvement will be made in New Mexico broadband deployment relative to the nation with the status quo.

<u>Background.</u> Broadband is a term used to describe high speed internet. Broadband infrastructure allows for the exchange of information, which is linked to increased productivity and job creation. According to a 2011 Federal Communications Commission fact sheet, a 7 percent increase in broadband adoption is estimated to create an additional 2.4 million jobs nationwide, and the internet accounted for 15 percent of U.S. gross domestic product growth from 2004 to 2011. Broadband can also be used to provide access to education, healthcare, and emergency services in rural areas.

There are three main types of wired broadband technologies: digital subscriber line (DSL), cable, and fiber optics. DSL is run over telephone wires and is most commonly the only available connection to the home in rural areas. Cable runs over cable television wires and is largely available to the home in urban and higher density rural areas. Fiber is run over flexible glass tubes and is available to the home only in parts of Albuquerque, with some exceptions. Table 1 provides examples of content that is reliably accessible in most areas under these different technologies. Only fiber is suitable for users that want to engage in heavy broadband traffic like streaming video on multiple devices, managing large online datasets, or running cloud-based software applications. Wireless technologies are also widely available, but are limited to low speeds for most users for the foreseeable future.

Table 1: Reliable Functionality of Broadband Technologies in Rural New Mexico

DSL	**Can:** Email 	**Can't:** Stream Video 
Cable	**Can:** Stream Video 	**Can't:** Video Conference 
Fiber	**Can:** Video Conference 	**Can't:** FUTURE PROOF

Source: LFC Files

Fiber infrastructure consists of two main components: the fiber optic cable that connects everything, which is expensive to build but has very little recurring costs and rarely needs to be upgraded and the electronics that drive content across the fiber, which are somewhat expensive to install and require significant upkeep and frequent upgrade. Comparative descriptions of these components are given in Table 2 and Figure 1 below.

Table 2. Fiber Infrastructure has Two Main Cost Components

Fiber Optic Cable	Expensive to install **$$**	Low Maintenance	No Upgrade
Electronics	Expensive to Install **$**	High Maintenance **$$**	High Upgrade **$$**

Source: LFC Files

Figure 1. Network Electronics have Much Higher Recurring Costs than Fiber Optic Cables

Fiber optic cables have low recurring costs

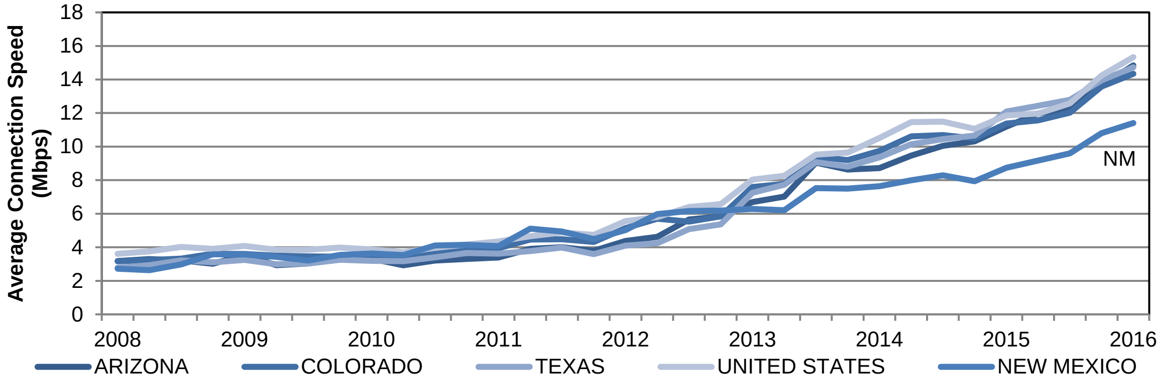
Source: New Mexico Broadband Guidebook

Network electronics have high recurring costs

Source: Westin Building Exchange Carrier Hotel in Seattle, WA

History. New Mexico allocated $6 million to study broadband in 2010, with funding mostly coming from American Recovery and Reinvestment Act money. Since then, several broadband deployment studies have been produced, including an implementation framework in 2012, deployment recommendations in 2013, a strategic plan in 2014, an education broadband study in 2015, a financial modeling study in 2016, and an ongoing business broadband study in 2017. In recent years, the legislature has appropriated funding for broadband deployment to public schools, 92 percent of which are now connected to fiber. The Governor has adopted several broadband initiatives, most notably resulting in an ongoing request for proposal (RFP) for a statewide price agreement for internet access to public schools. While broadband deployment has improved since 2010, New Mexico is consistently falling behind our neighboring states and the nation in average connection speed, the most useful metric for determining broadband deployment according to the Akamai State of the Internet Report, as seen in Figure 2.

Figure 2. New Mexico Broadband Deployment Falling Behind



Source: Akamai State of the Internet Report

<u>Status.</u> Internet access at public institutions in New Mexico is largely an individual strategy where public schools and local governments are left to procure internet services on their own. State agencies are largely assisted in their RFPs by the Department of Information Technology (DoIT), but there is no public statewide network to connect to causing institutions to pay different costs to different providers for the same connection speeds. Higher education institutions have a large, collaborative statewide network, and it has been effective at lowering costs significantly and also obtaining some of the highest connection speeds in the state.

Ninety-two percent of public schools have fiber according to the Public Schools Facility Authority (PSFA), and so there must be a vast distribution of fiber infrastructure throughout the state. However, New Mexico ranks 40th in the percent of population with fiber to their door, at 7.5 percent, compared to the national average of 25 percent, according to Broadband Now, a broadband availability aggregator. This implies the reason New Mexico households have poor access to high speed internet is not because of a lack of fiber backbone but because of a lack of the electronics that drive information across the fiber, which have expensive maintenance costs and upgrade requirements. Indeed, according to Education Superhighway, New Mexico ranks in the top half of the country for the percent of schools connected to fiber but near the bottom for schools' connection speed, which is driven by the electronics. The most likely reason for the absence of electronics is demand is not high enough for a good return on investment. In addition, the only neutral location for carriers to connect out to the World Wide Web in New Mexico is in Albuquerque, which means any rural carrier has to either build fiber all the way back to Albuquerque or lease fiber from the few carriers who have it.

The status of broadband distribution in New Mexico is that there is a robust fiber backbone throughout the state but not to the "last mile" to homes and businesses, and the expensive electronics that drive content are located mostly in Albuquerque. There are three common solutions to this:

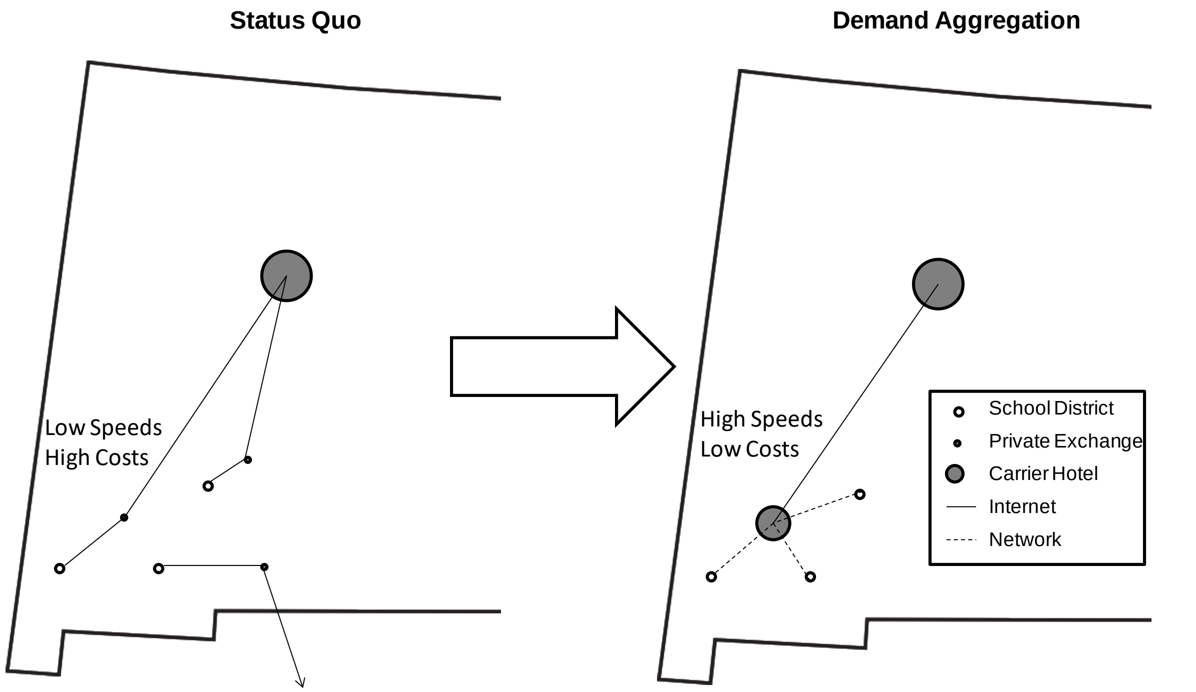
1. The state builds the last mile and electronics itself;
2. The state subsidizes the costs for providers to invest in underserved areas; or
3. The state finds a way to increase demand in underserved areas.

The recommendations in this memo will only focus on solutions to the third option above, as the first two are considered to be more expensive and less efficient.

Solutions. Public schools are the largest single purchaser of internet access, are located across the state, and currently have several state and federal funding sources available for broadband, making them suitable to increase demand in low demand areas. Currently, schools and districts procure internet separately from each other and pay varying prices. To improve upon this, DoIT published a RFP in September 2016 employing a method called "procurement optimization", which is similar to a statewide price agreement for broadband. This should help lift the burden of schools having to issue their own RFPs, allow schools to shop around, create transparency, streamline the procurement process, and normalize prices from one district to the next. Procurement optimization requires minimal government resources and will likely reduce internet costs for school districts, though it does not necessarily increase demand enough for providers to invest in broadband deployment to other customers.

"Demand aggregation" is a method of having institutions in a geographical region RFP together for very high connection speeds at one internet access point and then share the connection over a wide area network (WAN). Similar to how a family pays one price for internet and shares the connection on their devices, a WAN can purchase internet at one location and share the connection to users across a fiber network. This can have the benefit of increasing connection speeds a hundred fold and significantly lowering cost per connection speed to the institutions in the network. As suggested before, schools are an ideal group of institutions to utilize for this. Demand aggregation requires some coordination from government, but can significantly benefit homes and businesses in the region of the WAN because providers' investment in more electronics in the area increase capacity for all users. This works because the broadband industry operates on an oversubscription business model (i.e. if a provider supplies 10 Mbps to one consumer, they will sell the same 10 Mbps to other consumers in the area). If demand increases significantly in an area, providers will supply more access, selling oversubscribed amounts to other nearby consumers, driving up speeds and costs down for all of them. This can work particularly well if the aggregation points are neutral locations, meaning any provider can install equipment there, often called a "carrier hotel." Ultimately, the WANs created through demand aggregation can be connected to each other to form a statewide education network. Figure 3 and Table 3 illustrate the differences between status quo, Procurement Optimization, and Demand Aggregation models in New Mexico.

Figure 3. Demand Aggregation can Distribute Whole Sale Internet Statewide Using Existing Fiber Infrastructure



Source: LFC Files

Table 3. NM Broadband Deployment Models

		Status Quo	Procurement Optimization	Demand Aggregation
Cost	Human Capital	None	Low	Low
	Capital Cost	None	None	Low
	Recurring Cost	High	Medium	Low
Benefit	Speed	Low	Medium	High
	Availability	Low	Low	High

Source: LFC Files

Evidence that demand aggregation can accelerate broadband deployment to the door in rural towns is overwhelming. Pennsylvania studied the results of their efforts in the 2000s to aggregate demand among schools and found school broadband capacity increased by 534 percent, price per unit bandwidth was reduced by 92 percent, and provider revenues increased by 69 percent over the six-year life span of the program. The program attributes its success to investments in new infrastructure made by private companies to serve schools, and in turn the upgraded infrastructure became available to other customers in the surrounding community. From 2008 to 2016, Pennsylvania gained in ranking of average connection speed from 20th to 9th while New Mexico slipped from 29th to 48th over the same time period according to the

Akamai State of the Internet report. New Mexico has similar average connection speeds as Iraq and Molodova while Pennsylvania has similar connection speeds as Sweden and the Netherlands.

Similar evidence is found in nearby states as well. Almost all rural towns in nearby states that have built statewide education networks through demand aggregation have access to fiber, while almost no rural towns have robust fiber access in nearby states that have not developed statewide networks. Table 4 compares fiber availability to businesses in rural towns within nearby states. The dominant availability of fiber to businesses in states with education networks is obvious. The investments in electronics to deliver internet to schools throughout their state has clearly made it profitable to deliver to other consumers as well. The methodology of how Table 4 was calculated is described in the Appendix.

Table 4. Fiber Offered to Businesses in Rural Towns Overwhelmingly Higher in States with Statewide Education Networks

Statewide Network

Utah	Coverage %	Provider
Moab	7.3	Emery
Vernal	0	*
Price	56	Emery
Nephi	63.5	CentraCom
Trementon	57.5	Veracity
Hurrricane	43.8	Interlinx

Nebraska	Coverage %	Provider
Chadron	11.7	NebraskaLink
McCook	4.9	Allo
Beatrice	24.8	Unite
Alliance	21.9	Allo
Lexington	4.7	NebraskaLink
Scottsbluff	34.2	Allo

North Dakota	Coverage %	Provider
Williston	57.5	Nemont
Jamestown	93.5	DCT
Devils Lake	88.5	NDTC
Valley City	12.8	Bek
Wahpeton	51.6	Red River
Dickinson	99.6	Consolidated

No Network

New Mexico	Coverage %	Provider
Silver City	0	
Las Vegas	0	*
Artesia	0	*
Ruidoso	0	*
Shiprock	0	
Raton	0	*

Kansas	Coverage %	Provider
Colby	0	*
Coffeyville	0	
Atchison	0	
Great Bend	0	
Fort Scott	0	
Wellington	0	*

Arizona	Coverage %	Provider
Holbrook	0	
Show Low	1.6	Frontier
Bisbee	0	
Sedona	0	
Payson	0	
Benson	0	

*These Providers advertise fiber to private residences but not to businesses
Source: Broadband Now

Demand Aggregation Example: The Role of the State

1. Convince several school districts in a region to agree to purchase internet together;
2. Identify a neutral aggregation point for the carrier hotel in the region. This can be a college, a municipal building, county fairgrounds, etc. It will require a small room with electricity and climate control and should allow 24/7 access for providers to check on their equipment. It should be preferentially located where several provider traffic already occurs;
3. Request proposals for 10 Gbps of internet connection to come into the neutral aggregation point; and
4. Request proposals for each leg of the network to transport data from the neutral aggregation point to each school district in the region.

Recommendations: The Legislature should consider mandating the deployment of wide area education networks through the strategy of demand aggregation, potentially requiring the completion of a pilot network by July 1, 2018.

The Legislature should consider identifying an agency, director, council, or some other form of actor to carry out and be responsible for fulfilling the mandate. Potential actors and funding sources are listed in the Appendix.

APPENDIX.

Table 5. List of Potential Demand Aggregators

	Strengths	Weaknesses
DoIT	Most obvious choice, most technically qualified, good project management	Funding, no authority over schools
PED	Most effective school coordinator, most impacted by lower broadband costs	Funding, lack technical expertise
PSFA	Funding, technical expertise, good project management	Lack of authority
Higher Education	Already has a network, technical expertise, locations throughout the state	Funding, no authority
RECs	Already aggregates schools' procurements into regions	No technical expertise, project management
Broadband Council	Shared responsibility, workload, cooperation, focus	Does not exist, more bureaucracy

Source: LFC Files

Table 6. Cost and Possible Funding Sources Estimates for FY18 Demand Aggregation Pilot

Need	Description	Cost	Funding
Project Management	Coordinate Aggregation	$200 thousand	$4 million PSFA operating budget
Carrier Hotel	Retrofit Building	$50 thousand	$41 million DoIT cash balance
10 Gbps Internet	Increase Demand	$200 thousand	$6 million current internet access spending by schools
Data Transport	Connect WAN	$1million	$6 million current internet access spending by schools
Fiber Construction	Build missing pieces WAN	$2 million	$4 billion Federal E-rate, $25 million PSFA capital
Additional Funding Sources			$20 million PRC Rural Universal Service Fund

Source: LFC Files

Table 4 Methodology: Rural towns are defined as having populations between 5,000 and 15,000 that are geographically isolated from any other major town or metropolitan area. Rural towns are defined this way because they do not typically provide enough return on investment with the market left to itself. The towns shown in Table 4 were chosen at random except they are spread as evenly around their state as possible. The states in the left column of Table 4 were chosen as being the three nearest states to New Mexico that have a statewide education network started before 2010 and developed through coordinated procurement of private provider services according to the State Educational Technology Directors Association (SETDA), though California was excluded because of their historical involvement in internet technology. The states in the right column of Table 4 were chosen as not having a cohesive statewide broadband policy according to SETDA, being near New Mexico, and as comparable as possible to their counterparts in the left column. Fiber coverage areas were identified by internet search results and statistics on broadband availability compiled by Broadband Now. Only fiber advertised to businesses is reported here because businesses require strong service level agreements, meaning the providers will have installed the necessary electronics along with the fiber optic cable.