

# Community Assistantship Program

*...a program of the Center for Urban and Regional Affairs (CURA)*

## Findings on the Economic Benefits of Broadband Expansion to Rural and Remote Areas

Prepared in partnership with  
Region 5 Development Commission

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# **Findings on the Economic Benefits of Broadband Expansion to Rural and Remote Areas**

**Yuri Hupka**

**2014**

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# **Minnesota Region 5 Development Commission**

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## **Abstract**

Internet access has become vital to a progressive society. Communities with broadband access experience a wide array of economic, educational, and social advantages. However, many rural and remote areas are without sufficient bandwidth to fully and effectively participate in the world economy.

The perceived gap between areas with and without sufficient bandwidth is known as the 'digital divide'<sup>1</sup>. While the 'digital divide' was once a problem of access, internet proliferation in recent years has made it an issue of connection quality and speed<sup>2</sup>.

Congress as well as many private and public organizations have noted these problems and are initiating policies to counter them. However, development is slow due to perceived high costs and low benefits.

In reality, there are more benefits than many businesses expect. Research indicates that small communities and surrounding rural areas with high quality broadband access reap both short and long term economic benefits. Short term benefits are characterized by modest increases in business and job growth. Business growth is realized through practical applications such as e-commerce and cost reductions. For this reason, many businesses have already reached out to rural areas thus giving rise to the recent trend called 'rural sourcing'. Some long term benefits include growth in population, per capita income, and even GDP.<sup>3</sup>

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<sup>1</sup> (Access to Telecommunications Technology: Bridging the Digital Divide in the United States, 2013)

<sup>2</sup> (Servon, 2002)

<sup>3</sup> (Kolko, 2010)

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However, broadband access does not just help businesses in these outlying areas. Rural communities and its citizens also benefit. Educational and government institutions can use high speed internet for scholastic and vocational training thus building a competent and competitive workforce. Medical providers require high-speed connections to supply telehealth which can immensely improve health care in rural areas. Also, research indicates that adequately connected citizens are often more involved in their communities<sup>45</sup>.

By prudently developing and creatively financing broadband, rural communities can keep pace with the global economy and prepare citizens for participation and competition in the modern world.

## **1. Digital Divide and the Last Mile**

Communication technologies have transformed our society and changed the way people experience their lives. It can easily be argued that over the past decade internet access has become the most important of these technologies. So many activities from social interaction to business transactions depend in some way upon the transmission of data across the globe. However, there is still a large segment of the population without access to a reliable or affordable internet connection. According to a 2013 congressional report, nineteen million Americans still do not have access to high speed broadband internet, severely inhibiting their opportunities within modern society.<sup>6</sup>

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<sup>4</sup>(Whitacre B. H., 2009)

<sup>5</sup>(Stern, Adams, & Boase, 2011)

<sup>6</sup>(Access to Telecommunications Technology: Bridging the Digital Divide in the United States, 2013) Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

The economic and social disparities between information ‘have’ and ‘have-nots’ is known as the ‘digital divide’. As the importance of information and communications technologies (ICTs), has grown so has the divide.

To combat this deficit, congress has implemented the National Broadband Plan. This plan proposes to bring affordable high speed access to at least 100 million U.S. homes. It also intends to introduce more robust internet service to government agencies and first responders by 2020. This will no doubt ease the digital divide within the community but it is far from sufficient because it fails to address the needs of individual households living in rural areas. Almost everyone in America already has access to some form of internet yet all too often the level internet strength is frustratingly insufficient. In order to function adequately and participate fully in our modern world households, businesses, educational institutions, and health care facilities in rural areas require a larger bandwidth.

Unfortunately, many areas in rural America are in “the last mile” or the final leg of the telecommunications networks.<sup>7</sup> While the population density of consumers in urban areas makes infrastructure development profitable, less populated rural areas are often neglected because of a perceived large cost to benefit ratio.

## **2. Minnesota Region Five**

Neglected areas are seen in much of the state of Minnesota, especially in rural regions. In rural areas, broadband availability and connection quality are lower than their urban counterparts. Minnesota Region Five consists of Cass, Crow Wing, Todd, Morrison, and

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<sup>7</sup> (Prieger, 2013)

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Wadena counties. The region five population is primary rural with urban resident rates for the individual counties at only 22-37%.<sup>8</sup> Residents of ‘urban’ townships large enough to have cable broadband access is available are in the minority in region 5, while the rest rural areas or smaller townships with inferior, and often if-any, access.

A map of access shows fiber and DSL access is currently available in much of region five.<sup>9</sup> DSL connections are typically 15-20Mbps, but many ‘DSL’ connections in rural areas are only 4Mbps. Similarly, fixed wireless connections are also often at reduced speeds closer to 1Mbps instead of the potential 10Mbps. Wireless signals are also unreliable often losing connection due to topographical, weather, or service issues.<sup>10</sup>

Many residents in rural region five have agricultural business or at-home businesses, for which quality access is becoming increasingly valuable. Region five also has many large businesses such as health care providers, and small businesses that require large bandwidth service. Faster and more robust service in rural areas would benefit many. However, a preponderance of research has shown providers are failing to consider the potential benefits of expanding their service to these more remote areas that remain in ‘the last mile’.

### **3. The Benefits of Broadband Access**

According to Trajtenberg and Bresnahan (1995) general purpose technologies “imply a sort of increasing returns to scale phenomenon”, meaning that the more robust and available they are, the greater the benefits. The authors also note that decentralized economies are at

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<sup>8</sup> (City Data 2014)

<sup>9</sup> Appendix Region 5 Access Map

<sup>10</sup> (Mardeni & Chimheno 2013)

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a disadvantage because they are often unable to “exploit growth opportunities offered by evolving GPTs.”<sup>11</sup> Many rural areas fall under this decentralized category and, therefore, are limited in their ability to exploit growth and be competitive. However, broadband internet, like other general purpose technologies, when introduced to rural areas can quickly affect all aspects of their economy and increase productivity.

Because GPTs are often far-reaching in their benefits, literature on the impacts of broadband are primarily qualitative over quantitative. Much of the research also suffers from correlation vs. causation issues making specific and definitive conclusions difficult. However, this does not mean that there is not quantitative evidence of positive benefit of broadband internet service to rural communities and surrounding areas. Let’s look at some of the evidence.

## **A. Economic Growth**

Gillett, Lehr, Osorio, Sirbu (2006) demonstrated that broadband penetration could be reasonably estimated for specific zip codes and incorporated into economic impact models. In fact, they were able to show statistically that broadband drives economic growth. For example, they demonstrated that over a 4 year period broadband added 1.0-1.4% to local employment growth rates, 0.5-1.2% to the number of businesses established, and 6% to housing rents. Broadband availability also aided business growth by 0.3-0.6% annually. Kolko (2010) also studied the correlation between broadband and economic growth. He found that areas with one to three providers of broadband access had 6.4% higher

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<sup>11</sup> (Trajtenberg, 1995)

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employment growth and 2.4% more population growth. Areas with information and telecommunication industries and/or businesses that directly utilized broadband for their operations experienced even higher growth.

Atasoy (2011) analyzed the effects of the expansion of broadband internet access from 1999 to 2007 on labor market outcomes throughout the United States. He saw a modest labor market growth of 1.8% where there was at least one new 'high speed' internet provider. Other studies have shown that individual households also benefit economically. Qiang (2009) conducted a series of studies on developing economies and found that areas with higher broadband penetration see on average an initial 1.2% increase in the GDP per capita and annual per capita growth of 0.9 to 1.5%. Czernick (2011) had similar results with "modest" GDP growth.

Each of the above studies suggests a causal relationship between broadband and economic prosperity. Areas with broadband internet connections not only experience higher rates of employment growth but also the higher average incomes. The creation of jobs that are higher paying also stimulates population growth. Clearly, remote areas can expect to experience at least modest economic growth by merely gaining access to broadband.

## **B. Business Advantages**

Individual businesses require broadband to be competitive in the marketplace. Some of the practical advantages of broadband access include cost comparing and savings, improved efficiency and e-commerce participation. In fact, one could easily argue that the internet access with adequate speed is integral to business survival.

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Barkley, Markley, and Lamie (2007) studied over two dozen rural businesses to see if they were taking advantage of e-commerce. They found that all the rural businesses were all involved in some form of e-commerce and that their utilization of e-commerce was quite varied. For example, the internet was being used to develop new products, to research new markets, to analyze and lower marketing costs. All these firms gave credit to the internet and e-commerce for their business growth. Interestingly, many actually believed they were not suitably prepared for the rapid expansion they were experiencing. Unfortunately, problems with the stability and strength of their connections negatively affected their efficiency and inhibited even more productivity and growth.

Galloway, Sanders, and Deakins (2011) investigated firms in rural Scotland and found that small firms in particular experience optimal growth by integrating e-commerce into their current practices. These firms were better off seeking a balance between external orientation and local trade instead of only facilitating external trade with a small number of clients. Local trading limits transportation and inventory costs which translates into higher profit margins. Also, increased local trade helps communities by offering tax, employment and other advantages. These researchers concluded that “the real story about the use of the internet for rural small business and entrepreneurship is less about the dramatic gains of individual firms that have used it to re-orientate to the global market, and more about its use as a ubiquitous feature of modern business to improve the function, process and quality of the business and consumer experiences in the local rural economy.” (page 261 from 2011 article) However, the vast majority of the firms in the study admitted that without a sufficient internet source they would be unable to provide the heightened level of service or

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attract the necessary local and global markets.

Broadband is also associated with positive producer network effects on small and rural businesses. Network effects are a positive externality that occurs when many firms adopt similar technologies. For example, fax machines become increasingly valuable as more companies use them. Broadband internet acts the same way. When a small business has fast and easy access to the marketplace, broadband becomes not only more usable but also more necessary and valuable. In terms of production, it can make comparative shopping for inputs easier and cheaper. It can also facilitate the research and development of better products. In terms of sales, it can help businesses find and market to potential buyers and then serve them more effectively. In spite of these obvious advantages, many small firms often do not have high speed broadband. Perry (2005) found that the main reasons that small businesses had not adopted broadband were availability, affordability, and a lack of awareness of its benefits. One more reason given was because they were lacking a “culture of support” which describes the necessary conditions for community broadband development. A community can offer this “culture of support” by developing the infrastructure in their area which acts as a signal to businesses that they too should advance their technological capabilities.

### **C. Educational and Labor Market Advantages**

Many businesses are attracted to rural areas because of the lower property and labor costs and other market advantages. However, limited talent pools in rural areas often discourage prospective firms. But rural areas can utilize broadband to combat the dearth of highly

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skilled labor by providing internet based education and job training. In the United Kingdom funding for internet training programs has helped create thousands of new jobs on even a micro rural basis.<sup>12</sup> Through the use of services such as web kiosks and training seminars, people are being educated in new fields and earning valuable and often necessary certifications/degrees from online schools.

American universities and vocational schools are offering more online programs and/or are utilizing the internet more frequently to enhance existing programs. Rural students without sufficient internet access are often at a disadvantage compared to their urban counterparts. For example Dakota Bates, a student at Missouri State University, drives one hour each way five days per week to attend his classes. But he often stays at school long after classes are over in order to use the schools internet service to do online research and web based assignments.<sup>13</sup> Not only is Dakota unable to do his homework at home like his classmates but he also feels ‘out of the loop’ missing out on current events, social networking and other aspects of pop culture that are only to him available on-line.

Primary and high schools are adopting the use of technology in classrooms at growing rates. In Greenville, South Carolina the school district is also requiring students to use technology for learning outside the classroom. One teacher even has her students watch on-line lectures before class, work on web assignments, and participate in study groups online. Many students also complete multimedia and digital projects online instead of pen-and-

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<sup>12</sup> (The Northern Echo, 2013)

<sup>13</sup> (Grossman, 2013)

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paper reports.<sup>14</sup> Broadband internet is rapidly becoming an increasingly valuable educational tool.

Broadband is helping communities to overcome the lack of skilled laborers that so often discourages business development. Technology is allowing communities to provide a spectrum of e-learning opportunities including technical and academic training necessary for job growth. If businesses are attracted to a locally skilled labor pool, rural communities can stave off their aging population shift. Young people will no longer feel they need to flee to urban areas for decent paying jobs. In this way, economic development can begin and grow.

#### **D. Rural Sourcing**

A developing trend among many global firms is rural sourcing. Firms, of course, want to lower their labor, rent, and overhead costs in order to compete globally. In the past, companies achieved this by outsourcing their workload to developing countries. However, there are many drawbacks to outsourcing including loss of managerial control, international legal discrepancies, quality assurance problems, bad publicity and other issues that are making outsourcing less attractive. Rural sourcing is a viable alternative.

*Rural Sourcing Inc* is a company whose mission is to reverse the rural “brain drain” and bring jobs to areas of the United States where historically the job market was dominated by agriculture and manufacturing. It provides a domestic cost-effective, onshore alternative to

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<sup>14</sup> (Barnett, 2013)

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the traditional model for IT outsourcing by recruiting workers from smaller universities or community colleges and basing them in rural areas where rent is cheap. *Onshore Technology Services* is another company that is bringing jobs to rural America. It recruits workers from minimum wage jobs, gives them intense IT training and sets up centers in rural areas where their recruits will work for global clients. Minnesota has actually been part of the rural sourcing trend. *CrossUSA* of Burnsville recruits experienced, older IT workers for their Sebeka, MN and Eveleth, MN offices. Their employees are often happy to move to small rural towns where the cost of living is substantially lower and they can enjoy a small-town lifestyle.

However, rural sourcing requires broadband access. If communities want to attract businesses like Rural Sourcing Inc, Onshore Technology Services or Cross USA, they must provide the infrastructure for broadband access. Without broadband it wouldn't be possible to connect with the global markets or create/attract the high skilled talent that broadband provides.<sup>15</sup>

## **E. Telehealth**

Health care providers are an important part of many rural communities but they face challenges. Since rural health providers generally operate on lower budgets than their urban counterparts they must exploit any opportunity to lower costs and/or provide a greater level of care in order to be successful. For this reason, telehealth is becoming increasingly popular with providers. Telehealth (or telemedicine) is “the use of medical

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<sup>15</sup> (Alsever, 2010)

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information exchanged from one side to another via electronic communications to improve a patient's clinical health status.”<sup>16</sup>

These communications can take many forms ranging from simple chart reading or illness diagnosis to complex procedures and surgeries conducted remotely. The current reality is that for many rural health care providers, being able to conduct telehealth is a necessity, and one often requiring a sufficient high speed broadband connection.

The cost savings of telehealth can be staggering. A 2008 economic analysis of heart failure telemonitoring concluded that e-monitoring saved 2-68% in costs before accounting for additional factors such as travel and low incidence of rehospitalization. These findings are not uncommon. A 2009 study in Oklahoma found that in five rural communities a total of \$3.5 million in health care costs was saved for teleradiology and telepsychiatry alone.<sup>17</sup> Avera E-Care, a company specializing in tele- and e-health provision estimates that it saved over \$30 million on ICU visits alone from 2004-2012.

There are many more quantitative studies and individual cases that concur with these findings. Clearly, telehealth is currently an important part of health care provision and its prevalence will no doubt grow. However, for telehealth to succeed high speed broadband internet is essential for both the provider and the at home patient/subscriber alike.

## **F. Community Involvement**

Rural areas can reap benefits from increased community involvement when broadband

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<sup>16</sup> (American Telemedicine Association, 2012)

<sup>17</sup> (Whitacre B. H., 2009)

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access is available to citizens. Internet encourages citizen interaction by making engagement and participation easier. Rather than driving to municipal offices in town, rural residents can access records, keep abreast on local issues such as planning, land-use, and care for other business if the information is easily accessible online. Downloading necessary documents, paying bills, or even connecting with groups and local officials is easier with faster and more reliable broadband connection. Some research indicates that the quality of internet experience is important for participation and is positively correlated with higher levels of community involvement.<sup>18</sup> The authors also suggest that that “social capital formation is most important in rural communities where residents must rely more on local relationships to achieve personal and community goals.”

#### **4. Technical Information and Example Models**

The benefits internet access provides are often limited by one single defining factor, speed. The quality of a connection is becoming increasingly important as the amount of data increases. Appendix table 1 is a listing of internet access types and their speeds along with FCC goals and how they relate.

Direct connections are clearly faster and, therefore, more ideal for providing future-proofed access. The high cost associated with digging routes for, laying, and servicing line often make it seem like an unfeasible option for rural or ‘last-mile’ areas. This need not be the case.

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<sup>18</sup> (Stern, Adams, & Boase, 2011)

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A small rural region in the UK recently undertook a project to provide service to 100% of the population, including those in remote areas.<sup>19</sup> Their goal was to have a stunningly high quality of 1GB/s connection available to the over 1450 properties (8 parishes) in their area. They felt this would provide a sufficiently connection speed for at least the next 20 years but they had difficulty finding funding for laying the expensive fiber line and maintaining the service for such a small number of citizens. The funding issue was solved through some interesting means. The UK government and outside donors were willing to provide about 30% of the costs required to develop the plan. The remaining funding came through a series of community offerings which sold high dividend paying shares to local citizens. Purchase of the shares was tax refundable and those who opted to purchase them were given free installation and access to the service for a year. Local farmers and rural residents also had the opportunity to work digging the ducts to lay line, one of the largest development costs, in exchange for shares from the offering. The maintenance, staffing, and service costs come from customer subscription rates. The budget for the project was met and development took approximately two years to complete. This project was so successful that it was later expanded to cover 3200 properties over 21 parishes. This example shows that some ingenuity, creative financing and foresight high quality internet connection to many if not all rural areas is possible.

Similar projects are underway in American states facing similar rural broadband availability and speed issues. A broadband analysis by Marathon County, Wisconsin in 2009 found that most rural areas had only 1MBs availability or were “dead zones” with

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<sup>19</sup> (Forde, 2013)

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none at all.<sup>20</sup> A large number of at-home, small, and agri-businesses were also lacking a sufficient connection beyond dial up. Marathon county wanted to support those in the ‘middle mile’ so they encouraged providers to apply for grants and then matched their funding. Those in remote rural areas would then be provided service by using existing wireless towers and providing incentives for new towers where necessary. Other viable options included using municipal public safety and water towers to expand coverage. The goal of the plan was to provide fiber connections where possible and wireless signals of at least 5-10MBs. The region is very similar to Minnesota region 5 in terms of geography, demographics, and current infrastructure. Therefore, this exhaustive analysis and plan gives region 5 a realistic model for using existing companies and infrastructure to provide high quality access with little to no need for further construction.

## **5. Policy Impacts**

Solving the ‘digital divide’ issue and expanding access to ‘last mile’ areas is as much a policy as a business and economic issue. Although evidence suggests that broadband is vitally important for businesses, citizens, and the growth of a region, policy makers often blame telecom greed for the lack of availability. While profit margins are admittedly lower due to high infrastructure costs and few subscribers in rural areas, it should be the role of policy makers to create an environment where development projects are not only viable, but attractive. The Marathon County analysis showed that working with existing telecoms

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<sup>20</sup> (Chretien, Gray, Bradley, & Treich, 2009)

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is often the optimal choice for developing the middle mile. In more remote areas or smaller townships using existing municipal towers for wireless signals can significantly reduce costs.

Funding for projects need not be a barrier since resources can also come in a variety of creative ways. Virginia officials are utilizing a range of policy changes to stimulate development and fund projects. Direct federal and state grants, tax incentives, pro-investment legislation and other public resources are being offered to both small and large firms to assist them in managing development costs. Voucher and sliding scale subscription programs are also being used to help citizens adopt internet and computer use.<sup>21</sup>

Virginia has also made advances toward internet use being treated as a public utility regulated by the Public Service Commission. This aids in bringing state interest in providing universal and affordable access to all residents and businesses including those in remote or rural areas.

Contention and debate goes hand in hand with discussions of public spending.

It is not easy to foresee which projects are most likely to succeed and to make decisions must be made about where broadband development should take place and the speed of connections and level of service that should be provided. Many people have been called upon to give congressional testimony about federal stimulus programs effectiveness and appropriation of funding. John Paladino, administrator of the US Department of Agriculture Rural Utilities Service, believes that the stimulus has been effectively used

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<sup>21</sup> (Broadband, 2012)

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because broadband access has been expanded and projects are being completed.<sup>22</sup> While his statements are true, his testimony brings up an interesting issue for policy makers to consider. Positive data of broadband expansion does not necessarily mean the projects are reaching those with the most need. Vermont State President Michael Smith argues that many of the projects associated with the stimulus have gone toward overdeveloping ‘middle mile’ areas and have failed to bring high speed connections to those without.<sup>23</sup> He believes that private companies have been harmed by development in his regions and that private firms could utilize development funds more efficiently. Because of these issues Smith suggests that additional oversights, prior research, and joint plans between public and private enterprises are needed to make sure projects efficiently expand to the intended areas. Public officials and policy makers should keep these considerations in mind when implementing projects to create a “culture of support”.

## **6. Conclusions**

The incredible value of broadband to connect and successfully perform competitively in a global economy makes it imperative for businesses, citizens, and regions to access broadband high speed internet. Where the ‘digital divide’ previously was an issue of internet access, it is now an issue of speed. Public and private efforts are being made around the globe to make sure high speed access is available to all. Adopting the successes and learning from the mistakes of previous projects, rural communities can provide future broadband to their remote areas with relative ease. Despite the short term costs, policy

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<sup>22</sup> (Paladino, 2013)

<sup>23</sup> (Smith, 2013)

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makers and private firms should make every effort to continue developing broadband infrastructure in order to achieve the immense long term benefits of being connected in the twentieth century.

## **6. Appendix**<sup>24</sup>

### **Table 1-Broadband Speed**

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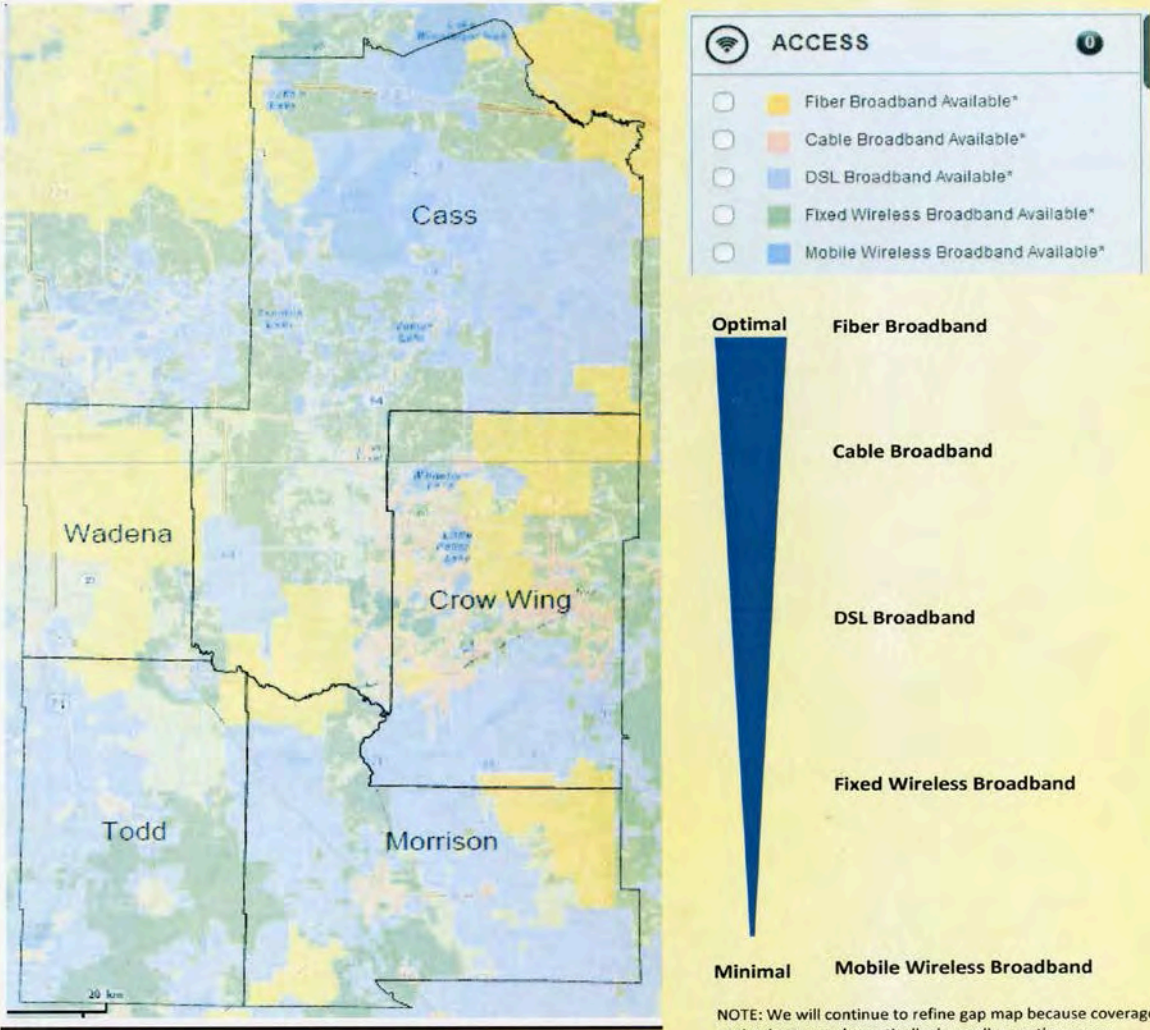
<sup>24</sup> Broadband Speed Table and Access Map from *Building A Resilient Region: Virtual Highway. 2012. Page 8.* Courtesy of Region 5 Development Commission, MN. Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

## BROADBAND SPEEDS

Goals:	Download Speed	Upload Speed	Comments
<b>FCC Goals</b> – “at least 100 million homes”	100 Mbps	50 Mbps	Most likely for urban areas
<b>FCC Goals</b> – anchor institutions in each community	1,000 Mbps (1 Gbps)	(not specified)	The FCC assumes that if fiber is brought to an anchor institution it will be easier to build out from there, but if anchor’s provider isn’t required to, it frequently doesn’t happen
<b>FCC goals</b> – everyone else	4 Mbps	1 Mbps	By 2020 - Rural groups feel this difference is very unfair
<b>Minnesota Goals:</b> Yardstick used:	“10 – 20” Mbps 10 Mbps	“5-10” Mbps 6 Mbps	By 2015
<b>Technologies:</b> Note: We are unable to find a standard speed rating for the technologies listed below; they are therefore a compilation of several sources of information and give estimated real-world capacity <i>at this moment</i> using typical ISP electronics with several users on the system; rather than theoretical capacity with advanced electronics in a controlled setting.			
<b>Dial-up</b>	40-56 Kbps		Ties up phone line; old phone lines cannot support this.
<b>DSL</b> (using ADSL2+ which is currently most common form)	15-20 Mbps	1 Mbps	Still see many rural packages at 4/1
<b>Cable</b>	Up to 20-30 Mbps, urban up to 100 Mbps	2-8 Mbps	Most rural packages lower. Real speed may be quite different from advertised. Cable is primarily located in towns and not present in rural areas.
<b>FTTH</b>	1 Gbps+	1 Gbps+	Depends on electronics, some only 100 Mbps (but can be easily upgraded per customer.) Typical modestly priced rural packages about 10/1 meg.
<b>Mobile wireless – 3G</b>	1-4 Mbps	0-1 Mbps	Reliability issues, Expensive data caps. The coverage in rural areas is spotty and focused along highways.
<b>Fixed Wireless</b>	1-10 Mbps (generally more toward 1)	1 Mbps	Line of sight and interference issues.
<b>Mobile wireless – 4G</b>	1-15 Mbps	1-5 Mbps	Reliability issues, Expensive data caps. The coverage in rural areas is spotty and focused along highways. Higher speeds requires fiber infrastructure.

### Region 5 Access Map

# ACCESS FOR THE COUNTIES OF CASS, CROW WING, MORRISON, TODD AND WADENA





## 7. Annotated Bibliography

Sources were chose based on a few defining factors.

### 1) Relevance of the article

While there are large amounts of information on broadband internet not all of it is useful for this research. 'Relevant' articles were meaningful to the individual sections, were important pieces in their field, or useful to developing the overall narrative. For statistical research, this often meant that the scope of the research was similar in context to Minnesota Region 5. Anecdotal references were chosen based on their narrative quality and how often similar stories were found.

Additional sources included, while not annotated, may be useful for further review and can be found in the extended bibliography.

### 2) Proper Methodology

'Proper Methodology' is primarily for statistical sources. Many articles available have incorrect modelling or insufficient data to come to the stated conclusions. The most common issue is the author's use of confidence intervals below the standard for the field. The common standard is 95%, however lower intervals are often used when data is difficult to find or missing. No research using an interval below 90% was used to draw conclusions in this research. Other issues include non-standardized time-gaps in time-series data and drawing conclusions from serial correlated variables.

A small number of unused sources are found in the extended bibliography for further review at the readers' discretion.

### **Access to Telecommunications Technology: Bridging the Digital Divide in the United States. (2013). *Congressional Digest*, Vol. 92 Issue 4.**

Congressional document outlining the issue of the "digital divide" and broadband in the US with a section specific to challenges faced in rural areas. Also details Congress' view on the role of the federal government in assuring internet quality for citizens and their National Broadband Plan to provide it.

**Alsever, J. (2010, July 8). *Forget India, outsource to Arkansas*. Retrieved 2013, from CNNMoney.com:  
[http://money.cnn.com/2010/07/08/smallbusiness/rural\\_onshoring/index.htm](http://money.cnn.com/2010/07/08/smallbusiness/rural_onshoring/index.htm)**

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

Short article detailing the rise of ‘rural-sourcing’ and companies spearheading the trend.

**American Telemedicine Association. (2012). *What is Telemedicine?* Retrieved 10 2013, from <http://www.americantelemed.org/learn/what-is-telemedicine>**

American Telemedicine Association website that gives a brief overview of telemedicine and its benefits. Includes informative videos as well.

**Atasoy, H. (2013). *The Effects of Broadband Internet Expansion on Labor Market Outcomes. Industrial & Labor Relations Review*, 315-345.**

Panel study of broadband's effects on labor markets from 1999-2007. Results show high speed internet access increases employment by an average 1.8% with greater effects found in rural and isolated areas.

**Bajarin, B. (2013, 10 15). *Living in the Last Mile: How to Improve Rural Internet Access.* Retrieved 10 20, 2013, from [Time.com](http://Time.com).**

Short article discussing how to improve internet access and the author's experience of living in rural Silicon Valley versus working in a serviced area.

**Barnett, R. (2013, February 18 ). *Rise Of Internet Learning Creates Digital Divide .* Retrieved 10 20, 2013, from USA Today: <http://www.usatoday.com/story/news/nation/2013/02/16/internet-learning-creates-digital-divide/1925189/>**

News article exploring the potential for home internet to assist classroom learning and the lack of availability in many rural schools and districts.

**Broadband, W. V. (2012). *Reducing the Broadband Gap in West Virginia.* Retrieved 10 15, 2013, from WestVirginia Broadband: [http://www.westvirginia.com/broadband/resources/broadband\\_policy\\_brief.pdf](http://www.westvirginia.com/broadband/resources/broadband_policy_brief.pdf)**

Policy brief of how West Virginia plans to address the broadband gap. Their intention is to primarily use \$128 million of federal grant money and investments to fund infrastructure upgrades. While they believe profit viable areas will be naturally expanded upon by private firms, firms entering non-viable areas or smaller sized firms may be given further tax incentives to expand.

**Brown, R., Barram, D., & Irving, L. (1995, July). *Falling Through The Net: A Survey of the "Have Nots" in Rural and Urban America.* Retrieved 10 14, 2013, from**

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

**National Telecommunications & Information Administration:**  
**<http://www.ntia.doc.gov/ntiahome/fallingthru.html>**

Exploration of the digital divide issue. Especially useful is the 'Tables and Charts' section where individual demographics, regions, and socio-economic groups are addressed.

**Carnevale, D. (2006). Technology Companies Bring Outsourcing Home. *Chronicle of Higher Education*, Vol. 52 Issue 31.**

Companies seeking high skilled/low cost labor are looking to domestic small college towns to stem the tide of outsourcing of previous years. Highlights the growing importance of 'rural sourcing' and how lower population regions can become uniquely competitive in skilled labor sectors.

**Center for Rural Policy and Development. (2012). *The 2012 Minnesota Internet Study: An Examination of Metro/Rural Differences in Digital Technology Adoption.***

Annual Minnesota internet adoption results. Rural areas have lower rates of internet access adoption and computer ownership than metro areas, though the rates for both are still quite high. Minnesota's broadband issue is one of speed or access, not availability. Both variables found to be heavily correlated to socio-economic factors and faster internet speed correlated with time spent engaged in online activities.

**Chretien, W., Gray, P., Bradley, M., & Treich, D. (2009, October). *Broadband Gap Analysis*. Retrieved 10 16, 2013, from Marathon County Wisconsin: [http://www.co.marathon.wi.us/Portals/0/Departments/CCD/Documents/BGA\\_MarathonCountyBroadbandGapAnalysis.pdf](http://www.co.marathon.wi.us/Portals/0/Departments/CCD/Documents/BGA_MarathonCountyBroadbandGapAnalysis.pdf)**

Marathon County, WI analysis of and plan for addressing the broadband gap in their region. Includes nearly all of the factors one may think of when planning such a project. Provides a valuable example for outlining and staging implementation if scaled to the MN 5 County region.

**Connect Minnesota. (2011). *Minnesota Broadband Availability and Adoption Statistics: An Initial Working Report*. [http://www.connectmn.org/\\_documents/MNPlanningReport\\_ALL\\_screen.pdf](http://www.connectmn.org/_documents/MNPlanningReport_ALL_screen.pdf).**

Complete look at Minnesota broadband markets and adoption statistics.

**Edward Feser, J. H. (2013). *Symposium Report: Findings from the Research*. NC Broadband.**

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

Symposium roundtable findings discussing the quality of findings from research on the economic and community impact of broadband. Shows that there exists a research bias that 'internet is inherently good' and that while it may be true, much of the research used to make such claims is not complex enough to provide policymakers with the necessary understanding to make efficient decisions.

**Forde, B. (2013, April 9). *B4RN Business Plan*. Retrieved 10 15, 2013, from  
Broadband For The Rural North: <http://b4rn.org.uk/wp-content/uploads/2011/11/B4RN-Business-Plan-v5-2.pdf>**

Business model for a small region of northern rural UK where 100gb/s cable was introduced to the entire region. Includes cost and technological structures and 'outside the box' methods for funding and implementation. Also details community outreach programs and methods for getting local citizens involved in multiple levels of the project. Very useful example of a sustainable and feasible broadband model.

**Funding provides internet training. (2013, August 27). *The Northern Echo*.**

Government funded internet training assists in citizens finding employment in rural UK. Successful programs of free internet training including web kiosks and seminars have potential to be positive influences to communities.

**Galloway, L., Sanders, J., & Deakins, D. (2011). Rural Small Firms' Use of the Internet: From Global to Local. *Journal of Rural Studies*, p254-262.**

Study of internet portals in rural Scotland. Suggests that rather than focusing on facilitating only external trade, small firms should seek a balance of local and external market orientation. Further evidence shows that internet plays a key role in small firms ability to attract markets. However, both of these aspects requires that internet be available within the local markets themselves so consumers can be effectively reached.

**Grossman, S. (2013). For Internet Access, Many Rural Students Still Have to Hit the Road. *Chronicle of Higher Education*, Vol 60. Issue 1.**

Gives a brief picture of the educational difficulties faced by post secondary students without high speed internet access.

**Kolko, J. (2010). *Does broadband boost local economic development?* Public Policy Institute of California Report.**

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

Research analysis indicating a positive relationship between broadband expansion and economic growth. The relationship found is stronger in industries that rely more on information technology and in areas with lower population densities.

**Lehr, W. H., Osorio, C. A., Gillett, S. E., & Sirbu, M. A. (2005). Measuring Broadband's Economic Impact. *Tepper School of Business., Paper 457.***

Cross sectional study of the effects of broadband on economic growth in the US. Results strongly suggest that markets with broadband availability experience more rapid growth in employment, number of businesses, IT sector growth, median wage, and property rental values. "Policy makers who have been spending their time or money promoting broadband should take comfort that their efforts and investments are not in vain."

**Mardeni, R., & Chimheno, R. (2013). Wireless Regional Access Networks: A Wise Choice for Internet Connectivity to Rural Areas Of Zimbabwe. *Modern Applied Science , Vol. 7 Issue 7, p29-41.***

Examines the "Zimbabwean Problem", an issue similar in dynamic and scope to the digital divide in rural Minnesota. Gives insight into the potential of WRAN and cognitive radio networks and thoroughly describes the technical aspects of wireless networking and implementation issues faced.

**Paladino, J. (2013, April 1). Has Federal Stimulus Money Been Used Effectively in Expanding Broadband Access? Con. *Congressional Digest, pp. Vol. 92 Issue 4, p27-31.***

Rural Utilities Service Administrators congressional testimony that broadband initiatives have helped utility companies expand access and keep technology up to date.

**Peery, S. (2005). Producer Network Effects for Rural Economic Development: An Investigation into the Economic Development Potential . *Virginia Polytechnic Institute and State University , --.***

Exhaustive study on economic benefits to rural regions. Broadband has a positive effect on long term growth and attraction of new businesses. Midrange or better internet connections necessary for business attraction and continued growth.

**Qiang, C. Z., Rosotto, C., Kimura, K. (2009). Economic Impacts of Broadband. *Information and Communications for Development 2009: Extending Reach and Increasing Impact. The World Bank. Pg 35-50.***

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

Complete text by the economics organization The World Bank. Provides a complete and exhaustive look at telecommunications and their global development. Economic impact is only Chapter 3. Other chapters cover a diverse set of topics including technical aspects of network development, integrating broadband into government services, stimulating global e-trade, and strategies for effective broadband implementation.

**Prieger, J. (2013, April). The Broadband Digital Divide and the Economic Benefits of Mobile Broadband for Rural Areas. *School of Public Policy Working Papers*.**

High speed broadband access positively impacts rural economies. Rural regions have large numbers of low speed providers but very few if any high speed options, though mobile broadband is helping fill in service gaps.

**Rolling out broadband to rural communities. (2013, July 22). *The Northern Echo*.**

News article detailing how communities in the UK use 4G technology to bring high speed wireless connections to rural areas.

**Servon, L. J. (2002). *Bridging the Digital Divide: Technology, Community, and Public Policy*. Oxford, UK: Blackwell Publishing.**

Exhaustive qualitative and quantitative academic book on the digital divide. Outlines dimensions of the 'digital divide' and explores options for solving the issue for specific demographics and labor markets.

**Smith, M. K. (2013, April). Has Federal Stimulus Money Been Used Effectively in Expanding Broadband Access? Con. *Congressional Digest*, pp. Vol. 92 Issue 4, p27-31.**

Business leaders' perspective that federal stimulus money has not been efficiently used. Instead of expanding service to underserved areas, stimulus money has been used to "overbuild the middle mile".

**Stern, M. J., Adams, A. E., & Boase, J. (2011). Rural community participation, social networks, and broadband use; Examples from localized and national survey data. *Agricultural and Resource Economics Review*, 158.**

Research data showing that the use of broadband is positively correlated with higher levels of community involvement.

**Trajtenberg, M. &. (1995). General Purpose Technologies: 'Engines of Growth'? *Journal of Econometrics*.**

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

Whole eras of technical progress and economic growth appear to be driven by a few key advances called General Purpose Technologies. GPT's spread throughout the economy, bringing about generalized productivity gains. Analysis shows that the characteristics of GPT's imply a sort of increasing returns to scale phenomenon, and that this may have a large role to play in determining the rate of technical advancement.

**Whitacre, B. H. (2009). A community perspective on quantifying the economic impact of teleradiology and telepsychiatry. *The Journal of Rural Health*, 194-197.**

Study of teleradiology and telepsychiatry in rural Oklahoma hospitals. Found 'staggering' cost savings to institutions utilizing cutting edge telemedicine techniques.

**Whitacre, B., & Mills, B. (2010). A need for speed? Rural Internet connectivity and the no access/dial-up/high-speed decision. *Applied Economics*, Vol. 42 Issue 15, p1889-1905.**

Quantitative study of factors that contribute to a households decision between high-speed, dial-up, or no internet access. Utilized econometric nested logit model. Results suggest policies that solely promote infrastructure in rural areas do not sufficiently address the 'digital divide' issue.

**City Data. Retrieved January 2014, <http://www.city-data.com/>**

Stats about all US cities - real estate, relocation info, crime, house prices, cost of living, races, home value estimator, recent sales, income, photos, schools, maps, weather, neighborhoods, and more. (n.d.).

## **8. Extended Bibliography**

**Barkley, D. L., Markley, D. M., & Lamie, R. D. (2007). E-commerce as a business strategy: Lessons learned from case studies of rural and small town businesses (Award No. 2005-45064-03212). Southern Rural Development Center's National Rural e-Commerce Extension Initiative. Washington D.C.: U.S. Department of Agriculture.**

**Crandall, R. W., & Jackson, C. L. (2003). The \$500 billion opportunity: The potential economic benefit of widespread diffusion of broadband Internet access. In A. L. Shampine (Ed.). *Down to the wire: Studies in the diffusion and regulation of telecommunications technologies (ch.8)*. Hauppauge, NY: Nova Science Press.**

Findings on the Economic Benefit of Broadband Expansion, Author: Yuri Hupka, Funded by U of MN CURA.

**Hu, Wei-Min, Prieger, J.E. (2008). The Empirics of the Digital Divide: Can Duration Analysis Help?. Pepperdine University, School of Public Policy Working Papers. Paper 10.**

**Katz, R. L., Avila, J., & Meille, G. (2011). Economic impact of wireless broadband in rural america. Study by Telecom Advisory Services, LLC, for the Rural Cellular Association.**

**Morris, D. E., & Goodridge, L. E. (2008, Sept. 29). What skills are at the end of broadband cables in rural America? Do they match up with firms wishing to engage rural sourcing? Paper presented at the Broadband in the Rural Economy Workshop, Economic Research Service, USDA, Washington, DC.**

**National Telecommunications and Information Administration. (2011, February). Digital nation: Expanding Internet usage: NTIA research preview. Washington D.C.: U.S. Department of Commerce. Retrieved from [http://www.ntia.doc.gov/reports/2011/NTIA\\_Internet\\_Use\\_Report\\_February\\_2011.pdf](http://www.ntia.doc.gov/reports/2011/NTIA_Internet_Use_Report_February_2011.pdf).**

**Pociask, S. B. (2005, December). Broadband use by rural small businesses. Study by TeleNomic Research, LLC, for the Small Business Administration Office of Advocacy.**

**Prieger, J. E. (2003). The supply side of the digital divide: Is there equal availability in the broadband Internet access market? *Economic Inquiry*, 41(2), 346-363**

**Prieger, J. E., & Heil, D. (2010b). The microeconomic impact of e-business. In I. Lee (Ed.). *Encyclopedia of e-business development and management in the global economy* (pp.12-22). Hershey, PA: IGI Global.**

**Prieger, J.E. (2013) The Impact of Government Policies on Access to Broadband. Pepperdine University, School of Public Policy Working Papers. Paper 44.**

**Ryan, J. T. Telecom companies offline with broadband stimulus. *Central Penn Business Journal*; 11/27/2009, Vol. 25 Issue 48, p17.**

**Varian, H., Litan, R. E., Elder, A., & Shutter, J. (2002). Net impact study: The projected economic benefits of the Internet in the United States, United Kingdom, France, and Germany. United States Department of Agriculture. (USDA) (2011, January). *Advancing broadband: A foundation for strong rural communities. Broadband Initiatives Program, Awards Report.***



**Wallsten, Scott J. and Riso, J. (2010). Residential and Business Broadband Prices  
Part 1: An Empirical Analysis of Metering and Other Price Determinants.  
Technology Policy Institute Working Paper.**

**Wilson, Carol . Economist Criticize U.S. Government Over Unorganized Broadband  
Program.  
Satellite News; 9/2/2009, Vol. 32 Issue 35, p1**