

# Draft Annual Report: 2016 Governor's Task Force on Broadband

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## Draft Annual Report: 2016 Governor's Task Force on Broadband

October 31, 2016

Dear Governor Dayton,

Access to broadband remains a critical issue for many Minnesotans, especially those living in rural areas of the state. We know that broadband plays a vital role in connecting people to healthcare, education, and the global economy, and ensuring every Minnesotan has access to broadband remains an objective of the Task Force on Broadband.

Since the last Task Force on Broadband report in January 2016, members have continued their work to understand the state of broadband in Minnesota, track progress towards statutory universal broadband access goals, and make recommendations to meet these goals. Two important milestones were achieved during the 2016 Legislative Session.

First, thanks to your leadership and that of the Legislature, the state's Border-to-Border Broadband Development Grant Program was funded at \$35 million. This level of funding is more than the program has received during its first two years of existence.

During the first two years of the Border-to-Border Broadband Development Grant Program, the Legislature allocated nearly \$31 million to the program, leveraging \$41 million in private investments and serving more than 9,000 households and more than 900 businesses. The most recent funding level of \$35 million promises to leverage at least this much private investment, serving additional households and businesses.

Second, the State updated its broadband speed goals to reflect the recommendations of the 2015 Task Force on Broadband. These new recommendations – to provide broadband service of at least 25 megabytes per second (Mbps) download and 3 Mbps upload (25 Mbps/3 Mbps) by 2022 and 100 Mbps/20 Mbps by 2026 – also reflect the changing nature of today's technology landscape and the demand for a high-speed Internet connection.

This report summarizes the work of the 2016 Task Force on Broadband, addressing issues related to broadband adoption and affordability; emerging technologies and cybersecurity; and broadband accessibility. The report also includes policy recommendations for you and the Legislature to consider during the 2017 Legislative Session.

We are confident that with broad, bipartisan leadership from you and the legislature, Minnesota will continue to make great strides in expanding broadband access throughout the state. We look forward to continuing to work with you and the Legislature on this important topic.

Sincerely,



Margaret Anderson Kelliher  
Chair, Governor's Task Force on Broadband

## **Draft Annual Report: 2016 Governor's Task Force on Broadband**

### **Members of the Governor's Task Force on Broadband**

Margaret Anderson Kelliher (Chair), Minnesota High Tech Association

Hannah Buckland, Leech Lake Tribal College

Denise Dittrich, Minnesota School Boards Association

Kevin Hansen, Thomson Reuters

Shannon Heim, Dykema

Maureen Ideker, Essentia Health

Bernadine Joselyn, Blandin Foundation

Steve Lewsader, Communications Workers of America

Neela Mollgaard, Red Wing Ignite

Donald Niles, City of Wadena

Daniel Richter, MVTV Wireless

Andrew Schriener, CenturyLink

Richard Sjoberg, Sjoberg's Cable

Paul Weirtz, AT&T

## Draft Annual Report: 2016 Governor's Task Force on Broadband

### Executive Summary

In 2011, Minnesota Governor Mark Dayton signed Executive Order 11-27 ([Executive Order 11-27](#)) establishing the Governor's Task Force on Broadband. Fifteen members, representing a variety of backgrounds, serve on the Task Force which is charged with developing, implementing, and promoting state policy, planning and initiatives to achieve state broadband needs and goals. This report highlights the work of the Task Force in 2016 and makes policy recommendations to the Governor and Legislature.

Since the last report in 2015, the state broadband speed goals, established in 2012, have expired. Following the recommendations of the 2015 Task Force on Broadband, the Legislature updated the state's broadband speed goals. These new speed goals, found in Minn. Stat. §237.012, state:

It is a state goal that (1) no later than 2022, all Minnesota businesses and homes have access to high-speed broadband that provides minimum download speeds of at least 25 megabits per second and minimum upload speeds of at least three megabits per second; and (2) no later than 2026, all Minnesota businesses and homes have access to at least one provider of broadband with download speeds of at least 100 megabits per second and upload speeds of at least 20 megabits per second.

These new goals reflect the changing nature of broadband technology, and the related desire from residents and businesses for increased broadband speeds.

As of July 2016, 89.98 percent of Minnesota households have broadband access available at a speed of at least 25 megabytes per second (Mbps) download and 3 Mbps upload (25 Mbps/3 Mbps), while 77.45 percent of rural Minnesota households have a broadband connection that meets these speeds (these figures include broadband service provided by wired, fixed wireless and wireless technologies as Minnesota Statutes did not specify a technology). As of July 2016, speeds of 100 Mbps/20 Mbps, from fixed, non-mobile service, were available to 52.46 percent of rural households in Minnesota; statewide, 70.83 percent of households have access to these speeds. As Minnesota strives to meet its updated broadband speed goals, much work remains.

The report begins with a review of progress toward the old and new state speed goals, and provides a recap of the 2016 Legislative Session. Then, the report examines broadband from three primary perspectives: affordability and adoption; emerging technologies (and impacts on cybersecurity); and accessibility.

Finally, the report provides a number of **policy recommendations** to help close the gap in access to broadband, including:

- Funding the Border-to-Border Broadband Development Grant Program at \$XX million in FY2018-19.
- Stimulate public participation in existing broadband subsidy programs by working through the OBD to increase public awareness of the programs.
- Establish a legislative cybersecurity commission to develop legislation to support and strengthen Minnesota's cybersecurity infrastructure.
- Amend building codes to require that multi-tenant housing units funded with public dollars deploy either category 5/6 or multi-mode fiber cabling between units and a central wiring location.

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- Take action to promote and communicate dig once policies, including development and dissemination of best practices and model policies to state agencies and other stakeholders. Assure that agencies with construction oversight, construction funding, and land stewardship responsibilities ensure that they lead by example in implementing "Dig Once" policies which encourage broadband competition and deployment, including planning, joint use, construction and notification.
- Provide the Office of Broadband Development funding for one (1) FTE to advance and implement these recommendations.
- Create an Office of Broadband operating fund to promote broadband adoption and use. The Task Force recommends that the fund be managed by the Office of Broadband Development, at a specific amount to be determined between the Office of Broadband Development and the legislature [or specific amount recommendation – TBD], that will allow the Office to advance and support programs and projects aimed at promoting broadband adoption and use.
- Continue to monitor advancing technologies with an eye towards those regulatory responses that would balance the desirable but sometimes seemingly conflicting goals of increasing capital investment in broadband and assuring adequate access, consumer protection and public safety in Minnesota.
- Fully fund Regional Library Telecommunications Aid (RLTA) at \$2.3 million annually. RLTA offsets the cost of Internet access for libraries participating in the federal E-Rate program. Cost coverage through E-Rate is incomplete and generates a funding gap between E-Rate payment and actual expenses; RLTA fills this gap. Libraries receiving RLTA can allocate a greater portion of their local budget to develop new digital literacy services and update their public computers.

### I. Introduction

From precision agriculture to the Internet-of-Things and connected devices, to health IT and consumer electronics, today's rapidly changing technology landscape is creating new industries and disrupting others. These advances in technology generate and use a significant amount of data, and in turn require access to broadband.

A recent report by IGR Research notes that the average household consumes 190 gigabytes per month.<sup>1</sup> According to Cisco, data usage is projected to accelerate by 2020<sup>2</sup>:

- Global mobile data traffic will increase nearly eightfold between 2015 and 2020. Mobile data traffic will grow at a compound annual growth rate (CAGR) of 53 percent from 2015 to 2020, reaching 30.6 exabytes per month by 2020.
- By 2020, more than three-fifths of all devices connected to the mobile network will be "smart" devices. Globally, 67 percent of mobile devices will be smart devices by 2020, up from 36 percent in 2015. The vast majority of mobile data traffic (98 percent) will originate from these smart devices by 2020, up from 89 percent in 2015.
- By 2020, mobile-connected tablets will generate nearly eight times more traffic than generated in 2015. The amount of mobile data traffic generated by tablets by 2020 (2.6 exabytes per month) will be 7.6 times higher than in 2015, a CAGR of 50 percent.

<sup>1</sup> <http://www.telecompetitor.com/igr-average-monthly-broadband-usage-is-190-gigabytes-monthly-per-household/>, accessed October 27, 2016.

<sup>2</sup> <http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html>, accessed October 27, 2016.

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The availability of broadband is also associated with positive economic impacts. For example, between 1998 and 2002, communities with broadband availability, compared to those without it, were associated with higher levels of growth in: employment, number of businesses, and number of businesses in the information technology industry.<sup>3</sup> Non-metro counties with relatively high levels of broadband adoption (i.e. county-level adoption rates greater than 60 percent) "had significantly higher levels of growth in median household income and significantly reduced growth in unemployment when compared with otherwise similar counties that did not meet this threshold."<sup>4</sup> Higher download speeds (i.e. greater than 10 Mbps) in rural areas are also associated with poverty levels 2.6 percentage points lower than similar areas without broadband.

A 2015 report by the Internet Innovation Alliance (IIA) notes that access to the Internet is associated with an American household saving, on average, \$10,500 per year. This figure takes into account the cost of connecting to the Internet as well as data plans for mobile devices. The savings arise from consumers shopping online, including online-only discounts and comparison shopping. The gross consumer savings associated with online shopping is \$11,944 per year. In 2010, the last year that IIA released its estimate, the annual savings was estimated to be \$7,707.<sup>5</sup>

The benefits and economic activity associated with broadband availability are not experienced, however, by all Minnesotans. Although the work by this and previous Task Forces on Broadband have helped to close the broadband availability gap in Minnesota, much work remains. This report captures and summarizes the work of the Governor's Task Force on Broadband in 2016. The report summarizes progress toward the expired and new state broadband speed goals, highlights issues related to broadband adoption and affordability; emerging technologies and cybersecurity; and broadband accessibility. Policy recommendations are highlighted throughout the body of the report and aggregated at the closing of the report.

### II. Update on State Speed Goals

Over the last six years, Minnesota has made progress toward expanding access to broadband and increasing adoption rates. Legislation was enacted in 2010 that put Minnesota's broadband goals into Minn. Stat. §237.012. The initial state broadband goals expired in 2015, but were updated in 2016:

#### Subdivision 1. Universal access and high-speed goal.

It is a state goal that:

- (1) no later than 2022, all Minnesota businesses and homes have access to high-speed broadband that provides minimum download speeds of at least 25 megabits per second and minimum upload speeds of at least three megabits per second; and
- (2) no later than 2026, all Minnesota businesses and homes have access to at least one provider of broadband with download speeds of at least 100 megabits per second and upload speeds of at least 20 megabits per second.

<sup>3</sup> Lehr, W., Osorio, C., and Gillett, S. (2005). Measuring broadband's economic impact. Presented at the 33<sup>rd</sup> research conference on communication, information, and internet policy (TPRC), Arlington, VA, [http://www.andrew.cmu.edu/user/sirbu/pubs/MeasuringBB\\_EconImpact.pdf](http://www.andrew.cmu.edu/user/sirbu/pubs/MeasuringBB_EconImpact.pdf).

<sup>4</sup> Whitacre, B., Gallardo, R., and Strover, S. (2014). Broadband's contribution to economic growth in rural areas: Moving towards a causal relationship. *Telecommunications Policy*, <http://dx.doi.org/10.1016/j.telpol.2014.05.005>.

<sup>5</sup> <http://www.internetinnovation.org/press-room/broadband-news-press-releases/ia-report-consumers-can-set-aside-10500-annually/>, accessed October 27, 2016.

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### Subd. 2. State broadband leadership position.

It is a goal of the state that by 2022 and thereafter, the state be in:

- (1) the top five states of the United States for broadband speed universally accessible to residents and businesses;
- (2) the top five states for broadband access; and
- (3) the top 15 when compared to countries globally for broadband penetration.

These new goals reflect the changing nature of broadband technology and its applications; they guide the work and policy recommendations of the Governor's Task Force on Broadband. These goals, along with those established in 2010, also serve as the benchmark upon which Minnesota measures progress toward connecting the state with border-to-border broadband service.

The state goals that were established in 2010, but which expired in 2015, stated:

#### *Subd. 1. Universal access and high-speed goal.*

*It is a state goal that as soon as possible, but no later than 2015, all state residents and businesses have access to high-speed broadband that provides minimum download speeds of ten to 20 megabits per second and minimum upload speeds of five to ten megabits per second.*

#### *Subd. 2. State broadband leadership position.*

*It is a goal of the state that by 2015 and thereafter, the state be in:*

- (1) the top five states of the United States for broadband speed universally accessible to residents and businesses;*
- (2) the top five states for broadband access; and*
- (3) the top 15 when compared to countries globally for broadband penetration.*

Data collected by Connected Nation indicate that, as of December 31, 2015, 94.69 percent of Minnesota households have broadband access available at a speed of at least 10 Mbps download and 5 Mbps upload.<sup>6</sup> Generally, rural areas are less likely to have broadband service available. As illustrated by the maps below, data confirms that rural areas, especially areas outside of a regional center, must remain a priority to meet the state's broadband speed goals. Indeed, 12.34 percent of rural households in Minnesota lack access to broadband of speeds of at least 10 Mbps download and 5 Mbps upload. If only fixed, non-mobile broadband service is considered, 17.5 percent of rural Minnesota households do not have access to these speeds.

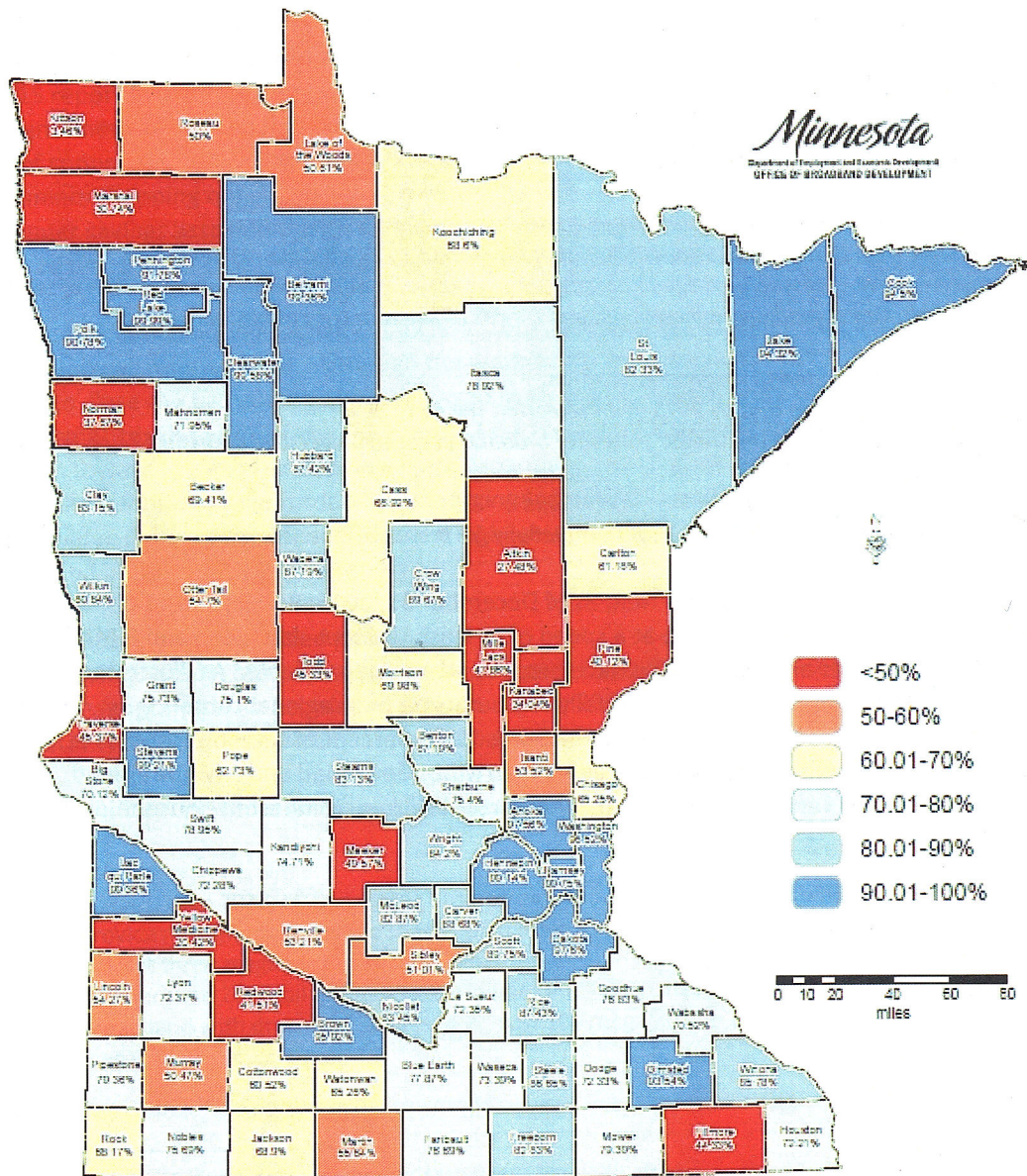
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<sup>6</sup> The 94.69 percent figure includes broadband service provided by wired, fixed wireless and wireless technologies as Minnesota Statutes did not specify a technology.

# 2016 Broadband Availability in the State of Minnesota

## Percentage of Households Served by Wireline Broadband Service

At Least 10 Mbps Download/5 Mbps Upload Speeds  
 Statewide Availability: 87.54%, Rural: 71.86%



This map was prepared by Connected Nation under contract with the Minnesota Department of Employment and Economic Development. The map represents areas of broadband service availability based on provider data submitted to and analyzed by Connected Nation and modified based on validation tools. The data is current as of December 31, 2016.

Additional maps and data are available at <http://mn.gov/deed/programs-services/broadband/maps>  
 Upon request, this information can be made available in alternate formats for people with disabilities by contacting the DEED Office of Broadband Development at 651-259-7510.

Submit questions or recommended changes to:  
 DEED.broadband@state.mn.us

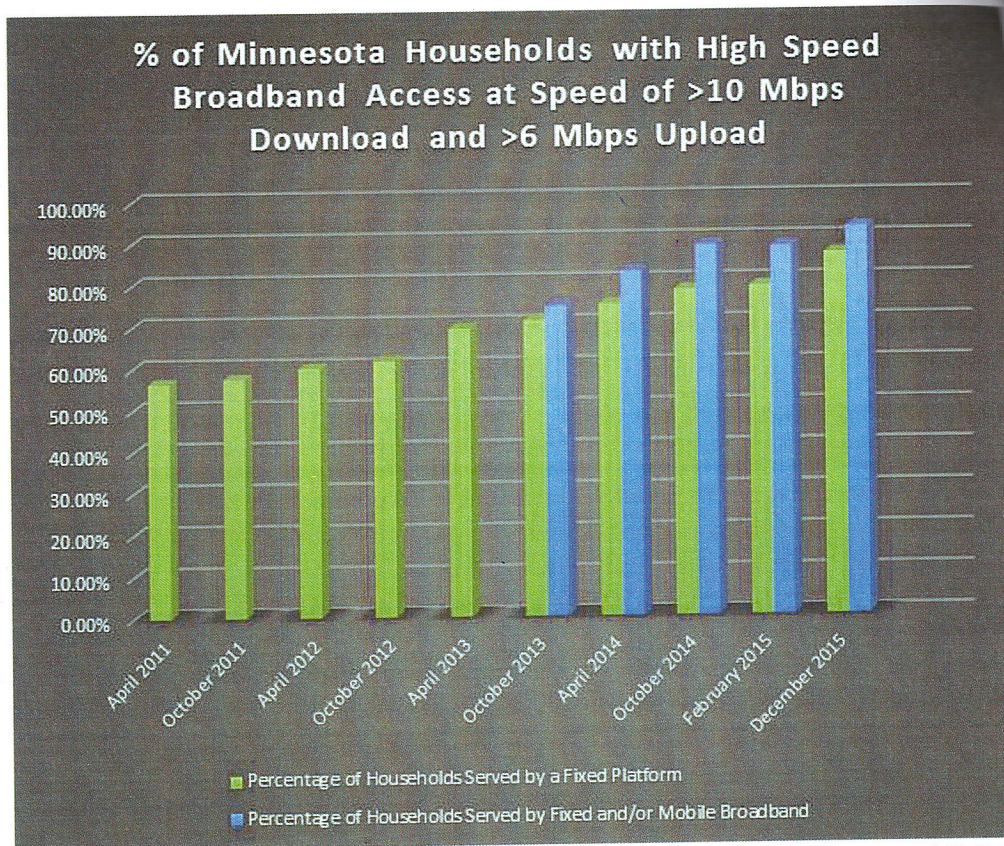
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<b>Rural Availability Estimate of Broadband Service of at Least 10 Mbps Download and 5 Mbps Upload</b>				
<b>Platform Type</b>	<b>Total Rural Households (‘000)</b>	<b>Unserved Rural Households (‘000)</b>	<b>Percent of Rural Households Served</b>	<b>Percent Households Served Statewide</b>
<b>Fixed, Non-Mobile Broadband Service</b>	<b>897</b>	<b>157</b>	<b>82.50</b>	<b>92.32</b>
<b>All Broadband Platforms, Including Mobile</b>	<b>897</b>	<b>111</b>	<b>87.66</b>	<b>94.69</b>

Broadband availability has increased across the state since measurement began approximately five years ago. The following bar chart shows this progress, measured in terms of household broadband availability at speeds of 10 Mbps download and 6 Mbps upload. Note that the chart shows broadband availability at 10 Mbps download and 6 Mbps upload, whereas the state broadband speed goals are at least 10 Mbps download and at least 5 Mbps upload.

However, because data under the State Broadband Initiatives (SBI) program, funded by American Recovery and Reinvestment Act (ARRA), was collected using federal parameters, the ability to measure broadband with an upload speed of at least 5 Mbps did not exist until the fall of 2014. For comparison over time, therefore, the Task Force retains the speeds of 10 Mbps download/6 Mbps upload for this chart.



Percent of Minnesota Households Served at 10 Mbps/6 Mbps (Source: Connected Nation)

#### Unserviced or Underserved Areas

According to the National Telecommunications and Information Administration (NTIA), a substantial gap remains between urban areas and rural and tribal areas with respect to access to high-speed broadband. The Federal Communications Commission's (FCC's) 2016 Broadband Progress Report found that "one in ten Americans lacks access to 25 Mbps/3 Mbps broadband."<sup>7</sup> In Minnesota, 99 percent of urban areas have access to speeds of 25 Mbps download and 3 Mbps upload, while only 57 percent of rural areas, including many tribal areas, have such access.

The FCC also noted in its 2016 Broadband Report that the rural-urban disparity in deployment of mass market broadband services "disproportionately impacts the ability of small businesses operating in rural areas to successfully compete in the 21<sup>st</sup> century economy." In discussing fixed versus mobile broadband, the FCC noted that these services generally have distinct pricing models which lead to different ways in which consumers use the services. Together these differences indicate that fixed and mobile broadband service different needs and are not substitutes for one another. This is supported by the finding that American consumers with available means adopt both services.<sup>8</sup>

<sup>7</sup> [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-16-6A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf)

<sup>8</sup> Ibid, p. 14.

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In the second quarter 2016, Minnesota's average connection speed was 14.7 Mbps, placing the state 26th amongst other states. Under the Akamai measurement,<sup>9</sup> the average connection speed is a reflection of what customers choose to purchase and not necessarily the speeds that are available. While Minnesota's average connection speed has increased, that increase is not at a rate greater than other states which would enable Minnesota to move up in the rankings.

**Rankings of Average Broadband Speed by State**

Rank	State	2Q 2016 Avg. Mbps
1	District of Columbia	24.3
2	Rhode Island	19.6
3	Delaware	19.5
4	Massachusetts	19.0
5	Utah	18.9
6	Maryland	18.6
7	New Jersey	18.4
8	Virginia	18.0
9	New York	17.8
10	Washington	17.2
26	Minnesota	14.7

The Task Force has traditionally reported Akamai's average broadband speed as a measure of Minnesota's standing with respect to broadband speed universally accessible. However, Akamai indicates that the average peak connection speed is more representative of Internet connection capacity. By using the fastest measurement observed from each unique IP address, Akamai indicates it is capturing just those connections that reach maximum throughput rates. Under this measure, Minnesota's average peak connection speed of 65.9 Mbps results in a ranking of #27 compared to other states.

In addition to Akamai, there are other data sources that can be used to measure broadband access and adoption. These rankings are included in Appendix C.

American Recovery and Reinvestment Act (ARRA) funding, under the State Broadband Initiatives (SBI) program administered by the NTIA of the U.S. Department of Commerce, was used to map broadband availability within each state, including Minnesota, twice a year from 2010 through 2014. That data was aggregated to create the National Broadband Map.<sup>10</sup>

Upon the expiration of the ARRA funding, the Office of Broadband Development, through a contract with Connected Nation and the participation of broadband providers in Minnesota, updated maps showing broadband availability as of December 31, 2015 (below). Additional information on broadband

<sup>9</sup> Akamai's average connection speed is a metric calculated by taking an average of all of the connect speeds calculated during the quarter from the unique IP addresses determined to be in a specific state.

<sup>10</sup> <http://broadbandmap.gov>.

availability can be found on the Office of Broadband Development website at <http://mn.gov/deed/programs-services/broadband/maps-tests/index.jsp>.

As of July 2016, speeds of 100 Mbps/20 Mbps, from fixed, non-mobile service, were available to 52.46 percent of rural households in Minnesota; statewide, 70.83 percent of households have access to these speeds. Speeds of 25 Mbps/3 Mbps, from fixed, non-mobile service, were available to 77.45 percent of rural Minnesota households.

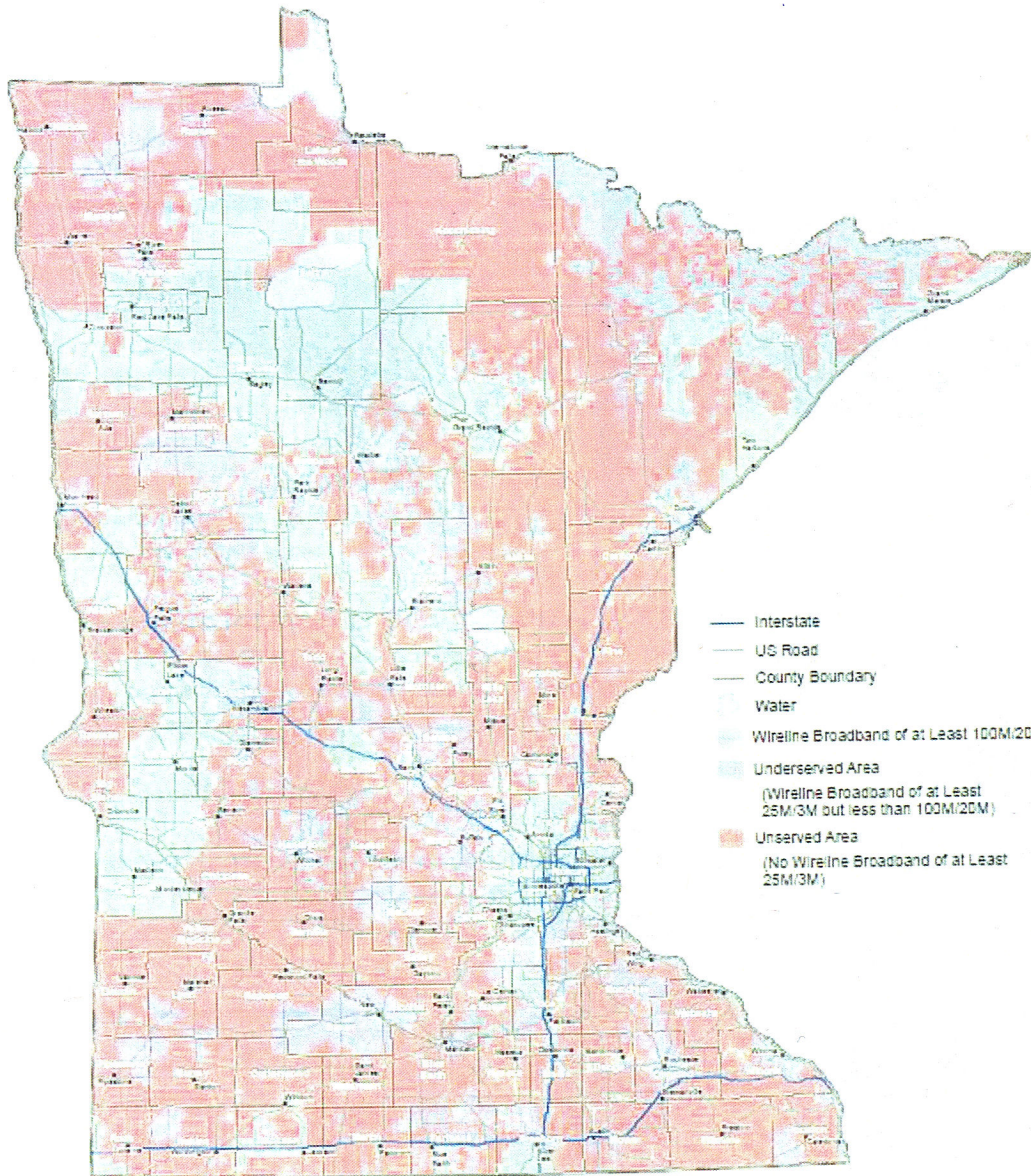
The below map illustrates *served*, *unserved*, and *underserved* areas of the state. "Served" areas of the state are those areas that have speeds of at least 100 Mbps/20 Mbps; "unserved" areas of the state are those areas that have access to speeds of 25 Mbps/3 Mbps, but not 100 Mbps/20 Mbps; "underserved" areas are those that do not have access to speeds of at least 25 Mbps/3 Mbps. The state's Border-to-Border Broadband Development Grant Program provides funding to expand broadband service in unserved and underserved areas of Minnesota.



# 2016 Broadband Service Inventory for the State of Minnesota

## Border-to-Border Broadband Development Grant Program

Uninsured, Underserved and Wireline Broadband Areas



Submit questions or recommended changes to: [CEED\\_broadband@state.mn.us](mailto:CEED_broadband@state.mn.us)

This map was prepared by Connected Nation under contract with the Minnesota Department of Employment and Economic Development. The map represents areas of broadband service availability based on provider data submitted to and analyzed by Connected Nation and modified based on validation tools. The data is current as of December 31, 2015.

Additional maps and data are available at <http://mn.gov/ceed/programs-services/broadband/maps>. Upon request, this information can be made available in alternate formats for people with disabilities by contacting the DEED Office of Broadband Development at 651-259-7510.



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### Broadband Development Grant Program: 2014-2016

The Border-to-Border Broadband Development Grant Program, created by the Legislature in 2014 and initially funded at \$20 million, provides funding to build the state's broadband infrastructure and promote broadband access in unserved and underserved areas of the state. The grants provide up to a dollar-for-dollar match on funds, not to exceed \$5 million for any one project, and are distributed to qualified entities, including a(n):

1. incorporated business or a partnership;
2. political subdivision;
3. Indian tribe;
4. Minnesota nonprofit organization organized under chapter 317A;
5. Minnesota cooperative association organized under chapter 308A or 308B; and
6. Minnesota limited liability corporation organized under chapter 322B for the purpose of expanding broadband access.

During the first two years of the Border-to-Border Broadband Development Grant Program, the Legislature allocated nearly \$31 million to the program, leveraging \$41 million in private investments and serving more than 9,000 households and more than 900 businesses. The 2016 Legislature allocated \$35 million to the grant program, with \$500,000 directed at delivering broadband to low-income areas of the state.

After reviewing [redacted] applications, the Office of Broadband Development funded [redacted] projects across the state. These projects are expected to bring broadband to [redacted] households and [redacted] businesses which previously lacked access.

Although Minnesota has made progress in expanding broadband availability to more Minnesotans, there are still obstacles that must be overcome if the state is to achieve its goal of universal access to broadband. Some of these obstacles related to broadband affordability and adoption; cybersecurity; and broadband accessibility are discussed below.

### III. **Affordability and Adoption**

"Internet access has become essential for full participation in our modern economy and our society, but 64.5 million Americans are missing out on the opportunities made possible by the most powerful and pervasive platform in history."

*Statement of FCC Chairman Tom Wheeler<sup>i</sup>*

Not all Minnesotans with broadband access use it. The reasons they don't have not changed much in the past 15 years. Non-adopters cite price, lack of relevance or interest, lack of training, and/or lack of a computer or other device as the main barriers to using broadband at home<sup>ii</sup>. Each barrier is an opportunity gap that poses a real threat to Minnesota's future prosperity.

#### What is Minnesota's broadband adoption rate?

The last statewide survey of broadband adoption was completed in 2013<sup>iii</sup>; that data is no longer relevant but the Federal Communications Commission (FCC) reports that Minnesota has an adoption rate of 42 percent for Internet access at speeds of 25 Mbps down and 3 Mbps up<sup>iv</sup>. That compares to a national average of 37 percent and a ranking of 17th<sup>v</sup>.

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The legislative goal is for Minnesota is to be in the top 15 when compared to countries globally for broadband penetration. Minnesota is not meeting its goal. We rank 17 nationally. According to the Organisation for Economic Co-operation and Development (OECD) the US ranks 17<sup>th</sup> for internet penetration. The measurements they use differ from the FCC methodology but is reflective of where the US stands globally.

### What are the benefits of broadband adoption?

Public investment in broadband adoption yields significant benefits; a recent economic study concluded that every \$1 invested in broadband in Minnesota generates \$10 in economic activity.<sup>vi</sup> The private benefits of broadband adoption impact all aspects of community and family life including increased educational opportunities, improved access to health care at reduced costs, and streamlined, more cost effective government services<sup>vii</sup>. For example, as previously noted, households with broadband save an average of \$10,500 annually<sup>viii</sup>.

The State can and should invest in broadband adoption for the benefit of residents and Minnesota's economy as a whole. State investment in broadband adoption and affordable access is needed to help ensure equal opportunity for all Minnesota residents.

### What works?

According to renowned digital inclusion expert Dr. Colin Rhinesmith, who testified before the Task Force, widespread agreement exists among researchers and practitioners alike that successful broadband adoption efforts utilize a four-pronged approach<sup>ix</sup>:

- access to good, affordable computers;
- reduced rates for broadband;
- public access; and
- training.

Happily, effective examples of each of these four elements of successful broadband adoption efforts already exist in Minnesota. Concerted support, coordination and promotion of these programs will make a measurable difference helping increase broadband utilization and shrinking Minnesota's digital divide. Below is a selection of such efforts; **more can be found in the appendix.**

### Access to Computers

PCs for People (PCfP) is a nonprofit organization that refurbishes donated computers to distribute to low incomes households. They have offices in St Paul and Mankato, with satellite offices in Grand Rapids and Bemidji (?). They also provider affordable computer support and repair and partner with providers to offer discounted Internet subscriptions. In 2015, PCfP distributed 8,712 computers to qualifying households and provided services to other communities in Minnesota through a partnership with Blandin Foundation.

PCs for People is one of several organizations in the state working to get computers with affordable internet connections into the hands of those who need them most. Demand outstrips supply. More donated computers are needed. Partnerships with more State offices and agencies, as well as promotion to entice business to follow suit, would help organizations such as PC for People serve more people.

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### Reduced Rates for Broadband

Several providers serving Minnesota residents offer low cost service to qualifying households. For example, Comcast offers a \$9.95 monthly subscription for 10 Mbps up and 1 Mbps down. In August, Comcast told the Task Force they had served 17,000 families in the Twin Cities since 2011. They also sell computers for \$149, host online tutorials and offer free computer training classes in select areas.

CenturyLink provides a similar service, as do some providers in rural areas (such as MidContinent, Charter, Sjoberg Cable and Mediacom). Providers told the Task Force they would welcome the State's assistance in promoting their reduced-price services.

There is a Federal subsidy program for low-income households called National Lifeline program, which provides \$9.25 subsidy (\$34.25 in tribal areas) to qualifying households to offset the cost of broadband. Minnesota has a Telephone Assistance Program that provides an \$2-4 discount to local phone service for low-income households. The programs would benefit more people if the funding were better aligned and extended to more people.

However, by no means do existing provider-sponsored programs address the needs of all Minnesota residents who lack affordable access to broadband. In the Twin Cities, monthly charges for broadband can vary by up to \$500 annually.<sup>x</sup> In rural Minnesota, rates also vary widely: Marc Johnson, an educator in rural Minnesota who has presented to the Task Force<sup>xi</sup>, has documented the range in costs for households in his school district<sup>xii</sup>; DSL and fixed wireless are not available to all areas. Generally, families living outside town limits do not have access to DSL or fixed wireless.

Service	Speed	Cost	Datacap (overage charges)
DSL	1.5 Mbps	\$35	Unknown
fixed wireless	5Mbps	\$100	Unknown
satellite	12 Mbps	\$130	25GB data cap
cellular	8Mbps	\$10 per GB*	

\*Cost per gigabyte (GB) can be confusing, which adds to a family's challenge, but in April (2016), the Wall Street Journal reported that Time Warner Cable's average household usage was 141 GB per month<sup>xiii</sup>, which would indicate a monthly cost of \$1410.

These disparities in access to affordable broadband lead to opportunity gaps in all aspects of social and economic life in Minnesota.

### Why the discrepancy in costs?

It is more expensive to provide broadband in rural areas and the return on investment in more difficult for the following reasons:

- Lower populations density means few customers available to buy services
- Greater distance between customers means greater expense to extend broadband to each location

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- The backhaul cost to get from local access (last mile) to the core internet (backbone) is much higher in rural areas. In 2014, the Task Force heard that the difference in backhaul can range from 50 cents in the Twin Cities to \$1 in Red Wing to \$10,000+ in Thief River Falls<sup>xiv</sup>.

Public Access

Public libraries are key to the State’s efforts to ensure broadband access for all. Librarians provide one-on-one digital training, many libraries offer computer classes and libraries provide abundant opportunities for people to get online free, either using their own devices or provided computers.

The table below tracks usage in Minnesota libraries in 2015 and 2014. While numbers have dropped slightly for in-library computer use, they have more than tripled for wireless sessions. (Instances when a patron accesses the Internet from their own device using the library wireless network.)

Like the road system, there is a hierarchy of transports for broadband delivery:

Backbone– like a major highway

Middle mile – like a county road

Last mile – like the road where you live

	Internet Sessions (in library, using library computers)	Wireless Sessions	Mobile Devices Available for Patrons
2015 <sup>xv</sup>	5,089,532	3,378,243	830
2014 <sup>xvi</sup>	5,594,135	918,102	529

While each of Minnesota’s 87 counties has at least one public library, hours are limited, and the quality of broadband access varies. Many libraries have long lines – and 30 minute limits – for public computer use. Existing offerings do not meet the public’s needs.

Adoption Efforts and Digital Inclusion Training

In Minnesota, computer and digital literacy training programs are offered by a range of organizations, including community education, libraries, workforce centers, and technology centers: libraries host training for seniors on how to use their devices; workforce centers train job seekers on how to use broadband to find a job and entrepreneurs on how to use social media to market their ventures; and community education provides a wide variety of technology classes.

Thanks to the leadership of the Technology Literacy Collaborative (TLC)<sup>xvii</sup>, Minnesota has developed two unique resources to help support digital inclusion training: Northstar Digital Inclusion Training<sup>xviii</sup> standards and a website that compiles information on community technology centers, curriculum available to trainers and upcoming digital inclusion events. Northstar provides standards for curricula and certification for basic computer skills. For example, Nobles County Community Education has used Northstar to develop training for New Americans by translating curricula into Spanish, Tigrinya, Amharic and Karen<sup>xix</sup>.

In addition, dozens of community-wide adoption and broadband utilization initiatives are underway across rural Minnesota, thanks largely to investments made by Grand Rapids-based Blandin Foundation. In 2010, on behalf of the rural communities it serves, Blandin Foundation sought and received \$4.8 million in American Recovery and Reinvestment (ARRA) funds for a \$6.6 million project to increase broadband adoption in 11 communities. Adoption jumped from 61.7 percent to

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68.8 percent in participating communities – nearly 15 percentage points faster than in the rest of rural Minnesota.

Since then, Blandin Foundation has partnered with an additional 20 rural communities, invested over \$3 million of its own money, and leveraged more than \$1.4 million dollars in matching funds, to launch community-wide efforts to increase broadband adoption and use.

Some examples of community designed and implemented projects include:

Community	Example
Nobles County	Providing opportunities for Round Lake area residents to develop computer and technology skills by supplying laptops for the Round Lake Community Center.
Carlton County Libraries	Providing mobile devices and hot spots for free home loan check out by un- and underserved residents of the County.
Region V Economic Development Commission	Working with five rural townships to identify and implement broadband solutions to provide public access in areas that currently have little to none.
Chisago County	Mobilizing community stakeholders to gather and share information about existing and proposed broadband services to develop and implement broadband improvement strategies.
Lower Sioux Indian Community	Providing reliable, high-speed internet access to key tribal buildings for residents, service providers, officials and visitors.
Redwood County	Providing a series of computer/internet classes for residents and businesses of Redwood County.
Sherburne County	Providing public access to computers in the Sherburne County Historical Building and equipping a community meeting room with a robust Wi-Fi network.
Fond du Lac Band of Ojibwe	Sponsoring an “Age to Age” mobile learning program, where elders receive instruction on the use of mobile devices from sixth graders.
Lake of the Woods County	Providing interactive learning experiences for at-risk youth through access to Wi-Fi to enhance student success.
Leech Lake Band of Ojibwe	Providing refurbished computers, skills and job training to Leech Lake Band members.
Mille Lacs County	Offering technology workshops to increase the online presence of local businesses via websites and social media.
Upper Minnesota Valley Regional Economic Development	Creating a regional IT professional network to ignite cross-industry collaborations so the region can fully integrate technology in day-to-day efforts and large scale planning efforts.

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Commission	
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These programs make a positive difference for participating communities:

"We've turned a corner and become a community that's actually growing and thriving instead of stagnant and dying . . . The enthusiasm and energy that we've generated for the town is phenomenal."

~ *Kristin Fake, business owner, Akeley*

"Our community broadband efforts have really contributed to creating a 'Culture of Use' amongst tribal members. . . . We have increased the economic vitality of our community."

~ *Mike Jones, Leech Lake Band of Ojibwe*

"Two of our region's smallest towns now have a footprint on the global web, which is so exciting!"

~ *Dawn Hegland, Upper Minnesota Valley RDC*

"We have built bridges across cultures in Winona. We are now a connected city, which helps everyone."

~ *Fatima Said, Project Fine, Winona*

"We feel a rejuvenated sense of community because there were so many people rallying to get these projects done for their school, community or organization."

~ *Jacki Anderson, Upper Minnesota Valley RDC*

"This effort has helped us develop wonderful community connections. We have reached out to our whole community."

~ *Keri Bergeson, Principal, Dawson/Boyd High School*

"The involvement of local citizens, government, business and non-profit groups working together to improve our region's broadband access and use is building hope for the future of the whole county."

~ *Michael Haynes, Stevens County Economic Development Director*

Based on direction from the **original** Task Force report calling for recommendations that stimulate, oversee and/or lead efforts to improve affordability and adoption, and on input from practitioners on what already is working well in Minnesota, the Task Force recommends the following:

### Recommendation

Stimulate public participation in existing broadband subsidy programs by working through the Office of Broadband Development to increase public awareness of the programs.

"It is extremely important that the people who live in rural MN have just the same sort of access as those who live in town. It's hard to do Township work without broadband. People want to move to our area, but can't because of the lack of Internet service."

Patty Bauchard Ripley

Township <http://wp.me/p3if7-3gR>

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Research<sup>xx</sup> indicates that increasing the use of Internet applications among businesses just 5%, the economic impacts are significant as demonstrated below:

**Broadband Economic Impact Estimate for Minnesota**

Measure	Impact
Businesses Adopting	3,949
New Revenues / Business	\$60,000
Annual GDP	\$ 293.0 M
Annual Tax Revenues	\$ 11.00 M
Total New Jobs	4,264

#### IV. Emerging Technologies and Broadband

Emerging Technologies are generally new technologies that can create a shift in competitive advantage. Many fields are contributing to the growth in this space. We will focus on two: Internet of Things (IoT) and Telemedicine.

##### Internet of Things (IoT)

The IoT is the interconnection of a collection of sensors which are embedded in a range of physical devices including vehicles and buildings. These sensors can collect data and perform actions on almost anything. Without us even knowing it, these sensors can tell us what the temperature is in our homes, how old the vegetables are in our refrigerators, or how many feet away from our vehicles an object is. With this information and a few rules, the sensors can also adjust the temperature in our homes, add vegetables to our grocery lists, or take corrective actions with our vehicles.

According to Gartner<sup>11</sup>, there will be 6.4 billion connected things at the end of 2016. By 2020, it will be nearly 21 billion or 2.7 devices per person on Earth. As the numbers increase, so will the importance of these devices. Whether connected to a wired or wireless network, broadband is at the core of enabling these devices and the functionality they provide.

##### **Top Trends in Emerging Technology**

"1) Community of things will outnumber people – IoT will greatly increase. 2) Golden Age of wireless innovation and breakthrough – can be gigabit speeds. 3) Software defined infrastructure. 4) Gigabit makes a big difference: big data, quick and sliced for privacy and security." – Glenn Ricart, CTO US Ignite

Year	Global Population (billions)	Connected Devices (billions)	Devices per person
2015	7.3	4.9	.67
2016	7.4	6.4	.86
2020	7.7	20.8	2.7

In May, the Broadband Task Force visited CommScope in Shakopee, MN to understand their view of emerging technologies and see a state of the art telecommunication development plant. One of the key

<sup>11</sup> <http://www.gartner.com/newsroom/id/3165317>

takeaways from this visit was hearing about some of the potential problems that IoT devices may actually create. Many of these devices are built to be inexpensive and will not have enough processing power to resist hacking attempts. If successful, the hackers can take over the IoT devices and force them to download software which will make the device act as a bot and participate in cyberattacks. These devices may become the Achilles' Heel of the home network.

### Telemedicine

Telemedicine is the remote diagnosis and treatment of patients by means of telecommunications technology. It began in the early 20th century but really began to grow in 1960's. At that time, most rural patients needed to make the long trip to the doctor's office to be diagnosed and treated for even the smallest of ailments. The ability to be diagnosed over the phone was just beginning to be tested and once it took hold, patients in even the most rural locations were able to have an easier time in obtaining their treatment. Hospitals were just beginning to share radiologic images over telephone lines.

With the continued expansion of broadband into rural areas, today's view of telemedicine sees consumers wearing devices that measure activity, look for unusual cardiac arrhythmias, or monitor glucose levels. This occurs while they can view the data on the device's screen. In many cases they can also share the data directly with their healthcare provider.

In addition to monitoring, today's telemedicine is also providing convenience. In California, more than 50% of Kaiser Permanente<sup>12</sup> doctor/patient interactions are done via smartphones, videoconferencing, kiosks, or other technology tools. This gets patient the care they need when and where they need it.

In Minnesota, the 2015 Telemedicine Act has now removed the patient location restrictions. Previously, Minnesota Medical Assistance and commercial insurers would only consider visits to licensed health care facilities as valid for coverage. With the 2015 law, a patient can access these services from their residence or place of work and still receive coverage.

This field is in the midst of a large growth cycle. The market research company Technavio<sup>13</sup> predicts that the global telemedicine market will grow at just under 19 percent per year through 2019. The growth is scheduled to be driven by an increased demand for remote patient monitoring, a shortage of healthcare professionals in rural and remote areas, and an increase in the popularity of mobile health devices.

Partnerships will be key to this growth. Medical technology vendors are currently in developing applications to remind patients when to take medications or to help the management of difficult medication regimes associated with hepatitis or organ transplants. In addition to new applications, the expansion of broadband will also grow partnerships between providers. One example is seen in central Minnesota where behavioral health providers and family practice clinics share video equipment that is used to treat group home residence across a five county area.

### Cyber Security

Cyber security focuses on protecting valuable technology assets (network, computers, and data) from attack, damage, or illegal access.

<sup>12</sup> <http://fortune.com/2016/10/06/kaiser-permanente-virtual-doctor-visits/>

<sup>13</sup> <http://www.businesswire.com/news/home/20160325005031/en/Growing-Demand-Remote-Monitoring-Significantly-Augment-Demand>

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Thirty years ago, most of a business' valuable assets were physical – cash registers with hard currency, ledger sheets of transactions, or a rolodex of contacts were just some of the assets businesses had. These assets were things you could easily touch or see. Someone who wanted to steal these assets had to physically show up at your door. When a business thought about securing these assets, they really only needed to be concerned with physically protecting them. If an attacker could not physically get to your assets, you really were not at risk. Learning how to prevent physical access was something easy for a business to do as it is a well-documented and understood concept.

In today's world, many valuable assets have become virtual – electronic currency, credit card transactions, and electronic contact lists. They are all part of the large amount of data businesses use and collect every day. Adding broadband connectivity enables virtual access to this data. Businesses now have to be concerned with not only protecting something they cannot physically touch, but they also have to be concerned about an attacker that does not physically present themselves and could be on the other side of the world. This has changed the way businesses have to think about securing these assets. Learning how to prevent the virtual access is less understood and obtaining information or guidelines on how to protect these assets is not easily obtainable.

“A lot of people find this surprising in our post-9/11 world but in 2013 ‘cyber’ bumped ‘terrorism’ out of the top spot on our list of national threats,” he said. “And cyber has led our report every year since then.” – Director of National Intelligence James Clapper<sup>1</sup>

One consequence of not protecting these assets is identity theft. In February, the White House declared identity theft as the fastest growing crime in America<sup>14</sup>. During 2014, 17.6 million people were impacted at a cost of \$15.4 billion<sup>15</sup> – including \$3.1 billion paid out by the IRS in fraudulent tax refunds<sup>16</sup>.

A 2015 Kaspersky Labs survey<sup>17</sup> showed that 42 percent of respondents did not understand how to use Internet security software with 12 percent of those respondents not sure what to install or where to get it. With so many dollars at risk and so many people unsure of what to do the problem will get worse unless something is done.

A recent Global Information Security Workforce Study<sup>18</sup> points to a shortfall of 1.5 million cyber security professionals by 2020. Opportunities in this field are very well compensated with average annual salaries starting at just under \$100K.

Virginia has chosen to tackle the problem by establishing cyber security Registered Apprenticeships<sup>19</sup>. The Virginia Department of Labor and Industry combines on the job learning with classroom instruction

<sup>14</sup> <https://www.whitehouse.gov/the-press-office/2016/02/09/fact-sheet-cybersecurity-national-action-plan>

<sup>15</sup> <https://www.bjs.gov/content/pub/pdf/vit14.pdf>

<sup>16</sup> <https://www.washingtonpost.com/news/powerpost/wp/2016/07/01/3-1-billion-lost-to-id-theft-tax-fraudsters-in-2014-at-least/>

<sup>17</sup>

[https://press.kaspersky.com/files/2015/12/B2C\\_Tracking\\_Report\\_2015.pdf?\\_ga=1.234434333.2081203460.1476824688](https://press.kaspersky.com/files/2015/12/B2C_Tracking_Report_2015.pdf?_ga=1.234434333.2081203460.1476824688)

<sup>18</sup> [https://www.isc2cares.org/uploadedFiles/wwwisc2caresorg/Content/GISWS/FrostSullivan-\(ISC\)%C2%B2-Global-Information-Security-Workforce-Study-2015.pdf](https://www.isc2cares.org/uploadedFiles/wwwisc2caresorg/Content/GISWS/FrostSullivan-(ISC)%C2%B2-Global-Information-Security-Workforce-Study-2015.pdf)

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from local community colleges or career and technical education centers. The state provides a financial contribution to support apprentice-related instruction. Students receive a portable credential of skills development and workplace experience. Businesses and government agencies receive a pipeline of trained cyber security workers.

With the costs attributed to cybercrime and identify theft quickly escalating into the trillions of dollars<sup>20</sup>, staying on top of current threats and vulnerabilities is critical to businesses, government entities, and citizens. Sharing information across these groups is one way to help minimize the damages. But many organizations are concerned about sharing because they may get bad publicity, feel they are open to additional legal ramifications or that the attackers may find out that they have been discovered and become more aggressive. The concerns can grow if government entities need to adhere to the Minnesota Open Meeting Law.

Heritage.org has recommended some things needed to effectively share this information.

1. Alleviate the privacy concerns by explaining the what/how/why of the information you are sharing.
2. A nimble process to share the rapidly changing information among members
3. Legal and regulatory protections for members sharing information

### Recommendation

Establish a legislative cybersecurity commission to develop legislation to support and strengthen Minnesota's cybersecurity infrastructure.

### The Other "Last Mile"

Broadband providers are often challenged to overcome that "last mile problem" to deliver high speed connectivity across the final leg between the provider's network and the home or building. But once the high speed connection is brought to the outside of a building, another problem appears. Many existing buildings do not have proper interior wiring or duct work to enable the high speed connection to be delivered to the devices that consume it. This becomes even more impactful in multi-tenant buildings as more businesses or consumers are impacted.

In 2004, Loma Linda, CA recognized this problem and passed an ordinance mandating that new construction projects install a structured cabling infrastructure to support high speed connectivity throughout the building. This infrastructure can consist of ductwork and fiber or Category 5/6 copper cabling. The city found the costs to deploy at construction time (\$3500) were two to three times less expensive than retrofitting. With the interior wiring in place, consumer can actually get the high speed connections that their providers offer to all of their devices.

### Recommendation

Amend building codes to require that multi-tenant housing units funded with public dollars deploy either category 5/6 or multi-mode fiber cabling between units and a central wiring location.

<sup>19</sup><http://www.doli.virginia.gov/apprenticeship/pdfs/2015%20Governor's%20Executive%20Order%20on%20Apprenticeships.pdf>

<sup>20</sup><http://www.securitymagazine.com/articles/86352-cybercrime-will-cost-businesses-2-trillion-by-2019>

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### V. Accessibility

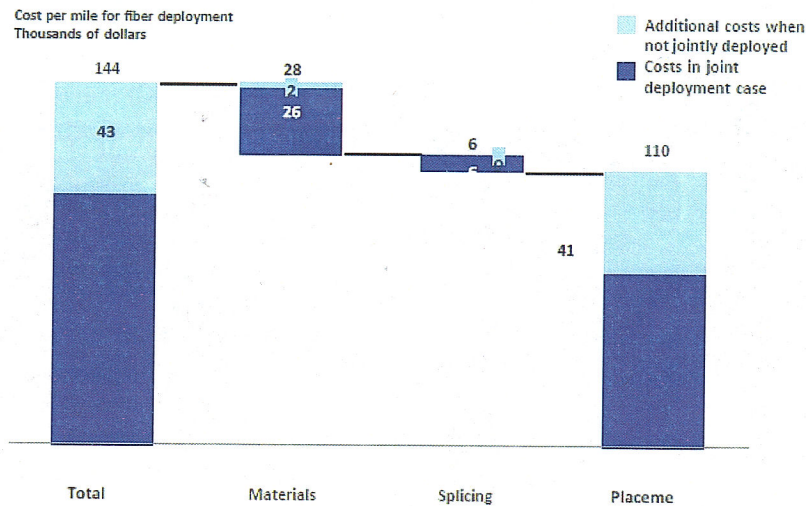
Ensuring all Minnesotans have access to broadband is a multi-pronged approach. From streamlining regulation to enacting policies that promote efficiencies in the installation of broadband, and coordinating activity among broadband providers and public infrastructure projects, there are a number of policies the State can consider to help increase broadband accessibility throughout Minnesota.

#### Dig Once Policies

"Dig Once" refers to policies and practices to facilitate installation of broadband infrastructure at the same time highway, street, water, sewer, gas and electric projects are taking place. Installing broadband infrastructure, usually conduit and/or fiber optic cable, in coordination with another trenching project is estimated to reduce the costs of deployment by 30 percent.<sup>21</sup> As compared to an aerial build, dig once practices can make installation three to four times less expensive.<sup>22</sup> Overall, the cost savings of using a dig once approach of installing conduit and fiber optic cable at the same time as other capital projects can result in savings of \$30,000 to \$100,000 per mile of fiber optic cable installed.<sup>23</sup>

Dig once practices can result in cost savings in the millions of dollars. There are additional benefits. A dig once approach results in greater longevity of streets and highways, less disruption of traffic and services, and greater coordination and information exchange among involved public and private sector entities. Just as important, dig once policies and practices result in accelerated broadband deployment through greater coordination and more efficient use of capital resources.

*Joint Deployment Can  
Materially Reduce  
the Cost of Fiber  
Deployment*



Source: Connecting America: The National Broadband Plan, Exhibit 6-B at p. 114

Minnesota has adopted legislation to encourage dig once policies and practices. Minnesota Statutes § 116J.391, passed in 2013, directs the Office of Broadband Development to work with the Department of Transportation and private entities to develop and encourage dig once practices in state right-of-ways and to work with other state agencies to develop a plan for conduit and broadband deployment on

<sup>21</sup> Connecting America: The National Broadband Plan, p. 114 (March 17, 2010) (found at <https://www.fcc.gov/general/national-broadband-plan>).

<sup>22</sup> Id.

<sup>23</sup> Santa Monica City Net – An Incremental Approach to Building a Fiber Optic Network, p. 9 (March 2014) (found at <http://ilsr.org/wp-content/uploads/2014/03/santa-monica-city-net-fiber-2014-2.pdf>).

state-owned lands and buildings. “[T]o the extent practicable,” the statute also authorized the Office of Broadband Development to work with local units of government for the same purposes.

Representatives from the Department of Transportation and the Office of Broadband Development informed the Task Force of significant efforts and steps since 2013 to effectuate broadband dig once policies, communications, and coordination in connection with state highway projects. These efforts appear successful and of continuing importance insofar as implementing Minnesota’s statutory goal of accelerating broadband infrastructure throughout the state.

The Task Force also believes there is an area of potential significant opportunity for further expansion and coordination of dig once policies and practices with regard to public water and sewer projects funded in part by the Minnesota Public Facilities Authority (“PFA”). The PFA funded 53 local government infrastructure projects throughout the State in fiscal year 2015 with loan and grant awards totaling \$228 million.<sup>24</sup> Many PFA-funded local government projects are for replacement of aging water and sewer lines involving the complete reconstruction of local streets and highways.



One of many sewer and water infrastructure projects taking place in 2016 in Minnesota.

The magnitude of this particular dig once opportunity is highlighted by the history of the PFA and the slate of future PFA-funded projects on the horizon. For example, since its creation in 1987 the PFA has made 920 loans totaling \$3.7 billion, primarily for water infrastructure improvements. The PFA has also awarded 540 supplemental assistance grants totaling \$473 million to meet affordability needs and address specific water quality goals. Looking forward, the MPCA’s 2016 project priority list for clean water (wastewater and storm water) infrastructure, used by the PFA for planning, identifies 293 projects totaling \$1.4 billion for construction over the next five years. The Minnesota Department of Health

<sup>24</sup> Minnesota Public Facilities Authority 2015 Annual Report, p. 2 (Jan. 14, 2016) (found at <https://www.leg.state.mn.us/docs/2016/mandated/160012.pdf>).

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(MDH) 2016 project priority list for drinking water infrastructure lists 271 projects totaling \$393 million over the same time frame.<sup>25</sup>

These projects present significant opportunities to speed Minnesota's deployment of broadband infrastructure and to save millions of dollars in the process. At the same time, however, the Task Force heard concerns that dig once not result in barriers, unwanted increased costs, or delays for local government projects, many of which are dealing with replacement of water and sewer infrastructure long past its useful life.<sup>26,27</sup>

### Recommendations

Take action to promote and communicate dig once policies, including development and dissemination of best practices and model policies to state agencies and other stakeholders. Assure that agencies with construction oversight, construction funding, and land stewardship responsibilities ensure that they lead by example in implementing "Dig Once" policies which encourage broadband competition and deployment, including planning, joint use, construction and notification.

Provide the Office of Broadband Development funding for one (1) FTE to advance and implement these recommendations.

### Office of Broadband Development: Overview and Operating Directives

Over the last five years significant legislative action bolstered broadband, including the creation of the Office of Broadband Development (OBD) located within the Department of Employment and Economic Development (DEED) during the 2013 Legislative Session,<sup>28</sup> and the establishment of the Border-to-Border Broadband Development Grant Program during the 2014 Legislative Session.<sup>29</sup>

OBD plays a critical role in developing Minnesota's broadband infrastructure, including working with partners on mapping broadband availability to more effectively direct state investment. OBD also assists the Governor's Task Force on Broadband, the Governor's Broadband Subcabinet, and oversees the state's Border-to-Border Broadband Development Grant Program.

The Office of Broadband Development considers a number of criteria, as defined in statute, in evaluating and awarding the grants to eligible entities, including cost, community support, the number of

<sup>25</sup> Minnesota PFA 2015 Annual Report, p. 9.

<sup>26</sup> A sample model "dig once" local ordinance and a chart listing some of the other state statutes and local ordinances dealing with "dig once" issues are included in the Appendix.

<sup>27</sup> Recommended Resources

- "Broadband Opportunity Council Report and Recommendations" (Aug. 20, 2015) (found at [https://www.whitehouse.gov/sites/default/files/broadband\\_opportunity\\_council\\_report\\_final.pdf](https://www.whitehouse.gov/sites/default/files/broadband_opportunity_council_report_final.pdf))
- "Collected Broadband Regulations and Policies in Action," Broadband & E-Commerce Education Center (May 2014) (found at <http://broadband.uwex.edu/wp-content/uploads/2014/05/003.019.2015-Collected-Broadband-Regulations-6-11-14.pdf>)
- "Draft Regional Broadband Strategic Plan," Northeast Colorado Association of Local Governments (Jan 8, 2016) (found at [https://www.google.com/?gws\\_rd=ssl#q=Northeast+Colorado+broadband+plan](https://www.google.com/?gws_rd=ssl#q=Northeast+Colorado+broadband+plan))

<sup>28</sup> Minnesota Session Laws, 2013 regular session, chapter 85 at Article 3, sections 13, 14, and 26

<sup>29</sup> Minnesota Session Laws, 2014 regular session, chapter 312 at Article 2, section 2, and Article 3, sections 3 and 4.

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households and community institutions impacted by the project, demonstrated need for economic development, among others.<sup>30</sup> More information about the Office of Broadband Development can be found in its annual report: <http://www.mn.gov/deed/images/broadband-dev-report.pdf>.

In addition to administering the state’s Border-to-Border Broadband Development Grant Program, the Office of Broadband Development is tasked with a number of other responsibilities. These responsibilities are assigned in state statute, and include serving as the central broadband planning body for the state of Minnesota; monitoring broadband development efforts of other states and nations in areas such as business, education, public safety, and health; driving job creation, promoting innovation, and expanding markets for Minnesota businesses. The full list of responsibilities, as defined in statute, are provided below.

Office of Broadband Development Statutory Charges/KPI	Source
All state residents and businesses have access to high-speed broadband that provides minimum download speeds of 25 megabits per second (Mbps) and minimum upload speeds of 3 Mbps by 2022; and 100 Mbps download and 20 Mbps upload by 2026.	<a href="#">Statute 237.012</a>
The top five states of the United States for broadband speed universally accessible to residents and businesses	<a href="#">Statute 237.012</a>
The top five states for broadband access	<a href="#">Statute 237.012</a>
Rank among top 15 when compared to countries globally for broadband adoption	<a href="#">Statute 237.012</a>
Encourage, foster, develop, and improve broadband within the state	<a href="#">Statute 116J.39</a>
Drive job creation, promote innovation, and expand markets for Minnesota businesses	<a href="#">Statute 116J.39</a>
Serve the ongoing and growing needs of Minnesota's education systems, health care system, public safety system, industries and businesses, governmental operations, and citizens	<a href="#">Statute 116J.39</a>
Improve accessibility for underserved communities and populations	<a href="#">Statute 116J.39</a>
Serve as the central broadband planning body for the state of Minnesota	<a href="#">Statute 116J.39</a>
Coordinate with state, regional, local, and private entities to develop, to the maximum extent practicable, a uniform statewide broadband access and usage policy	<a href="#">Statute 116J.39</a>
Develop, recommend, and implement a statewide plan to encourage cost-effective broadband access, and to make recommendations for increased usage, particularly in rural and other underserved areas	<a href="#">Statute 116J.39</a>
Coordinate efforts, in consultation and cooperation with the commissioner of commerce, local units of government, and private entities, to meet the state's broadband goals in section 237.012	<a href="#">Statute 116J.39</a>
Develop, coordinate, and implement the state's broadband infrastructure development program under section 116J.391	<a href="#">Statute 116J.39</a>

<sup>30</sup> Minnesota Session Laws, 2014 regular session, chapter 312 at Article 3, sections 3.

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Provide consultation services to local units of government or other project sponsors in connection with the planning, acquisition, improvement, construction, or development of any broadband deployment project	<a href="#">Statute 116J.39</a>
Encourage public-private partnerships to increase deployment and adoption of broadband services and applications, including recommending funding options and possible incentives to encourage investment in broadband expansion	<a href="#">Statute 116J.39</a>
Monitor the broadband development efforts of other states and nations in areas such as business, education, public safety, and health	<a href="#">Statute 116J.39</a>
Consult with the commissioner of Commerce to monitor broadband-related activities at the federal level, including regulatory and policy changes and the potential impact on broadband deployment and sustainability in the state	<a href="#">Statute 116J.39</a>
Serve as an information clearinghouse for federal programs providing financial assistance to institutions located in rural areas seeking to obtain access to high-speed broadband service, and use this information as an outreach tool to make institutions located in rural areas that are unserved or underserved with respect to broadband service aware of the existence of federal assistance	<a href="#">Statute 116J.39</a>
Provide logistical and administrative support for the Governor's Broadband Task Force	<a href="#">Statute 116J.39</a>
Provide an annual report	<a href="#">Statute 116J.39</a>
Coordinate an ongoing collaborative effort of stakeholders to evaluate and address security, vulnerability, and redundancy issues in order to ensure the reliability of broadband networks	<a href="#">Statute 116J.39</a>
Perform an analysis of current availability and use of broadband, including average broadband speeds, within the state	<a href="#">Statute 116J.39</a>
Analysis of actual speeds and unmet need for schools, libraries, hospitals, and public safety facilities	<a href="#">Statute 116J.39</a>
Analysis of incumbent broadband infrastructure within the state and its ability to spur economic development	<a href="#">Statute 116J.39</a>
Analysis of the degree to which new, additional, or improved broadband infrastructure would spur economic development in the state	<a href="#">Statute 116J.39</a>
Encourage and coordinate "dig once" efforts for the planning, relocation, installation, or improvement of broadband conduit within the right-of-way in conjunction with any current or planned construction, including, but not limited to, trunk highways and bridges	<a href="#">Statute 116J.391</a>
Develop a strategy to facilitate the timely and efficient deployment of broadband conduit or other broadband facilities on state-owned lands and buildings	<a href="#">Statute 116J.391</a>
The office shall encourage and assist local units of government to adopt and implement policies similar to those under paragraphs (a) and (b) for construction or other improvements to county state-aid highways, municipal state-aid roads, and any other rights-of-way under the local unit of government's jurisdiction, and to other lands or buildings owned by the local unit of government.	<a href="#">Statute 116J.391</a>
Administer the Border-to-Border Broadband Development Grant Program	<a href="#">Statute</a>

[116J.395](#)

Contract for the collection of broadband deployment data from providers and the creation of maps showing the availability of broadband service. Household and business broadband use surveys.

[Statute](#)  
[116J.396](#)

The office's responsibilities are broken into eight broad categories, among three members of staff and an executive director: broadband access, measuring broadband, adoption and use, Broadband Task Force, resource center/information clearinghouse, outreach and engagement, policy, and planning.

### **Office Activities and Responsibilities**

#### Broadband Access

- B2B Grant administration
- Community Anchor Institutions
- Deployment Facilitation (Permitting/ROW, Dig Once, etc)

#### Measuring Broadband

- Mapping Program
- Adoption and Use Survey

#### Adoption and Use

#### Broadband Task Force

- Administrative and Logistical Support

#### Resource Center/Information Clearinghouse

- Coordination of OBD Information Resources

#### Outreach and Engagement

- Coordination of outreach and engagement
- Policy
- State policy development and consultation
- Federal policy analysis

#### Planning

- State broadband planning
- Local planning advancement and support

Currently, \$250,000 from the state's General Fund supports OBD's operations and administration, which include: two full-time employees; office space, utilities, computers, advertising, printing, supplies; expenses for holding meetings of the Governor's Task Force on Broadband; outreach; and staff research and development. The Minnesota Department of Commerce provides one full-time employee, as an analyst and general support to the program. Finally, as specified in statute, up to three percent of the grant appropriation is available for grant administration, mapping, data acquisition, and analysis.

**Recommendation**

Create an Office of Broadband operating fund to promote broadband adoption and use. The Task Force recommends that the fund be managed by the Office of Broadband Development, at a specific amount to be determined between the Office of Broadband Development and the legislature [or specific amount recommendation – TBD], that will allow the Office to advance and support programs and projects aimed at promoting broadband adoption and use.

Regulatory Reform

Regulatory reforms for the purpose of advancing Minnesota's broadband goals pose major challenges. Advancing, ever-changing technologies are moving at incredible speeds and technological complexity. There are new broadband technologies and applications that are substitutes for plain old telephone service. The regulatory interface of new technologies and services with the important goals of assuring equal access, consumer protection and reliable public safety communications systems is often uncharted.

The FCC has moved forward with significant new broadband initiatives with the purpose of moving federal regulatory frameworks from historic support of plain old telephone service into support of broadband as the primary form of telecommunications connectivity. Many states, including Minnesota, have been presented with various legislative proposals designed to reduce regulation and potential regulatory barriers to capital investment. While a number of states have adopted various forms of reduced regulation,<sup>31</sup> there is not yet a clear picture of the actual impacts these legislative initiatives have had.

A primary example of these tensions is reflected in the ongoing debate over the appropriate means and level of Voice over Internet Protocol ("VoIP") technologies. VoIP, also sometimes referred to as IP telephony, "is a technology for communicating using 'Internet protocol' instead of traditional analog systems."<sup>32</sup> VoIP technologies can function with or without connection to the public switched telephone network, can be static or mobile, and may include other bundled services outside the scope of telecommunications regulation. There are pending lawsuits involving the FCC and a lawsuit in which the State of Minnesota is a party that will hopefully add clarity to future regulatory pathways.

**Recommendation**

Continue to monitor advancing technologies with an eye towards those regulatory responses that would balance the desirable but sometimes seemingly conflicting goals of increasing capital investment in broadband and assuring adequate access, consumer protection and public safety in Minnesota.

<sup>31</sup> A chart listing the status of other states' telecommunications regulatory reform statutes is included in the Appendix.

<sup>32</sup> FCC definition (found at <https://www.fcc.gov/consumers/guides/voice-over-internet-protocol-voip>).

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Given these uncertainties, the new FCC initiatives and pending litigation, the Task Force is not making specific recommendations for regulatory reform at this time. Nonetheless, the Task Force encourages close monitoring of federal and state regulatory developments so that opportunities and appropriate Minnesota initiatives can be pursued and implemented as appropriate.

### Libraries

Minnesota's public libraries are engaged and inclusive leaders in building digitally equitable communities. Across the state, 355 public library locations and eight bookmobiles provide broadband connections, computer access, and technology training to people who may not otherwise be able to access or afford these necessities. Beyond books, some public libraries lend mobile hotspots, allowing people to access the Internet for free from their homes. As more government services, K-12 classroom assignments, employment resources, and day-to-day tasks move online, public libraries deliver critical services to ensure everyone can participate in all facets of modern life.

According to the Pew Research Center,<sup>33</sup> 61 percent of U.S. adults who use public library computers report doing research for school or work, and 80 percent of U.S. adults think their public libraries should "definitely" provide "programs to teach people, including kids and senior citizens, how to use digital tools such as computers, smartphones, and apps." After access, Minnesota's public libraries strive to deliver these digital literacy services through a wide range of partnerships. At the St. Paul Public Library, the *WORKplace* program pairs librarians with CTEP AmeriCorps members to help St. Paul residents acquire basic digital literacy skills and find jobs. Through February of 2016, the *WORKplace* program has helped over 5,200 participants improve their digital literacy skills, 2,870 of whom also received job placement training.

The success of public library digital literacy programs like *WORKplace* depends, in part, on access to online assessment and instructional resources. Northstar Digital Literacy Assessment<sup>34</sup> allows librarians and other digital literacy educators to award certificates—which may be used as credentials for employment—to people who achieve passing levels of digital literacy. People looking to improve their digital literacy skills can use library resources available through the Electronic Library for Minnesota.<sup>35</sup> Open and welcoming to everyone, public libraries are ideal and necessary promoters of digital literacy. To provide digital literacy programs and services, public libraries require quality online resources, expert staff, up-to-date computers, and high-speed broadband. Investment in these areas supports public libraries in their mission to foster digital equity statewide.

### MN Public Libraries in 2015

355 Library Locations
8 Bookmobiles
2,208 FTE Public Librarians
14,886 Service Hours per Week
5,729 Public Computers
24,340,258 Visits
52,512,434 Material Checkouts
5,089,532 Desktop Internet sessions
3,378,243 Wireless Internet sessions
49% Download Speeds > 20 Mbps
46% Upload Speeds > 20 Mbps
68% Fiber to Building
27% Category 6 Wiring in Building

### **Recommendation**

Fully fund Regional Library Telecommunications Aid (RLTA) at \$2.3 million annually. RLTA offsets the cost of Internet access for libraries participating in the federal E-Rate program. Cost coverage through E-Rate is incomplete and generates a funding gap between E-Rate payment and actual expenses; RLTA fills this gap. Libraries receiving RLTA can allocate a greater portion of their local budget to develop new digital literacy services and update their public computers.

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### Policy Recommendations

- Funding the Border-to-Border Broadband Development Grant Program at \$XX million in FY2018-19.
- Stimulate public participation in existing broadband subsidy programs by working through the OBD to increase public awareness of the programs.
- Establish a legislative cybersecurity commission to develop legislation to support and strengthen Minnesota's cybersecurity infrastructure.
- Amend building codes to require that multi-tenant housing units funded with public dollars deploy either category 5/6 or multi-mode fiber cabling between units and a central wiring location.
- Take action to promote and communicate dig once policies, including development and dissemination of best practices and model policies to state agencies and other stakeholders. Assure that agencies with construction oversight, construction funding, and land stewardship responsibilities ensure that they lead by example in implementing "Dig Once" policies which encourage broadband competition and deployment, including planning, joint use, construction and notification.
- Provide the Office of Broadband Development funding for one (1) FTE to advance and implement these recommendations.
- Create an Office of Broadband operating fund to promote broadband adoption and use. The Task Force recommends that the fund be managed by the Office of Broadband Development, at a specific amount to be determined between the Office of Broadband Development and the legislature [or specific amount recommendation – TBD], that will allow the Office to advance and support programs and projects aimed at promoting broadband adoption and use.
- Continue to monitor advancing technologies with an eye towards those regulatory responses that would balance the desirable but sometimes seemingly conflicting goals of increasing capital investment in broadband and assuring adequate access, consumer protection and public safety in Minnesota.
- Fully fund Regional Library Telecommunications Aid (RLTA) at \$2.3 million annually. RLTA offsets the cost of Internet access for libraries participating in the federal E-Rate program. Cost coverage through E-Rate is incomplete and generates a funding gap between E-Rate payment and actual expenses; RLTA fills this gap. Libraries receiving RLTA can allocate a greater portion of their local budget to develop new digital literacy services and update their public computers.

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### APPENDIX A

#### Task Force Report Definitions

**2G:** Second generation wireless service. This level of wireless service was fundamentally used for voice communication and very basic data communication.

**3G:** Third generation mobile system. This level of wireless service includes voice communication and data service that provides up to 2 megabits per second or roughly equivalent to a DSL service.

**4G:** Fourth generation cellular wireless network. This level of wireless service can achieve download speeds of 10 to 20 Mbps.

**ARRA:** America Recovery and Reinvestment Act of 2009. An economic stimulus package signed by President Obama on February 19, 2009 to save and create jobs, to provide temporary relief programs and to invest in infrastructure, health, education and renewable energy. The package included approximately \$7.2 billion for broadband programs, including the State Broadband Initiatives (SBI) program for broadband mapping, and the Broadband Initiatives Program (BIP) and Broadband Technology Opportunities Program (BTOP) for broadband infrastructure investment.

**Bandwidth:** The capacity of a telecom line to carry signals. Bandwidth is measured in bits per second.

**Bit vs. Byte:** 1 byte equals 8 bits. Bits are used to measure speed, while bytes are used to measure data storage.

**Broadband:** Evolving digital technologies that provide consumers a signal switched facility offering integrated access to voice, high-speed data service, video-demand services, and interactive delivery services.

**Cable Broadband:** High-speed Internet access provided by a cable TV company over its cable network.

**CAF:** Connect America Fund. The FCC replacement program for traditional universal service funding and deployed in two phases: CAF I and CAF II. Reforms have not been completely implemented for the smallest, rural carriers.

**Dark Fiber:** Fiber that has been deployed but is not being used.

**DEED:** Minnesota Department of Employment and Economic Development.

**Download:** To receive data from another computer or host computer (commonly referred to as the Internet) to your computer.

**DSL:** Digital Subscriber Line. A generic reference to the broadband provided by local telephone companies and competitors over a traditional copper network.

**E-Rate:** A federal discount program to assist schools and libraries with the cost of telecommunications infrastructure and services. The program has transitioned from voice service to broadband and Wi-Fi services.

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**EducationSuperhighway:** A non-profit focused on upgrading the Internet access in every public school classroom in America.

**FCC:** Federal Communications Commission. Federal agency responsible for regulating telecommunications carriers and the services they provide.

**Fiber Network:** A telecommunications network based on the use of optical fiber ("Fiber Optics"). Instead of using electricity run over copper-based cables, a fiber network sends information using LEDs or lasers, which can travel at the speed of light. Wireless networks and many broadband networks rely on fiber to provide adequate capacity to carry data.

**FTTH:** Fiber to the home. A communications network where fiber is used all the way to the home.

**Gigabit (Gb):** A measure of data transfer speed. A speed of 1 gigabit per second (Gbps) transfers 125 megabytes (MB) of data in 1 second.

**Gigabyte (GB):** A measure of data storage. Technically defined as  $2^{30}$  bytes. Commonly thought of as 1,000 megabytes, or approximately 1 billion bytes. New computer hard drives contain more than 100s or 1000s gigabytes of storage space.

**Internet of Things (IoT):** A name given to the concept of connecting an increasing number of household and business objects and devices to the Internet. The IoT allows people to remotely access physical objects over the internet.

**Internet Protocol (IP):** The method or protocol by which data is sent from one computer to another on the Internet. IP is commonly used to describe a telecommunications network capable of providing digital signals versus a more traditional analog network.

**Landline:** Traditional wired telephone service. Also referred to as Plain Old Telephone Service (POTS).

**Lifeline:** The Lifeline program is administered by USAC and is a federal program that provides a monthly discount of \$9.25 on landline or wireless phone service to qualifying low-income households. Tribal households receive a discount of \$34.25 to account for the higher costs of serving Tribal lands.

**Lit Fiber:** Fiber which has electronics placed on each end enabling data to be transmitted.

**LTE:** Long-Term Evolution. LTE is a wireless communication standard for mobile phones. Commonly marketed as "4G LTE," this level of wireless service includes voice communications and data service that provides up to 40 megabits per second download speeds.

**Megabit (Mb):** A measure of data transfer speed. Commonly thought of as 1 million bits. A speed of 25 megabits per second (Mbps) transfers 3.125 megabytes (MB) of data in 1 second.

**Megabyte:** A measure of data storage. Technically defined as  $2^{20}$  bytes. Commonly thought of as 1,000,000 bytes. Some picture and music files are often 3-5 megabytes in size.

**OBD:** Office of Broadband Development. Governor Dayton and the legislature created the OBD in 2013 to facilitate border to border broadband connectivity in Minnesota. The OBD is located in DEED.

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**PUC:** Minnesota Public Utilities Commission. The PUC is the State of Minnesota's regulatory agency, with oversight over telecommunications, including landline telephones, electric, and natural gas companies. The PUC is a quasi-judicial agency that has both rulemaking and dispute settling authority. The PUC does not have authority to regulate broadband.

**Price Cap Carrier:** A term used by the FCC to classify the larger investor-owned telephone companies for purposes of the Connect America Fund.

**Rate of Return Carrier:** A term used by the FCC to classify the smaller telephone companies that generally serve in rural areas.

**RBE:** Rural Broadband Experiments. A \$100 million program designed by the FCC and administered by USAC to fund new, robust broadband networks in rural areas.

**RUS:** Rural Utilities Service. Division of the United States Department of Agriculture that provides critical grant and loan support for rural broadband.

**Terabyte:** Technically defined as  $2^{40}$  bytes. Commonly thought of as 1,000 gigabytes, 1 million megabytes, or 1 trillion bytes.

**Underserved:** Defined in Minnesota law §116J.394(h) as areas of Minnesota in which households or businesses lack access to wire-line broadband service at speeds that meet the state broadband goals of ten to 20 megabits per second download and five to ten megabits per second upload.

**Universal Service:** The financial mechanism which helps compensate telephone companies or other communications entities for providing access to telecommunications services at reasonable and affordable rates throughout the country, including rural, insular and high costs areas, and to public institutions. Funding to support this program is through fees assessed to consumers of telecommunications services.

**Unserved:** Defined in Minnesota law §116J.394(i) as areas of Minnesota in which households or businesses lack access to wire-line broadband service at the FCC definition of broadband, currently 25Mbps download and 3Mbps upload.

**Upload Speed:** The performance of an Internet connection, as measured by the number of bytes per second that data travels from a device to the Internet.

**USAC:** Universal Service Administrative Company. USAC is the non-profit company that manages the contributions to and distributions from the Universal Service Fund. USAC oversees several programs, including Lifeline, E-Rate, and Rural Health Care.

**Wi-Fi:** Wi-Fi is the wireless networking technology that allows computers, phones, and other devices to communicate via wireless signal. Often incorrectly believed to mean "Wireless Fidelity," like high fidelity.

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**Data Storage by File Size**

8 Bits is the equivalent of 1 Byte
1024 Bytes is the equivalent of 1 Kilobyte (KB)
1024 KB is the equivalent of 1 Megabyte (MB)
1024 MB is the equivalent of 1 Gigabyte (GB)
1024 GB is the equivalent of 1 Terabyte (TB)
1024 TB is the equivalent of 1 Petabyte (PB)
1024 PB is the equivalent of 1 Exabyte (EB)

APPENDIX B

Detailed Descriptions of Technologies Used to Deploy Broadband

**Fiber:** Data is transmitted over a hair-thin strand of glass using light signals over fiber optics. There are two main types of Fiber to the Home (FTTH) systems that can be used to ensure that the transmitted data gets to its proper destination. The two types of systems are active optical networks and passive optical networks. An active optical network uses electrically powered switching equipment to manage and properly distribute the light signals. Under this network, a customer may have dedicated fiber running to the home. A passive optical network uses optical splitters to manage and distribute the light signals. Fiber strands are shared for portions of the network. Electric power is only required at the originating and receiving ends of the signal.

Active optical networks have the advantage of using Ethernet technology so interoperability among vendors is facilitated. Customers can also select hardware that meets their needs and change out the hardware as those needs increase. Drawbacks include reliance on power, so less reliable than a passive optical network. Active optical networks also require switching equipment for every 48 customers.

The advantages of passive optical networks include each fiber strand being able to serve up to 32 users, and lower building and maintenance costs than active optical networks. Disadvantages include a lower range so customers have to be geographically closer to the central source of data, greater difficulty in isolating a failure, and because of shared usage there can be slowdowns during peak demand periods.

**DSL:** Digital Subscriber Line (DSL) is the family of technologies that provide digital data over the wires of a local telephone network. DSL is commonly used by traditional wireline telephone companies to deliver broadband service to consumers and small businesses. Over the years speed levels have increased dramatically. In the early 2000s, high end broadband speeds of 640 kbps and 1.5 Mbps were common. Today, telecommunications providers are offering speeds up to 100 Mbps through DSL due to hybrid fiber-copper networks and improved electronics in the network.

The most common DSL deployment in Minnesota today is through Fiber-to-the-Node (FTTN). FTTN networks rely on fiber from the central office to the neighborhood node and then ride on the existing copper network to the home. FTTN networks can achieve speeds up to 100Mbps depending on the distance of the end user from the node. FTTN networks are fully capable of providing a quality IPTV product.

In recent years, DSL acceleration techniques have been developed, such as vectoring and bonding. These techniques increase the maximum speed over the existing copper network. Bonding is the term applied to combining copper pairs to increase the total capacity of the communications channel to increase speed or extend the reach. Vectoring is a technology that reduces crosstalk between signals that results in optimization of the copper facilities.

Finally, trial deployments of the emerging technology, G.fast, are underway that may result in speeds up to 1Gbps.<sup>36</sup> G.fast is a DSL standard for relatively short local loops.

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<sup>36</sup> Alcatel Lucent has completed initial trials of this emerging technology. See <https://www.alcatel-lucent.com/solutions/g.fast>.

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**Cable:** Data over a cable TV system has been around for years. In the 1980s, a service called Express would bring updated news, weather and stock market information to the desktop. In the earlier 1990s, several companies developed Internet based data transfer systems. The critical problem was that these products were not interchangeable. That changed in 1997 when CableLabs developed the DOCSIS (Data Over Cable Service Interface Specifications) standards for the worldwide market. Now, a person with a DOCSIS modem can take it with them when they move and not have to buy another cable modem in the next community they live in.

The first DOCSIS 1.0 modems delivered the then astounding speed of 20 Mbps. This was followed by evolutions of DOCSIS 1.1, 2.0, 3.0 and 3.1. And speeds have risen significantly. The currently deployed DOCSIS 3.0 is enabling speeds of over 1Gbps download and 245 Mbps upload. The DOCSIS 3.1 standards which will be deployed in 2016 are capable of download speeds of 5 Gbps and upload speed of 1Gbps.

The DOCSIS service has traditionally run over a coaxial fiber hybrid system where the signals are sent out of the cable company's headend/central office to receiving nodes that generally serve 500 homes. The transportation to the individual customers is via coaxial cable. As data loading has increased, cable operators are moving the receiving nodes closer to the customer, reducing the amount of coax in the circuit. Coaxial cable has a theoretical upper bandwidth of 6 gigahertz. Current technology allows for 6 bits per hertz meaning that coaxial cable is capable of moving 36 Gbps in one direction or 18 Gbps symmetrically.

Two newer protocols are Fiber Deep and Passive Coax. Fiber Deep, as the name implies, is used to place fiber deep into the neighborhoods and business areas. This reduces the amplifier cascades and improves performance and reliability.<sup>37</sup> Passive Coax brings the fiber to the curb so that there are no active devices other than the node. Since there are no additional electronics to maintain, reliability and bandwidths are further enhanced. Both technologies are currently being rolled out in cable systems in Minnesota.

Cable operators use PON (Passive Optical Networks) as a method of delivering specialized higher and symmetrical bandwidth to customers who need high capacity services today. The PON is used as an extension of the company's existing fiber network. These PON networks have the following capacities:

- 1) **BPON** -A typical BPON provides 622 megabits per second (Mbps) of downstream bandwidth and 155 Mbps of upstream traffic.
- 2) **GPON** -The standards permit several choices of bit rate, but the industry has converged on 2.488 gigabits per second (Gbps) of downstream bandwidth, and 1.244 Gbps of upstream bandwidth.
- 3) **EPON/10G EPON** – EPON provides symmetric 1 gigabit per second upstream and downstream rates. 10G EPON provide speeds of 10 Gbps downstream and 1 Gbps upstream. EPON/10GE PON is applicable for data-centric networks, as well as full-service voice, data and video networks.

Many cable operators in Minnesota are also using Radio Frequency over Glass (RFoG). It is a type of passive optical network that transports RF signals over fiber that were formerly transported principally over the hybrid fiber cable. In the forward direction RFoG is either a stand-alone Point 2 MultiPoint

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<sup>37</sup> A system of amplifier cascades consists of a daisy chain of devices that improve network performance where existing infrastructure is insufficient to meet the demand. The less a network relies on amplifier cascades, the more reliable and robust it will be.

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system (i.e. a cable system) or an optical overlay for existing PON such as GEAPON/EPON. The overlay for RFOG is based on Wave Division Multiplexing (WDM) -- the passive combination of wavelengths on a single strand of glass. One of RFOG's advantages is that it does not require a new type of technology in the Headend/central office, nor does it require new test equipment or comprehensive training of the tech staff.

**Fixed Wireless:** Fixed wireless system may be designed with both point-to-point and point-to-multipoint topologies. A point-to-point being more similar to a dedicated connection, i.e. dedicated T-1, DS3, FTTH, while point-to-multipoint is considered a shared system, i.e. DSL, Cable, PON fiber systems. Point-to-point fixed wireless radios currently can sustain throughput greater than 1Gbps.

Performance of fixed wireless systems are dependent on the technologies employed and the selection of services offered. Wi-Fi or WLAN (Wireless Local Area Network) implementation, based on IEEE 802.11a/b and extensions, generally operate in the unlicensed ISM bands of 2.4GHz and 5.8GHz. Early implementation within FCC licensed spectrum of the 2.3GHz and 2.5GHz bands employed a converged platform utilizing the ITU DOCSIS (Data Over Cable Service Interface Specification) standard called wireless cable. Wireless Metropolitan Area Networks or WMAN, as defined in IEEE 802.16a-d and extension to 16e-2005 for mobility, represented the next generation of fixed wireless, TDD and WiMAX systems. Systems within this last group have been developed across a broad spectrum of frequencies; 700MHz, 2.4GHz, 2.5GHz, 3.65GHz, 4.9GHz, and 5.8GHz comprise the majority of frequencies utilized by these systems. Current subscriber radios can operate at speeds within the 10-20 Mbps+ speeds across a 100Mbps interface.

Convergence is occurring within the next evolution of fixed wireless coinciding with the 3GPP (3<sup>rd</sup> Generation Partnership Project) standards. 3GPP has defined an all-encompassing roadmap (GSM through LTE; 2G-4G cellular technologies) with LTE-Advanced standardization. Fixed wireless systems are currently being deployed under the LTE umbrella with a roadmap to LTE-Advanced. The long-term objective of the LTE-Advanced standard is to sustain a subscriber interface at 1000Mbps (1 Gbps) of throughput and maintain/expand all current services for voice, video, data.

**Wireless:** Consumers have adopted new, Internet-based technologies and mobile connections at an unprecedented rate. Internet-based products and devices, including smartphones and tablets, allow mobile access to applications like mobile health, distance learning, social media and a host of video-conferencing services, and are providing consumers everywhere with new choices to connect, to communicate, and to access information and entertainment. IP (Internet Protocol) technology allows consumers to use a range of devices -- anything from your TV, phone, laptop and tablet -- to seamlessly communicate using voice, data, and Internet applications on wireless and wireline networks--opening the door to boundless opportunities.

People are actively choosing new and innovative products, services and devices that require faster, more robust and more advanced technology--whether wired or wireless. Every month, 450,000 consumers switch to phone services that run on wireless and Internet-based networks. In fact, across America in 2013, two in every five American adults lived in homes that were wireless-only and 40.2 percent of homes utilized VoIP.

Consumers no longer just use a phone to make a voice call. Now we use our cell phones, smartphones, tablets, netbooks, e-readers, laptops and more to communicate using more than just voice -- through these new products and devices we can now share our schedules, photos, business plans, documents,

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contacts, location and thoughts. In 2013, global mobile data traffic grew by 81%, nearly 18x the size of the entire global Internet in 2000. By the end of 2014, the number of mobile-connected devices exceeded the number of people on earth. Increasingly, smartphones are the product of choice to perform these functions; as of January 2014, 58 percent of adults in the United States own a smartphone.

A 2013 study conducted by research firm Information Age Economics projects that wireless infrastructure investment will generate as much as \$1.2 trillion in economic growth while creating 1.2 million new jobs over the next five years.

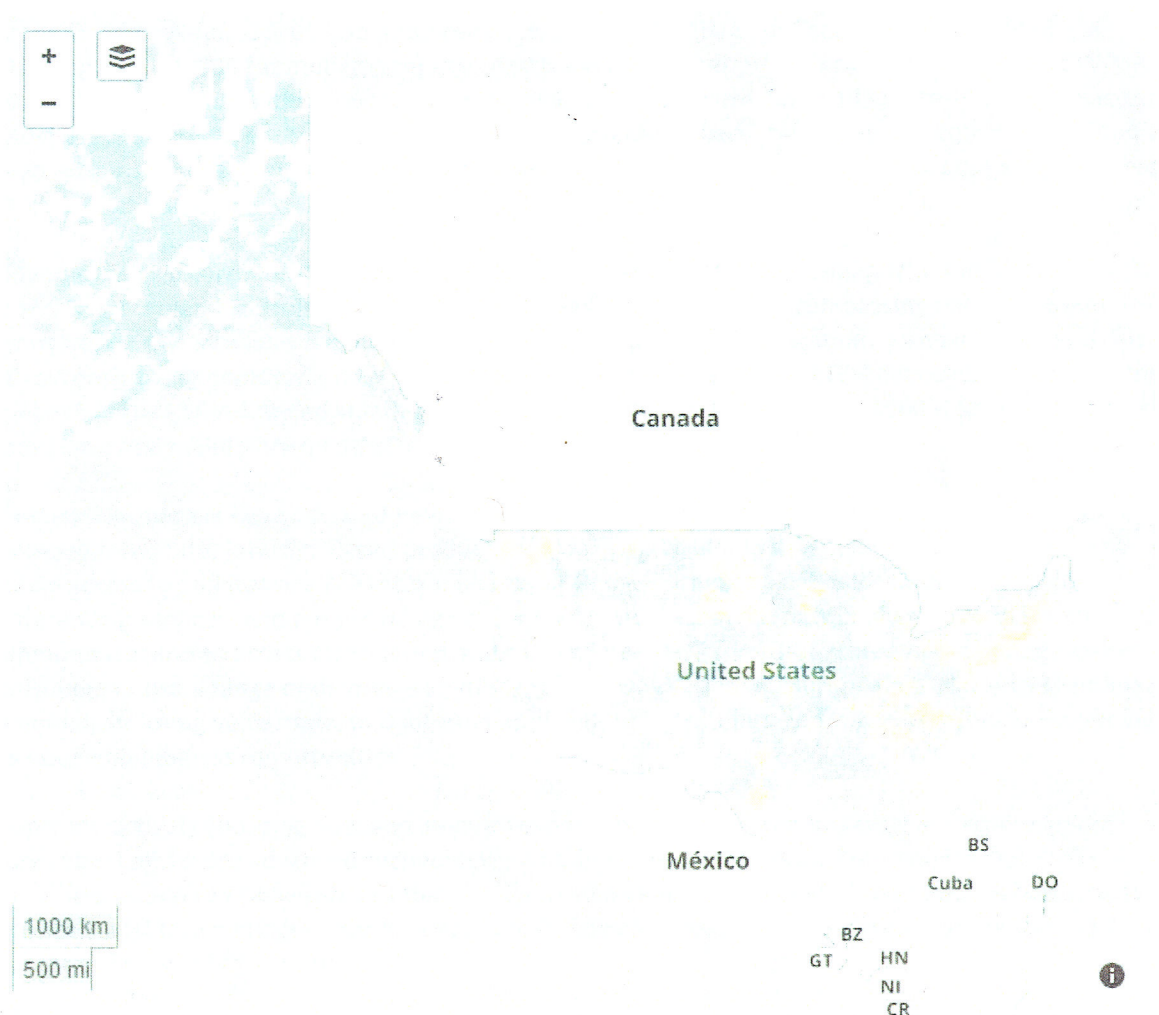
Appendix C

National and International Broadband Rankings

Minnesota is amongst the 18 states listed as having 100 percent availability at speeds of 3 Mbps download and 768 kbps upload according to the National Broadband Map. (Data as of June 30, 2014.)

Minnesota is 44<sup>nd</sup> (between Greece at #43 and Croatia) out of a combined 109 geographies (108 qualifying countries plus Minnesota) with an 86 percent adoption rate as measured by Akamai. Andorra and Malta ranked first and second, respectively, with adoption rates of 97 percent. This number considers broadband connections at 4 Mbps and above (download) compared to all connections in that state or country, to determine its broadband adoption rate. Thus, it is not a measure of adopters versus non-adopters but does allow for an adoption comparison to other countries.

The map below illustrates areas of the country that are meeting and failing to meet the FCC's broadband speed definition of 25 Mbps download and 3 Mbps upload (based on December 2013 data).



Source: <https://www.fcc.gov/reports-research/maps/bpr-2016-fixed-25mbps-3mbps-deployment/>

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Appendix D

2016 Broadband Task Force Meeting Locations

Meeting Date	Topic
February 3	Legislative panel, 2016 planning
March 17	Drivers of broadband adoption
April 14	Cyber security
May 24	Emerging technologies that use broadband 1: Business and Consumers
June 15	Office of Broadband Development operating fund
July 6	Emerging technologies that use broadband 2: Government
August 17	Barriers to broadband adoption: Affordability
September 7	Streamlined state regulation for expanding broadband deployment
October 5	Draft report 1
November 2	Draft report 2
December 15	Finalize report

For more information, including meeting locations, materials, and minutes, visit:  
<https://mn.gov/deed/programs-services/broadband/task-force/>.

<sup>i</sup> Statement of Chairman Wheeler, *Lifeline and Link Up Reform and Modernization*, WC Docket No. 11-42, Telecommunications Carriers Eligible for Universal Service Support, WC Docket No. 09-197, Connect America Fund, WC Docket No. 10-90.

<sup>ii</sup> *Digitally Unconnected in the U.S.: Who's Not Online and Why?* September 28, 2016 by Maureen Lewis, Director, Minority Telecommunications Development, Office of Policy Analysis and Development  
<https://www.ntia.doc.gov/blog/2016/digitally-unconnected-us-who-s-not-online-and-why>

<sup>iii</sup> <http://www.connectednation.org/residential-survey-data?state=Minnesota>

<sup>iv</sup> [https://apps.fcc.gov/edocs\\_public/attachmatch/FCC-16-6A1.pdf](https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf)

<sup>v</sup> National average includes stats and territories; however 11 entities were not included because data was unavailable.

<sup>vi</sup> [http://broadband.blandinfoundation.org/uls/resources/SNG--ROI from Broadband Infrastructure and Utilization--01-31-14.pdf](http://broadband.blandinfoundation.org/uls/resources/SNG--ROI%20from%20Broadband%20Infrastructure%20and%20Utilization--01-31-14.pdf)

<sup>vii</sup> to be added

<sup>viii</sup> Internet Innovation Alliance <http://www.internetinnovation.org/press-room/broadband-news-press-releases/ia-report-consumers-can-set-aside-10500-annually/>

<sup>ix</sup> Professor Rhinesmith publishes extensively on the issue of adoption and inclusion. His work can be viewed at <http://crhinesmith.com/research/>.

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- <sup>x</sup> Lisa Peterson e la Cueva <http://spnn.org/blogs/201605/lifeline-is-a-good-step-but-lets-keep-going>
- <sup>xi</sup> <https://blandinonbroadband.org/2016/08/17/mn-broadband-task-force-august-2016-meeting-digital-inclusion/>
- <sup>xii</sup> Marc Johnson <http://mnedtech.blogspot.com/2014/01/rural-broadband-and-education-part-4.html>
- <sup>xiii</sup> <http://www.wsj.com/articles/broadband-data-caps-pressure-cord-cutters-1461257846>
- <sup>xiv</sup> <https://blandinonbroadband.org/2016/09/08/mn-broadband-task-force-notes-policy-from-the-provider-perspective-and-library-as-digital-inclusion-partner/>
- <sup>xv</sup> <https://blandinonbroadband.org/2016/09/08/mn-broadband-task-force-notes-policy-from-the-provider-perspective-and-library-as-digital-inclusion-partner/>
- <sup>xvi</sup> <https://blandinonbroadband.org/2015/10/15/mn-broadband-task-force-october-meeting-notes-lessons-from-libraries-and-speed-goals/>
- <sup>xvii</sup> <http://www.tlc-mn.org/>
- <sup>xviii</sup> <https://www.digitalliteracyassessment.org/standards>
- <sup>xix</sup> <https://blandinonbroadband.org/2016/09/28/blandin-broadband-community-tour-nobles-county-where-digital-inclusion-builds-bridges-to-new-americans/>
- <sup>xx</sup> The Strategic Networks Group has done excellent research in this area. See <http://sngroup.com/50states/>.