December 21, 2016

Annual Report 2016

This document contains the Task Force's 2016 Annual Report with recommendations for policy makers and stakeholders to consider in the 2017 legislative session.

Governor's Task Force on Broadband

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Table of Contents

Dear Governor Dayton,

Access and the ability to use broadband remains an issue for many Minnesotans. This is especially true for those living in historically disadvantaged communities. We know that broadband plays a vital role in connecting people to healthcare, education, and the global economy.

Grade-schooler, Sophia Stading echoed this perspective in her comments and letter (see Appendix H) to the Task Force. As a resident of rural Minnesota, she emphasized the importance of broadband, and in particular wireless Internet connections on school buses, for children in Greater Minnesota. Sophia noted that, since homework typically requires access to the Internet and a number of homes in rural Minnesota lack access to a reliable Internet connection, wireless Internet on buses provides students the opportunity to complete homework assignments as they travel to and from home and school.

It is stories like Sophia's that drive the work of the Task Force. 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 received $35 million in funding during the 2016 Legislative Session. However, demand for this program continues to outpace its funding.

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 as much private investment to expand broadband coverage.

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 megabits per second (Mbps) download and 3 Mbps upload (25 Mbps/3 Mbps) by 2022 and access to at least one provider of speeds of at least 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 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.

Sincerely,

Margaret Anderson Kelliher
Chair, 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

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Daniel Richter, MVTV Wireless

Andrew Schriner, CenturyLink

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Paul Weirtz, AT&T

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 January 2016, the state broadband speed goals, established in 2012, have been updated. 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 demand 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 megabits 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 on broadband: 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:

- Provide $100 million in on-going biennial funding for the Border-to-Border Broadband Development Grant Program.

- Allocate $10 million in FY2018-19 to provide the Office of Broadband with operating funds to implement a broadband adoption and use program; implement a "Dig Once" policy; provide specific funding for mapping services; support the Broadband Task Force; coordinate information resources and outreach and engagement activities; support statewide broadband planning, among other tasks.

- 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.

- Establish a legislative cybersecurity commission, whose scope of work includes information-sharing between policy-makers, state agencies, and private industry related to Minnesota's cybersecurity infrastructure, cybersecurity workforce issues and emerging technology, to develop legislation to support and strengthen Minnesota's cybersecurity infrastructure.

- Continue to monitor advancing telecommunications technologies with an eye towards encouraging ongoing stakeholder dialogue as to 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.
- Amend building codes to require that multi-tenant housing units funded with public dollars deploy cabling (such as category 5/6 or multi-mode fiber) that supports easier management of broadband connectivity.

- Build computer donation partnerships between state agencies and community-based organizations getting computers into the hands of those who need them. The State could stimulate the effort by encouraging others, especially local governments, to donate their unused computers to community partners. Working through the OBD, the State could provide information on organizations that refurbish computers securely and on opportunities to both donate and receive computers.

- The State should modify the Telephone Assistance Program that provides a $3.50 discount to local wired telephone service for low-income households by better aligning it with the National Lifeline program, which provides a $9.25 subsidy ($34.25 in tribal areas) to qualifying households to offset the cost of broadband.

- Support continued funding of Regional Library Telecommunications Aid (RLTA) at $4.6 million over FY2018-19, as recommended by the Minnesota Library Association. 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.

- Fully fund the Telecommunications Access Equity Aid by raising its cap. This program offsets the cost of Internet access for schools participating in the federal E-Rate program.

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 (GB) of data per month.[1] According to Cisco, data usage is projected to accelerate by 2020[2]:

- 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.

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.[3] 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."[4] 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.[5]

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.[6]

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

[2] 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.

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

[4] 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.

[5] 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

[6] http://www.internetinnovation.org/press-room/broadband-news-press-releases/iia-report-consumers-can-set-aside-10500-annually/, accessed October 27, 2016.

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, along with other stakeholders, such as broadband providers and community-based organizations, 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 state's old and new 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. The report also contains a number of appendixes, including a glossary of terms and letters submitted to the Task Force from interested stakeholders.

II. Update on State Speed Goals

Expanding access to broadband, at speeds sufficient to meet tomorrow's demand for consumption, is a key driver in the work of this Task Force. Having in place state broadband speed goals helps state leaders, policymakers, and stakeholders focus on meeting an objective, and conveys to other states that Minnesota is a leader in broadband issues.

Minnesota's first broadband speed goal was enacted in 2010, codifying the state's broadband goals into Minnesota Statutes §237.012. Those state speed goals were updated in 2016, and are noted below. The state's broadband goals include both speed goals (Subdivision 1) and goals related to national and international leadership positions (Subdivision 2).

Minn. Stat. 237.012 BROADBAND GOALS.

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.

Subdivision 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, and 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 table below compares the state's old speed goals with the new set of goals established in 2016.

Comparison of Old and New State Broadband Speed Goals

Year Goals Established	Minimum Lower Speed		Minimum Upper Speed	
	Speed Goal	Time Horizon	Speed Goal	Time Horizon
2010	≥10 Mbps/5 Mbps	2015	N/A	N/A
2016	≥25 Mbps/3 Mbps	2022	≥100 Mbps/20 Mbps[7]	2026

Before addressing the progress made toward the new speed goals, we first review progress toward meeting the old speed goals.

Old State Broadband Speeds Goals: 2010-2015

As noted in previous reports, the state's old broadband speed goal is:

> 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.

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.[8]

Rural areas of the state, however, are less likely to have access to broadband that meets the state's old 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.

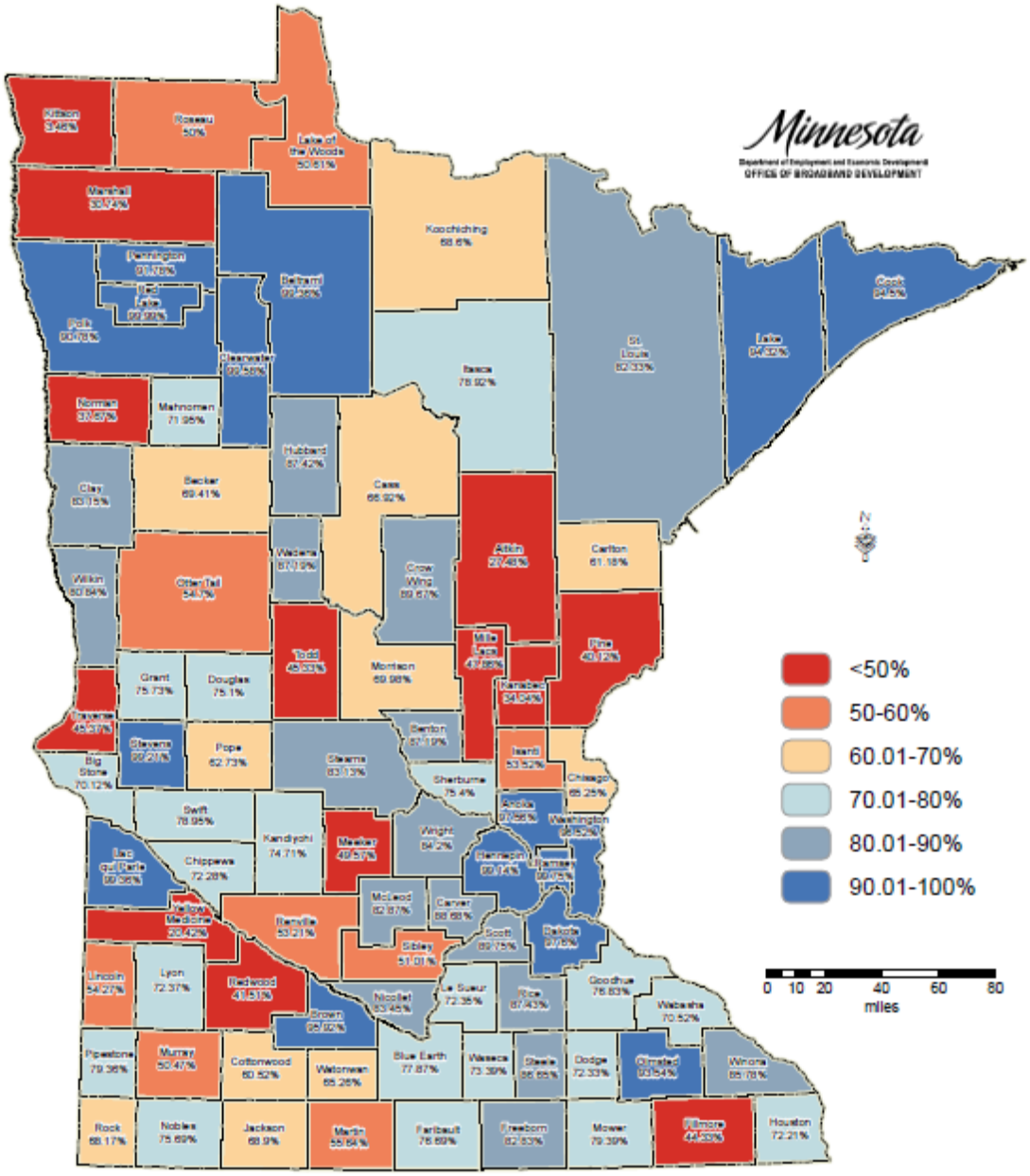
[7] The state's speed goal here is access to at least one provider that meets these speeds.

[8] 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, 2015.

Additional maps and data are available at http://mn.gov/deed/programs-services/broadband/maps

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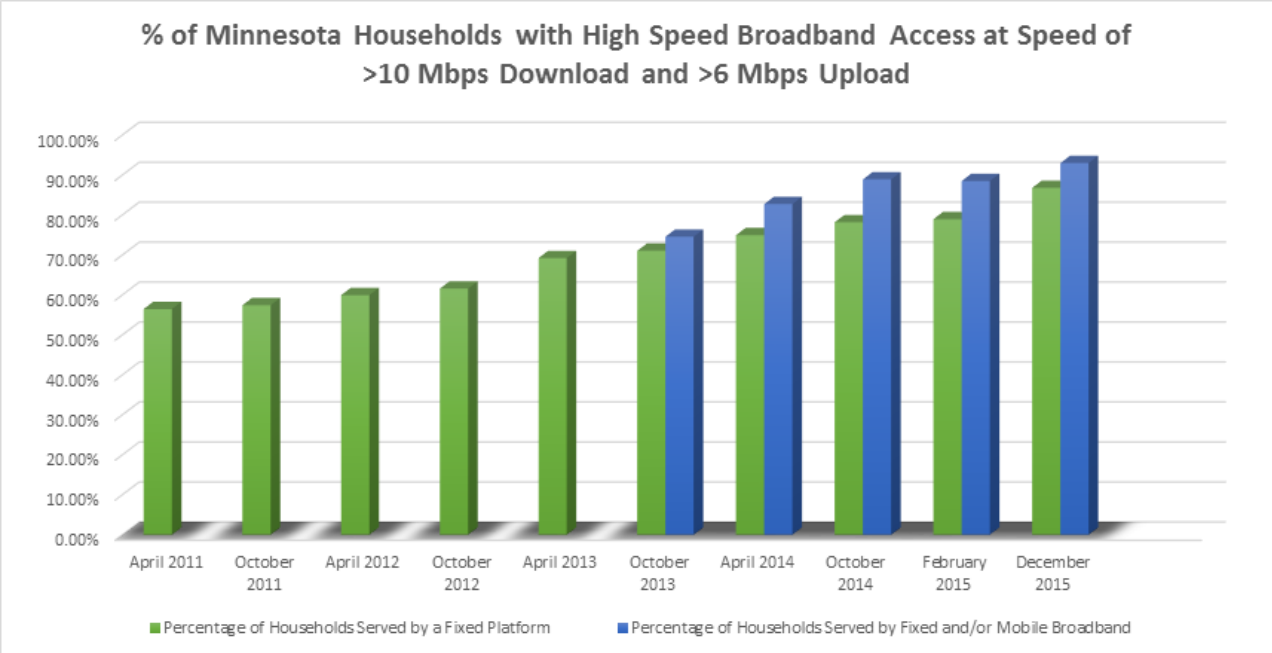
Submit questions or recommended changes to: DEED.broadband@state.mn.us

Rural Availability Estimate of Broadband Service of at Least 10 Mbps Download and 5 Mbps Upload				
Platform Type	**Total Rural Households**	**Unserved Rural Households**	**Percent of Rural Households Served**	**Percent Households Served Statewide**
Wireline Only	897,000	252,000	71.86	87.54
Fixed, Non-Mobile Broadband Service	897,000	157,000	82.50	92.32
All Broadband Platforms, Including Mobile	897,000	111,000	87.66	94.69

Broadband availability under the state's old speed goals of 10 Mbps/5 Mbps 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, but that the state broadband speed goals are at least 10 Mbps download and at least 5 Mbps upload. This discrepancy is due to the data collection process. Under the State Broadband Initiatives (SBI) program, funded by American Recovery and Reinvestment Act (ARRA), data was collected using federal parameters, which, until the fall of 2014, was not capable of measuring broadband with an upload speed of at least 5 Mbps. To maintain comparison over time 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)

Minnesota's Leadership Position: How Minnesota Compares

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 notes that "one in ten Americans lacks access to 25 Mbps/3 Mbps broadband."[9]

> 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. -2016 FCC Broadband Progress Report

The FCC also notes 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 21st century economy." In discussing fixed versus mobile broadband, the FCC notes 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 serve different needs and are not substitutes for one another. This is supported by the finding that American consumers with available means adopt both services.[10]

In terms of Minnesota's position compared to other states, in the second quarter of 2016, Minnesota's average connection speed was 14.7 Mbps, placing the state 26th among other states. Under the Akamai measurement,[11] 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

[9] https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.

[10] https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf, p. 14.

[11] 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.

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 notes 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.

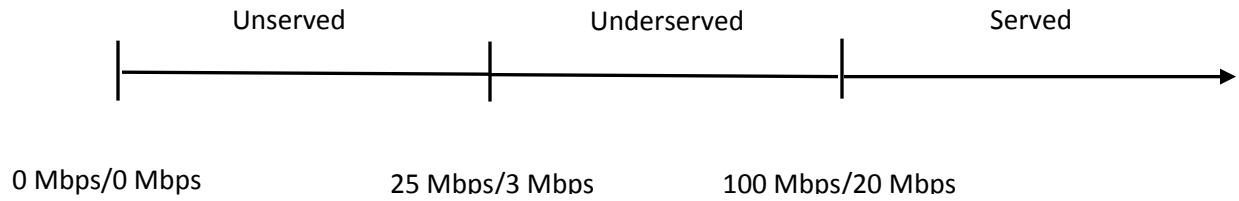
In addition to Akamai, there are other data sources that can be used to measure broadband access and adoption. These rankings are included in Appendix C.[12]

New State Broadband Speed Goals: 2016

As noted above, the state's broadband speed goals were updated during the 2016 Legislative Session.

As of July 2016, 52.46 percent of rural households in Minnesota had access to speeds of at least 100 Mbps/20 Mbps, from fixed, non-mobile service; statewide, 70.83 percent of households had 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.

In addition to updating the state's broadband speed goals during the 2016 Legislative Session, the Legislature also updated the state's definitions of *unserved* and *underserved*, as related to broadband availability. "Unserved" areas are those that do not have access to speeds of at least 25 Mbps/3 Mbps; "Underserved" areas of the state are those areas that have access to speeds of 25 Mbps/3 Mbps, but not 100 Mbps/20 Mbps; "served" areas of the state, then, are those areas that have speeds of at least 100 Mbps/20 Mbps. The exhibit below illustrates these definitions graphically.



The state's Border-to-Border Broadband Development Grant Program provides funding to expand broadband service in unserved and underserved areas of Minnesota.

Recall that the state's new speed goals are:

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

[12] Additional information on broadband availability can be found on the Office of Broadband Development website at http://mn.gov/deed/programs-services/broadband/maps.

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.

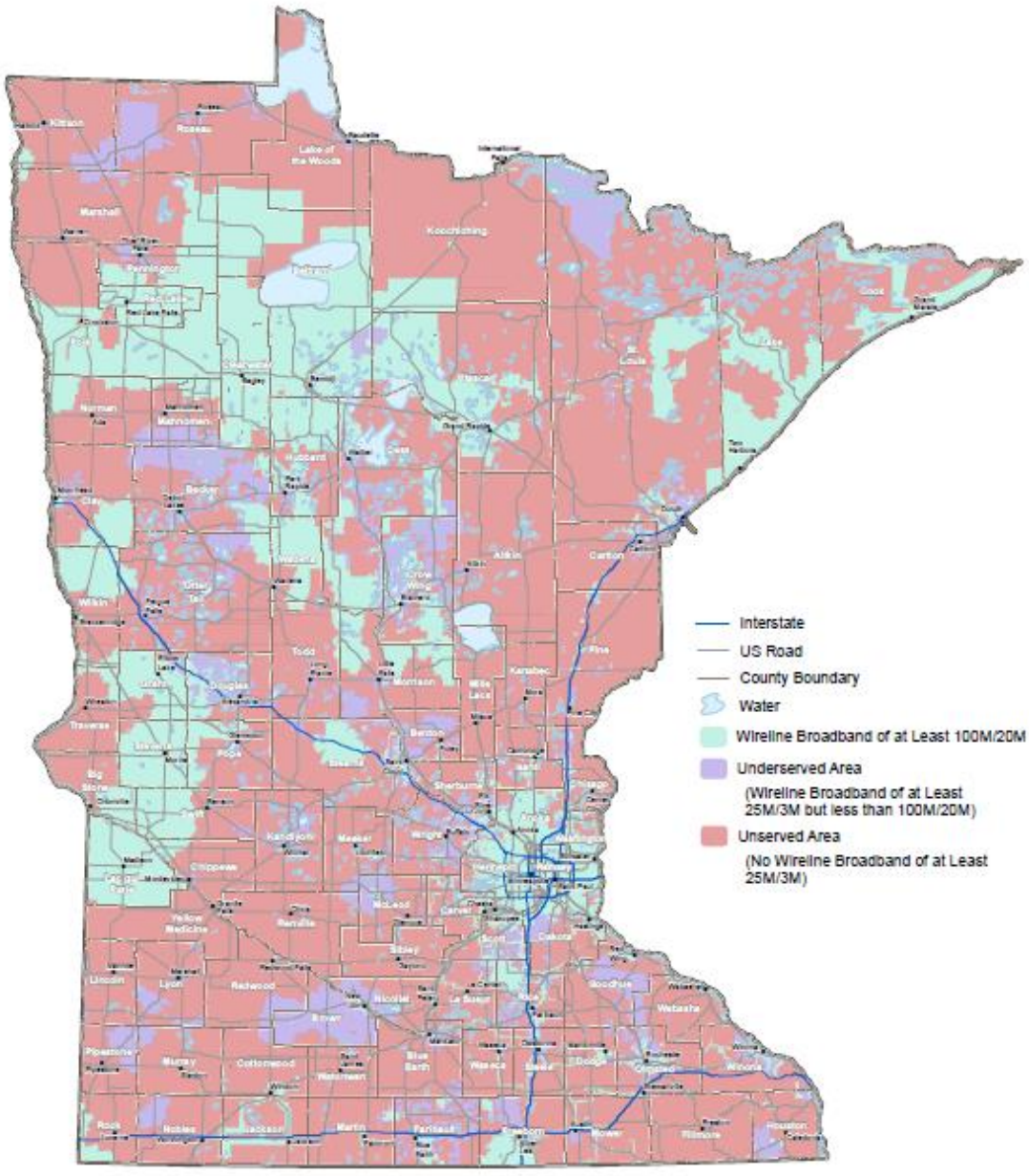
Note that the maps below identify areas of the state with wireline broadband service (or lack thereof), though the state's broadband speed goals do not specify a particular technology. The map immediately below identifies *served*, *unserved*, and *underserved* areas of the state. The subsequent map displays availability of 100 Mbps/20 Mbps on a county-by-county basis. The map on page 17 shows broadband availability by city and township.

Minnesota
Department of Employment and Economic Development
OFFICE OF BROADBAND DEVELOPMENT

2016 Broadband Service Inventory for the State of Minnesota

Border-to-Border Broadband Development Grant Program

Unserved, Underserved and Served Wireline Broadband Areas



Submit questions or recommended changes to:
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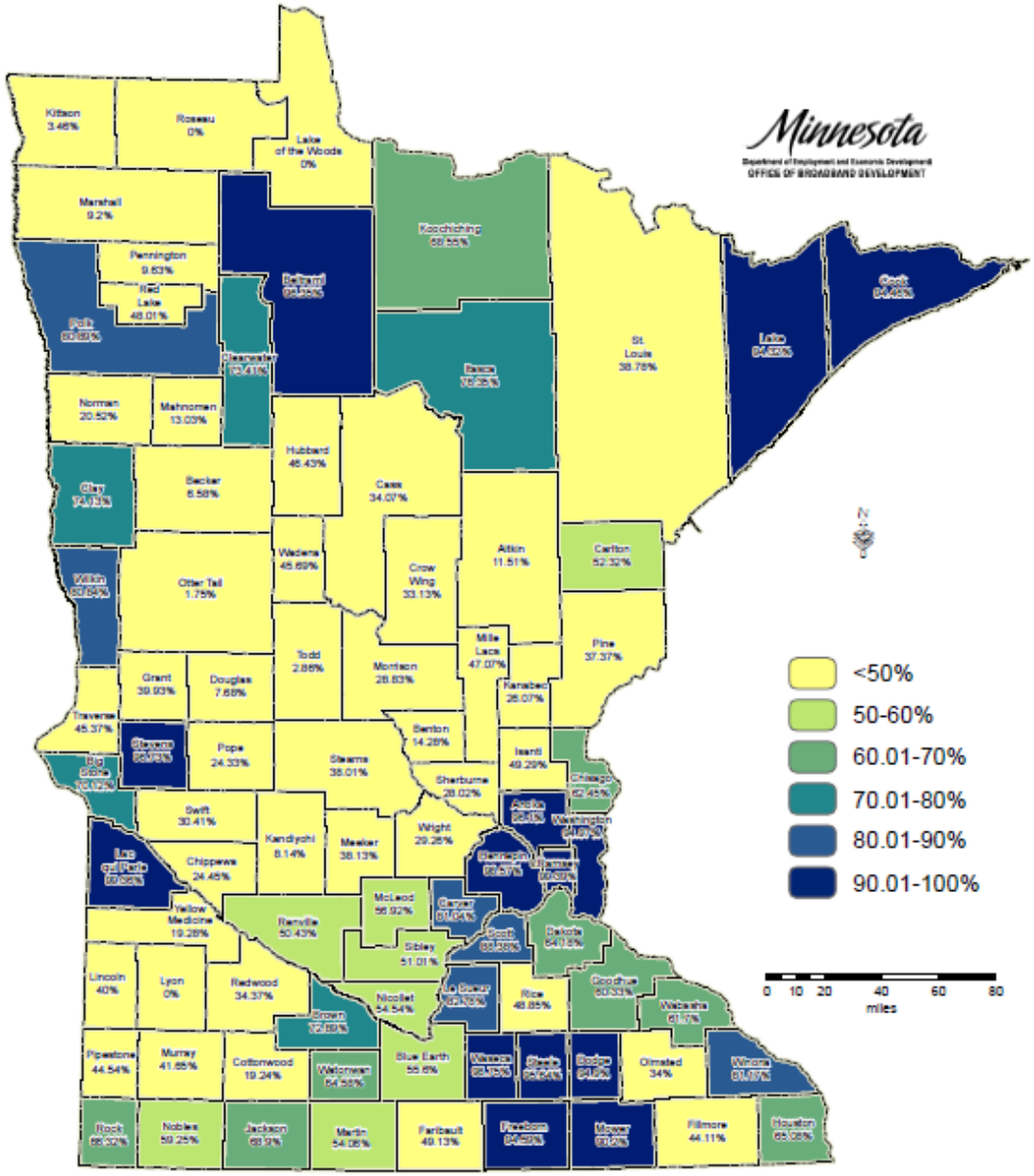
2016 Broadband Availability in the State of Minnesota

Percentage of Households Served by Fixed, Non-Mobile Broadband Service

At Least 100 Mbps Download/20 Mbps Upload Speeds (2026 State Broadband Goal)

Statewide Availability: 70.83%, Rural: 52.46%



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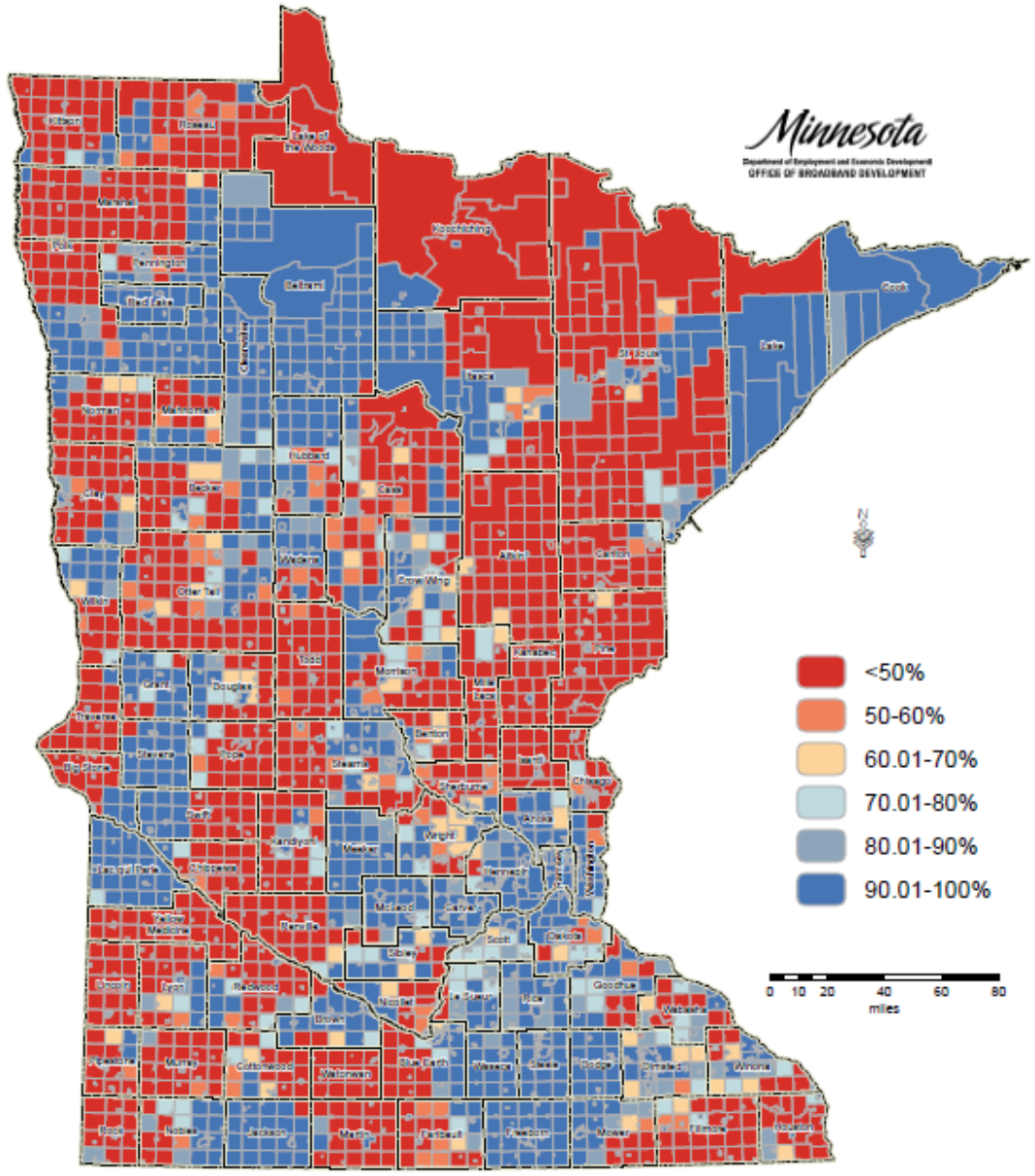
2016 Broadband Availability in the State of Minnesota

Percentage of Households Served by Fixed, Non-Mobile Broadband Service by City/Township

At Least 25 Mbps Download/3 Mbps Upload Speeds
(2022 State Broadband Goal)
Statewide Availability: 90.15%, Rural: 78.04%



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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, making service available to 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.

The Office of Broadband Development is in the process of reviewing 62 grant applications, with requests totaling $55 million, for $35 million in funding allocated to the grant program in 2016. Final announcement of the grant recipients is expected in early 2017.

In addition to updating the state's broadband speed goals and the state's definitions of unserved and underserved with respect to broadband availability, the 2016 Legislature added a formal challenge process to the grant program.[13] A joint letter from 17 community stakeholders addressing the challenge process is included in Appendix H.

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.

Recommendation

Provide $100 million in on-going biennial funding for the Border-to-Border Broadband Development Grant Program.

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."[14]

[13] OBD provides a summary of the challenge process and procedures: https://mn.gov/deed/assets/grant-challenge-process-2016_tcm1045-257998.pdf.

[14] 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.

Not all Minnesotans with broadband access use it. The reasons they don't use broadband 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.[15] Each barrier is an opportunity gap that threatens Minnesota's future prosperity.

The FCC reports that Minnesota has an adoption rate of 42 percent for Internet access at speeds of 25 Mbps down and 3 Mbps up,[16] which compares to a national average of 37 percent and a ranking of 17th.[17] The last statewide survey of broadband adoption was completed in 2013[18] and is no longer timely.

> "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)

Minnesota's statutory goal is to place in the top 15 when compared to countries globally for broadband penetration. Minnesota is not meeting its goal. We rank 17th nationally. According to the Organisation for Economic Cooperation and Development (OECD) the US ranks 17th for internet penetration.[19] The measurements they use differ from the FCC methodology but is reflective of where the US stands globally.

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.[20] 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.[21] Research suggests that households with broadband save an average of $10,500 annually.[22] Investment in broadband adoption benefits residents and Minnesota's economy as a whole.

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[15] *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.

[16] https://apps.fcc.gov/edocs_public/attachmatch/FCC-16-6A1.pdf.

[17] National average includes states and territories; however 11 entities were not included because data was unavailable.

[18] http://www.connectednation.org/residential-survey-data?state=Minnesota.

[19] http://www.oecd.org/sti/broadband/1.2-OECD-WiredWirelessBB-2015-12.xls.

[20] http://blandinfoundation.org/_uls/resources/SNG--ROI_from_Broadband_Infrastructure_and_Utilization--01-31-14.pdf.

[21] http://broadband.blandinfoundation.org/_uls/resources/SNG--ROI_from_Broadband_Infrastructure_and_Utilization--01-31-14.pdf.

[22] Internet Innovation Alliance http://www.internetinnovation.org/press-room/broadband-news-press-releases/iia-report-consumers-can-set-aside-10500-annually/.

Evaluating Minnesota's broadband adoption rate

According to digital inclusion expert Dr. Colin Rhinesmith, who addressed the Task Force, widespread agreement exists among researchers and practitioners alike that successful broadband adoption efforts utilize a four-pronged approach:[23]

1. Access to good, affordable computers;
2. Reduced rates for broadband;
3. Public access; and
4. Training.

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.

> "It is difficult for middle class households to understand not having a computer in their homes for personal and professional use. Yet the inability to own a personal home computer reminds us of the gaps in opportunities between those with and those without. 21st century skill development is necessary to navigate worlds in education, tele-health, employment, community connections, etc."
>
> PCs for People, The Shop, Brainerd (http://wp.me/p3if7-3fX)

Access to Computers

Low income Minnesotans are the least likely to own a computer, which impairs broadband adoption.[24] PCs for People (PCfP), a nonprofit organization, refurbishes donated computers to distribute to low incomes households in Minnesota. It also provides affordable computer support and repair and partners with providers to offer discounted Internet subscriptions. So far in 2016, PCfP distributed 7,805 computers to qualifying households and provided services to 8 communities in Minnesota through a partnership with Blandin Foundation.

Other organizations provide similar services, but demand outstrips supply and more donated computers are needed.[25]

Recommendation

Build computer donation partnerships between state agencies and community-based organizations already getting computers into the hands of those who need them. The State could stimulate the effort by encouraging others, especially local governments, to donate their surplus computers to community partners. Working through the OBD, the State could provide information on organizations that refurbish computers securely and on opportunities to both donate and receive computers.

[23] Professor Rhinesmith publishes extensively on the issue of adoption and inclusion. His work can be viewed at http://crhinesmith.com/research/.

[24] Pew Research suggests that those "smart phone dependent" experience distinct challenges. Pew Research, *Home Broadband Report 2015*, http://www.pewinternet.org/2015/12/21/home-broadband-2015/.

[25] Other organizations appear to work on a smaller scale than PCsF, but offer important services. *See* Free Geek at freegeektwincities.org and the U of M Technology Empowerment Center at https://diversity.umn.edu/bced/node/40.

Reduced Rates for Broadband

Research suggests that reducing the rate for broadband improves broadband adoption.[26] Several Minnesota providers offer low cost service to qualifying households. The Task Force heard about programs offered by Comcast, CenturyLink, Charter, Sjoberg Cable and Midco.[27] On average, low-income Minnesotans pay $9.95 for broadband up to 10 Mbps upload and 1 Mbps download. Comcast recently expanded its program to include Minnesotans receiving Housing and Urban Development (HUD) assistance which should increase subscribership beyond the 17,000 participants to date. Providers assured the Task Force they would welcome the State's assistance in promoting reduced-priced services. The Task Force recommends the State stimulate public participation in existing broadband subsidy programs by working through the OBD to increase public awareness of the programs.

The federal Lifeline program also works to defray the cost of broadband for low-income Minnesotans. Through reforms enacted in 2016, Lifeline provides a $9.25 consumer subsidy ($34.25 in tribal areas) to qualifying households to offset the cost of broadband.[28] Minnesota's Telephone Assistance Program provides a $3.50 discount but is limited to local landline telephone service for low-income households. Unfortunately, existing programs fail to address the needs of all Minnesota residents who lack affordable access to broadband. Monthly charges for broadband can vary widely and many Minnesotans need help, but do not qualify for support.[29]

Marc Johnson, Executive Director of the East Central Minnesota Education Cable Cooperative presented to the Task Force[30] and documented the range in broadband costs for households in his school district.[31] In his experience, DSL and fixed wireless are not available to all areas. Mr. Johnson provided information to the Task Force regarding the range of costs associated with broadband in rural Minnesota.

Broadband rates and return on investment in rural areas are disproportionate for the following reasons:

- Lower population density means fewer customers available to generate revenue.
- Greater distance between customers means greater expense to extend broadband to each location.
- 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/Mbps in the Twin Cities to $1/Mbps in Red Wing to $10/Mbps in Thief River Falls.[32]

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[26] Pew Research suggests that those "smart phone dependent" experience distinct challenges. Pew Research, *Home Broadband Report 2015*, http://www.pewinternet.org/2015/12/21/home-broadband-2015/.

[27] *See* Comcast Internet Essentials: www.InternetEssentials.com; http://www.centurylink.com/home/internetbasics/; https://www.midco.com/lifeline/; and http://trf.mncable.net/internet-service/.

[28] Recent reform of the Lifeline program to include broadband is just beginning. Next year the Task Force will know whether or not the program actually improved broadband adoption.

[29] Lisa Peterson e la Cueva http://spnn.org/blogs/201605/lifeline-is-a-good-step-but-lets-keep-going.

[30] https://blandinonbroadband.org/2016/08/17/mn-broadband-task-force-august-2016-meeting-digital-inclusion/.

[31] Marc Johnson http://mnedtech.blogspot.com/2014/01/rural-broadband-and-education-part-4.html.

[32] https://blandinonbroadband.org/2016/09/08/mn-broadband-task-force-notes-policy-from-the-provider-perspective-and-library-as-digital-inclusion-partner/.

Disparities in access to affordable broadband widen opportunity gaps in all aspects of social and economic life in Minnesota.

Recommendation

The State should modify the Telephone Assistance Program that provides a $3.50 discount to local phone service for low-income households by better aligning it with the National Lifeline program, which provides $9.25 subsidy ($34.25 in tribal areas) to qualifying households to offset the cost of broadband.

Public Access to Broadband: Libraries

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.

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. The Electronic Library for Minnesota (ELM), for example, gives residents 24/7 access to a suite of 48 online resources that support K-12 and college education, employment and digital literacy.

Minnesota's Public Libraries Broadband and Usage Statistics

	2005	2010	2015
Library Locations	N/A	358	355
Bookmobiles	15	10	8
FTE Public Librarians	720.38	776.34	790
Service Hours per Week	14,093	14,737	14,865
Public Computers	3,470	5,209	6,559
Visits	24,573,595	27,878,920	24,340,258
Material Checkouts	48,654,798	58,895,728	52,512,434
Desktop Internet Sessions	10,582,765	7,074,170	5,089,532
Wireless Internet Sessions	N/A	N/A	3,378,243
Download Speeds > 20 Mbps	N/A	N/A	69%
Upload Speeds > 20 Mbps	N/A	N/A	64%
Fiber to Building	N/A	N/A	98%
Category 6 Wiring in Building	N/A	N/A	39%

According to the Pew Research Center,[33] 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 WORK*place* 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 WORK*place* 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 WORK*place* depends, in part, on access to online assessment and instructional resources. Northstar Digital Literacy Assessment[34] 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 ELM.[35] 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.

Recommendation

Fully fund the Telecommunications Access Equity Aid by raising its cap. This program offsets the cost of Internet access for schools participating in the federal E-Rate program.

Recommendation

Support continued funding of Regional Library Telecommunications Aid (RLTA) at $4.6 million over FY2018-19, as recommended by the Minnesota Library Association. 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.

Digital Literacy Training

Broadband adoption lags where those who would benefit from it lack the essential skills to use it effectively. A wide range of Minnesota organizations offer computer and digital literacy training programs. 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. Anecdotal evidence suggests that training new users in familiar and comfortable locations promotes participation and learning.

[33] http://www.pewinternet.org/2016/09/09/libraries-2016/.
[34] https://www.digitalliteracyassessment.org/.
[35] https://www.elm4you.org/.

Two Minnesota organizations have been critical to digital literacy efforts in the state. The St. Paul Public Library and the St. Paul Community Consortium developed the Northstar Digital Literacy Assessment[36] standards. Northstar provides standards for curricula and certification for basic computer skills. Nobles County Community Education used Northstar to develop training for New Americans by translating curricula into Spanish, Tigrinya, Amharic and Karen.[37] The Technology Literacy Collaborative (TLC)[38] hosts a website that compiles information on community technology centers, curriculum available to trainers and upcoming digital inclusion events.

> "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

Dozens of community-wide adoption and broadband utilization initiatives exist across rural Minnesota, including many funded by the Blandin Foundation.[39] Blandin's adoption programs resulted in an increase in adoption of 15 percent in participating communities—substantially faster than in the rest of rural Minnesota.[40] Examples of projects funded by the Blandin Foundation are included in Appendix D.

> "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

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 the Internet-of-Things (IoT), telemedicine and cyber security.

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[41], 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.

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[36] https://www.digitalliteracyassessment.org/standards.
[37] https://blandinonbroadband.org/2016/09/28/blandin-broadband-community-tour-nobles-county-where-digital-inclusion-builds-bridges-to-new-americans/.
[38] http://www.tlc-mn.org/.
[39] The Blandin Foundation, based in Grand Rapids, provides grants and technical assistance to help communities improve broadband adoption and utilization. http://broadband.blandinfoundation.org/.
[40] http://broadband.blandinfoundation.org/_uls/resources/U_of_MN_Crookston_final_report_FINAL.pdf.
[41] http://www.gartner.com/newsroom/id/3165317.

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 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.

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, Chief Technology Officer, US Ignite

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 the 1960s. 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 percent of Kaiser Permanente[42] doctor/patient interactions are done via smartphones, videoconferencing, kiosks, or other technology tools. This gets patients 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.

[42] http://fortune.com/2016/10/06/kaiser-permanente-virtual-doctor-visits/.

This field is in the midst of a large growth cycle. The market research company Technavio[43] 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 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 residents 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.

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 them self 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, http://www.federaltimes.com/story/government/cybersecurity/2016/02/04/cyber-bigger-threat-terrorism/79816482/

One consequence of not protecting these assets is identity theft. In February 2016, the White House declared identity theft as the fastest growing crime in America.[44] During 2014, 17.6 million people were

[43] http://www.businesswire.com/news/home/20160325005031/en/Growing-Demand-Remote-Monitoring-Significantly-Augment-Demand.

[44] https://www.whitehouse.gov/the-press-office/2016/02/09/fact-sheet-cybersecurity-national-action-plan.

impacted at a cost of $15.4 billion[45]—including $3.1 billon paid out by the IRS in fraudulent tax refunds.[46]

A 2015 Kaspersky Labs survey[47] 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[48] 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 $100,000.

In 2015, there were 780 data breaches, exposing nearly 178 million records, across government/military, and the financial, business, educational, and healthcare industries.

"Data Breach Report," Identity Theft Resources Center, http://www.idtheftcenter.org/images/breach/DataBreachReports_2015.pdf

Virginia is tackling the problem by establishing cyber security Registered Apprenticeships.[49] The Virginia Department of Labor and Industry combines on the job learning with classroom instruction 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.

Recommendation

Establish a legislative cybersecurity commission, whose scope of work includes information-sharing between policy-makers, state agencies, and private industry related to Minnesota's cybersecurity infrastructure, cybersecurity workforce issues and emerging technology, to develop legislation to support and strengthen Minnesota's cybersecurity infrastructure.

With the costs attributed to cybercrime and identify theft quickly escalating into the trillions of dollars, staying on top of current threats and vulnerabilities is critical to businesses, government entities, and citizens.[50] Sharing information across these groups is one way to help minimize the damages. Many organizations are concerned, however, about sharing because they may get bad publicity, feel they are

[45] https://www.bjs.gov/content/pub/pdf/vit14.pdf.
[46] https://www.washingtonpost.com/news/powerpost/wp/2016/07/01/3-1-billion-lost-to-id-theft-tax-fraudsters-in-2014-at-least/.
[47] https://press.kaspersky.com/files/2015/12/B2C_Tracking_Report_2015.pdf?_ga=1.234434333.2081203460.1476824688.
[48] https://www.isc2cares.org/uploadedFiles/wwwisc2caresorg/Content/GISWS/FrostSullivan-(ISC)%C2%B2-Global-Information-Security-Workforce-Study-2015.pdf.
[49] http://www.doli.virginia.gov/apprenticeship/pdfs/2015%20Governor's%20Executive%20Order%20on%20Apprenticeships.pdf.
[50] http://www.securitymagazine.com/articles/86352-cybercrime-will-cost-businesses-2-trillion-by-2019.

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.

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.[51] As compared to an aerial build, dig once practices can make installation three to four times less expensive.[52] 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.[53]

> 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.
>
> - Connecting America: The National Broadband Plan, p. 114, https://www.fcc.gov/general/national-broadband-plan.

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.

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 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.

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[51] A sample model "dig once" local ordinance and a listing of examples of dig once policies are included in Appendix E.

[52] Connecting America: The National Broadband Plan, p. 114 (March 17, 2010) (found at https://transition.fcc.gov/national-broadband-plan/national-broadband-plan.pdf).

[53] 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).

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.[54] 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.
Photo credit: Donald Niles, Wadena, MN

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 (MDH) 2016 project priority list for drinking water infrastructure lists 271 projects totaling $393 million over the same time frame.[55]

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. [56]

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[54] 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).

[55] Id., p. 9.

[56] 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)

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.

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 alternatives 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 more than 30 states have adopted various forms of reduced regulation, 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 regulation 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."[57] VoIP technologies can function with or without connection to the public switched telephone network, can be fixed or nomadic, and may include other bundled services outside the scope of telecommunications regulation. There is a pending lawsuit in which the State of Minnesota is asserting jurisdiction over fixed VoIP services. The outcome of this lawsuit or state legislative action could clarify questions over regulatory jurisdiction with respect to fixed VoIP services.

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.

- "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)

[57] FCC definition (found at https://www.fcc.gov/consumers/guides/voice-over-internet-protocol-voip).

Recommendation

Continue to monitor advancing telecommunications technologies with an eye towards encouraging ongoing stakeholder dialogue as to 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.

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 of an issue 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 ($3,500) 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 cabling (such as category 5/6 or multi-mode fiber) that supports easier management of broadband connectivity.

VI. Office of Broadband Development: Overview and Operating Directives

The Office of Broadband Development (OBD), located within the Department of Employment and Economic Development (DEED), was established during the 2013 Legislative Session.[58] 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. [59]

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 households and community institutions impacted by the project, demonstrated need for economic development, among others. [60]

[58] Minnesota Session Laws, 2013 regular session, chapter 85 at Article 3, sections 13, 14, and 26

[59] 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.

[60] Minnesota Session Laws, 2014 regular session, chapter 312 at Article 3, sections 3.

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.

Aside from the state speed goals identified in Minn. Stat. §237.012, the Office of Broadband Development has 27 statutory obligations, spread across four statutes (see Appendix E for a complete list of obligations):

- Statute 116.J.391,
- Statute 116.J.396,
- Statute 116J.39, and
- Statute 116J.395.

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.

Current Office Activities and Responsibilities[61]

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

[61] Provided by OBD. A list of OBS's statutory obligations is included in Appendix F.

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

Allocate $10 million in FY2018-19 to provide the Office of Broadband with operating funds to implement a broadband adoption and use program; implement a "Dig Once" policy; provide specific funding for mapping services; support the Broadband Task Force; coordinate information resources and outreach and engagement activities; support statewide broadband planning, among other tasks.

VII. Policy Recommendations to Governor Dayton and Members of the State Legislature

- Provide $100 million in on-going biennial funding for the Border-to-Border Broadband Development Grant Program.

- Allocate $10 million in FY2018-19 to provide the Office of Broadband with operating funds to implement a broadband adoption and use program; implement a "Dig Once" policy; provide specific funding for mapping services; support the Broadband Task Force; coordinate information resources and outreach and engagement activities; support statewide broadband planning, among other tasks.

- 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.

- Establish a legislative cybersecurity commission, whose scope of work includes information-sharing between policy-makers, state agencies, and private industry related to Minnesota's cybersecurity infrastructure, cybersecurity workforce issues and emerging technology, to develop legislation to support and strengthen Minnesota's cybersecurity infrastructure.

- Continue to monitor advancing telecommunications technologies with an eye towards encouraging ongoing stakeholder dialogue as to 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.

- Amend building codes to require that multi-tenant housing units funded with public dollars deploy cabling (such as category 5/6 or multi-mode fiber) that supports easier management of broadband connectivity.

- Build computer donation partnerships between state agencies and community-based organizations getting computers into the hands of those who need them. The State could stimulate the effort by encouraging others, especially local governments, to donate their unused computers to community partners. Working through the OBD, the State could provide information on organizations that refurbish computers securely and on opportunities to both donate and receive computers.

- The State should modify the Telephone Assistance Program that provides a $3.50 discount to local wired telephone service for low-income households by better aligning it with the National Lifeline program, which provides a $9.25 subsidy ($34.25 in tribal areas) to qualifying households to offset the cost of broadband.

- Support continued funding of Regional Library Telecommunications Aid (RLTA) at $4.6 million over FY2018-19, as recommended by the Minnesota Library Association. 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.

- Fully fund the Telecommunications Access Equity Aid by raising its cap. This program offsets the cost of Internet access for schools participating in the federal E-Rate program.

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.

5G: Fifth generation cellular wireless network. A new generation of mobile technology has appeared about every 10 years. Standards are expected to be finalized by about 2019, but companies are currently testing 5G to help inform those standards.

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 are being implemented in 2017 for the smallest, rural carriers, as recommended by the Federal Communications Commission.

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.

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.

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.

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 of at least100 megabits per second download and at least 20 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.

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.[62] G.fast is a DSL standard for relatively short local loops.

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,

[62] Alcatel Lucent has completed initial trials of this emerging technology. *See* https://www.alcatel-lucent.com/solutions/g.fast.

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 speeds 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.[63] 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 system (i.e. a cable system) or an optical overlay for existing PON such as GEPON/EPON. The overlay for RFoG is based on Wave Division Multiplexing (WDM) -- the passive combination of wavelengths on a

[63] 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.

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 (3rd 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, 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.

Most devices, based on subscription choice of consumer, have access either through Wi-Fi or cellular access. A user can access a network, such as at the school or a coffee shop, and the expense of the access is shifted to the network owner. When such a network is not available, they can use their cellular plan. Speeds for cellular are based on provider access and location. In urban areas, speeds are generally 3G or 4G. In rural areas, speeds can be slower and even non-existent in some cell phone dead spots.

When it is faster than other local options, some consumers use their cellular connection (personal hotspot or Mi-Fi) as their primary household connection. Data caps can become an issue.

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 among 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.[64] (Data as of June 30, 2014.)

Minnesota is 44th (between Greece 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.

[64] https://www.broadbandmap.gov/rank/all/state/percent-population/within-nation/speed-download-greater-than-3mbps-upload-greater-than-0.768mbps/ascending/.

Appendix D: Examples of Community-Designed-and-Implemented Broadband Adoption Projects

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 Commission	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.

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*

> "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*

Appendix E: Model "Dig Once" Local Ordinances and Examples

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)

MODEL OPEN TRENCH/DIG ONCE ORDINANCE[21]

WHEREAS, obstructions and excavations in City/Town/County rights of way disrupt and interfere with public use of the Rights of Way; and

WHEREAS, obstructions and Excavations in City/Town/County Rights of Way result in loss of parking and loss of business to merchants and others whose places of business are in the vicinity of such obstructions and Excavations; and

WHEREAS, it is desirable to adopt policies and regulations which will enable the City/Town/County of _____ to gain greater control over the disruption and interference with the public use of public streets and Rights of Way, in order to provide for the health, safety and well-being of the City's/Town's/County's residents and users of City/Town/County Rights of Way; and

WHEREAS, significant public funds have been invested to acquire, build, maintain and repair the streets within the City/Town/County, and Excavations in the Rights of Way reduce the useful life of the pavement infrastructure; and

WHEREAS, significant public funds have been invested to place and maintain Landscaping within Rights of Way in the City/Town/County and Excavations in the Rights of Way cause damage to, and increase the costs of maintaining that Landscaping; and

WHEREAS, at the present time, the City's/Town's/County's Department of Public Works does not have [or desires to update, as appropriate] a detailed map or database indicating the location, nature, or extent of the system underground utility, communications and similar Facilities; and

WHEREAS, the various public and commercial utilities, broadband and communications providersand similar entities which install, maintain, and operate Facilities under the City's/Town's/County's Rights of Way are constrained, from time to time, to make excavation cuts which degrade the surfaces of these Rights of Way, thereby reducing their useful life; and

WHEREAS, demand for access to broadband services is growing, and in order to fill such demand, more broadband network infrastructure is being installed in Rightsof Way; and

[21] This Model Open Trench/Dig Once Ordinance is intended as a starting point to address issues that local governments might include in their own rights of way codes. It may be considered as a separate ordinance or for inclusion in a more comprehensive ordinance government rights of way management, permitting and construction. All provisions relate in some way to coordinating and attempting to minimize excavations, but all may not be appropriate in every jurisdiction. The provisions of this Model may also, where authorized, be modified and adopted as local policies or regulations.

WHEREAS, in other jurisdictions, the demand for access and the number of entities seeking to install Facilities has sometimes resulted in multiple, serial Excavations within the Rights of Way, which can and has resulted in traffic disruption, a weakening of pavement integrity, and a shortening of the useful life of paved surfaces; and

WHEREAS, while Colorado state statutes, particularly, C.R.S. 38-5.5-109, contains some procedures for addressing joint trenching in connection with broadband provider operations in the Rights of Way, at the present there is no comprehensive mechanism nor legal requirement that all public and commercial entities coordinate Excavation in the Rights of Way, and construct Facilities in newly developed areas to minimize future Excavations; and

WHEREAS, the [City/Town/County] of _____ intends to responsibly manage its Rights of Way by anticipating such demand and planning accordingly.

NOW, THEREFORE, be it enacted by the City/Town/County of _____ as follows:

I. PURPOSE AND OBJECTIVES

A. Purpose: to provide principles and procedures for the coordination of construction Excavation within any public Rights of Way, and to protect the integrity of the Rights of Way and road system.

B. Objectives. Public and private uses of Rights of Way for location of Facilities employed in the provision of public services should, in the interests of the general welfare, be accommodated; however, the City/Town/County must insure that the primary purpose of the Rights of Way, namely the safe and efficient passage of pedestrian and vehicular traffic, is maintained to the greatest extent possible. In addition, the value of other public and private installations, Facilities and properties should be protected, competing uses must be reconciled, and the public safety preserved. The use of the Rights of Way corridors for location of Facilities is secondary to these public objectives. This ordinance is intended to assist in striking a balance between the public need for efficient, safe transportation routes and the use of Rights of Way for location of Facilities by public and private entities. It thus has several objectives:

1. To insure that the public health, safety and welfare is maintained and that public inconvenience is minimized.

2. To facilitate work within the Rights of Way through the standardization of regulations.

3. To conserve and fairly apportion the limited physical capacity of the public Rights of Way held in public trust by the City/Town/County.

4. To promote cooperation among the Applicants and Permittees (as defined herein) and the City/Town/County in the occupation of the public Rights of Way, and work therein, in order to (i) eliminate duplication that is wasteful, unnecessary or unsightly, (ii) lower the Permittee's and the City's/Town's/County's costs of providing services to the public, and (iii) minimize Rights of Way Excavations.

II. DEFINITIONS

For the purpose of this Chapter the following words shall have the following meanings:

A. "Applicant" means an owner or duly authorized agent of such owner, who has submitted an application for a Permit to Excavate in the Rights of Way.

B. "City"/"Town"/"County" means the City/Town/County of _____, Colorado.

C. "Conduit" means a single enclosed raceway for cables, fiber optics or other wires, or a pipe or canal used to convey fluids or gases.

D. "Department" means the Department of Public Works.

E. "Developer" means the person, partnership, corporation, or other legal entity who is improving property within the City/Town/County and who is legally responsible to the City/Town/County for the construction of improvements within a subdivision or as a condition of a building permit or other land use or development authorization.

F. "Director" means the Director of Public Works of the City/Town/County or his/her authorized representative.

G. "Emergency" means any event which may threaten public health or safety, or that results in an interruption in the provision of services, including, but not limited to, damaged or leaking water or gas conduit systems, damaged, plugged, or leaking sewer or storm drain conduit systems, damaged electrical and communications facilities, and advanced notice of needed repairs is impracticable under the circumstances.

H. "Excavate" or "Excavation" means any Work in the surface or subsurface of the Rights of Way, including, but not limited to opening the Rights of Way; installing, servicing, repairing or modifying any Facility(ies) in or under the surface or subsurface of the Rights of Way, and restoring the surface and subsurface of the Rights of Way.

I. "Facilities" means, including, without limitation, any pipes, conduits, wires, cables, amplifiers, transformers, fiber optic lines, antennae, poles, ducts, fixtures and appurtenances and other like equipment used in connection with transmitting, receiving, distributing, offering, and providing broadband, utility and other services.

J. "Landscaping" means materials, including without limitation, grass, ground cover, shrubs, vines, hedges, or trees and non living natural materials commonly used in landscape development, as well as attendant irrigation systems.

K. "Major Work" means any reasonably foreseeable Excavation that will affect the Rights of Way for more than five (5) consecutive calendar days.

L. "Owner" means any Person, including the City, who owns any Facilities that are or are proposed to be installed or maintained in the Rights of Way.

M. "Permit" means any authorization for use of the Rights of Way granted in accordance with the terms of this ordinance, and other applicable laws and policies of the City/Town/County.

N. "Permittee" means the holder of a valid Permit issued pursuant to this Chapter and other applicable provisions of applicable law for Excavation in the Rights of Way.

O. "Person" means any person, firm, partnership, special, metropolitan, or general district, association, corporation, company, or organization of any kind.

P. "Rights of Way" means any public street, road, way, place, alley, sidewalk or easement, that is owned, held or otherwise dedicated to the City/Town/County for public use.

Q. "Work" means any labor performed on, or any use or storage of equipment or materials, including but not limited to, construction of streets and all related appurtenances, fixtures, improvements, sidewalks, driveway openings, street lights, and traffic signal devices. It shall also mean construction, maintenance, and repair of all underground structures such as pipes, conduit, ducts, tunnels, manholes, vaults, buried cable, wire, or any other similar Facilities located below surface, and installation of overhead poles used for any purpose.

III. POLICE POWERS

A Permittee's rights hereunder are subject to the police powers of the City/Town/County, which include the power to adopt and enforce ordinances, including amendments to this ordinance, and regulations necessary to the safety, health, and welfare of the public. A Permittee shall comply with all applicable ordinances and regulations enacted, or hereafter enacted, by the City/Town/County or any other legally constituted governmental unit having lawful jurisdiction over the subject matter hereof. The City/Town/County reserves the right to exercise its police powers, notwithstanding anything in this ordinance or any Permit to the contrary. Any conflict between the provisions of the ordinance or a Permit and any other present or future lawful exercise of the City's/Town's/County's police powers shall be resolved in favor of the latter.

IV. JOINT PLANNING AND CONSTRUCTION; COORDINATION OF PLANNED EXCAVATIONS

A. Excavations in City/Town/County Rights of Way disrupt and interfere with the public use of those Rights of Ways and can damage the pavement and Landscaping. The purpose of this section is to reduce this disruption, interference and damage by promoting better coordination among Applicants and Permittees making excavations in City/Town/County Rights of Way and between these Persons and the City/Town/County. Better coordination will assist in minimizing the number of Excavations being made wherever feasible, and will ensure the Excavations in City/Town/County Rights of Way are, to the maximum extent possible, performed before, rather than after, the resurfacing of the Rights of Way by the City/Town/County.

B. Any Permittee owning, operating or installing facilities in City/Town/County Rights of Way, providing water, sewer, gas, electric, broadband, communication, video or other utility or utility-like services, shall meet annually with the Director, at the Director's request to discuss Permittee's excavation master plan. At such meeting, to the extent not already in possession of the City/Town/County, Permittee shall submit documentation, in a form required by the Director, showing a location of the Permittee's existing Facilities in the City/Town/County Rights of Way. Permittee shall discuss with the Director, its excavation master plan, and identify planned Major Work in the City/Town/County. The Director may make his own record on a map, drawing or other documentation, of each Permittee's planned Major Work in the City/Town/County; provided, however, that no such document prepared by the Director shall identify a particular entity, or the planned Major Work of that particular entity. An excavation master plan shall be submitted in both hard copy and digital format. As used in this subsection, the requirement to identify planned Major Work refers to any Major Work planned to occur more in the ensuing three (3) years after the date that the Permittee's master plan or update is discussed. Between the annual meetings to discuss planned Major Work, a Permittee shall use its best efforts to inform the Director of any substantial changes in the planned Major Work discussed at the annual meeting.

C. The Director shall review the major excavation plan and identify conflicts and opportunities for coordination of Excavations. The Director shall notify affected Owners and Permittees of such conflicts and opportunities to the extent necessary to maximize coordination of Excavation. Each Applicant for a Permit shall coordinate, to the extent practicable, with each potentially affected Owner and Permittee to minimize disruption in the Rights of Way.

D. The City/Town/County may disclose information contained in a Permittee's master excavation plan to any public or private entity planning on conducting Excavation activities in the Rights of Way only on a need-to-know basis in order to facilitate coordination

among excavators and to avoid unnecessary Excavation in the Rights of Way. To the maximum extent permissible under the Colorado Open Records Act, as amended, the City/Town/County shall not otherwise disclose to the public any information contained in a master excavation plan submitted by a Permittee that is proprietary, trade secret or is otherwise protected from disclosure; provided, however that the City/Town/County shall have no duty to decline to disclose any information that the Permittee has not identified on its face as proprietary, trade secret or otherwise protected from disclosure. The City/Town/County shall notify a Permittee of any request for inspection of public records that calls for disclosure of any master excavation plan on which any information has been identified as proprietary, trade secret or otherwise protected from disclosure. The City/Town/County shall consult with its legal counsel regarding any such request and shall inform the affected Permittee either that the City/Town/County will refuse to disclose the protected information or, if there is no proper basis for such refusal, that the City/Town/County intends to disclose the requested information unless ordered otherwise by a court.

E. The Director shall prepare a Repaving Plan showing the Rights of Way resurfacing planned by the City/Town/County. For purposes of this section, the Repaving Plan shall include a Landscaping or other Rights of Way improvement plan. The Repaving Plan shall be revised and updated on an annual basis. The Director shall make the City's/Town's/County's Repaving Plan available for public inspection. In addition, after determining the City's/Town's/County's Rights of Way resurfacing Work that is proposed for each year, the Director shall send a notice of the proposed Work to all Permittees that have had an annual meeting with the Director, and those broadband providers that are identified on the list maintained by the Colorado Department of Transportation pursuant to C.R.S. 39-5.5-109 (1)(b).

F. Prior to applying for a Permit, any Person planning to Excavate in the City's/Town's/County's Rights of Way shall review the City's/Town's/County's Repaving Plan on file with the Director and shall coordinate, to the extent practicable, with the utility and street Work shown on such plans to minimize damage to, and avoid undue disruption and interference with the public use of the Rights of Way.

G. In performing location of Facilities in the Rights of Way in preparation for construction under a Permit, Permittee shall compile all information obtained regarding its or any other Facilities in the Rights of Way related to a particular Permit, and shall make that information available to the City/Town/County in a written and verified format acceptable to the Director. If the Permittee fails to provide the locate information requested by the City/Town/County, the City/Town/County may obtain this information and charge the Permittee the actual costs for obtaining the information.

V. JOINT EXCAVATION

A. Public Entity Excavators. Whenever two or more public entity excavators propose Major Work in the same block within a three-year period, such Work shall be performed by one public entity excavator. The participants to the excavation shall pay their pro rata share of the Work, or as otherwise agreed to by the affected public entities. For purposes of this subsection, the public entity excavators shall be treated as a single Permit Applicant and shall submit one application.

B. Private Entity Excavators. Whenever two or more private entity excavators propose Major Work in the same block within a three-year period, such Work shall be performed by one private entity excavator. For purposes of this subsection, the private entity excavators shall be treated as a single Permit applicant and shall submit one application.

C. Public Entity Excavator and Private Entity Excavator. Whenever a public entity excavator(s) and a private entity excavator(s) propose Major Work in the same block within a three-year period, the Department shall condition Permits for such Work in a manner that maximizes coordination and minimizes the total period of construction.

D. Excavations Not Identified on Major Excavation Plans. When an Applicant seeks a Permit for an Excavation, and such Excavation has not been identified on a major excavation plan so as to allow the City/Town/County to coordinate joint Excavation as set forth in subsections A through C of this section, an Applicant may, in the discretion of the Director, be required to circulate a description of its proposed Excavation to the Permittees and other parties described in Section IV.E above, to determine whether any Persons have requirements for installing Facilities along the proposed route.

1. The Persons notified should be provided with the Applicant's proposed route plan, the target commencement date and the estimated completion date.

2. Within ten (10) working days after the notification required by this subsection, any interested Person must notify the Applicant of their requirements so that the Applicant may incorporate these requirements, where reasonable, in its Permit application. The Applicant should summarize the responses it receives from other Persons in its Application.

3. If the Applicant believes that it is not reasonably feasible to entertain the requests made by another Person(s) for conditions of joint Excavation, it should notify City/Town/County and the other Person(s) within ten (10) working days from the date of receiving the requirements from the other Person(s) and provide reasons why it is considered not reasonable to do so. The parties are expected to endeavor to resolve any technical or commercial concerns among themselves, and the Applicant shall report the results of these efforts together with its application for a Permit.

E. Waiver of Joint Excavation Requirements. Permit Applicants may seek a waiver of the joint Excavation requirements with respect to a particular Excavation.

1. Except in cases of Emergencies, within thirty (30) calendar days of receipt of a written request for a waiver, the Director, in his or her discretion, may grant a waiver to the joint Excavation requirements for good cause. In making his or her decision on the request for waiver, the Director shall consider the impact of the proposed Excavation on the neighborhood, the applicant's need to provide services to a property or area, facilitating the deployment of new technology and improved services, and the public health, safety, welfare, and convenience. The Director shall indicate in written, electronic, or facsimile communication the basis for granting any waiver pursuant to this subsection.

2. The Director may waive the requirements for joint Excavation in cases where Emergency conditions exist.

3. The Director may place additional conditions on any Permit(s) subject to a waiver, including, without limitation, the charging of additional fees. The Director's decision regarding waivers of the joint Excavation requirements shall be final.

VI. CONSTRUCTION OF NEW STREETS

A. Intent. The intent of this section is to provide for the construction of infrastructure sufficient to allow broadband communications entities desiring to deploy Facilities in the future to do so by pulling the same through the conduit and appurtenances installed pursuant to this section and without Excavating within the Rights of Way. This section is not intended to require Owners of broadband Facilities to install additional ducts or conduit in existing Rights of Way; rather, it is intended to require those constructing public streets, including the City/Town/County and Developers, to provide and install such conduit and appurtenances as may be necessary to accommodate future broadband needs within the Rights of Way without further Excavation.

B. Requirements—Adoption of Standards. Whenever any new public street is constructed, whether by the City/Town/County as a public works project or by a Developer or other private party in conjunction with development, the following shall be required:

1. In all new local streets serving or abutting residential development, a minimum of two 2" conduit with pull box every 1000' feet or less (and at every 90 degree turn) shall be installed by the party constructing the street.

2. In all new collector or arterial streets serving or abutting residential development, and in all new streets serving or abutting nonresidential development, a minimum of four 2" conduit with pull box every 1000' feet or less (and at every 90 degree turn) shall be installed by the party constructing the street; provided however that at the discretion of the Director, the number and size of the conduit and spacing of pull box may be modified to address the reasonably known plans and/or demand for broadband capacity in these locations.

3. In addition to installing conduit, the party constructing the street will be required to install such vaults and other appurtenances as may be necessary to accommodate installation and connection of broadband Facilities within the conduit.

4. All construction and installation shall be accomplished according to construction standards adopted by the City/Town/County. The construction standards shall be adopted with due consideration given to existing and anticipated technologies and consistent with industry standards.

5. All Facilities installed by Developers or other private parties pursuant to this section shall be conveyed and dedicated to the City/Town/County with the dedication and conveyance of the public street and/or Rights of Way.

6. All installation costs shall be the responsibility of the party constructing the public street.

C. Use by Broadband Service Providers and Network Owners. Whenever conduit installed or to be installed under this section is available or will become available within a newly constructed public streets or Rights of Way upon dedication, all broadband service providers or network owners thereafter locating Facilities within such street or Rights of Way shall be required to locate their communications lines within such conduit unless it can be demonstrated to the reasonable satisfaction of the City/Town/County that such location is not technologically feasible or reasonably practicable. Conduit capacity shall be allocated to broadband service providers or network owners on a first-come, first-served basis; provided, that the City/Town/County may reserve capacity within such conduits for its own use; and provided further, that the Director may adopt additional rules for conduit allocation in order to ensure that all broadband service providers and network owners have reasonable access to the Rights of Way and that no barriers to entry or competition result from the allocation of conduit space.

D. Fees. The City/Town/County reserves the right to charge reasonable fees for the use of conduit installed pursuant to this section, to the extent consistent with and as limited by federal and state laws. Any such fees shall be established by resolution or ordinance.

This Ordinance shall take effect immediately upon [insert language appropriate for individual jurisdictions ...]

INTRODUCED, READ, ADOPTED ON FIRST READING AND ORDERED PUBLISHED, as provided by law, by the City Council/Town Board of Trustees/Board of County Commissioners of the City/Town/County of _____, at its regular meeting held on the __ day of _____, 201_.

_____

Name and Title

ATTEST:

_____

City/Town/County Clerk

READ, ADOPTED ON SECOND READING AND APPROVED this __ day of _____, 201_.

_____

Name and Title

ATTEST:

_____

City/Town/County Clerk

Example "Dig Once" Ordinances

Dakota County, Minnesota

The Dakota County Broadband Network is one of the leading dig once platforms in the United States. The program seeks broadband development through collaboration, a "dig once" approach, cost sharing of stakeholders, and building with an eye toward future capacity. See Dig Once (with Many Partners) The Dakota County Broadband Network (found at https://mn.gov/deed/assets/dakota-15june2016_tcm1045-245873.pptx).

San Francisco, California

Ordinance No. 220-14 (http://tinyurl.com/oaz2qly). A five-year moratorium is placed on opening up a road bed once the trench along that road bed has been closed. San Francisco uses a notification process to ensure that other interested parties have the opportunity to install conduits and cabling in the open trench.

The Dig Once Ordinance requires "the installation of City-owned communications infrastructure in excavation projects where the City has determined that it is both financially feasible and consistent with the City's long-term goals to develop the City's communications infrastructure." The ordinance accomplishes this by (1) requiring all municipal utilities to take communications infrastructure into account in their planning process and (2) establishing a process for the Department of Technology (DT) to participate in utility excavation. The Department of Public Works (DPW) can only approve an application for an excavation permit if the applicant includes communications facilities that meet DT specifications, or if DT has opted out of the excavation project. *See generally* http://sfgov.org/dt/dig-once.

Santa Monica, California

One of the most successful "dig once" policies in the United States adopted in 1998, reducing the cost of laying fiber by coordinating fiber and conduit installation with other capital projects or in joint trenching with other entities. See generally http://www.smcitynet.com; also http://www.qcode.us/codes/santamonica/index.php?topic=7-7_06&expand=1.

Boston, Massachusetts

The city of Boston has implemented a "Joint Build Policy," in which the first company to request a trench takes a lead role, inviting other companies to add additional empty (or "shadow") conduits for future use by either the city of Boston or a later entrant. See generally FHWA Policy Brief "Minimizing Excavation Through Coordination," https://www.fhwa.dot.gov/policy/otps/policy_brief_dig_once.pdf (Oct. 2013).

Chicago, Illinois

The city of Chicago seeks to inexpensively deploy excess conduit when streets are opened for other infrastructure and public works projects. See Connecting America: The National Broadband Plan, p. 114 (March 17, 2010) (found at https://www.fcc.gov/general/national-broadband-plan).

Akron, Ohio

When Akron was deploying facilities and conduit to support its public safety network, it shared those facilities with OneCommunity, a northeast Ohio public-private partnership that aggregates demand by public institutions and private broadband service providers. As a result of that coordination, those same facilities and conduits now support health care institutions, schools and Wi-Fi access in Akron. See Connecting America: The National Broadband Plan, pp. 114-115 (March 17, 2010) (found at https://www.fcc.gov/general/national-broadband-plan).

Lawrence, Kansas

The City of Lawrence, Kansas, has expanded its network infrastructure by installing fiber or conduit to support important internal needs, or in concert with a private partner. The city engineer and IT department have developed a well-functioning process to take advantage of capital improvement projects in the rights-of-way to place conduit, and the city engineer reports that the incremental cost of the conduit placement has been negligible relative to the broader cost of the capital improvement project. See Gigabit Communities, Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community p. 36 (2014) (found at http://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf).

Arlington, Virginia

The "ConnectArlington" project has coordinated with public works construction and the electric utility's fiber construction. The project has placed fiber during construction of public safety backhaul fiber to radio towers and during installation of fiber connections to traffic signals. See Gigabit Communities, Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community pp. 38-39 (2014) (found at http://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf).

Centennial, Colorado

The City of Centennial, Colorado collaborates with entities that are undertaking construction projects in the city. Each opportunity is evaluated as a means to extend city-owned fiber and conduit in new routes. As a result of this strategy, the city has successfully built hundreds of miles of fiber and conduit at relatively low cost. See Gigabit Communities, Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community p. 39 (2014) (found at http://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf).

Hong Kong

This notification strategy has been successful in the City of Hong Kong, where private providers that open a road or sidewalk to build infrastructure are required to notify all other fixed service providers, including their competitors. Those entities are then provided with a set time interval in which they can place their own underground infrastructure. Once construction is complete, a multi-year moratorium along the path reduces disruption and wear-and-tear to the rights-of-way—and simultaneously incenting private carriers to place conduit efficiently and promptly while the road is open. See Gigabit Communities, Technical Strategies for Facilitating Public or Private Broadband Construction in Your Community p. 40 (2014) (found at http://www.ctcnet.us/wp-content/uploads/2014/01/GigabitCommunities.pdf).

Illinois

Illinois State Government started formal statewide "dig once" policies in 2009. Beginning in 2009 Illinois Department of Transportation began working under legislative authority to work with other state agencies for a statewide fiber conduit network. See http://www.ilga.gov/legislation/ilcs/fulltext.asp?DocName=060500050K9-131. IDOT, Illinois Tollway and others now provide leadership, working with Illinois Broadband Deployment Council, to compile "dig once" best practices, draft ordinances and other resources to help county and city agencies, and to recommend training programs assisted by regional planning agencies and utility engineering specialists. See http://www.broadbandillinois.org/news/181.

Colorado

Colorado state statutes, particularly, C.R.S. 38-5.5-109, contains some procedures for addressing joint trenching in connection with broadband provider operations in the Rights of Way, at the present there is no comprehensive mechanism nor legal requirement that all public and commercial entities coordinate Excavation in the Rights of Way, and construct Facilities in newly developed areas to minimize future Excavations.

Appendix F: Office of Broadband Development Statutory Charges/KPI

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.	Statute 237.012
The top five states of the United States for broadband speed universally accessible to residents and businesses	Statute 237.012
The top five states for broadband access	Statute 237.012
Rank among top 15 when compared to countries globally for broadband adoption	Statute 237.012
Encourage, foster, develop, and improve broadband within the state	Statute 116J.39
Drive job creation, promote innovation, and expand markets for Minnesota businesses	Statute 116J.39
Serve the ongoing and growing needs of Minnesota's education systems, health care system, public safety system, industries and businesses, governmental operations, and citizens	Statute 116J.39
Improve accessibility for underserved communities and populations	Statute 116J.39
Serve as the central broadband planning body for the state of Minnesota	Statute 116J.39
Coordinate with state, regional, local, and private entities to develop, to the maximum extent practicable, a uniform statewide broadband access and usage policy	Statute 116J.39
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	Statute 116J.39
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	Statute 116J.39
Develop, coordinate, and implement the state's broadband infrastructure development program under section 116J.391	Statute 116J.39
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	Statute 116J.39
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	Statute 116J.39
Monitor the broadband development efforts of other states and nations in areas such as business, education, public safety, and health	Statute 116J.39

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	Statute 116J.39
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	Statute 116J.39
Provide logistical and administrative support for the Governor's Broadband Task Force	Statute 116J.39
Provide an annual report	Statute 116J.39
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	Statute 116J.39
Perform an analysis of current availability and use of broadband, including average broadband speeds, within the state	Statute 116J.39
Analysis of actual speeds and unmet need for schools, libraries, hospitals, and public safety facilities	Statute 116J.39
Analysis of incumbent broadband infrastructure within the state and its ability to spur economic development	Statute 116J.39
Analysis of the degree to which new, additional, or improved broadband infrastructure would spur economic development in the state	Statute 116J.39
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	Statute 116.J.391
Develop a strategy to facilitate the timely and efficient deployment of broadband conduit or other broadband facilities on state-owned lands and buildings	Statute 116.J.391
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.	Statute 116.J.391
Administer the Border-to-Border Broadband Development Grant Program	Statute 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 116.J.396

Appendix G: 2016 Broadband Task Force Meetings

Meeting Date	Topic	Location
February 3, 2016	Legislative panel, 2016 planning	DEED – James J. Hill Conference Room
March 17, 2016	Drivers of broadband adoption	Ramsey County/St. Paul Workforce Center
April 14, 2016	Cybersecurity	Target Cybersecurity Center, Brooklyn Park, MN
May 24, 2016	Emerging technologies that use broadband 1: Business and Consumers	CommScope, Shakopee, MN
June 15, 2016	Office of Broadband Development operating fund	Minnesota Senate Office Building-Room 2308
July 6, 2016	Emerging technologies that use broadband 2: Government	Minnesota Senate Office Building-Room 2308
August 17, 2016	Barriers to broadband adoption: Affordability	Minnesota Senate Office Building-Room 2308
September 7, 2016	Streamlined state regulation for expanding broadband deployment	Minnesota Senate Office Building-Room 2308
October 5, 2016	Draft report 1	Minnesota Senate Office Building-Room 2308
November 2, 2016	Draft report 2	Minnesota Senate Office Building-Room 2308
December 15, 2016	Finalize report	Minnesota Senate Office Building-Room 2308

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

Appendix H: Letters from Stakeholders

3/11/2016
5th grade
Sophia Stading

How to put Wifi on buss

Dear Mr. Beert I would like to change Something on buss to get wifi on buss let Me tell you why.

I think buss Should have Wifi Because all are things for School are on the internet And we boys and girls have Homework they can not get it done on buss Because they do not have wifi and wifi will give them the time to get there home work done.

Another reason to have wifi on buss Because the country people mite not have very good wifi So if they do not get there homework done and if there was wifi they could do there homework done of the bus.

How we can change this is to raise money like a fundraser to provied the money that we need to put Wifi on buss

Sincerely

Sophia Stading

October 3, 2016

Margaret Anderson Kelliher
Chair, Governor's Broadband Task Force
St. Paul, MN

Dear Chair Anderson Kelliher:

Our organizations represent a broad cross-sector of statewide and community interest groups – schools, economic development, and local government. This letter is built on the priorities that our group has discussed based on our knowledge of our community opportunities and challenges and our observations about broadband trends. We strongly urge the task force to consider our priorities as you develop and adopt recommendations for legislative and executive branches and help policy leaders understand the central role that robust broadband plays in rural community vitality.

Our priorities are:

1. **Fund the Office of Broadband**

The Office of Broadband is a visible sign that improving broadband networks and services – Border-to-Border – is a shared and non-partisan priority for Minnesota. The Minnesota legislature charged the office with a long list of important goals critical to the well-being and economic prosperity of all Minnesotans. These include to:

- drive job creation, promote innovation, and expand markets for Minnesota businesses;
- serve the ongoing and growing needs of Minnesota's education systems, health care system, public safety system, industries and businesses, governmental operations, and citizens; and
- improve accessibility for unserved and underserved communities.

The OBD must be adequately resourced to accomplish those important goals. Accordingly, we urge the Task Force to again include, as it did in its 2015 report to the legislature, a recommendation to create an Office of Broadband operating fund to advance and support programs and projects aimed at promoting broadband adoption and use.

2. **Fund the Border-to-Border Broadband Fund**

Creating the partnerships, plans, financial models, engineering, and market information necessary to submit an application for funding requires long timelines and sustained efforts and is costly to all project partners – local governments and providers alike. Increased funding as well as sustained funding from year to year is necessary for good planning. Funding uncertainty creates disincentives for applicants weighing the costs/benefits of mounting the considerable efforts needed to craft successful and impactful projects.

We urge the Task Force to again include in its 2016 report a recommendation that the legislature allocate $100 million to the border-to-border broadband fund. Additionally, we urge the Task Force to recommend that the legislature explore options for putting the fund on a more sustainable and predictable footing.

3. **Fix the Border-to-Border Broadband Fund**

We believe that there are a number of policy elements with a significant negative impact that are slowing down the process and discouraging some communities from applying. This bottleneck may not only hinder disbursement of the 2016 allotment of $35 million, but may give policymakers the wrong impression that funds are neither needed nor desired by the target communities.

First, the challenge process is vague and overly protective of incumbent providers that are not delivering broadband consistent with state speed goals in rural Minnesota. Though official information is not yet available, the word among applicants is that nearly all applications have generated challenge letters from incumbent providers. With no remedy for obstructive challenges, the net result of the current challenge process has been to create confusion and uncertainty, which in turn has discouraged and stifled prospective applications.

Second, providers that challenge projects are not required to commit, in writing with financial guarantees, to deploying equal or better broadband to that proposed by grant applicants within specific, enforceable timeframes. With Gigabit broadband increasingly common, it is not in the public interest to prevent community leaders and their competitive provider partners from submitting projects that will provide better service than the incumbent would provide after using the challenge process. The challenge process should revert to its original form as adopted when the grant program was created that allows conversations to happen among providers while allowing the Office of Broadband flexibility.

Third, in a competitive grant environment, all grant funds should be used to deliver broadband services that are transformative, not incrementally better than what exists today. At a minimum, all networks funded should be able to reach the 2026 goal of 100 Mb/20 Mb when installed.

Fourth, Minnesota's commitment to "border-to-border broadband" means that we must find a way to bring broadband even to the most difficult to serve areas of our state. Financial models and experience show that even with a 50 percent grant, some areas will not provide adequate cash flow to pay for debt service and operations. The grant program guidelines should be made flexible enough so that state grants could exceed 50 percent of project costs.

Thank you for your consideration of our recommendations. A representative of our Broadband Coalition plans to participate in the public comment portion of the October broadband task force meeting.

Sincerely,

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