MINNESOTA GO

Planning Minnesota's
Transportation Future

# WEB ACCESS AND TECHNOLOGY TREND ANALYSIS

# CONTENTS

## SUMMARY

In today's digital age, the internet is a necessity. It connects people, educates, creates jobs and makes travel safer. However, many places in the United States, particularly in rural and economically depressed areas, have inconsistent internet and cellular service. Many homes and businesses do not have a fixed high-speed internet connection (also called broadband). These disparities leave people behind as many higher-paying jobs require a high-speed internet connection. Though some people substitute cellular wireless for a high-speed internet connection, this is not a long-term solution.

Lack of reliable high-speed internet creates access barriers in many different areas. Without reliable high-speed internet, health providers in underserved communities cannot use electronic health records or telemedicine to help treat patients. Banking, telecommunications, e-commerce, entertainment and online classes are limited or inaccessible. Access to customers and suppliers around the world are highly reliant on broadband infrastructure. Transportation systems and services use internet-based applications to improve mobility and increase safety for all. If these barriers are not addressed, the digital divide will grow. Viewing broadband access as an essential service will increase quality of life for all Minnesotans.

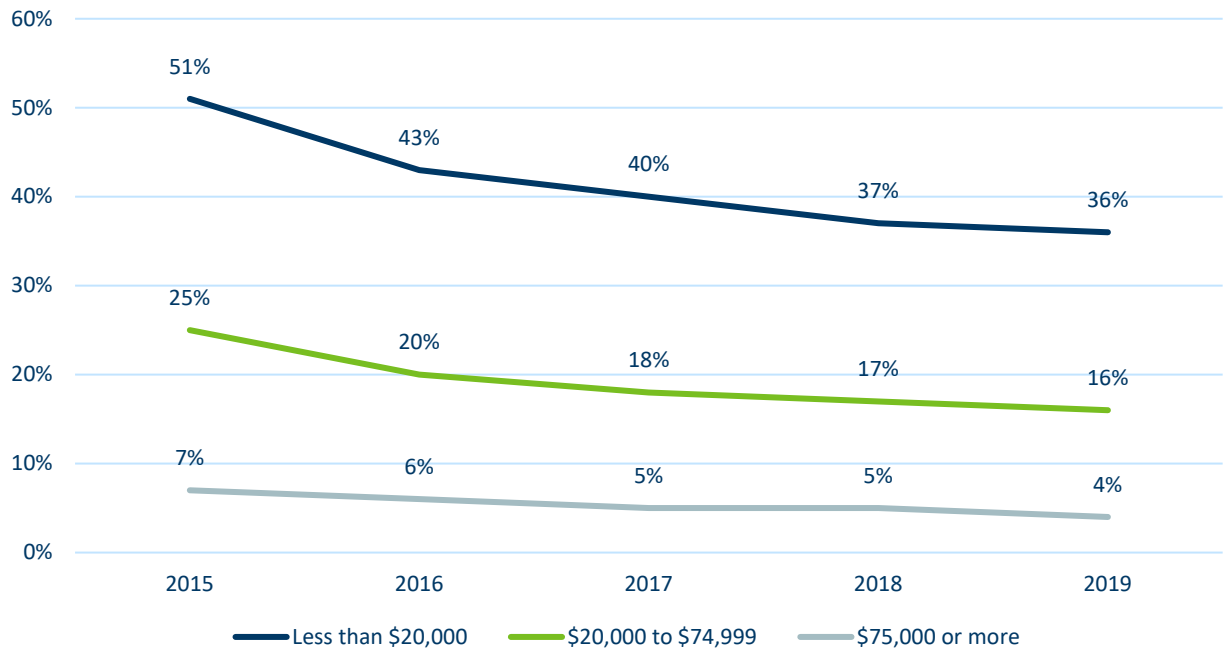
There have been legislative efforts at the federal, state and local levels to promote greater high-speed internet access. Many states have allocated resources to address access gaps and some local governments have prioritized building and implementing broadband infrastructure and providing public Wi-Fi to citizens. A combination of fiber optic infrastructure for broadband and the deployment of wireless 5G small cells on existing structures will help to connect more people regardless of location or existing coverage.

## BROADBAND AND INTERNET ACCESS NATIONALLY

Broadband refers to physical infrastructure that allows for a minimum of 25 megabits per second (Mbps) downloading and 3 Mbps uploading.[1] In practical terms, you can stream Netflix or YouTube on one or two devices without buffering delay.[2] The Federal Communications Commission (FCC) uses fixed broadband as the standard for hosting reliable and fast internet. A basic internet subscription is necessary to enable a broadband connection, which is quickly becoming a necessity for businesses and individuals alike. However, the cost of a basic internet subscription is a hurdle for many. Figure 1 shows that U.S. households without an internet subscription are primarily low income. In 2015, 51% of households making less than $20,000 annually did not have an internet subscription. By 2019, the percentage of households making less than $20,000 annually with no internet subscription dropped to 36%.

[1] Federal Communications Commission, "2019 Broadband Deployment Report," May 29, 2019. https://docs.fcc.gov/public/attachments/FCC-19-44A1.pdf (accessed August 31, 2020).
[2] Broadband Now, "How Much Internet Speed do I Need?" https://broadbandnow.com/guides/how-much-internet-speed-do-i-need (accessed August 31, 2020).

Figure 1: Percentage of United States households without an internet subscription by income level[3]




There are several key factors that contribute to whether someone can easily access an internet subscription and/or a broadband connection. A 2019 Brookings Institution study found that household income, race, share of rural population and education were the key determinants in access to internet.[4] Some people substitute cellular wireless for an internet subscription at home. The FCC sees cellular wireless as a complement to fixed broadband—a temporary connection since it is less reliable. There can be coverage gaps for cellular service and often customers run into strict data cap issues. This can make wireless an expensive option if used as a primary broadband solution.

In 2020, the FCC estimated that 85% of Americans now have a fixed broadband connection. This is a 47% increase since 2017. This progress can be attributed partially to an estimated $70 to $80 billion investment in network infrastructure by the broadband industry[5] in 2018. This investment is the highest annual amount in the past decade. In July 2021, the FCC announced that it will authorize $311 million in broadband funding across 36 states through the Rural Digital Opportunity Fund. This will allow 48 broadband providers to bring 1 Gbps broadband speeds to nearly 200,000 homes and businesses over the next ten years.[6] In August 2021, Congress passed the Infrastructure Investment and Jobs Act (IIJA) which included $65 billion for broadband infrastructure. This

[3] United States Census Bureau, "Types of Computers and Internet Subscriptions," American Community Survey 1-Year Estimates 2015-2019, (S2801), https://data.census.gov/cedsci/table?text=Internet&t=Telephone,%20Computer,%20and%20Internet%20Access&tid=ACSST1Y2015.S2801&hidePreview=false (accessed April 28, 2022).
[4] Lara Fishbane and Adie Tomer, "Broadband Adoption is on the Rise, but States Can do Much More," *Brookings Institute*, October 10, 2019. https://www.brookings.edu/blog/the-avenue/2019/10/10/broadband-adoption-is-on-the-rise-but-states-can-do-much-more/ (accessed August 31, 2020).
[5] Federal Communications Commission, "New FCC Report Shows Digital Divide Continuing to Close," *FCC News*, April 24, 2020. https://docs.fcc.gov/public/attachments/DOC-363985A1.pdf (accessed August 31, 2020).
[6] Federal Communications Commission, "FCC makes available over $311 million for broadband in 36 states, while taking steps to clean up the rural digital opportunity fund program," July 26, 2021, DOC-374406A1.pdf

included about $42 billion in grants directly to states, $685 million for the State Digital Equity Capacity Grant Program and $625 million for the Digital Equity Competitive Grant Program.[7]

### COVID-19 AND WEB ACCESS

The COVID-19 pandemic highlighted gaps in broadband and Wi-Fi coverage. The majority of individuals who transitioned to a work from home status during the pandemic earn higher incomes. Sixty-two percent of workers earning in the top 25% of salaries are working from home. In contrast, only 9% of workers earning wages in the bottom 25% say they can work from home.[8]

Public school students were not so fortunate. In April 2020, U.S. teachers reported that fewer than half of their students were able to participate regularly in online classes.[9] In March of that year, the FCC asked private broadband companies to open public Wi-Fi networks, waive late fees and temporarily stop disconnecting individuals.[10] Comcast and AT&T were among several companies that made their Wi-Fi public for the remainder of the 2020 school year.[11]

The FCC also provided the Emergency Broadband Benefit, which was designed to help families and households struggling to afford internet service during the COVID-19 pandemic. The program provided a $50 per month internet service discount and up to $75 per month for households on qualifying Tribal lands. It also provided a one-time discount of up to $100 to purchase a computer or tablet. The Emergency Broadband Benefit was replaced with the Affordable Connectivity Program in December 2021. That program provides $14 billion for broadband affordability to continue to ensure internet connections are affordable for work, school, health care and more.[12]

## BROADBAND AND INTERNET ACCESS LOCALLY

The Minnesota Legislature established statewide targets for broadband expansion through 2026. By 2022, the state wants all Minnesota businesses and households to have access to high-speed broadband—at least 25 Mbps. As of October 2021, 92% of Minnesota households met the 2 5 Mbps standard.[13] By 2026, the state of Minnesota wants all businesses and households to access a broadband provider with at least 100 Mbps.[14] In October 2021,

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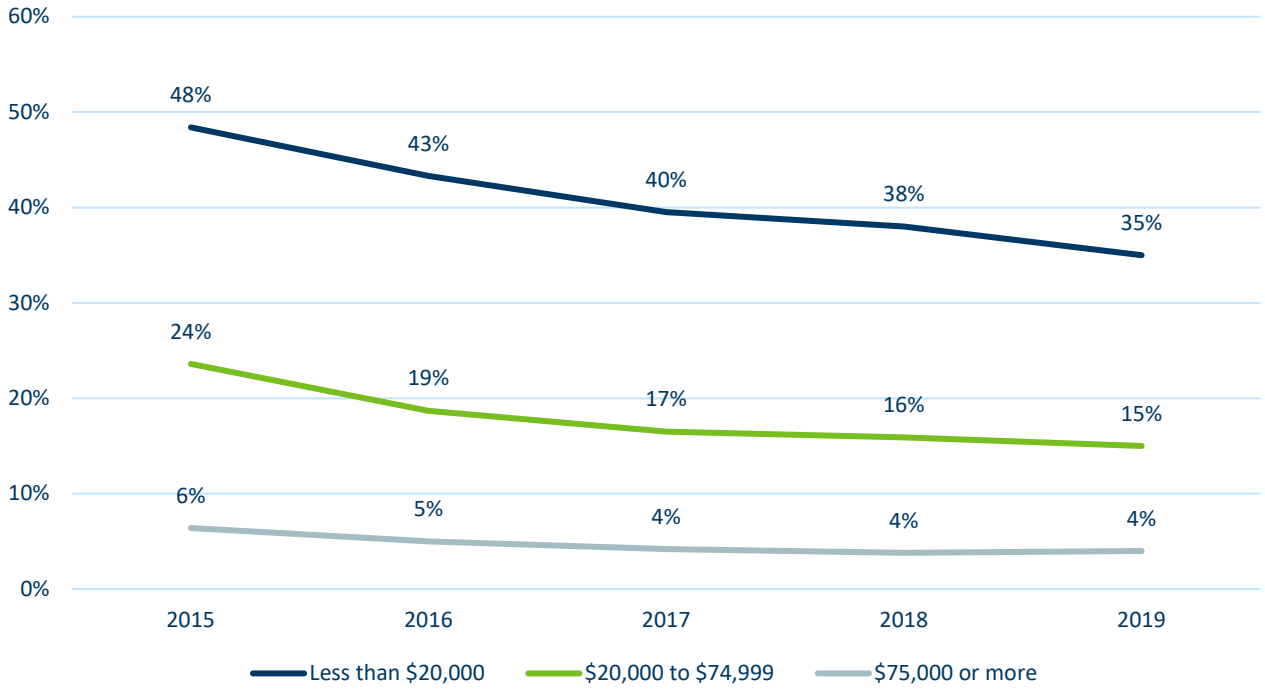
[7] Thomas Curtin, Richard Lukas and Alex Whitaker, "Senate Passes Bipartisan Infrastructure Package," *National Governors Association*, August 11, 2021, https://www.nga.org/news/commentary/senate-passes-bipartisan-infrastructure-package/.
[8] Katherine Guyot and Isabel Sawhill, "Telecommuting Will Likely Continue Long After the Pandemic," *Brookings Institute*, April 6, 2020. https://www.brookings.edu/blog/up-front/2020/04/06/telecommuting-will-likely-continue-long-after-the-pandemic/ (accessed August 31, 2020).
[9] Dana Goldstein, Adam Popescu, and Nikole Hannah-Jones, "As School Moves Online, Many Students Stay Logged Out," *New York Times*, April 8, 2020. https://www.nytimes.com/2020/04/06/us/coronavirus-schools-attendance-absent.html (accessed August 31, 2020).
[10] Federal Communications Commission, "Commissioner Rosenworcel on Broadband Companies' Pledge to Keep Americans Connected: This is a Good Start, but We Need to Do More," *FCC News*, March 13, 2020. https://docs.fcc.gov/public/attachments/DOC-363036A1.pdf (accessed August 31, 2020).
[11] Associated Press, "U.S. Providers Offer Free Wifi for 60 Days," *Fortune*, March 14, 2020. https://fortune.com/2020/03/14/free-public-wifi-coronavirus/ (accessed August 31, 2020).
[12] Federal Communications Commission, Office of Consumer and Governmental Affairs, "Emergency Broadband Benefit," December 20, 2021, https://www.fcc.gov/broadbandbenefit.
[13] Minnesota Department of Employment and Economic Development, "Estimate of Wireline Broadband Service Availability in the State of Minnesota by Speed Combinations," *Connected Nation*, October 2021. https://mn.gov/deed/assets/household-bb-various-speeds_tcm1045-297687.pdf (accessed December 27, 2021).
[14] Minnesota Department of Employment and Economic Development, "Minnesota Broadband Goals," under *Office of Broadband Development*, https://mn.gov/deed/programs-services/broadband/goals/ (accessed September 1, 2020).

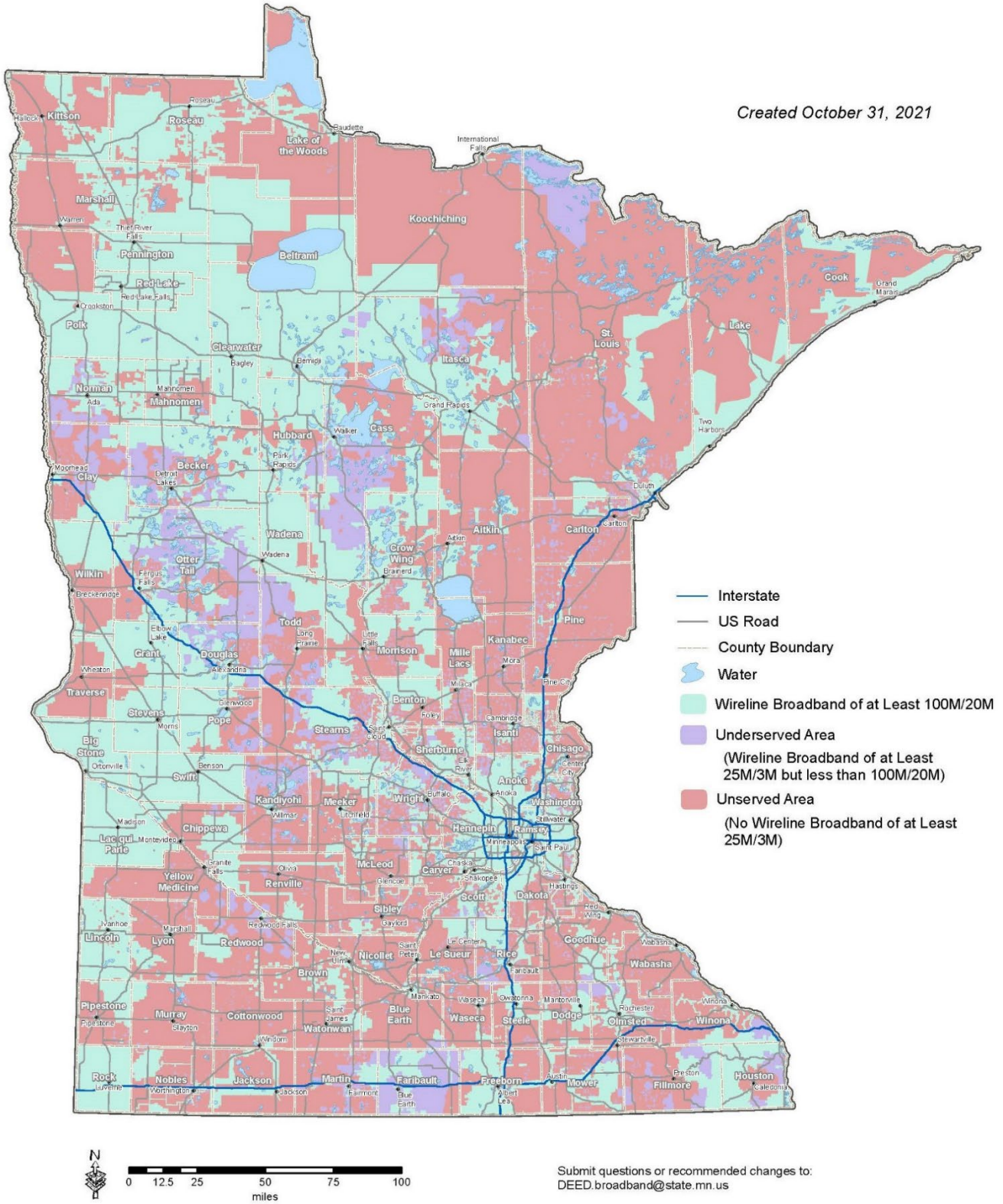
89% of Minnesota households met the 100 Mbps standard.[15] Figure 2 shows the percentage of Minnesota households without an internet subscription by income level between 2015 and 2019. Figure 3 shows areas unserved, underserved and served by broadband in Minnesota as of October 2021.

Figure 2: Percentage of Minnesota households without an internet subscription by income level




[15] Minnesota Department of Employment and Economic Development, "Estimate of Wireline Broadband Service…," https://mn.gov/deed/assets/historic-bb-various-speeds_tcm1045-297688.pdf. Accessed April 27, 2022.

Figure 3: Unserved, underserved and served broadband areas in Minnesota, 2021[16]




[16] Minnesota Department of Employment and Economic Development, "2021 Provider Broadband Service Inventory," https://mn.gov/deed/assets/infrastructure-grant_tcm1045-134198.pdf. Accessed April 27, 2022.

Currently, Minnesota funds broadband infrastructure through a variety of means including state grant programs, federal funding and non-profits. Minnesota's Border-to-Border Broadband Grant Program has provided over $126 million toward 179 projects since 2014.[17] Recent federal funding includes $180.7 million from the American Rescue Plan Act Capital Projects Fund of which $70 million has been appropriated to Border-to-Border by the Minnesota Legislature. An additional amount of federal funding is expected as part of the Infrastructure Investment & Jobs Act's Broadband Equity, Access and Deployment Act.[18]

Non-profits, such as the Blandin Foundation in Minnesota, provide grants, technical resources, lobby legislators and conduct feasibility studies to attract investment.[19, 20] The Blandin Foundation estimates that broadband access drives an additional $1,850 in household economic benefits annually,[21] including a 3% increase in home values.[22]

In 2013, the Minnesota Legislature enacted a policy to have the MnDOT alert broadband providers of upcoming construction projects so that broadband infrastructure can be coordinated with MnDOT construction work.[23] MnDOT manages more than 14,000 roadway miles across the state, which creates opportunities to expand broadband.[24] Within the public right-of-way, broadband infrastructure like conduit and fiber optic cables can be installed. Figure 4 shows fiber optic cable being installed on a roadway in Colorado.[25]

[17] Minnesota Department of Employment and Economic Development, "Progress Toward Minnesota's Broadband Goals," https://mn.gov/deed/assets/2022-broadband-budget-acc_tcm1045-519475.pdf. Accessed April 27, 2022.
[18] Ibid.
[19] Anne Stauffer and Kathryn de Wit, "How States are Expanding Broadband Access," *Pew Research Center*, February 27, 2020. https://www.pewtrusts.org/en/research-and-analysis/reports/2020/02/how-states-are-expanding-broadband-access (accessed August 31, 2020).
[20] Blandin Foundation, "Robust Network Feasibility Fund Grants,"under *Broadbabnd,* https://blandinfoundation.org/programs/expanding-opportunity/broadband/robust-network-feasibility-fund-grants/ (accessed August 31, 2020).
[21] Blandin Foundation, "Blandin on Broadband: Making the Case," https://blandinonbroadband.org/bbroi/ (accessed August 31, 2020).
[22] Fiber Broadband Association, "Study Shows Home Values Up 3.1% with Access to Fiber," June 29, 2015. https://www.fiberbroadband.org/blog/study-shows-home-values-up-3.1-with-access-to-fiber (accessed August 31, 2020).
[23] Minnesota Department of Transportation, "Minnesota Broadband Initiative: Planning Tools for Broadband Providers," http://www.dot.state.mn.us/broadband/ (accessed September 1, 2020).
[24] Minnesota Department of Transporation, "MnDOT Transportation Asset Management Plan," under *Asset Management*, http://www.dot.state.mn.us/assetmanagement/tamp.html (accessed September 1, 2020).
[25] Colorado Department of Transportation, "CDOT Completes Fiber Optic Installation on US 160 East of Wolf Creek Pass," under *2017 News,* https://www.codot.gov/news/2017-news/september/cdot-completes-fiber-optic-installation-on-us-160-east-of-wolf-creek-pass-1 (accessed September 1, 2020).

Figure 4: Colorado Department of Transportation installation of fiber optic cable during a mill and overlay project


Native American reservations have significant gaps in broadband service. Reservations nationally lag behind even the rural broadband adoption rates. American Community Survey's 2015 to 2019 data show that the average share of households with home internet in tribal areas is 66% compared to 87% for neighboring non-tribal areas.[26] In Minnesota, the Fond du Lac Band of Lake Superior Chippewa became their own broadband provider.[27] Aaniin, the Ojibwe word for 'hello,' launched in 2018. All businesses and homes on the 39,000-acre reservation are eligible for a free broadband connection, but must subscribe to the monthly Wi-Fi service.

## ALTERNATIVES TO TRADITIONAL FIXED BROADBAND CONNECTIONS

The FCC includes mobile internet under the broadband umbrella. However, the agency does not believe that this service is an adequate substitute for fixed at-home broadband.[28] Fixed home broadband provides consistent connection, faster speeds and higher download limits. Mobile internet on a smartphone is seen as a complement to fixed broadband and is best used as a temporary means of internet connection.

Despite the FCC's position, studies show that mobile internet is sometimes sufficient for some. Pew Research Center found a growing number of non-broadband users cite that their smartphone is an adequate substitute for at-home broadband. From 2015 to 2019, the percentage grew from 12% to 23%. Also, the percentage of those

[26] Federal Reserve Bank of Minneapolis, "Center for Indian Country Development research reveals depth of tribal digital divide," September 1, 2021. https://www.minneapolisfed.org/article/2021/center-for-indian-country-development-research-reveals-depth-of-tribal-digital-divide (accessed April 27, 2022).
[27] Aaniin, "About Us," http://www.aaniin.net/aboutus.html (accessed September 1, 2020).
[28] Federal Communications Commission, "2018 Broadband Deployment Report," February 2, 2018.

who said the cost of a monthly internet subscription and computer were the primary reasons for not having at-home broadband declined from 43% to 27%.[29]

The trend of forgoing at-home broadband for smartphone internet may make it easier for states and the federal government to connect everyone. The performance gap between mobile internet and at home broadband service is narrowing. 5G wireless promises to bridge the gap. 5G operates with low lag time and the largest capacity of any mobile wireless connection ever. It is 25 times faster than 4G wireless.[30, 31] At present, 5G download speeds are between 400 and 500 Mbps—16 to 20 times faster than the broadband standard of 25 Mbps.[32] This would allow full-length movies to download in seconds and support connected vehicles using roads and bridges. These speeds are only available in certain areas. 5G wireless providers are rapidly expanding their 5G capability, with 5G networks in aggregate now covering the majority of the country's population, especially in urban areas. They are still planning more live launches nationwide.[33]

5G is more flexible than fiber optic cables. At present, most broadband relies on digging trenches to lay cable (see Figure 4). Once a connection is established, the fiber is dependable. On average, fiber optic infrastructure deployment costs between $18,000 and $22,000 per mile.[34] 5G is not measured in miles of wires. Instead, 5G relies on a dense network of wireless devices attached to buildings, streetlights and poles.[35] Together, the devices create coverage. The range of a single device is 250 to 500 feet.[36] 5G devices save costs because there is no fiber, power distribution or trench digging costs. The actual cost of a device can vary based on geography, existing capacity and cell type.[37] Generally, the study found 5G deployment to be cheaper per user in urban areas as compared to users in rural areas. The future is likely a mix of fiber optic and wireless 5G small cells reinforcing each other.

## STATE DOTS AND GOVERNMENT ROLES

State and local transportation agencies are exploring how they could support the growth of traditional broadband connections and 5G. Many cities, such as the City of Portland, have established permitting guidelines for wireless companies deploying cell towers and 5G cells on streetlights and in the public right-of-way.[38] 5G is also being

[29] Monica Anderson, "Mobile Technology and Home Broadband 2019," *Pew Research Center*, June 13, 2019. https://www.pewresearch.org/internet/2019/06/13/mobile-technology-and-home-broadband-2019/ (accessed September 1, 2020).
[30] Verizon, "5G," https://www.verizon.com/5g/?cmp=KNC-C-HQ-PRO-R-NB-NONE-NONE-2K0PX0-PX-GAW-71700000060148468&gclid=Cj0KCQjwpNr4BRDYARIsAADIx9wDMdIgXmD3biIEjwqHObcNzoebaf-EVOAaaLc6wZz94saiIc-IQ2MaAnCGEALw_wcB&gclsrc=aw.ds
[31] 99% of the United States population has 4G LTE coverage based on 2019 US Census data. Verizon, "4G LTE," https://www.verizon.com/about/our-company/wireless-network (accessed September 1, 2020).
[32] Bob O'Donnell, "How Fast Will 5G Really Be?" *Forbes*, November 19, 2019. https://www.forbes.com/sites/bobodonnell/2019/11/19/how-fast-will-5g-really-be/#1113ddec5cf3 (accessed September 1, 2020).
[33] Federal Communications Commission, "2020 Broadband Deployment Report," April 24, 2020, FCC-20-50A1.pdf.
[34] OTELCO, "Lightwave Fiber Infrastructure: Where, When, Why, and How," June 1, 2018. https://www.otelco.com/fiber-infrastructure/#:~:text=Making%20the%20Connection%20to%20the,and%20%24750%20per%20average%20location. (accessed September 1, 2020).
[35] Federal Communications Commission, "FCC Facilitates Wireless Infrastructure Deployment for 5G," September 27,2018. https://www.fcc.gov/document/fcc-facilitates-wireless-infrastructure-deployment-5g (accessed September 1, 2020).
[36] Larry Thompson and Warren Vande Stadt, "5G is Not the Answer for Rural Broadband," *Broadband Communities Magazine*, March/April 2017. https://www.bbcmag.com/rural-broadband/5g-is-not-the-answer-for-rural-broadband (accessed September 1, 2020).
[37] Edward J. Oughton, Zoraida Frias, Sietse van der Gaast, and Rudolf van der Berg, "Assessing the Capacity, Coverage and Cost of 5G Infrastructure Strategies: Analysis of the Netherlands," *Telematics and Informatics* 37, (April 2019): 50-69.
[38] City of Portland, "Vertical Infrastructure in the Public Right-of-Way," *Portland Bureau of Transportation*, https://www.portlandoregon.gov/transportation/78507 (accessed September 1, 2020).

incorporated into connected and automated vehicles (CAV) and roadway infrastructure. These roadway networks are often referred to as connected corridors. The corridors support communications infrastructure and vehicle-to-Infrastructure (V2I) technology that allow the exchange of information between vehicles and equipment at intersections.[39]

It is important to consider that there have been concerns associated with 5G. The National Oceanic and Atmospheric Administration raised concerns that 5G frequencies may affect the accuracy of their forecasts, leading to reduction in accuracy by as much as 30%.[40] The Federal Aviation Administration has expressed concerns about 5G frequencies interfering with aircraft equipment that accurately measures how far an airplane is from the ground, allowing it to land safely even in poor visibility.[41]

## USING TECHNOLOGY TO ADDRESS INEQUALITIES AND IMPROVE TRAVELER SAFETY

State Departments of Transportation and transportation agencies can bridge the digital divide and use technology to help people travel safely. U.S. DOT has highlighted a variety of strategies that cities can explore to address inequalities[42]:

- Improving first-mile/last-mile[43] connections to transit through subsidized transportation network companies (TNCs),[44] car and bike share or autonomous shuttles.
- Expanding access to free public Wi-Fi on buses, taxis and parks.
- Developing specialized internet-based apps for non-English speakers and people with disabilities.
- Providing universal transportation payment cards for the unbanked[45] and subsidizing the use of a range of travel services by people with low incomes.

Some cities have applied these practices. Kansas City installed connected kiosks that provide transit tracking and information about nearby restaurants, public events and weather. The kiosks also translate information into various languages and individuals can call 911 from the locations.[46] These kiosks are useful for people without a smartphone. The Southeastern Pennsylvania Transportation Authority, which serves Philadelphia and surrounding

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[39] Minnesota Department of Transportation, "MnDOT Connected Corridor Initative," 2018. https://www.dot.state.mn.us/its/projects/2016-2020/connectedcorridors/conopssummary.pdf (accessed September 1, 2020).

[40] Eric Niller, "5G Networks Could Throw Weather Forecasting Into Chaos," *Wired*, May 17, 2019. https://www.wired.com/story/5g-networks-could-throw-weather-forecasting-into-chaos/ (accessed September 1, 2020).

[41] Federal Aviation Administration, "FAA Statements on 5G," January 3, 2022, https://www.faa.gov/newsroom/faa-statements-5g.

[42] United States Department of Transportation, "How We Grow Opportunity For All," under *Smart City*, https://www.transportation.gov/smartcity/how-we-grow-opportunity (accessed September 1, 2020).

[43] "First-Mile/Last-Mile" "Transportation trips can be understood as the entire journey from origin to destination – for example, to and from work, school, medical appointments, shopping or entertainment. Individuals often use multiple types of travel to complete the journey. They may walk, drive, ride a bicycle, take a bus or train, or in many cases combine a number of modes. While bus and rail services might cover the core of these trips, people often need to complete the first and last portion by other means. They must first walk, drive or use another method to get to and from the nearest station or stop." City of Richmond—California, "First Mile/Last Mile Transportation Strategic Plan," under *Transportation*, http://www.rtransit.com/3485/First-MileLast-Mile-Transportation-Strat (accessed September 1, 2020).

[44] "Transportation Network Companies" through a cellphone app, riders are paired with drivers who use personal, non-commercial vehicles to transport riders to a destination. Lyft and Uber are the most common TNCs.

[45] "Unbanked," "an informal term for adults who do not use banks or banking institutions in any capacity. Unbanked persons generally pay for things in cash or else purchase money orders or prepaid debit cards. Unbanked persons also typically do not have insurance, pensions, or any other type of professional money-related services." Investopedia, "Unbanked," under *Banking*, https://www.investopedia.com/terms/u/unbanked.asp (accessed September 2, 2020).

[46] Bobby Burch, "Kansas City's Smart City Taking Shape with Kiosks' Arrival," *Startland News*, March 7, 2016. https://www.startlandnews.com/2016/03/kansas-citys-smart-city-taking-shape-kiosks-arrival/ (accessed September 2, 2020).

communities, developed a universal transportation card that does not require a bank account to open.[47, 48] The card also acts as a reloadable pre-paid debit card. A user can set up direct deposit, withdraw money and make purchases with it.[49]

Public Wi-Fi is also popping up across the country. In 2010, The City of Minneapolis established 117 wireless hotspots for Minneapolis residents and businesses to connect to the internet for free.[50] The hotspots are strategically placed along corridors and in public places. The city coordinated with USI Wireless, a low-cost internet provider, to offer the service.[51] The City of Chattanooga, Tennessee, owns EPB, a telecommunications company that provides high quality and subsidizes internet to residents. The city-owned telecommunications company was the first U.S. company to offer 1 Gbit per second high-speed internet in 2010. In 2015, EPB began offering discounted rates to households with students who qualify for free or reduced-fee lunch.[52]

In July 2021, FHWA announced $60 million in grants to fund new technologies that improve transportation systems. For the first time, there is a new focus on racial equity, environmental justice and access to opportunity. This program also supports electric vehicle charging stations and other technologies to reduce emissions. The intention of these grant dollars is to encourage new technologies that will make transportation greener, improve job access and other opportunities. The grants provide funding to help states, local governments, transit agencies and metropolitan planning organizations implement advanced technologies at a large scale that can serve as national models, improve safety and reduce travel times.[53]

Preparing for a connected and automated transportation system will create new mobility options to connect residents to jobs, workforce training, education and healthcare. It is important to ensure that the benefits of technology reach everyone to reduce the digital divide.

## RELATED TRENDS

- Autonomous Vehicles
- Cyber Security and Big Data

Minnesota's vision for transportation is known as Minnesota GO. The aim is that the multimodal transportation system maximizes the health of people, the environment and our economy. A transportation vision for generations, Minnesota GO guides a comprehensive planning effort for all people using the transportation system and for all modes of travel. Learn more at MinnesotaGO.org.

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[47] Jim Saksa, "Can SEPTA Key Unlock Financial Services for the Underbanked?" *WHYY PBS NPR*, April 8, 2015. https://whyy.org/articles/can-septa-key-unlock-financial-services-for-the-underbanked/ (accessed September 2, 2020).
[48] Southeastern Pennsylvania Transportation Authority, "SEPTA Key FAQ: Buying a Key Card," http://www.septa.org/key/faq.html (accessed September 2, 2020).
[49] Jim Saksa, "Can SEPTA Key Unlock Financial Services for the Underbanked?" *WHYY PBS NPR*, April 8, 2015.
[50] City of Minneapolis, "Wireless Minneapolis During Coronavirus," under *Free Wireless Hotspots*, http://www2.minneapolismn.gov/wireless/index.htm (accessed September 2, 2020).
[51] City of Minneapolils, "Digital Inclusion," under *Information Technology Department*, http://www.minneapolismn.gov/it/inclusion/index.htm (accessed September 2, 2020).
[52] EPB, "Enrollment Underway for EPB NetBridge Student Discount Program," August 10, 2015. https://epb.com/about-epb/news/articles/43 (accessed September 2, 2020).
[53] Federal Highway Administration, "FHWA Announces $60 million for Transportation Technology Grants with Focus on Equity, Environment and Economic Opportunity," July 7, 2021, https://highways.dot.gov/newsroom/fhwa-announces-60-million-transportation-technology-grants-focus-equity-environment-and

# REVISION HISTORY

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|---|---|
| May 2022 | Original paper. |