CLOSING THE **DIGITAL DIVIDE**

Digital connections have become more important in a time of social distancing, but rural broadband access still lags behind cities'

By Tim Sablik

For better or worse, the internet has become increasingly indispensable to the way we connect with each other. In 2000, only about half of American adults were online; today, nine in 10 are. Yet despite living in the country where the internet was born, not all Americans have equal access to it.

Much of this gap is along geographic lines. According to the Federal Communications Commission (FCC), 98.5 percent of urban households have access to fast wired home internet, while only 77.7 percent of rural residents do. In many states, one doesn't need to travel far outside of metro areas to see stark differences in connectivity.

Virginia provides a good example of this contrast. Northern Virginia is home to the largest collection of data centers in the world, handling more than 70 percent of all internet traffic by data volume. Residents there and in other major metropolitan areas across the state enjoy easy access to speedy broadband networks. But for residents in more sparsely populated communities, options are more limited.

"From where I work in downtown Richmond, I could reach multiple communities that don't have broadband access in a 45-minute drive in any direction," says Evan Feinman, chief broadband adviser to Virginia Gov. Ralph Northam. "A significant majority of Virginia counties have unserved residents."

For families sheltering at home during the coronavirus pandemic, a reliable internet connection has become even more of a necessity. Businesses have asked workers to telecommute, schools have moved to online classrooms, and doctors have turned to telemedicine for nonemergency care, all in an effort to reduce person-to-person contact and slow the spread of the virus. Indeed, access to broadband may be crucial to enabling households to follow social distancing guidelines. A recent National Bureau of Economic Research working paper by Lesley Chiou of Occidental College and Catherine Tucker of the Massachusetts Institute of Technology's Sloan School of Management found that income and access to reliable home broadband played a role in whether or not households stayed home during the pandemic.

Having access to broadband is just one step to crossing the digital divide, though. Even if broadband service is available, low-income households may not be able to afford it, and lack of digital training can dissuade households from subscribing. These adoption barriers extend beyond the rural-urban divide, affecting households in cities as well as in the country. To the extent that social distancing measures persist or return in the future, closing the digital divide may be a more pressing concern now than ever before.

Mapping Need

For most of the 21st century, discussions of the digital divide have focused on expanding the availability of broadband, a catchall term for any high-speed internet connection. The FCC defines broadband as a connection with download speeds of at least 25 megabits per second (Mbps) and upload speeds of at least 3 Mbps. By all measures, the United States has made progress in expanding broadband access, but there is debate over just how much.

Since 2014, the FCC has required all broadband providers to report where they currently offer service or could provide it without an "extraordinary commitment of resources." According to the FCC's data, the gap between rural and urban areas in the availability of broadband has narrowed from 36.1 percentage points in 2014 to 20.8 percentage points in 2018, the latest year of data available. But everyone, including the FCC, acknowledges shortcomings with this data. The main problem is that broadband providers are only required to report whether they provide service at the census block level. In densely populated urban areas, census blocks may indeed be the size of a city block. But in rural areas, census "blocks" can cover thousands of square miles. As long as an internet service provider (ISP) has connected one customer in that census block, it can count the entire block as served, even if many households actually lack service.

"There are many areas that the FCC classifies as served, but when you meet with people in that community, they will say that they don't have broadband or that their connectivity is awful," says Robert Hinton,

chairman of the West Virginia Broadband Enhancement Council, which was created by the state legislature to oversee broadband issues.

The Pew Research Center has used surveys to track home broadband subscriptions since 2000, and their data also point to a persistent rural-urban divide. (See chart.) An accurate picture of which communities are unserved is important for determining which regions have the greatest need. It also plays a role in determining eligibility for federal subsidies to build broadband infrastructure.

The gap between rural and urban broadband infrastructure is largely an issue of profitability. Fiber-optic cables are the current gold standard for broadband because they enable the fastest speeds and largest data capacity, but building out a fiber network is expensive. Estimates vary, but the U.S. Department of Transportation placed the cost of building a new fiber network at around $27,000 per mile.

In densely populated cities, service providers can recoup these fixed costs more easily through a large subscriber base. But in sparsely populated rural locations, the cost of laying fiber can easily exceed the returns. Difficult terrain can further raise the costs of reaching remote places. West Virginia, which ranks 48th among states in terms of broadband access according to the FCC, faces challenges of both density and topography.

"Our terrain is beautiful, but when it comes to building infrastructure like broadband, it certainly is an impediment," says Hinton.

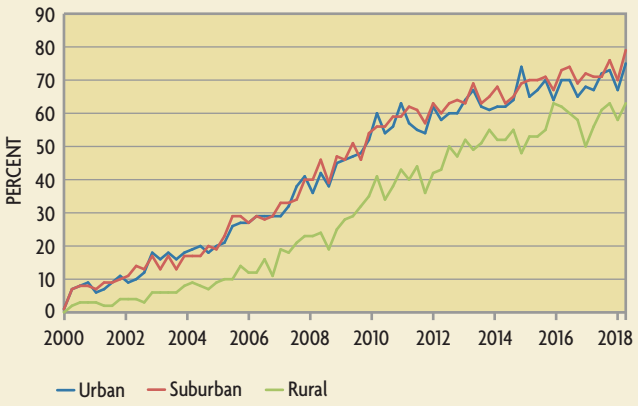
Policymakers at both the federal and state level have explored various ways to offset some of the cost of reaching unserved customers. At the federal level, this has mostly taken the form of infrastructure grants and subsidies. In January 2020, the FCC launched its Rural Digital Opportunity Fund, which sets aside $20 billion over the next decade to finance the construction of broadband networks in unserved rural areas. And in December 2019, the U.S. Department of Agriculture announced $600 million in funding for the ReConnect Program in the form of grants, loans, and grant/loan combinations to deploy rural broadband.

Nearly every state also has its own grants for broadband. For example, North Carolina's Growing Rural Economies with Access to Technology (GREAT) Program provides grants for broadband development in distressed communities from a $10 million pool. The Virginia Telecommunications Initiative has a budget of $19 million to provide grants for broadband projects.

Funding for subsidies is finite, however, which means policymakers need to know how to direct the money to where it will do the most good. To qualify for subsidies, firms need to show that they plan to build infrastructure in unserved areas — a challenge if service maps are inaccurate. In March 2020, President Donald Trump signed into law the Broadband Deployment Accuracy and Technological Availability Act, also known as the Broadband DATA Act, which requires the FCC to collect more granular data on broadband availability and create a process for consumers and ISPs to challenge coverage data that they believe is inaccurate. But it will take time for those data to be collected. Some states have decided not to wait.

The Rural-Urban Digital Divide

Percent of U.S. adults who are home broadband users



SOURCE: Pew Research Center

Feinman says that instead of relying on the FCC's maps, Virginia allows firms to apply for broadband infrastructure grants to build a network in any area that they believe is unserved. Incumbents in those regions then have an opportunity to submit a challenge and show that they do provide service in those locations. The threat of state-subsidized competition gives incumbents an incentive to disclose where they actually provide broadband service.

"While an accurate map would be beneficial to our efforts, we'll be able to achieve universal coverage without ever having generated a reliable Virginia coverage map," says Feinman.

Filling in the Middle

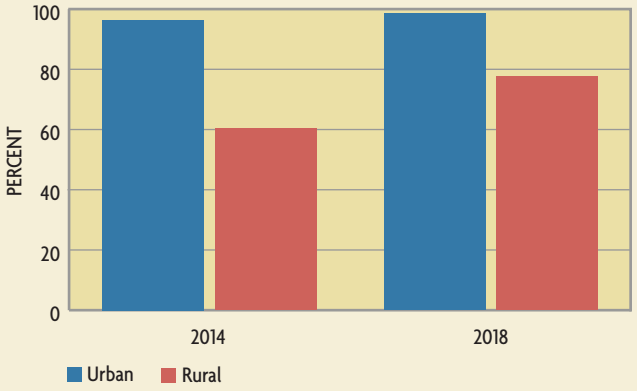
The gap in rural broadband coverage has often been framed as a "last mile" problem. Internet infrastructure can be broken up into three categories: backbone, middle mile, and last mile. While geography comes into play, these categories are more a description of the types of customers served. Backbone infrastructure is the high-capacity fiber that connects the large data centers that comprise the internet itself. Middle mile infrastructure runs between the backbone and last mile connections, which serve households and businesses.

In order to serve customers, ISPs need to build last mile connections to the nearest middle mile or backbone infrastructure. Those connections could be close or miles away, and that distance affects the total cost of closing the last mile.

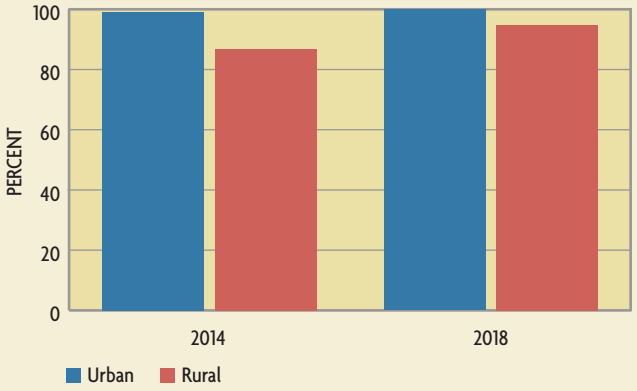
"If you're a company looking to provide service to a rural area, the upfront capital costs are the real barrier to doing that," says John Horrigan, a senior fellow at the Technology Policy Institute, a Washington, D.C., think tank that receives support from major tech and telecom firms. "If the government reduces that capital cost by building out

Digital Divide Narrows with the Inclusion of Mobile Wireless

Share of Households with Access to Wired Broadband



Share of Households with Access to Wired Broadband or Mobile LTE



NOTE: "Wired Broadband" refers to wired internet with download speeds of at least 25 Mbps and upload speeds of at least 3 Mbps. "Mobile LTE" refers to mobile wireless internet with median download speeds of at least 10 Mbps and upload speeds of at least 3 Mbps.

SOURCE: Federal Communications Commission, "2020 Broadband Deployment Report."

the middle mile infrastructure, that makes it much more attractive for private firms to come in and complete the last mile investment to serve customers."

Some states have spearheaded their own initiatives to improve the middle mile. In 2013, Maryland completed the One Maryland Broadband Network, a fiber-optic network connecting government facilities and community anchor institutions across the state, facilitating easier last mile development.

Other states have partnered with private firms to build out their middle mile. In West Virginia, electric companies upgrading their networks to facilitate the development of smart grids have agreed to run additional fiber capacity and lease it to last mile carriers. Legislation passed in 2017 opened the door for ISPs to access roadbed right-of-way for laying fiber. Previously, that access was limited to regulated utilities. As a result of the change, both Zayo Group and Facebook announced plans to build middle mile networks in the state and lease capacity to last mile providers.

"Tech companies are running their own fiber to connect their data centers and their offices. In doing so, they also make dark fiber available on the market for anyone to lease," says Hinton. Dark fiber is any unused fiber-optic cable. Since the cost of building out a fiber network doesn't vary significantly by the number or size of cables — most of the cost is in the easements and construction — tech firms like Facebook and Google or power companies creating a smart grid can fairly easily create excess capacity on their network to lease to ISPs.

Fiber Alternatives

While fiber offers the best broadband speeds, it is also the most expensive solution.

"It would be great to connect fiber to everyone, but we have to think about the costs," says Gregory Rosston, senior fellow at the Stanford Institute for Economic Policy Research. He served as deputy chief economist at the FCC during the implementation of the Telecommunications Act of 1996 and helped design and implement the first U.S. spectrum auctions. "It is worth asking whether everyone needs to have a fiber connection or whether other substitutes like satellite could be good enough."

Traditionally, satellite internet service has been considered a poor substitute for fiber due to the time it takes the signal to travel to a customer's dish on Earth from the satellite orbiting in space. While some internet applications like browsing the web and watching videos aren't affected by this delay, it poses a challenge for things like real-time videoconferencing. Recently, low-Earth orbit satellite networks, like SpaceX's Starlink project and Iridium Communications' network, have promised to provide broadband with much lower latency compared to geostationary satellites.

"If this is successful, we could have pervasive broadband coverage not just of the United States but the entire world in the next three to five years," says Rosston.

Another method of reaching unserved households without running cables all the way to the home is a hybrid known as "fixed wireless." Fixed wireless ISPs connect transmission towers to the backbone or middle mile via fiber and use wireless signals to beam that broadband to customers.

"Depending on the design of your fixed wireless system, you can run a broadband connection to someone's house at about a seventh the cost of fiber," says Mike Wendy, director of communications for the Wireless Internet Service Providers Association, a trade organization representing fixed wireless ISPs.

Wireless providers don't have to worry about securing right of way or digging trenches to run cables to homes, allowing them to reach customers more quickly. Wireless networks aren't completely immune to physical barriers, however. They face a trade-off between speed and reach.

"On the lower part of the spectrum band, used in TV and radio, the signal can travel far distances and through solid objects," says Wendy. "But you don't get the massive

data capacity of broadband. As you move up into the mid-band and beyond, you get more capacity but can cover less distance and need to maintain more line-of-sight between the transmitter and receiver."

Mobile wireless faces similar trade-offs. The new 5G data networks being built by Verizon, AT&T, and newly merged Sprint and T-Mobile promise speeds comparable to or even faster than home broadband, but the signal has a harder time crossing distances and penetrating buildings than existing 4G networks. Still, researchers and policymakers have long hoped that mobile technology might one day make building expensive fiber networks in hard-to-reach places unnecessary for closing the digital divide. A growing number of respondents to Pew Research Center's surveys already say that the reason they don't subscribe to home broadband is because smartphones and mobile wireless satisfy their needs; some 45 percent said so in 2019, up from 27 percent in 2015.

Counting mobile wireless as broadband makes the digital divide seem much narrower. (See chart.) Still, relying only on a smartphone to access the internet has shortcomings. Most wireless plans place caps on how much data customers can use each month, whereas wired home broadband services typically do not, or they have caps that are much higher. Mobile wireless is also often slower than a wired home connection, which may limit the ability of households that rely on it to use applications like streaming video and videoconferencing that have become even more important during the COVID-19 pandemic.

"Those who rely only on smartphones for internet access tend to be low-income households or households of color," says Horrigan. "They can only afford one way to get online, and they choose the smartphone. Something that the pandemic has really shined a light on is that if you are reliant on just a smartphone for internet access, there are many things that are harder to do than if you had a wireline subscription and a computer."

Growing Adoption

While much of the focus in the policy debate over the digital divide has been on improving access, barriers to adoption also matter. Unsurprisingly, much of the research on the economic benefits of broadband finds that it isn't enough for households simply to have access to it; they must also decide to subscribe. Higher adoption rates can also improve access by letting ISPs spread the capital costs of new infrastructure across more customers.

A 2017 study by the Brookings Institution found that nearly a quarter of Americans lived in low-subscription neighborhoods, meaning that fewer than 40 percent of households subscribed to broadband service despite having access to it. As in the case of access, low subscribership was more concentrated in rural areas. But the study also found pockets of low adoption rates in cities, particularly in neighborhoods with low median incomes and lower rates of educational attainment.

As in the case of infrastructure costs, subsidies can help reduce subscriber costs for low-income households. As a condition for its merger with NBCUniversal in 2011, Comcast agreed to create a discounted broadband plan for low-income households. Comcast's Internet Essentials program offers a broadband connection to eligible households for about $10 a month. In a recent study of the program, Rosston and Scott Wallsten of the Technology Policy Institute estimated that about two-thirds of Internet Essentials subscribers represented true gains in low-income broadband adoption due to the discount. The remaining one-third either switched from a competitor service or would have subscribed anyway as part of a general upward trend in broadband adoption.

Cost isn't the only barrier to adoption, though. A 2015 article in *Information Economics and Policy* that attempted to calculate households' willingness to pay for broadband found that around two-thirds of non-adopters indicated that they would not consider subscribing to broadband at any price. More recently, 80 percent of respondents to Pew Research Center's 2019 survey of non-broadband users said that they had no interest in having home broadband service in the future.

Households that have never had home broadband may not be fully aware of its benefits. Comcast's Internet Essentials program includes access to discounted computers and free digital literacy training. In a 2019 paper, Horrigan found that Internet Essentials subscribers who had training were more likely to use the internet for schoolwork and job searching.

"We know that both discounts and digital skills training are effective," says Horrigan. "The discount gets more people online than would otherwise be the case, and digital skills training makes people more likely to use the internet for homework and lifelong learning."

Closing the digital divide, it seems, means crossing barriers not only of geography, but also of income and awareness. **EF**

Readings

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