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Accessing the Internet in Rural America

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Abstract

In recent decades, rural economies have lagged their urban counterparts. Internet access may be of particular value for small businesses in rural areas, but access there remains lower. This issue brief analyzes recent survey data on internet subscriptions through three popular kinds of technology. Subscription rates in rural areas were lower for traditional broadband and mobile broadband services and higher for satellite services. Rates also varied substantially across rural areas, with subscription rates for traditional broadband services much lower in the South than in the upper Midwest. The geographic variation in subscription rates and the relationships between subscription rates for different technologies are argued to have policy implications.

Businesses increasingly rely on the internet to connect with customers. In 1999, the internet accounted for less than one percent of sales. By 2018, that share had risen to 10 percent, or about $500 billion per year.[1]

Rural areas have lagged the rest of the country in gaining high-speed access to the internet. In a 2018 survey by the Pew Research Center, 58 percent of rural respondents reported that access to high-speed internet was a problem for their communities. It was cited as a major problem for their communities more often than access to quality education or medical care.[2]

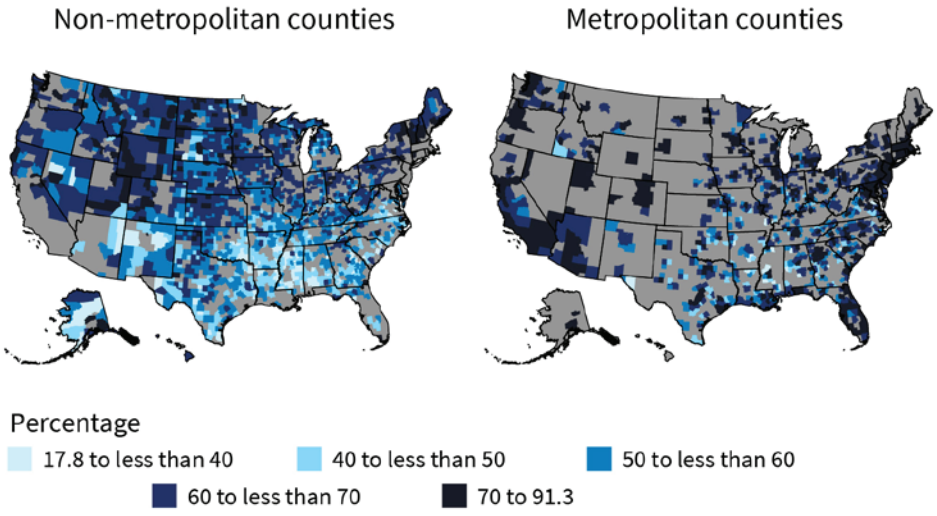
The Federal Communications Commission (FCC) is charged with monitoring the deployment of advanced telecommunications capability and each year releases a report describing internet availability.[3] According to its most recent report, in 2017 high-speed internet was available to about 93.5 percent of the population through fixed terrestrial technologies like cable, including about 73.6 percent of the rural population. Furthermore, high-speed internet was available through satellites to virtually the entire population.

1. US Census Bureau, "US Quarterly Retail E-Commerce Sales: 1st Quarter 2019." May 17, 2019.
2. Parker, Kim, Juliana Horowitz, Anna Brown, Richard Fry, D'Vera Cohn, and Ruth Igielnik, "What Unites and Divides Urban, Suburban and Rural Communities." Pew Research Center, May 22, 2018.
3. Federal Communications Commission, "2019 Broadband Deployment Report." May 29, 2019.

However, the availability rates reported by the FCC provide an incomplete account of internet availability in rural areas. As discussed in a subsequent section, the FCC method for determining availability likely overstates availability in rural areas, and the value of internet services to rural residents depends not only on availability but also on the price and quality of the services available.

This issue brief provides an alternative perspective on internet access using household survey data on actual subscriptions. As discussed in the next section, geographic variation in household access likely corresponds to geographic variation in business access, because household access necessarily implies the presence of the infrastructure needed for business access. Figure 1 shows internet subscription rates in rural and metropolitan counties. Subscription rates were significantly lower in rural counties, especially in the South. For example, the subscription rate for households in rural counties in Mississippi was only about 48 percent, while the subscription rate for metropolitan counties in New Hampshire was about 82 percent.

Figure 1: Households with broadband subscriptions



Note: Excludes households with cellular data plans only
Source: 2013-2017 American Community Survey data from the Census Bureau

In recent decades, rural economies have lagged their urban counterparts.[4] Policy options for encouraging rural growth include improving access to the internet,[5] and this issue brief discusses how internet access may be of particular value to small businesses in rural areas. Geographic variation in access to the internet is explored, including variation among rural areas, and the patterns observed are argued to have implications for the design of policies to promote rural development.

This issue brief describes variation in internet access using three popular categories of technology. However, technologies providing internet access continue to evolve, creating new challenges and opportunities. Some emerging technologies have the potential to improve internet access in rural areas. However, as this issue brief discusses, the effect of those technologies on the disparity between rural and urban areas may ultimately depend on the decisions of policymakers.

4. Wilmoth, Daniel R., "The Retreat of the Rural Entrepreneur." SBA Office of Advocacy, September 29, 2017.

5. Interagency Task Force on Agriculture and Rural Prosperity, "Report to the President of the United States from the Task Force on Agriculture and Rural Prosperity." October 21, 2017.

Measuring Access

The availability rates published by FCC reflect information reported by internet service providers through FCC Form 477. Service providers report availability by census block. Service is reported to be available in a census block if it is available to anyone residing there or if it could be made available "within a service interval that is typical for that type of connection—that is, without an extraordinary commitment of resources."[6]

A census block is a geographical unit defined by the Census Bureau for statistical purposes. In an urban area, a census block generally corresponds to a city block. In a rural area, a census block can be far larger. Thousands of census blocks cover areas larger than the District of Columbia, and several are larger than the state of Connecticut.[7] FCC availability rates reflect the share of the population residing in census blocks where service is reported to be available. As FCC discusses, assuming that service is available to all residents in a census block on the basis of availability to any resident in the census block likely overstates coverage in large census blocks.[8]

As a result, FCC likely overstates the availability of internet services in rural areas. An analysis by Microsoft contrasted the availability reported by FCC with internal Microsoft data on realized access. The FCC definition of "advanced telecommunications capability" for fixed terrestrial internet services involves the ability to download at speeds of 25 megabits per second or faster. While FCC reported that such services were available to over 90 percent of the population, Microsoft found that probably less than half of the population actually accessed the internet at those speeds.[9]

An alternative perspective on internet access is provided by surveys.[10] The American Community Survey (ACS) is a large national survey of households conducted on an ongoing basis by the Census Bureau. The survey involves several questions about internet access, including type of subscription. This issue brief focuses on access through three popular technologies: satellite; mobile broadband, which involves using cellular networks; and fixed terrestrial broadband, including technologies like digital subscriber line (DSL), traditional (coaxial) cable, and fiber optic cable. The data analyzed here were processed after release by the Census Bureau to facilitate analysis.[11]

The survey is an attractive source of data for this analysis because it was large, recent, and collected detailed information about internet subscriptions. The data also have important limitations. Key limitations relate to the population surveyed, the accuracy of the responses, and the availability of geographic information about the respondents.

The ACS is a survey of households rather than businesses. Analogous data for businesses are not available, but geographic variation in household access likely corresponds to geographic variation in business access. Use of

6. Federal Communications Commission, "Form 477 Local Telephone Competition and Broadband Reporting: Instructions." December 5, 2016.

7. McCormick, Mike. Written Statement of the Mississippi Farm Bureau Federation to the United States Senate Committee on Commerce, Science, and Transportation. "Broadband Mapping: Challenges and Solutions." April 10, 2019.

8. Federal Communications Commission, "2019 Broadband Deployment Report," 13 (footnote 92).

9. Microsoft, "An Update on Connecting Rural America: The 2018 Microsoft Airband Initiative." December 3, 2018.

10. For an example of, and citations for, previous studies of internet access by the Office of Advocacy that involve survey data, see Columbia Telecommunications Corporation, "The Impact of Broadband Speed and Price on Small Business." SBA Office of Advocacy, November 2010.

11. Ruggles, Steven, Sarah Flood, Ronald Goeken, Josiah Grover, Erin Meyer, Jose Pacas and Matthew Sobek. IPUMS USA: Version 9.0 [dataset]. Minneapolis, MN: IPUMS, 2019.

ACS data as a proxy for business access parallels FCC use of Form 477 data as a proxy for business access. As FCC argues with respect to the use of Form 477 data, household access necessarily implies the presence of the infrastructure needed for business access.[12]

Another limitation of the ACS data is that survey respondents may provide inaccurate responses, and the problem may be more acute for technical issues like internet access. A comparison of survey results to other data suggests that accuracy is a problem. For example, survey responses indicated that about 8 million households accessed the internet via satellite in 2017. However, the president of the leading provider of satellite internet services has estimated the total number of satellite internet subscribers in the United States to be much lower, only about 2 million.[13] While the presence of inaccurate responses calls for caution, not all responses are inaccurate, and variation across regions driven by variation in accurate responses can provide insight into geographic differences in internet access.

Another limitation of the ACS data is the kind of geographic information provided. The term "rural" generally denotes areas of low population density, but technical definitions vary. FCC uses a definition based on census blocks, and ACS data are not available at the census block level. ACS data about internet access have been released at the county level, but only after aggregating several years of survey data. Metropolitan Statistical Areas (MSAs) are regions of high population density defined by the Office of Management and Budget for statistical purposes. MSAs are composed of counties, so data released at the county level can be used to examine differences between MSAs and other areas. Therefore, studies investigating differences between rural and urban areas often compare areas within MSAs to those outside, as with Figure 1.

However, the questions about internet access changed during the period over which the data were aggregated, and the change resulted in a dramatic increase in the share of the population reporting access to the internet through cellular networks. The revised questions are more likely to yield accurate responses, so the data available at the county level are less accurate than more recent data.

The data analyzed here are from the most recent year available, 2017. While estimates at the county level are not available for 2017, estimates can be derived for an alternative geographic unit, the Public Use Microdata Area (PUMA). Unlike counties, PUMAs may straddle the borders delineating MSAs, so households cannot be cleanly divided according to residence in MSAs on the basis of their PUMAs.

However, PUMAs can still be used to investigate the relationship between internet access and population density. PUMAs are delineated so that each contains about 100,000 people. Since PUMAs contain roughly equal populations, smaller ones are more densely populated, and comparing PUMAs of different sizes provides information about how internet access varies with population density.

12. Federal Communications Commission, "Business Data Services in an Internet Protocol Environment; Technology Transitions; Special Access for Price Cap Local Exchange Carriers; AT&T Corporation Petition for Rulemaking To Reform Regulation of Incumbent Local Exchange Carrier Rates for Interstate Special Access Services." Federal Register 82, No. 105 (June 2, 2017): 25660.

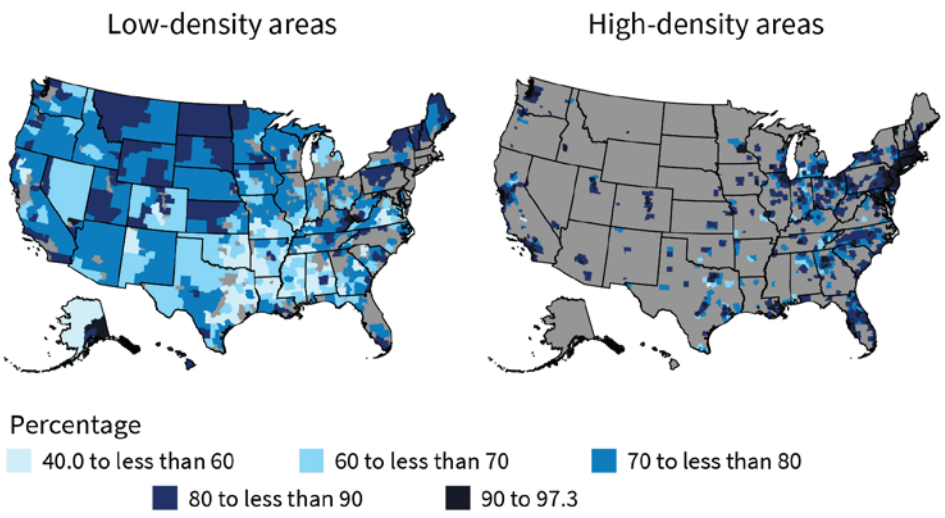
13. Henry, Caleb, "Echostar's take on high-throughput satellites: Best bought one at a time." SpaceNews, February 21, 2019.

Geographic Variation in Internet Access

Analysis of geographic variation in internet access may aid policy formation by identifying areas that would benefit from improved access and by revealing how access has been shaped by past policy choices. This section describes geographic variation in subscription rates for popular categories of technology as well as the relationship between the subscription rates for different technologies.

Responses to the ACS indicated that about 69 percent of households in the United States had fixed terrestrial broadband subscriptions in 2017,[14] which is very close to the subscription rate estimated by FCC on the basis of Form 477 data.[15] Figure 2 shows how household subscription rates varied with population density. The map labeled "Low-density areas" depicts subscription rates in the largest 20 percent of PUMAs, while the map labeled "High-density areas" depicts subscription rates in the smallest 80 percent. The figure echoes the patterns observed in Figure 1, with subscription rates positively related to population density. Among areas with low population density, subscription rates vary geographically, with higher rates in the upper Midwest and lower rates in the South.

Figure 2:
Households with fixed terrestrial broadband subscriptions



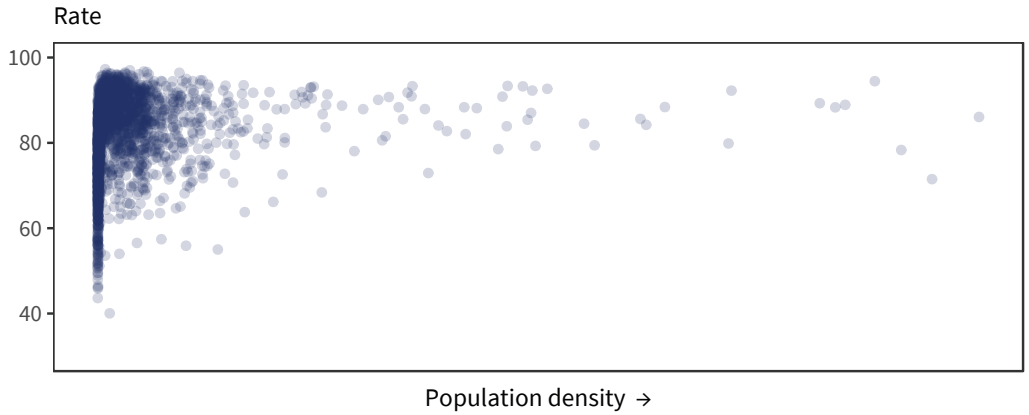
Source: 2017 American Community Survey data from the Census Bureau

14. US Census Bureau, 2017 American Community Survey 1-Year Estimates, Table S2801.

15. Federal Communications Commission, "2019 Broadband Deployment Report." May 29, 2019, 29.

Figure 3 shows the relationship between population density and fixed terrestrial subscription rates more explicitly by plotting the subscription rate for each PUMA against the inverse of its size.[16] Larger values on the horizontal axis correspond to smaller PUMAs and therefore higher population densities. The figure demonstrates the positive relationship between population density and subscription rates, with the lowest subscription rates observed primarily at lower population densities. Less than 1 percent of high-density PUMAs had subscription rates below 60 percent, while over 11 percent of low-density PUMAs had subscription rates below that value.

Figure 3: Fixed terrestrial broadband subscription rates



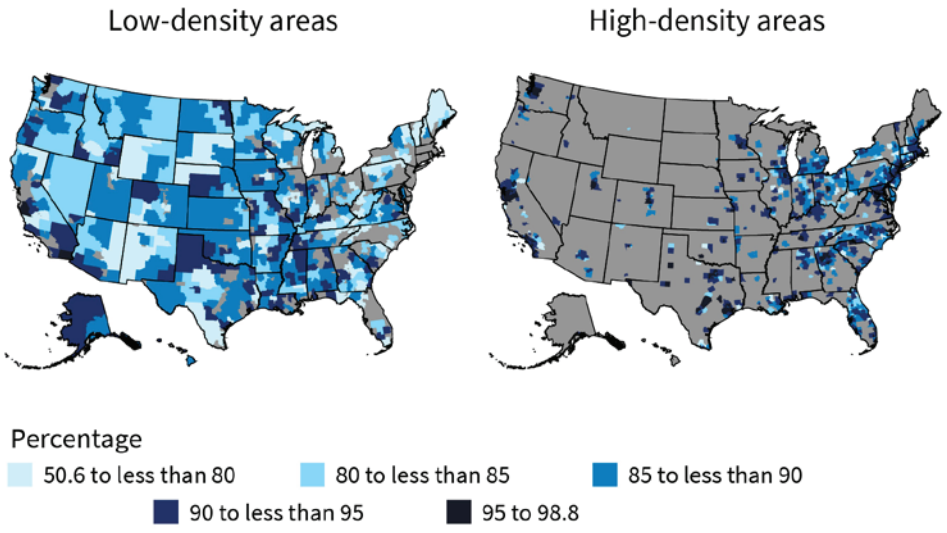
Note: Population density is proxied using the inverse of the size of each Public Use Microdata Area, with population density increasing toward the right; subscription rates below 60 percent were observed primarily in low-density areas
Source: 2017 American Community Survey data from the Census Bureau

16. The multiplicative inverse of a number is one divided by that number.

Responses to the ACS indicated that about 73 percent of households had mobile broadband subscriptions in 2017.[17] Figure 4 show a difference between high-density areas and low-density areas similar to that observed for fixed terrestrial broadband, with higher subscription rates in areas with higher density.

However, among the less dense areas, a different pattern of geographical variation is observed. In the South, where fixed terrestrial subscription rates were low, mobile broadband subscription rates were high. In the upper Midwest, where fixed terrestrial broadband subscription rates were high, mobile broadband subscription rates were low. Although mobile broadband and fixed terrestrial broadband subscription rates were positively correlated for the nation as a whole, they were negatively correlated in areas with low population density. That negative correlation is consistent with limited availability of some technologies in rural communities and a reliance by those communities on whatever technology is available.

Figure 4: Households with mobile broadband subscriptions



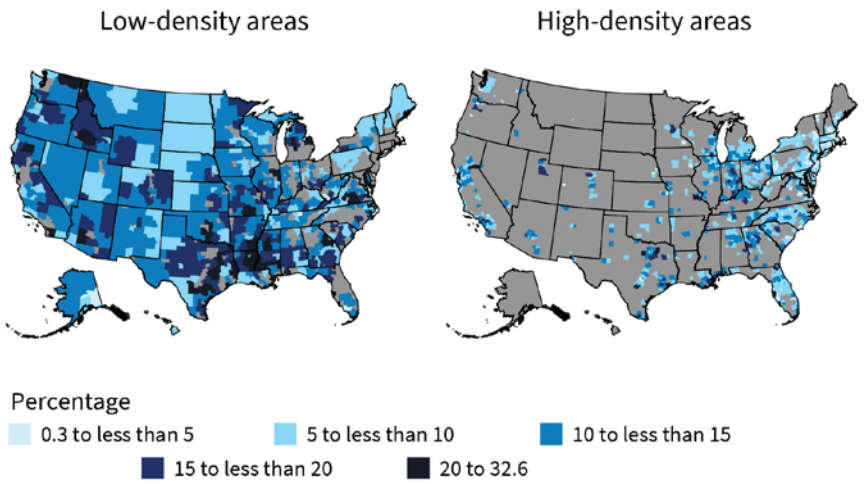
Source: 2017 American Community Survey data from the Census Bureau

17. US Census Bureau, 2017 American Community Survey 1-Year Estimates, Table S2801.

Figure 5 shows that satellite internet subscription rates also varied by population density. However, the relationship between satellite subscription rates and population density was the opposite of that for fixed terrestrial or mobile internet subscription rates. Satellite subscription rates were higher in low-density areas like the rural South and lower in high-density areas like the urban Northeast.

Satellite internet access does not rely on the kinds of costly local infrastructure necessary for fixed terrestrial and mobile internet access. Figure 5 suggests that households turn to satellite services in areas that lack the necessary infrastructure for fixed terrestrial or mobile broadband.

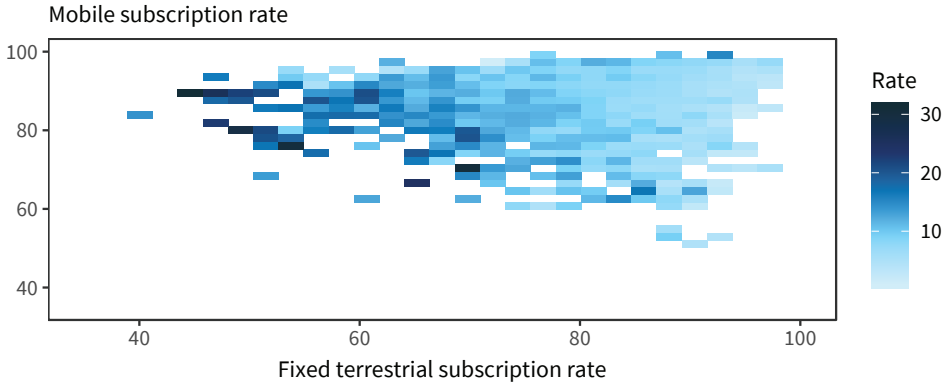
Figure 5: Households with satellite broadband subscriptions



Source: 2017 American Community Survey data from the Census Bureau

Figure 6 shows how satellite internet subscription rates varied with fixed terrestrial and mobile broadband subscription rates. The horizontal axis corresponds to fixed terrestrial subscription rates, and the vertical axis corresponds to mobile subscription rates. The shading indicates average satellite subscription rates for each combination of fixed terrestrial and mobile subscription rates. The darker shading along the lower left of the distribution shows that satellite subscription rates were highest in the areas where mobile and, especially, fixed terrestrial internet subscription rates were lowest.

Figure 6: Average satellite internet subscription rates



Note: Shaded blocks correspond to groups of Public Use Microdata Areas, with the shade of each block showing the average satellite subscription rate for the group with that combination of fixed terrestrial and mobile subscription rates
Source: 2017 American Community Survey data from the Census Bureau

The figures presented in this section demonstrate the gap in internet access between rural and urban areas and the extent to which rural areas relied on satellite as a substitute for fixed terrestrial and mobile broadband services. They also show a significant amount of variation among rural areas, with higher subscription rates for fixed terrestrial broadband in the upper Midwest and lower rates in the South. The next section discusses the potential policy implications of these and related issues.

Discussion

In recent decades, economic growth was highly concentrated in a few densely populated areas, while the economies of rural areas struggled.[18] Businesses that sell only to local customers struggle when the local economy struggles. Businesses that sell online are less vulnerable to local economic conditions, and some evidence suggests that growth in online retailers has been more evenly distributed geographically than growth in other types of businesses.[19] Internet access may therefore be particularly important for rural communities.

However, rural areas lag urban areas in internet access. Lower broadband subscription rates in rural areas reflect the higher cost per customer of providing the necessary infrastructure when population density is lower.[20] Nevertheless, the preceding section demonstrates substantial geographic variation in broadband subscription rates, which suggests that lower population density does not entirely explain lower subscription rates in rural areas.

A particularly stark contrast is provided by North Dakota and Mississippi. In North Dakota, the average fixed terrestrial broadband subscription rate in rural counties was 73 percent, while in Mississippi the average was only 48 percent. The difference between North Dakota and Mississippi may be explained by differences in policy, among other reasons. For example, local utility cooperatives provide electricity and telephone service in many rural areas, and local utility cooperatives also provide internet access across much of North Dakota.[21] In contrast, Mississippi state law prohibited electric cooperatives from providing internet service until revised in 2019.[22] Policies that limit competition among internet service providers can harm small businesses in rural areas by decreasing internet access.

Internet subscription rates reflect not only the availability of internet services, but also the demand for them. Demand is influenced by familiarity with computers, including smartphones, and their applications. Rural communities may be able to increase demand for internet services through educational programs at schools or libraries.

Accurate data on the availability of broadband services are helpful for guiding federal efforts to improve broadband availability. Different sources of data present different limitations. FCC data on fixed terrestrial broadband availability overstate availability in rural areas. Survey data on actual subscription rates provide a noisy account of availability because subscription rates are influenced by both availability and demand. However, the patterns described in the preceding section suggest a strategy for disentangling availability and

18. Economic Innovation Group, "The New Map of Economic Growth and Recovery." May 2016.

19. eBay, "United States Small Online Business Trade and Inclusive Growth Report." May 2019.

20. Bock, Wolfgang, Derek Kennedy, Maikel Wilms, Simon Bamberger, and Sam Fatoohi, "The Economic Case for Bringing Broadband to the Rural US." The Boston Consulting Group, June 4, 2018.

21. Trostle, H., Katie Kienbaum, and Christopher Mitchell, "Cooperatives Fiberize Rural America: A Trusted Model for the Internet Era." Institute for Local Self-Reliance, June 2019.

22. Pittman, Ashton, "Gov. Bryant Signs Law Aimed at Expanding Broadband to Rural Areas." Jackson Free Press, January 30, 2019.

demand. Satellite broadband services are nearly universally available in the United States, but, as Figure 6 illustrates, accessing the internet through fixed terrestrial technologies seems generally to be preferred. High satellite subscription rates therefore likely correspond to areas of high demand for fixed terrestrial broadband services but low availability.

Technologies for providing internet services continue to evolve. Some technologies that do not rely on the same kinds of infrastructure as traditional fixed terrestrial broadband services may be particularly appealing in rural areas. Evolving technologies with potentially significant implications for rural internet access include fixed wireless, satellite, and 5G mobile broadband.

Fixed wireless refers to technologies that, like other fixed terrestrial technologies, provide access at fixed locations. However, like mobile broadband, fixed wireless does not require wires reaching the access location. Instead, connection to the internet is made by exchanging transmissions with a base station that may be several miles away. The cost of fixed wireless broadband depends partly on the spectrum used for transmission. However, because fixed wireless does not require the same infrastructure as other fixed terrestrial options, the costs are likely to be lower than other fixed terrestrial options in areas of lower population density.[23]

Satellite services with download speeds of 25 megabits per second became available to nearly the entire population of the United States in 2017, the year the data analyzed in this issue brief were collected.[24] Nevertheless, satellite internet services continue to exhibit some disadvantages relative to fixed terrestrial services, including latency. Because of the great distance between users and satellites, interactions with the internet through satellite services involve substantial delays as signals are transmitted. However, that latency could be reduced by the use of constellations of satellites in low earth orbit, and several firms have begun the process of launching such constellations.[25]

The FCC classifies mobile internet services as providing "advanced telecommunications capability" at speeds considerably lower than those for fixed internet services.[26] However, new "5G" mobile technologies are being developed that would allow internet access at speeds comparable to fixed services. Although access rates in rural areas are higher for mobile internet services than for fixed terrestrial services, the development of 5G technologies may not improve parity between rural and urban areas.

The new 5G technologies will require a broader range of electromagnetic spectrum. Signals travel farther at lower frequencies, and many countries are developing 5G technologies using relatively low frequencies. However, in the United States, much of that part of the spectrum is reserved for government use, and 5G technologies are being developed for higher frequencies with more limited range.[27] With more limited range, network coverage would require more extensive infrastructure, the kind of infrastructure likely to be excessively costly in areas with lower population density. Without a change in spectrum allocation, 5G mobile broadband is unlikely to become available in lower-density areas.

23. Bock et al., "The Economic Case for Bringing Broadband to the Rural US."

24. Federal Communications Commission, "2019 Broadband Deployment Report.," 17.

25. Ibid., 38.

26. Ibid., 7–9.

27. Medin, Milo, and Gilman Louie, "The 5G Ecosystem: Risks and Opportunities for DoD." Defense Innovation Board, April 3, 2019.

Access to the internet is becoming increasingly important for small businesses and may be particularly important for small businesses in rural areas. However, subscription rates are lower in rural areas for the most popular broadband technologies, especially in the rural South, with rural communities turning to alternatives like satellite. The current gap between rural and urban areas in internet access parallels earlier gaps in electrical and telephone access. Each technology relied on an infrastructure that made access more costly in areas with lower population density. New technologies for providing access to the internet without the need for such infrastructure are developing. However, the effects of those technologies on the disparity between rural and urban areas may ultimately depend on the decisions of policymakers.

Previous Research from the Office of Advocacy

The Impact of Broadband Speed and Price on Small Business, by Columbia Telecommunications Corporation. Produced under contract SBAHQ-09-C-0050 and published by the Office of Advocacy, 2010.

Broadband Use by Rural Small Businesses, by Stephen B. Pociask, TeleNomic Research. Produced under contract SBAHQ-04-M-0528, and published by the Office of Advocacy, 2005.

A Survey of Small Businesses' Telecommunications Use and Spending, by Stephen B. Pociask, TeleNomic Research. Produced under contract SBA-HQ-02-M-0493, and published by the Office of Advocacy, 2004.