Toward Effective Administration of State and Local Fixed Broadband Programs

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The Vernonburg Group

The Vernonburg Group helps corporate, non-profit, and government clients close the global broadband connectivity gap. The Vernonburg Group offers decades of practical experience in technology, media, and telecommunications (TMT) business model incubation, market assessment and entry, technical design and support, project financing, policy and regulation, and program development and management—in both developed and emerging markets.

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I. Executive Summary

This is a once-in-a-generation moment in which policy makers and regulators are directing unprecedented funding toward availability and adoption of faster internet connectivity. State, municipal, and other local governments, including counties, townships, and school districts, may be overwhelmed implementing the vast array of federal, state, and local funds set aside for fixed broadband deployment and adoption.[1] This report is intended to help state, municipal, and other local governments seize this funding opportunity and develop comprehensive broadband strategies to improve residents' quality of life, develop an advanced workforce, and promote and attract businesses. Ubiquitous and affordable broadband connectivity facilitates distance learning, remote work, telehealth, advanced manufacturing, precision agriculture, and civic engagement. For these reasons, this report is designed to help governments and community-based organizations think holistically about how broadband availability and adoption initiatives can complement and further other public policy priorities.

This report explains how best to maximize the impact of funding from the 2021 American Rescue Plan Act (ARPA),[2] the Infrastructure Investment and Jobs Act (IIJA),[3] commonly referred to as the Bipartisan Infrastructure Bill, and other federal, state, and local programs. In addition to summarizing key administrative requirements for these Acts and programs, this report provides high-level principles to guide administrators as they seek to increase broadband availability and adoption while providing them with practical advice on conducting needs analyses, prioritization, goal setting, and evaluations. Most helpfully, it features effective pilot programs and case studies that can be copied and shows how governments and partner organizations can meet short- and long-term goals most cost effectively and equitably.

The IIJA aims to make affordable fixed broadband, with download speeds of at least 100 Megabits per second (Mbps) and upload speeds of at least 20 Mbps,[4] available to every U.S. household and used by all. This report will explain how and why the IIJA's 100/20 Mbps speed goal is both appropriate and achievable, based on where consumer needs are greatest and on how U.S. households will consume online services for the foreseeable future. It will also describe a wide array of technologies that can provide internet connectivity with speeds that meet or exceed 100/20 Mbps, such as so-called cable modem, fiber optic cable, terrestrial fixed wireless, and satellite communications. This report will help state and local government administrators navigate technology and funding options and encourage them to allocate limited available funding as effectively as possible based on nine guiding principles: (1) prudent administration and oversight, (2) targeted, (3) technology neutral, (4) broadband capable, (5) secure and resilient, (6) best value, (7) non-distortionary, (8) deployed quickly, and (9) equitable by design.

However, this report notes that achieving universal high-speed internet use by all citizens isn't just a question of providing faster connections. It also involves making sure people can afford the fixed broadband services made available to them, have devices that enable them to productively work and learn online, and have the skills, comfort, and motivation to navigate and leverage online content and services. Interestingly, available data shows that the so-called "broadband adoption gap" is far greater than the broadband availability gap. While the availability gap is closing, the adoption gap persists. Non-adoption appears strongly linked to certain demographic variables, such as income, age, disability, education level, rurality, and some ethnic distinctions—factors that state and local governments can effectively address.

This report recognizes that closing the broadband adoption gap may be more challenging for state, municipal, and local governments than closing the broadband availability gap. Even if fixed broadband was made available to the entire U.S. population for little or no cost, state and local governments and their partners would need to overcome demographic and other factors that hinder some citizens from using the internet. These factors may include the unaffordability of services and devices, irrelevance of content, illiteracy, concerns over safety and security of internet use, lack of so-called "digital skills" or knowing how to work devices and apps, lack of trust in private and public low- and no-cost programs, and misunderstandings about such programs.

With this crucial adoption gap in mind, this report explains why a goal of making affordable so-called "symmetrical" 100/100 Mbps fixed broadband, where upload speed equals download speed, available to all households is not justified based on current and foreseeable consumption patterns. A symmetrical 100/100 Mbps fixed-broadband funding requirement would also lead to discriminatory policymaking, generating even greater digital divides and costing approximately three times as much as providing 100/20 Mbps without providing commensurate benefits. While there is a once-in-a-generation amount of funding available, using that limited funding to make symmetrical fixed broadband available to all households would exhaust all funds well before broadband connectivity could be made available to all households and divert funds away from addressing the problem of incomplete broadband internet adoption. The resulting funding gap would force policymakers to make challenging decisions about which areas get broadband internet access and which do not. Most critically, internet service providers (ISPs) would be incented to deploy first in urban and suburban markets where per-user costs are lower and average revenues are higher, even though most of these areas already have access to high-speed internet.

This report takes the stance that governments can and should do more to reduce digital inequities. It shows state and local government administrators how the Affordable Connectivity Program (ACP), created under the IIJA and managed by the Federal Communications Commission (FCC), offers the best near-term hope of addressing the internet adoption gap and making high-speed broadband affordable for low-income households. This report shows why and how state and local governments should supplement the ACP to provide additional support to vulnerable or marginalized communities with low rates of broadband and technology adoption. Administrators should pursue targeted programs, such as basic and advanced digital skills programming, and community-based public and private partnerships, to stimulate broadband adoption.

Following this executive summary, the second section of this report provides a common understanding of broadband definitions and reliable figures about fixed broadband in the U.S., looking at broadband availability and adoption from technological and human points of view. The third section presents an overview of broadband technologies, followed by a fourth section that sets out broadband program funding mechanisms and modalities, covering their history and the newest funding sources. The fifth section focuses on nine principles that underpin a sound approach to broadband programming. The final section pulls all the information together with case studies and a nine-step path that state and local broadband program administrators can take toward cost-effectively and equitably ensuring that all residents in their communities enjoy the many benefits of fixed broadband internet.

For those readers already familiar with the technical and funding details of broadband programs, our recently published "A Handbook for the Effective Administration of State and Local Broadband Program" presents a summarized version of this report.[5] It describes the nine principles that should guide fixed broadband program development and implementation, as seen in Section V. It also gives a high-level overview of the nine steps presented in Section VI—steps that state, municipal, and local governments should take to achieve ubiquitous fixed broadband connectivity to the internet for all residents, prioritizing locations, people, and communities that have the greatest need for government intervention.

II. Key Facts and Figures About U.S. Fixed Broadband

High-quality data is key to having an accurate picture of broadband internet availability, adoption, and performance, and is essential for good policymaking. Data that is recent and granular will better inform policymakers and lead to more effective marketplace interventions. Data should be collected at regular intervals from ISPs by federal agencies, such as the FCC, and corroborated by trusted third-party data sources. This section looks at current fixed broadband availability, adoption, and performance; exposes availability and adoption gaps; and uncovers some possible reasons for low adoption rates.

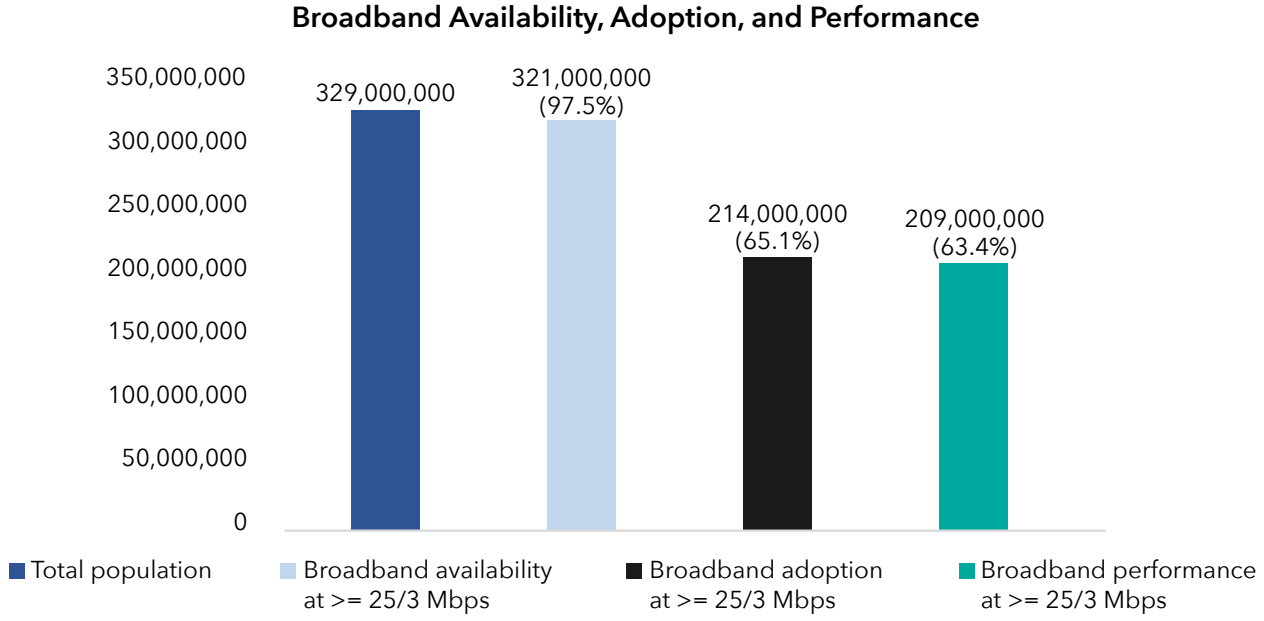
A. Introduction

It is important to define broadband internet availability, adoption, and performance. The FCC defines internet speeds that are at least 25 Mbps down and 3 Mbps up (25/3 Mbps) as "broadband." "Fixed broadband" refers to a service delivered to a fixed location via cable modem, fiber optic cable, terrestrial fixed wireless, or satellite technologies. (See Section IV for a deeper dive into various types of fixed broadband technologies and Appendix D for helpful definitions.) Fixed broadband "availability" means there is an ISP (also known as a broadband operator) that either does provide internet connectivity through a fixed broadband connection to people's homes across a defined geographic region—the coverage area—or could do so, as the FCC puts it "within a service interval that is typical for that type of connection—that is, without an extraordinary commitment of resources."[6] A subset of the population with homes that have broadband availability will "adopt" or pay for broadband service; i.e., "adoption" means subscription to a fixed broadband service. Adoption can be at the level of a household or an individual; many individuals may share an internet connection and/or a device to connect to the internet. For this reason, calculations of broadband adoption will differ depending on whether one is counting households or individuals. It is important to note that in terms of broadband statistics, population percentages will be roughly equivalent to household percentages when averaged over the whole country or at state level.[7]

Households and individuals that adopt fixed broadband service receive a certain level of broadband "performance," i.e., a connection to the internet at or above the 25/3 Mbps speed. The broadband performance level received should be roughly the same as the service level purchased, but, unfortunately, not all consumers have a connection that performs at the speed subscribed to due to factors such as poor in-home Wi-Fi configuration, outdated equipment and devices, or, in increasingly rare cases, a service not performing at advertised speeds.

In most cases, ISPs deliver the performance they advertise. Between September and October 2020, nine of the 12 ISPs measured in the Measuring Broadband America report met or exceeded their advertised download speed and seven of the 12 ISPs measured met or exceeded their advertised upload speed.[8] Furthermore, a Microsoft study of its customers' actual internet performance confirms that most U.S. broadband subscribers receive the performance speeds they purchased. Based on its study, Microsoft reports that 65.1% of the population (households) subscribe to 25/3 Mbps or higher broadband services and only slightly fewer, 63.4%, access the internet at such speeds (Figure 1).

Figure 1: Visualizing Fixed Broadband Availability, Adoption, and Performance for 25/3 Mbps (2020)



Source: FCC Form 477 data (2020);[9] Microsoft data (2020)[10]

B. Technology Aspects: Broadband Availability and Performance

1. Fixed Broadband Availability Statistics Differ by Source

FCC data show that 8.2 million people in about 3.2 million households lack access to 25/3 Mbps, but other sources show that the availability gap is likely larger.

The FCC's Broadband Data Collection program is expected to provide more precise and detailed data on broadband availability.

The FCC provides data on fixed broadband availability based on FCC Form 477 submissions, which record type of fixed access, ISP details, and download and upload speeds down to the smallest census level, the census block. The latest FCC Form 477 data from December 31, 2020, shows that the number of U.S. residents without 25/3 Mbps broadband available to them is 8.2 million (2.48%).

This translates to approximately 3.2 million households, which is a good low-end estimate of the number of residential locations without access to a fixed broadband network. The FCC Form 477 considers fixed broadband connections at 25/3 Mbps to be available in a census block if the provider does, or could, within a service interval that is typical for that type of connection – that is, without an extraordinary commitment of resources – provision two-way data transmission to and from the internet with advertised speeds exceeding a 25 Mbps download and a 3 Mbps upload to end-user premises in the census block.[11]

However, a March 2021 BroadbandNow study provides evidence that the FCC Form 477 likely overstates fixed broadband availability. BroadbandNow checked fixed broadband availability at 58,000 representative addresses across the U.S.; availability was primarily determined using online broadband coverage tools provided by ISPs.[12] The study showed that 43.7 million people in the U.S. (13.30%) do not have access to broadband.[13] This translates to approximately 17.27 million households. The BroadbandNow study also estimates state-level broadband availability, as summarized in Appendix A Table 5.

The comparison reveals extreme differences in the lack of broadband availability in three states. In West Virginia, BroadbandNow finds 50.22% of the population does not have access to broadband versus 9.47% reported by the FCC. In Vermont, BroadbandNow finds 29.17% of the population does not have access to broadband versus 4.78% reported by the FCC. In Mississippi, BroadbandNow finds 39.52% of the population does not have access to broadband versus 14.66% reported by the FCC.

These discrepancies showed a need modernize the FCC's Form 477 data collection process, which has led to the creation of the Digital Opportunity Data Collection (DODC) program (now called the Broadband Data Collection).[14] It aims to enable better decision making by collecting geographically precise and detailed data on broadband service deployment, that would be subject to stakeholder challenges and ISP verification. The FCC recently issued a Public Notice announcing commencement of the BDC.[15] Broadband availability data as of June 30, 2022, must be submitted to the FCC no later than September 1, 2022.

2. Broadband Definitions Are Evolving Over Time

The FCC's broadband definition, 25/3 Mbps, is now over six years old. In 2015, the FCC concluded that the 25/3 Mbps broadband definition was justified considering "advances in technology, market offerings by broadband providers and consumer demand." In 2013, approximately 83% of the U.S. population had access to 25/3 Mbps broadband, but less than half of the rural U.S. population had such access.[16]

There have been recent calls to change the threshold numbers in the FCC's broadband definition from 25/3 Mbps to 100/20 Mbps.[17] Indeed, several federal, state, city, and local broadband programs now target support to areas lacking access to 100/20 Mbps service. For example, the United States Department of Agriculture's (USDA's) ReConnect program now targets support to areas lacking access to 100/20 Mbps broadband. Other programs require fund recipients to deploy networks capable of providing at least 100/20 Mbps services. The IIJA stipulates that deployment grants will only support ISPs that offer 100/20 Mbps broadband service through networks that are scalable to even faster speeds.[18]

Some parties have even suggested that the broadband definition and network deployment goals should be increased further and based on so-called "symmetrical" speeds of 100 Mbps download and 100 Mbps upload in order to meet future demand.[19] They argue that two-way video conferencing, smart grids, artificial intelligence, virtual and augmented reality, and tactile telemedicine will require symmetrical speeds and that installing symmetrical 100/100 Mbps connections now will ensure that network deployments are not outdated upon completion.

Using FCC data, 89.6% of the U.S. population has access to 100/20 Mbps broadband and 46.7% of the U.S. population has access to 100/100 Mbps broadband.

But we estimate that 80% of the U.S. population might have access to 100/20 Mbps broadband and 42% of the U.S. population might have access to 100/100 Mbps broadband.

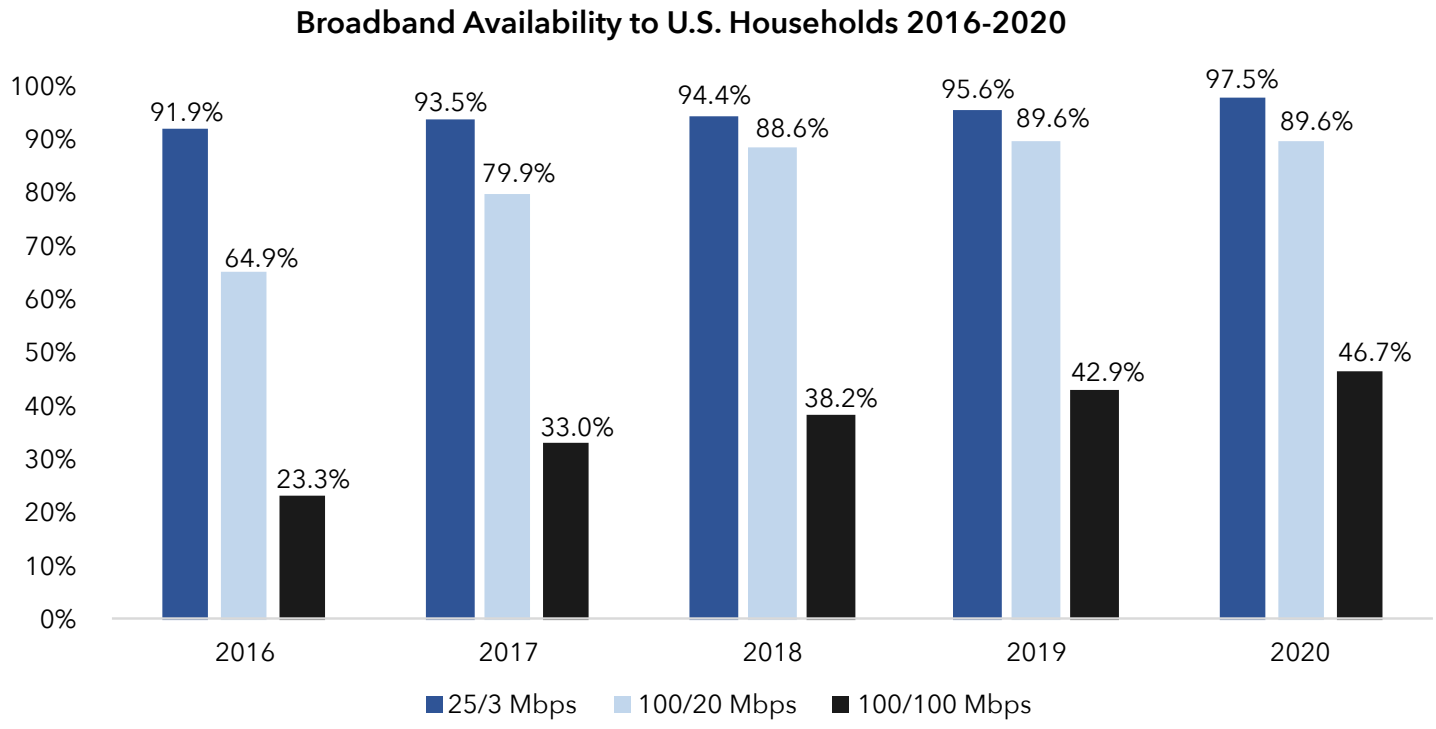
To check the impact of changing the broadband definition to 100/100 Mbps or 100/20 Mbps, we analyzed the FCC Form 477 data to examine the share of the U.S. population with access to these speeds. As of December 2020, 89.6% of the U.S. population already has access to 100/20 Mbps broadband and 46.7% already has access to 100/100 Mbps broadband. Due to the methodological issues with the FCC's broadband access data discussed earlier, the real figures for broadband availability at 100/20 Mbps and 100/100 Mbps are likely to mirror the discrepancies in 25/3 Mbps availability data. Therefore, we estimate that 80% and 42% of the U.S. population might have access to 100/20 Mbps broadband and 100/100 Mbps broadband, respectively.

If the FCC's broadband definition changes from 25/3 Mbps to at least 100/20 Mbps, then 10.2 million U.S. households would have access to 25/3 Mbps connections but lack access to 100/20 Mbps connections, according to FCC data. This would mean 10.2 million additional U.S. households would be considered unserved.

If the FCC's broadband definition changes to at least 100/100 Mbps, then 65.4 million U.S. households would have access to 25/3 Mbps connections but not 100/100 Mbps connections. This would mean 65.4 million additional U.S. households would be considered unserved.

Unfortunately, the cost to bring 100/100 Mbps networks to all locations exceeds the available and substantial funding that Congress recently appropriated, and additional federal funding is unlikely to materialize (Appendix B). Cartesian, a specialist consultancy, estimates that the subsidization cost could be as high as $179 billion—far higher than available federal and state broadband infrastructure funding.[20] However, a goal of universal 100/20 Mbps fixed broadband availability appears within reach, with funding to spare for broadband adoption programs. Cartesian estimates that 19 million households lack access to at least 100/20 Mbps fixed broadband, and that the total subsidy cost to connect these locations would be $35 to $67 billion. It also estimates a subsidy cost of $5 to $20 billion per year to close the adoption gap in the next 10 years.[21]

Figure 2: Growth of FCC Broadband Speed Tiers in Mbps for U.S. Households Between 2016 and 2020 Aggregated Across All 50 States and the District of Columbia (2016-2020)



Regulatory interventions are needed to close the 25/3 Mbps and 100/20 Mbps availability gaps; the private sector continues to drive growth of 100/100 Mbps availability.

We also tracked the growth of 25/3 Mbps, 100/20 Mbps, and 100/100 Mbps availability using FCC broadband year-end data between 2016 and 2020 aggregated across all 50 states and the District of Columbia (Figure 2). The relative changes are fairly accurate even though the absolute percentages are likely too high. 25/3 Mbps availability grew by 1.9 percentage points between 2019 and 2020 compared to only 1.2 percentage points between 2018 and 2019. 100/20 Mbps availability grew quite rapidly until 2018 (14.9 percentage points between 2016 and 2017 and 8.7 percentage points between 2017 and 2018), and then had very little or no growth after 2018. 100/100 Mbps availability has steadily increased every year, by 9.7 percentage points between 2016 and 2017, and has shown a steady yearly percentage point growth between 2017 and 2020 of 5.2, 4.7 and 3.8, respectively.[23]

Thus, FCC broadband availability statistics show that a large majority of US households already have access to 100/20 Mbps or faster broadband internet connection that enables each member of a household to simultaneously run a variety of high-capacity, latency-sensitive applications, such as high-definition (HD) video streaming, video conferencing, and online gaming. Yet broadband availability at speeds of 100/20 Mbps or less remains out of reach for a significant percentage of the U.S. population, so spending government funds to achieve universal access to these essential experiences should be the goal of state and local broadband availability programs.

3. Broadband Network Performance Meets Demand with Increasing Speeds

Performance is key to understanding if users have a broadband service that meets their needs. Performance is typically measured by testing the download speed (on the connection between an internet service and the internet user's device) and the upload speed (on the connection between a user's device and internet service). Measurements are either carried out by users themselves when doing speed tests from the device's web browser or by operators or service providers that measure the speeds inside their own networks. Speed that an ISP delivers to the home may differ from speed delivered to the device due to several factors, including in-home Wi-Fi configuration, a home's internal wiring and architecture, and whether equipment and devices are outdated. Ookla Speedtest data, measured from users' devices, shows a mean average download performance of 209.73 Mbps and a median download performance of 134.16 Mbps for fixed networks in November 2021.[24] This demonstrates that just over 50% of U.S. fixed broadband subscribers enjoy average download speeds above 130 Mbps. The average is significantly higher than the median, which shows fixed broadband performance varies widely, as very high-capacity services skew the average.[25]

Just over 50% of U.S. fixed broadband subscribers have download speeds above 130 Mbps.

Slightly under 50% of U.S. fixed broadband subscribers have upload speeds above 20 Mbps.

The average upload performance was 75.9 Mbps and the median upload performance was 19.45 Mbps for fixed networks in November 2021. The median download to upload ratio is 6.9 to 1 showing that fixed networks in the U.S. have highly asymmetric speed capabilities.[26] Actual usage (traffic to and from internet services while users engage in typical internet activity) is even more asymmetric with a download to upload ratio of 14 to 1.[27] The Ookla data shows that slightly under 50% of U.S. fixed broadband subscribers have an upload performing above 20 Mbps. Ookla Speedtest data from November 2020 to November 2021 shows that download and upload performance has been steadily improving. Median download performance grew from 101.42 Mbps in November 2020 to 134.10 Mbps in November 2021 and median upload performance grew from 14.89 Mbps in November 2020 to 19.45 Mbps in November 2021. The FCC's Measuring Fixed Broadband report also reports high yearly speed increases. The weighted average advertised download speed was 193.9 Mbps in September-October 2020 among the measured ISPs, which represents a 33% increase compared to the average, in September-October 2019, of 146.1 Mbps and a 166% increase compared to 2017, of 72.9 Mbps.[28]

Microsoft, too, carried out a study in 2020 to estimate broadband performance speeds from multiple Microsoft first party and third-party services to confirm if users were accessing the internet at speeds that meet or exceed the FCC's broadband definition of 25 Mbps download speeds.[29] Microsoft made use of the throughput and location data (down to zip code level) captured every time a device receives an update or connects to a Microsoft service. Microsoft estimated that over a third of people in the U.S. (about 120.4 million) were not accessing the internet at currently defined broadband speeds.[30] This suggests that approximately 63.3% of U.S. residents access the internet at currently defined broadband speeds, only slightly below the 65.1% of U.S. residents that subscribe to fixed broadband internet services (Figure 2).

Approximately 63.3% of the U.S. population is accessing the internet at the FCC-defined broadband speed.

4. Observations on the Broadband Definition

Broadband definitions should reflect a mix of available technologies and consumer demand, while also being resilient to the accelerating pace of technological change. This approach is consistent with how the FCC has previously defined broadband.

Based on available data, download speeds of up to 100 Mbps support high performance video and multiple users using videoconferencing or HD streaming. Researchers at Princeton University carried out a study on 60 households and 200,000 video streams to check if subscribing to higher tier internet packages improved the performance of typical applications they were using.[31] The study found that streaming video performance plateaus long before the upper tier plans offered by ISPs, with plans above 100 Mbps only marginally improving start-up delays and resolution, even when multiple devices are viewing videos simultaneously.[32]

Even with increased demand during the COVID-19 pandemic, video conferencing applications such as Zoom still account for only 5% of overall network traffic.

Video streaming still dominates internet traffic and downstream to upstream traffic grew from 3:1 to 14:1 between 2010 and 2019.

In terms of the required upload speed, there is no strong justification for symmetrical speeds. Although the bandwidth requirements have increased over the past decade, the average downstream-to-upstream traffic ratio grew from 3:1 in 2010 to 14:1 by the beginning of 2019, mostly driven by streaming video content.[33] Although video-conferencing traffic during the COVID-19 pandemic has grown anywhere from 300% to 700%, compared to pre-shutdown levels, that traffic still only accounts for 5% of overall network traffic.[34]

According to our analysis, only 42% to 46.7% of the U.S. population has access to 100/100 Mbps connectivity and 80% to 89.6% has access to 100/20 Mbps connectivity. A 100/100 Mbps broadband definition would mean 42% to 42.9% of the well served 100/20 Mbps users would be considered unserved and potentially eligible for subsidies—diverting finite funding from U.S. residents with greater needs. Given the current market offerings by broadband providers and the highlighted asymmetric nature of consumer demand, there is no justification for a 100/100 Mbps broadband definition, but ample justification for a 100/20 Mbps broadband definition.

5. U.S. Fixed Broadband Networks Are Resilient

The COVID-19 pandemic tested the resilience of internet infrastructure as bandwidth demand skyrocketed to meet the needs of at-home workers collaborating with colleagues and pre-kindergarten through university students continuing their education over bandwidth-intensive applications such as video conferencing and HD video streaming, as well as latency-sensitive applications such as multi-user video conferencing.

Network resilience is defined as the ability of a country to provide internet services to its citizens at an acceptable level of service in the face of faults and challenges to normal operations.[35] Country-level fixed broadband network resilience depends on: (1) critical infrastructure resilience, (2) network/ISP resilience, and (3) market resilience.[36] While a country's communications network can always be made more resilient, and there most certainly are locations in the U.S. where resiliency is a concern, particularly those lacking broadband availability, the U.S. scores high on all three measures of resilience overall.

In terms of critical infrastructure, the U.S. generally has well-diversified power infrastructure supplied by approximately 3,300 electric utility companies. Nonetheless, there are some areas in the U.S., such as the Navajo Nation, where thousands of homes still lack electricity.[37] The U.S. also has well-diversified network cable infrastructure from approximately 340 cable ISPs. To ensure efficient and resilient routing of internet traffic, the U.S. also has 120 Internet Exchange Points (IXPs), the most of any country.[38]

In terms of network/ISP resilience, fixed broadband networks in the U.S. saw only small reductions in performance during the pandemic. Using data from multiple sources, Recon Analytics, a specialist consultancy, shows that broadband networks withstood both the sudden shift and increase in demand. In fact, wireless download speeds are twice as fast as before the pandemic and fixed download speeds increased more than 30%.[39] The Broadband Internet Technical Advisory Group (BITAG) similarly found nothing to suggest the internet did not meet users' needs.[40] BITAG noted that infrastructure operators and ISPs responded to the sudden increase in internet application and network usage by quickly adding server, interconnection, and last-mile access network capacity at rates far beyond pre-pandemic levels. BITAG did find that home Wi-Fi networks performed less well because of increased bandwidth demand and more connected devices.

Network/ISP resilience also rests on cybersecurity measures that prevent denial-of-service attacks or theft of personal information. According to the 2020 International Telecommunication Union Global Cybersecurity Index, which factors in multiple network security measures, the U.S. ranked first globally.[41] In terms of the number of secure servers per million people, the U.S. ranked third

for the number of secure servers per million people, behind Denmark and the British Virgin Islands, with 141,460 secure servers per million.[42] Cybersecurity does come with a cost. Cisco reported that 50% of large enterprises with 10,000 or more employees spent $1 million or more annually on network security in 2019.[43]

The U.S. also shows strong market resilience. While competitive options vary significantly by location, the U.S. has a large number of fixed broadband providers. In addition, the U.S. is a global leader in the development and deployment of next-generation connectivity technologies. As discussed in section III, fixed broadband ISPs offer an increasing array of technology options to subscribers. In addition, fixed broadband pricing is increasingly dynamic, with private sector programs, such as Comcast's Internet Essentials program, and government programs, such as the FCC's Affordable Connectivity Program (ACP), providing discounted services for qualified low-income households.

C. Human Aspects: The Broadband Adoption Gap

1. The Gap Between Fixed Broadband Availability and Adoption Persists

The lack of universal fixed broadband internet availability is but one of the problems in achieving universal broadband for all U.S. residents. The fixed broadband adoption rate, as measured by fixed broadband subscriptions as a percentage of U.S. households, has been flat over recent years while existing users are enjoying faster speeds.

The three main government sources for fixed broadband adoption data include the FCC Form 477 Internet Access Service Reports, U.S. Census Bureau's American Community Survey (ACS), and the FCC Communications Marketplace Reports. The most recent reports on fixed broadband adoption date from December 2018,[44] December 2019,[45] and December 2020,[46] respectively. The Pew Research Center also provides useful and more recent information on broadband adoption and internet use.

Existing broadband customers are upgrading to faster broadband plans, but overall growth in broadband adoption has slowed significantly.

Overall, while we see that existing broadband customers are upgrading to faster plans, growth in fixed broadband adoption has slowed significantly. According to the FCC, between 2017 and 2018, excluding satellite, fixed broadband subscriptions grew by 1.03 percentage points, representing 2.4 million additional households; between 2018 and 2019, they grew by 2.01 percentage points or 3.4 million additional households (Figure 3).

Pew Research Center surveys conducted in 2021 with a much smaller sample than FCC and U.S. Census data reveal a significant slowing in the growth of home fixed broadband connections beginning in 2013, increasing by only three percentage points to 73% in 2019. However, Pew's latest survey shows that fixed broadband connections grew by 4 percentage points from 2019 to 2021 and now stand at 77%;[47] this growth might derive from increased demand for broadband internet during the COVID-19 pandemic, as well as government-funded adoption programs.

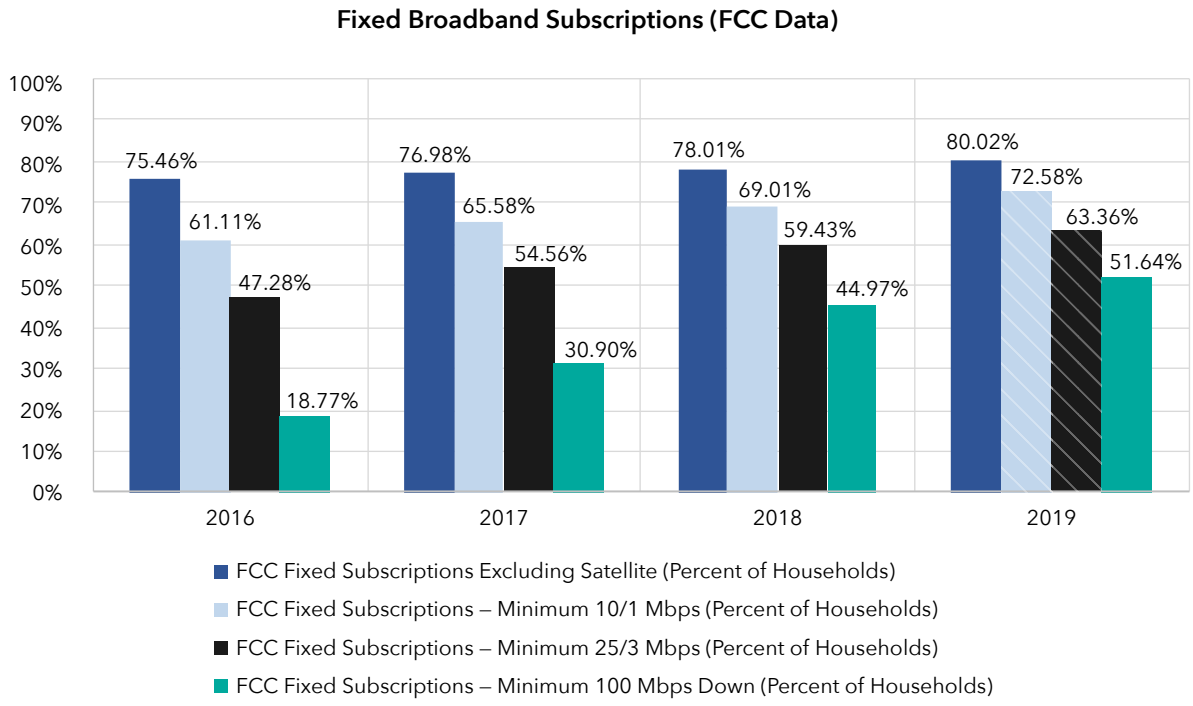
The ACS also shows slow fixed broadband adoption growth between 2016 and 2019 (Figure 4). The ACS survey identifies about 7% fewer connected households compared to FCC reports, even when some other technologies, such as powerline communication and fixed wireless, are deleted from the FCC data.

ISPs' subscription data, as reflected in the FCC data, is generally more reliable than survey data, which can reflect question bias when users may not fully understand the speed of the service they have subscribed to, and sample bias when, for example, rural areas may be under-sampled, skewing results.

ISP data shows that, while new fixed broadband subscriptions are growing slowly, speeds that ISPs provide to subscribers are increasing. Household subscriptions to plans with minimum download speed capability of 100 Mbps nearly tripled between 2016 and 2019, jumping from 18.77% to 51.64%. In contrast, subscriptions with a minimum download speed capability of 25 Mbps and a minimum upload capability of 3 Mbps (25/3 Mbps) grew only 16.08 percentage points over the same period, from 47.28% to 63.36%.

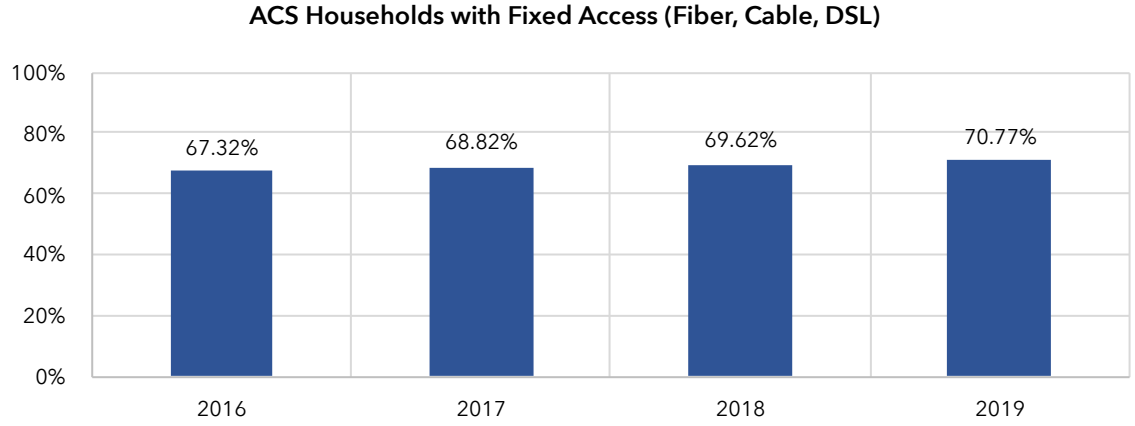
Although this section of the report tracks fixed broadband subscriptions, it is worth noting that in 2019 the ACS reported approximately 14.5 million U.S. households (11.3%) had only a mobile cellular data plan with no other type of internet access subscription.[48] The many reasons people have an internet-capable device and mobile internet service but not a fixed broadband subscription are discussed in a later section.

Figure 3: Fixed Access Broadband Subscriptions Overall and by Speed (2016-2019)



Note: Estimates for 10/1 Mbps and 25.3 Mbps are shown with a hash pattern
Source: FCC Internet Access Service Report (2019)[49]

Figure 4: Households with Fixed Access via Fiber, Cable, or DSL (2016-2019)



Source: U.S. Census Bureau's American Community Survey (2019)[50]

2. Gauging the Fixed Broadband Adoption Gap

The large broadband adoption gap stems from several factors, so fixed broadband infrastructure availability and adoption programs must take a multi-faceted approach to fully close the digital divide. Interestingly, more households with access to 25/3 Mbps broadband did not subscribe to it (71 million people according to our analysis) than there are households where fixed broadband is not available (43.7 million people according to BroadbandNow). This further demonstrates that both availability and adoption gaps need to be addressed to close the digital divide.

The broadband adoption gap for 25/3 Mbps in 2020 is estimated to be 21.6% (28 million households).

FCC data shows that the adoption gap for 25/3 Mbps has been slowly closing, decreasing from 44.6% of households in 2016 to 35% in 2018 (Figure 5). We estimate that the 25/3 Mbps fixed broadband adoption gap decreased further, to 32.4% by the end of 2020 (shown by hash pattern in Figure 5).

We refined our adoption gap estimate by combining FCC figures with BroadbandNow data on 25/3 Mbps availability and trendline modelling and predict that the 25/3 Mbps broadband adoption gap decreased from 34.4% (43 million households) in 2016 to 21.6% (28 million households) in 2020 (shown by a hash pattern in Figure 6).

Figure 5: Household Availability and Adoption Gap for 25/3 Mbps Broadband (2016-2020)

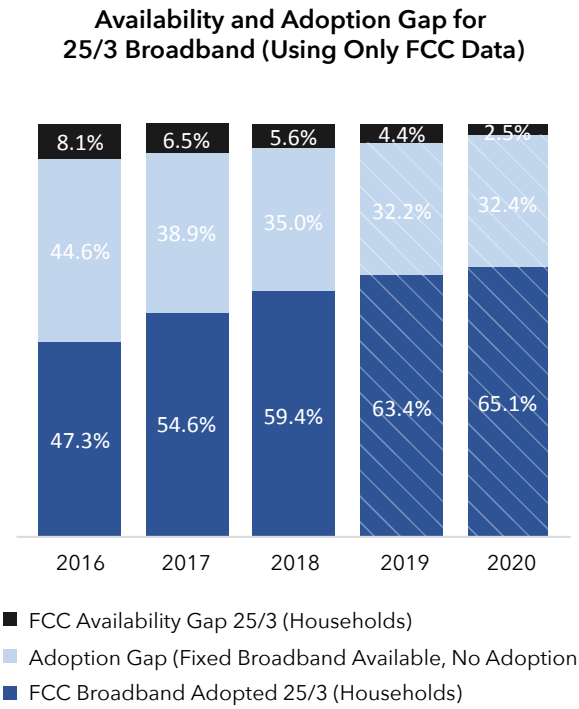
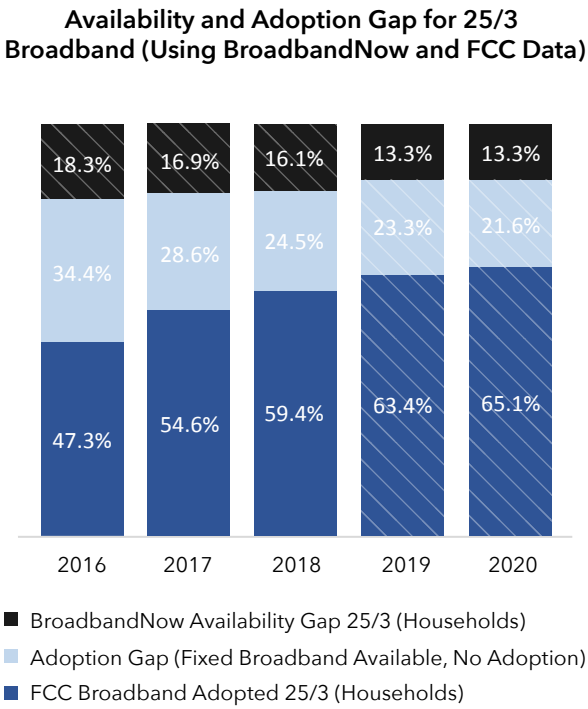


Figure 6: Household Availability and Adoption Gap for 25/3 Mbps Broadband (2016-2020)



Note: Estimates beyond 2018 make use of trendline modelling and are shown with a hash pattern

Source: FCC Form 477 data (2020)[51] and FCC Internet Access Service Reports (2018)[52]

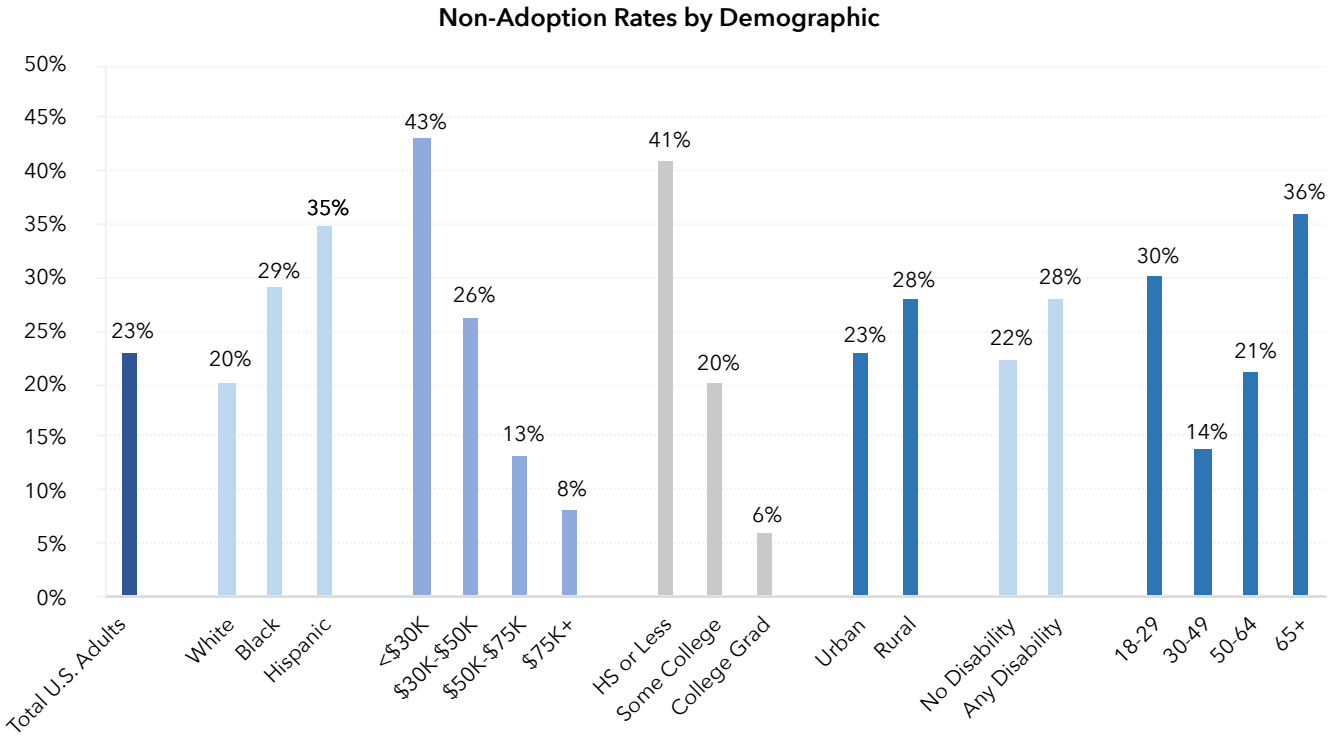
Sources: FCC Form 477 data (2020);[53] FCC Internet Access Service Reports (2018);[54] BroadbandNow data (2020)[55] and Vernonburg Group Analysis

3. Non-Adoption Is More Prevalent in Certain Demographics

Comprehensive fixed broadband infrastructure and adoption programs should be targeted and tailored to U.S. residents most vulnerable to the digital divide, chiefly older adults, lower-income households, less-educated individuals, persons with disabilities, rural residents, and/or certain ethnic minorities.

Pew Research Center's February 2021 survey found that 23% of U.S. adults do not have broadband service at home.[56] Household income and educational attainment remain the strongest contributing factors: 43% of adults living in households earning less than $30,000 a year and 41% of adults with a high school education or less do not adopt home broadband (Figure 7). Age also remains a strong factor: for U.S. adults ages 65 and older, 36% are not adopting home broadband. Where one lives is also strongly linked to home broadband adoption. More rural U.S. residents do not adopt home broadband compared to their urban counterparts (28% versus 23%). There are no statistically significant differences in non-adoption by gender but there are statistical differences in non-adoption by race and ethnicity. 29% of Black adults and 35% of Hispanic adults said they have not adopted home broadband, compared to 20% of White adults.

Figure 7: Non-Adoption Rates by Demographic



Source: Pew Research Center (2021)[57]

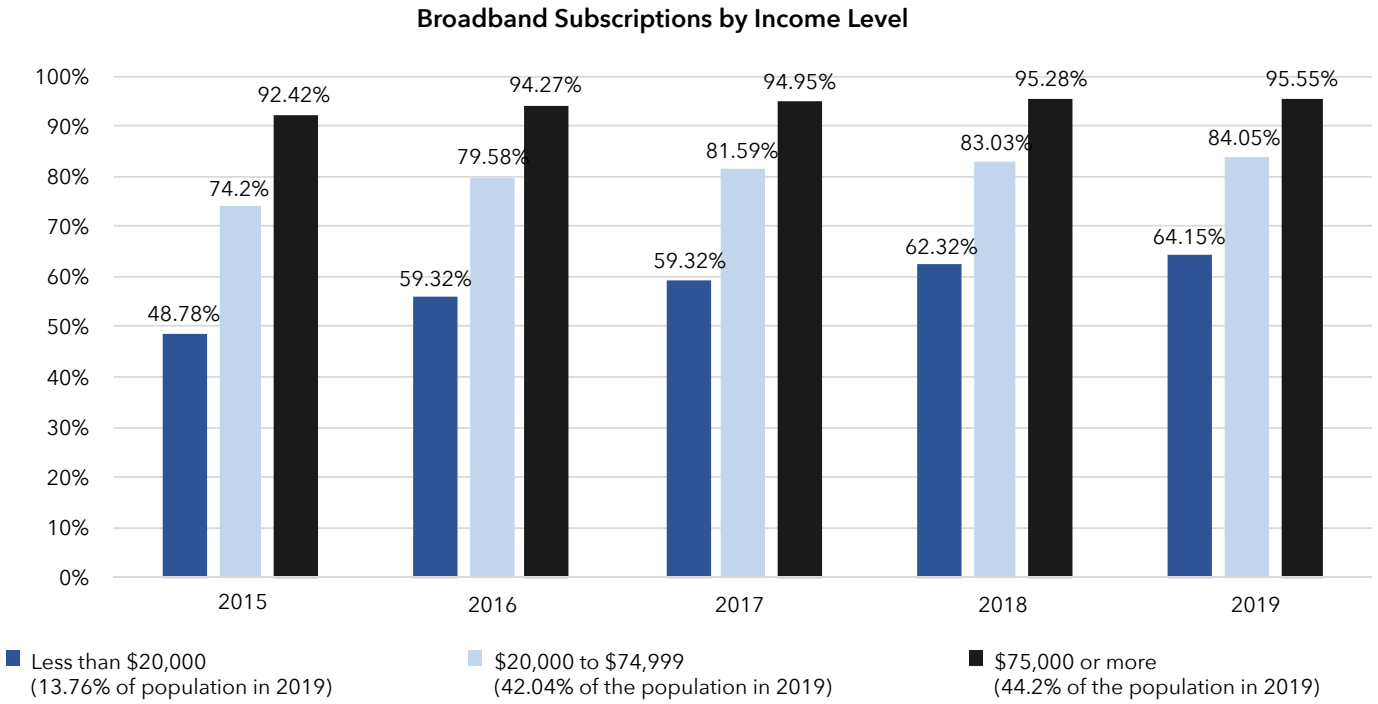
Broadband infrastructure and adoption programs need to ensure that they address the specific needs of historically vulnerable groups, including persons with disabilities and Tribal and low-income communities.

A recent Pew Research study found that U.S. residents with a disability are less likely than those without one to have a computer, smartphone, and home broadband.[58] 62% of adults with a disability versus 81% of adults without a disability owned a desktop or laptop computer, while 72% of adults with a disability versus 78% of adults without a disability had a home broadband connection. More than 40 million people in the U.S. have a disability, according to the U.S. Census Bureau, and that number is bound to increase as the population ages.[59] In addition, having a disability is correlated with having less income; therefore, these statistics also reflect age and income-level determining factors.

Tribal areas are some of the least-connected communities in the U.S. The American Indian Policy Institute found that only 49% of Tribal area residents had a fixed broadband service in 2020.[60] For example, the Navajo Nation confirmed that over half of all Navajo chapters lacked any form of broadband access in 2020, and where it was available, it was more expensive than elsewhere in the country. It is worth noting that several federal, state, and local programs target additional funding to increase broadband availability and adoption in Tribal areas.

The U.S. Census Bureau collects data on fixed and mobile broadband subscriptions by income level (Figure 8).[61] Broadband subscriptions for U.S. residents earning $75,000 or more per year only increased slightly between 2015 and 2019, from 92.42% to 95.55%. Although broadband subscriptions increased considerably over the same period for U.S. residents earning less than $20,000 per year, from 48.75% to 64.15%, a more than 30 percentage point gap in adoption remains between the highest and lowest income groups.

Figure 8: Broadband Subscriptions by Income Level (2015-2019)



Source: U.S. Census Bureau American Community Survey (2019)[62]

4. Fixed Broadband Affordability Is a Central Issue

While the cost of fixed broadband services creates a barrier to adoption for low-income households, the share of those citing "affordability" as the primary barrier has decreased in the past decade according to the U.S. Census Bureau, Pew Research Center, and other studies.

US Telecom, a broadband trade group, reports that the U.S. weighted-average price for entry-level broadband offered in urban areas by the top 14 fixed "wireline" or cable, fiber optic, and DSL broadband ISPs was $35.13 per month in 2021. The U.S. weighted average price for subscriptions to the most popular speed tiers was $48.42 per month.[63]

Those entry-level or popular subscription costs may remain out of reach for households living in poverty. In the U.S. in 2019, 39.4 million individuals (12.3% of the population or approximately 15.6 million households) lived below 100% of the poverty threshold and 92.4 million individuals (28.9% of the population or approximately 36.5 million households) lived below 200% of the poverty threshold.[64] As detailed in Table 1, assuming that a household can afford to spend up to 1% of its monthly income on fixed broadband connectivity, a one-person household living at 100% of the poverty line could spend up to $10.73 per month on fixed broadband. At 200% of the poverty line, they could spend up to $21.47 per month on a fixed broadband connection.

To address the unaffordability issue, private sector and government programs provide discounted services for low-income households. A lot can be learned from the nation's longest running broadband adoption initiative, Comcast's Internet Essentials program. It provides 50/10 Mbps fixed broadband service for $9.95 per month, as well as low-cost Google Chrome or Microsoft Windows 10 laptops, to eligible low-income households.[65] It can also provide 100/10 Mbps for $29.95 per month, where available.[66] Thus, the Comcast program has provided affordable fixed broadband to over 10 million U.S. residents, without any government subsidies, which is a tremendous accomplishment.[67] Other ISPs also offer comprehensive affordable fixed broadband adoption programs. For example, through its Connect2Compete program, EveryoneOn (in collaboration with Cox Communications and Mediacom) charges low-income households between $10 to $20 per month for internet connectivity and has connected over 890,000 U.S. residents.[68]

To help more low-income families adopt broadband, the FCC's Affordable Connectivity Program (ACP) offers monthly subscription subsidies to households living at or below 200% of the poverty line and a one-time benefit to defray the cost of an internet-capable device, as discussed later. The ACP follows the FCC's highly successful Emergency Broadband Benefit (EBB) program, which provided discounted broadband services to over 9 million U.S. households in a span of only eight months.[69]

A key question is whether these programs effectively address the fixed broadband affordability barrier for low-income households. A program like Comcast's Internet Essentials eliminates the affordability barrier for all but the most impoverished households. Assuming that a household should spend only 1% of monthly income on fixed broadband, at $9.95 per month the Comcast Internet Essentials program would be affordable for households with only one person roughly at or above the poverty line (household income of $12,880 per year spending less than $10.73 per month on fixed broadband internet access).[70] In cases where such a low-cost service is still unaffordable, the FCC's ACP would more than cover the difference.

While all ISPs should be encouraged to implement affordable programs for low-income households, not all ISPs have implemented such programs. Assuming a market rate of $50 per month for entry level 25/3 Mbps fixed broadband (though many ISPs now offer significantly higher speeds at that price point), a $30 per month ACP discount would make fixed broadband affordable for one-person households with incomes higher than approximately 200% of the poverty line ($25,760 per year) and spending 1% of their monthly income ($21.47 per month) on broadband. States, municipalities, and local governments, therefore, could make broadband affordable for most residents living below 200% of the poverty line by providing an additional monthly subsidy. They could use federal broadband funding to simply "top up" the ACP benefit to $50 per month for all households below 200% of the poverty line, for example. They could also provide higher subsidies to lower income households, such as a $10 "top up" for all households at or below 200% of the poverty line, and an additional $10 "top up" for households at or below 100% of the poverty line.

Given that households comprised of more than one person generally share a fixed broadband connection, we estimate the following subsidy "top up" costs based on household poverty levels presented earlier. The cost to provide $10 monthly "top up" subsidies to 36.5 million households living below the 200% poverty line is approximately $4.4 billion per year, and the cost to provide additional $10 monthly "top up" subsidies to 15.6 million households living below 100% of the poverty line is approximately $1.9 billion per year. The combined annual cost of these subsidies is $6.3 billion.

States, cities, and local governments can help close the affordability gap by "topping up" support available under the Affordable Connectivity Program.

To ensure funding reaches the most vulnerable households, subsidies should be prioritized. For example, four- or five-person households earning between 100% and 200% of the poverty threshold may be able to afford $20 per month fixed broadband for home internet access and could be categorized as low priority, whereas a one-person household earning below 100% of the poverty threshold may not be able to afford $20 per month and could be categorized as high priority. Table 1 below suggests a way of prioritizing additional subsidies beyond the $30 per month FCC ACP for different household sizes.

Table 1: Household Need for Additional Subsidies Beyond the $30 FCC Affordable Connectivity Program Assuming 1% of Monthly Income Spent on Fixed Internet Access (48 Contiguous States and the District of Columbia)

Household Size	100% Poverty Threshold	200% Poverty Threshold	25/3 fixed monthly home internet access affordability threshold for 100% poverty threshold	25/3 fixed monthly home internet access affordability threshold for 200% poverty threshold	Earning less than 100% of the poverty threshold		Earning between 100% and 200% of the poverty threshold	
					Household priority for $10 subsidies	Household priority for additional top up $10 subsidies	Household priority for $10 subsidies	Household priority for additional top up $10 subsidies
1 person	$12,880.00	$25,760.00	$10.73	$21.47	high	high	medium	medium
2 people	$17,420.00	$34,840.00	$14.52	$29.03	high	high	medium	medium
3 people	$21,960.00	$43,920.00	$18.30	$36.60	high	high	medium	medium
4 people	$26,500.00	$53,000.00	$22.08	$44.17	medium	medium	low	low
5 people	$31,040.00	$62,080.00	$25.87	$51.73	medium	medium	low	low

Source: Vernonburg Group

We note that if only 25% of the 36.5 million U.S. households below 200% of the poverty line receive a subsidy for fixed broadband subscriptions and internet-capable devices, the ACP could cost as much as $4.198 billion per year. The current appropriation of $14.2 billion could run out in as little as three and a half years. As noted above, over nine million U.S. households signed up for the EBB program in only eight months, so ACP funding—with its expanded eligibility criteria—could very well run out much sooner. To ensure that broadband services remain affordable for low-income households, Congress should permanently fund the ACP and supplementary state and local programs. In addition, governments can encourage ISPs to continue voluntarily offering discounted services for those low-income households that cannot afford to pay monthly fees not covered by ACP and other government discounts.

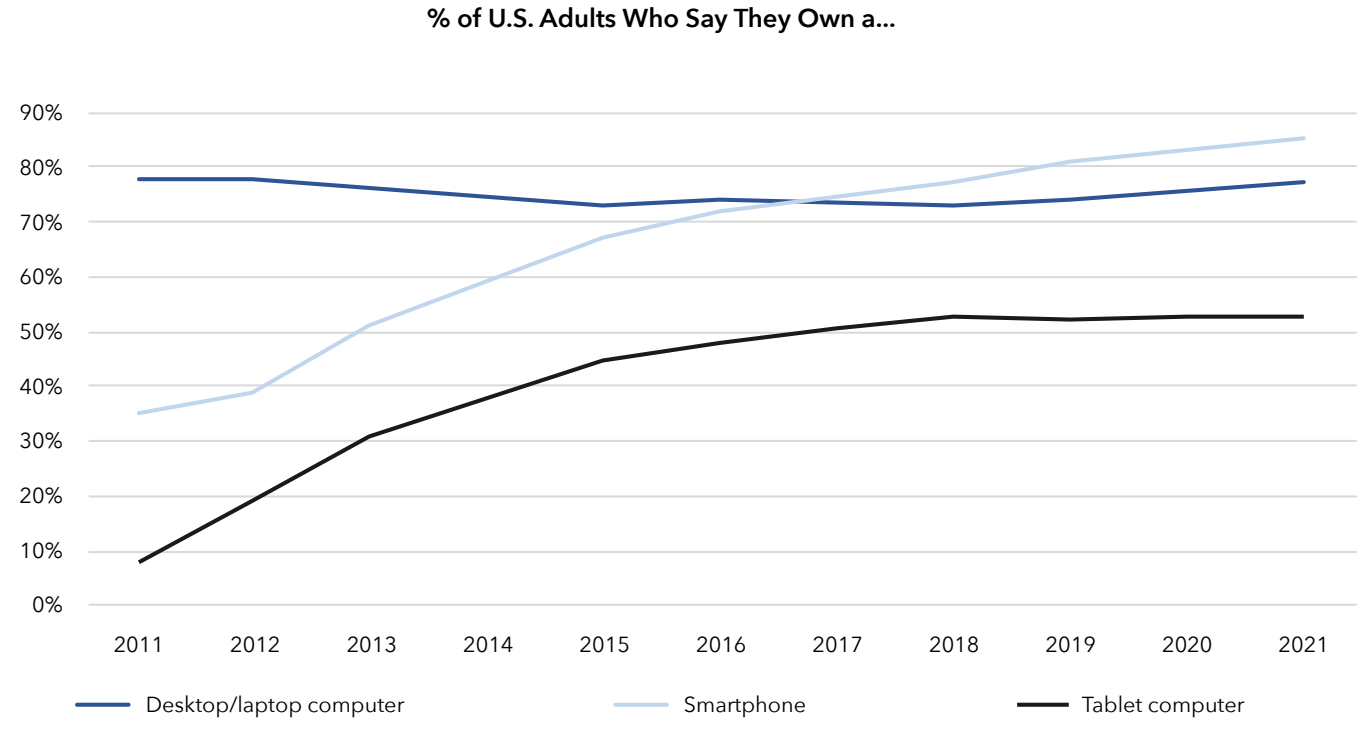
To ensure that broadband services remain affordable for low-income U.S. households, Congress should permanently fund the Affordable Connectivity Program and supplementary state and local affordability programs.

5. Lack of Device Ownership Is Also a Barrier to Fixed Broadband Adoption

Another barrier to broadband adoption is lack of internet-capable devices, such as laptop computers. While people who don't have their own, personal internet-capable device at home might be able to use the internet at an office, internet café, public library, or elsewhere, as we saw during COVID-19 pandemic lockdowns, having home fixed-broadband access and owning one's own laptop or tablet certainly motivates internet use and facilitates online education, working from home, and meaningful participation in the digital economy and society.

Similar to broadband adoption statistics, the percentage of U.S. residents that own an internet-capable device varies according to easily identifiable socioeconomic factors. Pew Research Center, which has conducted internet-capable device ownership surveys for the past decade, found in February 2021 that 77% of U.S. adults own a desktop or laptop computer, a percentage that has remained constant since 2008,[71] 53% own a tablet computer and 85% of own a smartphone. However, smartphone ownership falls to 61% for older adults (65+), 80% for rural residents, and 76% for those earning less than $30,000 per year.

Figure 9: Computing Device Ownership in the U.S. Over Past 10 Years (2011 to February 2021)

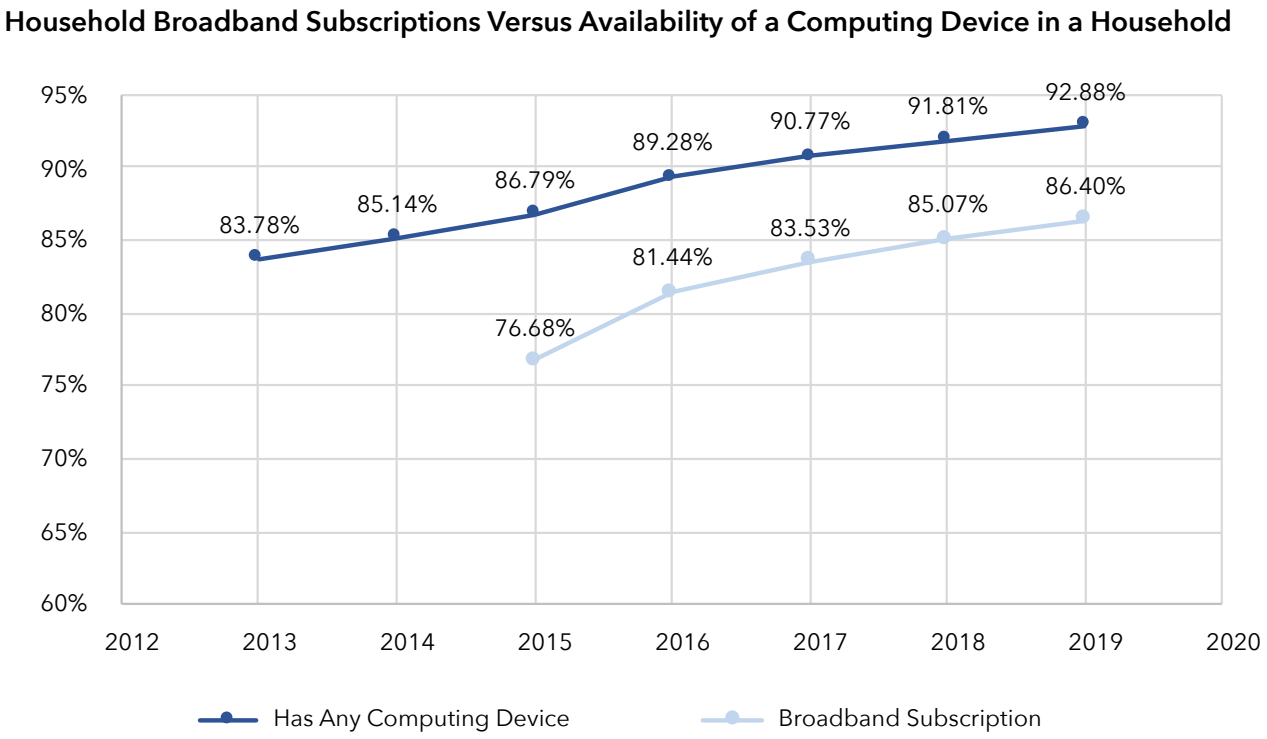


Source: Pew Research Center (2021)[72]

The U.S. Census Bureau's 2019 American Community Survey (ACS) of U.S. households finds device ownership rates similar to Pew's, pegging smartphone ownership at 86.59%, laptop or desktop at 77.32%, and tablet or other portable device at 61.45%. Household ownership of any kind of internet-capable computing device has increased from 8% to 92.88% over the past 12 years.

Interestingly, broadband adoption as measured by fixed or mobile subscriptions parallels household device adoption. In 2015, approximately 10.1% of homes had a device but no broadband connection, a gap that had narrowed to 6.5% in 2019. This shows that in addition to subsidizing infrastructure to extend fixed broadband availability and subscriptions to increase affordability, achieving universal internet use in the U.S. will depend on state and local government assistance to subsidize internet-capable device purchases. Federal programs like the ACP, as well as state, municipal, and local government digital equity programs, can be used to further close this device ownership gap.

Figure 10: Growth of Household Broadband Subscriptions and Computing Device Ownership (2013-2019)



6. Broadband at Community Anchor Institutions Should Be Open to All

We have been looking at how state and local governments can target funding and programs to close the fixed broadband adoption gap, and therefore residents' internet-use gap, by increasing fixed broadband availability, affordability, and access through internet-capable devices that can be used at home. Even with efforts to extend fixed broadband to more homes and make fixed broadband services and internet-capable devices affordable, some households will still choose not to subscribe. In addition, not everyone resides in a house or other officially recorded residence for an ISP to connect to. This includes community members who are unhoused, undocumented, or who reside in unlicensed housing.

A state, municipal, or local government's digital equity program should seek to better understand and overcome the unique challenges these communities face. One relatively easy solution to helping them access the internet is to provide connectivity at so-called "anchor institutions", locations where fixed broadband internet access via Wi-Fi and/or desktop computers are available for free public use. Wi-Fi-only provision allows only those who own internet-capable devices to use the internet. A broader program could allow access to desktop computers and/or allow residents to check out internet-capable devices which can connect to broadband over Wi-Fi and/or mobile broadband connections.

The installation of freely available fixed broadband access in public places, such as schools, libraries, healthcare facilities, and government buildings, will improve education and health outcomes, stimulate economic activity, and foster digital inclusion. Public provision of free Wi-Fi and fixed connectivity in public places will also strengthen community resilience to lockdowns, should they again occur. Consistent with the IIJA, state, municipal and local government fixed broadband infrastructure and digital equity

programs should ensure that anchor institutions have high-speed connectivity. Some anchor institutions, such as schools and libraries, should be used to teach skills needed to capably use the internet, such as basic and advanced literacy and so called "digital skills", i.e., operating computers and other devices and using online services.

Furthermore, and regardless of residential broadband adoption, high-speed fixed broadband internet access in schools and/or public libraries can improve learning outcomes. It can also increase the effectiveness and efficiency of healthcare facilities by enabling automated records management and improving access to care via telehealth consultations with doctors and other health specialists.

Therefore, to maximize digital equity, inclusion, learning, health, and achieve other meaningful outcomes, states and localities should allocate a portion of federal funding towards infrastructure within public, and some private or non-profit, anchor locations. This means that every library and recreation center should have free access to fixed broadband internet along with a computer lab and a maker lab. Every hospital and clinic should be equipped with fixed broadband internet access for internal and patient use. All anchor locations must offer technology freely accessible by disabled persons. Public-private partnerships may be tapped to fulfill such expansive and equitable needs. For example, Comcast's Lift Zone initiative has created over 1,000 Wi-Fi-connected community centers nationwide. While Lift Zones are primarily designed to help provide low-income students with a safe, clean space to participate in distance learning or to do homework, anyone can use them.[74] In 2021, Lift Zones enabled students to complete over 25 million hours of homework and remote education.[75] In addition to Comcast, many smaller ISPs around the country created free community Wi-Fi hotspots in low-income communities during the COVID-19 pandemic.[76]

According to EducationSuperHighway, a non-profit working to close the digital divide, the classroom connectivity gap is essentially closed, as 99% of K-12 schools in the U.S. had a high-speed fiber connection to the internet in 2019.[77] This was achieved through decades of state and local investment in schools' broadband networks and the modernization of the federal E-Rate program in 2014.

While this is an excellent development, it cannot be confirmed yet because up-to-date data about community anchor institution broadband availability and adoption is lacking. Currently, FCC Form 477 data collection processes, or processes by any other federal agency fails to capture anchor institution broadband data. To remedy this gap, the Schools Health and Libraries Broadband (SHLB) Coalition, an organization representing the interests of anchor institutions, has called for the new 2020 Broadband Deployment Accuracy and Technological Availability Act, or Broadband Data Act, to incorporate a provision to collect data on all serviceable locations, including schools, libraries, healthcare providers, higher education institutions, public housing, community centers, and other community anchor institutions.[78] In addition, the IIJA's data collection requirements, which include semiannual reports with details on anchor locations, should help provide a clearer picture soon of the current broadband availability and adoption status for anchor institutions.

In another excellent development, at SHLB's request, the 2020 Accessible, Affordable Internet for All Act also includes funding for gigabit capacity connections to every community anchor institution.[79] Reliable data and gigabit connectivity for institutions are good ideas, and state, municipal and local governments could fund these activities with existing federal appropriations.

III. Overview of Fixed Broadband Technologies

First-generation broadband services—initially defined in 1996 by the FCC as anything that delivered throughput of over 200 kbps in each direction—were delivered over reengineered copper loops. To deliver fixed broadband access today, an ISP has a variety of technologies from which to choose, ranging from fiber optic and coaxial cable connections to terrestrial fixed wireless access (FWA) and satellite communications. These technology options continuously evolve and expand. The mix of technologies ISPs choose to deliver last-mile broadband access depends on a variety of factors, including the geographic characteristics and population densities of the area(s) of intended service, the cost of deploying and maintaining infrastructure and services, and the availability of public subsidies.

High-capacity fiber optic, coaxial cable, and emerging higher frequency wireless technologies typically prove most cost-effective in high-density suburban and urban areas. In less dense suburban and rural areas, ISPs often find that terrestrial (i.e., non-satellite) fixed wireless technologies most cost-effective for last mile broadband connectivity. These fixed wireless technologies operate on low-band (e.g., TV white spaces[80]), mid-band (e.g., 2.5 GHz, 3.5 GHz, 5 GHz bands), and high-band spectrum (e.g., 6 GHz bands and millimeter-wave bands). The low bands are good for long-range connections in rural locations and the high bands are good for short-range, high-throughput connections in urban locations. Fourth Generation (4G) and Fifth Generation (5G) mobile technologies have been adapted for fixed wireless connectivity and are being deployed across these spectrum bands, especially those identified for International Mobile Telecommunications (IMT) by the 3rd Generation Partnership Project (3GPP).[81] ISPs also successfully deploy other proprietary terrestrial fixed wireless access (FWA) technologies on these bands. In some of the most remote and rural areas, satellite communication technologies prove most cost-effective.

New developments are creating more last-mile access options for ISPs. For example, new high-capacity terrestrial FWA solutions can now be utilized in more places, including in high density urban areas. For better coverage in rural areas, ISPs are testing other innovative solutions, such as high-altitude platform stations (HAPS) that deploy drones and balloons. In addition, new Non-Geostationary Satellite Orbit (NGSO) Low-Earth Orbit (LEO) satellite solutions promise to bring internet connections with lower latency and higher throughput to locations around the world.

Table 2 summarizes different last-mile access technologies that an ISP could utilize to bring broadband access to customers in various locations. All of these technologies can deliver 25/3 Mbps broadband, although some terrestrial and satellite services will sometimes fall short because of capacity limitations and other factors. As noted earlier, many new funding programs, such as the USDA ReConnect program, direct support to areas lacking access to 100/20 Mbps connectivity. Apart from geostationary earth orbit (GEO) satellite connectivity, each of these technologies can deliver these speeds with low latency.

Some argue that all locations lacking access to 100/100 Mbps should be eligible for subsidies and that only ISPs deploying networks that can deliver 100/100 Mbps connectivity should be eligible for funding. Fiber-optic connections can deliver 100/100 Mbps connectivity. Coaxial cable networks traditionally can only deliver asymmetrical connectivity; however, the evolution of the Data Over Cable Service Interface Specification (DOCSIS) has seen increased download and upload speeds. For example, current generation DOCSIS 3.1 offers theoretical speeds of 10 Gbps download and 1-2 Gbps upload. These theoretical cable speeds are, however, hard to meet because of signal degradation due to old cable, long cable runs, and sharing capacity with other users and other TV channels. DOCSIS 4.0 promises significantly increased upload speeds compared to DOCSIS 3.1.[82] According to CableLabs, a non-profit research laboratory, DOCSIS 4.0 technology promises up to 10 Gbps download capacity and up to 6 Gbps upload capacity, allowing for multi-gigabit symmetric services over hybrid fiber-coaxial networks.[83] Cable ISPs are taking steps to implement the technology in the coming years.[84] Likewise, with enough available spectrum, fixed wireless technologies can be configured to deliver symmetrical 100/100 Mbps throughputs. At this point, it is not clear that satellite connectivity will be able to deliver these throughputs at scale. New LEO satellite technology has shown the ability to deliver speeds in excess of 100/20 Mbps,[85] but some modelling studies show that LEOs will meet these speeds in the future only if the number of LEO network users remains limited.[86]

There is no one-size-fits-all solution or any rationale to strictly adhere to a specific technology or product. One can see how ISPs would utilize different technologies and products for customers located in different urban, suburban, and rural areas. ISPs operating in urban areas will primarily deploy fiber optic and coaxial cable networks, complemented with fixed wireless technologies in higher spectrum bands, in order to offer more throughput and serve more customers simultaneously. In rural areas, ISPs will rely more on fixed wireless technologies, using lower spectrum bands that have signals that can travel over longer distances, and, in very low-population-density rural areas, will utilize a growing variety of satellite communications technologies.

Table 2: Last Mile Technologies for Broadband Access

Broadband Technology	Typical Delivered Throughput	Speed	Latency	Reliability	Costs	Notes	Examples of Providers
Fiber to the Home	50 Mbps to 1 Gbps download and upload					Pros: Highest throughputs Cons: High cost to deploy (CAPEX)	AT&T, Verizon, Lumen, Frontier
Coaxial Cable	50 Mbps to 1.2 Gbps download; 5 Mbps to 200 Mbps upload					Pros: Very high throughputs Cons: High cost to deploy new builds (CAPEX); upgrades to existing facilities will cost much less (HFC already deployed to 90% of U.S. households)[87]	Comcast, Charter, Cox, Altice
5G Fixed Wireless	5-500 Mbps download; 2.5-250 Mbps upload					Pros: Mature technology ecosystem Cons: Requires licensed spectrum, high entry barriers	AT&T, Verizon, T-Mobile
Other Non-3GPP Fixed Wireless	5-500 Mbps download; 5-500 Mbps to upload					Pros: Lowest-cost options, low barriers to entry Cons: Less mature ecosystem	Wireless ISPs
LEO Satellite	5-100 Mbps download; 1-20 Mbps upload					Pros: Low-latency, high throughput Cons: Still in pilots, expensive to deploy	Starlink, Amazon Kuiper
GEO Satellite	2-50 Mbps download; 0.2 – 5 Mbps upload					Pros: Ubiquitous coverage Cons: High-cost, low throughput, high latency	Hughes, Iridium, ViaSat

Source: Vernonburg Group

Good Better Best

IV. Overview of Federal Broadband Funding Mechanisms

Given the growing importance of improved broadband access and adoption across the U.S., the federal government continues to provide financial support. Broadband funding programs are often designed to support the most vulnerable communities that remain unserved or underserved in terms of broadband connectivity and digital services. The following section reviews funding programs working to close the digital divide.

A. Historical Federal Programs

While most broadband network deployments are financed entirely by private sector entities, the U.S. federal government plays a vital role in supporting ISP efforts to provide broadband internet access services and in subsidizing the deployment of mobile and fixed broadband networks in locations where the costs are so high that networks and service cannot be profitably deployed. A 2020 Government Accountability Office report found that from 2009-2017, private capital investments in mobile and fixed telecommunications network deployments totaled $795 billion, while federal investments targeting broadband infrastructure over the same time period totaled $47 billion.[88] USTelecom reported that in 2020 alone, network capital investment reached $79.4 billion.[89] In rural areas, private capital investment often is lower as the population density does not yield the necessary revenues to justify upfront costs. As a result, government funding plays an important role in providing the necessary capital to bridge the digital divide. At the federal level, this has happened mostly through the Universal Service Fund (USF) under the FCC and the Rural Utilities Service (RUS) of the United States Department of Agriculture (USDA). The FCC USF and USDA RUS provide broadband funding through various grant and loan programs. A comprehensive broadband infrastructure and adoption program should ensure that these historical programs are optimized for ongoing support, including to critical anchor institutions, and that any funding overlaps are avoided. In addition, the American Recovery and Reinvestment Act (ARRA) provided funding for two federal broadband programs in 2009: the Broadband Technology Opportunities Program (BTOP) and the Broadband Initiatives Program (BIP).

1. Universal Service Fund—Federal Communications Commission

The USF consists of four programs that support broadband initiatives. The Connect America Fund provides support for eligible ISPs to help offset the higher-than-average costs of providing service in unserved rural and other high-cost areas. In 2019, this program was expanded to include the Rural Digital Opportunity Fund (RDOF) that targets unserved census blocks. Through RDOF, the FCC plans to commit $20.4 billion to bring high-speed fixed broadband service to rural homes and small businesses in two phases. In December 2020, the FCC announced that the Phase I auction was complete with $9.2 billion awarded to 180 winning bidders to service areas lacking 25/3 Mbps broadband.[90] The FCC provided weighted scales to guide the bidding process related to both speed and latency requirements.[91] Nearly all the winning locations are expected to receive at least 100/20 Mbps with some bidders committing to provide gigabit-speed service. Phase II might award up to $11.2 billion to support broadband access in areas determined by the FCC's new mapping approach, the BDC. The timing for Phase II has yet to be determined by the FCC as of this report.

USF's Schools and Libraries (E-Rate) Program provides support for internet access for eligible elementary and secondary schools, as well as libraries. E-Rate has an annual program funding cap of $4.276 billion, subject to an annual increase for inflation.[92] The Lifeline Program subsidizes telephone and internet service costs for eligible low-income consumers. It offers up to $9.25 per month for eligible subscribers, $34.25 for those living on tribal lands. Finally, the Rural Health Care Program provides support to eligible rural healthcare providers for broadband services. This includes the Healthcare Connect program that provides a 65% discount on internet services to eligible recipients and the Telecommunications Program that awards funding based on the difference between urban and rural broadband rates enabling rural health care providers to obtain pricing that is comparable to corresponding urban rates for similar services. The annual budget for these two programs is $612 million, subject to annual inflation.[93] The Connected Care Pilot Program has $100 million to fund selected projects to provide services for connected healthcare over three years.

It is important to note that USF traditionally has not been funded through federal appropriations but instead has been funded by telephone service providers who pay a percentage of their interstate telecommunications revenues into the fund on a quarterly basis (based on what is known as the USF contribution factor). Over the years consumers have been switching to internet-based alternatives and telecommunications revenues have been declining in parallel. The FCC has repeatedly increased the contribution factor to make up for this decline and there have been numerous proposals to change how USF is funded.

2. Rural Utilities Service—United States Department of Agriculture

USDA's RUS focuses on improving broadband access in eligible rural areas, with eligibility requirements varying for unserved and underserved areas. Unlike USF, RUS is funded through annual U.S. congressional appropriations. Currently, RUS oversees five broadband programs. The Telecommunications Infrastructure Program finances projects through loans and loan guarantees in rural areas with a

population of 5,000 or less for construction, maintenance, or improvement of services. The ReConnect Program provides loans and grants to cover broadband costs in rural areas with the least access. The Rural Broadband Access Loan Program is like ReConnect in that it finances construction, improvement, and acquisition of facilities and equipment to provide service but uses loans and loan guarantees. The Distance Learning and Telemedicine Grant Program covers the cost of equipment and software to help rural users connect to teachers and medical service providers through grants. And last, the Community Connect Grants Program funds deployments of facilities and equipment in rural communities where it is not yet economically viable for the private sector to deliver service via grants. Applicants for this program must agree to provide free broadband service to critical community facilities for two years.

3. Other Broadband Programs—ARRA, BTOP, BIP

The American Recovery and Reinvestment Act (ARRA), signed into law by President Obama in February 2009, was enacted following the fallout from the Great Recession to provide "supplemental appropriations for job preservation and creation, infrastructure investment, energy efficiency and science, assistance to the unemployed, and State and local fiscal stabilization."[94] ARRA provided $7.2 billion to support broadband infrastructure programs.

$4.6 billion was allocated to the National Telecommunications and Information Administration (NTIA), a U.S. Department of Commerce agency, to support the implementation of the BTOP. The purpose of the program was to provide access to broadband service to consumers residing in unserved and underserved areas of the U.S., and to provide broadband education, awareness, training, access, equipment, and support, improve access to, and use of, broadband service by public safety agencies, and to stimulate the demand for broadband, economic growth, and job creation.[95] Support under BTOP was to target schools, libraries, medical, and healthcare providers, community colleges and other institutions of higher education, and other community support organizations, organizations and agencies that provide services to facilitate greater use of broadband by low-income, unemployed, aged, or otherwise vulnerable populations, and job-creating facilities. BTOP included earmarks for expanding public computer center capacity (not less than $200 million), innovative programs to encourage sustainable adoption of broadband service (not less than $250 million) and developing and maintaining a broadband inventory map (up to $350 million).[96]

An additional $2.5 billion in funding was provided to USDA's RUS for the BIP. The funding was made available for grants, loans, and loan guarantees for broadband infrastructure in the U.S.[97] At least 75% of this funding was designated to projects that serve rural areas without sufficient access to high-speed broadband to facilitate rural economic development.

B. Funding Related to COVID Relief

The COVID-19 pandemic brought to light the critical need for broadband services, motivating the government to act to reduce costs and provide emergency access. Altogether, Congress appropriated unprecedented amounts for broadband programs during the pandemic, with proposals to extend such programs as the pandemic transitions to a long-term consideration.[98]

1. Coronavirus Aid, Relief, and Economic Security Act

The Coronavirus Aid, Relief, and Economic Security (CARES) Act, enacted on March 27, 2020, provided funding for several programs related to connectivity in relation to the pandemic. $100 million was provided to the USDA's ReConnect Program that provides loans and grants for the construction, improvement, or acquisition of facilities and equipment needed to provide broadband service in eligible rural areas. CARES also established the COVID-19 Telehealth program, run by the FCC, with an initial funding amount of $200 million. These funds were used to reimburse providers for broadband services and equipment used to deliver telehealth during the pandemic. Educational institutions struggling to support online learning also received financial support from CARES.[99] The CARES Act allocated to elementary and secondary education institutions up to $13.2 billion in the form of state grants, 90% of which were then distributed to local educational agencies.[100] The CARES Act made available another $14.25 billion to colleges to defray increased costs during the pandemic, including technology for distance learning. The Institute of Museum and Library Services (IMLS) was also provided $50 million from the CARES Act to expand digital network access in areas of the country that were lacking, including a provision for the purchase of internet-capable devices.

2. Consolidated Appropriations Act

In December 2020, the Consolidated Appropriations Act (CAA) was enacted and included several funding initiatives that build upon what CARES established as well as created new initiatives to support broadband expansion in the U.S. The CAA funded several grant programs administrated by the NTIA to further the deployment and use of broadband and other technologies in the U.S. The goal is for these programs to lay the groundwork for sustainable economic growth, improved education, public safety, and health care

as well as the advancement of other national priorities. NTIA manages three grant programs: 1) Broadband Infrastructure Program ($288 million); 2) Tribal Broadband Connectivity Program ($980 million); and 3) Connecting Minority Communities Pilot Program ($268 million).[101] Both the Broadband Infrastructure and the Tribal Broadband Connectivity programs required broadband service with speeds of 25/3 Mbps and latency sufficient for "real-time, interactive applications."[102] While all three programs closed their funding periods during 2021, the Tribal Broadband Connectivity Program will get additional funding from the 2021 Infrastructure Act (detailed below), with others potentially receiving additional funding for future rounds of grants. CAA also appropriated an additional $250 million to the FCC's COVID-19 Telehealth Program.[103]

CAA also established the $3.2 billion Emergency Broadband Benefit (EBB) to help U.S. residents afford internet access services during the pandemic.[104] EBB provided qualifying low-income households with a $50 monthly subsidy (up to $75 for households on Tribal lands) towards broadband service and up to $100 for a connected device purchase (excluding cellular phones and smartphones). Qualifying households included those that had an income at or below 135% of the federal poverty guidelines or participated in assistance programs, received free/reduced-price school lunch, received a Federal Pell Grant in 2021, experienced substantial income loss in the last year, or participated in a provider's existing low-income or COVID-19 program.[105] The EBB has now transitioned to the ACP pursuant to the IIJA, detailed in a later subsection.

3. American Rescue Plan Act

The American Rescue Plan Act (ARP or ARPA) includes nine provisions that provide about $388.1 billion in flexible funding for a variety of digital equity activities.[106] Table 3 below shows the breakdown of the nine provisions.

Table 3: ARPA Funding to Address the Digital Divide

ARPA provision	Funding and Expiration	Primary Recipients	Physical Network Build-Out	Device Support	Broadband Connectivity Subscription Support	Digital Literacy Trainings
Elementary and Secondary School Emergency Relief Fund	$122.775 billion through Sept 30, 2023	Local educational agencies				
Institute of Museum and Library Services	$200 million until expended	State library administrative agencies				
Economic Adjustment Assistance	$3 billion through Sept 30, 2022	Department of Commerce, states, and communities				
Homeowner Assistance Fund	$9.961 billion through Sept 30, 2025	States, territories, and Tribal governments				
Emergency Connectivity Fund	$7.171 billion through Sept 30, 2030	Schools and libraries				
Coronavirus State Fiscal Recovery Fund	$219.8 billion through 2024	States, territories, and Tribal governments				
Coronavirus Local Fiscal Recovery Fund	$130.2 billion through 2024	Metropolitan cities, non-entitlement units of local government, and counties				
Coronavirus Capital Projects Fund	$10 billion until expended	States, territories, and Tribal governments				
Local Assistance and Tribal Consistency Fund	$2 billion through Sept 30, 2023	Revenue sharing counties and Tribal governments				

Source: Brookings analysis of ARPA[107]

Out of the $1.9 trillion in fiscal relief provided by the American Rescue Plan, approximately $362 billion was sent directly to states, counties, local municipalities, and Tribal governments.[108] The funding was allocated for pandemic response, including for necessary investments in water, sewer, and broadband infrastructure. Many states, cities, and local governments have already taken steps to utilize ARPA funds—a detailed breakdown of fund allocations can be found on the National Conference of State Legislatures' (NCSL's) website.[109]

Of the $130.2 billion Coronavirus Local Fiscal Recovery Fund, $45.570 billion was reserved to make payments to metropolitan cities and to be allocated using the formula under section 106(b) of the Housing and Community Development Act of 1974. $19.530 billion was reserved to make payments to states for distribution by the state to non-entitlement units of local government in the state. Finally, $65.1 billion was allocated to make payments directly to counties based on population.[110] Allowable uses of these funds include investments in broadband infrastructure and have a spending deadline of December 31, 2024.[108]

Under ARPA, Congress granted the U.S. Department of the Treasury (Treasury) broad discretion to utilize Coronavirus State and Local Fiscal Recovery Funds for digital inclusion activities.[111] Treasury's final rules permit Coronavirus State and Local Fiscal Recovery Funds to be used for broadband infrastructure projects and assistance to households to support internet access or digital literacy.[112] The funding emphasizes affordability, prioritizes unserved populations, and encourages investment in fiber-optic infrastructure where feasible. Broadband infrastructure projects can involve the construction and deployment of broadband infrastructure in areas that are underserved or unserved (i.e., those lacking access to a fixed connection that reliably delivers a minimum speed of 25/3 Mbps) and require deployment of fiber-based broadband infrastructure capable of delivering at least 100/100 Mbps symmetrical speeds, unless impracticable due to topography, geography, or financial cost.[113]

While significantly smaller at only $10 billion, the Coronavirus Capital Projects Fund also covers initiatives such as broadband mapping and subsidies to pay for home internet service.[108] The money for this fund is allocated in the form of state block grants, with all states, DC, and Puerto Rico receiving an allocation of $9.8 billion.[114] Another $100 million is divided among other U.S. territories and $100 million is earmarked for Tribal governments and Native Hawaiian entities. Eligible states, territories, freely associated states, and Tribal governments applied for their allocations through the Treasury Submission portal launched in Fall 2021 with an application deadline of Dec 27, 2021, for non-Tribal entities, and a deadline of June 1, 2022, for Tribal governments.[115] Using broad discretion given to it under the ARPA, Treasury determined that Capital Projects Fund dollars can be used for connectivity purposes under two types of projects:

1. **Broadband Infrastructure Projects:** The construction and deployment of broadband infrastructure projects are eligible for funding under the Capital Projects Fund program if the infrastructure is designed to deliver, upon project completion, service that reliably meets or exceeds symmetrical download and upload speeds of 100 Mbps. If it would be impracticable, because of geography, topography, or excessive cost, for a broadband infrastructure project to be designed to deliver services at such a speed, the project must be designed so that it reliably meets or exceeds 100 Mbps download speeds and between 20 Mbps and 100 Mbps upload speeds and be scalable to a minimum of 100 Mbps symmetrical for download and upload speeds. Treasury encourages recipients to focus on middle-mile projects that will achieve last-mile connections. Recipients considering funding middle-mile projects are encouraged to have commitments in place to support new and/or improved last-mile service.[116]

2. **Digital Connectivity Technology Projects:** The purchase and/or installation of devices and equipment to facilitate broadband internet access are eligible for funding under the Capital Projects Fund program where affordability has been identified by the recipient as a barrier to broadband adoption and use. Permitted devices and equipment include laptops, tablets, and desktop personal computers for distribution to members of the public through a short- or long-term loan program or to be made available for use in public facilities. Permitted equipment includes equipment installed as part of public Wi-Fi infrastructure (e.g., access points, repeaters, routers).[117]

The EBB and the Emergency Connectivity Fund set aside funding for digital equity programs, while the State and Local Fiscal Recovery Funds and the Capital Projects Fund permits funds to be used for both infrastructure deployments and for digital equity programs (specifically digital literacy assistance).

4. Infrastructure Investment and Jobs Act

On November 15th, 2021, President Biden signed into law the Infrastructure Investment and Jobs Acts (IIJA) that includes $65 billion to improve high-speed internet access and affordability.[118] The broadband funding in the bill is aimed at building high-speed internet networks, helping low-income families pay for service, and a digital equity program. IIJA will provide further funding to three current broadband programs, the EBB program (now called the Affordable Connectivity Program or ACP), ReConnect, and the Tribal Broadband Connectivity Grant Program, as well as fund entirely new broadband programs, as summarized in Table 4. Broadband funding from IIJA follows new broadband guidelines that discourage overbuilds while prioritizing unserved and underserved areas with deployed speeds of at least 100/20 Mbps.[119]

Table 4: IIJA Funding to Address the Digital Divide

IIJA provision	Funding and Expiration	Primary Recipients	Physical Network Build-Out	Device Support	Broadband Connectivity Subscription Support	Digital Literacy Trainings	Other
Broadband Equity, Access, and Deployment (BEAD) Program	$42.45 billion, until expended	States; Subgrants to cooperatives, non-profits, PPPs, private company, public or private utilities, local gov'ts					
Affordable Connectivity Program	$14.2 billion, until expended	Consumers -Households, Tribal households					
State Digital Equity Planning Grant Program	$60 million	States					
State Digital Equity Capacity Grant Program	$1.44 billion, $240 million for 2022 and $300 million each year 2023-2026	States					
Digital Equity Competitive Grant Program	$1.25 billion, distributed over 5 years	Political subdivisions; agencies responsible for adult education, literacy, workforce development; native American tribes; non-profits; community anchor organizations					
ReConnect	$2 billion	States, territories, and Tribal governments, corporations, LLCs/LLPs, cooperatives					
Tribal Broadband Connectivity Program	$2 billion	Tribal governments, organizations, colleges, or universities; Dept of Hawaiian Homelands; Native corporations					
Enabling Middle Mile Broadband Infrastructure Program	$1 billion, through Sept 30, 2026	States; Tribal governments; tech companies; public, private, and cooperative utilities; private companies; non-profits; regional planning councils; Native entities; economic development authorities					
Private Activity Bonds	$600 million	State and local government projects					

Source: Vernonburg Group

The NTIA has been given a key oversight role in how $42.45 billion in state funding will be spent via the Broadband Equity Access and Deployment (BEAD) program as the lead agency tasked with approving plans for broadband grants, including reviewing low-cost service options providers will be required to offer in order to receive funding.[120] An initial allocation of $100 million will be made to each state, the District of Columbia, and Puerto Rico and $100 million will be allocated to, and divided equally among, the U.S. Virgin Islands, Guam, American Samoa, and the Commonwealth of the Northern Mariana Islands.[121] This funding will be used to support planning efforts including building capacity in state broadband offices as well as supporting outreach and coordination with local communities.[122] To receive funding, states will need to submit a 5-year action plan in addition to initial and final proposals. The remaining funding will be distributed based on a formula that considers the number of unserved and high-cost locations in each state or territory.

Eligible entities (states) must direct funding to unserved areas (below 25/3 Mbps), followed by underserved areas (below 100/20 Mbps), and then to anchor institutions (below 1/1 Gbps).[123] In mid-May 2022, NTIA issued a Notice of Funding Opportunity ("NOFO") that directs eligible entities to submit letters of intent to participate in the BEAD program by July 18, 2022. The NOFO also sets out other relevant program deadlines and rules. In addition to requirements directly tied to broadband availability and adoption—the program's primary objectives--the NOFO imposes certain ancillary obligations on participants reflecting policy concerns that are largely unrelated to and risk distracting from that goal.[124]

Under the IIJA, Congress also created the ACP to replace the EBB Program. The new program is long-term, as compared to an emergency action, and totals $14.2 billion in funding at the time of its establishment. Both programs operate under a similar structure, providing monthly subsidies for household internet service. However, the ACP program offers a monthly subsidy of $30 compared to the EBB's $50, providing an opportunity for state, city, or local funding to make up the difference, but maintains the same device benefit.[125] Under both EBB and ACP, qualifying Tribal households receive $75 per month. The ACP also has slightly different qualifiers, including adding the Women, Infants and Children (WIC) federal assistance program as a qualifying program and raising the maximum eligible income to 200% of the Federal Poverty Guidelines for households.[126]

V. Broadband Funding Principles

While they have evolved over time, certain key principles have guided successful broadband availability and adoption programs over the last few decades. To allocate limited broadband funding as effectively as possible, states, cities, and local governments should follow nine broadband funding principles: (1) prudent administration and oversight, (2) targeted, (3) technology neutral, (4) broadband capable, (5) secure and resilient, (6) best value, (7) non-distortionary, (8) deployed quickly, and (9) equitable by design. These principles also inform our publication that summarizes this report, "A Handbook for the Effective Administration of State and Local Broadband Programs."[127]

1. Prudent Administration and Oversight

Programs should minimize red tape and only impose requirements on recipients that are necessary to achieve the defined objectives of the programs while ensuring their integrity. In situations where programs are likely to utilize multiple pools of grant money, the state, city, or local government's broadband office should work to streamline the application and reporting process to avoid duplicative work for the grantee. At the same time, state, city, and local broadband program administrators should implement robust accountability measures to protect public funds, avoid waste, fraud, and abuse, and protect taxpayers and consumers.

2. Targeted

Any broadband funding mechanism should be designed and limited to addressing known market failures, and should not allow other policy objectives to distract from the primary goal--bridging the digital divide. As discussed in greater detail above, high-quality granular data is critical to precisely revealing gaps in availability and adoption, which in turn will help state, city, and local program administrators determine where market failures exist, and fashion regulatory interventions narrowly tailored to address such failures. The data discussed above supports efforts to prioritize as unserved those communities lacking access to 25/3 Mbps broadband and then those underserved areas lacking access to 100/20 Mbps broadband with a requirement that ISPs make 100/20 Mbps broadband available to all residents. This is the same approach taken in the IIJA. Similarly, efforts to close the adoption gap should prioritize communities with the lowest rates of broadband adoption—older adults, persons with disabilities, lower-income households, households located in rural areas, and minority groups with low rates of adoption—and each intervention focused on adoption should be tailored to each community's particular needs.

3. Technology Neutral

Broadband funding should be made available on a technology neutral basis. To promote a technology neutral framework, states, cities, and local governments should tailor the language in their grant programs to reflect the needs of their constituents in a reasonable and prudent manner. For example, recent guidance from the United States Department of Treasury under the Coronavirus State and Local Fiscal Recovery Funds and NTIA under the IIJA BEAD program encourages grantees to prioritize funding for projects deploying fiber-optic facilities, but each program allows program administrators to consider less expensive alternative technologies where deployment of fiber infrastructure is not "feasible" (e.g., accounting for topography, geography, and financial costs).[128] In addition, states, cities, and local governments should avoid facially neutral rules that have a discriminatory intent or outcome. For example, a 100 Mbps symmetrical broadband definition might be facially neutral, but it does not reflect how most customers consume digital content and would end up disqualifying non-fiber based broadband providers even when the technology will allow a user to do everything they need or want to do online. By narrowing the scope of eligible technologies and providers, a 100 Mbps symmetrical broadband definition would reduce competition for subsidies and increase program costs.

4. Broadband Capable

Both current and proposed networks should be required to meet at least the FCC-defined speed for broadband, both on an advertised and actual basis. As discussed above, the FCC's current broadband definition of 25/3 Mbps was adopted in 2015 based on "advances in technology, market offerings by broadband providers, and consumer demand." When the FCC adopted the current 25/3 Mbps broadband definition, it noted that approximately 87% of U.S. residents had access to 25/3 Mbps broadband. Similarly, today approximately 76% to 89.6% of U.S. residents have access to 100/20 Mbps connectivity. A 100/20 Mbps connection enables each member of a household to simultaneously run a variety of high-capacity, latency-sensitive applications, such as HD video streaming, video conferencing, and online gaming. Of course, there will be a small subset of households that require more throughput and lower latency, but that should not be the basis for a baseline broadband definition used to develop policies guaranteeing access for all U.S. households. For these reasons, a 100/20 Mbps broadband definition can be well justified. A 100/20 Mbps broadband definition aligns with the goals of new broadband funding programs, such as the IIJA BEAD program that requires fund recipients to deliver at least 100/20 Mbps connectivity. Based on evidence detailed in this report, the U.S. Department of the Treasury lacks a factual basis for its "requirement that eligible projects be designed to, upon completion, reliably meet or exceed symmetrical 100 Mbps download and upload speeds" as part

of Coronavirus State and Local Fiscal Recovery Funds.[129] Unfortunately, the USDA ReConnect Program also has a similar requirement.[130]

5. Secure and Resilient

The COVID-19 pandemic has tested the resilience of the infrastructure of the internet. As discussed in Section II.B., the U.S. scores high on all three measures of resilience (i.e., critical infrastructure reliance, network/ISP resilience, and market resilience). In addition, the U.S. performs better than most countries in the world in measures of cybersecurity preparedness (i.e., its ability to ensure that networks do not fall prey to Denial-of-Service attacks or theft of personal information).

Nonetheless, there is no room for complacency when it comes to resiliency and cybersecurity. Broadband fund recipients should be required to deploy technologies and implement measures to optimize their critical infrastructure and network resilience and implement best-in-class cybersecurity measures. To that end, the IIJA BEAD program obligates subgrantees to implement prudent cybersecurity and supply chain risk management practices, broadband infrastructure reliability and resiliency best practices, and prohibitions on purchase or support of covered communications equipment or services.[131] Other programs should do the same.

6. Best Value

To minimize costs while aligning on desired and integrated outcomes, funding amounts should be determined through a competitive bidding process (the FCC's use of reverse auctions is an example of such a mechanism), a scoring system that balances project costs and other factors such as service quality or speed of network deployment, or by some combination of the two. The IIJA will require competitive bidding for BEAD funds, and we encourage such a system for other programs.

7. Non-Distortionary

Any program should aim to minimize market distortions in how funds are collected and how they are distributed. Examples of market distortions would be targeting support to places where unsubsidized commercially sustainable networks can be deployed, choosing to fund only one technology solution when equally capable less costly solutions are available, or requiring certain market participants to internally cross subsidize the cost of deploying networks in high-cost and other commercially infeasible areas. A prime example of the cost of market distortion is the Australian government's "once-in-a-lifetime" funding of a future-proof Fiber to the Premises (FTTP) network through the National Broadband Network (NBN).[132] In this instance, the labor market for skilled fiber installation was greatly distorted by compressing two decades worth of network deployment into just a few years, driving estimated project costs from $29.5B in 2013 to $51 billion in late 2018.[133] This principle also further reinforces the technology neutrality principle.

8. Deployed Quickly

Preference should be given to broadband providers that commit to rapid deployment of broadband networks and services, especially in areas deemed "unserved" or "underserved." Speed of deployment can be built into project scoring criteria, as will be required in the IIJA BEAD program. Program administrators could release funds more quickly to fund recipients that achieve milestones ahead of schedule. Furthermore, additional preference should be given to broadband providers committing to address the adoption gap quickly though digital literacy, affordable services, and devices, along with any other means necessary.

9. Digital Equity By Design

Efforts to close the digital divide must account for underlying social and economic inequities. Equal access will not necessarily address inequitable access. Much like other forms of inequality, digital divides continue to disproportionately impact people who are: lower income; located in rural areas; are less educated; lack digital skills; older; and from vulnerable groups such as persons with disabilities and ethnic minorities. Programs should be designed to address digital inequities; for example, giving ISPs participating in infrastructure deployment programs bidding credits for targeted interventions to increase adoption for vulnerable groups.[134] In addition, states, cities, and local governments can award digital equity grants to companies, non-profits, and other community-based groups implementing broadband and digital technology adoption programs, as is envisioned under the CARES Act, ARPA, and the IIJA.

Both Minnesota and Michigan award broadband infrastructure grant applicants points for their efforts to increase digital equity.

VI. How to Apply the Principles and Take Nine Steps Toward Effective Fixed Broadband Programs

States are now in the enviable position of having the funding needed to address many of the market failures that leave some communities without access to fixed broadband and/or unable to subscribe to the internet and use digital services. One note of caution comes from past experience: many governments' broadband deployment and adoption programs have proven unsuccessful.

To increase their likelihood of success, broadband offices must include appropriate guardrails for grant and funding administration. This report is designed to help broadband program administrators see the big picture and act on details, including but not limited to the following suggestions. Fund administrators should develop a diverse pipeline of subsidy and subgrant applicants by proactively engaging small and medium-sized ISPs. Fund recipients should be required to deploy broadband throughout the funded service area. Subsidies should be open to all qualified competitors and available on a technology-neutral basis. Subsidies should be determined through a competitive process, such as the FCC's RDOF reverse auctions mechanism. Fund recipients should be held accountable for meeting quantifiable targets; they should also be rewarded for beating buildout deadlines. Mechanisms for funding universal-service subsidies should minimize marketplace distortions and ensure that funds are not diverted to other government programs. Finally, funds should be administered independently, with appropriate fiscal oversight. In this section, we tie these intentions and actions to nine principles and nine steps that will lead broadband program administrators toward broadband program success.

By leveraging the nine principles, (1) prudent administration and oversight, (2) targeted, (3) technology neutral, (4) broadband capable, (5) secure and resilient, (6) best value, (7) non-distortionary, (8) deployed quickly, and (9) equitable by design, state, municipal, and other local governments can implement effective and successful fixed broadband programs through prudent administration and oversight of targeted data-driven interventions that increase broadband availability and adoption while also increasing internet use and digital equity. In this section, we begin with a brief assessment of the administrative structures currently in place to implement and manage broadband programs and funding. We then lay out the nine steps state and local governments can take to create or strengthen their administrative capacity and we explain and show how administrators can most effectively implement CARES, CAA, ARPA, IIJA, and other funds according to the rules of each funding mechanism.

For ease of reference, in Appendix E, we include a briefer "snapshot" guide for successful state and local government implementation of a fixed broadband funding program. The snapshot guide is also included in an accompanying publication, "A Handbook for the Effective Administration of State and Local Broadband Programs."[135] The nine steps that follow expand on the steps listed in the fixed broadband program snapshot guide.

A. Prudent Administration and Oversight Rests on Structures and Plans

Although ISPs have been replacing dial-up connectivity with broadband services for most of the past two decades, state, municipal, and local government broadband offices, broadband funding, and formalized broadband planning remain very much in their infancy. For example, as of November 2021, the average age of all state offices is just under three years, with 46% of states having no office or one for less than a year, 28% of states having offices for two to five years, and only 26% having offices established more than five years ago.[136]

In addition to having a broadband office to serve as a central point of contact for broadband-initiatives coordination, it is also important for governments to financially support broadband availability and adoption efforts. Interestingly, more states lack a broadband office than broadband funding (46% of states lack an office versus 24% that lack a broadband fund). Furthermore, 18% of states have had funding between 1-2 years, 26% of states have had funding between 3-5 years, and 32% of states have had funding for over 5 years.[137]

Perhaps most importantly, state and local governments need formalized broadband plans. A good plan should set comprehensive, time-bound goals for administrations to rally around, and it should be co-created with key stakeholders, including localities and community service organizations. For state-level administrations, this will be a requirement of the IIJA's BEAD program, scoped over a five-year time horizon. As of November 1, 2021, 68% of states have published a broadband plan, although many lack clear time-bound goals, and even more fail to meet the IJJA five-year requirement through 2027.[138] Many of these plans also likely fail to meet the IIJA's procedural and substantive requirements.

Most, if not all, state and local broadband programs are funded predominately by federal funds that flow down through the various laws and programs. States and municipalities use non-federal funds to supplement the federal funding they receive. Federal funding is often allocated to lower-level governmental entities in the form of block grants that allow state and local entities to govern deployment specifics. This autonomy has led to distinct approaches to broadband programs and their deployment between and within states.

With so many broadband funding opportunities coming from so many diverse sources, critics have raised concerns surrounding funding duplication and overbuilding.[139] These same concerns can also unintentionally lead to the exclusion of unserved and underserved communities. It is important for federal, state, city, local, and tribal entities alike to strive to design programs that are not duplicative and avoid exclusion. We address these issues and other administrative concerns in detail in the nine steps toward effective broadband administration that follow.

Key Insights

- A single entity should be responsible for developing and overseeing implementation of a state, municipal, or local government's broadband strategy.
- Consistent with the IIJA, each state should develop a five-year broadband plan with clear, ambitious, and achievable policy-related commitments and quantifiable supply-side (availability), demand-side (adoption), and network resilience targets.
- State-wide, city-wide, and local broadband plans should be developed through an open and transparent process, with maximum input accounting for factors unique to the locality.
- Intra- and inter-governmental coordination is key to gaining necessary support for broadband plan development and implementation.

Step 1: Set up a Broadband Office

A single entity or its functional equivalent, such as an assigned team or individual, should be responsible for developing and overseeing implementation of a state, municipal, or local government's broadband strategy. To that end, we recommend that legislatures establish broadband offices with enabling statutes that give the broadband offices or their functional equivalent clear authority, aligned with federal statutes and regulations, and provide sufficient recurring funding needed to achieve agreed-upon multi-year digital equity goals.

Step 2: Prepare for Federal Funding Allocations

Because IIJA funding will be allocated based on the FCC's new BDC data mapping of the "unserved" population (defined as lacking access to broadband speeds of 25/3 Mbps), if states have access to mapping tools of their own, they should make them public in case they need to address discrepancies between their maps and the new FCC maps. As of 2021, 37 out of 50 states have begun to create their own mapping tools. For states that have mapping tools in place, state broadband offices should begin to identify the population and location of unserved areas lacking 25/3 Mbps, along with the population and location of underserved areas lacking 100/20 Mbps. This will allow states to (1) begin collaborating in a targeted fashion on how they can get to 100% availability in areas deemed unserved, setting the stage to unlock funding for underserved areas, and (2) be positioned to challenge the FCC's BDC map if there are material discrepancies.

Step 3: Develop a Five-Year Broadband Action Plan

State-wide, city-wide, and locality-wide broadband plans should be developed through an open and transparent process that allows sufficient time and opportunities for stakeholders to weigh in. Draft broadband plans should be open for public comment and the perspectives of a wide array of stakeholders should be considered. There might be multiple rounds of comments, and separate comments sought on several aspects of a draft broadband plan. In addition, a variety of other mechanisms can be used to stimulate stakeholder input, including field hearings, workshops, and advisory committees comprised of government agencies, the private sector, non-profits, and community-based organizations for specific issue areas (e.g., infrastructure access) or industries (e.g., agriculture). As broadband offices develop their broadband plans, it is important for them to develop an understanding of and account for industries that impact the local economy. An example of this for the agriculture industry would be ensuring that fixed broadband connectivity and cloud computing capabilities are available both to *and on* farms and ranches.[140]

Intra-governmental coordination is critical to gain needed buy-in from other government agencies that will be tasked with supporting and, in some cases, implementing aspects of the broadband plan. In addition, inter-governmental coordination between the state or local broadband office and federal authorities such as the NTIA, FCC, and others is critically important. The IIJA

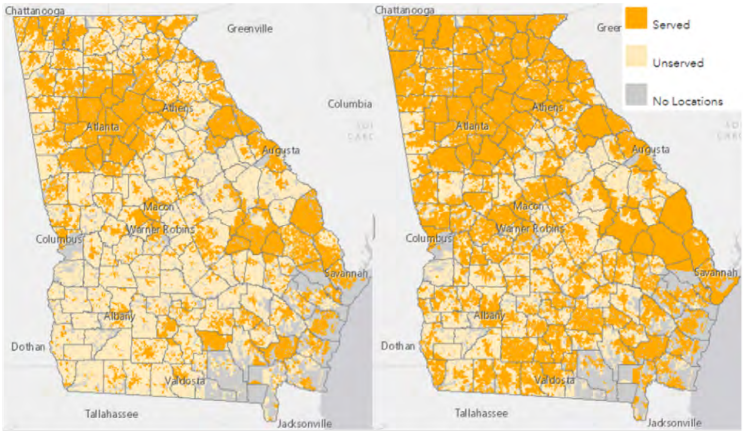
includes provisions on inter-agency coordination at the federal level and such coordination also will be critical at the state, regional, municipal, and local levels.[141] Once the broadband plan is adopted, the broadband office's coordination of competing priorities between key stakeholders and government agencies will help set the stage for successful implementation of the plan. For example, the state broadband office might need to coordinate with other state offices, including the departments of education, public health, transportation, community affairs, economic development, and the public service commission, among others. The state broadband office will also need to coordinate with county, municipal, and other local governments. These governments in turn will need to coordinate with each other as well, particularly neighboring and overlapping jurisdictions.

The IIJA provides states with detailed guidance on how to structure and implement their broadband plans and programs.[142] Given its level of detail, state, municipal, and local governments can also use aspects of the IIJA guidance to structure funding made available under the CARES Act, CAA, ARPA, and other COVID economic-stimulus legislation, although care should be taken to promote technology neutrality and not allow other policy considerations to distract from the ultimate goal—broadband availability and adoption. Specifically, the IIJA provides extensive guidance to eligible entities (in most cases, state broadband offices) on Letters of Intent, Five-Year Action Plans, Initial Proposals, and Final Proposals, as well as program administration considerations. These requirements are summarized in Appendix B.

Step 4: Set Clear, Data-Driven Goals

Goal setting is a critical aspect of broadband planning, implementation, and success. These goals should be based on data, leveraging the best available data on fixed broadband availability, adoption, and performance. Prior to setting broadband availability and adoption goals, state and local broadband offices can leverage data available from the FCC, NTIA, and other parties. In some cases, administrators might conduct their own data collections to obtain deeper insights. This data analysis will help state and local broadband administrators set baseline goals for fixed broadband availability, adoption, and funding deployment. One example of this data-driven approach comes from the State of Georgia, which uses census block data as its base but defines "served" as >80% of locations having access to fixed broadband. This differs from the FCC Form 477 broadband mapping model, which considers "served" as having broadband service available in at least one location in a census block. The difference between the two definitions is illustrated in Figure 11.[143] In this example, Georgia passed into legislation the Achieving Connectivity Everywhere Act, which requires ISP data to be kept confidential. The more detailed maps that use more granular data help states to direct funding appropriately, while ISPs get the benefit of funding to improve their networks.[144]

Figure 11: Georgia Broadband Program Versus FCC Mapping Comparison



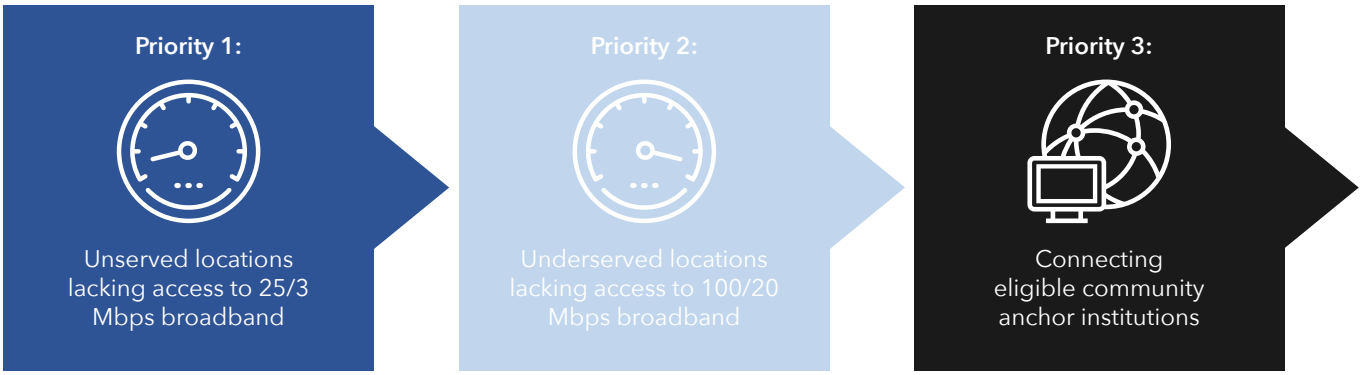
Georgia Broadband Mapping Program FCC

Source: Georgia Broadband Program

Fixed broadband program goals should include policy-related commitments and quantifiable supply-side, demand-side, and network resilience targets. Goals should include both fixed broadband availability and adoption targets combined with a clear plan as to how broadband connectivity will tie into other interagency goals.

To meaningfully connect to the internet, as seen earlier, consumers require at-home fixed connections that support a full range of applications requiring high bandwidth or "throughput", such as multiple HD video streams, and low latency, such as HD videoconferencing and gaming applications. Fixed broadband definitions and policies should be aggressive but achievable and based on the connectivity goals the government wants for all its citizens. The IIJA provides some cascading guidance on these issues. Specifically, it defines unserved communities as those lacking access to 25/3 Mbps broadband[145] and defines underserved communities as those lacking access to 100/20 Mbps broadband.[146] The IIJA also directs "eligible entities", i.e., states to prioritize "unserved service projects", i.e., in locations lacking access to 25/3 Mbps broadband. Once the eligible entity can certify coverage of broadband services to all unserved locations, then it can spend funding dollars on underserved areas, i.e., those lacking access to 100/20 Mbps. Once it addresses underserved locations, only then can it prioritize eligible community anchor institutions, such as schools, libraries, health clinics, health centers, hospitals or other medical providers, public-safety entities, higher-education institutions, public-housing organizations, or community support organizations.[147]

Figure 12: Order of Priority for IIJA Broadband Network Deployment Subgrants



Source: Vernonburg Group

All these factors can guide state and local government goals for fixed broadband availability and adoption, and digital inclusion. Following the lead of states like Minnesota, broadband offices at each government level could develop chronological goals for achieving universal availability of both 25/3 Mbps and 100/20 Mbps residential and anchor institution fixed broadband. For example, a goal may be to ensure that all anchor institutions have access to at least 1 Gbps connectivity by a set date.

The ARPA Coronavirus State and Local Fiscal Recovery Funds and Capital Projects Fund regulations require deployment of fiber-based broadband infrastructure capable of delivering at least 100/100 Mbps symmetrical speeds, unless doing so is impracticable because of topography, geography, or financial cost. For the reasons discussed earlier, broadband program administrators should carefully consider topography, geography, and financial cost prior to imposing relatively costly 100/100 Mbps symmetrical speed requirements under these programs.

When deploying ARPA funds, broadband program administrators should carefully consider topography, geography, and financial costs prior to imposing 100/100 Mbps symmetrical speed requirements.

State, municipal, and local broadband offices should also set fixed broadband adoption targets, including for vulnerable communities, such as older adults, persons with disabilities, and ethnic minorities. Broadband program administrators should create plans to achieve these targets, addressing various barriers to adoption. In addition, administrators should set fixed broadband affordability targets for low-income households at varying levels of poverty, such as 100%, 150%, and 200% of the poverty line. As discussed earlier, state and local governments could supplement the FCC's ACP program funding to achieve fixed broadband affordability and adoption targets. Similarly, governments could set targets for complementary internet-use factors, such as internet-capable device ownership and basic literacy and digital skills attainment, which often precede broadband adoption and internet use.

Considering all these factors, basic fixed broadband availability and adoption targets might include:

- By December 31, 2025:
  - 100/20 Mbps broadband availability in 50% of unserved locations lacking access to 25/3 Mbps (per V.1 of the FCC's BDC).
  - 80% of households subscribing to broadband.
  - 80% of households owning a laptop, tablet, or personal computer.
  - 60% of population acquiring essential digital skills.
- By December 31, 2028:
  - 100/20 Mbps broadband availability in 100% of unserved locations lacking access to 25/3 Mbps (per V.1 of the FCC's BDC).
  - 100/20 Mbps broadband availability in 100% of underserved locations lacking access to 100/20 Mbps broadband (per V.1 of the FCC's BDC).
  - 90% of households subscribing to broadband.
  - 85% of households owning a laptop, tablet, or personal computer.
  - 80% of the population acquiring essential digital skills.

While availability and subscription data can be collected from ISPs, statistically valid household and consumer surveys will be needed to assess progress on goals such as device ownership and digital skills acquisition. To maximize accountability, the best practice is to enshrine these goals and set statutory or at least regulatory benchmark targets along the way toward achieving goals.

B. Federal Funding Programs Require Project Reports and Accountability

The successful implementation of broadband-rollout programs, guided by a fixed broadband strategy or plan, depends heavily on the use of monitoring and evaluation programs and regular public reviews. Effective rollouts also require program administrators' willingness to make timely policy or operational changes to keep the plan on track. Once broadband program administrators deploy broadband funds, it becomes the state, municipal, or local broadband office's responsibility to ensure that commitments are delivered on time and within budget. For this reason, an implementation monitoring and evaluation program should be included from the outset. Additionally, the broadband office should hold an open and transparent assessment and progress review at least every year. Since the broadband environment changes rapidly, broadband program administrators at every level should be prepared to make course corrections, updating action plans in response to changed conditions.

Key Insights

- State broadband offices should be prepared to submit annual and semi-annual grant expenditure reports to NTIA that describe (1) which entities received funds, including each ISP; (2) the number of locations where broadband service was made available and utilized; and (3) certify compliance with the IIJA and NTIA reporting requirements.
- State broadband office administrators should regularly collect granular data on fixed broadband availability, adoption, and performance.
- Under the IIJA, states are required to collect detailed broadband data from subgrantees semiannually, including:
    - Addresses or locations to be served by the project, categorized by residential, commercial, or community anchor institution;
    - The types of facilities that were constructed and installed;
    - Advertised and actual speeds of fixed broadband services;
    - Non-promotional prices of each tier of broadband services offered; and
    - Any other broadband mapping data required under FCC reporting requirements.
- More frequent data collection might be needed to track specific interventions.
- Broadband offices should share reporting data with the public to establish a baseline and help set clear goals.
- Broadband program administrators should hold an open, transparent, and unbiased assessment and progress review at least annually.
- Broadband program administrators should be prepared to make course corrections and update the plan in response to changed conditions.

Step 5: Establish a Monitoring and Evaluation Program for IIJA and Other Reporting Requirements

The IIJA includes several provisions for monitoring and evaluation programs. As part of their IIJA Five-Year Action Plans, states will be required to collect broadband data from ISPs on a semiannual basis. Under the IIJA, eligible entities must submit semiannual reports (one every six months) not later than one year after receiving grant funds and until all funds are expended.[148] States must submit their first report to the NTIA within 90 days of receiving grant funds; the report covers planned use of funds, subgrant procedures, and subgrantee compliance. A final report must be submitted by the eligible entity within one year after all funds are

expended.[149] Similarly, subgrantees must submit to the state semiannual reports with details on addresses or locations to be served by the project, specifying whether those addresses or locations are residential, commercial, or community anchor institutions; the types of facilities that have been constructed and installed; advertised and actual speeds; non-promotional pricing; and mapping.[150] State, municipal, and local broadband offices should use these reports to publicly seek feedback from a full range of stakeholders and inform any changes to policies and programs.

Step 6: Establish Robust Accountability Measures

State broadband offices should regularly collect granular data on fixed broadband availability, adoption, and performance to ensure they are tracking and making progress towards broadband availability and adoption goals. States should establish a regular cadence of aggregating and analyzing availability, adoption, and performance data from a variety of sources, including ISPs, household surveys, and other third-party data. For example, the FCC's Broadband Data Collection, as well as its challenge and verification process, will be a rich source of data. Third-party sources might also include those cited in Section II, Pew Research Center, BroadbandNow, and Microsoft, as well as others. Drawing on the collected data, broadband program administrators should create pertinent and actionable reports that cover relevant time periods. For example, quarterly reports may be required when an ISP or other grantee puts specific interventions in place, such as connecting a certain percentage of schools by a target date. All collected data and data collection techniques should be open to the public and transparent.

Case Study: The State of Minnesota's Office of Broadband Development

The State of Minnesota provides a good example of prudent broadband program administration and oversight. At the program's inception, Minnesota established an Office of Broadband Development to ensure broadband access and adoption throughout the state, thus enabling online education, healthcare, and business development. In 2016, Minnesota set clear goals that, at the time, were both aggressive and achievable, prioritizing areas with the greatest need, i.e., communities lacking access to 25/3 Mbps broadband. Minnesota set a "North Star" to guide the extension of broadband availability to all homes and businesses at speeds of at least 25/3 Mbps by the end of 2022, and 100/20 Mbps by 2026.

The broadband office's sequencing of these goals aims to ensure that everyone in "unserved areas" has access to at least the current FCC definition of broadband by the end of 2022, before including "underserved areas" in the larger goal of ubiquitous access to 100/20 Mbps broadband by 2026. This sequence also creates a natural place to pause, as the first milepost is reached in 2022, a checkpoint to evaluate if the goal has been achieved, what has or hasn't worked, and what lessons can be applied to the longer-term goal of border-to-border 100/20 Mbps broadband available to all.

Had Minnesota set broadband availability targets that leapfrogged the 25/3 Mbps goal by going straight to a 100/20 Mbps connections, an unintended consequence could have transpired where grant funds would have been redirected to more urban areas, effectively leaving truly unserved communities farther behind. It's also worth noting that the targeted speeds coincide with asymmetrical internet usage, representing an approach that is evidence-based and focused on how the vast majority of customers purchase fixed broadband and use the internet. Minnesota's approach is also technology neutral, which maximizes technology efficiencies and minimizes marketplace distortions.

The State of Minnesota has made notable progress in achieving its goals. FCC Form 477 data from December 31, 2020 suggests that Minnesota has achieved >99% border-to-border 25/3 Mbps (up from 93% in 2016) and >93% 100/20 Mbps (up from 82% in 2016). The effectiveness of Minnesota's approach is evidenced by the fact that it has the third highest rate of 25/3 Mbps availability according to the FCC, behind New York and Connecticut – both which have larger percentages of urban populations. Refer to Appendix A for details.

C. Optimize Funding and Other Resources Effectively to Increase Fixed Broadband Availability

One of the key challenges to achieving universal fixed broadband coverage or availability is that the average cost of building a network rises as population density declines. This undermines the commercial viability of deploying fixed broadband networks in small markets and rural areas. While state, municipal, and local governments have fewer levers than the federal government, they can take many steps to improve the commercial viability of fixed broadband deployments in less densely populated areas. A wide array of steps can be taken to increase the supply and reduce the cost of fixed broadband deployments while promoting competition.

Key Insights

- State, municipal, and local broadband offices can take a wide array of steps to increase the supply and reduce the cost of fixed broadband deployments:
    - Enacting flexible "dig-once" policies provides opportunities for multiple ISPs to deploy flexible conduit and fiber-optic cables in public rights-of-way during publicly funded road construction projects;
    - Removing red tape and hastening the permitting process for ISP reuse of poles, lampposts, towers, public buildings, and other public infrastructure; and
    - Encouraging and incentivizing ISPs and communities to engage in public-private partnerships to develop or operate fixed broadband services.
- Broadband availability funds should always be considered a last resort when other efforts fail to incentivize ISPs to extend affordable broadband services to unserved and underserved communities, the locations where profitable services cannot be made available or affordable by market-only means.
    - The IIJA includes detailed guidance on areas to prioritize and criteria to consider when awarding subgrants to localities and ISPs, including proposed service speed, latency, quality, and geography. These criteria can also be used for other fixed broadband funding programs.
    - As part of the funding award process, reward subgrantee efforts to ensure that citizens from historically vulnerable groups, such as low-income households, persons with disabilities, older adults, and ethnic minorities, have equitable access to fixed broadband internet and other digital services.
- Robust accountability measures should be implemented to ensure grantees minimize waste, fraud, and abuse.
- Consider policies that promote privately or publicly owned and operated community-based for- or non-profit ISPs, especially in rural, Tribal, and unserved areas, ensuring that any such model will be sustainable over the long term.

Step 7: Implement Measures in your Community to Increase the Availability of Broadband

States, municipal, and local broadband offices should work to identify areas where they can catalyze fixed broadband deployments. These areas include: (1) leveraging road and other infrastructure improvements by including new broadband infrastructure build outs through a "dig-once" policy, requiring public works offices to notify ISPs of the opportunity to lay fiber; (2) leveraging existing infrastructure by removing red tape and improving the speed of the permitting process for the reuse of poles, lampposts, towers, public buildings, and other public infrastructure; and (3) encouraging and incentivizing ISPs and communities to engage in public-private partnerships to develop or operate fixed broadband services.

Many state, municipal, and local governments provide good examples of making it easier for broadband providers to deploy and leverage infrastructure. California eased fixed broadband infrastructure deployments by implementing a "dig once" policy. ISPs receive formal notice of roadwork projects planned by the California Department of Transportation, allowing them to leverage its work and lay fiber cables while the ground is open for other projects.[151] In addition, in October 2021, California adopted Assembly Bill 537; it established a shot clock to help streamline the permitting of wireless broadband deployments.[152] Arizona's Smart Highway Corridor Program will install more than 500 miles of broadband conduit and fiber optic cable along designated highway segments.[153] The program will redress market failures and digital divides by building out future broadband capacity along a corridor in rural and tribal areas of the state. West Virginia has made it easier for ISPs to use utility poles through its "One-Touch Make-Ready" policy. It requires pole owners to allow a single crew to move multiple wires on a pole, as opposed to requiring each owner of each wire to have its own crew make the change.[154] At the federal level, the NTIA has been working with other agencies to incentivize private investment by streamlining the permitting process for the use of federal assets.[155] State, municipal, and local governments should do their best to employ programs like these examples in a technology-neutral manner.

Broadband infrastructure funds act as a last resort when other efforts fail to incentivize ISPs to extend broadband services to unserved and underserved communities. In limited circumstances and despite greater efficiencies, policy incentives, and tappable significant federal support, there may be some areas where no private sector entity is willing to competitively bid on a new

broadband deployment. In such cases and as a last resort, governments may consider "investing" in broadband infrastructure, such as through public investment in a wholesale open-access network. Such public-investment interventions can be modeled on a "build-operate-transfer" model to limit the longevity of their public support: in this model, public funds are used for the initial capital investment and operations, and then the business is sold off to a private entity.

Obligations for IIJA BEAD Subgrantees

The IIJA sets out extensive obligations for entities that receive BEAD subgrants for broadband network deployments in its section 60102(h)(4). Specifically, the IIJA states that any entity that receives a subgrant to deploy a broadband network shall provide broadband service: (1) at speeds of at least 100/20 Mbps; (2) that can support latency sensitive (real time, interactive) applications; (3) with at least 99.45% uptime; and (4) serve any customer requesting services in the project area.

The BEAD subgrantee must offer at least one low-cost broadband option to eligible subscribers. The low-cost broadband option is defined by the eligible entity (state), and included in the Final Proposal submitted to NTIA, according to IIJA sec. 60102(h)(5)(B). However, regulation of broadband rates by NTIA is not permitted according to IIJA sec. 60102(h)(5)(D).

The BEAD subgrantee must deploy the network and begin providing services to each customer that desires service within four years of receiving the subgrant. Exceptions can be made. For any project that involves laying fiber optic cables or conduit underground or along a roadway, the subgrantee shall include interspersed conduit access points at regular and short intervals. The subgrantee shall also conduct public awareness campaigns in communities where infrastructure has been deployed and to promote adoption.

The BEAD subgrantee must also be willing to provide wholesale access if the entity can no longer provide services to locations covered under the subgrant.

The IIJA and NTIA's NOFO also describe other BEAD subgrantee obligations, including adherence to quality-of-service standards, compliance with prudent cybersecurity and supply chain risk management practices, broadband infrastructure reliability and resiliency best practices, and prohibitions on purchase or support of covered communications equipment or services, according to IIJA sec. 60102(g).

When working with subgrantees on broadband deployment projects, state, municipal, and local broadband program administrators should implement robust accountability measures to protect public funds, avoid waste, fraud, and abuse, and protect taxpayers and consumers. These measures could include:

- **Reporting and certification obligations and audits,** e.g., requiring semiannual reports from the time funds are received to five years after completion of the project. The reports should be subject to audit and include detailed accounting of the use of the funds received and the progress toward fulfilling the objectives for which the funds were granted.
- **Investigation for non-compliance and penalties,** e.g., the government entity overseeing the funds is authorized to investigate use of funds for compliance with the applicable program requirements, and may impose penalties for non-compliance (e.g., including forfeiture of funds). Third parties may submit complaints on a confidential basis regarding any compliance concerns.
- **Accountability may be guaranteed through a letter of credit or performance bond.** However, the program should not grant the government a lien or other security interest in the subsidized broadband facilities, because doing so would deter many qualified subgrant applicants.
- **Return unused funds** to the government that provided the funds within a specified time upon project completion.

Creating a fair, balanced, and reasonable challenge process also ensures that ISP subgrantees do not use limited government funding to overbuild existing broadband networks.[156] Various states have developed mechanisms to implement challenge processes. For example, Colorado uses a 16-member board, with half of the board members representing the broadband industry, and the other half consisting of local government, state, or public representatives, to adjudicate challenges.[157] Minnesota has additional requirements, including that ISPs must assist with the state's mapping efforts to submit a challenge and that any provider failing to deliver a planned upgrade loses the opportunity to issue subsequent challenges in that area.[158] Standard practice suggests that any grantee receiving funding for existing or planned broadband infrastructure coverage areas should be challengeable, with repercussions for unwarranted challenges that unnecessarily block development.

D. How to Remove Barriers to Increase Fixed Broadband Adoption and Internet Use

Broadband program administrators should give equal weight to programs that increase fixed broadband adoption and internet use and programs that promote fixed broadband availability. As discussed earlier, the broadband adoption gap in the U.S. (and globally) is far greater than the broadband availability gap; it is also more complex and intractable in many respects. As stated earlier, according to our analysis of FCC and BroadbandNow data, the 25/3 Mbps fixed broadband adoption gap, which stands at about one-quarter of U.S. residents, is about 1.6 times larger than the availability gap.[159] Analysis by Cartesian estimates the adoption gap to be about 2 times larger than availability gap.[160]

Key Insights

- Programs focused on adoption of broadband and internet use should be given equal weight to programs focused on promoting broadband availability.
- Using the discretion available under state and federal funding programs, state, municipal, and local broadband offices can take steps to ensure that low-cost fixed broadband services and internet-capable devices are available to low-income individuals and households.
    - Informed by relevant data, such steps should include targeted programs that provide discounted services for vulnerable and marginalized groups that have low rates of connectivity and device ownership.
- Efforts to increase broadband adoption must be tailored to each location. Local communities and community-based organizations are likely best positioned to take the lead in such efforts.
- As part of Five-Year Action Plans, broadband offices (eligible entities) should set targets for a percentage of their population to acquire digital skills and consider partnerships with community-based organizations and private-sector organizations for digital skills programming delivery.

Step 8: Implement Measures to Increase Demand for Broadband and Online Applications

As seen earlier, fixed broadband adoption rates are lowest for older adults, the less-educated, lower-income households, persons with disabilities, rural residents, and some ethnic minorities.[161] Even as current fixed broadband adopters upgrade to ever-faster tiers, fixed broadband adoption growth has slowed significantly. Consequently, the broadband adoption gap between high-speed internet "haves and have-nots" grows larger as non-adopters get left further and further behind. This implies that regulatory interventions are needed to close adoption gaps.

Some federal broadband funding program requirements aim to address broadband adoption barriers. States, as part of their IIJA BEAD program Five-Year Action Plans, should propose solutions for the deployment of "affordable" broadband services within their borders.[162] In addition, the BEAD legislation says that states may use grant funds received under the IIJA for competitively awarded broadband-adoption subgrants, including programs that provide affordable internet-capable devices.[163] States should use this discretion to set targets and pursue digital skills programming for a specified percentage of their population. Moreover, the IIJA requires states to prioritize projects based on broadband network deployments to persistently impoverished counties or high-poverty areas.[164] IIJA BEAD program subgrantees will be required to offer a state-defined low-cost broadband option.[165]

Similarly, the NTIA will be implementing the Digital Equity Program, which includes $2.75 billion for digital inclusion and equity projects, allocating $60 million for the State Digital Equity Planning Grant Program, $1.44 billion for the State Digital Equity Capacity Grant Program, and $1.25 billion for the Digital Equity Competitive Grant Program.[166] Under the Digital Equity Program, target beneficiaries include households with income no more than 150% above the poverty line, senior citizens, incarcerated individuals, veterans, rural residents, racial or ethnic minorities, and persons with disabilities or a language barrier.[167]

In addition, state, municipal, and local broadband offices can use federal funding, such as CARES, CAA, and ARPA appropriations, to address barriers to broadband adoption and internet use. The offices' level of discretion and specific program details vary. See Section IV and Appendix B. Moreover, state, municipal, and local governments are free to use their own tax revenue to fund efforts to close adoption and use barriers.

Increasing Affordability of Fixed Broadband Services and Internet-Capable Devices. The FCC recently transitioned from the extraordinarily successful EBB program to the ACP,[168] which was established under the IIJA.[169] The ACP provides much-needed broadband service and device discounts to low-income households, including a $30 monthly subsidy towards internet access service (up to $75 for eligible households in Tribal areas) and up to $100 for a "connected device" purchase, provided that the "charge to such eligible household is more than $10 but less than $50 for such connected device."[170] In other words, a $150 device is discounted by $100 and costs the consumer only $50. A $100 device would be discounted by $90 and costs the consumer $10. A connected device is defined by statute as a laptop, desktop computer, or a tablet. The ACP defines its pool of eligible households as those with incomes up to 200% of the poverty line.

Using the discretion available under state and federal funding programs, broadband offices can take steps to ensure that low-cost fixed broadband services and internet-capable devices are available to low-income individuals and households. For example, broadband offices could use federal ARPA and CARES funding, and appropriations from state legislatures, to fund digital equity programs. They could also use such funding to "top up" the monthly $30 federal ACP subsidy to the $50 per month subsidy previously available under the EBB for all households below 200% of the poverty line.

Case Study: City of Houston, Texas Digital Inclusion Initiative

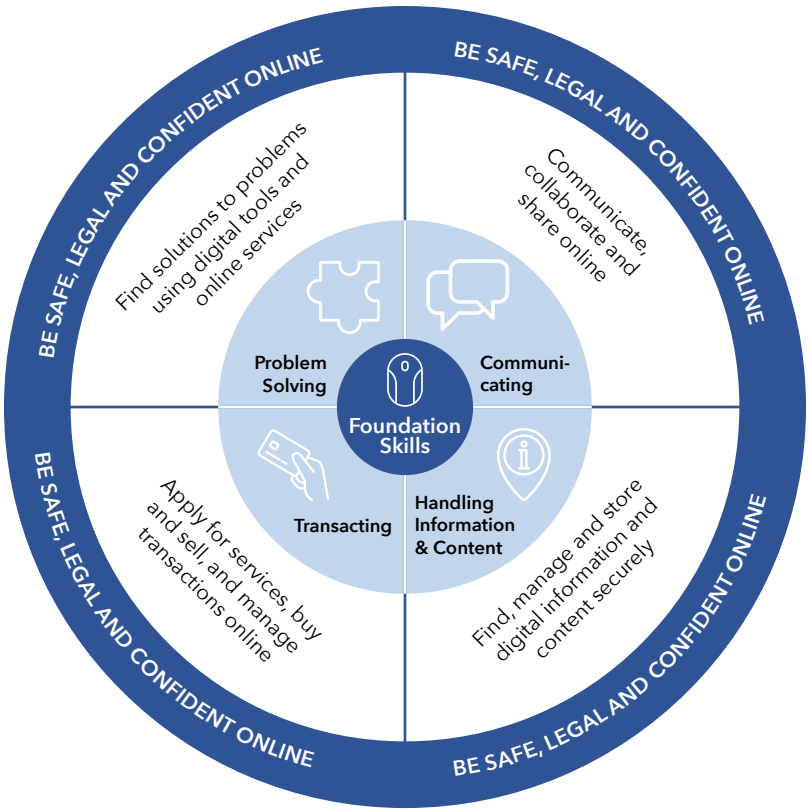
The City of Houston, Texas has implemented a program ensuring that affordable low-cost fixed broadband services and devices are available to low-income individuals and households. After the State of Texas received $200 million in CARES Act funding towards devices and hotspots for many of its K-12 students, Houston recognized that from a digital inclusion perspective, there were still many other vulnerable populations being left behind. In response to this, the city targeted its digital equity efforts towards low-income seniors, 16-24-year-old individuals who were not in school and unemployed, and parents with children under the age of five. To address the devices gap, Houston partnered with a local non-profit, Comp-U-Dopt – which distributed thousands of refurbished computers to these vulnerable groups. To address internet access and adoption, the city's public libraries added an additional 2,300 Mi-Fi hotspots to be checked out, while the mayor's office worked with four other city agencies to develop a voucher program granting one free year of Comcast broadband service to 5,000 eligible city residents. From here, the city's next steps will be to build upon these initiatives and find a way to quantify progress.

In addition, broadband offices could utilize such funding to help low-income households obtain further discounts above those provided for under the ACP for connected laptops, desktop computers, or tablets. This might enable low-income residents to purchase more capable, higher cost devices than those normally available under the ACP. A broadband office might also help an eligible household with large numbers of members purchase more than one connected laptop, desktop computer, or tablet since only one device subsidy is permitted per household by the ACP.[171] Broadband offices should also note that the BEAD legislation discussed earlier in the context of infrastructure buildouts, states that eligible entities (states) may use grant funds received under the IIJA for competitively awarded subgrants for broadband adoption, including programs to provide affordable internet-capable devices.[172]

Addressing the Skills Gap with a Digital Skilling Program. When it comes to addressing the digital skills gap, the area that gets the most focus is building so-called "digital foundation skills". Foundation skills comprise the basic knowledge necessary to use a technology, such as turning a device on and off, accessing the controls on a device, connecting to the internet, and opening a browser. These skills are sufficient for basic use of digital devices with little to no focus on productivity. More effective digital skills gap reduction programs must also teach people to confidently and skillfully use the internet, devices, and sometimes complicated applications in order to improve their day-to-day lives and their education, health, and livelihoods.

In addition to the digital foundation skills, five "Digital Essential" skills allow internet users to obtain the full benefit of today's digital technologies.[173] The first four skills, problem-solving, communicating, transacting, and handling information and content, are supported by the fifth skill, which comprises being safe, legal, and confident online. While popular digital-skills frameworks vary slightly, these five ideas, even if named differently, remain foundational for meaningful use of the internet to support everyday life and work activities.

Figure 13: Essential Digital Skills Framework



Source: UK Government

While foundational and essential digital skills remain fundamental, many people find they are insufficient for full participation in an increasingly digital and technologically advanced world. For example, rapid growth in the information and communications technology (ICT) sector is creating a massive number of new jobs without a properly skilled workforce to fill them.[174] This under provision of skilled labor partially stems from a disconnect between educational systems that only teach foundational skills, leaving students on their own to learn the more advanced skills sought by employers. Solving the labor-skill mismatch will require training and reskilling un- and under-skilled workers throughout their lifetime. Since an employment landscape can rapidly evolve, as demonstrated by the COVID-19 pandemic, reskilling programs will be essential to match jobs with properly skilled workers.

Governments can do their part to incentivize and support workers by investing in training and upskilling programs and by closing the gap between employers and the education sector.[175] Governments can ensure that digital skills are included in a life-long learning process by working outside of solely primary and secondary education, supporting workforce development programs, and collaborating with employers. Broadband offices can partner with non-profit organizations to provide digital skills and workforce training to ensure, in particular, that underserved communities learn how to use the internet in both personal and professional settings. Large-sale digital-skilling programs can improve economic development opportunities by supporting existing businesses and attracting new companies to a region.[176]

Case Study: City of Detroit Digital Inclusion Strategy

The City of Detroit has done a good job of designing a model to guide the Detroit Department of Innovation and Technology's digital inclusion strategy. The model focuses on internet access, devices, and digital skills, each supported by specific programming to target the barriers to internet use that Detroit residents face. The programs include providing low-cost internet and internet-capable devices, using community anchor organizations to provide access to broadband and internet services and devices, and providing tailored digital skills classes. Detroit Director of Digital Inclusion Joshua Edmonds attributes the success of any digital inclusion program to "partnerships, funding, engaged residents, and political will."

Addressing Other Barriers to Adoption. Even when the previously discussed barriers to fixed broadband adoption are addressed, some households remain unconnected and do not use the internet despite programming meant to address their issues. A 2021 Boston Consulting Group (BCG) survey on broadband adoption found that people did not sign-up for programs because "there were multiple numbers to call, they didn't have access to the online form, they couldn't get a promo code, they couldn't find resources in their language, or they weren't sure if they qualified."[177] To boost the success of digital equity programs, broadband program administrators will need to simplify application requirements and eligibility criteria, and address issues like language barriers.

Lack of trust and security concerns create two other barriers that prevent households from taking advantage of fixed broadband adoption programs and using the internet. Prospective broadband-adoption program participants have concerns about the expiration of promotional periods or a general bias against free services because they suspect such offers are too good to be true. Many households have concerns about sharing the personal information required to sign up for broadband-access programs, so they prefer to err on the side of caution and remain unconnected.[178] Some households believe even connecting to the internet is a security risk. Concerns about online security and privacy increasingly prompt some people to limit their online presence.[179] Mistrust is a difficult barrier to overcome, but steps must be taken to better educate eligible participants on broadband adoption programs and processes. Digital skilling programs that increase people's confidence and sense of security online will help instill trust and increase fixed broadband adoption and internet use.

A recently published study by EveryoneOn, a nonprofit that promotes internet use, explored the relationship between digital skills and trust as it relates to adoption. The study finds that households with high levels of digital skills are "more than twice as likely to say it would be easy to keep internet service than those with low levels of digital skills."[180] Learning digital skills helps people approach new online challenges with less worry and increases how much they value having and maintaining internet services. The study also finds that "46% of those with high levels of trust in community anchors searched for a more affordable internet plan during the pandemic versus 37% of all others."[181] Local libraries and schools garnered the highest levels of trust from survey respondents, while ISPs were highly mistrusted. This surveying indicates that digital skills programming can be a way for both ISPs and governmental institutions gain more trust from disenfranchised communities, while increasing participation in fixed broadband adoption programs.

E. Boosting Achievements via Public-Private Partnerships and Community-Led Initiatives

As state, municipal, and local broadband offices prepare to receive and optimize their federal funding, they should ensure that grant programs, at a minimum, have private-public partnerships built into award scoring mechanisms and may go as far as to require it. This section presents numerous examples of how broadband offices have successfully leveraged community-based organizations and public private partnerships to increase fixed broadband availability, adoption, and internet use.

Key Insight

- Broadband offices should pursue, facilitate, and encourage community-led initiatives and public private-partnerships.

Step 9: Leverage Community-Led Initiatives and Public-Private Partnerships

The final step in achieving successful and effective broadband program centers on broadband offices multiplying their talents and budgets by partnering with like-minded entities. For example, the North Carolina Broadband Infrastructure Office sees the county or municipal government's role as being an expert in building community support, identifying needs, and offering resources to the ISP to make deployments more financially attractive.[182] The ISP contributes its technical expertise, innovation, equipment, and capital investment to the project. An example of this process in action is the collaboration between the Caldwell Education Foundation and Google piloting a 2016 project called "Rolling Study Halls" by equipping busses with Wi-Fi and Chromebooks to help close the homework gap, and then parking busses in public areas to serve as hotspots when not in use.[183]

States, such as Virginia and Maryland, go as far as to require cooperation between a public and private entity to qualify for digital equity grant funding.[184] Alternatively, Massachusetts is taking a program-based approach to partnerships in launching its $9 million initiative, Mass Internet Connect. This program aims to improve broadband internet access through partnerships with Comcast, Spectrum, and Verizon with the Massachusetts Broadband Institute's Last Mile Program in underserved communities.[185]

It is worth noting that not all digital equity programs involve government interventions. Indeed, perhaps the most successful digital equity program in the last decade is Comcast's Internet Essentials program, which has invested $700 million over a 10-year period, connecting over 10 million low-income U.S. residents. Comcast has pledged an additional $1 billion over the next 10 years to empower an additional 50 million low-income U.S. residents with the tools and resources necessary to succeed in today's world. A key learning for Comcast was to empower communities by setting up local partnerships and applying a "wraparound solution" to address barriers through three things: (1) awareness and training; (2) low-cost service; and (3) equipment. Broadband offices can leverage Comcast's learnings and successes as they implement their own digital equity programs.[186]

Case Study: City of Philadelphia's PHLConnectED Program

In the summer of 2020, in response to the COVID-19 pandemic, the City of Philadelphia brought together businesses, schools, and civic leaders to create PHLConnectED, a program aimed at ensuring that all K-12 public students had what they needed to learn in a remote environment. The program utilizes *digital navigators* who can help residents, in-person or remotely, as they access and set up affordable and low-cost internet connectivity. These digital navigators also help low-income households apply for the federal government's Emergency Broadband Benefit (now called the Affordable Connectivity Program) to reduce or eliminate the cost of their internet bill. To date, this program has distributed over 128,000 devices to students without devices at home and enabled over 18,700 internet connections through either Comcast's Internet Essentials or a T-Mobile Mi-Fi Hotspot programs. PHLConnectED demonstrates the synergistic effect of leveraging community-led initiatives and public-private partnerships to drive adoption.

VII. Conclusion

By accounting for available data, best practices, and relevant statutory provisions, this paper serves as a guide to state, municipal, and local governments as they develop, fund, implement, and oversee fixed broadband availability and adoption programs. In developing their strategies and programs, state, municipal, and local governments should follow the principles and elements common to successful national, state, and local broadband programs. Data shows that the fixed broadband adoption gap far exceeds the fixed broadband availability gap. Therefore, state, municipal, and local governments should give appropriate weight to programs closing both availability and adoption gaps. Similarly, state, municipal, and local governments should be wary of broadband definitions and deployment targets that are divorced from residents' needs and marketplace realities and that could exacerbate already widening broadband availability and adoption divides. Federal, state, and local partnerships and collaboration will be critical to success. Administrators new to broadband programs can call on federal programs, such as the IIJA BEAD program, to provide state, municipal, and local governments funds needed to hire external experts who can provide critical support throughout broadband funding program strategy, development, and implementation phases.

Appendix A: Broadband Availability in the 50 States

Table 5: Comparison of State Broadband Availability Data from FCC 2020 Form 477 and BroadbandNow

State	Urban Rate	Population in 2020	FCC Dec 2020 Estimate - Population without Broadband Access	FCC Dec 2020 Estimate - Population without Broadband Access (%)	Broadband Now 2021 Estimate - Population without Broadband Access	Broadband Now 2021 Estimate - Population without Broadband Access (%)	Percentage Point Difference between 2021 Broadband Now and 2020 FCC Data
Alabama	59%	4,921,437	370,307	7.52%	1,202,976	24.54%	17.02
Alaska	66%	730,680	101,249	13.86%	237,512	32.49%	18.63
Arizona	90%	7,421,240	294,730	3.97%	851,877	11.70%	7.73
Arkansas	56%	3,030,410	259,379	8.56%	1,010,599	33.49%	24.93
California	95%	39,368,046	441,982	1.12%	3,888,258	9.84%	8.72
Colorado	86%	5,807,299	66,438	1.14%	674,433	11.71%	10.57
Connecticut	88%	3,557,006	22,147	0.62%	386,786	10.85%	10.23
Delaware	83%	986,768	14,655	1.49%	43,665	4.48%	2.99
District of Columbia	100%	712,787	9,788	1.37%	13,906	1.97%	0.60
Florida	91%	21,732,917	529,157	2.43%	2,373,981	11.05%	8.62
Georgia	75%	10,709,715	426,407	3.98%	1,848,422	17.41%	13.43
Hawaii	92%	1,407,006	26,789	1.90%	654,398	46.21%	44.31
Idaho	71%	1,826,689	47,909	2.62%	255,282	14.29%	11.67
Illinois	89%	12,587,504	115,197	0.92%	1,226,709	9.68%	8.76
Indiana	72%	6,754,708	148,850	2.20%	890,116	13.22%	11.02
Iowa	64%	3,163,416	44,698	1.41%	387,344	12.28%	10.87
Kansas	74%	2,913,724	28,772	0.99%	341,908	11.74%	10.75
Kentucky	58%	4,477,217	135,714	3.03%	832,791	18.64%	15.61
Louisiana	73%	4,645,294	315,559	6.79%	1,152,783	24.80%	18.01
Maine	39%	1,350,136	13,831	1.02%	297,567	22.14%	21.12
Maryland	87%	6,055,772	109,747	1.81%	222,923	3.69%	1.88
Massachusetts	92%	6,893,557	99,071	1.44%	179,089	2.60%	1.16
Michigan	75%	9,966,429	257,435	2.58%	1,317,805	13.20%	10.62
Minnesota	73%	5,657,155	36,281	0.64%	880,011	15.61%	14.97
Mississippi	49%	2,966,751	435,035	14.66%	1,175,639	39.52%	24.86
Missouri	70%	6,151,378	185,205	3.01%	1,058,308	17.25%	14.24
Montana	56%	1,080,541	56,940	5.27%	258,878	24.22%	18.95
Nebraska	73%	1,937,499	30,973	1.60%	184,638	9.55%	7.95
Nevada	94%	3,138,794	105,221	3.35%	139,261	4.52%	1.17

State	Urban Rate	Population in 2020	FCC Dec 2020 Estimate – Population without Broadband Access	FCC Dec 2020 Estimate – Population without Broadband Access (%)	Broadband Now 2021 Estimate – Population without Broadband Access	Broadband Now 2021 Estimate – Population without Broadband Access (%)	Percentage Point Difference between 2021 Broadband Now and 2020 FCC Data
New Hampshire	60%	1,366,269	30,239	2.21%	247,022	18.16%	15.95
New Jersey	95%	8,882,344	106,631	1.20%	413,500	4.66%	3.46
New Mexico	77%	2,106,306	151,187	7.18%	482,345	23.01%	15.83
New York	88%	19,337,145	119,229	0.62%	1,258,600	6.47%	5.85
North Carolina	66%	10,600,602	210,615	1.99%	1,567,091	14.94%	12.95
North Dakota	60%	765,257	20,980	2.74%	122,583	16.09%	13.35
Ohio	78%	11,693,026	111,687	0.96%	1,404,448	12.02%	11.06
Oklahoma	66%	3,986,278	234,521	5.88%	931,800	23.57%	17.69
Oregon	81%	4,241,446	93,041	2.19%	686,854	16.28%	14.09
Pennsylvania	79%	12,783,223	208,076	1.63%	1,224,298	9.56%	7.93
Rhode Island	91%	1,057,125	11,130	1.05%	32,438	3.06%	2.01
South Carolina	66%	5,217,820	226,990	4.35%	1,192,700	23.16%	18.81
South Dakota	57%	892,688	14,763	1.65%	143,124	16.17%	14.52
Tennessee	66%	6,886,674	234,940	3.41%	1,270,431	18.60%	15.19
Texas	85%	29,360,186	645,470	2.20%	4,396,820	15.17%	12.97
Utah	91%	3,249,832	99,918	3.07%	221,454	6.91%	3.84
Vermont	39%	623,347	29,785	4.78%	182,028	29.17%	24.39
Virginia	76%	8,596,191	348,582	4.06%	936,208	10.96%	6.90
Washington	84%	7,693,492	170,584	2.22%	1,285,107	16.88%	14.66
West Virginia	49%	1,784,784	168,947	9.47%	900,010	50.22%	40.75
Wisconsin	70%	5,832,546	176,594	3.03%	670,592	11.52%	8.49
Wyoming	65%	582,322	28,872	4.96%	101,252	17.49%	12.53

Sources: FCC (2021); BroadbandNow (2021)[187]

Appendix B: Federal Funding Overview

	Funds Allocated	Eligible Recipients	Program Details	Application/Funding Window
Federal Communications Commission				
Rural Digital Opportunity Fund	$20.4 billion through 2030	Entities w/an eligible telecommunications carrier (ETC) designation	Program is designed to close the digital divide by investing in the construction of rural broadband networks. Bids were accepted across four weighted performance tiers: 1) Minimum tier of 25/3 Mbps; 2) Baseline tier of 50/5Mbps; 3) Above baseline tier of 100/20 Mbps; 4) Gigabit tier of1Gbps/500Mbps. High latency bidders of 750 ms were given additional weight.	Application and auction process divided into two phases. Phase I was completed November 25, 2020 with timing for Phase II tbd.
Emergency Connectivity Fund	$7.171 billion through Sept 30, 2030	Schools and libraries eligible for the E-Rate program	Program that will help schools and libraries provide the tools and services their communities need for remote learning during the COVID-19 emergency period. The ECF Program will cover reasonable costs of laptop and tablet computers; Wi-Fi hotspots; modems; routers; and broadband connectivity purchases for off-campus use by students, school staff, and library patrons.	Funds dispersed through two application windows, the second of which closed on Oct 13, 2021.
Affordable Connectivity Program (Formerly "Emergency Broadband Benefit")	$14.2 billion	Broadband providers designated as an ETC or approved by FCC to participate	Subsidies for qualifying low-income households for service offerings and devices.	ACP replaced EBB on Jan 1, 2022. Existing EBB consumers will continue to receive $50 subsidy during 60-day transition period before dropping to new $30 amount.
Lifeline Program	$836 million (FY2020)	Eligible low income consumers.	Provides discounts on phone services and was extended to include broadband as a covered service in 2016 Allowance as of December 1, 2021 is $9.25/month for fixed broadband meeting speeds of 25/3 Mbps and mobile broadband meeting 3G.	Discounts provided to qualifying applicants.
E-Rate Program	$4.276 billion annual cap	Direct funding to schools, school districts, and libraries. Sub-grant funds to private sector providers.	Funds discounts for eligible services for schools and libraries. Generally, funding for two categories: 1) Data transmission services and internet access; and 2) internal connections, managed internal broadband services, and basic maintenance of internal connections.	FCC announces the application window each year, which typically opens in mid-January and closes at the end of March
Rural Health Care Telecommunications Program	$612 million annual cap	Direct funding to qualified rural healthcare providers. Sub-grants to private providers.	Supports high-capacity broadband connectivity to eligible health care providers. Eligible services include internet access, dark fiber, business data, traditional digital service line (DSL), and private carriage services.	Latest funding window opened on December 1, 2021; most funding decisions are made by the following December.
Healthcare Connect Fund	Program provides a 65% discount on eligible broadband connectivity expenses for eligible rural health care providers (HCPs).	Rural health care providers (individual providers or as a consortium, i.e., a group of HCPs that can be both rural and non-rural).	Program provides a 65% discount on eligible broadband connectivity expenses for eligible rural health care providers (HCPs). Consortium applicants may receive support for upfront charges, as long as (1) the upfront payment is used for services that provide a bandwidth of at least 1.5 Mbps (symmetrical) and (2) the upfront payment is part of a multi-year contract. Individual applicants are not eligible to receive support for upfront charges, except for installation charges.	Application by HCPs; Competitive bidding by service providers.
Emergency COVID-19 Telehealth Program	$449.95 million (total funding for round 1 and 2)	Health care providers responding to COVID-19	To help health care providers provide connected care services to patients at their homes or mobile locations in response to the COVID-19 pandemic. The COVID-19 Telehealth Program provides immediate support to eligible health care providers responding to the COVID-19 pandemic by fully funding their telecommunications services, information services, and devices necessary to provide critical connected care services.	Round 2 application window closed April 6, 2021.
Department of Agriculture				
ReConnect Program	$635 million (FY2021), $2 billion (IIJA), $100 million (CARES Act)	No restriction on type of recipients	Offers funding for broadband infrastructure to connect rural residents, businesses, farms, and educational public safety facilities. $200 million reserved for projects where at least 90% of households lack service speeds of 25/3 Mbps. Deployed network must "to the extent possible" have speeds of 100/20 Mbps. $74 million will be set aside for broadband loans to be disbursed by RUS.	Annual funding application window. Latest funding window opened on November 24, 2021 and closes on February 22, 2022.

	Funds Allocated	Eligible Recipients	Program Details	Application/Funding Window
Community Connect Program	Up to $30 million in FY2020	Incorporated organizations; federally-recognized tribes; state and local units of government; any other legal entity, including cooperatives, private corporations, or limited liability companies organized on a for-profit or not-for-profit basis.	To provide financial assistance in the form of grants to eligible applicants that will provide, on a "community - oriented connectivity" basis, broadband service that fosters economic growth and delivers enhanced educational, health care, and public safety benefits. Funding requires a 15% match from non-federal sources. Partnerships with other federal, state, local, private, and nonprofit entities are encouraged. Potential funding service areas must lack existing broadband speeds of 10/1 Mbps with new service providing 25/3 Mbps.	Application windows for this program are announced through the national office on a periodic basis.
Telecommunications Infrastructure Loans	$690 million (FY2021)	State and local governmental entities; Federally recognized Tribes; Non-profits, including cooperative, and limited dividend or mutual association; For-profit businesses (corporation or limited liability company).	This program provides financing for the construction, maintenance, improvement and expansion of telephone service and broadband in rural areas.	Applications are accepted year round through the national office
Rural Business Development Program	Subject to the availability of appropriations funding	Towns, communities, state agencies, authorities, nonprofit corporations, institutions of higher education, federally-recognized tribes, rural cooperatives (if nonprofit). Projects must benefit rural communities outside the urbanized periphery of any city with a population of 50k or more.	This program is designed to provide technical assistance and training for small rural businesses. Small means that the business has fewer than 50 new workers and less than $1 million in gross revenue. Enterprise grants must be used on projects to benefit small and emerging businesses in rural areas as specified in the grant application.	Application period closes on February 28, 2022. Applications are accepted through USDA's state or local offices once per year.
Distance Learning and Telemedicine Program	$57 million (FY2021)	State and local government entities; federally recognized tribes; nonprofit organizations; for-profit businesses; consortia of eligible entities	This program helps rural communities acquire the technology and training necessary to connect educational and medical professionals with students, teachers, and patients in rural areas.	Applications windows for this program are announced through the national office on a periodic basis. Latest application window closed on June 4, 2021
Appalachian Regional Commission				
Central Appalachia and North Central/North Appalachia Broadband Programs	$15 million (FY2021)	Libraries; K-12 schools; higher education institutions; state, local, territorial, and tribal governments; public safety entities; healthcare facilities; Non-profit organizations; electric utilities/co-ops	The development of broadband communications networks is one of the best ways to equip communities with the basic "building blocks" essential for economic and community development. ARC is dedicated to continuing broadband deployment in distressed counties in Central Appalachia as well as funds for a program of broadband deployment in distressed counties in North Central and Northern Appalachia.	Application window closed April 16, 2021.
National Telecommunication and Information Administration				
Tribal Broadband Connectivity Grant Program	$980 million (FY 2021) & $2 billion (IIJA)	Direct funding to Tribal Entities. Sub-grant funds to private sector providers.	Providers grants to expand access to and adoption of a) broadband service on Tribal land; or b) remote learning, telework, or telehealth resources. Deployed networks much have speeds of at least 25/3 Mbps.	Application window closed September 1, 2021.
Broadband Equity Access and Deployment Program	$42.45 billion	Grants awarded to states. No restrictions on eligibility on sub-grants, but will be prioritized by 1) unserved projects (80% lacks 25/3Mbps), 2) underserved projects (80% lacks 100/20 Mbps), 3) eligible anchor institutions w/out gigabit	Project objective is to close the availability gap by deploying to unserved and underserved areas; connecting community anchor institutions; data collection, broadband mapping, and planning; installation of broadband equipment or providing reduced-cost broadband to multi-family residential buildings; broadband adoption programs.	A) NOFO within 180 days (May 14, 2022); B) Initial $100 million to each state likely disbursed soon after final proposals submitted, including a 5-year action plan; C) Remaining funds likely disbursed in late 2022/early 2023
Connecting Minority Communities Pilot Program	$268 million (FY2021)	Direct funding to HBCUs, TCUs, and MSIs. Su-grant funds to private sector providers.	Provides grants to eligible HBCUs, TCUs, and MSIs in anchor communities for the purchase of broadband internet access service or any eligible equipment, or to hire and train information technology personnel.	Application window closed December 1, 2021.
State Digital Equity Planning Grant Program and State Digital Equity Capacity Grant Program	$1.5 billion	State agencies, non-profits, community anchor institutions, local education agencies, entities that carry out workforce development program	Program is suppose to support the closure of the digital divide & promote equity and digital inclusion. Targets households no more than 150% above the poverty line, senior citizen, incarcerated individuals, veterans, rural residents, racial or ethnic minorities, and individuals with a disability or language barrier. $60 million first granted to states for develop State Digital Equity Plan. 2 years after planning grants awarded, $1.44 billion to be dispersed to implement plans and other digital inclusion activities	Planning grants awarded in first fiscal year after enactment, i.e., FY 2023 or beginning Oct 2022

	Funds Allocated	Eligible Recipients	Program Details	Application/Funding Window
Competitive Grant Program	$1.25 billion	Any of entities listed in State Capacity Grant Program, plus partnerships between listed entities and entities determined to be in public interest	Grants may be used for digital inclusion and adoption activities. Award evaluation factors include whether applicant plans to subcontract with certain small business concerns, comparative geography diversity , and duplication. Technology-neurtal "to the extent practicable."	Program to be established within 30 days after States Capacity Grant Program implementation grants begin being awarded
Enabling Middle Mile Broadband Infrastructure Program	$1 billion	Private ISPs, non-profits, and state and local authorities	Project objective is to encourage the expansion and extension of middle mile infrastructure to reduce the cost of connecting unserved and underserved areas and to promote broadband connection resiliency. Targets unserved and underserved locations and anchor institutions. Technology-neutral middle mile broadband infrastructure with speeds of 1/1 Gbps.	NOFO within 180 days (May 14, 2022) with awards within 270 days of NOFO (February 8, 2023, at the latest)
Broadband Infrastructure Deployment Grant Program	$288 million	Covered partnerships between a state or its political subdivisions and broadband providers	Broadband deployment program to support broadband infrastructure deployment to areas lacking broadband, especially rural areas. Priority given to applications from partnerships that: 1) Provide broadband service to the greatest number of households in an eligible service area; 2) Provide broadband service to rural areas; 3) Are most cost-effective in providing broadband service; or 4) Provide broadband service with a download speed of at least 100 Mbps and an upload speed of at least 20 Mbps.	Application window closed August 17, 2021.
Department of the Treasury				
Coronavirus State and Local Fiscal Recovery Fund	$350 billion through 2024	States, territories, and Tribal governments, metropolitan cities, non-entitlement units of local government, and counties	Funds provide substantial flexibility for each government to meet local needs—including support for households, small businesses, impacted industries, essential workers, and the communities hardest hit by the crisis. These funds can also be used to make necessary investments in water, sewer, and broadband infrastructure. Specifics amounts have been allocated to specific entities based on Treasury's allocation methodology.	Eligible entities can request their allocation of funds through the Treasury Submission Portal.
Coronavirus Capital Projects Fund	$10 billion	Grants awarded to states, territories, and Tribal governments. No restrictions on eligibility for sub-grants.	Program designed to allow recipients to invest in capital assets, including infrastructure, the meet communities' critical needs in the short- and long-terms. Key priority of program is for broadband infrastructure and other digital connectivity technology projects. Requires network symmetrical speeds of 100 Mbps, unless exemption, then 100/20 Mbps but scalable to symmetrical 100 Mbps.	Application window for states closes December 27, 2021; for Tribal governments, June 1, 2022. Sub-grantees may begin receiving funds in 2022 from state programs.
Local Assistance and Tribal Consistency Fund	$2 billion through Sept 30, 2023	Revenue sharing counties and Tribal governments	Counties may use the funding for any governmental purpose, excluding lobbying activity. Like the Fiscal Recovery Funds, the fund requires periodic reports from counties.	Allocated $1.5 billion to revenue-sharing counties in states, D.C., Puerto Rico, Guam, and the Virgin Islands over FY 2022 and 2023. The Consistency Fund also provides tribal governments with $500 million. The Department of Treasury will determine the funding formula based on the economic conditions of counties and tribes.
Department of Education				
Elementary and Secondary School Emergency Relief Fund	$122.775 billion through Sept 30, 2023	State educational agencies (SEAs) and local educational agencies (LEAs)	Funds are provided to State educational agencies and school districts to help safely reopen and sustain the safe operation of schools and address the impact of the coronavirus pandemic on the Nation's students.	Funds are awarded in the same proportion as each State received funds under Part A of Title I of the Elementary and Secondary Education Act of 1965, as amended, in fiscal year 2020.
Institute of Museum and Library Services				
Grants to States	$150 million until expended	State library administrative agencies (SLAAs)	Using a population based formula, more than $150 million is distributed among the State Library Administrative Agencies (SLAAs) every year. SLAAs may use the funds to support statewide initiatives and services, and they may also distribute the funds through competitive subawards to, or cooperative agreements with, public, academic, research, school, or special libraries or consortia. The program emphasizes broadband adoption through digital literacy, tech support, and digital skills trainings.	The Library Services and Technology Act requires each SLAA to submit a plan that details library services goals for a five-year period. SLAAs must also conduct a five-year evaluation of library services based on that plan.

Source: Vernonburg Group

Appendix C: Abbreviations

3GPP	3rd Generation Partnership Project
4G	Fourth Generation of broadband cellular network technology
5G	Fifth Generation of broadband cellular network technology
ACP	Affordable Connectivity Program
ACS	American Community Survey
ARP	American Rescue Plan
ARPA	American Rescue Plan Act
BCG	Boston Consulting Group
BDC	Broadband Data Collection
BEAD	Broadband Equity Access and Deployment
BIP	Broadband Initiatives Program
BITAG	Broadband Internet Technical Advisory Group
BTOP	Broadband Technology Opportunities Program
CAA	Consolidated Appropriations Act
CAPEX	Capital Expenditures
CARES	Coronavirus Aid, Relief, and Economic Security
DOCSIS	Data Over Cable Service Interface Specification
DODC	Digital Opportunity Data Collection
DSL	Digital Subscriber Line
EBB	Emergency Broadband Benefit
FCC	Federal Communications Commission
FTTH	Fiber-to-the-Home
FTTP	Fiber-to-the-Premises
FWA	Fixed Wireless Access
GEO	Geosynchronous Equatorial Orbit
GNI	Gross National Income
HAPS	High-Altitude Platform Stations
HD	High-Definition
HFC	Hybrid Fiber-Coaxial
ICT	Information and Communications Technology
IIJA	Infrastructure Investment and Jobs Acts
IMLS	Institute of Museum and Library Services
IMT	International Mobile Telecommunications
ISP	Internet Service Provider
K12	Kindergarten to 12th grade
LEO	Low Earth Orbit
LLC	Limited Liability Company
LLP	Limited Liability Partnership
NBN	National Broadband Network
NCSL	National Conference of State Legislatures
NOFO	Notice of Funding Opportunity
NTIA	National Telecommunications and Information Administration
PPP	Public Private Partnership
RDOF	Rural Digital Opportunity Fund
RUS	Rural Utilities Service
SHLB	Schools, Health and Libraries Broadband Coalition
USDA	United States Department of Agriculture
USF	Universal Service Fund
WIC	Woman, Infants and Children

Appendix D: Useful Definitions

Adoption (Subscription): Broadband is considered adopted when a consumer to whom broadband is available subscribes to or purchases broadband service. Consumers will subscribe to or purchase service at a specific speed tier available to them. When describing broadband statistics, the terms "broadband adoption rates" and "broadband subscription rates" are often used interchangeably.

Availability (Access, Deployment): Broadband is considered available if an ISP can provide a location with a broadband connection without an extraordinary commitment of resources. This may be as simple as installing a modem in a residence that connects to a copper, fiber optic, or coaxial cable, or may require adding a short section of cable or a fixed wireless connection to a premises. The terms broadband availability, access to broadband, and broadband deployments are often used interchangeably. An ISP's broadband availability rate can be reported at different levels of geography, such as a census block or at an individual location. Speed tiers that are available in a geographic location such as census blocks or to a premises are also often reported. Speed tiers are characterized using a combination of download and upload speeds such as 25/3 Mbps, 100/20 Mbps, or 100/100 Mbps.

Broadband: The FCC defines internet speeds that are at least 25 Mbps down and 3 Mbps up (25/3 Mbps) as broadband. In 2015, the FCC concluded that the 25/3 Mbps broadband definition was justified considering advances in technology, market offerings by broadband providers, and consumer demand. At that time, the FCC reported that, as of 2013, approximately 83% of the U.S. population had access to 25/3 Mbps broadband, but that less than half of the rural U.S. population had such access. While standard broadband definitions are largely a legal and regulatory construct, they are important for regulators and program administrators because they 1) define areas lacking access to desired service levels, 2) help prioritize policy interventions, and 3) set baselines for broadband funding obligations.

Fixed Broadband Connections: These are fixed data transmission lines used to connect homes and businesses and use technologies such as Digital Subscriber Lines (over copper lines), Cable (over coaxial lines), Fiber, and Fixed Wireless Access. Technologies can also be combined such as Hybrid Fiber-Coaxial (HFC) that combines fiber to a headend and cable to subscriber premises.

- **Digital Subscriber Line (DSL):** A family of technologies that are used to transmit digital data over copper telephone lines. DSL services can be delivered simultaneously with wired telephone service on the same telephone line. The current typical speeds available are 8 Mbps to 24 Mbps downstream; 1 Mbps to 3.3 Mbps upstream.

- **Fiber:** Fiber to the home or premises is a type of high-speed broadband technology that uses fiber optic cables to transmit data to a network interface on the exterior of the customer premises. When fiber is delivered to a premises, it is called Fiber-to-the-Premises (FTTP). FTTP is also sometimes called FTTH (Fiber-to-the-Home). The current typical speeds are 50 Mbps to 1 Gbps downstream and upstream.

- **Hybrid Fiber-Coaxial (HFC):** A network technology that combines optical fiber and coaxial cable to deliver broadband services. The fiber optic network extends from the cable operators' master headend, sometimes to a regional headend, and out to a neighborhood hub site, and finally to an optical node which typically serves from 100 to 450 homes. In the optical node, the broadband signal is transformed from an optical signal to a radio frequency (RF) signal for transmission over the coaxial network to subscriber homes. HFC networks provide bi-directional high-speed data service that can simultaneously deliver cable television and broadband service; this is the typical network architecture for most modern cable ISPs. At the time of publication, the current typical speeds available are 50 Mbps to 1.2 Gbps downstream; 5 Mbps to 200 Mbps upstream. Next generation HFC technology being rolled out in the near term is scalable to deliver download speeds up to 10 Gbps, and multi-gigabit upload speeds.

- **Fixed Wireless Access (FWA):** This is a way of providing wireless connectivity through radio links between two fixed points and can provide wireless internet access to homes or businesses without laying fiber and cables to provide last mile connectivity. To deliver service, the ISP will install a wireless device at the customer's premises, which will be wirelessly connected to another wireless device at a tower or another high site location. A variety of fixed wireless technologies have been used such as LTE, Wi-Fi, and Wi-Max, and most recently 5G. The current typical speeds available for FWA are up to 500 Mbps downstream and up to 500 Mbps upstream.

Internet Performance: The experience that a user has when connected to the internet can be measured quantitatively or qualitatively. Quantitative measurements are carried out by users themselves when doing speed tests through web browsers, or by operators using equipment in their networks. These tests usually measure the download performance (speed from an internet service to the user's device) in Mbps, upload performance (speed from a user's device to an internet service) in Mbps, and the round-trip delay measured in milliseconds between a user's computer and an internet service (latency). Qualitative measurements are usually done by asking a user to offer a personal rating (e.g., one to five stars) of the quality of an internet service. This is often presented to a user after using a service like Zoom or Skype.

Internet Speeds: This captures the amount of digital information that can move through an internet connection in one second. Speeds are provided for the download (the connection between an internet service and a user's device) and the upload (the connection between a user's device and an internet service). Today, speeds are usually specified in Megabits per seconds (Mbps); however, the speed of internet connections is increasing with each new generation of technology introduced into the market.

Satellite Broadband Connection: Provides broadband access through communication satellites. Communication satellites can be Geostationary Earth Orbit (GEO) satellites or more recent Low Earth Orbit (LEO) satellites. LEO satellites such as the newly launched Starlink and OneWeb satellites provide much higher speed and lower latency connections than GEO satellites. Users install a satellite dish at their premises to receive a broadband service from a satellite broadband service provider. The current typical speeds available for LEO satellites are 5 Mbps to 100 Mbps downstream; 1 Mbps to 20 Mbps upstream. The current typical speeds available for GEO satellites are 2 Mbps to 50 Mbps downstream; 0.2 Mbps to 5 Mbps upstream.

Appendix E: Broadband Program Snapshot Guide

This guide is an extract from the recently published "A Handbook for the Effective Administration of State and Local Broadband Programs," which presents a summarized version of this report.[188]

To allocate broadband funding as effectively as possible, state, city, and local governments should follow nine broadband funding principles.

Broadband Funding Principles		
Prudent administration and oversight	Targeted	Technology neutral
Broadband capable	Secure and resilient	Best value
Non-distortionary	Deployed quickly	Equitable by design

With careful planning, coordination, and assessments, officials can use targeted, data-driven interventions to increase both availability of broadband and demand for broadband and digital services. Below we summarize steps that state, city, and local governments can take to develop and implement broadband programs.

Step 1: Set Up a Broadband Office to Enable Prudent Administration and Oversight

Accountability and administration should be vested in a single entity to ensure consistent decision-making and transparency. The entity should have:

1. clear authority to implement the administration of the program;
2. knowledge of state and federal rules and all broadband funding programs; and
3. sufficient funding to ensure achievement of the multi-year goals.

Step 2: Prepare for Federal Funding Allocations

States should identify those areas that lack 25/3 Mbps and 100/20 Mbps to:

1. begin planning on how they can get to 100% availability in areas deemed unserved (setting the stage to unlock funding for underserved areas); and
2. be positioned to challenge the Federal Communications Commission's (FCC's) Digital Opportunity Data Collection (DODC) map (the basis for allocating IIJA funding among the states) if there are material discrepancies.

Step 3: Develop a Five-Year Broadband Action Plan

Consistent with IIJA requirements, state, city, and local governments should develop a five-year broadband action plan with clear, ambitious, and achievable policy-related commitments. The plan should include quantifiable supply-side (availability), demand-side (adoption), and network resilience targets to assess progress toward its goals.

Collaboration and coordination between federal, state, and local governments will be key to successful development and implementation of fixed broadband availability and adoption programs. Officials should also establish open and transparent decision-making, accounting for the widest array of perspectives from non-profits, community-based organizations, the private sector, and individuals. This will help build public trust and the feedback loops needed to ensure funds are being spent wisely.

Step 4: Set Clear, Data Driven Goals

Set clear, multi-year broadband availability and adoption goals that are aggressive and achievable. Publicly stated goals will create the right incentives and benchmarks to hold stakeholders accountable to get the job done.

Suggested targets to measure effective broadband accessibility and adoption include:

By December 31, 2025	By December 31, 2028
• 100/20 Mbps broadband availability in 50% of unserved locations lacking access to 25/3 Mbps. • 80% of households subscribing to broadband. • 80% of households owning a laptop, tablet, or personal computer. • 60% of population acquiring essential digital skills.	• 100/20 Mbps broadband availability in 100% of unserved locations lacking access to 25/3 Mbps. • 100/20 Mbps broadband availability in 100% of underserved locations lacking access to 100/20 Mbps broadband. • 90% of households subscribing to broadband. • 85% of households owning a laptop, tablet, or personal computer. • 80% of the population acquiring essential digital skills.

These targets should be developed through a transparent process that incorporates input from impacted stakeholders.

Step 5: Establish a Monitoring and Evaluation Program for IIJA and Other Reporting Requirements

The IIJA requires states to track progress towards their five-year action plans by collecting broadband data from ISPs every six months.

- The **first report** is due to NTIA **within 90 days of receiving grant funds** covering planned use of funds, subgrant procedures, and subgrantee compliance.
- Thereafter, eligible entities must submit **semiannual reports** (every six months) not later than one year after receiving grant funds and until all funds are expended.
- A **final report** must be submitted by the eligible entity **within one year after all funds are expended.**
- Likewise, **subgrantees must submit to the state semiannual reports** with details on unserved, underserved, and anchor locations covered and served, advertised and actual speeds, pricing, and mapping.

To make monitoring and evaluation programs more meaningful and effective, broadband availability and adoption programs should be performance based.

Step 6: Establish Robust Accountability Measures

To inform their decision making, state, city, and local governments should conduct regular assessments of broadband availability, adoption, and usage combining data from ISPs, household surveys, and third-party data so that they can best identify priority needs.

Officials should adopt best practices to ensure real-time transparency of funding awards, performance issues (e.g., cost overruns), and individual projects' progress to help guard against waste. These protections should be made available for public comment before being finalized.

- States should regularly collect granular data on broadband availability, adoption, and performance.
- Under the IIJA, states are required to collect a range of broadband data from subgrantees once every six months, but more frequent or more detailed data collection might be needed to track specific investments and to better target future interventions.
- This data should be regularly shared with the public to establish a baseline and help facilitate clear goal setting.
- Hold an open, transparent, and unbiased assessment and review of progress at least annually.
- Be prepared to course-correct and update the action plan in response to changed conditions.

Step 7: Implement Measures in your Community to Increase the Availability of Broadband

- Governments should use best practices to optimize broadband network deployments. Officials should utilize, as appropriate, policies that reduce barriers and promote efficiencies, such as flexible "dig-once" policies, removing red tape and streamlining permitting, and encouraging public-private partnerships.
- When other efforts fail to incentivize ISPs to extend broadband services to unserved and underserved households, limited federal and other funds should then be allocated **to build networks to reach unserved and underserved households.** IIJA BEAD subgrantees must meet the following requirements, and these could be the basis for other broadband availability programs:
    - **Deploy broadband networks** to any customer requesting service in the project area at speeds of at least 100/20 Mbps that can support latency sensitive applications with at least 99.45% uptime.
    - **Offer** at least one **low-cost broadband option,** as defined by the state, to eligible subscribers.
    - Deploy the network and **begin providing service within four years** of receiving the grant, in most cases.
    - **Conduct public awareness campaigns** in communities where infrastructure has been deployed to promote adoption.
    - **Provide wholesale access** if the entity can no longer provide services to locations covered by the grant.
    - Adhere to other **quality of service** and best practice **network administration requirements.**
- **Create a fair, balanced, and reasonable challenge process** to ensure that limited government funding is being spent consistent with the law and is not being used, for example, to overbuild broadband networks in ways that the IIJA and other programs forbid.
- Federal, state, and local **coordination will be critically important** to ensure that various federal, state, and local broadband programs complement—and do not conflict—with one another (e.g., mistakenly funding the same broadband network deployment more than once or funding multiple network deployments to the same locations).

Step 8: Implement Measures to Increase Demand for Broadband and Online Applications

Policy makers should give equal weight to programs focused on adoption of broadband and online applications as to programs focused on promoting broadband availability. Officials should encourage private sector-led broadband adoption initiatives and public-private partnerships. Many internet service providers (ISPs) already have highly successful broadband adoption programs in place to utilize the ACP and these can be further supported by state, city, and local government programs.

- Consistent with the IIJA, each local authority should produce five-year action plans for the deployment of **"affordable" broadband services** within their borders. The plans should address the various barriers to broadband adoption, including cost, digital literacy and skill levels, perceived lack of relevance, safety and security concerns, and lack of trust in private and public digital inclusion programs.
- Develop plans to competitively award subgrants for broadband adoption, including programs to provide **discounted services and internet-capable devices** for vulnerable or marginalized groups such as low-income households, persons with disabilities, older persons, and minority populations.
    - Consider "topping up" the FCC's ACP to increase monthly service subsidies from $30 to $50 per month for eligible low-income households.
    - Help low-income households obtain device discounts above those provided for under the ACP.
- **Establish a digital skilling program** that promotes the five Essential Digital Skills of problem-solving, communicating, transacting, handling information and content, and being safe, legal, and confident online – with a focus on training and upskilling workers.
- **Develop an outreach plan** that focuses on populations that have not adopted broadband due to language barriers, misunderstanding of available programs, and online security and privacy concerns.
- **Establish streamlined programs** with simple application requirements and eligibility criteria.

Step 9: Leverage Community-Led Initiatives and Public-Private Partnerships

States, cities, and local governments should leverage community-based organizations and public-private partnerships to successfully increase availability and adoption of broadband and online services. Public-private partnerships between state and local governments and ISPs can further accelerate broadband availability and adoption programs and serve as a model for others. Because the causes of the adoption gap are so varied, policymakers may need to localize broadband adoption interventions and fully utilize community-based organizations and leaders who best know the local community challenges.

States may implement one or more of the following:

- **Require cooperation between a public and private entity** to qualify for funding.
- **Apportion duties with private partners,** taking on tasks such as coordination with local entities and outreach, while private partners focus on network deployment and administration.
- **Encourage public support for non-governmental digital equity programs.**

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81. While the introduction of 5G is exciting, it is important to remember that new communication technologies are designed for urban markets where demand and wealth concentrate. The lack of economies of scale makes it difficult to deploy these technologies profitably in rural areas, with lower average incomes and population densities. Indeed, mobile wireless networks in rural areas with low population densities are often provisioned to provide basic coverage and are not designed to handle high-throughput connectivity. This should be an important consideration as 5G wireless technologies are rolled out over the next decade.

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