

Issue: AZ Economy

Broadband and the Digital Divide

Much of Arizona Left Behind

The steep rise in internet use since the start of the COVID-19 pandemic has highlighted the advantages that access to broadband brings to our daily lives. Sheltering in place means that many of us now work from home. Our children and college students study from home. We have doctors' appointments from home. We have countless meetings with friends and family from home. Many of us now shop from home. But these essential interactions require access to broadband speeds capable of handling the real time video communications that enable teleconferencing, tele-medicine, tele-education, tele-work, and more.

Unfortunately, many of Arizona's rural and lower-income residents, who are sheltering at home without broadband, have little or no access to these opportunities. They are experiencing what is commonly referred to as the "digital divide." They must resort to Wi-Fi hotspots near schools and libraries if they have a way to get to them, or to creating their own mobile hotspots using smart phones if they have enough data in their cell phone plan.¹ Rural families often need access to specialists through telemedicine. Now, during the pandemic, the demand for remote healthcare is even higher. In terms of online education, many rural and lower income students without access to broadband are unable to take classes, while many rural schools cannot easily offer classes to students who are sheltering at home. This lack of access on both sides is causing many students to fall further behind.²

For tribal areas, the situation is even worse. There are many more health disparities among tribal populations. They have higher rates of asthma, diabetes, heart disease, and cancer. In addition, they often live in close quarters with an elderly population, a situation that facilitates the spread of the COVID-19 virus.³ For many tribes, even getting to a hospital is difficult, if not impossible, and no broadband access means telemedicine is not an option.⁴ In Mid-May of 2020, the Navajo nation in northern Arizona surpassed New York in having the highest per-capita infection rate in the United States with over 4,000 cases in a population of approximately 174,000.⁵

The Digital Divide

It is clear that access to broadband matters and that the lack of access has exposed glaring inequities as citizens living in rural areas or on tribal lands are forced to deal with third world connectivity. But the digital divide is not limited to rural areas. In urban areas across the country, where there is extensive broadband coverage, many low-income citizens are not able to afford the technology and computers required for access. Yet for years, federal and state governments have funded broadband network efforts in underserved rural communities, while neglecting urban Americans unable to afford high-speed internet access.⁶

For example, in Mesa Public Schools, Arizona's largest school district with 64,000 students, approximately 9,000 kindergarten-through-sixth-grade students have no computers or tablets at home, and 7,000 elementary school families have no internet access. School closures in March 2020 and the shift to online learning revealed the digital divide between those with wealth and access and those without. "While coming to learn at school could ease some of those gaps among students of different backgrounds, learning from home exacerbated them." The city of Mesa and Mesa Public

Schools plan to address the issue by spending \$7 million of its federal COVID-19 aid on computers and internet service for its elementary school students, so that all Mesa students will have access to technology for the upcoming school year.⁷

In a June 2020 National Digital Inclusion Alliance (NDIC) paper, authors Angela Siefer and Bill Callahan maintain that the digital exclusion of urban areas “is counterproductive for reducing the nation’s overall digital divide. It is also structurally racist, discriminating against unconnected Black Americans and other people of color who make up the majority of those lacking home broadband service for reasons other than network availability.”⁸ Without access to the internet, these communities’ members will lack access to “employment opportunities, education, healthcare services, financial and commercial access, and social and civic participation.”⁹ Siefer and Callahan also point out that, “all of the nation’s counties whose populations are at least 75% rural, taken together, accounted for less than 8% of Americans living in households with no broadband. In contrast, the most urban counties—those with fewer than 5% rural residents—accounted for more than 35%.”¹⁰ While funding for rural broadband is essential, and the primary focus of this paper, it is equally important to address the digital divide in the nation’s cities. “To connect every household to high-quality Internet access, governments must invest in efforts to increase broadband affordability and access to devices, in addition to rural broadband expansion.”¹¹

Federal Accommodations for Rural Broadband

At the federal level, the FCC has primary responsibility for handling and funding the expansion of broadband. Through their efforts, much has been accomplished over the last 20 years, but much remains to be done. Since broadband expansion is generally a slow process involving the installation of infrastructure, there is little that can be implemented during this pandemic that will have an immediate effect.¹² The FCC did take an important first step with its April 2020, “Keep Americans Connected Pledge.” So far, over 800 telecommunication companies have pledged not to cut off service to any residential or small business customer, to waive any late fees caused by the inability to pay, and to open Wi-Fi hotspots around schools and libraries.¹³ While the initial Pledge provisions concerning inability to pay expired on June 30, 2020, they did indicate awareness of pervasive affordability issues. Unfortunately, the \$2 trillion CARES act contained less than \$375 million nationally in rural broadband funding, although some of the funds will provide improved equipment for broadband access and some for the provision of telemedicine.¹⁴ These measures clearly will not have an immediate impact for broadband access for many rural residents. A number of members of Congress have proposed additional funding for rural broadband. This funding is essential as we enter an era of fundamental change to medicine, work, remote jobs, banking, and education. A renewed focus for funding that narrows the digital divide in all areas is essential now and in the future.

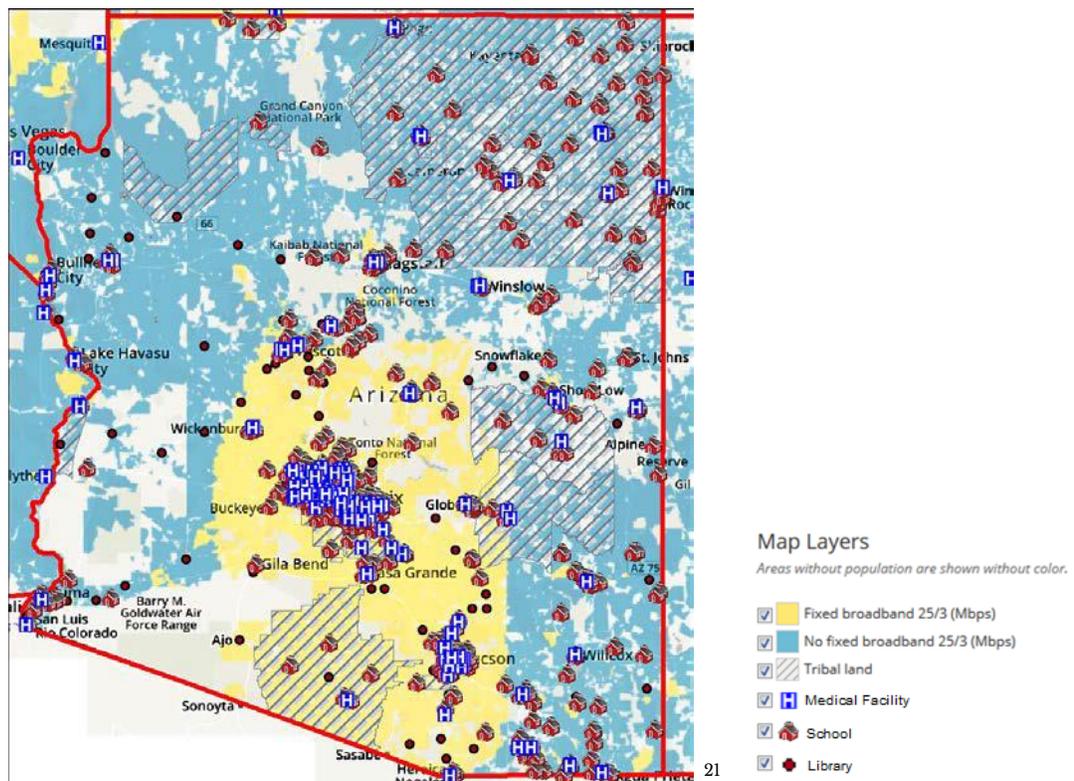
Lack of State Funding

At the state level, Arizona’s years of failing grades in funding for rural broadband access have come home to roost.¹⁵ Since the mid-1990s the Republican-controlled legislature has passed tax cuts benefiting Arizona’s wealthiest citizens.¹⁶ And although the state has generally given positive lip service to the need for rural broadband, little state funding has been allocated until recently. Governor Ducey’s proposed 2021 budget finally boosted funding for rural broadband that included infrastructure to be built over approximately the next ten years.¹⁷ Unfortunately, the “skinny budget” passed in March 2020, before the legislature adjourned as a result of COVID-19, did not include the funding for rural broadband, which is on hold for the foreseeable future.

Status of Rural Broadband in Arizona

What electricity did to improve rural life 100 years ago and telephone connections did 75 years ago, broadband connections could do today. However, when compared to rural residents of nearly every other state, rural Arizonans are losing out when it comes to wired broadband access.¹⁸ The 2018 “Arizona Statewide Broadband Strategic Plan” indicates that “approximately 898,724 Arizona citizens—mostly in rural and tribal communities—have limited or no access to high-speed internet, creating a digital divide between communities that can or cannot participate in global opportunities for education and economy.”¹⁹ As of May 2020 BroadbandNow estimates that 11.3% of Arizonans (about 834,000 people) do not have access to wired broadband 25mbps or faster, putting Arizona 36th on their state broadband access ranking²⁰.

BROADBAND INFRASTRUCTURE LEAVES RURAL ARIZONANS FAR BEHIND



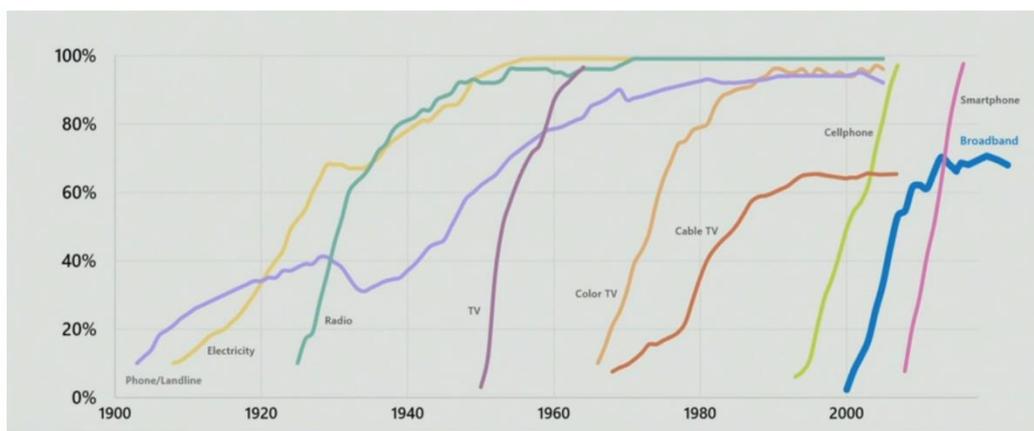
The definition of an acceptable speed for modern broadband applications has moved from 10 megabits per second (Mbps) download speed and 1 Mbps upload speed to 25 Mbps download and 3 Mbps upload.²² Under this criterion, a large swath of Arizona is in the slow lane, as the above map from the 2018 Arizona Statewide Broadband Strategic Plan shows. Recognizing the critical need for broadband expansion, the plan states that “access to the information provided by broadband services is integral to education and job readiness, commerce, public safety, health care, infrastructure, research, government and just about every other facet of today’s life.”²³

Federal Role in Rural Broadband Expansion

The rate of rural adoption of broadband does not compare favorably with the historical spread of other new technologies, from electricity to telephones to smart phones. One of the major reasons for

this slow rate of adoption is that federal broadband programs have favored a free market approach (see below) over the kind of homegrown alternatives that grew up with emerging technologies during the New Deal. In the 1930s and 1940s, federal laws supported smaller rural electric cooperatives and telephone co-ops.²⁴

BROADBAND ADOPTION LAGS BEHIND IN EMERGING TECHNOLOGIES



Source: Our World in Data

MICROSOFT/ON THE ISSUES²⁵

Current Federal Role

Federal agencies like the FCC and USDA have provided billions of dollars in subsidies and grants, mainly to existing carriers to extend and improve broadband across the country. The FCC earmarks more than half of its \$8.8 billion annual budget for broadband subsidies for rural areas. The Connect America Fund (CAF), the CAF Phase II, and now the Rural Development Opportunity Fund (RDOF) form the FCC’s main funding for rural broadband under its “High Cost” Program.²⁶ The CAF provided a total of \$9 billion between 2012 and 2015.²⁷ The CAF Phase II provided an additional \$1.8 billion per year, and in 2018 switched to a more equitable bidding process. The RDOF, a continuation of CAF I/CAF II, will provide another \$20.4 billion over the next ten years.²⁸ These programs are all part of the Universal Service Fund (USF) that assesses fees on telecommunication providers. The USF was originally intended to subsidize telephone service for low-income households but was expanded in the 1996 Telecommunications Act to include broadband internet access.²⁹ The USF also has three other programs:

- The Lifeline Program supporting \$1.6 billion annually in aid to low-income families
- The Rural Health Care Program with \$400 million in annual grants supporting eligible rural health care providers that qualify for reduced rates for high-speed broadband access
- The E-Rate program, with grants capped at \$3.9 billion annually, helps schools and libraries expand access to the internet and telecommunications services and obtain related equipment at affordable rates.³⁰

Precursors to the CAF/RDOF programs include a multitude of initiatives, some of which continue to disperse broadband-related funds today. The 2009 American Recovery and Reinvestment Act (ARRA), passed after the 2008 recession, provided \$7.2 billion in loans and grants for rural broadband expansion. Two Commerce Department programs oversaw the distribution of these funds. The Agriculture Department’s Rural Utilities Service (RUS), a successor to the Rural Electrification Administration, distributed an additional \$2.5 billion. And the National Telecommunications and Information Administration (NTIA) distributed \$4.7 billion mostly for building infrastructure through their Broadband Technology Opportunities Program (BTOP).³¹ On an ongoing basis, the

RUS gives loans and grants worth \$800 million annually, to which Congress added \$600 million in 2019 under the ReConnect Program.³²

Fortunately, in June 2019, the NTIA announced the availability of a new searchable database of “50 federal broadband programs, spanning a dozen federal agencies with billions of dollars for broadband grants, loans, and other resources.”³³ Understanding the vast number of potential funding sources for broadband is a daunting task, yet the benefits can be highly profitable for all involved in rural broadband expansion.

Limitations of Free Market Approach to Funding

As a result of the preferences for free market solutions, major for-profit telecommunication companies, whose primary focus is urban areas, receive the bulk of federal funding for rural broadband expansion. The following chart illustrates how grants from the CAF Phase II favored these large companies.

Recipients of Connect America Fund II³⁴

Company	Amount Given (per year)	Total Given (over 6 years) (2015-2020)
CenturyLink	\$505,702,762	\$3.03 billion
AT&T	\$427,706,650	\$2.56 billion
Cincinnati Bell	\$4,449,130	\$26,694,780
Consolidated Communications	\$13,922,480	\$83,534,880
Fairpoint Communications	\$37,430,669	\$224,584,014
Hawaiian Telecom Inc.	\$4,424,319	\$26,545,914
Micronesia Telecom	\$2,627,177	\$15,762,702
Verizon	\$48,554,986	\$291,329,916
Windstream	\$174,895,478	\$1.04 billion
TOTALS	\$1,500,895,507	\$7,318,282,218

Unfortunately, the high cost of installing wired broadband into rural areas and the low prospects for revenues have often resulted in internet access with slow variable speeds and intermittent reliability delivered over existing telephone wires (DSL), causing ongoing problems before and during the current pandemic.³⁵

Compounding the slow access and reliability problems, according to independent estimates of the FCC data by companies such as BroadbandNow and Microsoft, prior to 2019, the major for-profit telecommunication providers overestimated the actual extent of service.^{36,37} This was primarily due to the FCC’s rule that if one part of a census block was covered or could be easily covered by broadband for little additional cost, then the whole block was counted as covered.³⁸ According to a PBS News Hour report, “On one end, the FCC says that more than 24 million people lack access to broadband at home. On the other, a study by Microsoft found that 162.8 million Americans don’t use the internet at broadband speeds.”³⁹ Fortunately, the FCC voted in 2019 to require service providers such as Comcast and Verizon to provide more precise information about their coverage.⁴⁰

Arizona Legislative Success at National Level

U.S. Democratic Congressman Tom O’Halloran (AZ-01) has been working on rural broadband legislation for years. In March 2020, President Trump signed S. 1822, the *Broadband Deployment*

Accuracy and Technological Availability (DATA) Act, mirroring a bill that Representative O’Halloran introduced in 2019.⁴¹ The legislation will “update the national broadband map and ensure that the Federal Communications Commission (FCC) is collecting accurate coverage data and allocating robust infrastructure funds to the rural, tribal, and underserved areas that need them most.” Trump concurrently signed S. 893, “O’Halloran’s *Secure 5G and Beyond Act*, which requires the development of a national strategy to protect the security of 5G and future telecommunications systems in the United States and among U.S. allies.”⁴²

While it is essential to have Arizona leadership taking on broadband access, it is also painfully clear in this jumble of acronyms—and in light of the current pandemic—that there is a need to coalesce around a national broadband plan overseen by a single governmental agency. Such an agency would be singularly able to oversee the creation of an accurate coverage map, coordinate federal funding streams, and remedy the model that subsidizes large telecommunication companies at the expense of others.⁴³

Issues Affecting Rural Broadband Development

Background: Terminology and Technology

The following two terms are commonly encountered in the discussion of internet broadband:⁴⁴

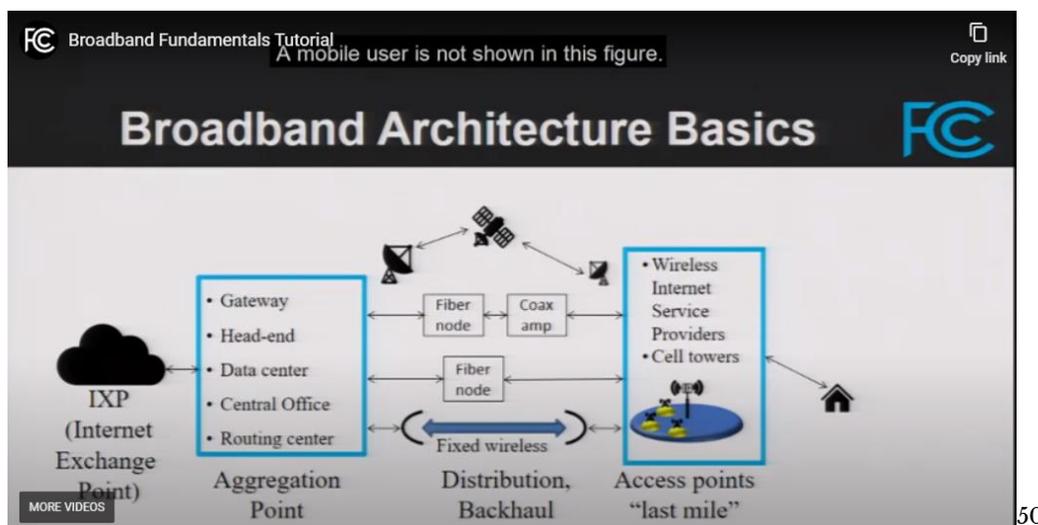
- **Bandwidth:** the maximum capacity of data transfer for an internet connection. The realized speed may often be less due to congestion or other factors.
- **Latency:** The amount of time it takes for a signal to travel to its destination and back and is largely dependent on distance traveled.⁴⁵ It is often referred to as lag.

In addition, in order to understand what makes some rural broadband offerings reliable and others hit or miss, it helps to be familiar with some of the existing technologies.

- **Wired Connections:** Internet connections carried over wires—whether cable television wires or advanced high-speed fiber wires—provide the most reliable signals but normally incur a hefty upfront cost to install. Fiber optic networks are the gold standard, having a lot of capacity for future upgrades. For example, if an application requires guaranteed uninterrupted 24/7 service, then the only real choice is a wired connection.
- **Fixed Wireless:** Some providers use fixed wireless, which requires a device on the home that is often placed on the roof or the side of house. This device can receive a signal and provide broadband speeds, but since it is “line-of-sight,” it is affected by local terrain, trees, and even weather.⁴⁶
- **Mixed:** In order to deploy broadband capacity rapidly in rural areas, some networks use a mix of fiber optics and fixed wireless as a stopgap during the years it takes to get fiber across a wide area.
- **Cellular:** Over-the-air mobile broadband connections via cell phone networks, often the only means of accessing the internet for rural population, have data caps and can get bogged down as more people sign on. It has iffy reception in rural areas if the cell towers are distant and the data plans can be quite expensive. 5G is the fifth generation of cellular networks that started being deployed in 2019. It is potentially 20 times faster than current 4G.⁴⁷
- **Satellite:** Another remote option is satellite-based broadband. It can be expensive, typically has long latency times, making it unsuitable for telecommunication applications, and has restrictive data caps as well.⁴⁸
- **TV Spectrum:** This technology takes advantage of television spectrum between commercial channels called “white space” to deliver broadband internet to rural homes and businesses.

Using this part of the spectrum has the advantage that it can be received inside buildings and has often been called super Wi-Fi.⁴⁹

- **Legacy Wired:** Finally, DSL, a legacy technology provided over telephone wires, has limited speed and bandwidth which decreases rapidly with the distance from a base station and is unsuitable for modern needs.



The above diagram comes from an excellent short [video tutorial on broadband fundamentals](#).

Alternate Models of Development

As stated above, the basic problem hampering rural service is that the largest telephone companies, which have often received federal subsidies to improve rural access, have little incentive to invest significantly in communities where customers are widely dispersed. Haphazard broadband deployment is a classic market failure.⁵¹ This puts a burden on states and localities to find creative solutions, whether through go-it-alone municipal efforts, or existing rural electric or telephone cooperatives, or private-public partnerships. Often these municipally created networks can offer better technology and are cheaper and faster than what major companies provide in rural neighborhoods.⁵²

The local governments that have built municipal broadband systems have often started with an institutional network. Fiber is connected to anchor institutions—the library, the fire department, the hospital, for instance. Some communities then extend that network to businesses and/or residents with fiber. Others install nearby towers to connect the end users. The Institute for Local Self-Reliance, a promoter of municipal efforts, reports that over 750 American communities have built their own internet networks, including 55 municipal networks using a fiber-to-the-home network through which they serve 108 communities. Another 76 communities now offer access to a locally owned cable network touching most of the community. As of January 2018, rural electrical cooperatives serve more than 258 communities.⁵³

Since 2017, Microsoft has focused on TV white space as it funds and expands rural broadband service in its Microsoft Airband Initiative program with the ambitious goal of eliminating the rural broadband gap by July 4, 2022.⁵⁴ In many cases, Microsoft itself builds transmission towers connected to local internet providers that typically transmit about ten miles from the tower.⁵⁵ As of March 2020, Microsoft had reached 633,000 people in rural areas in 25 states, even working with tribal

communities.⁵⁶ Arizona was selected for a pilot project in 2017, but it is still in its initial stages and has not progressed to commercial partnerships status.

Broadband Policy in Arizona

Arizona has long been a proponent of rural broadband expansion but has not always provided sufficient funding. In 2009 the Arizona Broadband Advisory Committee (ABAC) was formed to provide expertise and advice to the governor's office on broadband grant applications. ABAC, which still exists today, consists of representatives from ten different state agencies with the Government Information Technology Agency (now the Arizona Strategic Enterprise Technology, a division of Arizona Department of Administration). This group produced an extensive analysis of internet needs, entitled, "Arizona's Strategic Plan for Digital Capacity" which was, unfortunately, never adopted. The plan included strategic goals and recommendations that would leverage broadband connectivity to "transform education, healthcare, and research, improve public safety and government operations, create major new opportunities for business and employment, reduce energy consumption and protect the environment, and enable a long-term future of sustainable economic development."⁵⁷ This demonstrates the level of Arizona's progressive thinking about rural broadband expansion in 2012 that, unfortunately, went nowhere.⁵⁸

A byproduct of this effort was Arizona's first and only dedicated rural broadband legislation, the 2012 "Digital Highways" Bill (SB1402).⁵⁹ At the recommendation of the U.S. Department of Transportation,⁶⁰ the bill expanded the Arizona Department of Transportation's (ADOT) management of "right of way" to include transportation of information. This expansion gave private sector providers access to the state highways for broadband infrastructure. Additionally, the law established a Digital Arizona Council, which was subsequently dissolved when funding was cut.⁶¹ The law still stands but had little impact until recently (see Ducey 2020 budget proposal below).

In 2017, the Arizona Department of Administration (ADOA), working with a private corporation, Mission Critical Partners, LLC (MCP), and a number of other state agencies, held focus groups covering Arizona's rural broadband issues. Broadband providers attended one of the meetings, while relevant stakeholders in rural cities across the state attended the other five meetings. To no one's surprise, the focus groups' grading of the current conditions ranged from "C" to "D-" with an average grade of "D." An essential conclusion was that Arizona needed "a clearly defined state-level owner/office responsible for coordinating between local public stakeholders representing education, public safety, health care, individual citizens, elected officials, economic development entities, and private broadband providers."⁶²

The result of these focus group meetings led to the development of the Arizona Statewide Broadband Strategic Plan of February 2018. The plan laid out goals and initiatives to help organizations and other entities achieve accessible and affordable broadband. It also focused on pursuing strategically governed and implemented broadband expansion. The Arizona Commerce Authority (ACA) subsequently established the Arizona Broadband Office that has taken over this oversight function. The strategic plan remains as the framework for rural broadband expansion, but much remains to be done in its implementation.⁶³

Broadband Funding in Arizona

Until recent years, rural communities in Arizona have been getting broadband access in fits and starts. From 2011 to 2013, the Navajo Tribal Utility Authority received over \$32 million from the 2009 ARRA funds that installed over 550 miles of middle mile fiber in a joint Arizona and New Mexico project.⁶⁴ The states put up \$18 million in required matching funds.⁶⁵ The NTIA also

provided funding for tribal broadband infrastructure through the BTOP program, and another of over \$39 million through GovNet for microwave infrastructure across the state.^{66,67}

Arizona has used the federal E-Rate program for many years. Although not all funding has gone towards rural broadband expansion, a large part has. As of 2017, “the E-Rate program in Arizona has assisted 3.2 million students, improved the infrastructure of 2,229 buildings, and benefitted 545 schools. The state has improved from procuring just 33 percent of its requested E-Rate funds in 2008 to obtaining roughly 90 percent of its funding requests now, allowing technology to reach more Arizona students than ever before.”⁶⁸ In order to expand funding from the annual \$3.9 billion E-Rate program, Governor Doug Ducey, in conjunction with the Arizona Corporation Commission (ACC), organized the 2017 Arizona Broadband Initiative for education. In March 2017 the Arizona Universal Service Fund (AUSF) adjusted its rules and pledged \$8 million for the initiative.^{69,70} In April 2017 the legislature approved an additional \$3 million for the 2018 budget for a total of \$11 million for the 2017 - 2019 fiscal years.⁷¹ In total, the initiative has supported “building high speed connectivity for over 220,000 students and 2 million residents across 14 counties. Seven out of the 14 counties formed consortia to leverage economies of scale in their broadband planning and will serve hundreds of sites throughout their respective counties.”⁷²

In 2019, the state finally increased its commitment to rural broadband development. On September 19, 2019, the Arizona Broadband Office announced the Arizona Rural Broadband Development Grant (ARBDG) of \$3M for the 2020 budget⁷³ for rural broadband development.⁷⁴ In January 2020 the awardees were announced. Three projects capped at \$1 million each were awarded to the following companies:

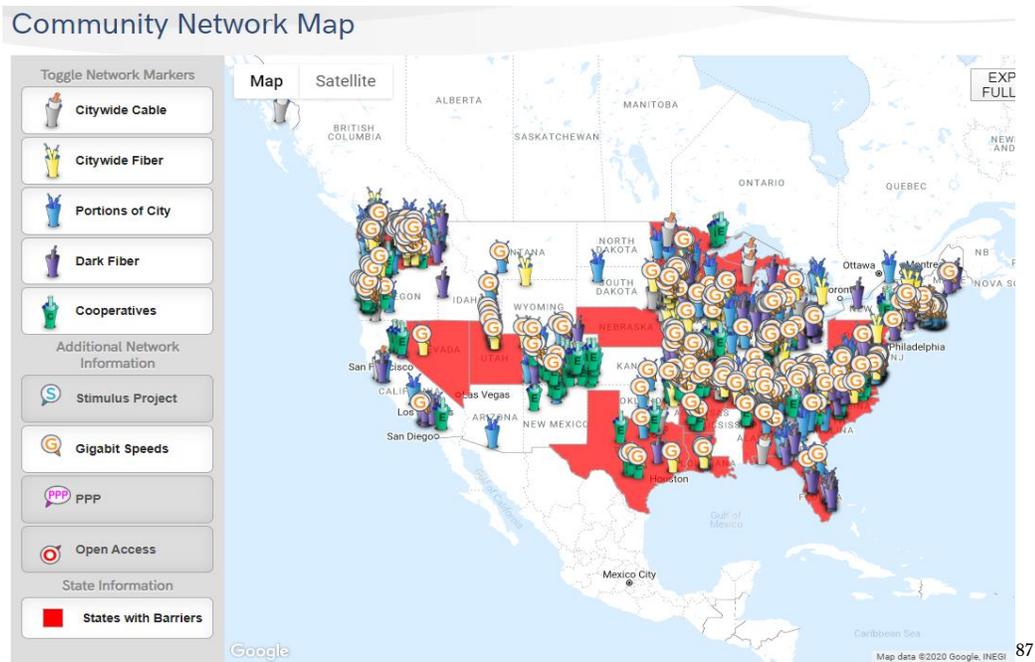
- **Sparklight**, formerly known as Cable One, will provide fiber to approximately 400 business customers in Payson, Star Valley, and Tonto Apache Tribe that has symmetrical service up to 2 Gbps.
- **Mohave Electric Coop** will provide high-speed broadband service at speeds up to 10 Gbps symmetrical to its 35,000 members. The project will serve Bullhead City, Fort Mohave, and Mohave Valley.
- **Commnet Wireless** will create a new fiber-optic middle mile to Page to serve 310 small businesses and 1,066 households within the area.⁷⁵

In addition to the above, Arizona has many other resources for state and private funding of rural broadband expansion. The Fiber Broadband Association has put together lists of resources on a state-by-state basis that show a broad range of opportunities and give guidance for how to pursue them.⁷⁶

In January 2020 Governor Ducey announced an even greater expansion of broadband funding in his proposed 2021 budget^{77,78} The proposal consisted of two major components. The first is to increase the ARBDG to \$10 million, more than triple its 2020 size.⁷⁹ The second is to invest \$50 million in the Smart Highways Corridor for broadband conduits and fiber optical cable along highways that can then serve broadband expansion to future rural and tribal areas^{80,81} This is the first significant funding that takes advantage of the 2012 “Digital Highways” Bill.⁸² The designated highways include Interstate 17 between Sunset Point and Flagstaff, Interstate 19 between Tucson and Nogales, and Interstate 40 between the Arizona-New Mexico and the Arizona-California borders.⁸³ Unfortunately, this proposed increased funding is only a drop in the bucket and falls far short of meeting the needs of rural areas.⁸⁴ As stated earlier, the funding was not in the “skinny budget” passed by the Arizona Legislature in March 2020, and it is uncertain whether it will be considered if and when the legislature reconvenes in special sessions over the summer.

Community-Based Programs

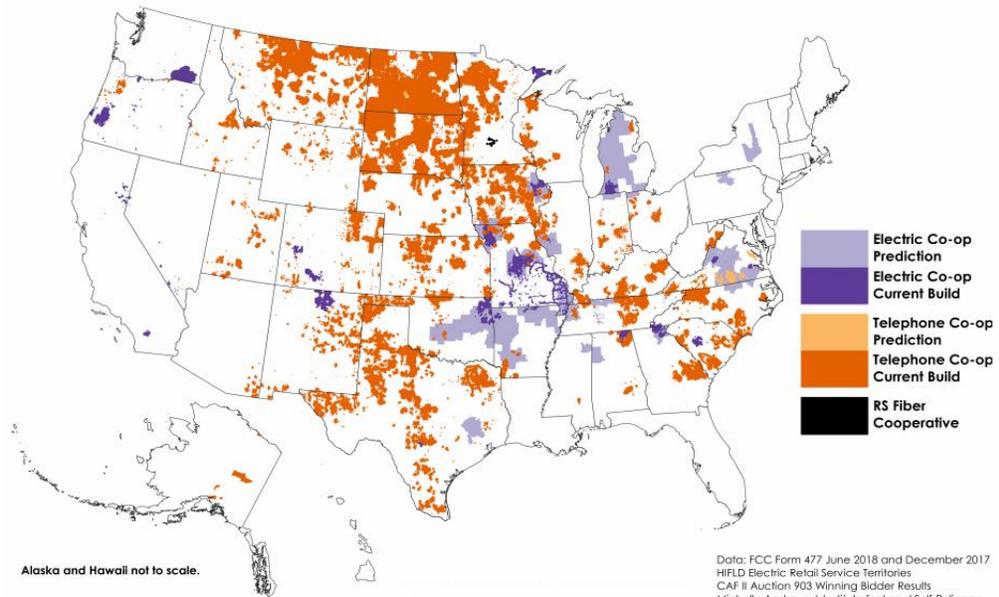
In 2010, Arizona took advantage of a community-based model for internet. The Tohono O’odham Nation received “\$7.1 million through grants and loans to improve internet access as part of the American Recovery and Reinvestment Act.”⁸⁵ This is another case where a local utility is providing internet to the community but, unfortunately, only at DSL speed which is too slow for modern applications.⁸⁶ A look at the Community Network Map shows Arizona lagging far behind.



The Mohave project, awarded an ARBDG grant in 2019 as described previously, is unique in Arizona because it is the state’s first cooperative-based broadband program.⁸⁸ Utility cooperatives, similarly, were instrumental in solving problems with rural electrical and telephone infrastructure expansion nearly a century ago, as shown in the Broadband Adoption chart on page 3 above. Other states have definitely made greater use of this model in expanding broadband to rural areas, and it is one that could be promising if expanded in Arizona.

Unfortunately, the above efforts are the only two community-based broadband projects that do not rely on networks owned by large telecommunication businesses.

**Predicted and Current
Cooperative Fiber Networks**

 IISR INSTITUTE FOR Local Self-Reliance **Community NETWORKS**


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Broadband on Tribal Lands in Arizona

The need for broadband access on tribal lands is greater than ever during the current pandemic. According to U.S. census data estimates, however, only about one in three of the households on tribal lands in Arizona have a broadband internet subscription.⁹⁰ An Arizona State University (ASU) study, published in the fall of 2019 entitled, “Tribal Technology Assessment,” found that

“Residents on tribal lands are predominantly using smart phones to access the internet, while many are also accessing it through public Wi-Fi or at a friend/relative’s house. However, the data should not be interpreted or used to defend ‘mobile only’ as the singular solution to providing internet service. In this study 50% of respondents stated that their internet use was limited because they did not have enough data in their cell phone plan.”⁹¹

Access to broadband would open up opportunities for residents on tribal lands that most Americans take for granted. In addition, due to the remoteness of their situation, access to broadband “can mean so much more in tribal areas. On reservations with a high rate of doctor turnover, it can mean uninterrupted time with an online therapist or a video chat with a doctor. For students, it might mean access to different educational resources and for small businesses, a strong network could help put them on the map.”⁹² As the COVID-19 pandemic has shown, learning and medicine can indeed be conducted remotely if necessary, but only if adequate broadband is available.

Like all rural broadband, the expansion of tribal broadband infrastructure has been significantly underfunded, coming in a scattershot pattern in fits and starts. The federal government has funded the majority of the larger projects. The national programs, applied to Arizona mainly through the E-Rate program, have been well intentioned, but have hardly met tribal needs. In addition, Arizona’s Republican-controlled legislature has allocated only a small portion of funding to tribal broadband expansion at a rate of a few tens of millions of dollars here and there. While in some instances, private investors have provided funding, a large share of the burden has fallen on the tribal nations themselves.⁹³

The push to expand coverage in tribal lands has increased in the last few years, but according to the FCC, there will not be a measurable effect for many years to come.⁹⁴ In June 2019, for example, the FCC allocated \$20M that will take the next 10 years to bring broadband to only 5000 homes and businesses in the Navajo Nation areas of northern Arizona.⁹⁵

This federal neglect of the Native population's needs has not gone unnoted. Highlighting the blatant deficiency,

“The Government Accountability Office (GAO) has repeatedly admonished the Federal Communications Commission (FCC) for making radio waves called spectrum (a natural resource) and other telecommunications necessities almost completely inaccessible to tribal nations. In 2018, the GAO said the FCC ‘has done little to promote and support tribes’ access to radio frequency spectrum that can be used for such wireless service.”⁹⁶

Finally, in February 2020, the FCC allowed tribes in selected areas of the country the exclusive right to bid on acquiring access to available broadband spectrum over their lands.⁹⁷ This opportunity will be available to most tribal lands in Arizona.⁹⁸ Unfortunately, the tribes must apply before August 2020, and they will have to build their own towers and antennas. In addition, much of any available federal funding for these costly projects comes in the form of loans, which would be exceedingly difficult for the low-income tribal communities to repay.

These are but a few examples of how funding for broadband expansion in Arizona has often been too little, too late. So much has been promised for rural broadband for so many years with so few results, one can only hope that emerging technologies and the painful lessons learned from the COVID-19 pandemic will pave the way for the drastic improvements required.

Emerging Technologies

Currently, there are two emerging technologies which will have an immensely positive impact on rural areas—assuming they are fully implemented.

5G Upgrade to Mobile Broadband Technology

This technology promises to make over 1.0 gigabits per second (Gbps) data rates available in urban areas—a vastly expanded capability over that currently available. Early assessments in 2017 were skeptical that the technology would be the answer for rural broadband needs, in large part because of its limited range, making it more suitable for urban settings.⁹⁹ However, the technology has evolved considerably since that time. The expansion of 4G LTE mobile using a mix of high frequency radio channel technology has allowed broadband to penetrate into rural areas and forms the basis for 5G upgrading.¹⁰⁰ T-Mobile in its recent merger with Sprint is promising to accomplish this rollout using Sprint's existing rural cell networks with T-Mobile's 5G technology.¹⁰¹

On the federal side, in April 2020 the FCC proposed a \$9 billion *5G Fund for Rural America* based on funds from the USF over the next ten years.^{102,103} About \$1 billion would be allocated to farms and ranches to facilitate the support for precision agriculture.¹⁰⁴ At this time, the FCC commission is seeking comments on the proposal. However, issues around the reliability of 4G LTE coverage maps submitted by mobile carriers might delay the initial bidding for contracts until 2023.¹⁰⁵ The bottom line is that the possibility of 5G technology providing upgraded rural broadband is promising, but will most likely not happen in the near future.

Low Earth Orbit (LEO) Satellite Constellations

This technology can provide internet at high speed and low latency (lag time). Satellites already provide internet to rural America,^{106,107} but can be expensive and suffer from longer latencies that make it impractical for modern applications like remote telemedicine, video conferencing, or games.¹⁰⁸ The most ambitious LEO project is the StarLink system being rolled out by Elon Musk's SpaceX Company, which has the advantage of high speed and low latency.¹⁰⁹ As of June 2020 SpaceX has launched 540 of its 600-pound desk-sized satellites, out of an ultimate potential of 42,000 satellites, and has started asking for beta testers.¹¹⁰ Current projected plans are for initial availability in Canada and North America by late 2020 and ultimately throughout the world. Pizza box-sized receivers, costing around \$100 to \$300, would be placed outdoors, providing high speed broadband internet access for an estimated \$80 per month.¹¹¹ Ultimately, various business models can be used to allow connection sharing in order to reduce the individual user's cost still further. If StarLink meets its stated goals, and if it can be subsidized by federal or state funds, it is currently one of the most promising options for providing rural broadband access by early 2021. OneWeb and Amazon's "Project Kuiper" are other LEO projects currently under development.

Narrowing the Urban-Rural Economic Divide

For the first time in 100 years—when the nation was literally illuminated as the 20th century emerged—technology is available with the potential to narrow the urban-rural economic divide across the country. In today's global economy and especially during the current pandemic, access to broadband is essential. Unfortunately, inconsistent and insufficient funding, failure to adopt community based service providers, and incomplete implementation of a comprehensive rural broadband plan have left many of Arizona's poorest citizens without remote access to education, health care, jobs, goods, and services. Should Arizona's legislators fail to ensure the availability of broadband technology to *all* of their constituents, they will perpetuate the persistent gap between early-adopters and their lower-income and rural peers, as ever-newer, ever-faster technology becomes available; available, that is, to *most* of the people in a country that claims to lead the world in technical innovation.

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