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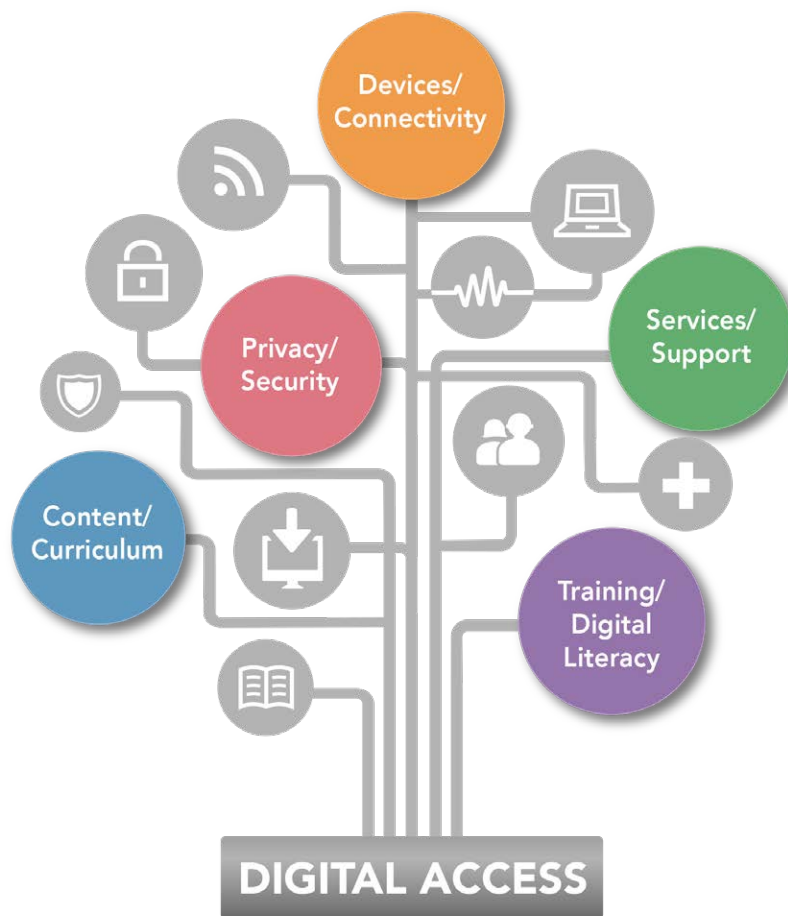
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# COVID-19 Digital Access Task Force Report and Recommendations

November 2, 2020



Respectfully Submitted by:

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- **Steve Peters**, Coordinator, AZBSN COVID-19 Task Force and the Greater Arizona Educational Leadership Organization (GAZEL)
- More than 60 public and private Digital Access advocates participating in the statewide AZBSN COVID-19 Digital Access Task Force

# COVID-19 Digital Access Task Force

## Executive Summary

In response to COVID-19 the world is creating the largest telecommunity of all time. Social and physical distancing is becoming the new normal requiring unprecedented demand for **digital access, including affordable Internet access and other digital inclusion and digital equity resources**. The pandemic has illuminated the long-standing deficiencies in affordable broadband Internet access in Arizona, particularly in tribal, rural and other underserved communities and low-income neighborhoods in Arizona. Many Arizona citizens, including students, parents, teachers, seniors, library patrons and the general public do not have affordable and equitable access to the Internet. As a result, the homework gap is a major issue for many of our students. Broadband is essential to connect schools, universities, community colleges, homes, libraries, health care facilities, businesses and communities to support education, health care, community services and economic development.



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**But digital access is more than affordable Internet access.** While we need to get everyone connected, many Arizona citizens don't have access to other digital access requirements including affordable devices such as computers, smartphones and home hotspots; skills and technical support to enable them to use the devices, the Internet and applications effectively; digital literacy and web literacy skills; and access to digital content, applications and other resources.

This report is submitted on behalf of the more than 60 public and private digital access advocates participating in the statewide **Arizona COVID-19 Digital Access Task Force** led by the [Arizona Broadband Stakeholder Network \(AZBSN\)](#). In 2019 the [Arizona Telecommunications and Information Council \(ATIC\)](#) and the [Greater Arizona Educational Leadership \(GAZEL\)](#) organization created the Arizona Broadband Stakeholder Network (AZBSN) to facilitate collaboration, coordination, information sharing and communication among key public, private and nonprofit stakeholders committed to promoting the expansion of broadband deployment in Arizona.

Consistent with this AZBSN mission, and in response to the dramatic increase in demand for digital access due to COVID-19, AZBSN established the **COVID-19 Digital Access Task Force**. When the Task Force was created, the initial focus was on Internet access, but it soon became clear that we needed to address **Digital Inclusion and Digital Equity**. The Task Force has engaged over 60 public and private leaders as well as industry experts, to share information and collaborate on recommendations and critical digital inclusion initiatives for the State. Participation in the Task Force includes representation across State and Local Government, Public Policy Makers, Rural Community Leaders, Economic Development, Education, Health Services, Public Safety, Libraries, Nonprofit Organizations, Telecommunication Service Providers, Technology Companies <https://www.arizonatele.org/about-stakeholder-network.html> and more.

AZBSN formed four Planning Committees to address digital access challenges: (1) Education and Libraries, (2) Communities, (3) Technology and, (4) Funding and Resources. The results from these Committees and the overall Task Force are presented in this report.

This report is a must read for public and private policy and decision-makers representing State and Local Government, Business and Industry, Rural Communities, Economic Development, Education, Health Services, Public Safety, Libraries, Nonprofit Organizations, Telecommunications and Technology Companies and anyone who has the responsibility and authority to serve all Arizona citizens and to ensure their safety and quality of life during this trying period.

Arizona's ability to support and sustain its citizens, businesses and institutions in these times of pandemic crisis, while at the same time positioning the State, its enterprises, institutions and citizens for future recovery and growth, is dependent upon our investments in robust digital inclusion strategies and initiatives including connecting citizens, businesses, institutions and communities via reliable high-speed broadband.



The pandemic has created a demand for digital access including affordable internet access, devices and digital resources.


Please note that this report includes recommendations to address immediate needs presented by COVID-19, as well as longer term strategies and solutions.

### The Report includes:

- A concise intro to Internet and digital inclusion/digital equity, including challenges and requirements.
- An overview of some of the key Internet infrastructure and digital access initiatives and resources available, planned and underway in Arizona.
- Recommendations to address Internet access, other digital inclusion/digital equity requirements, and the role of the State in providing broadband and digital inclusion leadership, coordination, planning and funding.
- An overview of broadband connectivity technology & trends, including decision factors regarding new and innovative technologies such as satellite, mesh networks, Wi-Fi 6E, CBRS, White Space Wireless and 5G that, with collaboration and effective and innovative community planning, can be deployed relatively rapidly and inexpensively to provide free or affordable Internet access.
- An explanation of middle mile and last mile broadband infrastructure, including policy and deployment issues and challenges.
- A discussion of business model options for State & Local Community Broadband Network Ownership and Public-Private Partnerships (P3).
- Tracking broadband legislation policy and initiatives, nationally.
- A compendium of Arizona Broadband Grants, Pandemic Response and Recovery Resources.
- Arizona broadband initiatives visual recap for the years 2010-2019.

## Recommendations-at-a-Glance

- **Technology and Infrastructure**  
Recommendations that include strategies to provide affordable and equitable broadband Internet access and devices for all Arizona citizens through actions such as: adopting a statewide definition of broadband speeds of 100 Mbps download and 10 Mbps upload (100/10 Mbps); leveraging the use of Arizona's Research & Education Sun Corridor Network; and expanding Arizona's Smart Highway Corridors broadband infrastructure initiative.
- **State and Community Digital Access Planning**  
Recommendations that include strategies and resources to support Arizona communities, organizations and education institutions in planning and securing funding for digital access and broadband infrastructure initiatives through actions such as: state support for creation and development of local community Broadband Access Teams (BATs); maximizing the use of E-rate funding and; support for broadband mapping.
- **Funding and Resources Support Strategies**  
Recommendations that include strategies and resources to increase Arizona funding opportunities for broadband development through actions such as: creating a new Broadband Development Authority; providing assistance for planning, research and development of grants; repurposing the Arizona Corporation Commission's Universal Service Fund to support broadband and; developing a state strategy to access millions of dollars of Community Reinvestment Act Digital Equity/Digital Divide funding.
- **State Broadband and Digital Inclusion Leadership, Policy and Regulation**  
Recommendations that include strategies and resources for State government to provide leadership and changes or adoption of policies and recommendations to accelerate broadband deployment in rural areas and other unserved or underserved communities through actions such as: establishing a State



Our recommendations include the acceleration of broadband deployment in rural areas and other unserved or underserved communities.



Broadband Office; removing barriers and providing incentives for private sector investment; initiatives to enable access telehealth and telemedicine resources and services in Arizona and; policies to enable electric cooperatives to provide middle mile and last mile broadband to rural communities.

- **Technical Support and Professional Development for Education and the Community**  
Recommendations that include strategies and resources to enable educators and all citizens to effectively use the Internet and devices through actions such as: providing professional development and training for educators and the public, and developing strategies to sustain ongoing tech support and service desk support services for students and the public in general.
- **Public Access to Digital Resources**  
Recommendations that include strategies and resources to enable easy public access to Digital Access resources such as the Connect Arizona portal that includes a statewide map of free or affordable Internet access options, and links to other digital inclusion resources such as professional development and technical support organizations.
- **Educational Digital Content and Resource Sharing**  
Recommendations that include strategies and resources to provide easy public access to educational digital content and resources to support online instruction by actions to: provide access to Digital Resources and Digital Literacy services and resources such as digital curriculum, instructional videos, virtual labs, and informational resources.
- **Safe Operations of Schools, Libraries and Public Spaces in the COVID-19 Environment**  
Recommendations to enable safe operations of schools, libraries and public spaces in alignment with CDC best practices and guidelines through actions such: as enabling safe school and library hygiene for public access computers in schools and libraries through the use of technologies such as IoT based Detection and Prevention technologies and; providing links to other resources, guidelines and other detection and prevention solutions.

## Acknowledgements

The Task Force leadership would like to thank the many individuals and organizations representing a wide range of digital inclusion and digital equity advocates who have been participating in the Task Force and Committees. We particularly want to provide a shout out to the [Arizona State Library](#) for the tremendous work that they have done to launch our [Connect Arizona](#) website and interactive map for user friendly access to free Wi-Fi hotspots and other digital inclusion resources in Arizona.

While there are many others that deserve recognition, we especially thank Jeff Sobotka, State Broadband Director at the [Arizona Commerce Authority \(ACA\)](#) for his innovative and tireless efforts to coordinate broadband development activities in partnership with state and local government stakeholders and the private sector, to streamline regulatory hurdles and maximize strategic broadband funding for Arizona.

The primary authors of this Report were Steve Peters, AZBSN Coordinator and Mark Goldstein, ATIC Chair with significant authoring and editing assistance from John Kelly, Triadvocates, Karen Ziegler, Consultant, Henry Goldberg, ATIC Vice Chair and Oris Friesen, ATIC Acting Secretary. Special thanks also go to our industry partners, [MSS Business Transformation Advisory](#) for their contribution of strategic planning assistance and to [Insight](#) for their leadership, technology expertise and assistance in presenting this report in a professional publication format.





## CALL TO ACTION

This report identifies needs and issues, as well as providing the recommendations that have emerged from this process. While this report is being submitted to key government officials, executive leadership organizations and a broad array of digital inclusion stakeholders in Arizona, it is the responsibility of the entire community to champion these recommendations to accomplish the goal of digital equity and digital inclusion for all Arizonans.

The recommendations contained in this document are intended to mitigate the negative effects of the COVID-19 pandemic, especially as they relate to the digital equity and inclusion gaps for underserved and low-income communities in Arizona. Going forward, these recommendations are the basis for improving the quality of life for all Arizonans. Work has already begun on implementing many of these recommendations, but it will take the entire digital access stakeholder community to realize the goals of digital equity and digital inclusion.

## NEXT STEPS

- Develop a Marketing Team to develop and manage a marketing strategy to distribute the report to key government officials, executive leadership organizations and a broad array of digital inclusion stakeholders in Arizona such as schools, universities and community colleges, state and local government agencies, libraries, associations and nonprofit organizations, healthcare and telemedicine organizations, local communities, and economic development organizations
- Develop an AZBSN implementation plan including high, medium and low priorities, implementation strategies and Teams/Committees for implementation of initiatives
- Schedule meetings with key policy and decision makers to advocate for implementation of Task Force recommendations.
- Continue to identify and engage potential partners and collaborators
- Update and expand AZBSN COVID-19 Digital Access Website
- Develop and distribute a periodic AZBSN and Digital Access Task Force newsletter
- Present informational online webinars and networking events for stakeholders and the broader public
- Seek sponsors and grants to fund and support AZBSN and COVID-19 Task Force initiatives
- Support the State government and other responsible organizations in developing strategic and tactical plans and implementation strategies to carry out the task force recommendations.



## About the AZBSN Task Force

In 2019 the [Arizona Telecommunications and Information Council \(ATIC\)](#) and the [Greater Arizona Educational Leadership \(GAZEL\)](#) organization created the [Arizona Broadband Stakeholder Network \(AZBSN\)](#). AZBSN is facilitating collaboration, coordination, information sharing and communication among public, private and nonprofit stakeholders engaged in initiatives to promote digital access in communities throughout Arizona, including deployment of affordable and reliable broadband internet access, and to enable those communities to utilize those connections to: support 21st Century education, create jobs and support economic development; train a 21st century workforce; enhance public safety and health care and; connect their citizens to the world. The Network may lead to collaborative projects, development of joint grant applications, sharing of funding and other resources, aggregation of demand at the state and local level and



Photo by Ketut Subiyanto from Pexels

policy discussions. AZBSN has become a primary organization for communication to stakeholders throughout the state.

Consistent with this AZBSN mission, and in response to the COVID-19 dramatic increase in demand for digital access, AZBSN established the [COVID-19 Digital Access Task Force](#). The Task Force has engaged over 60 public and private leaders, as well as industry experts, to share information and collaborate on the development of a **statewide COVID-19 digital equity and digital inclusion strategy including recommendations and initiatives for action**. The strategy is designed to provide equitable digital inclusion services and resources for schools, universities, community colleges, students, homes, libraries, health care facilities, businesses and communities, particularly for tribal, rural and other underserved communities and low-income neighborhoods in Arizona. Participation in the Task Force includes representation across State and Local Government, Public Policy Makers, Rural Community Leaders, Economic Development, Education, Health Services, Public Safety, Libraries, Nonprofit Organizations, Telecommunication Service Providers, Technology Companies and more.

The Task Force has been meeting weekly at, believe it or not, 7:30 am every Monday morning. True dedication! Task Force meetings include regular Federal and State updates from the: Arizona Commerce Authority's State Broadband Director, Arizona State Library, Archives and Public Records, the Office of the Superintendent of Public Instruction with Arizona Department of Education, the Sun Corridor Network, the Arizona Corporation Commission, the Arizona Telemedicine Program and the Arizona Telemedicine Broadband Action Team, Arizona Department of Administration's Public Safety Program Manager and a number of educational and nonprofit organizations.

### The Task Force was created to:

- Facilitate collaboration, coordination, information sharing and communication among key public, private and nonprofit stakeholders in the COVID-19 environment.
- Collaborate on priority initiatives for schools, libraries, telemedicine, communities and more.
- Develop a statewide COVID-19 digital inclusion strategy to support schools, universities, community colleges, students, homes, libraries, health care facilities, businesses and communities.
- Identify and advocate for funding to enable implementation of COVID-19 Digital Access projects.

### AZBSN Task Force Leadership

- Steve Peters, Coordinator, GAZEL, AZBSN, and COVID-19 Digital Access Task Force
- Mark Goldstein, International Research Center & ATIC Chair
- Henry Goldberg, Consultant & ATIC Vice Chair
- Oris Friesen, Future Information Technologies & ATIC Acting Secretary

### Charge to Task Force Committees and Committee Leadership

Four Planning Committees were created to identify needs and issues, prepare tactical and strategic recommendations, and provide a forum for information sharing and collaboration among digital inclusion advocates. The charge to the Committees included:

- **Education and Libraries Committee:** What Digital Access/Digital Inclusion requirements such as Internet access and devices, as well as training, funding and technical support are imperative for libraries and library patrons, public and private K-12 schools, community colleges, universities, students, families, faculty, community? What are the barriers? What specific strategies, initiatives, resources, partnerships, technologies or opportunities can we recommend or initiate to help address these needs?

**Under the Leadership of:** Mala Muralidharan, E-rate Administrator for Public Libraries, Arizona State Library, Nicole Umayam, Digital Inclusion Librarian,

Arizona State Library and Nan Williams, Executive Director, Arizona Technology in Education Association

- **Funding and Resources Committee:** What funding and resources opportunities are there, such as federal, state and local funding, foundations, donation campaigns, volunteer support, refurbished equipment, donations and support from Internet providers and technology companies? How can they best be optimized, accessed and leveraged by Arizona stakeholders?

**Under the Leadership of:** Lea Márquez Peterson, Commissioner, Arizona Corporation Commission

- **Technology Committee:** What Digital Access technologies should be considered to provide Internet access to schools, libraries, families, enterprises and communities such as fiber or other wireline technologies, satellite, mesh networks, cellular, microwave, Wi-Fi on buses, access to schools and libraries E-rate networks? What kinds of devices are needed and should be considered such as computers and tablets, cell phones, hot spots, webcams, software, conferencing services?

**Under the Leadership of:** John Kelly, Principal, Triadvocates and Steve Hill, President, Satellite Broadcasting and Communications Association

- **Communities Committee:** What Digital Access capabilities are needed to support community entities such as small business owners and employees, economic development, government services, public safety, nonprofit organizations, etc.? What are the barriers? What specific strategies, initiatives, resources, partnerships, technologies or opportunities can we recommend or initiate to help address these needs?

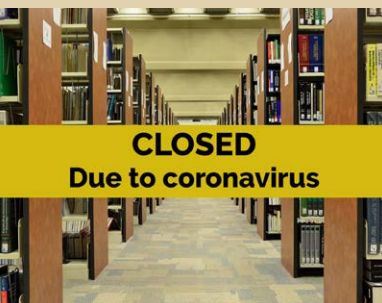
**Under the Leadership of:** Alan Pruitt, Executive Director, Western Arizona Economic Development District (WAEDD) and John Lucas, President, Community Broadband Advocates

**Telemedicine and Public Safety:** While the Task Force also has interest in Telemedicine and Public Safety, the Arizona Telemedicine Program-Southwest Telehealth Resource Center and the Arizona Broadband Director at the ACA are leading an Arizona Telehealth Broadband Action Team. The Arizona Public Safety Broadband Network and State 9-1-1 Program Director with the Arizona Department of Administration is also leading a Public Safety initiative around FirstNet wireless that is also dependent on strong fiber and vertical asset infrastructure, so we are coordinating with, but not duplicating those efforts, sharing information and building on synergies in the Arizona broadband ecosystem.

## Why This is Important - Unprecedented Demand for Digital Access

Due to the COVID-19 global pandemic, the world is creating the largest telecommunity of all time. Social and physical distancing is becoming the new normal requiring unprecedented demand for digital access. Schools are working hard to convert to online and hybrid learning, businesses are closed or transitioning to online engagement with their customers, while millions of employees are working from home and participating in online meetings with colleagues, clients and business partners. Libraries may be closed and often unable to provide Internet access to their patrons. Overwhelmed healthcare facilities committed to meeting demand and protecting patients and staff, are providing interaction with patients through telemedicine. Government services are transitioning to online citizen access.

**None of this is possible without fast, reliable, secure and affordable broadband Internet access. Unfortunately, those services are not available to many tribal, rural and other underserved communities and low-income neighborhoods in Arizona. Many rural communities lack the business case for private broadband investment due to the high cost of infrastructure and the low number of customers in potential service areas. In many neighborhoods and communities, infrastructure is available and there may be**



one or more providers available, however, these services are not affordable for many in the community.

Many students can't participate in online learning, creating a major homework and overall learning gap for these students. Those with existing serious health conditions and populations most in need of telemedicine such as the elderly, often cannot access telemedicine services. Many small businesses are unable to provide telework opportunities for their employees. Without broadband, many people are isolated and unable to communicate with their friends, family, colleagues and, perhaps most importantly, their healthcare providers. These individuals are being left behind because they don't have access to affordable broadband.



## Change the Dialogue - Digital Access and Inclusion is More Than Internet Access

When the Task Force was created, the initial focus was on Internet access, but it soon became clear that it was time to change the dialogue from Internet Access to [Digital Inclusion](#) and Digital Equity. Digital Inclusion is more than just connectivity and needs to include all of Arizona's institutions and citizens, especially populations underserved due to location as well as disenfranchised students, parents, teachers, seniors, those needing telehealth, small businesses and government itself.

As defined by the [National Digital Inclusion Alliance \(NDIA\)](#), *Digital Inclusion refers to the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of Information and Communication Technologies (ICTs). Digital Inclusion must evolve as technology advances, requiring intentional strategies and investments to reduce and eliminate historical, institutional and structural barriers to access to and use of technology. Digital Equity is a condition in which all individuals and communities have the information technology capacity needed for full participation in our society, democracy and economy. Digital Equity is necessary for civic and cultural participation, employment, lifelong learning and access to essential services.*

Achieving Digital Inclusion and Digital Equity must always include these 5 elements:

- Affordable, robust, secure and reliable broadband Internet service;
- Free or affordable Internet-enabled devices that meet the needs of the user such as computers, laptops and smartphones, as well as other digital equipment such as routers, hotspots and web cameras;
- Access to digital literacy and web literacy skills assistance and training;
- Quality, real-time technical support to enable them to use the devices, Internet and applications effectively;
- Access to applications, digital content and resources designed to enable and encourage self-sufficiency, participation and collaboration.

## Digital Access Needs and Issues

### Affordable Internet Access, Devices and Support for All

Due to lack of funding and technical challenges, affordable and equitable Internet access is still not available to many tribal, rural and other underserved communities and low-income neighborhoods in Arizona for schools, libraries, businesses and community organizations, as well as to the home for students, parents, teachers, seniors, library patrons and the general community. Lack of middle mile connectivity has been a major barrier to deployment of broadband throughout Arizona.

In many neighborhoods and communities, infrastructure is available and there may be one or more providers available, but the services are not affordable for many in the community. Students, communities and families without Internet access at home are even more disadvantaged by the closure of public libraries due to the pandemic. Students and adults use libraries for multiple purposes including education, job searches,



Digital Inclusion refers to the activities necessary to ensure that all individuals and communities, including the most disadvantaged, have access to and use of Information and Communication Technologies.



telehealth and various other activities. Libraries are a central resource for many small rural communities. However, many households do not have the broadband Internet service to access their libraries during the COVID-19 library closures and may be limited to access the library Wi-Fi network from the parking lot.

**Need for Internet for students in Arizona:** While there are multiple sources of data about the need for Internet access, available data is far from conclusive. Several research reports found on the [Schools, Health & Libraries Broadband \(SHLB\) Coalition](#) site show that the “homework gap” of students who lack broadband Internet access is substantial across the U.S. According to the [Pew Research Center](#), about 209,000 students or about 20% of Arizona K-12 students do not have broadband Internet service at home. These students are either in low-income households that cannot afford the Internet service or in rural areas that lack broadband service.

The Arizona Department of Education (ADE) has recently conducted its own survey of Arizona schools and school districts that preliminarily appears to support this estimate of unconnected Arizona students. The International Society for Technology in Education (ISTE) will be conducting a national survey this fall that will provide additional information on this. **Local school districts in Arizona are now tasked with collecting this data for their districts and communities. Some districts don't have the resources to collect this information.** There appears to be no data available on the number of Arizona university and community college students that lack home Internet access.

According to the [US Census American Community Survey](#) from 2018, about 14% of Arizona households have no broadband Internet service of any type (wired or wireless). And according to [Broadband Now](#), 755,000 people in Arizona do not have access to a wired connection capable of 25 Mbps download speed (the FCC definition of broadband). According to the [FCC 2018 Broadband Deployment Report](#), only 34% of rural Arizonans have access to fixed broadband service meeting the minimum 25 Mbps downstream and 3 Mbps upstream definition. The report also determined that an estimated 36% of all tribal lands lacked access to both terrestrial and mobile broadband services compared to 8% of the U.S. overall, with 59% of rural tribal lands and about 11% of urban tribal lands lacking access to terrestrial and mobile services. In 2019, ASU's [American Indian Policy Institute](#) published the [Tribal Technology Assessment: The State of Internet Service on Tribal Lands](#), finding that 18% of tribal reservation residents have no Internet access at home, wireless or land-based and 33% rely on Internet service from a smartphone at home.



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**18% of tribal reservation residents have no Internet access at home, wireless or land-based and 33% rely on Internet service from a smartphone at home.**

## New and Innovative Last Mile Technologies and Solutions

While lack of infrastructure is still an issue for many communities, today there are many new wireless technologies such as satellite, mesh networks and CBRS, White Space, LTE, 5G, that with collaboration, effective and innovative community planning, can be deployed, individually, or in combination relatively rapidly and inexpensively, to provide affordable access. Yet many schools and communities are not aware of the opportunities provided by these new technologies. See the menu of Internet access technologies and discussion of emerging broadband technologies in Appendix B of this report.

## Access to Free or Affordable Devices

Digital access is more than just Internet access. While people may have Internet access, many students, teachers and households need access to free or affordable devices such as laptops, tablets and smartphones, as well as other digital equipment such as routers, hotspots and web cameras. [The US Census American Community Survey](#) from 2018 estimated about 20% of households in Arizona do not have a desktop or laptop computer (some of these may have tablets).

## Technical Support

While many schools, libraries and individuals, including students, parents, seniors, library patrons and community, may have Internet access and devices, they are not able to effectively use those devices and the Internet. They need easy, cost effective or free access to on-demand technical support. While there are a number of organizations ramping up to address the technical support issue, there is still lots of work to be done



Photo by Anna Shvets/Power

Educators have had to transition from in-person to online training with little or no experience.

to identify, coordinate and provide easy access to these resources. We need to expand funding, support English and Spanish services (plus possibly additional languages), identify gaps, explore creative solutions and provide a portal, marketing campaign and more to promote and provide access to these resources.

## Professional Development Opportunities for Educators

The transition from in person to online and hybrid learning has presented huge challenges for educators, many who have had little or no experience in online teaching. While schools have been working hard in making this transition, we need to support schools in providing expanded professional development and training opportunities for educators in K-12, community colleges and universities, on remote and hybrid instruction. While there are a number of organizations currently, or planning to provide professional development such as the Arizona Technology In Education Association and the recently announced [ASU Prep Digital's Arizona Virtual Teacher Institute](#), there is no portal or database of existing organizations, little coordination, and no strategic or unified professional development strategy.

## Government and Other Funding and Support Resources

While there will be many millions of federal dollars coming available, many of the grant programs require complex application processes and detailed management and reporting requirements. Many schools, libraries, telemedicine programs and communities do not have the personnel and expertise to prepare and manage these applications. As a result, Arizona may miss out on millions of dollars in federal funding.

In addition to government funding, there are other untapped sources of funds and resources such as foundations, donation campaigns, volunteer support, refurbished equipment donations, corporate funding and equipment donations. but these funding sources are often difficult to find.

## Digital Content and Digital Literacy Services and Resources

Students, teachers, parents, seniors and library patrons need access to digital literacy training, services and resources to be able to use the digital devices and Internet services effectively. Digital content of various kinds such as digital curriculum, instructional videos and informational resources offer opportunities to substantially enhance and improve student education.

## Access to Digital Access Resources

While there are many organizations, resources and initiatives in the State, information about these resources is difficult to find. We need to create a simple, easy to navigate, public-facing Digital Access Resources Portal to provide easy access to resources such as free or affordable Wi-Fi hotspots, professional development and tech support organizations, digital resources and Personal Protective Equipment (PPE) resources.

# Understanding Broadband Infrastructure Deployment - Issues, Challenges and Solutions

## Middle Mile and Last Mile Infrastructure

There are two primary types of telecommunications infrastructure required to deploy broadband into a community:

- **Middle Mile** refers to the high capacity trunk lines and associated infrastructure that connect communities to the Internet backbone points-of-presence generally in Phoenix and Tucson and in some cases, Albuquerque or Los Angeles.
- **Last Mile** represents the Internet connection networks of wired (copper, fiber optic and coaxial cables) and wireless access points between the Internet Service Provider (ISP) and end users, such as businesses, homes, schools, libraries, health care facilities, community centers.

## Barriers to Resolving Broadband Deployment

There are a number of critical and persistent barriers to resolving the broadband deployment issues that were identified in the [Statewide Broadband Strategic Plan](#) of 2018 and preceding documents that are amplified because of COVID-19:

- Arizona has unique geographic factors that make planning, siting and maintaining broadband infrastructure especially challenging and costly. These include vast distances between communities, challenging terrain, sparse middle mile and long-haul fiber-optic cable and the need to permit and site infrastructure across local community, federal, state, tribal and private lands.
- **Return on Investment (ROI):** Broadband deployment requires a balance between deployment costs, “affordable” monthly end user rates and the length of time for the provider’s ROI or Return on Investment. Considering the cost of middle mile investment, this is often not a feasible model in rural and under-served areas. Public and private organizations need some form of long-term, low cost financing. Due to recent advancements in wireless and other technologies, last mile deployment of broadband is becoming more cost-effective, even in rural and underserved areas of the State with distributed populations. A number of companies have expressed interest in providing last mile service in these areas. In order to deploy their networks and charge reasonable rates, they must have access to sufficient and reasonably priced middle mile connections. If a common middle mile infrastructure is not available at reasonable rates, communities or last mile providers must construct their own middle mile infrastructure. This increases costs that can impact investment decisions and significantly increase the end users’ monthly rates.
- **Access to Rights-of-Way (ROW):** Federal, tribal, state and local Rights-of-Way issues such as multiple jurisdictions permitting, delayed application approvals and unequal and prohibitive fees have been significant barriers and disincentives for deployment of services. Some last mile providers have reported that legal fees for permitting are as much as 50% of the cost of the project.
- **Funding:** There is insufficient state funding and lack of a dedicated Arizona funding mechanism such as a Broadband Authority or a Broadband Arizona Universal Service Fund earmarked for broadband deployment in Arizona.
- **Redundancy:** An additional problem is the lack of redundancy (more than one path for telecommunications transport) to and from a community in order to maintain connectivity in the event of network damage or failures. Many of Arizona’s rural communities are “fed” by a single route of fiber or microwave radio systems. Repeatedly, communities and even regions of the State have been “cut off” from the rest of the world due to damage inflicted on these single-point-of-failure routes. In the event of an emergency or disaster, most communities would have no backup system, unless cell or wireless phone companies had built their own parallel network into the community.

How do we address these issues? The State should take significant action to accelerate broadband deployment in rural communities. These actions include direct investment of State funds, reduction of regulatory hurdles, and promotion of public-private partnerships to deliver digital connectivity to unserved and underserved areas.

## Some Short - Term Internet Access Solutions

While the State and local communities are working on long term initiatives to solve the lack of Middle Mile connectivity to their neighborhoods and communities, we are seeing schools, libraries, local governments, nonprofit organizations and communities, as well as providers, implementing short term and affordable Last Mile solutions. Many use cellular, wireless and even satellite solutions which allow for rapid deployment at modest cost. For example:

- Wireline or wireless Internet providers are offering special programs and discounted service plans, free access to their Wi-Fi hotspots, and funding to help schools and libraries connect their communities. The Arizona State Library



Photo by Saurabkumar Singh/Pixabay

Many of Arizona’s rural communities are “fed” by a single route of fiber or microwave radio systems.



Wi-Fi on parked school buses can provide Internet access for schools and communities.

[Connect Arizona](#) site is tracking and publicizing this information.

- Schools and libraries are providing neighborhood Wi-Fi networks using “smart” school buses, library bookmobiles or other Wi-Fi enabled vehicles parked in neighborhoods and connecting to the Internet using cellular or satellite connections
- Schools, libraries and community organizations are teaching people to enable their smartphones as a personal Wi-Fi hotspot. In many cases wireless providers are offering free or discounted expanded data plans
- Schools, libraries, businesses, nonprofit organizations that want to provide free public access, are extending access to their networks into their parking lots and communities to provide Internet while practicing safe social distancing
- Schools, libraries, government agencies, nonprofit organizations, communities and service providers are providing free or discounted mobile Internet hotspot devices or cellular-enabled tablets and laptops with pre-paid services to their constituents or targeted populations which can then be used to share broadband with others, including an entire household.
- Municipalities and nonprofit organizations are establishing public, private or partnership owned community networks providing free or affordable access for the community.
- Neighborhood or community residents are creating “mesh networks.” Residents “agree” to share their services by meshing their Wi-Fi connections with their neighbors’ networks to provide public access, usually with a secondary SSID. In some cases, they are utilizing satellites or cellular services for backhaul combined with a mesh network where other service options are not available.

See our Appendix B for more details on both short-term and longer term solutions to Arizona’s digital access issues.

## State of Arizona Broadband Initiatives

### Arizona Broadband Infrastructure Initiatives

The following is an overview of some major Arizona broadband infrastructure initiatives.

- **Statewide Broadband Strategic Plan:** In February 2018 Arizona, led by the [Arizona Department of Administration \(ADOA\)](#), created an [Arizona Statewide Broadband Strategic Plan](#) to effectively coordinate, manage and collaborate on the resources required to deliver accessible, affordable and reliable access to broadband services. This Plan is designed to serve as a roadmap for ensuring that Arizonans are afforded equal access to digital opportunities regardless of geographic location.
- **Arizona Commerce Authority State Broadband Director:** In 2018, following the recommendation from the [Arizona Statewide Broadband Strategic Plan](#), the [Arizona Commerce Authority \(ACA\)](#) hired its first State Broadband Director to coordinate and accelerate rural broadband development, focusing on middle mile and last mile strategies for rural Arizona. The Broadband Director is responsible for strategically managing relationships with state government agencies, local leaders, telecommunications carriers, federal communications policymakers and nonprofits to advance the expansion of broadband statewide. The Broadband Director coordinates broadband development activities in partnership with local communities, state and local government stakeholders and the private sector to streamline regulatory hurdles and maximize strategic broadband funding for Arizona. See the [ACA’s Broadband Page](#) for more information.
- **Middle Mile Infrastructure and Smart Highway Corridors:** Lack of backhaul and middle mile connectivity has been a major barrier to deployment of broadband to all tribal, rural and other underserved communities and low-income neighborhoods in Arizona. In June 2020, Governor Ducey allocated \$40 million dollars from his GEER fund to install fiber-optic cable along I-17 from Sunset Point to Flagstaff and along I-19 from Tucson to Nogales. The proposed “[Smart Highway Corridors](#)”





APS (Arizona Public Service Electric) currently has a new build underway between Phoenix and Flagstaff that increases the fiber optic capacity from 24 to 432 fibers.

would result in broadband conduit along the lengths of Interstates I-17 and I-19 by January 2022. This conduit will be available for transportation purposes and Public Private Partnerships (P3s) with telecommunications companies that will result in connectivity improvements for K-12 education, higher education and rural community connectivity. In addition, identification of additional funding is needed for comparable deployment of fiber along the I-40 from the California border to the New Mexico Border, U.S. Route 89 from the Utah border to Flagstaff and I-8 from Yuma to the intersection with I-10. ADOT had released an RFI in August 2020 to explore public-private partnerships to deploy and manage middle mile fiber infrastructure along State highways to reach all Arizona communities and is evaluating the responses received.

- **Arizona State Land Department Rights-of-Way Access.** [The Arizona State Land Department \(ASLD\)](#) has approved a change to allow broadband rights of way (ROW) for third party use on State Land. This rule change for example allows APS to sublease dark fiber optic infrastructure to broadband carriers such as CenturyLink and Cox. APS currently has a new build underway between Phoenix and Flagstaff that increases the fiber optic capacity from 24 to 432 fibers for this purpose and is repositioning their fiber infrastructure portfolio to encourage more private provider and community use. ASLD also provides the online [AZGEO Clearinghouse](#), a central repository for the sharing of GIS data in Arizona.
- **Broadband Action Teams:** [The Arizona Statewide Broadband Strategic Plan](#) recommended the creation of BATs or Broadband Action Teams. Often with leadership and assistance from the ACA Broadband Director, BATs have been created in a number of communities in the State to coordinate efforts and support community needs assessments, broadband infrastructure planning and grant writing. These BATs have been extremely successful in securing millions of dollars of federal and state grants to connect their communities, schools and libraries. Teams have included representatives from schools, libraries, economic development officials, telehealth and other relevant local organizations. For example, Payson is focusing on a fiber ring for high-capacity and reliable middle mile connectivity to support economic development. Yuma is focused on agriculture economic development and Page is focused on the tourism business.
- **Arizona Rural Broadband Development Grants (RBDG):** In 2019 Arizona allocated \$3 million to expand broadband services in underserved rural areas across the State. Another recommendation from the [Arizona Statewide Broadband Strategic Plan](#), the Arizona Rural Broadband Development Grants have been used to support planning and deployment, enabling Arizona communities to more easily access broadband services at speeds and prices equal to national averages in rural areas and provide consistent and reliable service. Grants were awarded in 2 categories: RBDG-A Shovel-ready projects to immediately improve broadband infrastructure, with a maximum award of \$1,000,000 per project and: RBDG-B Broadband planning activities for projects that are not shovel ready, with a maximum award of \$50,000 per project.  
  
RBDG-A recipients included: 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 Cooperative](#) will provide high-speed broadband service at speeds up to 10 Gbps symmetrical to its 35,000 members, will serve Bullhead City, Fort Mohave and Mohave Valley; and Commnet Wireless will create a new fiber-optic middle mile pathway to Page to serve 310 small businesses and 1,066 households within the area. RBDG-B recipients included Coconino County, Gila County, Town of Springerville and City of St. Johns.
- **Arizona Broadband for Education Initiative:** The Federal Communications Commission administers the E-rate program. With funding from the USAC Universal Service Fund, E-rate provides discounts for telecommunications, Internet access and internal connections to eligible schools and libraries. Three years ago, the Federal Communications Commission (FCC), which oversees the E-rate program, approved enhanced discounts for special construction of

broadband infrastructure, based on a dollar-for-dollar state match, up to 10% of the total project cost. This presented school districts and public libraries with an unprecedented opportunity to get broadband connectivity and to dramatically increase their infrastructure. In March 2017, the Arizona Corporation Commission updated the [Arizona Universal Service Fund \(AUSF\)](#) rules to provide \$8M in funding for “Special Construction” projects in Arizona. In April 2017, the Arizona State Legislature approved an additional \$3M for “Special Construction” projects. Used in combination with the E-rate program, this funding resulted in approximately \$130 M in new broadband infrastructure projects within the State. Schools and Libraries in several counties have benefited from this including Apache, Cochise, La Paz, Pinal, Santa Cruz, Yavapai and Yuma Counties.

- **Sun Corridor Network:** Arizona Board of Regent’s (ABOR) [Sun Corridor Network \(SCN\)](#), Arizona’s Research & Education Network currently serves the three State universities along with a growing number of community colleges including the Maricopa County Community College District and K-12 school districts including Yuma Schools. Led by the Chief Information Officers from the State universities, the Sun Corridor Network’s (SCN) mission is to connect and enable every school, library, community anchor, healthcare organization and public service in the State of Arizona with a high-capacity, responsive and available network. Their network includes access to educational and research assets within the State along with direct access to the Internet2, the nation’s Research & Education network and exceptionally fast lanes to access the public Internet.
- **National Public Safety Broadband Network:** Arizona participates in FirstNet, an interoperable wireless public safety communications network for first responders being built out by AT&T. FirstNet was approved by all U.S. states and territories. The State may be able to leverage new FirstNet-driven infrastructure improvements, including fiber extensions, tower construction and small cell deployment to facilitate broadband expansion in rural communities for other purposes.
- **University of Arizona’s Arizona Telemedicine Program:** In today’s COVID-19 environment telemedicine is becoming even more critical for Arizona’s health care facilities, providers and patients. The [Arizona Telemedicine Program \(ATP\)](#), was established in 1996, to improve access to specialty medical services in rural Arizona. ATP is designated by the [Arizona Legislature](#) to oversee and coordinate statewide telemedicine clinical, education, research and telecommunications programs and has received over a dozen national and international awards as a top telemedicine program.

ATP reports to the [University of Arizona College of Medicine](#), for fiduciary reporting; and to the [Arizona Telemedicine Council](#), for programmatic review. ATP is headquarters of the HRSA (Health Resources & Services Administration)-funded [Southwest Telehealth Resource Center \(SWTRC\)](#). It’s [T-Health Institute](#) in downtown Phoenix is a go-to video conferencing center for the region. The SWTRC and The Arizona Broadband Director are now leading an **Arizona Telehealth Broadband Action Team (BAT)**.

The ATP network serves 70 communities and 160 sites. At its peak radiologists were diagnosing 130,000 cases per year. ATP is becoming a national leader in telemedicine training and, more recently, healthcare professions telemedicine training. The telemedicine network has evolved from a dedicated leased-line type network to a hybrid design that also incorporates secure cloud video communications services and virtual private networking facilitating telemedicine clinical services and healthcare education. ATP has competed successfully for federal grants and expanded its training reach to the Four Corner States and Nevada. In the telemedicine service arena, the ATP has facilitated telemedicine consults by a wide range of specialists for patients in rural and underserved areas of Arizona and in state and county correctional facilities.

The ATP is not a healthcare services organization, but rather works with healthcare providers and organizations throughout Arizona to support: telemedicine training



The State may be able to leverage new FirstNet-driven infrastructure improvements, including fiber extensions, tower construction and small cell deployment to facilitate broadband expansion in rural communities.



The Arizona Legislature recently passed legislation (SB1460) to enable electric cooperatives to deploy deep fiber and serve residential and enterprise broadband customers.

for service providers; innovations in education; federally funded telemedicine and telehealth research; and technical assistance services for clinical telemedicine and telehealth providers. Recently, it has begun offering technical services directly to patients and their families.

- **Electric Cooperatives:** A relatively new player in providing broadband to rural communities are the members of the [Grand Canyon State Electric Cooperative Association \(GCSECA\)](#). First established through the federal electrification initiative in the 1930's, Co-ops - which are not-for-profit membership organizations, have extensive experience serving rural communities. Electric cooperatives have access to rights-of-way, existing vertical assets, fiber infrastructure, existing plant, equipment, staffing and billing that can help enable and promote low-cost connectivity solutions for rural communities. The [Arizona Legislature](#) recently passed legislation (SB1460) to enable electric cooperatives to deploy deep fiber and serve residential and enterprise broadband customers. [Mohave Electric Cooperative \(MEC\)](#) with support from the [Arizona Commerce Authority's Arizona Rural Broadband Development Grants program](#), will be the first cooperative in Arizona to construct a fiber-to-the-premise network for its customers and is currently accepting [pre-registrations](#). They plan to provide last mile fiber to the premise of every cooperative member. The goal is a minimum of 25 Mbps symmetric feeds to member businesses with higher speed options and 1 Gbps symmetric broadband to all residences.
- **Discounted Provider Service Plans and Free Wi-Fi:** During the pandemic, many providers have been offering discounted service plans, free access to their Wi-Fi hotspots and helping schools and libraries connect their communities. The [Connect Arizona](#) site is seeking to track and help publicize this information going forward.
- **Schools, Libraries and Businesses:** Schools and libraries, as well as businesses are looking at creative ways to address the need for Internet access, such as schools providing Wi-Fi access on parked school buses in neighborhoods, or libraries extending access to their networks into their communities. Thanks to the Arizona State Library, for example, five public libraries have participated in a pilot project with Cisco to install Wi-Fi boosters enabling access to the users from the parking lots while the libraries are closed. Such Wi-Fi extensions could be provided at all schools and public libraries if funding and appropriate security is provided.
- **Arizona Smart Cities and Regions:** Arizona has become a leader in the establishment of smart cities and regions that use information and communications technology to enhance their livability, workability and sustainability. Advances in what is nominally called the "smart cities" space such as 5G, Internet of Things (IoT), autonomous vehicles, augmented and mixed reality, rich mobile-content delivery and the many forms of tele connection rely on robust broadband capabilities and in turn drive demand for bandwidth, services and data storage driving Arizona's massive data center expansion. Public, private, university and community partners have come together in the Greater Phoenix area as [The Connective](#), a smart region consortium, while the [Pima Association of Governments \(PAG\)](#) has launched their own [PAG Smart Region](#) initiative in the Tucson area. The [Arizona Commerce Authority \(ACA\)](#) is driving innovation in the autonomous vehicle and Mobility-as-a-Service (MaaS) space with their [Institute of Automated Mobility \(IAM\)](#) while ramping up **Smart State** efforts focusing on operational frameworks and metrics driving alignment and synergies from city to region to state.





## Other Digital Access Initiatives in Arizona

There are numerous other federal, state and local short and long-term initiatives and strategies planned, proposed or underway to address Digital Inclusion, for example, there are a number of public, corporate and nonprofit organizations nationally and in Arizona launching donation initiatives to deliver new or refurbished devices to students and families, schools, libraries and community organizations. The following are some Digital Access initiatives in Arizona.

- **Connect Arizona Website and Interactive Map:** The [AZBSN COVID-19 Digital Access Task Force](#), in cooperation with the [Arizona State Library, School Connect](#) and [Common Sense](#) has recently launched a [Connect Arizona](#) website and interactive map for user friendly access to free Wi-Fi hotspots and technical support resources in Arizona. The locations on this map include free public Wi-Fi hotspots at public libraries, schools, businesses and other sites, as well as broadband provider Wi-Fi capabilities made available to the public. The site also provides information on free and discounted resources to get connected and free technical support as described below.



- **Arizona Libraries Tech Access Phoneline (AZ LibTAP)** is supported by a team of librarians from libraries around the State providing free one-on-one phone support services. Learning to use technology is often intimidating. Everyone can benefit from patient, trusted guides who understand digital literacy as well as local contexts. These librarians will provide help with issues such as operating computers and devices; finding free Wi-Fi hotspots and Internet offers in local areas; getting things done online such as where to go for unemployment forms or online banking; using the Internet to stay connected to family and friends; accessing library e-resources; and more. AZ LibTAP is supported by the [Arizona State Library, Archives and Public Records](#) and available through the [Connect Arizona](#) website.



**AZ LibTAP is a free resource, available through Connect Arizona, to help with questions on how to operate technology.**

- **AZBSN Arizona Broadband Consultants Directory:** While there are many current funding opportunities and substantial additional funding will be coming to address COVID-19 digital inclusion and digital equity issues as well as broadband infrastructure gaps, most of the federal and state grant programs involve very complex application processes as well as challenging management and reporting requirements. In many cases schools, libraries, telemedicine programs and communities do not have the personnel and expertise to prepare and manage these applications so they frequently need to contract with consultants for grant applications development, as well as for more general funding consulting, community assessments, broadband planning, and project management needs. The Task Force has developed and maintains an extensive [Arizona Broadband Consultants Directory](#), most based here, that can provide these services which are conveniently indexed by Practice Areas and Specialties offered. The Directory is actively maintained, publicly posted on the [Task Force Resources Page](#) and has already proved to be a valuable tool for use by Arizona's institutions, communities and other broadband stakeholders.





Photo by Andrea Piacquadio/Pexels

**Az StRUT refurbishes donated computers and supports applied learning in Arizona's educational systems through scholarships and technical education along with student IT work experience.**



Photo by August de Richelieu/Pexels

**Computers 2 Kids Technology Assistance Program recycles and refurbishes used computers and donates them to families in need.**

- [\*\*ASU Prep Digital's Arizona Virtual Teacher Institute\*\*](#) The [Governor's Office](#), the [Arizona Department of Education](#), the [Helios Education Foundation](#) and [Arizona State University \(ASU\)](#) announced a new, \$7.5 million partnership to help the State's K-12 teachers deliver quality instruction and support for online and blended learning environments and to provide training and professional development for every teacher in Arizona. [ASU Prep Digital's Arizona Virtual Teacher Institute](#) will provide both group and personal training to help Arizona teachers succeed in delivering online instruction.
- **Free Mobile Devices and Broadband Services:** Municipalities, school districts and non-profit organizations are funding and distributing new tablets, laptops and mobile hotspots, often including pre-paid subscriptions to broadband services with programs mostly targeted at disadvantaged and disconnected populations. Both the City of Phoenix and the City of Tucson have begun major initiatives as have numerous school districts, with many other communities and organizations ramping up to help fill digital access gaps on an individual and family level with programs to provide mobile devices and broadband services. In particular, the City of Phoenix is actively expanding its public Wi-Fi coverage outside nearly 50 libraries and community, senior and recreation centers as reflected on their [Free Public Wi-Fi Map](#).
  - An exemplary example is the [Arizona State Library](#) which has allocated part of their CARES Act funds received from the [Institute of Museum and Library Services \(IMLS\)](#) for purchase of devices like tablets and chrome books for the use of the public libraries facilities and for distribution through the public libraries. The State Library through the public libraries, is also distributing hot spots with prepaid LTE service contracts.
- **Refurbished Technology Distribution Organizations:** There are several organizations in Arizona that are collecting, refurbishing and distributing free or low-cost devices such as PCs, laptops and tablets to schools, organizations or directly to students and families. Some of these organizations also provide tech support as well as educational and work experiences for students helping with device refurbishment.
  - [\*\*Arizona Students Recycling Used Technology \(AZ StRUT\)\*\*](#) is a nonprofit organization operating in Arizona for 22 years that refurbishes donated computers for use by K-12 students, libraries and nonprofit organizations. During 2018 and 2019 they refurbished and gave away about 100,000 computers. Many of their donations come from surpluses from the corporate world. The State Library has been using AZ StRUT for the last two years and has distributed approximately 600 computers to Public Libraries and through them, loans to the community. [The Arizona Technology Council \(AZTC\)](#) is partnering with AZ StRUT to lead a **Community Laptop Drive Initiative** for students in Greater Phoenix. AZ StRUT, more than a refurbishment organization, also supports applied learning in our educational systems through scholarships and donated electronics as well as providing technology and technical education along with student IT work experience.
  - The [Arizona Commerce Authority \(ACA\)](#) and [Arizona Department of Education \(ADE\)](#) launched a Hotspot Donation Drive to encourage private and public partners to donate their unused or surplus hotspot devices for students in need. Once a public or private sector partner has donated devices, ADE will match the devices to the students and families who need them.
  - [\*\*Chicanos Por La Causa \(CPLC\)\*\*](#) has teamed up with AZ StRUT to refurbish and distribute devices. For just \$30, this partnership can provide a family in need with a working laptop computer and Internet devices.
  - [\*\*Computers 2 Kids\*\*](#) has a robust [Technology Assistance Program](#) that recycles and refurbishes used computers and delivers them directly to families in need, with a one-year free warranty and lifetime technical support. Computers 2 Kids also provides education, training and technical support.

- [RefurbIT](#) in Yuma is an initiative of ACHIEVE Enterprise Services, a full-service electronic recycling center that is converting obsolete computer electronics into reusable and refurbished products and providing refurbished IT equipment at discounted prices. They offer low cost refurbished computers and iOS (iPads, iPhones) devices to individuals. They serve Yuma, San Luis, Somerton, Wellton, Gadsden, Parker, Quartzsite, Kingman, Lake Havasu City, Bullhead City, Casa Grande and Maricopa.
  - Although it is not based in Arizona, [TechSoup](#) is a national nonprofit organization with programs available to Arizonans. TechSoup provides access to free or discounted technology and services from companies such as Microsoft and Zoom, for libraries and 501(c)(3) nonprofit organizations.
- The [Valley of the Sun United Way \(VSUW\) Tech Support](#): As schools returned in the fall virtually, many families had to navigate this transition on their own, with limited understanding, experience and access to online learning. VSUW, in partnership with their corporate partners, launched a “Hotline” for families in their partnering school districts. In real-time, families were able to call the Hotline to get help with basic connections, whether that be to the internet, to their learning platform, or simply how to turn on their loaned devices. VSUW identified skilled volunteers from their corporate partners who staffed a phone line. Volunteers were provided a Zoom line and FAQ sheet explaining the platforms each of our school districts were using, the type of loaned device, tips and suggestions as well as the contact information for more specific technical assistance within each school district. The VSUW Hotline was open and available Monday - Friday from 9:00am - 4:00pm, July 29th through August 14th. This hotline was aligned to be available to our families the week before and the week during when most schools were returning to school virtually.

## AZBSN COVID-19 Digital Access Task Force Recommendations and Call to Action

The Task Force is providing the following strategic and tactical digital inclusion recommendations that address the short-term or immediate challenges presented by COVID-19, and some long-term solutions such as fixing the Middle Mile Internet connectivity deficiencies.

**A special note:** One of our many priorities is to provide recommendations to support Arizona communities, education institutions, telemedicine and nonprofit organizations in digital inclusion and broadband infrastructure planning, including coordinating efforts, needs assessments, project planning and grant writing. As mentioned earlier in this report, while there will be millions of federal dollars coming available, many of the grant programs require complex application processes and detailed management and reporting requirements. Many schools, libraries, telemedicine programs and communities do not have the personnel and expertise to prepare and manage these applications. As a result, Arizona misses out on millions of dollars in federal funding. Our recommendations include the need for increased state professionals at ACA, the State Library and the Department of Education or funding for professional consultants to provide technical support.

### Technology and Infrastructure

- **Adopt an Arizona Definition of Broadband.** The Task Force recommends that the State of Arizona adopt a goal of a minimum broadband speed of 100 Mbps download and 10 Mbps upload (100/10 Mbps) to guide infrastructure investments and program implementation similar to California [Governor’s Executive Order](#). Going forward, a scalable standard should be employed as application bandwidth needs and network capacity continue to grow. The FCC currently defines broadband as an Internet connection at a speed of 25 Mbps download and 3 Mbps upload (25/3 Mbps), which may be inadequate for a variety of emerging data intensive applications such as telemedicine, eLearning, augmented/mixed reality and IoT that will have ever increasing bandwidth requirements.



Many schools, libraries, telemedicine programs and communities do not have the personnel and expertise to prepare and manage grant applications.



A future-proofed K-20 education technology infrastructure is essential to enable modern digital-learning technologies and methods necessary for a workforce equipped for the knowledge-based economy.

- **Sun Corridor Network:** The Task Force recommends that the State engage in a strategic planning process to develop a short and long-term strategy, including new business models, to leverage the [Sun Corridor Network \(SCN\)](#), Arizona's Research & Education Network, to connect and enable every school, library, community anchor institution, healthcare organization and public service in the State of Arizona with a high-capacity, responsive and available network. SCN currently provides access to the national Internet 2 research and education network for the three state universities, along with several community colleges and K12 districts across the State along with fast lanes to the public Internet.

We support the SCN's participation in ADOT's investment in highway corridor fiber deployments along with the anticipated public-private partnership (P3) to grow and manage a robust State fiber network. This will lead to the improvement of rural broadband network capacity and availability across the region, as well as improved regional research collaborations. A future-proofed K-20 education technology infrastructure is essential to enable modern digital-learning technologies and methods necessary for a workforce equipped for the knowledge-based economy.

- **Arizona's Smart Highway Corridors:** The [Arizona Department of Transportation \(ADOT\)](#) recently received a \$40M allocation from the [Governor's Emergency Education Relief Fund \(GEER\)](#) to complete fiber builds between Flagstaff and Nogales on sections of I-17 and I-19. The Task Force recommends additional funding for comparable deployment of fiber along I-40 and other strategic segments. The Task Force also recommends that ADOT develop a robust business model, engage a public-private partner (P3) to manage these and other new fiber investments and work towards evolving Arizona's regulations to allow a wide range of public and private communication uses on their fiber network. Arizona needs to continue to develop strategies and initiatives to further deployment of middle mile infrastructure to rural communities throughout the State.

The [Utah Department of Transportation \(UDOT\)](#) is a model for how to make access to Rights-of-Way easier, trade and share conduit and fiber optics, and install empty conduit during highway construction to serve underserved areas. This initiative is complemented by [UTOPIA Fiber](#), an open access network owned by eleven Utah cities. Also of interest is Colorado's "Internet of roads" project led by the [Colorado Department of Transportation \(CDOT\)](#), extending along highways crisscrossing the state for connected vehicle interactions and public private fiber partnership use including Project Thor involving 14 northwest Colorado mountain communities. More than 140 Colorado communities have voted to opt out of the 15-year-old SB 152, thus enabling them to build and manage their own broadband networks, leading to a number of success stories in municipal Fiber-to-the-Home (FTTH).

- **Furnish Free or Affordable Mobile Devices and Broadband Services:** The task Force recommends that the state, municipalities, libraries, school districts and non-profit organizations should accelerate their funding and distribution of new or refurbished tablets, laptops and mobile hotspots that may include pre-paid subscriptions to broadband services for disadvantaged and disconnected populations. A great example is Texas that has launched [Operation Connectivity](#) earlier this year, a statewide initiative to remediate their educational Digital Divide by delivering Internet connectivity and end user computing (EUC) devices to school districts, students and families. Texas has allocated [\\$200 million in CARES Act funding](#) matched by school districts to procure over a million personal devices and mobile hotspots to ensure that all students attending a Texas public school will have both a device and a connection to the Internet throughout the 2020-21 school year and beyond.
- **Device Refurbishment and Donations Programs:** The Task Force recommends providing State and other funding to expand device refurbishment and donations programs such as Az StRUT to all schools, libraries and communities in Arizona. Set-up guides, processes and procedures, provide funding, publicize these programs, request donations of surplus computers from companies, state government and universities as well as school districts and individuals for refurbishment.

## CARES ACT Becomes Law



The CARES (Coronavirus Aid, Relief, and Economic Security) Act was signed into law on March 27, 2020.





**Device as a Service (DaaS)** is a comprehensive management solution that fuses device procurement, deployment and maintenance with ongoing support services.

- **Resources For Free or Discounted Technology and Services:** The Task Force recommends promoting nonprofit organizations, for example TechSoup, a national nonprofit organization, that provide access to free or discounted technology and services from commercial companies such as Microsoft and Zoom, for libraries and 501(c)(3) nonprofit organizations.
- **Supply Chain and Lifecycle Services:** The Task Force recommends exploring the use of strategic Value-Added Resellers (VARs) and Integrators that can provide Supply Chain and Lifecycle Services. These solutions enable institutions and enterprises to rapidly procure, build, image, configure and deploy hardware with the option to add device management with lifecycle support.
- **Device as a Service (DaaS):** The Task Force recommends exploring the use of strategic Value-Added Resellers (VARs) and Integrators that can provide [Device as a Service \(DaaS\)](#). This solution provides bundled endpoint hardware, software, device management and lifecycle services with financing options for an easy and predictable per-device monthly invoice.

## State and Community Digital Access Planning

- **Broadband and Digital Access Community Teams:** The Task Force recommends **continuation and expansion** of State support for the creation of Broadband Action Teams (BATs) or broader Digital Access Action Teams (DAATs) in neighborhoods and communities. Teams may include schools, libraries, business, economic development officials, telehealth and other relevant local organizations that should participate in community needs assessments, broadband infrastructure planning and grant writing. Some Arizona counties have established “Broadband Action Teams” in communities such as Payson (focusing on a fiber ring for high-capacity and reliable middle mile connectivity to support economic development), Yuma (focused on agricultural economic development) and Page (focused on the tourism business) that have enabled them to access federal or state funds to connect their communities, schools and libraries.
- **State Community Planning Assistance:** The Task Force recommends additional funding, including additional staff for the proposed State Broadband Office and/or the Arizona Commerce Authority, the Arizona State Library and the Arizona Department of Education, to enable them to expand their support of Arizona communities, education institutions, libraries and nonprofit organizations in community assessments and development of planning and grant identification and applications, including E-rate funding.
- **Data Collection Strategy:** The Task Force recommends developing a data collection strategy to provide actionable data and an overview of the current status, gap analysis and future Digital Access needs to enable more effective planning for education, telemedicine, economic development and more. Data collected may include connectivity, devices, technical support, professional development, and funding requirements. The strategy may include K-12, universities, community colleges, libraries, nonprofit organizations. Partners for this strategy might include the Arizona Department of Education, the Center for the Future of Arizona, universities and community colleges, school districts, telemedicine organizations, etc.
- **Leverage E-rate Funding:** The Task Force recommends that the Arizona Commerce Authority’s State Broadband Director, in cooperation with the Arizona Department of Education and State Libraries, should help maximize and leverage the use of E-rate funding provided for rural school, and libraries to enable service providers to better serve their surrounding communities including rural residences, businesses, local governments, health care facilities and public safety, a concept known as “to and through.”
- **Broadband Mapping:** The Task Force recommends that State government should provide up to date Arizona broadband mapping capabilities to enable broadband planning, location siting and public broadband stakeholders to track broadband coverage and fiber deployments, The mapping would be integrated





The Task Force recommends providing funding from State government, corporations and foundations to support AZBSN's efforts to facilitate information sharing, education and communication among stakeholders committed to promoting the expansion of broadband deployment, digital equity and digital inclusion for all citizens in Arizona.

with demographic and community anchor institution (CAI) details, making the data and mapping tools publicly available through the [AZGEO Clearinghouse](#), a central repository for the sharing of GIS data and otherwise open sourcing. Arizona should also sign on to participate in the [National Telecommunications & Information Administration's \(NTIA\) National Broadband Availability Map \(NBAM\) program](#), a national platform allowing for the visualization and analysis of federal, state, commercially available and open source data sets to help inform policymakers as they seek to expand broadband coverage in Arizona.

## Funding and Resources Support Strategies

- **Broadband Development Authority:** The Task Force recommends establishing a Broadband Development Authority to provide incentives and low cost, long-term financing to encourage private sector development of resilient, middle mile and last mile telecom solutions in the state, as done in other states. The Authority should be empowered to: issue bonds and notes; make loans and provide joint venture and partnership arrangements to broadband developers and broadband operators for financing or refinancing; enter into contracts for the lease or management of the infrastructure; and enter into joint venture and partnership arrangements with persons that will acquire, construct, develop, create, maintain, own and operate the infrastructure. Owners of the network may be private, public or public-private partnerships. Funding may come from sources such as the [Arizona Universal Service Fund \(AUSF\)](#), tax incentives, bonding, tribal gambling, E-rate and other Federal programs including homeland security.
- **Funding Research and Application Support:** The Task Force recommends providing State support to research, identify, advocate and apply for federal funding and write grant proposals to help fund digital access initiatives at the state and local level.
- **Government and Non-Government Grants Research:** The Task Force recommends providing funding to the State Broadband Office, recommended later in this report, for a research position to provide digital access grants information on federal government, state government, and foundation grants contained in the **eCivis state grants management system and other funding resources**. This research position would provide regular overviews to Arizona stakeholders on relevant digital access grants of interest to a broad variety of stakeholders as well as respond to customized search requests of the eCivis system from specific stakeholders. The recommended State Broadband Office should also set up, research and maintain a digital access funding portal or web site to provide easy access to non-government funding and resources such as foundations and corporate donations.
- **Arizona Broadband Stakeholder Network Funding:** The Task Force recommends providing funding from State government, corporations and foundations to support the Arizona Broadband Stakeholder Network (AZBSN) to continue to facilitate collaboration, coordination, information sharing, education and communication among key public, private and nonprofit stakeholders committed to promoting the expansion of broadband deployment, digital equity and digital inclusion for all citizens in Arizona, and expanded activities as discussed in this report. These activities, recommended in numerous state reports, are important for the future development of State broadband and digital inclusion efforts beyond the COVID-19 crisis and cannot be accomplished by State government alone.
- **Arizona Rural Broadband Development Grants:** The Task Force recommends supporting the Governor's 2020-2021 budget request for \$10 million to recapitalize the Arizona Commerce Authority's (ACA) Rural Broadband Development Grants (RBDG) program. The funding will expand and sustain the \$3 million in state funding allocated in 2019 to enable the program to provide matching funds and to support planning and construction costs to expand broadband services. The ACA should continue to award and manage broadband grants to local partnerships or ventures with clear and achievable plans to

provide/improve broadband services in unserved or underserved rural areas while also providing for community assessments or technical designs, matching funds for federal or other grants, or specific project implementation investments.

- **Student Digital Inclusion Fund:** The Task Force recommends creating a public and private Student Digital Inclusion Fund. In many neighborhoods and communities, especially in urban communities, infrastructure is available, and there may be one or more providers available, but the services are not affordable for many in the community. Arizona should launch a fundraising campaign to provide free or subsidized new or refurbished devices and Internet connections for students and families in those areas where connections are available but not affordable. A good example of this is [Connecting Kids Nevada](#), a public-private partnership seeking to connect every Nevada student in need with reliable Internet and devices.
- **State Digital Access Funding:** The Task Force recommends increasing State CARES Act, and other state funding, to support the needs of communities, education and libraries for broadband Internet services, end-user devices, technical support, professional development, digital content and safe operations during the COVID-19 environment.
- **Arizona Universal Service Fund Supporting Broadband:** The Task Force recommends expanding the role of the Arizona Corporation Commission (ACC) in broadband deployment including modifying the current [Arizona Universal Service Fund \(AUSF\)](#), or creating a new fund, to support deployment of broadband infrastructure in rural areas. The AUSF currently only supports subsidies for telephone lines to low income residents in high-cost rural areas. In 2018, through a limited rule making, the ACC provided \$8 million AUSF funds to match federal E-rate funding to connect schools and libraries in Arizona. The \$8 million AUSF funds, plus \$3 million from the Governor's Office provided the match for some \$130 million in E-rate infrastructure funding. This program was successful; however, the rule making expired. ACC Commissioner Lea Márquez Peterson is participating in a National Association of Regulatory Utility Commissioners (NARUC) Broadband Expansion Task Force that is looking at the role and strategies for regulatory organizations such as the ACC to support broadband deployment to underserved areas.
- **Major Donations Digital Access Campaign:** The Task Force recommends launching a major foundations and corporate fundraising and donations campaign to complement other fundraising activities to access Arizona and national foundations that support digital access needs of communities, education, library and telehealth organizations.
- **Public Awareness Campaign:** The Task Force recommends developing an ongoing Public Awareness Campaign to inform the public about funding and resource opportunities including press releases, newsletters, webinars and an optimized web portal.
- **Community Reinvestment Act Funding:** The Task Force recommends developing a statewide strategy to support communities and nonprofit 501(c)(3) organizations in applying for Community Reinvestment Act (CRA) funding. The Federal 1977 Community Reinvestment Act (CRA) requires all banking institutions that receive Federal Deposit Insurance Corporation Insurance (FDIC) to provide equitable access for those living in "low and moderate income" (LMI) communities to banking services as well as investments for community development (i.e., enhancing economic opportunity) in LMI communities. Banks must meet their CRA obligations through a mix of volunteerism, grantmaking and investments. In 2016 the Federal Reserve, in collaboration with the [National Collaborative for Digital Equity \(NCDE\)](#), issued guidance encouraging the nation's banks to invest CRA resources in digital equity. NCDE has launched a "One Percent for Digital Equity" campaign, advocating that banks and their community partners nationwide strive to reach a target of one percent of CRA funding to close the digital divide, as this would unleash fully \$1 billion annually. The challenge now



The Community Reinvestment Act (CRA), requires the Federal Reserve and other federal banking regulators to encourage financial institutions to help meet the credit needs of the communities in which they do business, including low- and moderate-income (LMI) neighborhoods.

is to educate banks about how to work with local communities, education and other organizations to provide digital equity funding. The Task Force has held preliminary discussions with the CRA policy-point person for Arizona to explore CRA funding opportunities in Arizona and how communities or organizations can apply for support.

## State Broadband and Digital Inclusion Leadership, Policy and Regulation

- **State Broadband Office:** Consistent with the recommendation included in the current [Arizona Statewide Broadband Strategic Plan](#), the Task Force recommends establishing a State-level Broadband Office under the Arizona Commerce Authority to coordinate statewide broadband governance, buildout, funding and delivery. The State Broadband Office should utilize a **Broadband Advisory Committee** to support the work of the broadband office. The **State Broadband Office** will expand on the role of the existing State Broadband Director at the ACA, to enable State coordination, support for community assessments, grant application development, planning assistance, coordination with broadband providers and reducing or removing barriers to broadband deployment.
- **Accelerate broadband deployment in rural communities:** The Task Force recommends that the State should take significant action to accelerate broadband deployment in rural communities. These actions may include direct investment of state funds, reduction of regulatory hurdles, and promotion of public-private partnerships to deliver digital connectivity to unserved and underserved areas.
- **Remove Barriers and Provide Incentives for Private Sector Investment:** The Task Force recommends that the State and local communities develop public policies and market-driven strategies that will remove barriers, encourage competition, private sector investment in, and rapid deployment of, advanced telecommunications services and affordable broadband Internet access throughout the State. Federal, tribal, state and local Rights-of-Way issues such as multiple jurisdictions permitting, delayed application approvals and unequal and prohibitive fees have been significant barriers and disincentives for private broadband investment and deployment. The State should provide leadership in coordinating all levels of government in developing policies to enable one-stop-shopping, consistent fees and expedited right-of-way permitting processes for last mile and middle mile services.
- **Statewide Broadband Funding Strategy:** The Task Force recommends that the state develop a statewide strategy and oversight mechanisms, including consideration of a Broadband Development Authority, to coordinate and optimize Arizona communities, education institutions, nonprofit organizations and broadband providers use of Digital Equity/Digital Divide funding resources such as providing new sources of federal monies that are now becoming available due to COVID-19. The state should ensure a level playing field for incumbent and new entrant broadband providers.
- **Telemedicine and Telehealth Infrastructure and Initiatives:** With social distancing and selective quarantining the new norm, telemedicine is becoming even more necessary and critical for Arizona's health care facilities, providers and patients during and in the wake of the COVID-19 pandemic. The Task Force recommends that Telehealth and its integration into delivery of health care through electronic means should continue to be enabled and broadly adopted throughout Arizona building on the strong, long-term success of the University of Arizona's [Arizona Telemedicine Program \(ATP\)](#), designated by the [Arizona Legislature](#) to oversee and coordinate statewide telemedicine clinical, education, research and telecommunications programs. We continue to advocate for the State to continue progressing with evolving, deploying and enforcing progressive telemedicine laws at state and local levels and to continue to invest in telemedicine programs and infrastructure. We recommend that Arizona actively participate in multi-state



Telemedicine is becoming even more necessary and critical for Arizona's health care facilities, providers and patients during and in the wake of the COVID-19 pandemic.

licensure compacts for physicians and nurses, as well as continue to facilitate and fund the expansion of statewide telehealth infrastructure and its associated ecosystem. Telemedicine issues.

- **Electric Cooperatives:** The Task Force recommends that the State should consider additional regulatory reform and incentives to drive rural broadband deployment by electric cooperatives. The [Arizona Legislature](#) recently passed legislation (SB1460) to enable electric cooperatives to deploy deep fiber and serve residential and enterprise broadband customers. [Mohave Electric Cooperative \(MEC\)](#) with support from the [ACA's Broadband Program](#) will be the first cooperative in Arizona to construct a fiber-to-the-premise network for its customers and is currently accepting [pre-registrations](#). More Arizona electric cooperatives should follow MEC's lead, leveraging their ROW and existing fiber to offer rural broadband services. The [National Rural Electric Cooperative Association \(NRECA\)](#) covers projects and policy from their [Broadband Issues](#) page.

## Technical Support & Professional Development for Education and the Community

- **Professional Development:** The Task Force recommends providing coordination of professional development initiatives and increased funding for Professional Development for educators. The transition from in person to online and hybrid learning has presented huge challenges for educators, many who have had little or no experience in virtual or hybrid teaching. While schools have been working hard in making this transition, we need to support schools in providing expanded professional development and training opportunities for educators in K-12, Community Colleges and Universities, on remote and hybrid instruction. While there are a number of organizations currently, or planning to provide professional development such as the [Arizona Technology In Education Association \(AzTEA\)](#), the recently announced [ASU Prep Digital's Arizona Virtual Teacher Institute](#) and the United States Distance Learning Association, there is no portal or database of existing organizations, little coordination, and no strategic or unified professional development strategy. We need to identify, coordinate and develop collaborative locally relevant strategies for all organizations including school districts, libraries, universities, community colleges and nonprofits that currently provide or plan to provide professional development and training for educators on remote and hybrid instruction.
- **Technical Support:** The Task Force recommends that while there are a number of organizations such as the Arizona Technology In Education Association, the State Library's AZ LibTAP program, school districts, community colleges, universities, the Gen YES program (discussed below), [Insight Help Desk](#), Arizona Department of Education and other nonprofit organizations, currently, or planning to provide technical support, there is no portal or database of existing organizations, little coordination and no strategic or unified technical support strategy. We need to identify, coordinate and develop locally relevant collaborative technical support strategies for all school districts, libraries, universities, community colleges and nonprofit organizations that are, or plan to provide, local and statewide tech support to schools, libraries and individuals in the State, including students, parents, seniors, library patrons and members of the community.
- **Cybersecurity and Privacy Technical Assistance:** The Task Force recommends that cyber security and privacy information awareness, training and technical assistance be available to all citizens, organizations and institutions in the State. As if COVID-19 is not bad enough, cyber security criminals have been hard at work with numerous threats: hacking business, government and personal networks and even mobile devices. The emergence of COVID-19 has caused dramatic increases in video conference intrusions, scams, phishing, viruses, ransomware and more. And of course, we are concerned about what our children are accessing on the web. There are many challenges and real cybersecurity threats to individuals, organizations and institutions. In addition to technical support and training for connectivity and devices, cyber security technical support and training needs



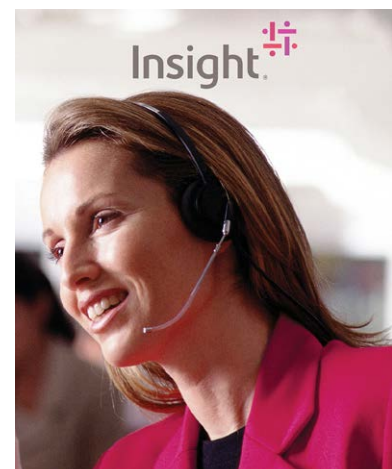
The transition from in person to online and hybrid learning has presented huge challenges for educators, many who have had little or no experience in virtual or hybrid teaching.





In addition to technical support and training for connectivity and devices, cyber security technical support and training needs to be readily available.

- to be readily available. We need to ensure that everyone has access to advice and information, strategies and technical support for cyber threat detection, protection, response and recovery for devices, operating systems, applications and connectivity. Assistance should be available to support installation of antivirus and antimalware software as well as browser security for example, patching operating systems and applications, help configuring Virtual Private Networks (VPNs), and much more. In Arizona, the universities, community colleges and even K-12 schools have cyber security resources and programs. Of particular note is on site and online [Arizona Cyber Warfare Ranges](#) open to the public. We also look to other groups such as the [Governor's Arizona Cybersecurity Team](#), [Arizona Cyber Threat Response Alliance \(ACTRA\)](#), [Arizona InfraGard](#) and [AZ Cyber Talent](#) for leadership as well as to specifications and best practices from national and international resources such as the [National Institute of Standards and Technology's \(NIST\) Cybersecurity Framework](#). Issues surrounding the use of personal data and individual privacy are significant, vary by jurisdiction and carve out special cases and rules for students, minors, personal medical information and other circumstances, requiring due consideration, planning and good governance.
- **Support Adopting New Broadband Technologies:** The Task Force recommends providing information and technical support to assist schools and communities in exploring and adopting new and innovative Internet access solutions and technologies available today that individually, or in combination, can provide unique and affordable solutions from wireline, satellite combined with mesh networks, cellular and 5G, microwave, Wi-Fi on school buses, open school and libraries networks and open provider Wi-Fi networks.
  - **Strategies to Provision Devices:** The Task Force recommends providing information and technical support to assist schools and communities in exploring and adopting new and innovative strategies for provisioning devices.
  - **Students Providing Tech Support:** The Task Force recommends developing an initiative to use K-12, university and community college students to provide tech support. Explore the use of national train-the-trainer nonprofit organizations that train students and provide them opportunities to be information technology leaders in their schools and communities. For example, [Youth and Educators Succeeding](#) (formerly known as **Generation YES**) students provide IT professional development and technical support for the teachers and other students in their schools, which is particularly critical during the COVID-19 crisis where teachers are stretched to perform online instruction. This program could be scaled up for multiple school districts across the State. A related resource is the [SciTech Institute's](#) STEM program of student [Chief Science Officers \(CSOs\)](#) in schools who could be involved with establishing and sustaining Gen YES-style tech support programs in schools statewide.
  - **Sun Corridor Network Tech Support:** The Task Force recommends exploring how technical support could be provided through the Sun Corridor Network.
  - **Service Desk Support Services:** The Task Force recommends exploring the use of commercial organizations that have experience in providing service desk support services for school districts and other users. [Insight](#) is an example of such an organization and has been providing service desk support services for school districts nationally for 20 years. Their service desk support model provides 24/7/365 multi-language technical support for teachers, students and parents. [Insight](#) Service Desk Support can be purchased by an individual school district or could be contracted on a large-scale statewide level at a value-added volume-based discounted model.



## Public Access to Digital Resources

- **Digital Access Resource Portal:** The Task Force recommends developing and promote a simple, easy to navigate, public-facing Digital Access Resources Portal (e.g., [Connect Arizona](#)) to provide easy access to digital equity resources such as locating free or low cost Wi-Fi hotspots, professional development and tech support organizations, digital resources and PPE resources.
- **Access to Digital Inclusion Resources:** The Task Force recommends coordinating and providing access to Arizona digital access organizations and resources that provide technical assistance, professional development, or free or affordable devices or Internet.

## Educational Digital Content and Resource Sharing

- **Digital Content and Virtual Labs:** Digital content of various kinds such as digital curriculum, instructional videos and informational resources offer opportunities to substantially enhance and improve student education. For example, in addition to providing general instruction online, K-12 and higher-education is facing challenges of reducing costs and providing instruction for science courses for students with limited access to physical labs. The Task Force recommends that Virtual lab simulations should be considered to offer remote science instruction effectively with a quick transition at lower cost than physical labs. Virtual Labs technologies have been proven to be highly effective in providing online STEM education. We recommend creating a statewide Virtual Labs Consortium to provide virtual laboratories for science courses. The Consortium could purchase virtual simulations that may enable us to obtain volume discounts for all Arizona educational institutions. For example, ATIC and GAZEL have been exploring a Consortium with [Labster](#), a Danish company that provides virtual laboratory simulations for a variety of science courses in biology, chemistry and physics. Over 500 community colleges and universities in the U.S. currently use Labster virtual labs, including ASU which has a major program with Labster. Labster simulations are also used in high school advanced placement courses.

## Safe Operations of Schools, Libraries and Public Spaces in the COVID-19 Environment

- The [Arizona Department of Education \(ADE\)](#) has published a [guidelines document on safe re-opening of schools](#) during the COVID-19 pandemic. The [Arizona State Library](#) has a [COVID Resources](#) page with best practices for safe functioning of libraries during the pandemic.
- The [Federal Communications Commission \(FCC\)](#) has tips on home network optimization, getting broadband, wireless security, cell phone hygiene and more at [fcc.gov/back-to-school](https://www.fcc.gov/back-to-school).
- The Task Force has considered some additional issues related to this, particularly the use of publicly accessed (shared) computers at schools and libraries. Discussions were held with the [Arizona Bioindustry Association \(AZBio\)](#), an industry association of biotech companies and organizations, on safe reopening practices. Discussions covered the use of public access computers including sanitation, antimicrobial keyboards and gesture (haptic) interfaces. [Mohave Educational Services Cooperative](#) has provided master contracts for purchase of PPE. The Task Force recommends consideration of cost-effective options to minimize coronavirus transmission.
- **Detection and Prevention Technology Solutions;** The Task Force recommends exploring use of commercial organizations such as [Insight](#) that are currently providing COVID-19 detection and prevention technology solutions to clients globally, which includes UV light cleaning systems, thermal cameras and temperature measurement devices, IoT hand sanitizers, social distance smart cones, personal virus testing centers and robust tracking and reporting services.



Virtual laboratories provide simulations for a variety of science courses in biology, chemistry, and physics.

## Now the Work Begins (Anew)

*Now is the time for governments to turn their attention to reimagining a stronger economic future by very deliberately addressing the vulnerabilities the crisis has exposed. National monetary, fiscal and other policy decisions will provide large-scale boosts to aggregate supply and demand and will help create the conditions for renewed economic growth. Yet it is state and local leaders, together with their business and civic communities, who will shape the speed and inclusivity of the recovery. The COVID-19 crisis is forcing states and localities to balance a surge in demand for government expenditures with unprecedented funding shortfalls. At the same time, it is requiring them to find ways to build and fund strategies and programs to deliver stronger, more equal and more resilient economies.”*

From the [McKinsey & Company](#) article, [Reimagining the Postpandemic Economic Future](#) from August 2020.

We challenge our state and local policy makers, as well as all of Arizona’s Digital Access stakeholders, to work with us to plan, partner and invest in digital access/digital inclusion initiatives to support our citizens and institutions during this time of pandemic crisis, while at the same time positioning ourselves for ongoing recovery and growth. This will serve to lay the foundation for Arizona’s sustainable economic development and a strong, healthy economy in the long run. Let’s make it happen!



## Appendix A - State and Community Broadband Business Models

The onset of the COVID-19 pandemic and subsequent restrictions on public convening has exposed major gaps and deficiencies in the availability, reliability and/or affordability of broadband Internet connections in society at large. These conditions have existed since the broad adoption of the Internet as a fundamental utility for commerce and communication. But the absolute dependency on the network required while people are working or educating from home has exponentially increased the priority of exploring and advancing technology solutions to close the gap. Myriad technologies and distribution infrastructure types are now available to provide broadband in today’s environment in a manner that could potentially touch literally every place on the planet. The only thing developing faster than the technological capability of delivering broadband signals is the user demand for that capacity.





Photo by Nicholas, PA, USA

**Additional funding is needed for comparable deployment of fiber along I-40 and other strategic segments.**

Beyond the challenges of delivering reliable, capable and affordable connections is the larger question of how these will be delivered in a sustainable way. The twin challenges of capital and operational expenditures must be paired with sufficient revenue potential. As Arizona organizes solutions to connectivity, either regionally or on a statewide basis, it must attend carefully to the business models, both current and future.

## Arizona State Level Broadband Business Models

Arizona's [Smart Highways Corridor](#) initiative is off to a good start with the recent \$40M allocation from the [Governor's Emergency Education Relief Fund \(GEER\)](#) to the [Arizona Department of Transportation \(ADOT\)](#) to complete fiber builds between Flagstaff and Nogales on sections of I-17 and I-19. We recommend the State commit additional funding for comparable deployment of fiber along I-40 and other strategic segments. ADOT is in the process of developing a robust business model, planning to select and engage a public-private partner (P3) to fund and manage these and other new middle mile fiber investments along state highways to reach as many rural communities as feasible as well as work towards evolving Arizona's regulations to allow a wide range of public and private communication uses on their fiber network.

Associated with this, the State must develop strategies and initiatives to also further deployment of middle mile infrastructure to rural communities throughout the State. a statewide strategy and oversight mechanisms including consideration of a **Broadband Development Authority** to coordinate and optimize Arizona communities, education institutions, nonprofit organizations and broadband providers' use of these Digital Equity funding resources.

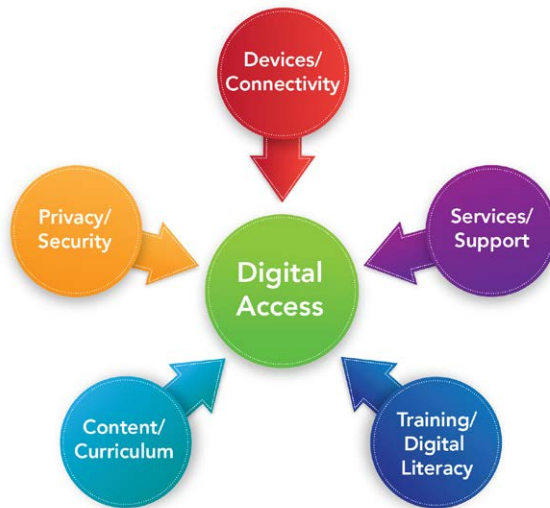
## Potential Arizona Municipal, Community and Regional Broadband Business Models

Every rural municipality and remote cluster of communities faces an array of challenges to universal broadband availability for their citizens, educational institutions, health care facilities, businesses and essential services. Broadband providers have specific business models and target markets of their own and apply their limited expansion capital strategically. Economic development activity may make areas more attractive to new investment and the availability of grants and incentives can make a difference in broadband providers' Return on Investment (ROI) calculations.

In order to stimulate additional thinking, the Technology Committee has discussed various possibilities to supplement existing business models. For example, we are aware of models, such as Chattanooga, Ft. Collins and others, where municipalities have developed broadband business models to serve residents. In Arizona, we have relied almost exclusively on carriers and private business models to grow broadband capacity. That has been enormously successful in many areas, but large gaps remain. Municipal models have the potential to utilize the best of private investment models, while allowing communities to raise their own capital and exploit their innate advantages to develop responsive, flexible network connectivity options utilizing the best of breed tech solutions.

The emergence of rural electrical cooperatives in delivering broadband is a great example. Utilizing existing plant, equipment, rights of way, staffing and billing, they can leverage market efficiencies to lower the cost and service barriers to delivering broadband service to a discrete group of customers. Governor Ducey's Smart Corridor investments are similarly intended to not only increase capacity, but also lower the cost and barriers to entry to deploy middle mile fiber capacity that can enable lower cost, flexible, high-capacity end-to-end solutions. Both of these examples should have long-term strategic benefits to addressing the chronic broadband deficits that Arizona faces outside of its urban core areas.

As complex as providing digital access to unserved and underserved communities has proven to be, solving the problem includes a number of defined elements. As described in the graphic that follows, "digital access" is inclusive of more than just connectivity to broadband. Effective access must incorporate elements of digital literacy, training, service and support, compatible devices, relevant and engaging content, and adequate elements



of privacy and security controls. Including these 5 elements makes the difference between a “connection” and a complete solution.

Given the rapid acceleration of technology options to deliver end-to-end broadband, new and disruptive business models become more available to more diverse communities. Another way to aggregate disparate resources and promote equitable and affordable access to broadband is through a statewide entity, such as a “Broadband Development Authority.” Vermont and Utah are two states that have used versions of this approach to consolidate demand for education, telehealth,

economic opportunity and other vital technology-enabled capabilities for all citizens. An Authority could aggregate resources from the federal government, potentially utilize government-backed bonds or loans and centralize service delivery and investment commitments with other public-entities, all while utilizing the capabilities of private sector companies to build and manage networks consistent with principles of Public-Private partnerships.

While Chief of Staff at the [FCC](#), Blair Levin led the development of the [U.S. National Broadband Plan](#) in 2010 and advised [Arizona’s Broadband Access Program \(AZ BAP\)](#) broadband efforts from 2010 to 2014. He currently is a Senior Fellow at [The Brookings Institution](#) and remains quite active in the broadband policy arena. His **Broadband Investor Costs and Benefits Calculations** formula is an exemplary and succinct positing of how broadband providers and their investors evaluate their options, determine and manage Return on Investment (ROI), and how to “change the math.”

## Broadband Investor Costs and Benefits Calculations

For the investor, the equation usually looks like this:

$$\overset{\text{Costs}}{C + O} > \overset{\text{Benefits}}{(1r)R + SB + (-CL)}$$

C – Capital Expenditures  
O – Operating Expenditures  
r – Risk  
R – Revenues

SB – System Benefits (Benefits that drive increased revenues outside the communities where the new or incremental investments are made.)  
CL – Losses due to competition

### How Do You Change the Math and Improve ROI?

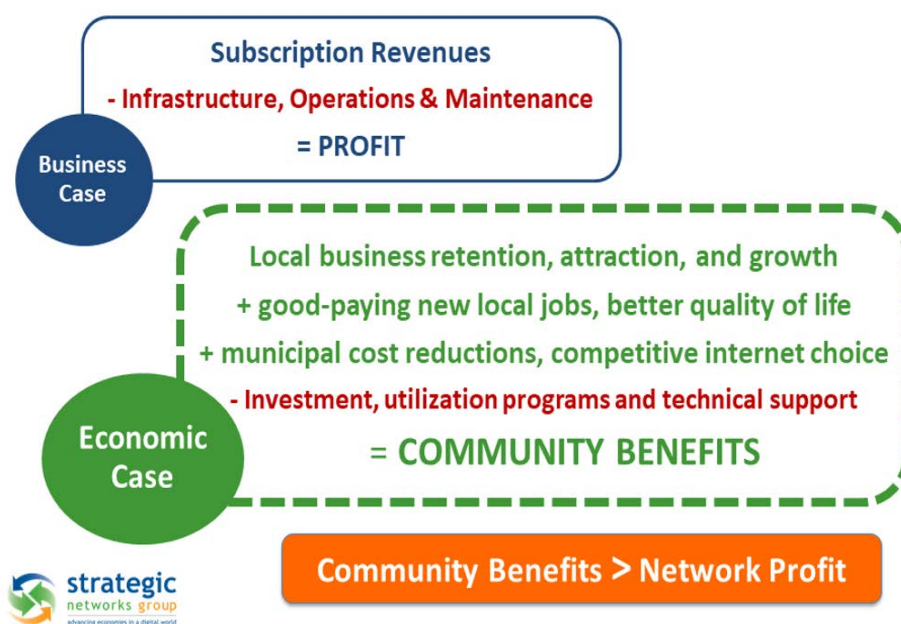
$$\begin{matrix} \uparrow & \uparrow & \uparrow \\ C + O > (1r)R + SB + (-CL) \\ \downarrow & \downarrow & \downarrow \end{matrix}$$

Source: Blair Levin 2013  
<https://www.brookings.edu/experts/blair-levin/>

Reduce Cap Ex	<ul style="list-style-type: none"> <li>Build to Demand Model</li> <li>Access to ROWs, Facilities</li> <li>Reduce Regulatory Time</li> </ul>
Reduce Op Ex	<ul style="list-style-type: none"> <li>Access Payments</li> <li>Reduce Ongoing Regulatory Costs</li> <li>Utilize Existing Billing Platforms</li> </ul>
Reduce Risk	<ul style="list-style-type: none"> <li>Build to Demand</li> <li>Standardize Functions Across Areas, Vendors</li> </ul>
Increase Revenues	<ul style="list-style-type: none"> <li>Demand Acceleration</li> <li>Marketing Platform</li> <li>New Services</li> </ul>
Increase Ecosystem Benefits	<ul style="list-style-type: none"> <li>Distributed Innovation</li> <li>Seeding Long-Term Growth</li> </ul>

For the more “math-averse,” another way to describe this challenge comes from the [Strategic Networks Group](#), a consulting firm working with communities to help transform through broadband, digital infrastructure and smart community services. In a recent report prepared for the [State of Oregon](#), they identify a private sector investment threshold of \$2,000 per household for private sector capital investment to find a suitable business justification for infrastructure and service investment. This benchmark estimate incorporates the variables of cost and revenue per mile of different technologies as part of the ROI calculation to help identify the most efficient solution and inform potential investment decisions. However, providers and communities must always keep in mind that beyond the business case financial ROI calculations, there lie real local economic development and quality of life benefits, both tangible and measurable as well as intangible. Those “catalytic impacts” need to be considered and valued when holistically viewing the community broadband economic case.

## The Economic Case for Broadband Cannot be Found on a Balance Sheet



## Municipal or Regional Broadband P3 Key Framework Considerations

A framework for how municipalities or clusters of nearby communities might consider a broadband service model is provided by [US Ignite](#), a nonprofit dedicated to accelerating the smart city movement and guiding communities into the connected future. In this framework, cities can consider what assets they have, what they lack and how to mix the right ingredients to deliver the best solution. In the Chattanooga model, the city has a full municipal broadband service that delivers broadband much like it delivers water. At the opposite extreme, the city can contract with one or multiple providers and serve as an aggregation and governance entity for the delivery of services. The chart below describes several different business model options and how sample municipalities implement them. The right solution is dependent on the capacity of the city, its population density and demand, access to capital and other elements.

Most municipalities that are considered well-served with broadband Internet rely entirely on private network service providers, however some have implemented a range of municipally enabled deployments and may even own and operate their own municipal

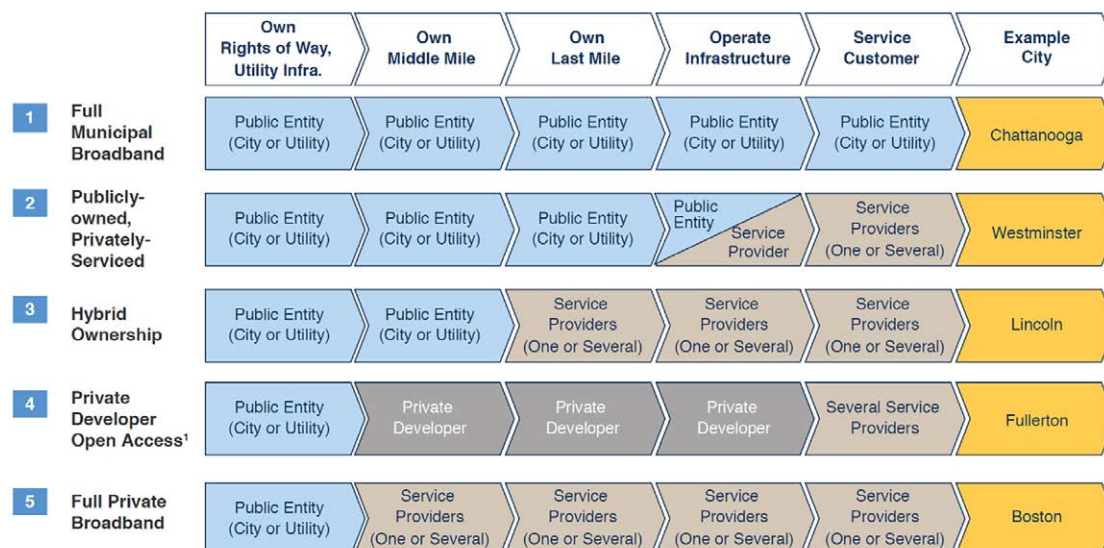
Image by Pete Linforth from Pixabay

In Chattanooga, TN, the city-owned utility laid a fiber optic network across its 600-square-mile service territory ten years ago to build a smart grid and the nation's first citywide gig internet service.



broadband networks. There is growing support for hybrid public-private deployments and evidence that hybrid solutions may offer a viable approach for some communities lacking sufficient broadband coverage. For more, see [US Ignite's](#) comprehensive study of municipally-enabled broadband deployment options, [Broadband Models for Unserved and Underserved Communities \(2020\)](#).

## City Main Business Model Options for Broadband Expansion



Note: 1) Private Developer is defined as private company that builds, owns and operates the network infrastructure and offers open access to it to several retail SPs that provide service on the top

## Municipal and Regional Broadband P3s Strategic Considerations and Steps

As communities across the country find themselves considering the potential of public-private partnerships, there are a variety of issues and considerations facing local governments and their private sector partners. The above US Ignite model gives a good basis for considering municipal and regional broadband business models, while the below list focuses on the steps communities should consider in the process of implementing. Note that the CLIC/Benton P3 model set differs slightly from the more complex US Ignite version but covers similar issues and solution sets.

### Determine Your Priorities

- Competition?
- Enhanced service?
- Equity and service to all?
- Public control over infrastructure?
- Risk avoidance?

### Consider and Select Your Primary Business Model

- Private investment, public facilitation
- Private execution, public funding
- Shared investment and risk

### Review and Resolve Authority and Responsibility Issues

### Understand the Legal Tools and Instruments That Could Shape the Partnership

- Financing
- Access issues
- Regulatory considerations
- Organizational issues

## Negotiate and Execute the Agreement(s) with Strategic Partner(s)

### Community Works with Private Partner(s) to Fund, Build, Launch and Manage the Network

See the [Coalition for Local Internet Choice \(CLIC\)](#) and [Benton Foundation's The Emerging World of Broadband Public-Private Partnerships: A Business Strategy and Legal Guide](#) (2016) report for more on this topic. Also see their recent [Public Infrastructure/Private Service: A Shared-Risk Partnership Model for 21st Century Broadband Infrastructure](#) (2020) whitepaper which is more specific regarding fiber infrastructure elements, comparing and contrasting dark fiber, lit fiber and conduit approaches, accompanied by a number of good case studies and an updated review of broadband P3 legal issues.

### Risk, Benefits and Control with P3 Model Variants

	MODEL 1 PRIVATE INVESTMENT, PUBLIC FACILITATION	MODEL 2 PRIVATE EXECUTION, PUBLIC FUNDING	MODEL 3 SHARED INVESTMENT & RISK
RISK	LOW	HIGH	MODERATE
BENEFIT	POTENTIAL BUT NOT ASSURED	HIGH	HIGH
CONTROL	NONE	MODERATE	MODERATE

## Appendix B - Broadband Connectivity Technology and Trends

In this Appendix, we endeavor to describe the current and near future state of broadband delivery technologies in the form of a solutions catalog. Each type of service delivery model has pros and cons, various cost profiles, maturities, speeds, ranges and standards. Efforts by communities, including hospitals, schools, libraries and governments to expand broadband network access will be enhanced by knowing what options are available in their areas, what is involved in deployment, and both who and how that capacity will be delivered. It is important to note that many communities are likely going to require the consideration of multiple technologies to meet all of their needs. This could be due to costs, geographic obstacles or other limitations which impact how the service is delivered to the end user. The Technology Committee sought to identify and characterize many of the broadband technology options and applications that are currently available to inform stakeholders and enable their ability to determine what would be the best solution to solve their specific individual, institutional and community needs.

But regardless of which technology is chosen, connectivity is only part of the equation. Areas with insufficient broadband may be lacking adequate infrastructure, insufficient economic power, or even supportive technical services. The formula for delivering broadband must also include elements that address the impact of poverty, the lack of community-based supportive services and assuring that consumers have opportunities to choose among competitive and affordable options. Wiring a community, a neighborhood or even a home must also include considerations of tech support, sustainability and eventual technology refreshes.

Photo by Mali Maeder from Pexels

Wiring a community, a neighborhood or even a home must also include considerations of tech support, sustainability and eventual technology refreshes.

## Some Short -Term Internet Access Solutions

Before we begin our deep dive into broadband technologies, considerations and technology solution examples, we'd like to first recommend a few short-term Internet access solutions that are already being utilized here with proven results, but could and should be funded, further expanded and more broadly socialized in the short-term to help address current critical broadband access gaps. A number of these revolve around cellular and Wi-Fi wireless which allow for rapid deployment at modest cost:

- Due to the pandemic, most wireline and wireless broadband service providers have special programs and discounts for their subscriptions available to low-income households and those with special circumstances. They also may make their network of Wi-Fi hotspots publicly available. The Arizona State Library is looking to expand their [Connect Arizona](#) site to also track providers' special programs and public Wi-Fi offers going forward and help publicize to the broader public.
- All sorts of local government, institutions and non-profits should be considering providing mobile Internet hotspot devices or cellular-enabled tablets and laptops with pre-paid services to their target populations which can then be used to share broadband with the recipients' entire household. We should otherwise be educating the public at large regarding using individuals' smartphones or tablets and laptops with SIM cards and cellular connectivity as personal Wi-Fi hotspots to share among nearby devices or authorized individuals.
- Build on programs currently providing Wi-Fi extenders reaching library and school parking lots as well as in and around businesses that want to provide free public access, so people who are without home Internet or are otherwise mobile can access the Internet while safely practicing social distancing from a variety of convenient locations. Five public libraries are participating in a pilot project with Cisco to install Wi-Fi boosters enabling access to the users from the parking lots while the libraries are closed and many other Arizona schools and libraries are doing similarly. Such Wi-Fi extensions should be provided at all schools and public libraries if funding and appropriate security, both physical and cyber, can be secured.
- Smart school buses, libraries' bookmobiles or other Wi-Fi enabled vehicles can be configured with cellular or satellite backhaul and moved from community to community on a schedule for neighborhood access.
- Municipalities can establish public Wi-Fi wireless mesh networks across all or parts of their community on their own or in partnership with a broadband service provider. An emerging alternative is for community residents to "agree" to share their services and a secondary channel on their Access Points (APs) by meshing connections with their neighbors' networks and providing public access. Such wireless networks can use satellite backhaul networks for isolated areas and further, may access school or library fiber connections to the Internet if allowed by federal regulation in the future.

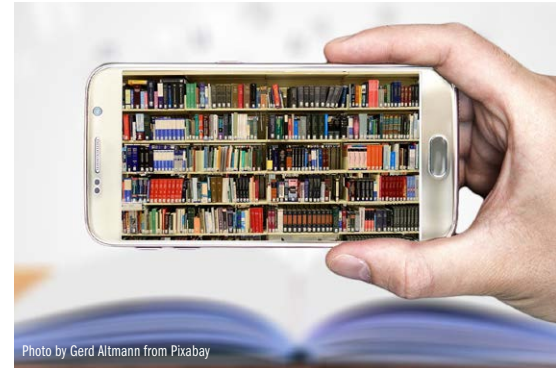


Photo by Gerd Altmann from Pixabay



The Pima County and Phoenix traveling Digital Bookmobiles have paused their tours due to the coronavirus and plan to resume their tours in 2021. For updates, visit [digitalbookmobile.com](http://digitalbookmobile.com).

## Broadband Connection Considerations

Broadband connectivity requires more than just the availability of an Internet access service, a necessary but insufficient measure of success in providing digital access. Other considerations are necessary to ensure that the configuration of technologies delivering broadband Internet will be adopted by the communities they are intended to serve. In deciding on community approaches and business models, possible factors include: upfront investment; cost to consumer; maintenance and OPEX costs; degree of difficulty; technical limitations; maturity of solution; range vs. speed vs. cost tradeoffs; last mile vs



middle mile; time to solution; narrow or general benefits and application; capabilities and commitment of strategic partner(s); and more.

Any location will have a mix of available technologies to consider that can improve broadband access. Denser, predominantly urban areas have more diverse broadband service models available. Backhaul connections are down the street. Homes may have multiple connection points available (copper, coax/cable, fixed wireless and even fiber). A fundamental preference is to have fiber connections delivered to the most efficient point. From there, other wired and wireless options provide flexible connectivity with various levels of capacity to the home, school or business. Those options begin to limit themselves the farther you travel from urban centers. Wireless options become more essential to deliver last mile connection and middle mile extensions where fiber remains unavailable, have difficulty keeping up with increasing demand. Costs, capacity and flexibility become more difficult to manage.

Regardless of location, adoption and effective use of Internet capacity is dependent on a variety of factors. Not only must the Internet infrastructure have sufficient capacity, but it also must meet certain thresholds of reliability and affordability for individuals to decide to invest their time and money to bring the technology into their homes.



## Geographic and Demographic Scenarios:

There are a variety of fundamental differences in broadband issues and appropriate and practical solutions between areas with varying geographies and demographics. A well-considered mix of technologies will be needed to deliver a capable, flexible and affordable digital experience for all classes of users. Variables include overall population and that of surrounding communities; proximity to transportation corridors; geographic and topographic diversity; current broadband service and utility providers; existing fiber and other infrastructure, presence of Community Anchor Institutions (CAIs); the presence of substantial businesses; community grassroots activism and more. The primary geographic types we consider are:

- Urban Center
- Suburb/Exurb
- Rural Major (larger populations or business activities - e.g. mines; near major transportation corridor(s); few if any topographic obstacles)
- Rural Minor (smaller populations; less economic activity)

The following table summarizes these geographic types indicating what broadband connection technologies may be appropriate and practical depending on full consideration of a variety of factors.

Geographic Type	Fiber	Microwave	DSL	Cable	Cellular	CBRS	Wi-Fi	Satellite
Urban								
Suburban/Exurban								
Rural-Major								
Rural-Minor								

- Mature solutions, readily available and advantageous
- Higher degree of difficulty, complexity and/or cost, may be suboptimal, but possible
- Expensive, complex and/or impractical solutions likely not warranted

## Comparison of Broadband Connection Technologies

Type	Description	Varients	Examples	Speeds	Cost Profile	Pros & Cons Considerations/ Notes
Fiber	Optical fiber-based conveyance of packets over light waves for long distances placed underground or aerially	Provisioned circuits between locations or to the Internet, dark & lit fiber leasing	Common for long-haul & middle mile, also as last mile to community POP, neighborhood or home; can be paired with fixed wireless; cellular; CBR	Gbps to Tbps; lambdas ( $\lambda$ ) of light create multiple independent channels on each fiber via Dense Wave Division Multiplexing (DWDM)	High capital investment cost for underground deployment, substantially less when aerial	Pros: Most reliable; fastest; capacity Cons: Capital intense; permits; rights of way access; "Future Proof," upgradeable at edge; potentially essential ingredient for backbone/backhaul; cost profile too high for most end-to-end
DSL	Digital subscriber Line - conveys digital signal over conventional telephone line (e.g. copper)	xDSL for multiple variants; most common is Asymmetric (ADSL) with higher download than upload speeds	Incumbent & Competitive Local Exchange Carriers (ILECs & CLECs) primarily utilize for residential & enterprise services	Range 6 Mbps to 100 Mbps (asymmetric or symmetric)	Relatively low cost when using existing copper lines; low cost modems	Pros: Most reliable; fastest; capacity Cons: Capital intense; permits; rights of way access; "Future Proof," upgradeable at edge; potentially essential ingredient for backbone/backhaul; cost profile too high for most end-to-end
Cable Modem	Using cable infrastructure over fiber or hybrid fiber/coax (HFC) to deliver digital signal	Various versions of DOCSIS consistent across industry	Cable companies deliver voice, data & tv over hybrid fiber-coax (HFC) facilities across municipalities	Range from 10 Mbps to 940 Mbps; speeds may vary based on use in local neighborhood	Cable companies have largely already invested in deep fiber; periodic upgrades at modest cost	Shared with other users on local loop; dependent on DOCSIS 3.0/3.1 modem performance; uses existing cable infrastructure where available
Cellular Wireless	Radio network through fixed transceivers direct to end-user devices; 5G requires densification with micro cellular and distributed access systems (DAS)	Public carrier or private network; 3G; 4G LTE; 5G (densification); cellular on wheels (COW); Flying COWs & Aerostats; Cloud Radio Access Network (C-RAN); public vs. private 5G deployment	Consumer cellular phones widely available; hot spot modems can serve fixed/movable locations and share service among devices via Bluetooth or Wi-Fi	Ranges up to 3 Mbps (3G) to 110 Mbps (4G, LTE) to up to 2 Gbps (5G)	Generally \$25-80 per line per month depending on data caps & usage	Pros: Large coverage areas; speed increasing; flexible and mobile where coverage available Cons: Signal loss through walls, structures & foliage; data rates lag wire-based options to home
Fixed Wireless (AKA Microwave)	Fixed Wireless Access (FWA) for long distance backhaul, two-way, line of site	Tower to tower or direct to end users or ISPs for redistribution; utilizes wireless or fiber backhaul	Commonly used for point to point connections & cellular backhaul; may be used for direct end user connections	Range from 10 Mbps to 500 Mbps		Pros: Comparable speed to fiber; towers easier than trenching & less capital intensive; essential backbone pathway Cons: Potentially limited capacity; regulated spectrum or unlicensed with potential incidental interference; impact on natural spaces; upfront costs; dependent on line of site & distance; potential weather disruption

Photo by Caeuje from Pixabay

A 5G network will be composed of networks of up to three different types of cells, each requiring specific antenna designs, each providing a different tradeoff of download speed vs. distance and service area.

## Comparison of Broadband Connection Technologies (Continued)

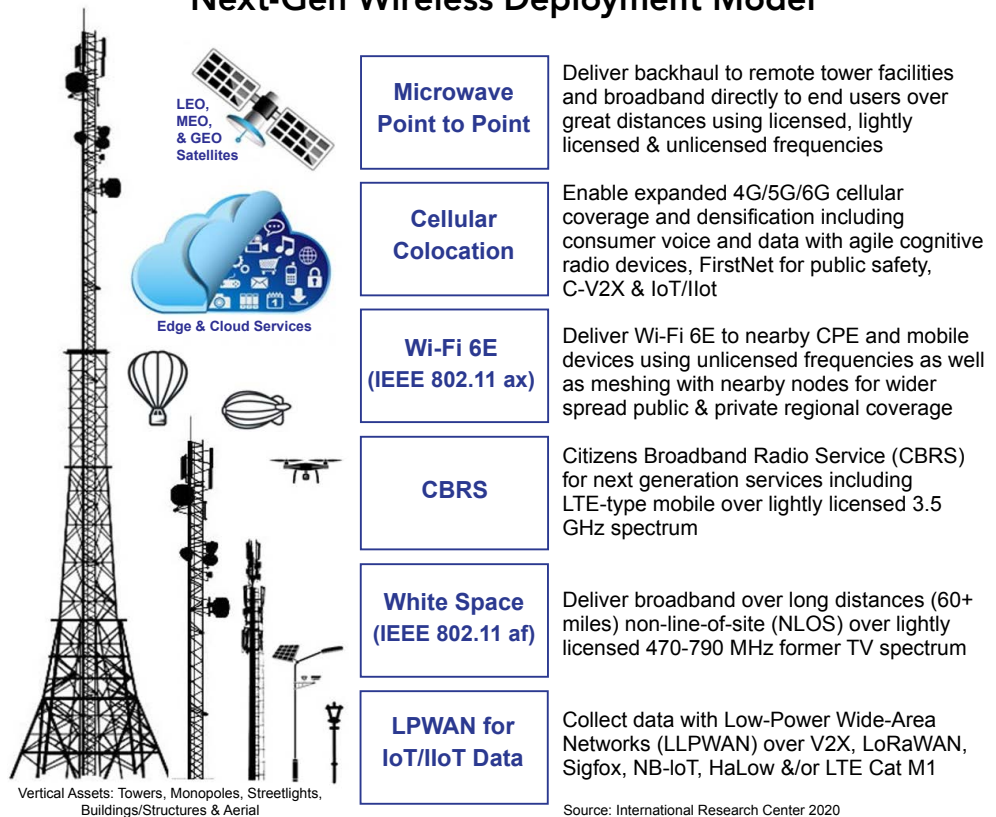
Type	Description	Varients	Examples	Speeds	Cost Profile	Pros & Cons Considerations/ Notes
Wi-Fi	Local area router to customer device most often fed by Ethernet connection to cellular, DSL or cable modem	Wi-Fi 4 = 802.11n; Wi-Fi 5 = 802.11ac, Wi-Fi 6E = 802.11ax with 6 GHz spectrum capabilities	Can be configured for multi-node "mesh" for better range & capacity; Community Wi-Fi is special case requiring grass roots participation	Earlier generations to 600 Mbps; with recent advances up to 3.5 Gbps	In-home use, Public & Community Wi-Fi may be available at no cost, commercial WISP services \$40 & up per mo.	Pros: Configurable; wireless flexibility; broadly available in most devices; mostly provided free; newly available 6 GHz spectrum; MIMO antenna use Cons: Short range; last mile specific dependent on backbone capacity
CBRS	Citizens Band Radio Service - LTE-type mobile for voice & data	Single standard with 3 classes of users with lightly licensed 3.5 GHz spectrum	Private enterprise networks or adjunct to commercial cellular providers	To 100 Mbps & beyond	Modest deployment costs; private enterprise use at nominal cost; commercial use cost TBD	Pros: Specs stable & equipment reaching the market; CBRS Alliance's OnGo has lots of industry interest/support Cons: Applications & markets not yet mature
White Space Wireless	Long distance; non line of site (NLOS), wireless	IEEE 802.11af (White-Fi) uses lightly unlicensed former TV bands from approx. 470-700 MHz	Point to point and backhaul over long distances for multiple consumer & industry applications	To 600 Mbps	Modest deployment costs; private use at nominal cost; commercial use cost TBD	Pros: Low frequency spectrum improves distance carried & building penetration; non line of site ground-breaking for rural area Cons: Applications & markets not yet mature
LP WAN	Low-Power Wide-Area Networks - over wide area network; suitable for IoT/IloT	Half dozen using unlicensed or licensed frequencies including V2X, LoRaWAN, Sigfox, NB-IoT, HaLow &/or LTE Cat M1	May be deployed by municipalities & enterprises as private services or thru commercial providers by subscription	10 Kbps to 100 Kbps to 1 Mbps depending on variant	No cost or low cost per device per month	Pros: Cheap & easy to self-deploy or utilize commercial providers; good range Cons: Relatively low data rates good for IoT/IloT data but not voice or broadband
Satellite	Space-based transmission between satellites to fixed and mobile locations controlled by earth-based ground stations	Geosynchronous or low earth orbit	Can be deployed for residential or commercial applications; satellite terminals can be set up to serve Wi-Fi or cellular terrestrial deployments; usable for IoT/IloT	Connection rates from 30 Mbps to 100 Mbps; next generation satellites will have increased speeds and capacity	Similar pricing to wireless; costs will vary based on desired speed and data caps desired	Pros: Broadband "anywhere"; flexibility; satellite capacity growing; ability to quickly deploy & install Cons: Latency restrictions may make some applications such as VPN and gaming difficult; potential QoS impacts from weather
Free Space Optics (FSO)	Point-to-Point optical laser solutions	Paired optical transceivers may have microwave link pair for backup & inclement conditions	For building to building or POP to customers and redistribution points	To 10+ Gbps	Once installed connects over unlicensed optical wavelengths	High-speed modest distance optical links largely equivalent to dedicated fiber circuits for distance covered



## Emerging Broadband Technology Options

This section explores a number of emerging broadband technology options, starting with a view of how next-generation wireless is evolving, followed by featurettes on a handful of promising technologies and associated regulatory and market developments, also discussing how they can best be deployed and utilized. Remember, advanced wireless deployments like these will often rely on fiber and other wireline circuits for backhaul. The emerging technology coverage is then followed by a half dozen quintessential **Broadband Technology Solution Examples**.

### Next-Gen Wireless Deployment Model



For a deep dive covering the next-generation wireless landscape with its underlying emerging technologies, markets, and trends capturing all of today's wireless essentials see [International Research Center's Next-Generation Wireless Overview & Outlook](#) presentation. Here are brief overviews of some selected emerging broadband technology options.

**Educational Broadband Service (EBS):** The FCC recently managed an [EBS Tribal Priority Window](#), designed to be an attractive special licensing opportunity for Native American broadband stakeholders. Tribes and K-12 educational institutions have special rights to 2.5 GHz spectrum for their own use and in leasing use under their licenses to others. EBS spectrum has been underutilized, is prime real estate for next generation wireless broadband operations and can play an important role in the deployment of broadband and other advanced communications services over rural and tribal lands. The FCC has removed limitations on leases entered into on a going-forward basis revising secondary markets rules, which will create incentives for schools and Tribes to partner with the private sector to build out infrastructure and services in rural areas. See the [FCC EBS](#) Page for more information.

**Citizens Broadband Radio Service (CBRS):** Use of **CBRS** capabilities is a new option created as a result of recent FCC actions reallocating a substantial band of 3.5 GHz spectrum for new uses under an innovative lightly licensed model. Legacy users (mostly military radar) retain priority, while second priority goes to those who have purchased **FCC Priority Access Licenses (PAL)** for certain geographies at auction. Third priority is reserved



Photo by Tatiana Syrikova from Pexels

**Tribes and K-12 educational institutions have special rights to 2.5 GHz spectrum for their own use and in leasing use under their licenses to others.**

for LTE-style voice and data plus other emerging uses under an innovative, lightly licensed model for spectrum sharing **General Authorized Access (GAA)**. Providers' base stations are dynamically granted assigned frequencies on demand by geo-aware **Spectrum Access System (SAS)** services for a very nominal database access fee. No lawyers, no filings, no licensing rigamarole or costs, just 3.5 GHz bandwidth to use whenever desired in a simple, transparent, well-coordinated manner. There should be plenty of lower priority CBRS GAA spectrum available for no cost use in most if not all locations. CBRS technology complements and leverages existing spectrum uses and will soon be readily accessible from CBRS base stations to consumer cell phones, IoT/IIoT devices and customer premise equipment (CPE).

**White Space Wireless:** Similar to CBRS, [Television White Space \(TVWS, IEEE 802.11af\)](#) is lightly licensed spectrum located in unused low frequency 470-790 MHz TV channels that can now be utilized at no cost other than a nominal fee for dynamic frequency assignments by geo-aware **Spectrum Access System (SAS)** services. The importance of the availability of this wide swath of under 1 GHz spectrum is extraordinary as it provides for a prodigious number of transmission bands with relatively high capacity. Such "low" frequencies can carry signals over long distances past and over topographic obstacles due to their inherent **non-line-of-site (NLOS)** capabilities and can penetrate foliage and structures more readily than signals carried on higher frequencies. The protocols, specifications, regulations and SAS services to utilize Television White Space are already in place, industry base stations and customer premise equipment (CPE) are coming to market, and pilots are underway for this emerging capability that is ideal for delivering broadband services to dispersed, distant areas with less customer density.

**6 GHz & Other Prime Spectrum Real Estate:** The FCC has recently opened up an enormous swath (1.2 GHz) of spectrum around the **6 GHz** band for unlicensed use. It will be the third Wi-Fi band (after 2.4 & 5 GHz), vastly expanding capacity and capabilities yielding what's known as [Wi-Fi 6E \(IEEE 802.11ax\)](#). 6 GHz has become wide open spectrum territory that can now also be utilized for unlicensed microwave backhaul and point-to-point as well as for LTE-style voice and data services similar to CBRS. There's **High-Band (mmWave)** spectrum reform and reallocations underway all the way from 24-100 GHz which will enable incredible throughput over modest distances for 5G/6G and other applications. These and other spectrum reallocations and regulatory reforms will drive further explosive growth in wireless capacity, capabilities and applications as spectrum again becomes a new frontier.

**Additional Wireless Innovations:** 5G requires significant densification adding substantial numbers of small cell transceivers in urban core and other target areas, which works to the advantage of using mmWave for high-bandwidth, low latency connections. Agile cognitive radios with adaptive **Multi-Input Multi-Output (MIMO)** antenna systems will switch seamlessly among frequency bands and networks to optimize services and the overall network on an as needed basis. Alternative wireless delivery platforms, temporary and semi-permanent, will increasingly include Cellular on Wheels (trailer or truck mounted COWs), Flying COWs (tethered drones) and aerostats, both tethered and in free-floating stratospheric arrays. Expect to see non-traditional players (e.g., electric utilities, cable companies, standalone facilities, community cooperatives) stand up LTE-style voice and data wireless networks using only unlicensed and lightly licensed spectrum, operating as a **Neutral Host Network (NHN)** for both private enterprise and general public LTE services, while peering/interchanging customers' voice and data LTE-style traffic with the major cellular providers.

**LEO, MEO & GEO Satellites:** New generations of **Non-Terrestrial Networks (NTN)** aka satellite systems are being heavily invested in and actively deployed accompanied by incredible leaps in space-based communications capacity and capabilities. This is creating three tiers of potential opportunities for expanded NTN broadband connections while becoming increasingly competitive with terrestrial offerings. Satellite advances will be absolutely transformative, but opportunities for fiber infrastructure complemented by a mix of terrestrial wireless distribution will retain a variety of advantages for capacity, costs, and integration to a range of applications and services.



An optical fiber tether carries an analog ground radio signal to its corresponding antenna aboard the aerostat, providing greatly increased transmission range.

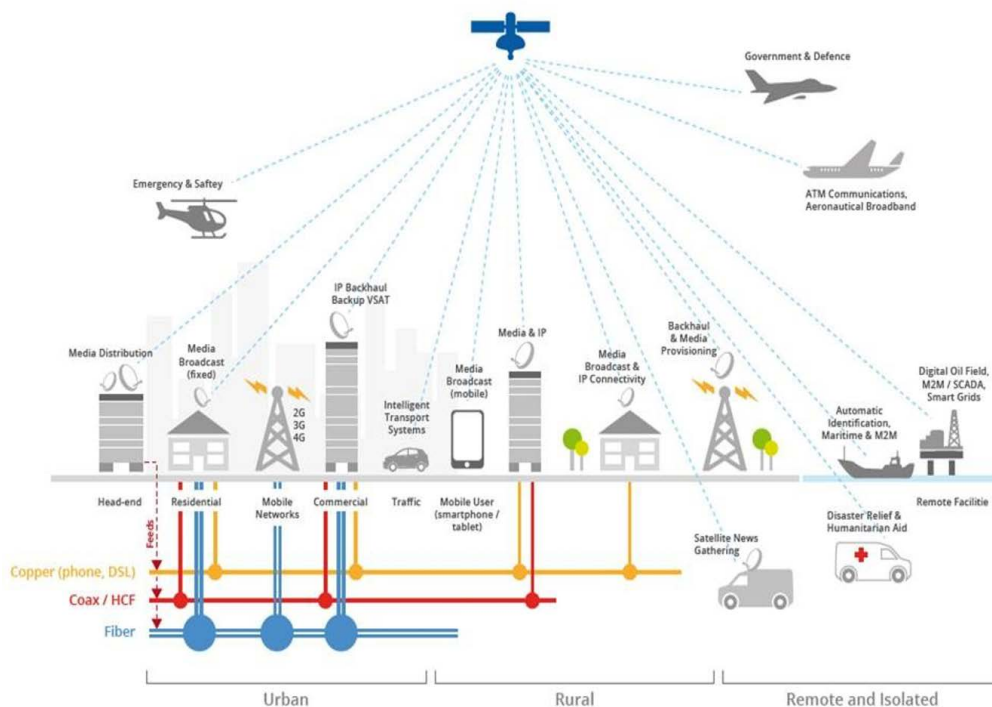




SpaceX in orbit. On Sept. 3, 2020, carrying a full load of 60 Starlink satellites, the Falcon 9 rocket launched in hopes of providing global broadband coverage to people in rural and remote areas.

- **Broadband:** Next generation Geosynchronous Earth Orbit (GEO, e.g. EchoStar's HughesNet & ViaSat-3), Medium Earth Orbit (MEO, e.g. SES O3b) & Low Earth Orbit (LEO, e.g. GlobalStar, Teledesic, Iridium NEXT, SpaceX's Starlink, Amazon's Kuiper & OneWeb) satellite systems will have terabytes of overall capacity and be able to deliver better broadband across a mix of massive coverage areas, while also serving narrow-focused target areas simultaneously. Generally, satellite coverage and speeds will continue to improve, more capable and discreet fixed and mobile devices will evolve and costs of service will fall.
- **Latency:** The LEO satellite systems like GlobalStar, Teledesic, Iridium NEXT, Starlink, Kuiper and OneWeb are close enough to the earth to largely resolve the space latency issues. These satellite systems will be practical for a wider range of demanding applications such as real time content streaming, augmented/mixed reality, tele-operations, remote collaboration and gaming.
- **Satellite-to-Satellite Optical:** Starlink and potentially other LEO constellations will utilize dynamic laser optical linkages among the satellites in their constellation that will allow for long-haul mostly optical pathways in direct competition for fiber-type services, though not nearly with the same overall channel and carriage capacity.

## Satellites Provide a Variety of Mobile & Fixed Communications Services



Source: ESOA/SIA 2018

## Broadband Technology Solution Examples

The technology landscape that delivers broadband to the business/school/hospital or home continues to evolve rapidly. As described in this appendix, there are multiple technologies that can be utilized on their own or in a combination that can overcome barriers. Each solution, depending on the end-user environment, has different capital and operational expenditure profiles, varying capacities, coverage flexibility and reliability. The point is that there are more options for delivery of broadband to the last mile than ever before and those options have become more expansive, mature and reliable by the day. The following case study examples provide insights into some of the options available. The half dozen technology solution examples that follow are not an exhaustive set of solutions, but rather a salient sampling.



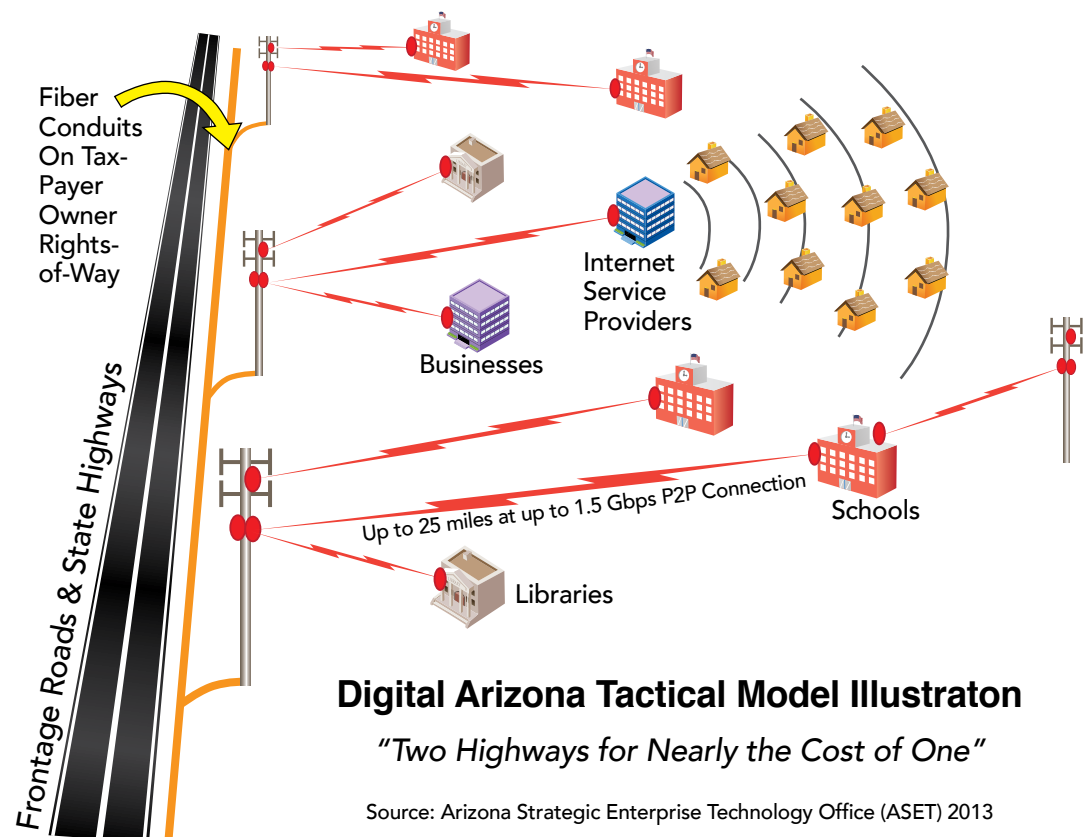
## Tech Solution: Digital Arizona Tactical Model

Arizona's Broadband Access Program (AZ BAP) ran from 2010-2014 in cooperation with the FCC and NTIA, funded under the **American Recovery and Reinvestment Act (ARRA)** and led by the Arizona Strategic Enterprise Technology Office (ASET). Biannual broadband data was collected and analyzed from some 80 providers and regional stakeholder policy initiatives involved all 13 rural Arizona counties. The Governor's **Digital Arizona Council (DAC)** undertook the broadband issues of the day and developed a detailed, draft strategic plan.

ASET developed and promoted a **Digital Arizona Tactical Model** where middle mile fiber is available or freshly deployed in highway ROW to feed towers from which mobile and fixed wireless broadband can be distributed to nearby communities and populations. Arizona enacted the Digital Arizona Highways Act (SB1402) in 2012 expanding existing rules governing ADOT's management of State ROW to include transportation-of-information as well as vehicles. This can streamline access to the ROW at significantly lower costs to providers, encouraging new investments to accelerate and improve availability of high-capacity digital services in poorly served areas of Arizona. For more information, see the ADOA ASET page at <https://aset.az.gov/digital-highways>.

**Benefits:** The incremental cost of adding conduit for eventual fiber deployment while highways are under construction is fairly modest, thus leading to the phrase, "Two highways for nearly the cost of one." Towers can be added and fiber pulled when warranted. Internet Service Providers (ISP) can backhaul from communities to the highway via fiber or wireless to bring new services online.

**Considerations:** Aligning fiber build needs with highway construction planning is a long-term process, but generally deploying conduit should always be considered to meet evolving needs.



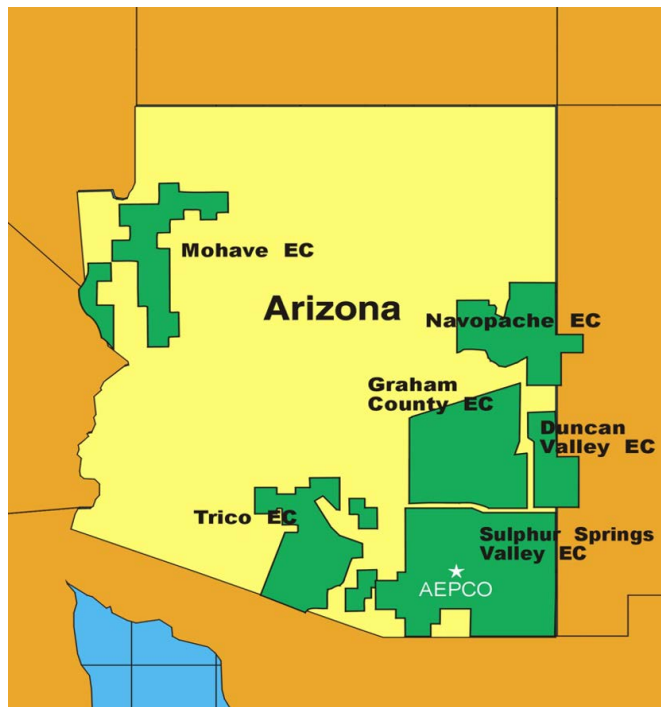
## Tech Solution: Fiber to the Home (FTTH) through Electric Cooperatives

A relatively new player on the broadband service provisioning market are the [Grand Canyon State Electric Cooperative Association \(GCSECA\)](#) members. First established through the federal electrification initiative in the 1930's, Co-ops - which are not-for-profit membership organizations - are accustomed to customer-facing service delivery of infrastructure beyond urban territory. One of the State's co-ops, the [Mohave Electric Cooperative](#), is the first co-op in Arizona to undertake broadband delivery. Their goal is for their last mile fiber to reach the premise of every cooperative member. The goal is a minimum of 25 Mbps symmetric feeds to member businesses with higher speed options and 1 Gbps symmetric broadband to all residences. There is a total of 5 other rural electrical cooperatives in Arizona that could follow Mohave's lead. See the [National Rural Electric Cooperative Association \(NRECA\) Broadband Issues](#) page for more information.

**Benefits:** The Arizona entry of electric cooperatives to the broadband services market, which has already started in other states, creates new levels of competition and service delivery in communities that may have previously been unserved or served by a single entity. It utilizes existing infrastructure, rights of way, field staff and customer service/billing capability. Nationally, more than 100 electrical cooperatives are deploying broadband and another 200 or more are exploring the option.

**Considerations:** Electrical Cooperatives are member-based organizations which provide benefits and service accountability through the membership model. Federal legislation is already in place providing grants and loans to support rural broadband development that electrical co-ops are uniquely positioned to benefit from and support such implementations.

### GCSECA's Electric Cooperative Members



Solution Source: Grand Canyon State Electric Cooperative Association

## Tech Solution: Private 5G/4G LTE Networks

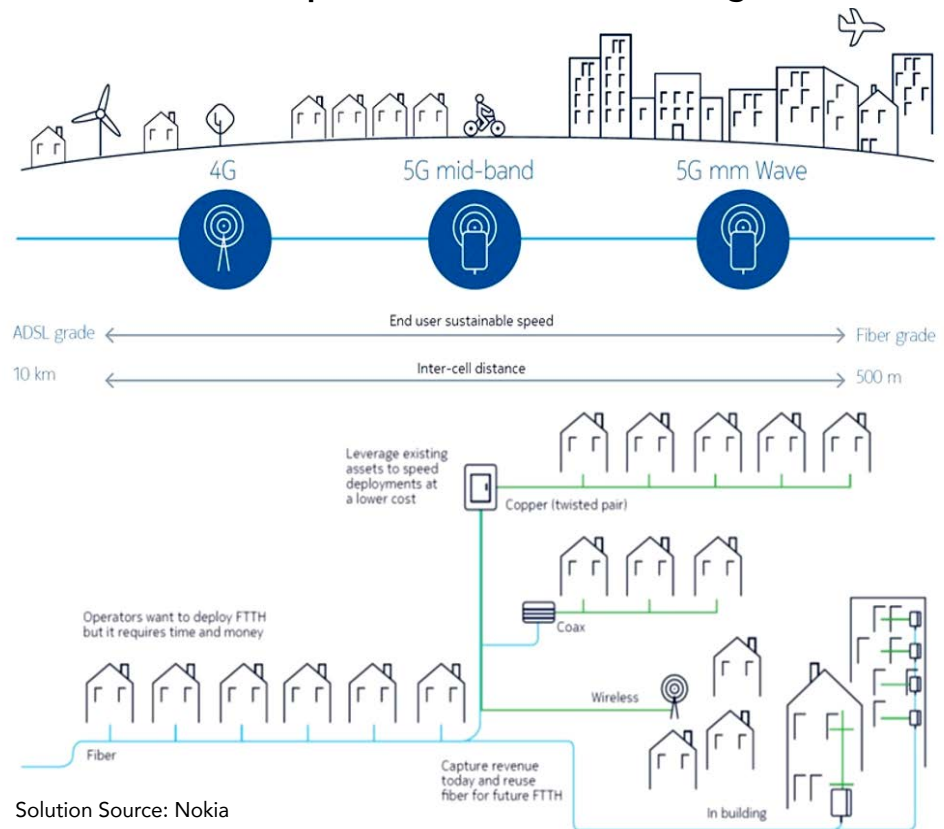
With 5G technology (both transmission and devices) on the imminent horizon, another technology approach involves utilizing Fixed Wireless Access (FWA) using 5G or 4G LTE connections. For example:

- Macrocell networks (2.6 GHz) in areas with lower density/sparse capacity range of 6-10 miles;
- Midband 5G - sub 6 GHz band - coverage comparable to LTE; including non-line-of-site (NLOS); can reuse existing base station sites
- mmWave - 24-39 GHz (higher frequency, shorter range) 500-meter range, requires small cells (infrastructure, power requirements). Requires line of site and premise based external antenna for penetration indoors.

**Benefits:** Fixed Wireless for delivery of private 5G/4G is an emerging opportunity fueled in part by recent action of the FCC to open up spectrum for Citizen Band Radio Service (CBRS) that is lightly regulated and therefore highly cost-effective.

**Considerations:** Recent advances in software-defined networking (SDN) make it far easier to create and manage a multi-technology network allowing for greater flexibility by providers to deliver locally optimized solutions in a way that improves the business case.

## Combining Fixed and Mobile Wireless Technologies for Ubiquitous Broadband Coverage





## Tech Solution: Distance Learning Connectivity - Community Bundle

To provide short-term episodic connections for communities, schools and families who lack adequate connective capacity, mobile solutions can be quickly & cost-effectively deployed to supplement long-term, more sustainable solutions. For example, a vehicle mounted Wi-Fi router with 1000-foot range; connected through Carrier LTE cellular services or satellite; mounted on a school bus or trailer (optionally available to carry within a building/facility via secured case enclosure).

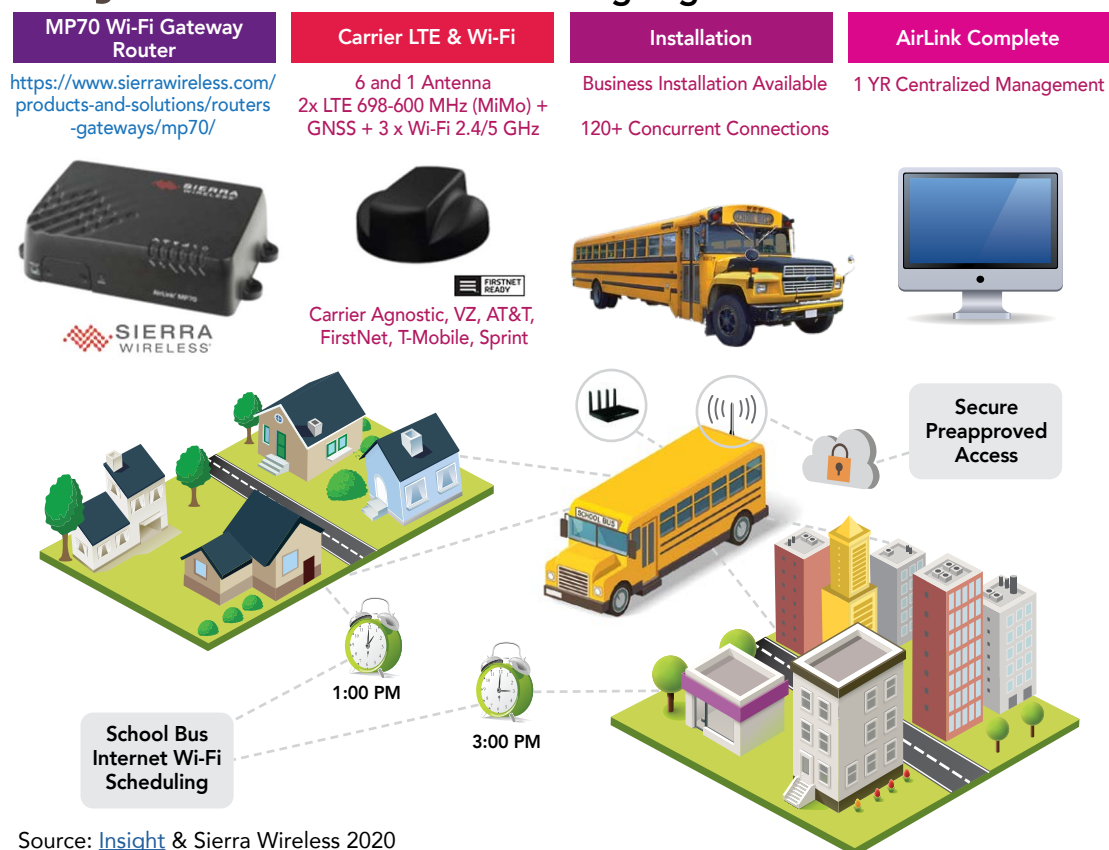
**Benefits:** The “connected smart school bus” could be combined with other school-based or community outreach services, such as food bank deliveries, or social/emotional well-being checks. Priced on a per unit low-cost basis, serving wireless up to 1000 feet diameter for download/upload connection at various high speeds depending on whether connection served through microwave, cellular or satellite. Fully managed solution outlined as follows:

- Centralized Program Management
- E-rate Carrier agnostic service
- AirLink Portal; Centralized Management
- Deployment Services; Staging & Kitting
- Professional Services; Vehicle Router Installation
- Service Desk; Day-1 End User Support

**Considerations:** These connections are effective shorter-term “interim/situational solutions” and not considered optimum as a long-term solution. These cost-effective models can also be utilized in the event of natural disasters or other emergencies, where other forms of on-premise connectivity may be compromised or underserved.

Insight<sup>+</sup>

### K-12 Distance Learning Digital Solution



Source: [Insight](#) & Sierra Wireless 2020

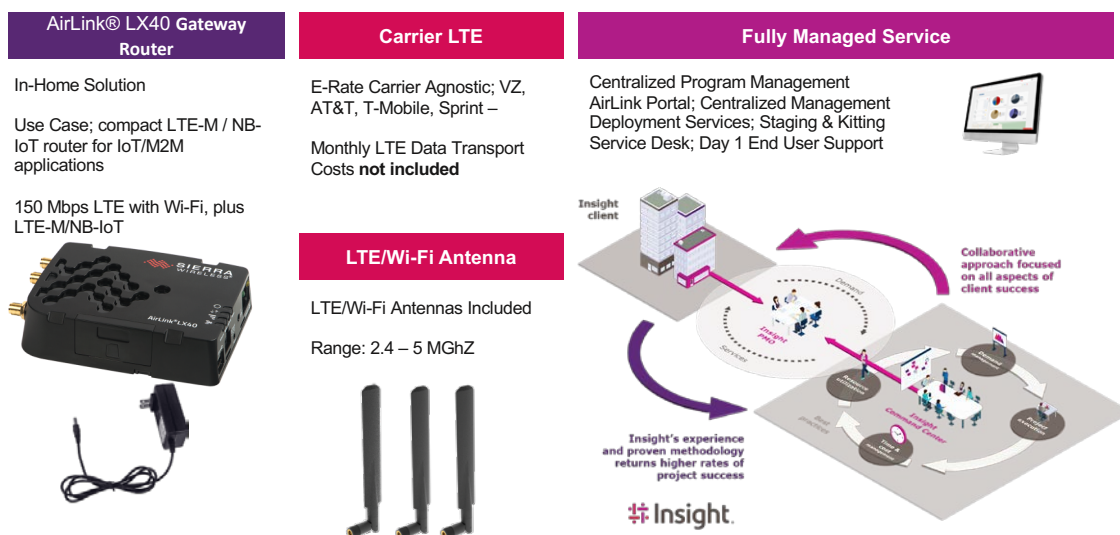
## Tech Solution: Distance Learning Connectivity - Student In-Home Bundle

Rather than providing “a la carte” components to families (device/connection/software), this in-home distance learning solution provides a Gateway Router connected through Carrier LTE cellular services, microwave or satellite; with management services included (deployment, staging, service desk, end user support).

**Benefits:** This scenario anticipates needs beyond connectivity and allows for community “anchor institutions” to utilize multiple connection scenarios bundled with compatible devices, deployment and support. Fully managed solution outlined as follows:

- Centralized Program Management
- E-rate Carrier agnostic service
- AirLink Portal; Centralized Management
- Deployment Services; Staging & Kitting
- Service Desk; Day-1 End User Support

**Considerations:** This model relies on the presence of a single “responsible party” that can manage the support relationship, either through contract or other agreement. Community anchor institutions, such as libraries, municipalities or school districts/county school service bureaus can potentially play that role in a locally relevant way.



Solution Source: Insight

## Tech Solution: Off-Grid Community Wi-Fi Terminal (OGCWFT)

ViaSat conveyed a configuration from a University of Arizona Engineering Senior Design program of an Off-Power Grid Community Wi-Fi Terminal. The technology ingredients included incoming signal transmitted from a geostationary satellite to a solar-powered wireless Wi-Fi transmitter delivering coverage over a wide radius on ground. The router was powered with a combination of solar energy panels and storage batteries connected to a renewable Energy Power System.

**Benefits:** This model is best for the most challenging and isolated locations where existing infrastructure, including telecom and power, may be sparse or completely non-existent. It is a highly mobile solution that utilizes the current and future satellite communications infrastructure which continues to evolve.

**Considerations:** This configuration is best for more episodic and short-term connectivity scenarios, or emergency situations. However, with proper physical security and tech support for the equipment, it may be used for an extended period of time.

## Off-Grid Community Wi-Fi Terminal (OGCWFT) Project



Figure 3: Inside the CWFT



Figure 5: Inside the REPS



Figure 7: Solar Panel Box Deployed

**Off-Grid Community Wi-Fi Terminal**  
Team 19002

**ViaSat**

<http://engineeringclinic.arizona.edu/design-day-awards>

**PROJECT GOAL**  
To provide off-grid internet access by powering a community Wi-Fi terminal with renewable energy.

Four billion people worldwide lack internet access. This project, the Off-Grid Community Wi-Fi Terminal (OGCWFT), provides reliable wireless internet to remote communities. The system – with solar panels to harvest energy and power the terminal and a battery to store the excess – is a portable, low-cost alternative to using cable or mobile data.

OGCWFT is split into four weather-resistant containers for ease of transportation. Two boxes house solar panels, one holds the Community Wi-Fi Terminal, which communicates with a geostationary satellite, and the last box contains the Renewable Energy Power System (REPS). A solar charge controller inside the REPS safely sends the modulated power from the solar panels to the battery and terminal. When sunlight is unavailable, the battery provides energy to an inverter and the terminal. The device can also run on external power. The system has fans to prevent overheating in extreme temperatures. Additionally, battery and temperature data are collected for trend monitoring.

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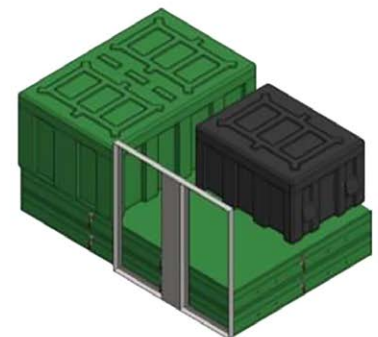


Figure 2: OGCWFT in Transport

Solution Source: ViaSat



## Appendix C - Tracking Broadband Legislation, Policy and Initiatives Nationally and in Other States



Photo by Panumas Nikhornkhai

- [The Federal Communications Commission \(FCC\)](#) leads a number of communications technology-related [Initiatives](#) including [Bridging the Digital Divide](#), the [5G FAST Plan](#), the [Keep Americans Connected Pledge](#), [Telehealth](#) and [Accessible Communications](#) with a number of [RSS Feed & E-Mail Updates](#) options and access to [FCC Broadband Maps](#) especially their [Fixed Broadband Deployment Map](#) and a variety of Data to search or download.
- [National Telecommunications & Information Administration's \(NTIA\)](#) programs and policymaking focus largely on expanding broadband Internet access and adoption in America, expanding the use of spectrum by all users, and ensuring that the Internet remains an engine for continued innovation and economic growth. See their topic areas on [Broadband](#) including [BroadbandUSA](#), [Digital Inclusion](#), [Broadband Grants](#), [Spectrum Management](#), [Internet Policy](#) and [National Broadband Availability Map \(NBAM\)](#) program.
- The [U.S. Department of Agriculture \(USDA\)](#) has been investing in rural telecommunications infrastructure for decades with their current programs offering substantial grants and loans for modern broadband e-Connectivity in rural communities. See their [Broadband Topics](#) page and [Rural Utilities Service's \(RUS\) Telecom Programs](#) including [Community Connect Grants](#), [ReConnect Loans and Grants](#), [Distance Learning and Telemedicine Grants](#), [Rural Broadband Access Loan and Loan Guarantees](#) and [Telecommunications Infrastructure Loans and Guarantees](#).
- The [Universal Service Administrative Company's \(USAC\) E-rate Program](#) ensures that schools and libraries across the U.S. are connected to information and resources through the Internet providing news, training, tools and support for E-rate applications for funding [Eligible Services](#).
- [The U.S. Economic Development Authority \(EDA\)](#) invests in sustainable job growth and the building of durable regional economies throughout the U.S. focusing on innovation and regional collaboration. A number of their [Programs](#) and [Funding Opportunities](#) can be applicable to community broadband planning and initiatives. Arizona opportunities are managed out of the [EDA's Seattle Office](#).
- The [National Exchange Carrier Association's \(NECA\) Washington Watch](#) provides timely summaries of actions and news from the FCC, other government agencies, Congress, the courts and the telecommunications industry, hyperlinking to key documents released by the FCC, NTIA, federal courts, Congress and other relevant sources via a free e-mail digest.
- The [National Council of State Legislators \(NCSL\)](#) tracks state legislation for a number of telecommunications and information technology areas including [Broadband Legislation](#), [Mobile 5G & Small Cell Legislation](#) and [Net Neutrality Legislation](#).
- [The Pew Charitable Trusts' State Broadband Policy Explorer](#) lets you search and discover how other states are expanding access to broadband through their laws and policies. Categories in the tool include Broadband Programs, Competition and Regulation, Funding and Financing, Infrastructure Access, and Definitions searchable by navigating a map or filtered queries, covering a broad range of state statutes and regulations related to broadband. Reports of interest include a [2019 State Broadband Policy Summary](#) and [How States are Expanding Broadband Access](#).
- The [Benton Institute for Broadband & Society](#) is another excellent source that develops broadband policy opinions and reports, as well as curating and distributing news related to universal broadband, connecting communications, democracy and the public interest via their free, reliable, non-partisan daily digest delivered via e-mail Monday-Friday mornings.



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- The [Information Technology & Innovation Foundation \(ITIF\)](#) tracks and provides policy commentary on a number of high tech areas including telecommunications, especially broadband and wireless via free weekly updates and notice of policy papers at the forefront of technology policy.
- [Broadband Communities Magazine](#) publishes a free monthly magazine, produces broadband webinars and conferences, and offers a variety of broadband resources on their site including [Fiber-to-the Home \(FTTH\) Tools & Resources](#) including FTTH project financial analyzers.
- [Government Technology Magazine](#) publishes a monthly magazine and aggregates news covering a variety of state and local government technology issues including [Digital Cities](#). Their [Center for Digital Government \(CDG\)](#) is a national research and advisory institute on information technology policies and best practices in state and local government.
- [Broadband Breakfast](#) has been building a community around broadband policy, Internet technology, better communications infrastructure, privacy and social media by offering expert opinions, webinars and a quality aggregated broadband news portal.
- [Baller Stokes & Lide](#) is a communications law firm with a community broadband practice area who offers broadband related resources and a periodic [BSL Newsletter](#) tracking broadband regulatory and policy developments.
- [EducationSuperHighway](#) is a nonprofit that helps lead work to close the classroom connectivity gap and upgrade Internet access in every public school and student's home in America. They track K-12 classroom connectivity and use, as well as offer resources and direct assistance with assessments, planning, E-rate applications and procurement support.
- [The Schools, Health & Libraries Broadband \(SHLB\) Coalition](#) strives to close the digital divide by promoting high-quality broadband for community anchor institutions (CAIs) and their surrounding communities. Resources provided include policy papers, webinars, a free newsletter and periodic news updates.
- The [Center for Education Reform \(CER\)](#) works to expand educational opportunities that lead to improved economic outcomes for all Americans. See their [Online Learning](#), [Research](#) and [Advocacy](#) areas as well as their [Arizona Online Learning Profile](#) for more.
- [Consortium for School Networking \(CoSN\)](#) is a professional association for school system technology leaders providing thought leadership resources, community, best practices and advocacy tools to help leaders succeed in the digital transformation.
- [Common Sense Media](#) is dedicated to helping all kids thrive in a world of media and technology, sourcing entertainment and technology recommendations for families and schools. Their [Connect All Students](#) initiative calls on Congress to connect all students and close the digital divide now.
- [United States Distance Learning Association \(USDLA\)](#) supports distance learning research, development and praxis across the complete arena of education, training and communications. USDLA offers several annual [Events](#) and [Distance Learning Resources](#).
- [National Collaborative for Digital Equity \(NCDE\)](#) provides free dissemination and policy education as well as comprehensive, fee-based consulting services, in support of digital equity for economic and educational inclusion. Their [Digital Equity Resources](#) include a [Guide to CRA Grantmaking for Digital Equity and Economic Inclusion](#).
- The [Coalition for Local Internet Choice \(CLIC\)](#) supports local communities in making their broadband Internet choices and offers a [Public-Private Partnerships \(P3\) Library](#) with resources and sample agreements.
- The [Institute for Local Self-Reliance \(ILSR\)](#) focuses on a number of community technology-related issues including [Community Broadband Networks](#). ILSR publishes relevant reports and weekly updates as well as offering an online [Community](#)

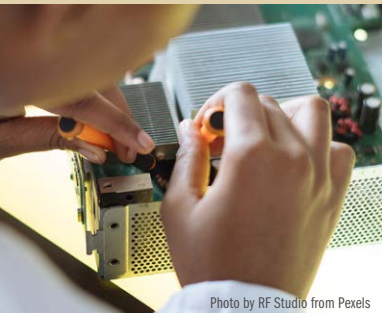


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[Network Map](#) for identifying projects around the nation.

- The [National Digital Inclusion Alliance \(NDIA\)](#) is a unified voice for home broadband access, public broadband access, personal devices, local technology training and support programs and digital inclusion programs. They promote [Digital Inclusion Policies](#), issue news and [Publications](#) and maintain a list of [Free & Low-Cost Internet Plans](#).
- [US Ignite](#) is accelerating the smart city movement by guiding communities into the connected future, creating a path for private sector growth, advancing related technology research and developing new business models. Of particular note is their [Smart Gigabit Communities \(SGC\) Project](#), [Smart Cities Data Exchange](#), NSF-funded [Platforms for Advanced Wireless Research \(PAWR\)](#), [CloudLab](#) and the [Broadband Models for Unserved and Underserved Communities Report](#) discussed in Appendix A.
- The [Intelligent Community Forum \(ICF\)](#) is a global network of cities and regions with a think tank at its center helping communities find a new path to economic development and community growth in the digital age. See their [Connect](#) resources page for broadband development strategies and funding models coverage.
- The [United States Telecom Association \(USTelecom\)](#), the Broadband Association, represents telecommunications-related businesses based in the U.S. Of note, they offer Action Centers for [Invest in Broadband](#), [Rural Development Opportunity Fund \(RDOF\)](#), [Broadband Mapping Initiative](#) and [Smart Infrastructure](#), as well as their annual [Broadband Pricing Index \(BPI\) Report](#).
- The [National Rural Electric Cooperative Association \(NRECA\)](#) works to promote and support co-ops and to champion their business model. Broadband policy and electric cooperatives' projects are covered on their [Broadband Issues](#) page.
- [BroadbandNow](#) provides tools to search for plans, prices, & ratings for every Internet provider in a specific geography. See also their [Arizona Internet Access Summary](#) and handy [Zip Code Search](#).
- [CompTIA](#) is the world's leading tech association, offering IT professional certification programs, original research including their annual [Cyberstates](#) guide and innovative technology-driven programs. See their [Advocacy](#) and [Resources](#) pages for more.
- The [State Science & Technology Institute \(SSTI\)](#) is focused on initiatives that support prosperity through science, technology, innovation and entrepreneurship through [Technology Based Economic Development \(TBED\)](#). Their [Federal Policy](#) advocacy covers a variety of technology related areas, in particular modernizing our nation's broadband infrastructure to include and support new technologies.
- The [Competitive Enterprise Institute \(CEI\)](#) is a non-profit public policy organization dedicated to advancing the principles of limited government, free enterprise, and individual liberty. Issues they cover of particular note include [Tech & Telecom](#) including [Telecommunications](#), [Transportation & Infrastructure](#), [Antitrust & Competition](#) including Net Neutrality coverage and [Regulatory Reform](#).
- [Electronic Frontier Foundation \(EFF\)](#) is the leading nonprofit defending net neutrality and protecting citizens' rights in cyberspace as it concerns digital privacy, the use of personal data, free speech, censorship, copyright, security and innovation. Visit their [Action Center](#) for more information or their [Tools Page](#) for access to privacy and encryption tools.
- The [Center for Democracy & Technology \(CDT\)](#) focuses on putting democracy and individual rights at the center of the digital revolution. Areas of focus include the [Open Internet](#) and [Privacy & Data](#).
- [Finley Engineering](#) is an engineering consultancy serving both the [Broadband](#), [Telecom](#), [Wireless](#) and [Energy](#) industries providing a useful [Newsletter](#) and rich [Resource Library](#).
- [Strategic Networks Group \(SNG\)](#) is a consulting firm working with communities to help transform through broadband, digital infrastructure and smart community services. Their site offers a series of [SNG Insights](#) and a variety of case studies and reports.

# Appendix D - Arizona Broadband Grants, Pandemic Response and Recovery Resources

## State of Arizona Resources:

Arizona Governor's Office - <https://azgovernor.gov/>

Arizona Together (#ReturnStronger) - <https://arizonatogether.org/>

Stay Healthy Toolkit - <https://arizonatogether.org/stayhealthy>

Arizona Together Grant Resources & Information (AZCares Fund, Arizona Express Pay Program, FEMA Public Assistance, eCivis Grant System) - <https://arizonatogether.org/grants>

Arizona Office of Grants & Federal Resources - <https://grants.az.gov>

Grant Manuals - <https://grants.az.gov/grant-manual>

COVID-19 Grant Resources - <https://grants.az.gov/covid-19-grant-resources>

Arizona Department of Health Services (DHS) Infectious Diseases Information - <https://www.azdhs.gov/preparedness/epidemiology-disease-control/infectious-disease-epidemiology/>

Arizona Commerce Authority (ACA) - <https://www.azcommerce.com/>

ACA Broadband Resources - <https://www.azcommerce.com/broadband/>

Essential Infrastructure - <https://www.azcommerce.com/covid-19/essential-infrastructure/>

ACA COVID-19 Business Resources - <https://www.azcommerce.com/covid-19/>

Arizona Department of Administration (ADOA) - <https://doa.az.gov/>

Arizona Strategic Enterprise Technology (ASET) - <https://aset.az.gov/>

Arizona Public Safety Broadband Network (FirstNet) - <https://azfirstnet.az.gov/>

Arizona Division of Emergency Management (ADEM) - <https://www.ready.gov/arizona>

Arizona Board of Regents (ABOR) - <https://www.azregents.edu/>

Arizona Virtual Teacher Institute at ASU Digital Prep - <https://www.asuprepdigital.org/training/>

Sun Corridor Research & Education Network - <https://suncorridornet.org/>

Internet2 Innovation Platform - <https://www.internet2.edu/vision-initiatives/initiatives/innovation-platform/>

Arizona Department of Education (ADE) - <https://www.azed.gov/>

ADE E-rate & Broadband Support - <https://www.azed.gov/erate/>

COVID-19 Guidance to Schools & Families - <https://www.azed.gov/covid-19-guidance>

COVID-19 Roadmap for Reopening Schools - <https://www.azed.gov/covid-19/covid-19-roadmap-reopening-schools>

Arizona State Library - <https://azlibrary.gov/>

Connect Arizona Free Wi-Fi Map - <https://www.connect-arizona.com/>

Arizona Libraries Tech Access Phoneline (AZ LibTAP Public Tech Support) - <https://sites.google.com/view/azlibtap/free-tech-help> or Call: 602-529-1519

E-rate Support - <https://azlibrary.gov/erate>

Digital Arizona Library (DAZL) - <https://azlibrary.gov/dazl>

Arizona Telemedicine Program (ATP) - <https://telemedicine.arizona.edu/>

Arizona Telemedicine Council - <https://telemedicine.arizona.edu/about-us/atc>

ATP Service Directory - <https://telemedicine.arizona.edu/servicedirectory>



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Southwest Telehealth Resource Center (TRC) Telemedicine COVID-19 Resources - <https://southwesttrc.org/resources/covid19>

Arizona Corporation Commission (ACC) - <https://www.azcc.gov/>

Utilities Division: Telecommunications - <https://www.azcc.gov/utilities/telephone>

Arizona Universal Service Fund (AUSF High-Cost Fund) -

<https://www.azcc.gov/utilities/telephone/arizona-universal-service-fund>

Arizona Universal Service Support for Schools and Libraries -

<https://www.azcc.gov/utilities/telephone/arizona-universal-service-support>

Arizona State Land Department (ASLD) - <https://land.az.gov/>

Arizona Geographic Information Council (AGIC) - <https://agis.az.gov/agis/>

AZGeo Data Hub (Geospatial Repository) - <https://azgeo-data-hub-agis.hub.arcgis.com/>

Publicly Available Wi-Fi Hotspots Interactive Map (Superseded by Connect Arizona) - <https://azland.maps.arcgis.com/apps/webappviewer/index.html?id=20dd52ea241e42f0932ac1a27580f3e0>

Arizona Department of Transportation (ADOT) - <https://azdot.gov/>

ADOT P3 Initiatives - <https://azdot.gov/business/programs-and-partnerships/p3-initiatives>

Digital Highways Act (SB1402 from 2012) - <https://aset.az.gov/digital-highways>

## Arizona Nonprofit COVID-19 Resources:

Arizona Broadband Stakeholder Network (AZBSN) COVID-19 Digital Access Task Force - <https://www.arizonatele.org/covid19-about.html>

Updates & Resources - <https://www.arizonatele.org/covid-resources.html>

Including the Current AZBSN Arizona Broadband Consultants List

Arizona Telecom & Information Council (ATIC) - <https://www.arizonatele.org/>

Greater Arizona Educational Leadership (GAZEL) - <http://www.gazel.org/>

Arizona Technology in Education Association (AzTEA) - <http://aztea.org/>

Arizona Business and Education Coalition (ABEC) - <http://www.abec.org/>

Arizona Technology Council (AZTC) - <https://www.aztechcouncil.org/>

COVID-19 Resources - <https://www.aztechcouncil.org/about-us/covid-19-resources/>

AZTechBase (Tech Ecosystem Database) - <https://www.aztechbase.com/#/dashboard>

Gregslist of Software Companies in Phoenix - <https://gregslist.com/phoenix/>

Pipeline AZ by Futures (Jobs Site) - <https://pipelineaz.com/>

Public Policy Guide - <https://www.aztechcouncil.org/public-policy/>

SciTech Institute (STEM Education) - <https://scitechinstitute.org/>

Greater Phoenix Chamber Response to COVID-19 Resources - <http://response.phoenixchamber.com/>

Arizona Economic Dashboard - <https://phoenixchamber.com/economic-development/arizona-economic-dashboard/>

AZ Cyber Talent - <https://www.azcybertalent.com/>

Apprenti Affiliate Arizona (Cybersecurity Talent Hub) - <https://apprenticareers.org/locations/arizona/>

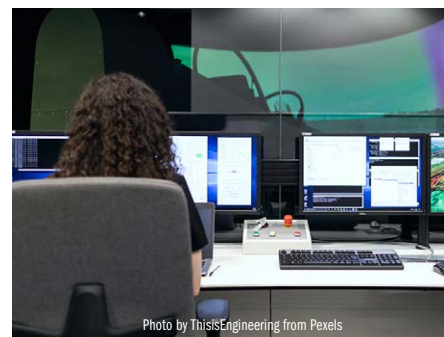




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Elevate EDAZ (Workforce Alignment) - <https://phoenixchamberfoundation.com/education/>

Greater Phoenix Economic Council (GPEC) COVID-19 Greater Together Resources - <https://www.gpec.org/covid-19/greater-together/>

Arizona Bioindustry Association (AZBio) COVID-19 Business Resource Center - <https://www.azbio.org/covid-19-business-resource-center>

BIO Coronavirus Hub - <https://hub.bio.org/landing-page/community-home>

AZ BioMap - <https://flinn.org/bioscience/resources/arizonas-bioscience-ecosystem/arizona-biomap/>

Arizona Grantmakers Forum COVID-19 Response Page - <http://arizonagrantmakersforum.org/resources/covid-19-response/>



# Appendix E - Arizona Broadband Initiatives Recap 2010-2019

## Arizona Broadband Initiatives 2010-2014



## Arizona Broadband Initiatives 2017-2019

