

Ector County Home Connectivity

U.S. & Texas Landscape

June 2020

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Rural Home Connectivity Landscape

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Introduction



The purpose of this project is to explore what options are available to improve broadband access to residents of Ector County.



Baseline
Assessment



Home
Connectivity
Landscape



Solution Analysis
& Roadmap

The purpose of this report is to illustrate national case studies and establish a common vocabulary around home connectivity.



Baseline
Assessment

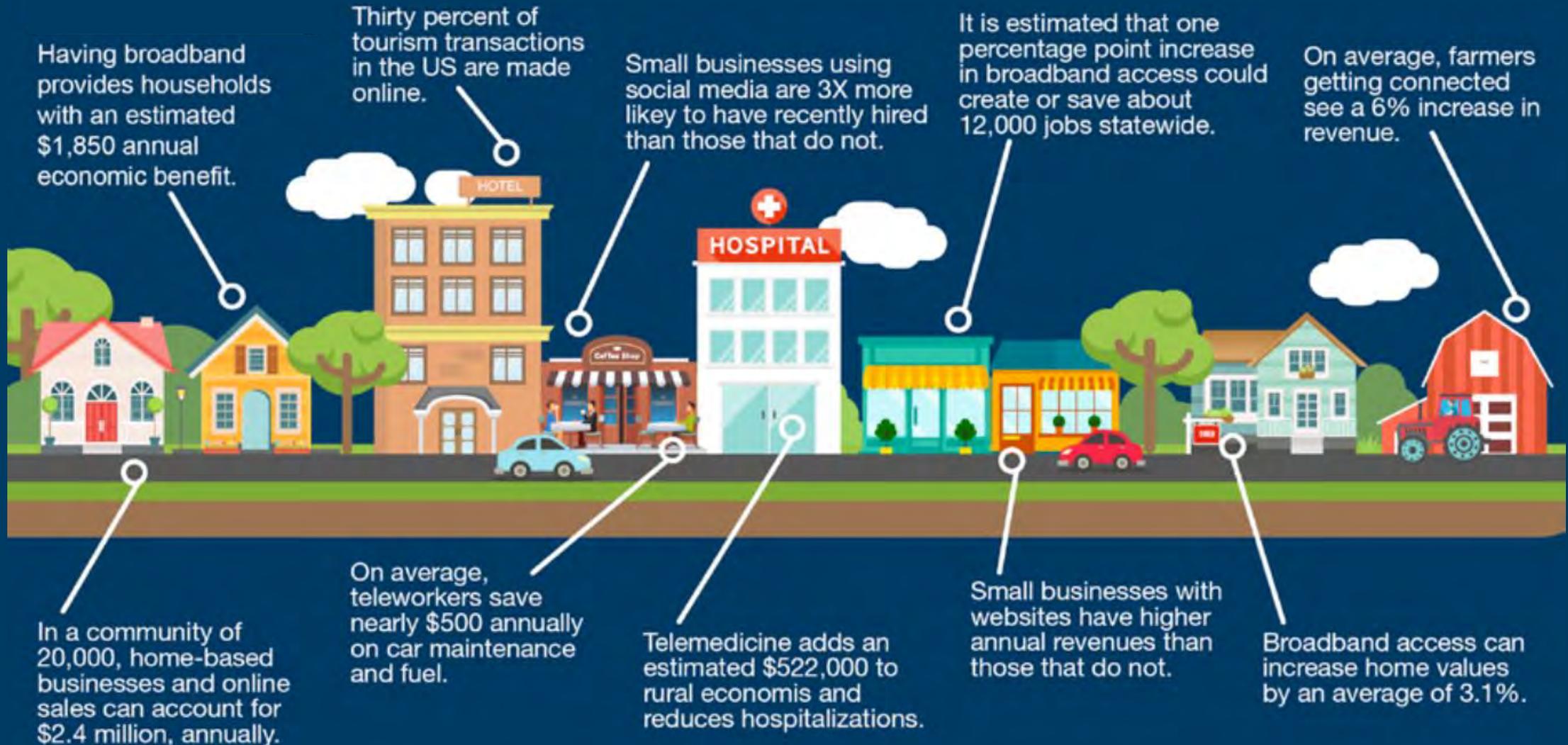


Home
Connectivity
Landscape



Solution Analysis
& Roadmap

Why broadband?



What is broadband?



Access

Broadband access refers to the infrastructure that enables a high-speed internet connection.

Adoption

Broadband adoption is the choice made by a resident, business, or institution to embrace and use broadband and its related technologies.

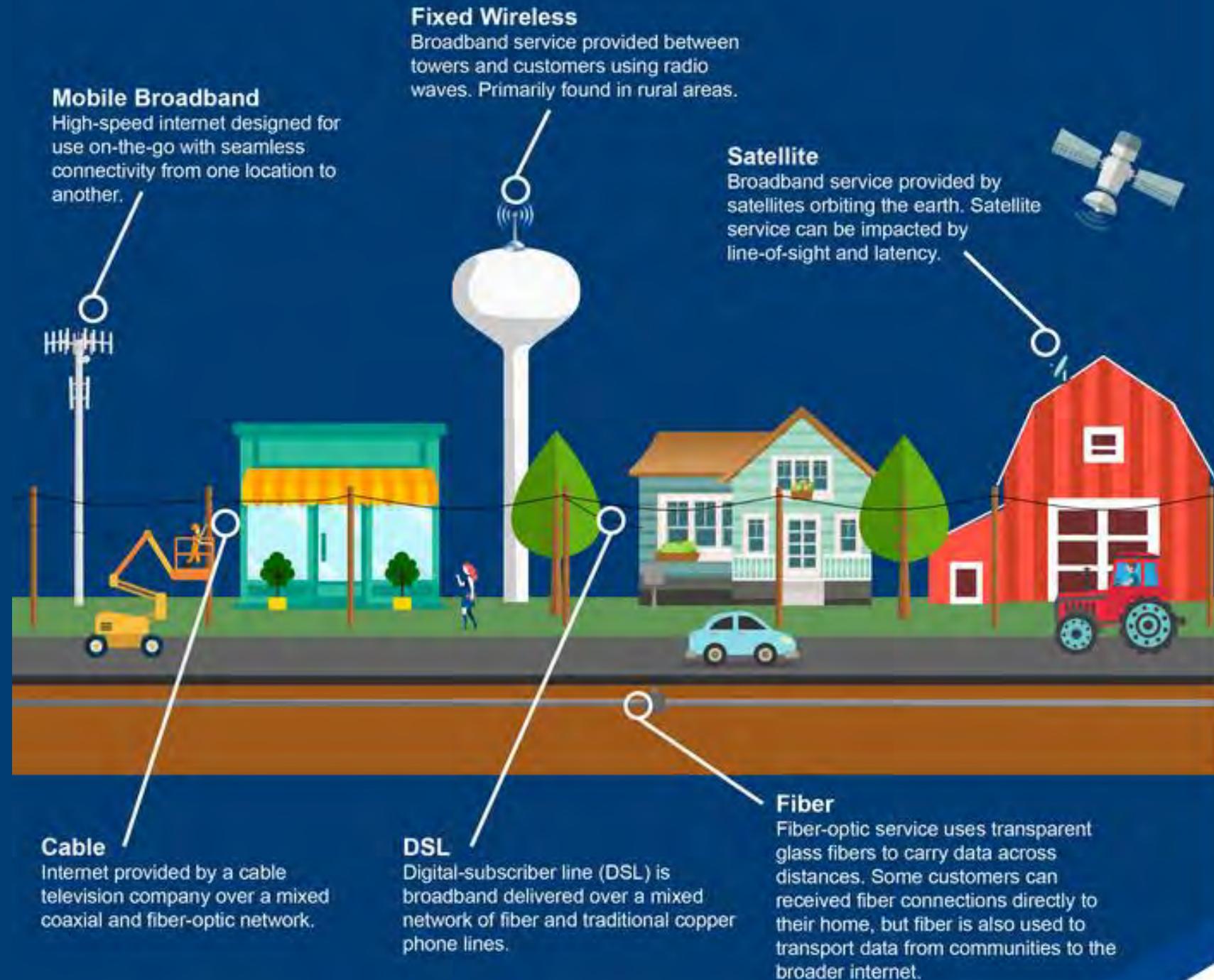
Use

Broadband use is a result of having the skills necessary to utilize and leverage broadband and related technologies across sectors.

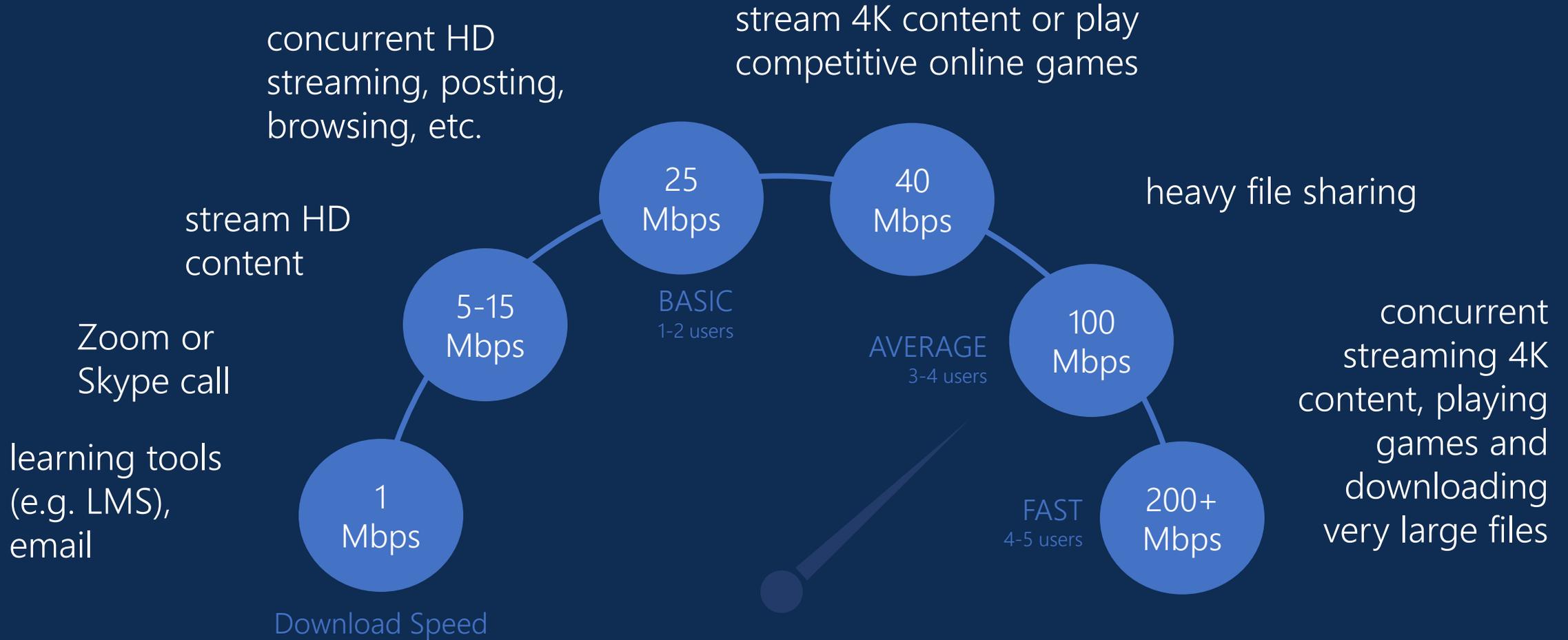
What is broadband access?

FCC: a connection of at least 25 Mbps download speed and 3 Mbps upload speed, (the Commission's current benchmark)

Image source: Connected Nation



What broadband speeds enable what functions?



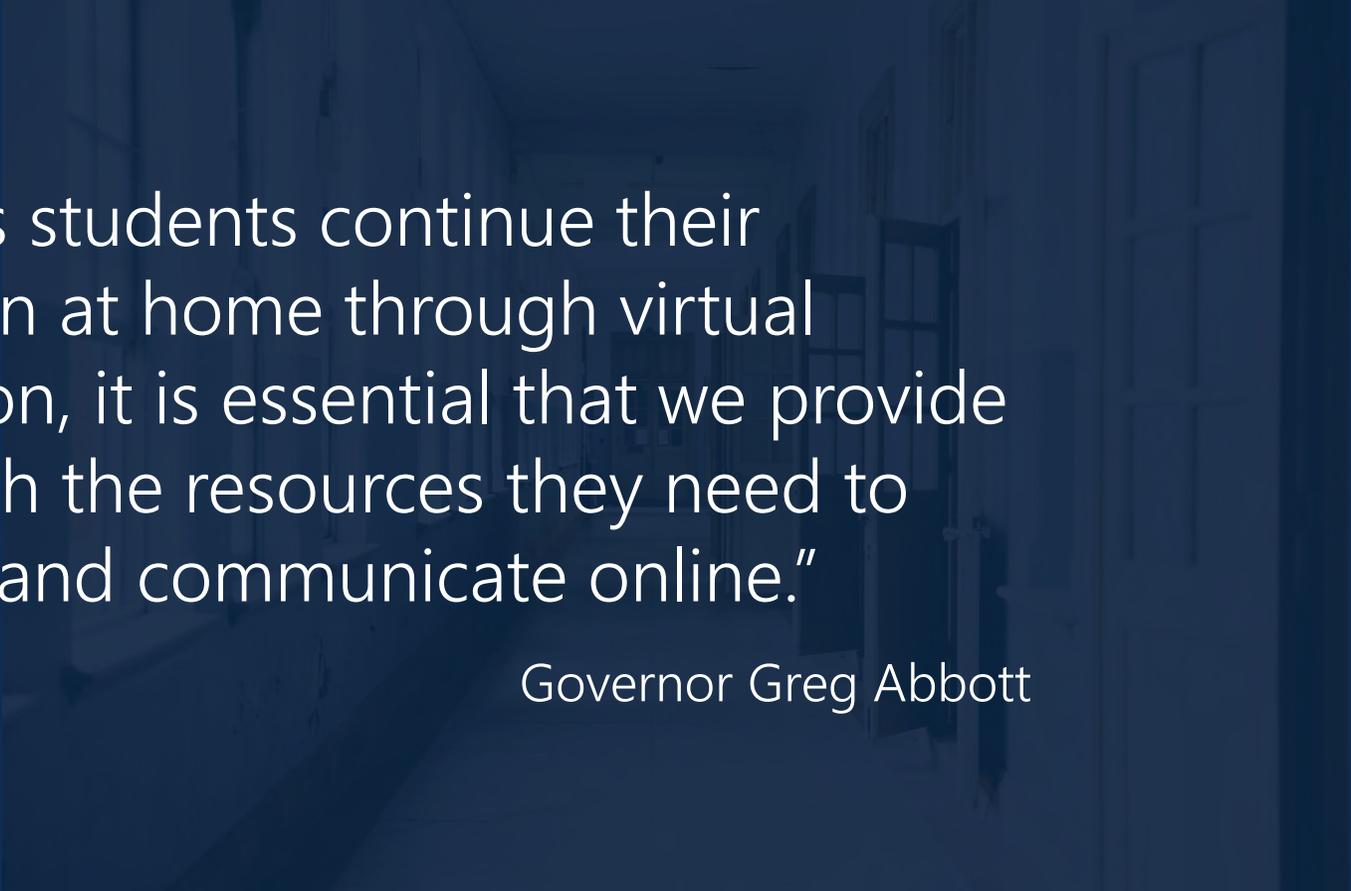
The findings in this report were formulated from interviews with national broadband experts, publicly available data, published case studies, and other industry research.

This document is intended to be an educational, informative resource for Ector County residents and leaders to continue their collective discussion on expanding broadband for residents.



Highlights





“As Texas students continue their education at home through virtual instruction, it is essential that we provide them with the resources they need to connect and communicate online.”

Governor Greg Abbott

“There are 12 million students in this country who fall into the homework gap and lack the regular broadband access they need to just do nightly schoolwork. From my perspective, this is the cruelest part of the digital divide, and it’s a divide we’re going to have to address, and a gap we’re going to have to fix.”

Jessica Rosenworcel
FCC Commissioner

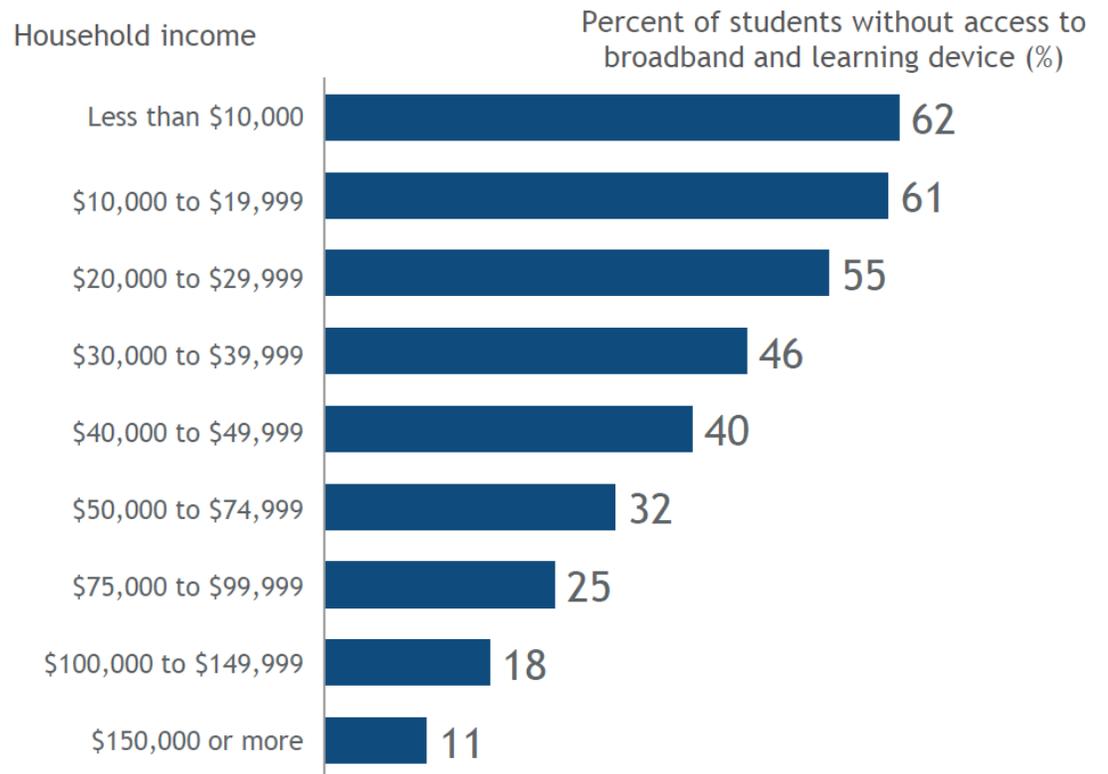
In areas where poor and non-white children have relatively lower test scores, such children are more likely to not have access to the internet.

A fifth of students (21 percent) live in households that receive food stamps; they were 16 percent less likely to have access to high-speed internet and 10 percent less likely to have access to internet at all.

African American children and youth were eight percent less likely to have access to high-speed internet and four percent more likely to have no internet access.

Source: Social Distancing and School Closures: Documenting Disparity in Internet Access among School Children (Carnegie Mellon/MIT, April 2020)

Students in lower income households are less likely to have access to high speed internet and an adequate learning device at home.



Operation Connectivity Taskforce (2020)

The United States has an internet access problem, especially in rural areas. The existing program to extend broadband has become a corporate entitlement for incumbent telephone companies. At the same time, the United States has an internet affordability problem. Too many low-income Americans cannot afford broadband internet access.

Tom Wheeler
Former FCC Chairman

Like any infrastructure investment, delivering broadband to rural area presents significant financial burdens. Like other networks, broadband communications networks exhibit economies of linear density, which create an economic barrier to deployment across vast regions of the United States



from the
perspective of
commercial
broadband
providers

“The economics of linear density tell us it is commercially unviable to deploy network infrastructure at affordable consumer rates in a rural environment without some form of subsidy, whether internal or external.”

Source: CQA/NTCA/USTelecom

Stretch Goal: By 2021-2022 academic year, 100% of Texas students have connectivity (broadband and devices)

Operation Connectivity Taskforce



With remote learning becoming a core component of our students' experience, Texas must take the necessary steps to ensure an equitable learning environment.

While there have been significant gains in on-campus connectivity, many students still lack robust Internet connectivity at home.

Five strategies districts are currently using to address these challenges:

1. Partner with Community Organizations to Create "Homework Hotspots"
2. Promote Low Cost Broadband Offerings
3. Deploy Mobile Hotspot Programs
4. Install Wifi on School Buses
5. Build Private LTE Networks

Source: *Digital Equity Action Toolkit*, CoSN (June, 2018)

Pending Congressional legislation may devote significant funds to expanding broadband access.

Sample - June, 2020

House Democrats are putting forward a framework to invest \$760 billion over five years in the nation's roads, bridges, transit systems, railways, airports, ports, inland waterways, wastewater and drinking water systems, brownfields, and broadband.

Invests \$80 billion over five years to deploy secure and resilient broadband and expand access for communities nationwide. This investment would fund connections to the internet to unserved and underserved rural, suburban, and urban areas across the country. A high-speed internet connection is an essential part of life, and helps create stronger small businesses, more jobs, and a powerful economy in communities that have been left behind.

Source: *Moving Forward Framework*, transportation.house.gov

The Trump administration is preparing a \$1 trillion infrastructure package to boost the nation's economy following months of lockdowns and business closures during the coronavirus pandemic.

The Department of Transportation is taking the lead on the project that would funnel money for roads and bridges, and would allocate funds for 5G wireless infrastructure and rural broadband, Bloomberg News reported. The administration sees an existing infrastructure funding law that is up for renewal by Sept. 30 as a way to push for a more expansive package.

Source: New York Post/Bloomberg, June 15, 2020

About half of states (22) do not allow the establishing of municipal networks to residents.

Texas state laws bar municipalities from offering specific types of telecommunication services to the public directly or through a private telecom company. The state law does allow some provisions for communities without any private telecom companies presently offering broadband service to residents.

In 2019, Gov. Greg Abbott signed into law legislation enabling electric cooperatives to offer broadband services to customers, but municipal governments are still barred from providing broadband services to residents.

Source: <https://broadbandnow.com/report/municipal-broadband-roadblocks>

More than 900 communities in the U.S. have deployed their own broadband (mostly fiber).

63 municipal networks serving 125 communities with a publicly owned Fiber-to-the-Home (FTTH) citywide network.

63 communities with a publicly owned cable network reaching most or all of the community.

237 communities with some publicly owned fiber service available to parts of the community (often a business district). More than 120 communities with publicly owned dark fiber available.

More than 230 communities in 33 states with a publicly owned network offering at least 1 gigabit services.

More than 330 communities served by rural electric cooperatives.
10 communities served by one broadband cooperative.

Seek to Provide Universal Broadband Access Throughout the Area

In conversations with local civic and education leaders as well as economic development professionals in areas of similar size around the state, it was consistently noted that one of the most important improvements that could be made is to significantly enhance broadband availability. Universal broadband internet access to the extent possible would greatly enhance the ability for remote work and education during periods of time when social distancing may be required. In addition, it would increase efficiency in the workplace once the current situation has passed.

continued...

Seek to Provide Universal Broadband Access Throughout the Area

...The need is especially acute in smaller and mid-sized metropolitan areas and rural regions, and future economic development could be negatively affected. It is also likely that in the post-COVID-19 environment, there will be greater emphasis on the use of virtual technology in education, corporate activity, and many other areas. Supporting investments in this crucial aspect of infrastructure can enhance recovery and growth potential in many ways.



Delivery Models



Ector County and ECISD are exploring the use of public hotspots, and continue negotiating with local ISPs in the near-term. But a vision for the future of Ector County connectivity is also needed.

The following slides detail broadband options and models that apply to the longer term. The best scenario for Ector County will be the one that not only fills gaps, but also provides economic opportunities to Ector County residents.

Broadband service delivery can be separated into wired and wireless.

Wired broadband delivers services over some type of wire connected to your home or office. Wireless broadband uses the electromagnetic spectrum and does not require a wire running to your home or office.

Wired



- Dial-up
- Digital Subscriber Lines (DSL)
- Cable
- Broadband Over Powerline (BPL)
- Fiber Optic Cable

Wireless



- Fixed wireless
- Wi-Fi
- Satellite
- Wi-Max
- Cellular (4G, LTE, 5G)

Wired Internet Access

Wired broadband technologies can run below ground or above ground, meaning that the primary real estate requirement is space in conduit or on utility poles. The wire connects to a building, where the signal is then redistributed within the building.



Fiber optic technology sends data via light through glass fibers that are roughly the diameter of a human hair. Fiber provides scalable capacity beyond thousands of gigabits per second; it is not susceptible to interference and can support multiple users. The useful life of fiber cable has not been determined, as neither use nor time appears to produce any degradation of fiber infrastructure. A fiber optic connection is generally the most reliable, highest capacity type of connection.

Cable or Digital Subscriber Line (DSL) Existing coaxial or copper wires, originally installed for cable television or telephone service, are also used for wireline internet service in combination with fiber optics. While new innovations are extending the useful life of copper in some locations, fiber optic lines are favored for all new deployments.

Fixed Wireless Access

Wireless broadband uses radio links between stationary sites, usually with one side connected with fiber optics and serving as a “hub” for multiple wireless links. Depending on the type of wireless technology, the distance of the connection and line of sight, a fixed wireless connection can support multi-gigabit speeds with high reliability.



Mesh Wi-Fi refers to a method of Wi-Fi deployment utilizing multiple transmitters that repeat a Wi-Fi signal and spread the reach of the network. This can reduce the number of wired connections needed and, where the Wi-Fi access points can get signals from multiple repeaters, can add resilience to the network

Millimeter Wave Fixed Wireless Access (mmWave-FWA) signals are highly susceptible to interference. Currently, mmWave bands that are licensed are generally being incorporated into 5G deployments.

Free Space Optics refers to the use of visible light and laser beams for wireless communication. No license is required and the technology supports connections of 1 Gbps up to 10 Gbps. There is no radio frequency interference - However, any physical obstruction blocks the signal completely and fog, smog, or water can cause disruptions.

Mobile Wireless

Mobile broadband allows for one side of a wireless link to stay connected while moving through a coverage area, which may be served by multiple stationary radios. The tradeoff for mobility is usually slower speeds and less reliability than a fixed connection. Mobile wireless can be supplemented with “hotspots” of higher capacity and more reliable connectivity.



5G refers to the technical standard for the next generation – the fifth generation – of mobile connectivity. The technical specification calls for speeds that are projected to be at least 10 times faster than the current 4G network speeds, with lower latency, lower battery power consumption, and capacity to handle many more connections from a single radio.

The Citizens Broadband Radio Service (CBRS) utilizes newly available radio frequency spectrum in the 3.5 GHz band (3550-3700 Mhz). CBRS can be used for fixed or mobile wireless, though it is not yet sufficient for ubiquitous bidirectional gigabit-speed services. CBRS is being further developed to support 5G.

Continued...

Mobile Wireless (continued)

Mobile broadband allows for one side of a wireless link to stay connected while moving through a coverage area, which may be served by multiple stationary radios. The tradeoff for mobility is usually slower speeds and less reliability than a fixed connection. Mobile wireless can be supplemented with “hotspots” of higher capacity and more reliable connectivity.



Educational Broadband Service or EBS is used to describe a specific band/block of microwave frequencies, licensed to educational institutions or nonprofit educational organizations for uses that are designed to accommodate a variety of fixed, portable, and mobile services relating to education and instruction (nebsa.org).

Wi-Fi 6 is the next generation of Wi-Fi, which continues to be the most common and most heavily used kind of wireless connection for internet service. Wi-Fi's popularity and value come primarily from the fact that it is available for use by anyone according to a standard set of rules, even without a license. Wi-Fi's ubiquity can also pose a challenge: multiple network operators can crowd into the same area, causing interference and decreasing signal quality for all users. Wi-Fi 6 is designed to improve performance under such conditions.

Satellite Internet Access

Satellite Internet access is Internet access provided through communications satellites. Most consumer grade satellite Internet service is typically provided to individual users through geostationary satellites. Latency and interference are the challenges.



Satellite Internet generally relies on three primary components: a satellite, typically in geostationary orbit (sometimes referred to as a Geosynchronous Earth Orbit, or GEO), a number of ground stations known as gateways that relay Internet data to and from the satellite via radio waves (microwave), and a small antenna at the subscriber's location, often a VSAT (very-small-aperture terminal) dish antenna with a transceiver.

Medium Earth Orbit (MEO) and Low Earth Orbit (LEO) satellite constellations, unlike geostationary satellites, do not stay in a fixed position in the sky. MEO/LEO satellite constellations reportedly do not have such great delays, as the satellites are closer to the ground. SpaceX is planning "StarLink" which will reportedly bring high-speed broadband to locations where it has historically been unreliable, expensive or unavailable in 2021.

Wireless solutions rely on a radio frequency to transmit the service.

Radio waves, which are primarily used in communication technologies, are a type of electromagnetic radiation (a form of energy); they make up a small part of what is called the electromagnetic (EM) spectrum, which is divided up into sections called frequency bands.



The EM spectrum is a limited resource—there are only so many radio frequencies in existence. But too much activity on a radio frequency band would create interference.

Most of the radio spectrum is licensed by the FCC to certain users, for example, television and radio broadcasters. Individual companies pay a licensing fee for the exclusive right to transmit on an assigned frequency within a certain geographical area. In exchange, those users can be assured that nothing will interfere with their transmission.

Continued...

Source: *Licensed Versus Unlicensed Spectrum*, Iota Communications

Wireless solutions rely on a radio frequency to transmit the service. *continued*

Individual companies pay a licensing fee for the exclusive right to transmit on an assigned frequency within a certain geographical area. In exchange, those users can be assured that nothing will interfere with their transmission.



The amount of spectrum that is available for public and unlicensed use is very small—only a few bands. Both the size of the area and the lack of exclusivity mean there's greater potential for interference from other users located nearby. (It's like the "wild west" of radio communication.)

Understanding the business structures and financial models for broadband delivery provides invaluable insights for a planning effort.



Private Sector
Delivery Model



Municipal
Delivery Model



Public-Private
Sector Delivery
Model



Community
Wireless
Networks



Utility
Cooperative

Community leaders faced with the inability to obtain broadband service through the phone or cable company look to other models to bring the service to the community.

Private Sector Broadband Delivery Model



Private Sector
Delivery Model

Traditional private sector providers such as telephone and cable companies are profit-driven. Private sector providers make infrastructure investments in communities where there is a reasonable return on investment within a short period of time to support stockholder value. There simply is very little financial incentive for telecommunications or cable companies that deliver services over cables to upgrade or extend their infrastructure in many rural communities.

Broadband providers are among the leading investors in American infrastructure, with over \$1.6 trillion invested since 1996, according to USTelecom. "The economics of linear density tell us it is commercially unviable to deploy network infrastructure at affordable consumer rates in a rural environment without some form of subsidy, whether internal or external," reports USTelecom.

Source: The National e-Commerce Extension Initiative, Connecting Communities
Source: *Government Support Key to Bridging Digital Divide in Rural America*, USTelecom

Municipal Broadband Delivery Model



Municipal Delivery Model

Municipal governments get involved in the provision of advanced telecommunications services when the private sector fails to deliver or when the cost of service is appreciably higher than in other locations. Local governments attempt to fill the gap by leveraging community resources such as right of ways, infrastructure, and other government property. Municipal broadband is normally delivered through a municipal utility or authority. The local government builds, owns, and operates the utility to deliver broadband service to customers within the government's or authority's geographical boundary.

Municipal utilities or authorities face challenges associated with private sector resistance, high startup costs and low population density.

Public-Private Broadband Delivery Model



Traditional public-private partnerships are contractual arrangements where the resources, risks and rewards are shared between the public and private sectors to provide greater efficiency and better access to capital. Through this agreement, the skills and assets of each sector (public and private) are employed to deliver a service or facility for the use of the general public. Public-private partnerships can take a wide variety of forms.

The public's interests are fully assured through provisions in the contracts that provide for on-going monitoring and oversight of the operation of a service or development of a facility.

Public-Private Broadband Delivery Model



Public-Private Sector Delivery Model

A

Private Investment, Public Facilitation

In this model, the County partners with a member of the private sector who is willing to invest capital, and design and deploy infrastructure. In addition, the private partner would assume responsibility for asset management, network services, and customer relations. In turn, the County facilitates construction through economic and procedural incentives, including tax benefits, streamlined permitting, public rights-of-way access, and allowing contracted inspectors to accelerate construction project timelines.

B

Private Execution, Public Funding

In this model, the public entity makes a significant investment, while the private partner assumes a combination of engineering, construction, financing, operations, and/or maintenance responsibilities. This model benefits the public partner as it capitalizes on the private partner's strengths to provide turnkey network services. The second model is a higher public risk/benefit variation on the traditional municipal model for broadband infrastructure. (Similar to current models used in the U.S. for highways, toll roads, and bridges)

C

Shared Investment and Risk

In this model, both partners develop a strategy to work together to realize their common goal in a framework unique to the project and locality itself. The public and private partners both leverage assets as appropriate, and negotiate logistics such as service provision, customer service operations, and maintenance to effectively realize their common goal. This concept manifests in a variety of ways. Frequently, the public partner provides fiber already in use for civil services, and the private partner invests to expand said fiber to develop a robust FTTP infrastructure.

Community Wireless Networks



Community
Wireless
Networks

A more informal delivery model is a common wireless network built and maintained collectively by community members to provide free or affordable Internet for the purpose of achieving digital inclusion. Community contributions to the development of these networks may include sharing access points, donating money, donating old hardware, hosting access points, developing software for the system, and/or providing manpower and technical support to build and maintain the network.

There is a variety of funding methods adopted by different CWNs. Some of these networks were built through volunteerism and donations. Others provide the service for free but charge local businesses. Other networks are built on the notion of cost sharing.

Source: Social and Economic Effects of Community Wireless Networks and Infrastructures, (Abdelnasser Abdelaal, 2013)

Cooperative (e.g. Telephone or Electric)



Utility
Cooperative

A utility cooperative is a type of cooperative that is tasked with the delivery of a public utility such as electricity, water or telecommunications to its members. Profits are either reinvested in infrastructure or distributed to members.

Many cooperatives provide Internet service as a natural extension of their existing infrastructure. Telephone cooperatives started with Internet access by providing dial-up and DSL service over their copper telephone lines. Most telephone co-ops are already transitioning to all-fiber networks, upgrading everyone in their territory from the old copper phone lines of 50 years ago. More than 110 rural electric coops have embarked on fiber optic projects to increase Internet access for their members, a number that is growing rapidly from just a handful in 2012.

Source: *Cooperatives Fiberize Rural America: A Trusted Model For The Internet Era*, (ISLR, Dec 2019)

Scenarios for expanding community internet access are built by selecting the most appropriate models.

Delivery Model	Business Model	Network Technology	Partners
Private	Free	Cable, DSL	State/Local Agencies
Municipal, Tribal	Subscription	Fiber Optics	Business Community
Public-Private	Subscription with Subsidy	Fixed Wireless / Mesh	Local ISPs, Global ISPs
Community Wireless Network	Pay-Per-Use	Mobile Wireless	Engineering, Construction, Architecture Firms
Cooperative, Member-Owned		Satellite	Hardware Providers

& Hybrid

Network elements also provide a framework for planning.



Real Estate

Conduit, rights-of-way, light and utility poles, hardened rooms, rooftops, and other facilities whose purposes are not solely to support communications networks



Infrastructure

Passive (non-electronic) infrastructure, including fiber, in-building wiring, towers, cabinets, racks, and other purpose-built structures to support equipment



Wireless Spectrum

The electromagnetic spectrum exists all around us, but only some portions can be used for broadband networks. The available wireless spectrum is similar to passive infrastructure, but is used in different ways that make it a unique element in a network



Equipment

Active electronic communications equipment including routers, modems, switches, radios, and antennas that transmit, receive, and manage the signals that carry packets of data



Operations

Labor, knowledge, and recurring costs required to run the equipment, "light" the passive infrastructure, and maintain the real estate



Service

Labor and knowledge required to engage with network users to market, sell, educate, and support the people who use the network



Bright Spots



Bright Spots are innovative and effective efforts to expand community broadband access.

The following are a sample of community efforts to bring affordable fixed or wireless broadband to households in rural areas (i.e. "bright spots").

In most instances, the effort or initiative came about due to a lack of affordable options for rural or tribal residents.



Axiom

Over the past decade, Axiom has designed and constructed more than 120 access points connecting more than 2,500 square miles in rural Maine. Throughout Maine, gaps in high-speed internet coverage are hurting rural communities, affecting areas from real estate sales and tourism to in-and-out migration in rural areas across Maine, according to representatives of businesses and organizations.

The company is not dedicated to any particular network technology, but rather uses a combination of solutions, including fiber, wireless, DSL and TV White Space, depending on what is deemed best for the particular neighborhood or community. "Broadband solution kits, planning partnerships, and digital education customized for the needs of rural communities" are their core service according to their website. Axiom customizes products and solutions based upon factors including proximity to existing community requirements, population density, and terrain.

Delivery Model
Private

Network Technology
Hybrid

Digital El Paso

The Digital El Paso (DEP) community wireless network was deployed as a proof of concept to test wireless technology and explore the possibilities of using wireless networks to improve the delivery of state and local government services. An MOU was developed between City of El Paso, El Paso County, El Paso ISD, Housing Authority of the City of El Paso aimed at social inclusion. Goals include serving as a test bed to gather data points for business/funding model and to align key local initiatives, such as Mayor's Next Gen Lyceum, Creative Cities Leadership Project (Richard Florida), Downtown Revitalization, etc.

Successes to date (2018) include growing utilization rates, \$10K Intel seed funding, Cisco design and engineering support, donated domain registration, web portal done by El Paso County, publicity, (National, State, Local), community support, grassroots governance, open monthly meetings, and State & National Recognition & Awards. Over 30 nodes are managed by El Paso County provide wireless internet access to zip code 79901.

Delivery Model
Municipal

Network Technology
Wi-Fi, Mobile Wireless

Digital Tribal Village, Southern California

The Southern California Tribal Chairman's Association, representing 18 tribal nations in northern San Diego County California obtained a Hewlett-Packard digital village grant (\$5M) and created the Tribal Digital Village. Resource centers at each tribe were created. Fourteen of the 18 tribal centers are supported via a wireless network. The rest are connected by a fiber backbone. The Digital Tribal Village is able to offer high-speed Internet service for every household. In addition, 65 community buildings are connected.

The original goal was to establish at least one high-speed Internet connection for each of the tribes. Due to the mountainous terrain and sparse population density, line of sight antennas were placed on top of several mountains. To date, they have created over 350 miles of point-to-point and point-to-multi-point links supporting 86 tribal buildings, i.e.- tribal administration buildings, EPA departments, fire stations, law enforcement, utilities departments, and Libraries, Schools and Head Start programs.

Delivery Model

Tribal Consortium-Owned

Network Technology

Hybrid

Electric Power Board, Chattanooga

Delivery Model
Cooperative

Network Technology
Fiber Optics

In late 2009, the Electric Power Board (EPB), a cooperative in Chattanooga, Tennessee, began to modernize the city's electrical grid in hopes of limiting outages. The utility also wanted to install "smart meters" on individual residents' homes, which would require a communications link as well. EPB and the city realized that with fiber running through much of the city, it would be relatively trivial for EPB to become an internet service provider.

After being sued multiple times by big telecom, EPB pushed forward, and the Chattanooga city council allowed EPB to take out a \$169 million loan to begin building the network; no taxpayer funds were used. As the project was being built out, the city earned a \$111 million stimulus grant from the federal government. **In 2010, the city turned on the fiber network and officially became the first city in the United States to offer gigabit internet speeds to all of its residents. EPB was the top internet service provider in Consumer Reports' telecom ratings in 2015 and 2017.**

An independent study published by University of Tennessee noted that EPB's network could be directly tied to the creation of between 2,800 and 5,200 new jobs, and said the economic benefits for the city have been roughly \$1 billion over the course of the last five years.

Lafayette Utilities System

In the late 1990s, the Lafayette Utilities System (Lafayette's municipally owned utilities company) needed to upgrade its outdated microwave system for connecting their substations. LUS chose to upgrade with Fiber Optic technology. In 2002, after installing the system for their needs, they used the surplus fiber optic strands to provide wholesale service to hospitals, universities and the Lafayette Parish School System.

In 2004, the city announced its proposal for a municipal fiber network providing broadband internet, cable TV telephone services to the City of Lafayette. Seventy percent of residents, and 80 percent of businesses responded positively to a market survey conducted by LUS.

In 2007, Lafayette was finally able to start issuing bonds. Construction started in 2008 on the network, and the first customers were receiving service in February 2009. Broadband internet is provided to homes and businesses from 3 Mbps to 10,000 Mbps. It is notable for being the first municipally owned company providing Fiber-To-The-Home services in the state of Louisiana, and one of the first municipally owned FTTH companies in the country.

Delivery Model
Municipal

Network Technology
Fiber Optics

Lockhart ISD, Texas

LISD plans to obtain seven network towers to provide wireless internet to all LISD students and staff throughout Caldwell County. LISD will partner with Particle Communications for access to three existing towers in Dale, Luling, and Seawillow, which will begin to provide internet service within an eight-mile radius to LISD students and staff by the end of this April. In addition, the district will build four new towers at Strawn Elementary School, Fentress, Maxwell, and Uhland. In total, seven towers will provide internet coverage countywide by the end of this July.

The total cost for the seven tower setup fee, installation of routers in up to 500 homes, and internet service for the first year is \$447,500. The annual cost of internet service in subsequent years would total \$60,000 per year. For any homes beyond the initial 500, the cost to the district would be an additional \$22,250 for each additional 50 homes the first year. The annual cost of the internet for subsequent years would be \$6,000 for those additional 50 homes.

Delivery Model
Public-Private

Network Technology
Mobile Wireless

Mont Belvieu, Texas

Delivery Model
Municipal

Network Technology
Fiber Optics

Faced with complaints from residents and businesses, city officials decided to deploy fiber and bring fast, affordable, reliable gigabit connectivity directly to the community. With more than 10,000 miles of pipeline within their salt domes, the town's history is based in the oil and natural gas industry.

Mont Belvieu believed they were in their right to bring FTTH to members of the community as they would electricity or water. They also believed that their chosen funding mechanism was within the boundaries of Texas law. Rather than wait for potential lawsuits against them, they asked the District Court to address the questions proactively. In February 2017, the city of Mont Belvieu filed a petition in the District Court of Chambers County asking for an Expedited Declaratory Judgment to determine whether or not they would be able to legally issue COs to fund deployment of their planned broadband infrastructure. After considering Mont Belvieu's arguments, the court confirmed the city's position that they had the authority to offer broadband to the public. The city now offers "MB Link" for Internet access, but no voice or video services, in keeping with state restrictions.

Oneida County, Wisconsin

The Town of Three Lakes, in Oneida County, Wisconsin, is a case study in how to develop and demonstrate consumer demand and to use that information to connect consumers with the providers of broadband. "Building subscribership in communities is about far more than merely providing access to the technology. Engaging people throughout the community is critical to the long-term success of the effort."

In 2007, like many rural towns with a population of 2,500 or less, Three Lakes had a single provider offering 3.1 Mbps DSL service. Jumping to 2012, almost 90% of residents have access to as many as five providers with the top speed now 12.0 Mbps cable service. They followed a five-step process and methodology:

Delivery Model
Public-Private

Network Technology
Cable

Change
and
Commit

Assess
and
Decide

Collabo-
rate and
Contact

Impleme
nt and
Execute

Evaluate
and
Refine

People's Rural Telephone Cooperative, Kentucky

Delivery Model
Cooperative

Network Technology
Hybrid

It wasn't that long ago, relatively, that Jackson and Owsley counties had no phone service at all. The PRTC was formed in 1950 and used money available in the form of low-interest loans through the federal Rural Electrification Administration to construct a telephone network. **Customers were owners of the business, and profits went to pay off the loans.** In the 1990s, PRTC partnered with four other small Eastern Kentucky companies to form Appalachian Wireless. As part of the effort to build that cellular network, a 375-mile ring of fiber optic cable was installed.

The PRTC funded construction of its fiber optic network through a combination of timely grants from the Rural Utilities Service arm of the USDA, loans, stimulus money from the American Recovery and Investment Act of 2009 and the PRTC's own capital. Money to pay back the \$50 million project will come from user fees, as well as the successful Appalachian Wireless business. The service can deliver that 1 gigabit or 1,000 megabytes per second Internet speed to every home, business and school in the two counties.

Sho-Me Power Electric Cooperative, Missouri

Delivery Model
Cooperative

Network Technology
Fiber Optics

Sho-Me Power Electric Cooperative (SMP) is a generation and transmission cooperative that supplies power to nine electric distribution cooperatives serving 220,000 member-owners across 26 counties in south central Missouri. Sho-Me Power's entry into broadband in 1997 with its for-profit subsidiary Sho-Me Technologies demonstrated that a statewide, largely wholesale model for providing broadband services was not only viable but could leverage other providers' attempts to reach unserved and underserved areas.

SMP began considering a fiber-optic network as one of several options to replace its 2 gigahertz (GHz) microwave communication system in the mid-nineties. The cooperative considered several alternatives and concluded that fiber broadband would be a safer investment offering higher reliability over the long-term. Several of its sister G&Ts reached the same conclusion. The resulting decision led to deployment of a statewide, fiber-optic network that meets the growing communication needs of Missouri electric cooperatives and brings high-speed Internet access to commercial and institutional facilities (non-residential).

Tacoma Cooperative Network

Tacoma Cooperative Network (TCN), a nonprofit, is just one of many communities across the United States and even around the world choosing to view the internet as an essential utility and manage it as a community, rather than purchase internet through big telecom providers.

Using antenna and receivers and beaming data from house to house allows community organizers to avoid the expense and logistical challenges of laying cable. Instead, they purchase equipment that works out of the box to transmit data in a line-of-sight stream from an antenna to a receiver, originating at a "gateway" that is connected to fiber at the street level. Every member household joining the network helps to grow the "mesh," and cutting edge software (Althea) allows the signal to take the most efficient path to the gateway and reduces latency for a smooth, fast experience online. Privacy is paramount, and relays (users that transmit the signal to the gateway) cannot see data from other users.

Delivery Model
Community Wireless Network

Network Technology
Wireless, Mesh

UTOPIA Fiber, Utah

UTOPIA Fiber started as a group of 11 local cities that joined together in 2004 to bring fiber internet to residences and businesses in their areas. The group lays down fiber optic cables, then leases the infrastructure to local internet service providers so residents can choose from a variety.

On April 27, UTOPIA Fiber completed its infrastructure in the city of Morgan, giving the 4,500 citizens access to some of the fastest internet speeds in the nation. About a third of Morgan's households signed up for the service during the five-month period, leading to all bond payments of the \$2.5 million project already being paid off. UTOPIA expects north of 60% of the city will eventually be using fiber.

"As a governmental agency, we don't have shareholders, we're a steward of the residents of Utah," chief of marketing, Kim McKinley said. "So we go into whatever city comes to us, and we'll go talk to him and say can we make this work? We've done Woodland Hills, which only had 300 residents, and we built out that city."

Delivery Model
Public-Private

Network Technology
Fiber Optics

Maryland

Households in Western Maryland will benefit from nearly \$9.6 million in funding for broadband internet connectivity administered by the Office of Rural Broadband, which was established by Gov. Larry Hogan in 2017 to expand broadband capabilities statewide in rural areas of Maryland. "This rapid and unprecedented shift to teleworking and distance learning during the COVID-19 pandemic further demonstrates the importance of high-speed internet access for all Marylanders," said Hogan.

The projects receiving funding will provide internet access to more than 1,300 households and approximately 70 businesses in rural communities. The funding follows the Maryland Board of Public Works' prior approval of emergency broadband resources to expand access to school and library networks in rural communities. Local governments will partner with an internet service provider to extend existing networks to incorporate underserved or unserved households.



Challenges





The Challenges of Expanding Rural Access

- Building broadband networks is incredibly expensive and difficult.
- There aren't enough potential customers in rural areas to entice Internet Service Providers (ISPs) to invest in building those networks.
- Internet service mapping policies by government agencies are unclear and inaccurate.
- Laws and regulations make it difficult for independent and local efforts in network building to work.
- Available rural internet options are riddled with problems of reliability, price, and throttling.

Source: Blinq Networks



The Struggles of Large, Urban Municipal Wireless Networks

Cities such as Chicago, Los Angeles, and San Francisco all announced municipal networks during the middle of the last decade (2000s). City governments expected these networks to spur economic development and bridge the digital divide. However, many cities found that the implementation was rather difficult, if not outright impossible. Costs to set up the network, signal barriers, and political disagreements stymied efforts, especially for free access models.

Oklahoma City was a typical example. A pilot program was launched in 2006, but there were technical problem and not as many people subscribed to the network as expected. City officials abandoned the program, deciding that if it were to resurrect it they would focus on certain hotspots rather than the entire city... Philadelphia and San Jose (and New York) are planning for the second attempts after the failure of initial efforts to establish municipal wireless networks.

Source: *Social and Economic Effects of Community Wireless Networks and Infrastructures* (Abdelnasser Abdelaal, 2013)



Building a broadband network poses challenges at different stages of the project life cycle.



Highly manual design process, unable to deliver efficient design capability at scale.

Design often delays construction or sub-standard designs are pushed through to meet deadlines.

Field validation for design rarely includes consideration of all constructability issues.

Despite the level of detail contained in the design, construction scope is often defined poorly.

Scope definition to date has not been done geospatially and hence is not utilizing all the data that is available.

Current reliance on the capability and experience of the construction team to define scope clearly.

Source: *Digital Network Construction* (Render Networks, 2019)



Potential Funding Opportunities



Summary: Federal Potential Funding Opportunities

Agency or Group	Program	Type	Timeframe
FCC	E-Rate for Home Connectivity	Grant	TBD
FCC	Rural Digital Opportunity Fund	Auction	October
USDA	Distance Learning and Telemedicine Program	Grant	Applications due in July
USDA / RUS	Rural Connect Pilot Program ("ReConnect")	Loan, Grant	TBD
US Dept of Commerce	Public Works and Economic Adjustment Assistance Programs	Grant, Cooperative Agreement	Rolling applications
US Dept of Commerce	EDA CARES Act Recovery Assistance	Grant	Rolling applications

Summary: Texas Potential Funding Opportunities

Agency or Group	Program	Type	Timeframe
Texas Department of Agriculture	Community Development Block Grant (CDBG) Program for Rural Texas	Grant	Applications Feb 2021
Texas AG and New T-Mobile	Texas Attorney General's T-Mobile Settlement	Settlement	Within 6 years of Nov. 2019
Governor's Office, TEA Commissioner	Operation Connectivity Task Force	Bulk purchase agreements	Fall, 2020

Potential Funding Opportunities - Details

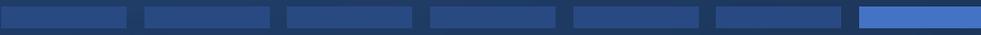
Agency or Group	Program	Description	Key Dates
FCC	E-Rate	If passed, the Emergency Educational Connections Act would direct the \$2-4 billion to the federal E-Rate program to insure that all K-12 students have access to "adequate" home broadband connectivity and devices during the COVID-19 pandemic.	TBD
	Rural Digital Opportunity Fund (RDOF)	Designed to bring fixed broadband to rural homes and small businesses. The Phase I auction will target over six million homes and businesses in census blocks that are entirely unserved by voice and broadband with speeds of at least 25 Mbps/3 Mbps.	Phase I auction is anticipated to begin on October 22, 2020
USDA	Distance Learning and Telemedicine Program	This program helps rural communities by funding connectivity to combat the effects of remoteness and low population density. The CARES Act appropriated \$25 million.	The CARES Act extended the application window to July 13, 2020.

Potential Funding Opportunities - Details (cont'd)

Agency or Group	Program	Description	Key Dates
USDA / RUS	Rural Connect Pilot Program ("ReConnect")	Offers federal financing and funding options in the form of loans, grants, and loan/grant combinations to facilitate broadband deployment in rural areas. The CARES Act appropriated an additional \$100 million.	Second round applications were due 3/31 – CARES Act supplements. New timeline TBD
U.S. Dept of Commerce, Economic Development Administration	Public Works and Economic Adjustment Assistance Programs	EDA solicits applications from applicants in rural and urban areas to provide investments that support construction, non-construction, technical assistance, and revolving loan fund projects under EDA's Public Works and EAA programs. (\$3M award ceiling)	Rolling application process
U.S. Dept of Commerce, Economic Development Administration	EDA CARES Act Recovery Assistance	Now accepting applications for CARES Act supplemental funds (EDA CARES Act Recovery Assistance) intended to help communities prevent, prepare for, and respond to coronavirus. \$1.5B to be distributed.	Funding made available on 5/7/20

Potential Funding Opportunities - Details (cont'd)

Agency or Group	Program	Description	Key Dates
Texas Dept of Agriculture	Community Development Block Grant (CDBG) Program for Rural Texas	This fund is available through a competition in each of the 24 state planning regions. (Max award \$275K – 800K)	Application deadline: February 2021
Texas AG and T-Mobile	Texas Attorney General's T-Mobile Settlement	The New T-Mobile must invest in and provide 5G wireless broadband coverage across most rural parts of the state – with at least 87% of the Texas Rural Population having access (94% total)	Within six years of closing, New T-Mobile will deploy a 5G network



Potential Scenarios for Ector County



The following are potential scenarios for Ector County to pursue, and the draft criteria by which to evaluate them for planning purposes. The results of this analysis will be published in our next report, *Home Connectivity Solution Analysis and Roadmap*.

They are presented here to facilitate discussion, seek expert feedback, and refine as necessary prior to being used in the solution analysis.

Draft Business Criteria for Evaluating Scenarios for Ector County



Connects Residents

Ability for any resident to access the service



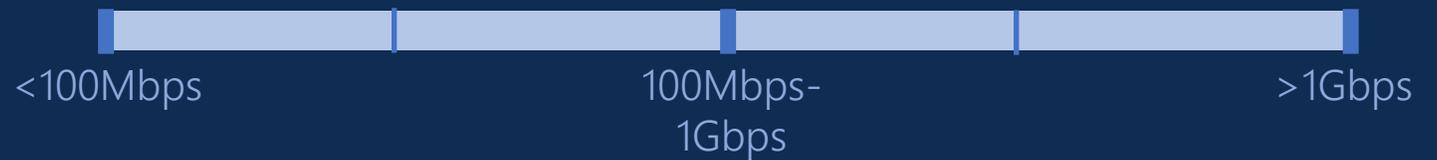
Longevity of Solution

The time in which substantial resources needed to upgrade



Performance (Speed)

The actual download speed for a customer of the service



Costs (opex, capex)

The amount of resources needed to build/run service



Draft Technology Criteria for Evaluating Scenarios for Ector County



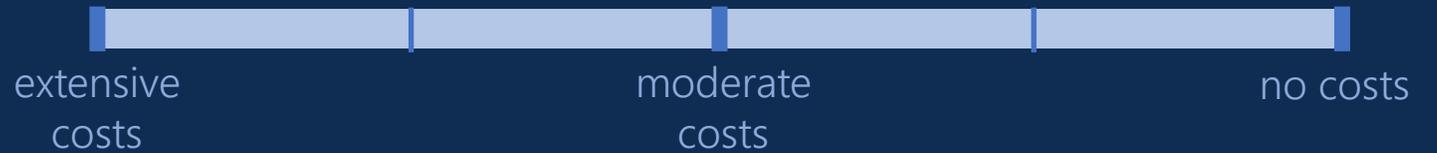
Security and Privacy

The ability of the network to protect user data



Scalability

The effort/costs to add new customers to the service area



Reliability

The anticipated frequency of outages given technology



Supportability

The ability to support network operations and maintenance



Scenarios are comprised of a combination of elements as outlined below.

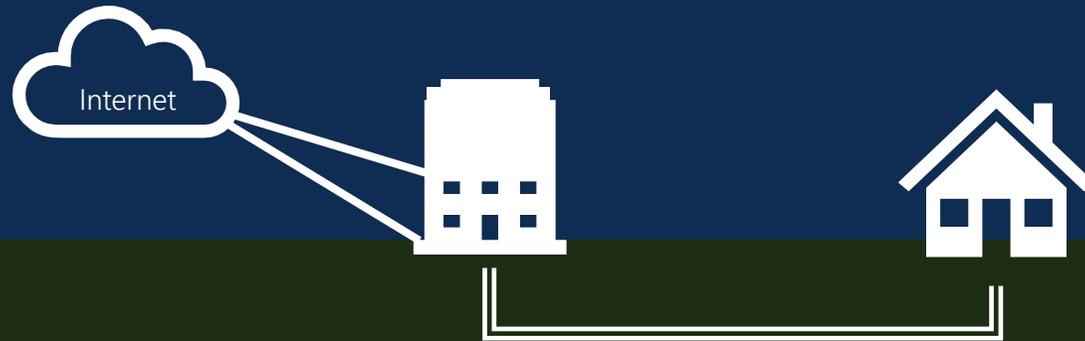
Delivery Model	Business Model	Network Technology	Partners
Private	Free	Cable, DSL	State/Local Agencies
Municipal, Tribal	Subscription	Fiber Optics	Business Community
Public-Private	Subscription with Subsidy	Fixed Wireless / Mesh	Local ISPs, Global ISPs
Community Wireless Network	Pay-Per-Use	Mobile Wireless	Engineering, Construction, Architecture Firms
Cooperative, Member-Owned		Satellite	Hardware Providers

& Hybrid

Scenario A

Cooperative Fiber-to-the-Home Service

Partner with an existing cooperative (e.g. electric) to build a for-profit, subscription, fiber service to all households in Ector County, with subsidies for low-income households



Delivery Model

Cooperative

Business Model

Subscription with Subsidy

Network Technology

Fiber Optics

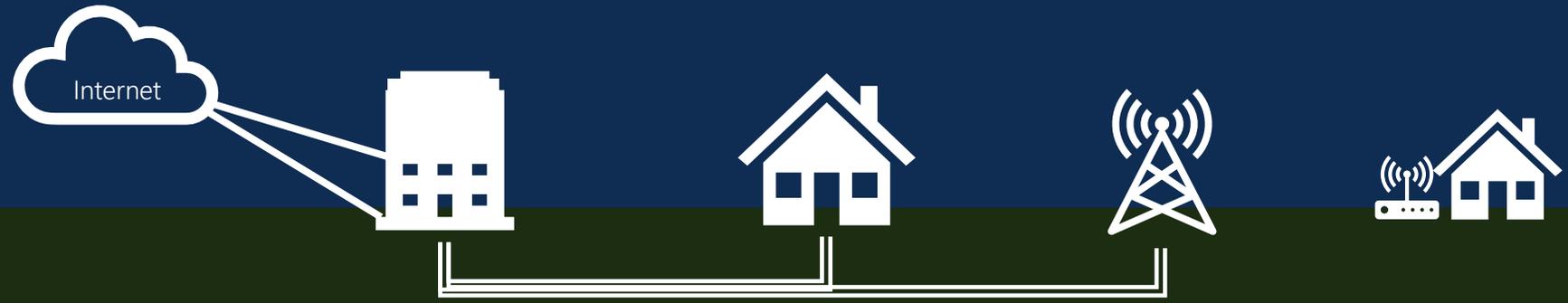
Partners

TBD

Scenario B

Private Hybrid Network

Work with an existing ISP to extend their fiber network as feasible to underserved areas, using fixed wireless as a last mile solution



Delivery Model	Business Model	Network Technology	Partners
Private	Subscription with Subsidy	Hybrid	TBD

Scenario C

Public-Private Hybrid Service

Build out existing City/ECISD fiber optics network to neighborhoods, and construct a wireless network to reach the most remote areas, under a new service/brand, "ConnEctor."



Delivery Model

Public-Private

Business Model

Subscription with Subsidy

Network Technology

Hybrid

Partners

TBD

Scenario D

Cooperative Hybrid

Partner with an existing cooperative (e.g. electric or telephone) to deploy a fiber-to-the-home network where possible, generating a wireless signal to the rest of homes



Delivery Model

Cooperative

Business Model

Subscription with Subsidy

Network Technology

Hybrid

Partners

TBD

Scenario 0

LEO Satellite/5G Scenario

Assume the gaps in access/availability of high-speed broadband are temporary. Wait for T-Mobile/5G and StarLink deployment to cover Ector County.



Delivery Model

Private

Business Model

Subscription with Subsidy

Network Technology

Mobile Wireless, Satellite

Partners

T-Mobile, StarLink

Recap of Draft Scenarios to be Refined, Evaluated in Next Phase

Scenario	Delivery Model	Business Model	Network Technology
A	Cooperative	Subscription with Subsidy	Fiber Optics
B	Private	Subscription with Subsidy	Hybrid
C	Public-Private	Subscription with Subsidy	Hybrid
D	Cooperative	Subscription with Subsidy	Hybrid
O	Private	Subscription with Subsidy	Mobile Wireless, Satellite

Appendix

The background of the slide is a dark blue gradient. In the lower half, there is a complex, glowing network of light blue lines and nodes, resembling a data visualization or a complex web structure. The nodes are small, bright blue dots, and the lines are thin, connecting them in a dense, interconnected pattern. The overall effect is a sense of digital connectivity and data flow.

More Americans than ever before have access to broadband internet services.

The number of Americans lacking a connection of at least 25 Mbps/3 Mbps (the Commission's current benchmark) dropped from 26.1 million Americans at the end of 2016 to 21.3 million Americans at the end of 2017, a decrease of more than 18%.

Moreover, the majority of those gaining access to such connections, approximately 4.3 million, are located in rural America.

Between 2013 and 2017, the percentage of Americans living in rural areas with coverage of LTE at 5 Mbps/1 Mbps increased from approximately 90% to approximately 99%. [\[including 100% in Ector County\]](#)

Source: Federal Communications Commission
2019 Federal Broadband Report

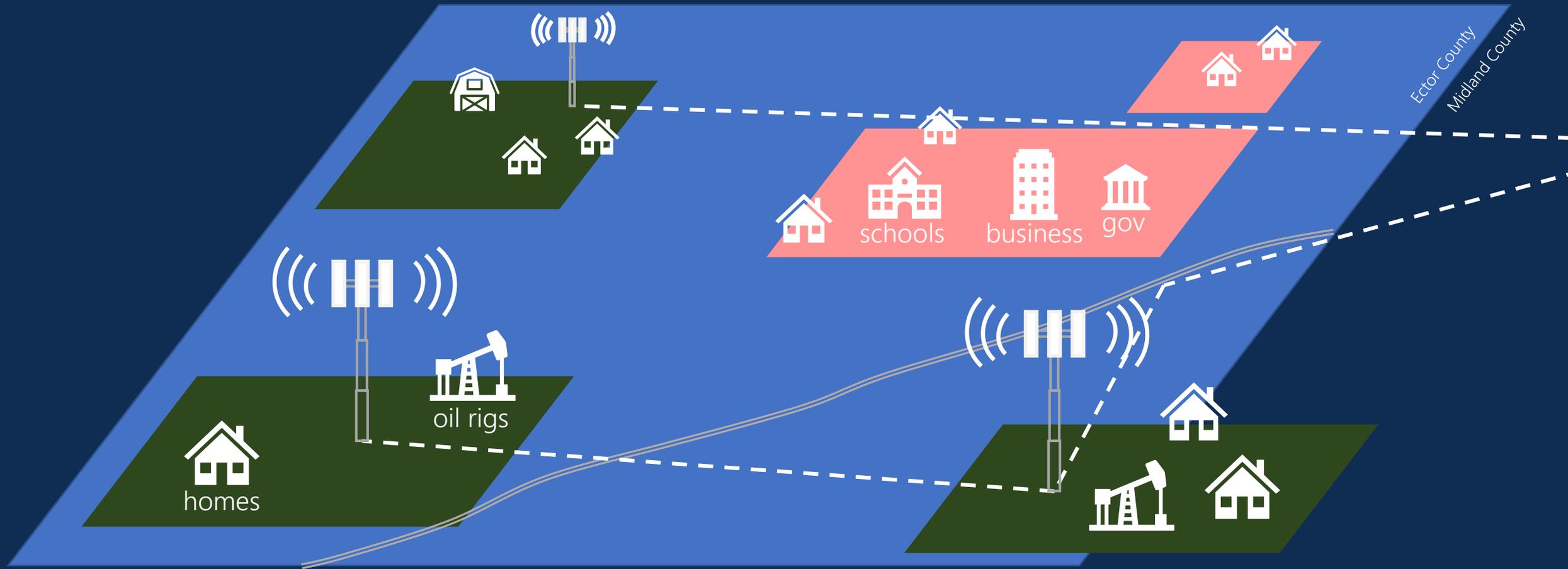
Over 20% of Americans in rural areas lack coverage from fixed terrestrial broadband.

The vast majority of Americans—surpassing 85%—now have access to fixed terrestrial broadband service at 250/25 Mbps, a 47% increase since 2017. Over the same period, the number of Americans living in rural areas with access to such service increased by 85%.

In 2019 alone, fiber broadband networks became available to roughly 6.5 million additional unique homes, the largest one-year increase ever, with smaller providers accounting for 25% of these new fiber connections.

22.3% of Americans in rural areas and 27.7% of Americans in Tribal lands lack coverage from fixed terrestrial 25/3 Mbps broadband, as compared to only 1.5% of Americans in urban areas. The data demonstrate, however, that the gap between urban and rural/Tribal areas has narrowed each year over the last five years.

Hybrid Technology/Service Concept



Some 15% of U.S. households with school-age children do not have a high-speed internet connection at home.

School-age children in lower-income households are especially likely to lack broadband access. Roughly one-third of households with children ages 6 to 17 and whose annual income falls below \$30,000 a year do not have a high-speed internet connection at home.

Pew Research Center analysis of 2015 U.S. Census Bureau data

NYC's *Internet Master Plan* is based on 5 principles.



Equity

No one will face a barrier based on who they are or where they live.



Performance

The internet should be fast and reliable, and the quality should improve over time as uses of the internet continue to evolve.



Affordability

Cost should not be a barrier for any New Yorker who wants to connect to the internet.



Privacy

New Yorkers must be able to determine how their data is or is not used.



Choice

There should be sufficient competition among providers and diversity of technological solutions to sustain the other principles.

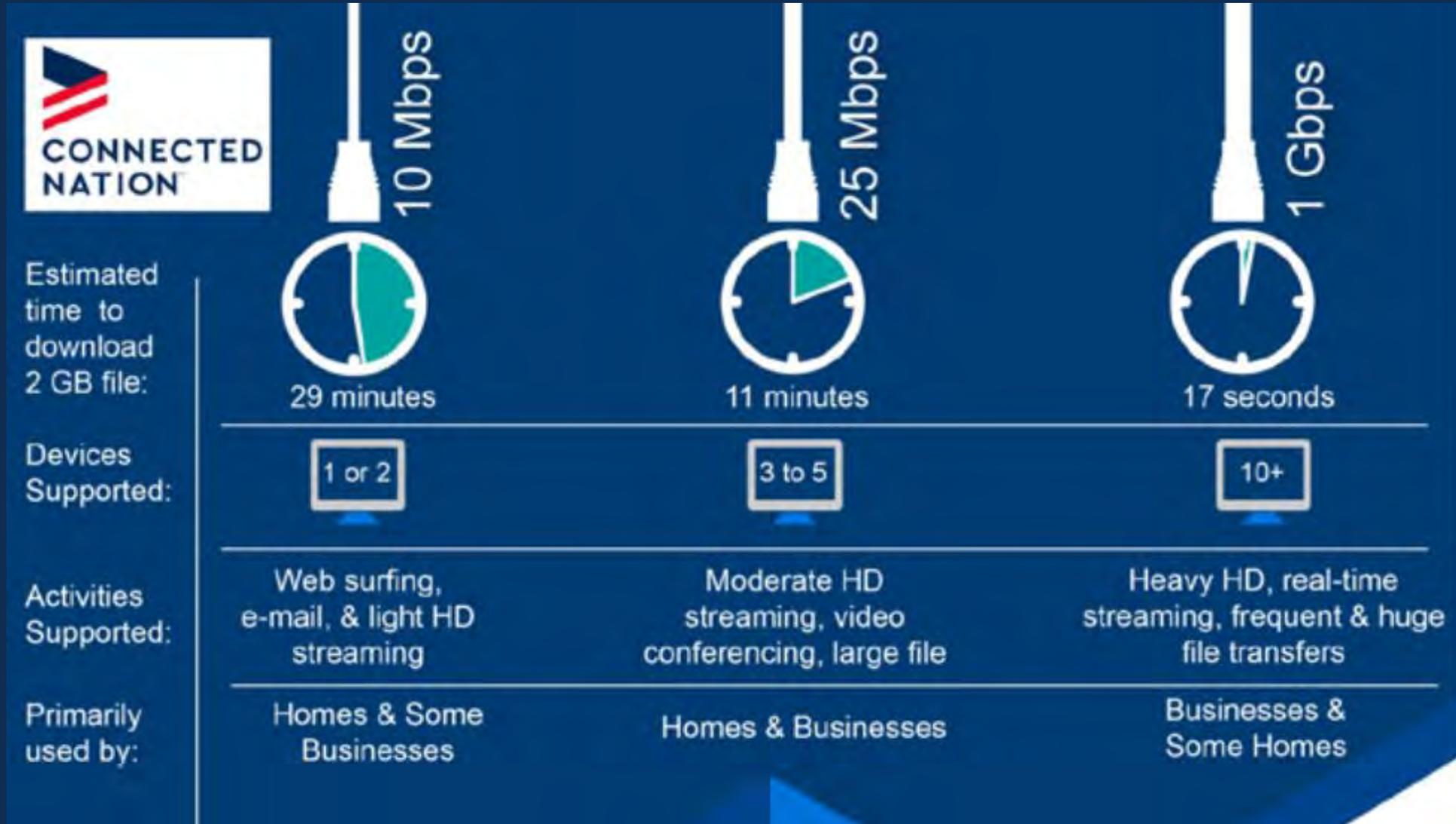
Groups Committed to Rural Broadband Access

Agency or Group	Program	Description
Connected Nation	Connected Nation Texas	Network mapping, validation, and analysis; Residential and business technology research; Local, state, and national policy analysis and capacity building; Community technology planning
Texas Rural Funders Collaborative	-	A group of funders convened to consider how working together we might bring additional attention and resources to areas of rural Texas, (private foundations, community foundations, and health-conversion foundations)
Microsoft TechSpark	Airband Initiative	The Microsoft Airband initiative partners with local organizations to develop cost-effective solutions to the unique needs of their communities.
Permian Strategic Partnership	-	The Permian Strategic Partnership (PSP) is a coalition of 20 leading Permian Basin energy companies who joined together to work in partnership with leaders across the region's communities.

Groups Committed to Rural Broadband Access

Agency or Group	Program	Description
Governor Greg Abbott, the Texas Education Agency (TEA), and Dallas Independent School District (DISD)	Operation Connectivity Taskforce	A statewide initiative to deliver internet connectivity and device solutions for school districts, families, and students in Texas. Operation Connectivity was originally started in Dallas to address the the lack of high-speed internet and/or home laptops for many DISD students which caused an interruption to their learning, as education in the classroom transitioned to at-home digital instruction due to COVID-19. This initiative now aims to provide internet connectivity to hundreds of thousands of students statewide.

Broadband Speeds Explained



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