FOUNDATION FOR RURAL SERVICE

Local Decision Makers Toolkit

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Glossary of Telecommunication and Broadband Terms

Rural America's Critical Connection: Broadband Whitepaper

Glossary

of Telecommunications and Broadband Terms

FOUNDATION FOR
RURAL SERVICE

About the **Foundation For Rural Service**

The Foundation for Rural Service (FRS) was established in 1994 as a non-profit 501(c)(3) by NTCA–The Rural Broadband Association. FRS is devoted to serving rural communities by creating opportunity through scholarships, grants, and innovative programs. We do so in partnership with NTCA – The Rural Broadband Association and the rural telecommunications providers that are vital to rural America, collaborating in ways that amplify our impact and elevate our shared sense of community. Our mission is important and personal. We're here to improve the quality of life in places that are often overlooked – the rural places we call home.

For more information about FRS, visit **www.frs.org** or call 703-351-2026.

FOUNDATION FOR
RURAL SERVICE

4121 Wilson Boulevard, Suite 1000
Arlington, VA 22203

(703) 351-2026
www.frs.org

Introduction

Over the decades, accessing the Internet has moved from a novel luxury to a true necessity for Americans. More and more, our daily lives and interactions with one another are happening "online." This access is made possible by networks that transmit data all around the world, which we refer to as broadband networks.

As these broadband networks have become more important than ever to commerce, productivity, education, health care, and a number of other social and economic interactions, there is an increased need to better understand the terms and concepts involved with broadband and telecommunications.

In publishing this glossary, our intent is to provide an overview of widely-used terms in the telecommunications industry. This is not a comprehensive list of all the highly technical terms used in the industry, but a quick reference guide to help those who hear of or read about particular terms or concepts and need further background.

Contents

Acronyms

ACAM	Alternative Connect America Cost Model
ADSL	Asymmetric Digital Subscriber Line
AK Plan	Alaska Plan
ARC	Access Recovery Charge
ARPU	Average Revenue per Unit
BIAS	Broadband Internet Access Service
BCM	Budget Control Mechanism
BDC	Broadband Data Collection
BDS	Business Data Services
CALEA	Communications Assistance for Law Enforcement Act
CAM or CACM	Connect America Cost Model
CATV	Cable Television
CAF	Connect America Fund
CAF II Auction	Connect America Fund Phase II Auction
CAF-BLS	Connect America Fund Broadband Loop Support
CAF-ICC	Connect American Fund Intercarrier Compensation
CBOL	Consumer Broadband Only Loop
CLEC	Competitive Local Exchange Carrier
CO	Central Office
COLR	Carrier of Last Resort
CLLI	Common Language Location Identifier
CMRS	Commercial Mobile Radio Service
COS	Class of Service
CPE	Customer Premise Equipment
CPNI	Customer Proprietary Network Information
CSRIC	Communications Security, Reliability, and Interoperability Council
DBS	Direct Broadcast Satellite
DDOS	Distributed Denial of Service

DODC	Digital Opportunity Data Collection
DOS	Denial of Service
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
DTV	Digital Television
DWDM	Dense Wavelength Division Multiplexing
EA	Economic Area
EAS	Emergency Alert System
EAS	Extended Area Service
ETC	Eligible Telecommunications Carrier
ETS	Ethernet Transport Service
EUCL	End User Common Line Charge
FCC	Federal Communications Commission
FDMA	Frequency Division Multiple Access
FNPRM	Further Notice of Proposed Rulemaking
FUSC	Federal Universal Service Charge
FTTC	Fiber to the Curb
FTTH	Fiber to the Home
FTTP	Fiber to the Premise
FTTx	Fiber to the “x”
GWAN	Global Wide Area Network
Gbps	Gigabit per Second
GPS	Global Positioning System
GHz	Gigahertz
GPON	Gigabit Passive Optical Networks
HCLS	High Cost Loop Support
HCP	High Cost Program
HDTV	High Definition Television
HFC	Hybrid Fiber Coaxial
HUBB	High Cost Universal Broadband Reporting Portal

ICANN	Internet Corporation for Assigned Names and Numbers
IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
ILEC	Incumbent Local Exchange Carrier
iVoIP	Interconnected Voice over Internet Protocol (VoIP)
IP	Internet Protocol
IPTV	Internet Protocol Television
ISP	Internet Service Provider
IVDS	Interactive Video Data Service
IXC	Interexchange Carrier
kbps	Kilobit per second
LAN	Local Area Network
LEC	Local Exchange Carrier
LEO	Low Earth Orbit Satellite
LCR	Least Cost Routing
LERG	Local Exchange Routing Guide
LMDS	Local Multipoint Distribution Services
LNP	Local Number Portability
LOS	Line of Sight
LTE	Long Term Evolution Wireless Technology
Mb	Megabits
MB	Megabytes
Mbps	Megabits per Second
MHz	Megahertz
MMDS	Multichannel Multipoint Distribution Service
mmW	Millimeter Wave Spectrum
MPLS	Multiprotocol Label Switching
MSA	Metropolitan Statistical Area
MSO	Multiple System Operator
MTA	Major Trading Area

MTSO	Mobile Telephone Switching Office
MVNO	Mobile Virtual Network Operator
MVPD	Multichannel Video Programming Distributor
NANP	North American Number Plan
NARUC	National Association of Regulatory Utility Commissioners
NECA	National Exchange Carrier Association
NIST	National Institute of Standards and Technology
NOI	Notice of Inquiry
NPA	Number Plan Area
NPRM	Notice of Proposed Rulemaking
NTIA	National Telecommunications and Information Administration
OTT	Over-the-Top
PBX	Private Branch Exchange
PEA	Partial Economic Area
PON	Passive Optical Network
POP	Point of Presence
POPs	Points of Presence
POTS	Plain Old Telephone Service
PSAP	Public Safety Answering Point
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RAN	Radio Access Network
RBOC	Regional Bell Operating Company
RDOF	Rural Digital Opportunity Fund
RF	Radio Frequency
RHC	Rural Health Care Program
RLEC	Rural Local Exchange Carrier
RoR	Rate of Return
RSA	Rural Service Area
RUS	Rural Utilities Service

SAC	Study Area Code
SDN	Software Defined Networking
SDSL	Symmetric Digital Subscriber Line
SHAKEN	Signature-based Handling of Asserted Information Using toKENs
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SLC	Subscriber Line Charge
SMS	Short Messaging Service
SONET	Synchronous Optical Network
SS7	Signaling System 7
STIR	Secure Telephone Identity Revisited
STIR/SHAKEN	Call Authentication Framework using STIR and SHAKEN Standards
TB	Terabyte
TCP	Transport Control Protocol
TDM	Time Division Multiplexing
TRS	Telecommunications Relay Service
USAC	Universal Service Administrative Company
USF	Universal Service Fund
UWB	Ultra Wideband
VoIP	Voice over Internet Protocol
VoLTE	Voice over LTE (Long Term Evolution wireless technology)
VPN	Virtual Private Network
WAN	Wide Area Network
Wi-Fi	Wireless Local Area Network
WISP	Wireless Internet Service Provider
WLAN	Wireless Local Area Network

Glossary of Telecommunications and Broadband Terms

4G

The fourth generation of mobile communications standards providing high-speed Internet and transmissions of text, voice, video, and multimedia (also see Long Term Evolution).

5G

The next generation standard that is promised to be much faster than 4G, although it will require the deployment of Small Cells and more robust Backhaul network facilities to accommodate the increased data demands and enable such higher speeds.

5G Fund

A Universal Service Fund Program mechanism that has not yet been created but is intended to support mobile 5G deployment in rural, high-cost areas lacking certain levels of service.

Access Charge

A fee charged by local exchange carriers (or LECs) for the use of local communications facilities by other service providers such as interexchange (or long distance) carriers.

Access Point

A hardware device or a computer's software that acts as a communication hub for users of a wireless device to connect to a wired local area network. Access points are important for providing heightened wireless security and for extending the physical range of service to which a wireless user has access.

Access Recovery Charge (ARC)

A charge created by FCC Order that allows incumbent local exchange carriers to recover from end user customers some of the revenues lost through FCC required reductions to Access Charges that would otherwise have been imposed on other carriers. The remaining revenues that cannot be recovered through ARCs are recovered through the Connect America Fund Intercarrier Compensation (CAF-ICC) Universal Service Fund mechanism.

Adware

Software that automatically downloads or displays advertising information while a program is running. Some types of adware are considered privacy invasive and are termed as Spyware.

Alaska Plan (AK Plan)

A Universal Service Fund High Cost Program mechanism that provides frozen support to electing eligible telecommunications carriers (ETCs) in Alaska over a ten year period. This program began in 2016 and continues through 2026.

Alternative Connect America Cost Model (ACAM)

A mechanism by which smaller rural local exchange carriers (or RLECs) may elect to receive support from the Universal Service Fund for delivering voice and broadband services in high-cost rural areas based upon a cost model in lieu of receiving support based upon the provider's actual costs of investment and operations. This model was offered to RLECs in multiple phases with different criteria in each phase, so some participated in ACAM I, Revised ACAM I, and ACAM II phases of funding.

Android

A Linux-based operating system for mobile devices such as smartphones and tablets. Originally created by the Open Handset Alliance, it is now one of the largest smartphone platforms in the world.

App or Application

A computer software program designed to help the user perform specific tasks. Although most commonly applied as software for smartphones, apps also are used on other wired and wireless broadband networks.

Asymmetric Digital Subscriber Line

An 'always on' technology designed to increase the bandwidth available over standard copper telephone wires. "Asymmetric" refers to the fact that the downstream speed is greater than the upstream. This technology works more effectively for one-way applications such as video on demand and graphics downloading, but is much less suitable for two-way applications, such as videoconferencing (also see Digital Subscriber Line). It is subject to speed limitations that are particularly affected by distance.

Average Revenue per Unit (ARPU)

The average revenue generated per customer unit per month. ARPU is an indicator of the financial performance of a company.

Backhaul

This term was originally used to describe the transmission of a telephone call or data beyond its normal destination point and then back again to utilize available personnel (operators, agents, etc.) or network equipment not available at the destination location. The term has evolved into a more generic reference to transmitting from a remote site or network to a central or main site. It implies a high-capacity line, for example, to backhaul from a wireless mesh network or Small Cell to the wired network means aggregating all the traffic on the wireless mesh over one or more high-speed lines to other aggregation points, a private network, or the Internet.

Bandwidth

The rate of data transfer, bit rate or throughput, typically measured in bits per second (bps).

Bit

Short for binary digit, a bit is the smallest unit of data in a computer and is used for storing information. A bit is a binary unit, which means it can have a value of a 1 or a 0. A byte is a capacity unit that contains eight bits. To distinguish between the two, a "b" represents "bit" and a "B" represents "byte." While a bit is generally used to measure the rate of data transfer (e.g., when discussing bandwidth and broadband speeds; kbps, Mbps, Gbps, etc.), bytes are often used to describe data capacity (e.g., the size of hard drives or the total amount of data traversing a broadband network) (also see byte, kilobit, megabit, gigabit and gigabyte).

Bluetooth

An open specification for seamless, wireless short-range communications of data and voice between mobile and stationary devices. For instance, it specifies how mobile phones, computers, and tablets interconnect with each other, with computers, and with office or home phones. The first generation of Bluetooth permits exchange of data up to a rate of 50 Mbps (for Bluetooth 5), even in areas with much electromagnetic disturbance. It transmits and receives via a short-range radio link using a globally available frequency band (2.4 GHz ISM band).

Broadband

A term used in evolving digital technologies in which multiple signals share the bandwidth of a medium, such as fiber-optic cable or higher-capacity spectrum. This allows the transmission of voice, data, and video signals over a single medium.

Broadband Data Collection (BDC)

Mapping initiative established by the Broadband DATA Act. Provides location-level data on broadband availability, including providers serving a location and the maximum speeds they offer to the location.

Broadband Deployment Accuracy and Technological Availability Act (Broadband DATA Act)

Signed into law on March 23, 2020, the Broadband DATA Act, among other things, requires the FCC to modify its mapping initiatives to provide location-level data on the availability of fixed and mobile broadband services and to ensure accuracy through processes to (1) verify service providers' coverage data; (2) allow consumers and other third parties to challenge service providers' coverage data; and (3) crowdsource information from third parties.

Broadband Internet Access Service (BIAS)

A mass-market retail service by wire or radio that provides the capability to transmit data to and receive data from all or substantially all Internet endpoints, including any capabilities that are incidental to and enable the operation of the communications service, but excluding dial-up Internet access service. This term also encompasses any service that the FCC finds to be providing a functional equivalent of the service described in the previous sentence. In effect, this is the FCC's regulatory definition for the offering of Broadband on a retail basis.

Budget Control Mechanism (BCM)

A mechanism adopted by the FCC and implemented by the Universal Service Administrative Co. to reduce CAF-BLS and HCLS support for carriers if necessary to fit within an annual budget specified by the FCC. The BCM applies a flat percentage reduction to all such support received by rural local exchange carriers where needed to meet the FCC's annual budget for that support.

Business Data Service (BDS)

Refers to the dedicated point-to-point transmission of data at certain guaranteed speeds and service levels using high-capacity connections.

Byte

Distinguished from bit. One byte is equal to eight bits. Bytes are often used to describe data capacity. For example, broadband speeds are typically described in bits, while the amount of data that traverses a broadband network is typically described in bytes.

Carrier

A provider of telecommunications services.

Carrier of Last Resort (COLR)

A telecommunications carrier that commits (or is required by state law) to provide service to any customer in a service area that requests it, even if serving that customer would not be economically viable at prevailing rates. A COLR may also be referred to as a Provider of Last Resort depending upon the operator's regulatory status and/or the scope of regulation by local or state law.

Cell Site

The central radio transmitter/receiver that maintains communications with a mobile telephone within a given range. A cellular network is made up of many cell sites, all connected back to the mobile telephone switching office via landline or microwave.

Cellular Technology

This term, typically used for all cellular phones regardless of the technology use, derives from cellular base stations that receive and transmit calls. Both cellular and personal communications service phones use cellular technology.

Central Office (CO)

A switching center where trunks and loops are terminated and switched for purposes of delivering traditional voice telephony services. The central office contains the associated inside plant network elements required to perform this function, such as distribution frames, interoffice facility termination points, etc.

Class of Service (COS)

A method of managing traffic on a network by grouping like traffic together and giving each type a different priority level. COS differs from quality of service in that it does not guarantee a certain level of service, but instead offers a "best effort" delivery. Retail broadband services (or BIAS) are typically provided on a "best effort" basis rather than with a committed level of service.

Cloud Computing (the cloud, cloud backup, cloud drive)

The use of computing resources such as hardware and software over a network (the Internet). A cloud drive is a storage or backup of resources using an online network.

Colocation

The placement of switches, routers, or other equipment by one provider within or on the premises or facilities of another provider to facilitate the offering of communications services or transmission of data. For example, it can refer to the placement of equipment by competitive local exchange carriers in an incumbent's central office for the provision of competitive telecommunications services, or it can refer to the placement of caching servers that hold the content of edge providers (such as Netflix or Google) at Internet service provider (ISP) facilities in order to allow Internet customers to retrieve data more quickly and lower transport costs for ISPs. Colocation also applies to locating antennas and other equipment of multiple wireless carriers on towers or other facilities to deploy service more efficiently and lower costs.

Commercial Leased Access

The manner through which independent video producers can access cable capacity for a fee.

Commercial Mobile Radio Service (CMRS)

Mobile wireless services made available to the public.

Common Carrier

A supplier of non-private telecommunications services. Under the common carrier principle, companies must offer service to the public without discrimination, within a territory approved by a governmental agency, and with the companies held strictly accountable to the public through government regulation.

Communications Assistance for Law Enforcement Act (CALEA)

A law enacted in October 1994 that defines the statutory obligation of telecommunications carriers to assist law enforcement in executing electronic surveillance.

Communications Security, Reliability, and Interoperability Council (CSRIC)

An advisory committee to the FCC providing recommendations on ways to promote the security, reliability, and resiliency of the nation's communications systems. CSRIC also provides recommendations on industry best practices to prevent and remediate cybersecurity attacks, alerts during natural disasters, and rapid restoration of communications during other disruptive events.

Competitive Local Exchange Carrier (CLEC)

A carrier that competes with other already established carriers (generally the incumbent local exchange carrier or ILEC).

Connect America Cost Model (CAM or CACM)

A model that identifies the costs of providing voice and broadband services in rural areas. The model has been used in the past for distribution of Universal Service Fund support to certain larger local exchange carriers under the Connect America Fund Phase II program, and it is still used to set the initial levels for bidding for Universal Service Support in the FCC's Connect America Fund and Rural Digital Opportunity Fund auctions.

CATV (Community Antenna Television, Community Access Television)

A system of distributing television programs to subscribers via radio frequency. It is more commonly referred to as cable television.

Connect America Fund (CAF)

The CAF refers to a series of reforms to high-cost Universal Service Fund programs undertaken by the FCC over the past decade. These reforms have applied to a number of different components of the high-cost Universal Service Fund, including CAF Phase II model support, CAF Phase II auction support, and CAF-Broadband Loop Support. At times, some may refer to the entire High Cost Universal Service Fund as the "Connect America Fund," but the high-cost program in fact contains other components beyond programs expressly labeled as CAF initiatives, including Alternative Connect America Model, the Rural Digital Opportunity Fund, the Mobility Fund, the 5G Fund, Alaska Plan, and High Cost Loop Support.

Connect America Fund Broadband Loop Support (CAF-BLS)

Previously known as Interstate Common Line Support (ICLS), CAF-BLS provides Universal Service support to smaller rural local exchange carriers (or RLECs) based upon their actual costs for deployment of broadband-capable networks and the ongoing delivery of voice and/or broadband services, including Consumer Broadband Only Loops, subject to certain caps and limitations.

Connect America Fund Intercarrier Compensation (CAF-ICC)

CAF-ICC is a Universal Service Fund mechanism that was adopted to provide incumbent local exchange carriers with recovery of FCC-mandated reductions in Access Charges that would otherwise have been imposed on other carriers and cannot be recovered through Access Recovery Charges on end user customers permitted by the FCC.

Connect America Fund Phase II Auction (CAF Phase II or CAF II)

An auction (also known as Auction 903) conducted by the FCC in 2018 to distribute Universal Service Fund support in high-cost rural areas where larger local exchange carriers had declined to receive CAF Phase II model support through the Connect America Model. Providers placed bids to deliver voice and broadband services in these areas, with winners determined based upon the amounts of support they were willing to receive to serve an area adjusted by a formula recognizing the speed and latency levels of broadband performance each bidder was willing to provide.

Common Language Location Identifier (CLLI)

An 11-digit alphanumeric code used to identify physical locations and equipment within telecommunications networks.

Consumer Broadband Only Loop (CBOL)

A network component used to deliver wireline broadband Internet access service to an end user customer where the customer does not also purchase regulated voice telephony service from the provider. Prior to the creation of CAF-BLS, such facilities were not supported through the Universal Service Fund in rural areas.

Covered Equipment and Services

In general, this term refers to communications equipment and services that are identified as posing an unacceptable risk to national security under the Secure and Trusted Communications Networks Act.

Covered List

This term refers to the list of Covered Equipment and Services published and maintained by the FCC Public Safety and Homeland Security Bureau.

Cramming

The addition of charges to a subscriber's bill for services that were neither ordered nor desired by the customer, or for fees for calls or services that were not properly disclosed to the customer.

Customer Premises Equipment (CPE)

The terminal, equipment and/or inside wiring located at a subscriber's premises, which are connected to a carrier's communication channel(s) at an interconnection point.

Customer Proprietary Network Information (CPNI)

Any information about customers that is obtained by a telecommunications carrier through the provision of the service that is personal such as call detail. CPNI requirements are found in Section 222(c) of the Communications Act and Part 64 of the FCC rules. Section 222(a) of the act is a more general requirement that all telecommunications carriers have a duty to protect the confidentiality of customers' "proprietary information" (PI). PI is much broader than CPNI in that it includes confidential information that is not network-generated such as "personally identifiable information" (PII)—information such as social security numbers which can be used on their own or with other information to identify an individual.

Dark Fiber

Fiber connection sold alone without any technology that sends information signals over the fiber strands (i.e., light). The customer can connect their own electronics to these strands of fiber.

Denial of Service (DOS) Attack

An attack on a computer system or network that causes a loss of service to users, typically the loss of network connectivity and services, by consuming the bandwidth of the victim's network or overloading the computational resources of the victim's system. A distributed DOS attack, or DDOS attack, is where the perpetrator attacks a network using more than one, and often thousands of IP addresses.

Dense Wavelength Division Multiplexing (DWDM)

Puts data from different sources together on an optical fiber, with each signal carried at the same time on its own separate light wavelength. Using DWDM, up to 80 separate wavelengths or channels of data can be multiplexed into a light stream transmitted on a single optical fiber. Each channel carries a time division multiplexed signal. In a system with each channel carrying 2.5 Gbps, up to 200 billion bits can be delivered per second by the optical fiber.

Detariffing

The removal of regulations requiring that a common carrier service be offered under a tariff approved by the regulatory agency. Detariffing affects direct price controls.

Digital Divide

A policy term referring to the difference in broadband access between areas in the U.S. that have access to high-speed broadband services and areas lacking such access.

Digital Opportunity Data Collection (DODC)

A broadband mapping initiative at the FCC, subsequently renamed the Broadband Data Collection which provides location-level data on broadband availability, including providers serving a location and the maximum speeds they offer to the location.

Digital Subscriber Line (DSL)

A technology for transmitting high-bandwidth information to and from homes and small businesses over copper telephone lines. xDSL refers to different variations of DSL, such as ADSL (asymmetric DSL), SDSL (symmetrical DSL), HDSL (high bit-rate DSL) and VDSL (very-high-bit-rate DSL).

Digital Subscriber Line Access Multiplexer

A network device, generally located within a company's central office, that receives signals from multiple customer DSL connections and puts the signals on a high-speed backbone line using multiplexing techniques.

Digital Television (DTV)

A technology for transmitting and receiving broadcast television signals. DTV provides clearer resolution and improved sound quality. Since June of 2009, full-power television stations nationwide have been broadcasting exclusively in a digital format.

Direct Broadcast Satellite (DBS)

TV programming or other content transmitted via high-powered satellite to a dish mounted outdoors whether on a residence or a business (e.g., DIRECTV and DISH Network).

DOCSIS (Data Over Cable Service Interface Specifications)

A set of communications and interface specifications for cable modems.

E-911

Short for enhanced 911, it enables mobile or cellular phones to process 911 emergency calls and enables emergency services to locate the geographic position of the caller.

Economic Area

A geographic area used by the FCC for issuing wireless licenses.

Eligible Telecommunications Carrier (ETC)

A voice (and usually broadband) service provider that is eligible to participate in the Universal Service Fund High Cost and Low Income programs. ETCs are designated either by a state commission or the FCC, and they are required to provide services to any requesting customer within their designated geographic area.

Emergency Alert System (EAS)

A national system in the U.S. put into place in 1994, superseding the Emergency Broadcast System. The system is jointly coordinated by the FCC, FEMA and the National Weather Service.

End User Common Line Charge (EUCL)

Also called the Subscriber Line Charge (SLC). A monthly access charge that telephone subscribers pay to compensate the local telephone company for a portion of its costs to install and maintain telephone wires, poles, and all other facilities.

End-User

Customers who directly use telecommunications or information services.

E-Rate

Also Called the Schools and Libraries Program. Funding from the Universal Service Fund that provides discounts for telecommunications, Internet access, and internal connections to eligible schools and libraries.

Ethernet

A frame-based, computer networking technology for local area networks. The name comes from the physical concept of ether. It defines wiring and signaling for the physical layer, and frame formats and protocols for the media access control/data link layer of operating such a network.

Ethernet Transport Service (ETS)

A private, dedicated point to point connection between two locations, including business locations or data centers, and/or local area networks.

Extended Area Service (EAS)

An extension of a service provider's local calling service area, allowing customers to call other parties within this area without incurring long-distance charges.

Federal Communications Commission (FCC)

The federal agency that regulates all interstate and foreign wire and radio communications services originating in the U.S., including radio, television, telegraph and telephone systems. The agency was established under the Communications Act of 1934.

Federal-State Joint Board

An advisory panel established by statute and composed of commissioners representing state and federal jurisdictions addressing various topics such as separations of costs between jurisdictions and shared responsibilities in furtherance of Universal Service.

Federal Universal Service Charge (FUSC)

The Federal Universal Service Charge recovers a carrier's or other provider's contribution to the federal Universal Service Fund programs as required by the FCC.

Fiber/Fiber Optics

Communications technology that uses thin filaments of glass or other transparent materials. Fiber-optic technology offers extremely high transmission speeds, allowing for data-intensive services such as video on demand.

Fiber to the "x"

A general term for any broadband network using optical fiber to replace the regular subscriber line. The term was generalized for several different configurations of fiber deployment, including fiber to the home (FTTH), fiber to the premises (FTTP), fiber to the curb (FTTC), etc.

FirstNet (First Responder Network Authority)

An independent authority that is charged with establishing a single nationwide, interoperable public safety broadband network. FirstNet was created by the Middle-Class Tax Relief and Job Creation Act of 2012.

Fixed Wireless

The operation of wireless devices or systems to provide high-speed data transmission to and from fixed locations such as homes and offices. Fixed wireless devices usually derive their electrical power from the utility mains, unlike mobile wireless or portable wireless that tend to be battery-powered. Although mobile and portable systems can be used in fixed locations, efficiency and bandwidth are compromised compared with fixed systems. Mobile or portable battery-powered wireless systems can serve as emergency backups for fixed systems in case of a power blackout or natural disaster.

Flat Rate

A type of service pricing charged on a monthly or other stated billing period that does not vary according to usage.

Form 477

A biannual report filed with the FCC by all providers of broadband and voice services detailing the availability and number of subscribers to these services.

Frequency Division Multiple Access (FDMA)

The division of the frequency band allocated for wireless communication into individual channels, each of which can carry a voice conversation or, with digital service, digital data. FDMA is a basic technology for analog AMPS, which divides the cellular spectrum into 832 channels each with 30 kHz bandwidth. With FDMA, each channel can be assigned to only one user at a time. D-AMPS also uses FDMA but adds TDMA to get three channels for each FDMA channel, tripling the number of calls that can be handled on a channel.

Further Notice of Proposed Rulemaking (FNPRM)

Issued by the FCC when it proposes additional rule changes after seeking comment on an initial proposal to change existing regulations. Before any changes to regulations can be made, interested parties are given a time period during which they can comment on the proposed changes.

Gigabit (Gb)

1 billion bits (also see bit).

Gigabit Passive Optical Networks (GPON)

Point-to-multipoint communications architecture in which unpowered fiber optic splitters are used to enable a single optical fiber to serve multiple customers without having to provision individual fibers between the hub and customer.

Gigabit per Second

A unit of data transfer equal to 1,000 megabits per second (see bit).

Gigabyte (GB)

A gigabyte is a unit of measurement for computer memory. One gigabyte is 1,073,741,824 bytes or 2^{30}. Gigabytes are a common storage measurement for computers and smartphones (also see byte). Gigabytes are also a common measurement for broadband usage, measuring the volume of data downloaded or uploaded by a device and/or customer. Some providers limit the amount of data customers can download and upload each month and will list these limits in terms of megabytes (MB), gigabytes (GB) or terabytes (TB).

Gigahertz (GHz)

A unit of frequency equal to one billion hertz or cycles per second.

Global Positioning System (GPS)

A satellite-based navigation system that allows people using small, hand-held receivers to pinpoint their geographic location within 10 to 100 meters. GPS consists of a "constellation" of 24 satellites that orbit the Earth at a height of 10,900 miles. The satellites use mathematical calculations to broadcast information that is translated by hand-held receivers as longitude, latitude and altitude. GPS is owned and operated by the U.S. Department of Defense but is available for general use around the world.

Global Wide Area Network (GWAN/backbone network)

A GWAN is a telecommunications network that covers a large area.

High-band Spectrum

Spectrum with wavelengths between 24GHz and 100GHz used for 5G wireless services because its high capacity allows it to transmit large amounts of data. Also called Millimeter Wave Spectrum.

High Cost Loop Support (HCLS)

A mechanism that provides support to certain rural Local Exchange Carriers based upon their actual costs of deploying networks and delivering services in very high cost rural areas, subject to certain caps and limits.

High Cost Program (or High Cost Fund)

A program under the Universal Service Fund aimed specifically at fulfilling the statutory mandate that certain communications services must be reasonably comparable in price and quality between rural and urban areas. Sub-parts of the High Cost Program include CAF Phase II model support, CAF Phase II auction support, and CAF-Broadband Loop Support, Alternative Connect America Model support, the Rural Digital Opportunity Fund, the Mobility Fund, the 5G Fund, the Alaska Plan, and High Cost Loop Support (HCLS), each of which has been designed to address distinct challenges in rural areas. At times, some may refer to the entire High Cost Program as the "Connect America Fund" despite the inclusion of numerous other initiatives within the program. The High Cost Programs do not themselves finance network construction, but they enable the availability of networks and the affordability of services by distributing funds over a series of years to supplement recovery of costs from end user rates.

High-Definition Television

A digital (as opposed to traditional analog) television broadcasting format that provides widescreen pictures with image resolution that is significantly higher than standard-definition television.

Hot Spot

(1) A portable device that provides an Internet access point for nearby mobile wireless devices or computers with WiFi capability. (2) A specific geographic location in which an access point provides public wireless broadband network services to mobile visitors through a wireless local area network. Geographic hot spots often are located in heavily populated places such as airports, train stations, libraries, convention centers and hotels. Hot spots typically have a short range of access.

HUBB

A portal used by participants in Universal Service Fund High Cost Program mechanisms to report progress towards meeting their broadband deployment obligations. These broadband providers submit location-level information on newly available broadband deployment.

Hybrid Fiber Coaxial

A broadband network, commonly used by cable companies, that combines optical fiber and coaxial cable. The technology is used in different portions of a network to carry broadband content such as video, data, and voice.

Incentive Auctions

A voluntary, market-based means of repurposing spectrum by encouraging licensees to voluntarily relinquish spectrum usage rights in exchange for a share of the proceeds from an auction of new licenses to use the repurposed spectrum.

Incumbent Local Exchange Carrier (ILEC)

A telephone company that was providing local service when the Telecommunications Act of 1996 was enacted. ILECs are in contradistinction to CLECs (although ILECs may have CLEC affiliates that have expanded into other ILECs' areas and compete with those other ILECs).

Institute of Electrical and Electronics Engineers (IEEE)

An international technical professional association composed of engineers, scientists, and students that fosters the development of standards that often become national and international standards. The institute is best known for developing standards for the computer and electronics industry. In particular, the IEEE 802 standards for local area networks are widely followed.

Interactive Video Data Service

A communications system operating over a short distance that allows nearly instantaneous, two-way responses by using hand-held devices at a fixed location. Examples include viewer participation in game shows, distance learning, and email on computer network.

Interconnected VoIP Service

An interconnected Voice over Internet Protocol (VoIP) service is a service that (1) enables real-time, two-way voice communications; (2) requires a broadband connection from the user's location; (3) requires Internet protocol compatible customer premises equipment (CPE); and (4) permits users generally to receive calls that originate on the public switched telephone network and to terminate calls to the public switched telephone network.

Interconnection

The physical linking of a network with equipment or facilities not belonging to that network. The term may refer to a connection between a network owner's facilities and the equipment belonging to its customer, or to a connection between two (or more) network operators.

Interexchange Carrier

A common carrier that interconnects with and uses services and facilities provided by LECs to provide services to the public between local exchanges on a long-distance basis in compliance with local or federal regulatory requirements.

Internet

A global wide area network (WAN), also described as a network of interconnected computer networks, linked by a wide spectrum of networking technologies including wireless and optical. This network includes numerous high-speed, high-bandwidth data networks that constitute the Internet "backbone." The "backbone" connects major Internet hubs that distribute data to web servers, regional and local ISPs, and other locations.

Internet Corporation for Assigned Names and Numbers (ICANN)

A global organization responsible for coordinating the maintenance and procedures of several databases related to the namespace of the Internet and ensuring the network's stable and secure operation.

Internet Engineering Task Force

A standards body that regulates the technical standards of the Internet.

Internet Protocol (IP)

The method by which data is transmitted from one computer (or host) to another over the Internet using a system of addresses and gateways.

Internet Protocol Television

A system where a digital television service is delivered to subscribing consumers using IP over a broadband connection. Often provided in conjunction with video on demand (VOD), the service also may include Internet services such as web access. In those cases, it may be called triple play and would typically be supplied by a broadband operator using the same infrastructure. A simpler definition would be television content received by the viewer through technologies used for the web.

Internet Service Provider (ISP)

A company that provides customers with access to the Internet, web hosting and/or other related services for a fee. Most ISPs today deliver their services via broadband Internet access service.

Interoperability

The ability of a network to coordinate and communicate with other networks, such as two systems based on different protocols or technologies.

Jitter

An undesired variation or delay in packet delivery often found in electronics and telecommunications.

Kilobit

1,000 bits (see bit).

Landline

Wired telephone service.

Last Mile

A phrase used by the telecommunications industry to refer to the technologies and processes used to connect the customer to the larger communications network.

Latency

A measure of time delay experienced in a network.

Least Cost Routing (LCR)

The process of selecting the path of communications traffic based on cost. Within a carrier's operations, an LCR team might periodically (monthly, weekly or even daily) choose between routes from several or even hundreds of operators for destinations across the world based upon prices offered by those operators. This function might also be automated by a device or software program.

Legacy Support

Certain federal high-cost support programs that predate the use of models or auctions to distribute Universal Service support and that instead reimburse actual costs incurred by providers to deliver universal service have been called Legacy Support despite such costs being incurred for the deployment of advanced networks and delivery of affordable voice and high-speed broadband services. Typically, for rural local exchange carriers, some use legacy support to refer to the Connect America Fund-Broadband Loop Support and High Cost Loop Support mechanisms.

Lifeline Service

A Universal Service Fund Low Income program that provides a monthly benefit on home or wireless phone and broadband service to eligible low-income households.

Line of Sight

Term used to describe an unobstructed path between the location of the signal transmitter and the location of the receiver in the context of wireless services and signals. Obstacles that can cause an obstruction in the line of sight include trees, buildings, mountains, hills, and other natural or manmade structures or objects.

Local Area Network (LAN)

A computer network limited to the immediate area, usually the same building or floor of a building.

Local Exchange Carrier (LEC)

A local wireline telephone company (compared to a long-distance carrier or mobile wireless provider).

Local Exchange Routing Guide (LERG)

A routing guide that lists the telephone carrier end offices (or central offices) and their association with Tandem switches. This guide is used to route telecommunications calls within the public switched telephone network (PSTN).

Local Loop

The physical connection, also called the subscriber line, from a telephone company's central office to a customer's telephone. This is an example of a last mile connection.

Local Number Portability (LNP)

Also called number portability. A term used to describe the ability of individuals, businesses, and organizations to maintain their existing telephone number(s) and the same quality service when switching to a new local service provider.

Long Term Evolution (LTE)

A standard for high-speed wireless for mobile phones and data terminals commonly used to refer to 4G wireless service capability.

Low Band Spectrum

Spectrum below 3G.hz often used for wireless networks because it has better propagation (it travels farther) than mid-band or millimenter wave spectrum.

Low Earth Orbit Satellites (LEOs)

Satellite communications technology that uses satellites in low earth orbit, allowing for lower latency and faster connection speeds than traditional satellite communications networks.

Major Trading Area (MTA)

An area consisting of two or more Basic Trading Areas as defined by Rand McNally & Co. These large areas are used by the FCC to determine service areas for some wireless licenses. The United States is divided into 51 MTAs.

Megabit

1 million bits (see bit).

Megabits per second (Mbps)

A measure of data transfer speed, particularly network transmissions (see bit).

Megabyte (MB)

1 million bytes (see byte).

Megahertz (MHz)

A unit of frequency equal to one million hertz or cycles per second.

Mesh

A type of Internet infrastructure that is decentralized, relatively inexpensive, and very reliable and resilient. Wireless mesh networking is mesh networking implemented over a wireless local area network. With this type of networking, each node must not only capture and disseminate its own data, but also serve as a relay for other nodes and collaborate to propagate the data in the network.

Metropolitan Statistical Area (MSA)

One of the 305 areas as determined by the federal Office of Management and Budget (OMB) and upon the basis of which the FCC defines urban cellular telephone service areas. When the FCC began issuing cellular radio licenses, it divided the United States into Rural Service Area and MSA markets.

Microwave

A form of wireless communication that uses frequencies between 300 MHz and 300 GHz to transmit radio waves.

Mid-Band Spectrum

Spectrum between 3-24GHz. The characteristics of these spectrum bands tend to have higher capacity than low-band spectrum and further propagation than millimeter wave spectrum.

Middle-Mile Networks

Network facilities that connect a local ISP access network with the rest of the Internet or web.

Millimeter Wave Spectrum (mmW)

Spectrum with wavelengths between 24GHz and 100GHz used for 5G wireless services because its high capacity allows it to transmit large amounts of data. Also called High-Band Spectrum.

Mobile Telephone Switching Office (MTSO)

The central computer that connects a wireless phone call to the public telephone network. The MTSO controls the entire system's operations, including monitoring calls, billing, and handoffs.

Mobile Virtual Network Operator (MVNO)

A mobile service operator that does not have its own licensed spectrum and does not have the infrastructure to provide mobile service to its customers. Instead, MVNOs lease wireless capacity from pre-existing mobile service providers and establish their own brand names different from the providers.

Multichannel Multipoint Distribution Service (MMDS)

A broadcasting and communications service that operates between 2.1-2.7 GHz. MMDS, also known as wireless cable, was originally conceived as a substitute for conventional cable TV.

Video Programming Distributor (MVPD)

A service provider that makes multiple channels of video programming available for purchase to subscribers or customers. Cable and IPTV providers are common forms of MVPDs.

Multiple System Operator (MSO)

A company that operates more than one cable TV system.

Multiprotocol Label Switching (MPLS)

A technology designed to accelerate network traffic and manage flow. Each packet is given a label that designates its network path. This helps to unclog networks because routers simply pass the packet on, instead of determining a route. MPLS is called multiprotocol because it works with multiple standards.

Municipal Wi-Fi

Wireless Internet provided by a municipal government entity or community.

National Association of Regulatory Utility Commissioners (NARUC)

An association of state and local utility commissioners that regulates intrastate utility services such as electric, power, gas, transportation and telecommunications.

National Exchange Carrier Association (NECA)

Established by the Federal Communications Commission, NECA prepares common tariffs and administers the revenue pool among its members for access provided to interexchange long-distance carriers. LECs can choose to participate in NECA's cost recovery mechanisms or to file their own tariffs for cost recovery for other carriers.

Net Neutrality

A principle applied to broadband networks that aims to ensure networks are free of certain restrictions on the kinds of equipment that may be attached to them or the kinds of devices that may be used to access them and to enable consumers' choice in terms of access to and use of content and applications over them.

Network

Any connection of two or more computers that enables them to communicate. Networks may include transmission devices, servers, cables, routers, and satellites.

NIST (National Institute of Standards and Technology)

A nonregulatory agency within the U.S. Department of Commerce that promotes and maintains measurement standards. NIST is also one of the nation's oldest physical science laboratories.

NIST Cybersecurity Framework

A resource published by NIST to assist critical infrastructure operators with managing and reducing cybersecurity risks.

North American Numbering Plan (NANP)

The telephone numbering system used in 25 distinct regions in 20 countries primarily in North America, including the United States and its territories, Canada, and the Caribbean. NANP format stipulates a 10-digit telephone number, comprised of a three-digit numbering plan area code (more commonly referred to as an area code), followed by a three-digit central office code, and ending with a four-digit line number.

Notice of Inquiry (NOI)

Issued by the FCC when it is seeking information or ideas on a given topic. Time periods are specified during which all interested parties should submit comments.

Notice of Proposed Rulemaking (NPRM)

Issued by the FCC when it proposes a new body of regulations or changes to existing regulations. Before any changes to regulations can be made, interested parties are given a time period during which they can comment on the proposed changes. If the FCC decides to make substantial alterations to the proposed rules, an additional comment period may be allotted (also see Further Notice of Proposed Rulemaking).

NPA-NXX

A six-digit numeric code that consists of the three-digit area code (NPA) and NXX central office code.

Numbering Plan Area (NPA)

A geographic area identified in the North American Numbering Plan by a unique, three-digit area code.

Number Portability

A term used to describe the ability of individuals, businesses, and organizations to maintain their existing telephone number(s) and the same quality service when switching to a new local service provider. Also, sometimes referred to as local number portability.

NXX Code

A code normally used as a central office code. It also may be used as an NPA code or special NPA code.

Open Radio Access Network (ORAN or Open RAN)

A radio access network (RAN) that uses open interfacing software and hardware specifications allowing interoperability between different vendor equipment within a single network. Traditional RANs use proprietary hardware and software elements requiring the network operator to purchase all elements from a single vendor. Open RAN specifications allow network elements to work together even if they are from different vendors.

Over-the-Top (OTT)

A general term for service utilizing a network that is not offered by that network operator such as over-the-top video or over-the-Internet video (e.g., Netflix). Often referred to as “over-the-top” because these services travel on top of and rely upon the broadband service to which a user subscribes.

Packet

In data communication, a sequence of binary digits, including data and control signals, which is transmitted and switched as a composite whole.

Packet Loss

When one or more packets of data travelling across a computer network fail to reach their destination. Packet loss is either caused by errors in data transmission, typically across wireless networks, or network congestion.

Packet-Switching

Technique whereby the information (voice or data) to be sent is broken up into packets of a few kilobits each (at most), which are then routed by the network between different destinations based on addressing data within each packet. The packets are typically split up and reordered during transmission, then reassembled upon reaching their destination. Use of network resources is optimized, as resources are needed only during the handling of each packet. This is an ideal model for ad hoc data communication, and works well for voice, video, and other streamed data.

Partial Economic Areas (PEA)

406 geographic areas used for wireless spectrum bidding areas and licensing. PEAs were created leading up the TV Whitespaces Incentive Auction (600Mhz) as a compromise between large and small stakeholders and have been used in the 600Mhz, 2.4GHz, C-Band (3.7GHz), and 3.45GHz spectrum bands.

Passive Optical Network (PON)

A system that brings optical fiber cabling and signals all or most of the way to the end-user. Depending on where the PON terminates, the system can be described as fiber to the curb (FTTC), fiber to the building (FTTB) or fiber to the home (FTTH).

Performance Measures Testing

Network performance testing required of Universal Service Fund High Cost Program participants to demonstrate delivery of broadband that meets the speed and latency of their broadband deployment obligations. Up to 50 locations that are reported to HUBB may be tested on a quarterly basis for two years to show that the deliverable speeds at the customer's location meet the standards established under the program (also called "Performance Testing" or "Network Performance Testing").

Plain Old Telephone Service (POTS)

The most basic form of residential and small business telephone connections still used in many parts of the world.

Point(s) of Presence (POP)

For "landline" communications, POPs define the physical interconnection points between the two networks. For wireless, POPs generally refer to the number of people in a specific area where wireless services are available (the population).

Price Cap

An alternative to rate-of-return regulation in which a ceiling price is set for telecommunications services. The regulated company is free to move rates to any point below the ceiling level without prior approval of the regulatory agency.

Private Branch Exchange (PBX)

A telephone switching system that interconnects in-house telephone extensions to each other, as well as to the outside telephone network. IP PBX is a PBX with Internet protocol connectivity and may provide additional audio, video, or instant messaging communication utilizing the Transmission Control /Internet Protocol (TCP/IP protocol) stack.

Propagation

Typically refers to how far a wireless signal can reach and how well that signal can move through interference (e.g., buildings, trees). Low-band spectrum tends to have the better propagation than mid-band or high-band spectrum.

Public Safety Answering Point (PSAP)

The dispatch office that receives 911 calls from the public. May be a local fire or police department, an ambulance service, or a regional office covering all services.

Public Switched Telephone Network (PSTN)

The system of interconnected networks that provide primarily voice telephony service.

Quality of Service (QoS)

The probability of the telecommunication network meeting a given traffic contract. Or in many cases, the term is used informally to refer to the probability of a packet succeeding in passing between two points in the network. In the field of telephony, telephony QoS refers to lack of noise and tones on the circuit, appropriate loudness levels, etc., and includes grade of service.

Radio Access Network (RAN)

Wireless network elements, including antennas and base stations that connect individual devices to the backhaul (often fiber) network and core network.

Radio Frequency (RF)

Any of the electromagnetic wave frequencies that lie in the range extending from around 3 kHz to 300 GHz, which include those frequencies used for communications or radar signals.

Ransomware

A type of malicious software (malware) designed to block access to a computer system until a sum of money is paid.

Rate of Return (RoR)

The percentage that a regulated telephone company, an interexchange carrier, or a public utility company is authorized to earn on its capital investment for services provided.

Regional Bell Operating Company (RBOC)

Any of the ILECs that were created at the AT&T/Bell telephone system breakup in the 1980s.

Retransmission Consent

A provision of the 1992 U.S. Cable Television and Competition Act requiring cable operators and other MVPDs to obtain permission from broadcasters before carrying their programming.

Reverse Auction

A type of auction in which the roles of buyer and seller are reversed. In an ordinary auction (also known as a forward auction), buyers compete to obtain a good or service by offering increasingly higher prices. In a reverse auction, the sellers compete to obtain business from the buyer, and prices will typically decrease as the sellers undercut each other. The FCC has used reverse auctions to distribute Connect America Fund Phase II and Rural Digital Opportunities Fund support to areas unserved with broadband service by the Price Cap Incumbent Local Exchange Carrier.

Roaming

Using a wireless phone outside of your service provider's local coverage area or home calling. Roaming arrangements between service providers expand the potential area for phone use. Service providers typically charge a higher per-minute fee for calls placed outside their home calling or coverage area. International roaming means that you can use networks other than your own when traveling abroad.

Robocalls

The use of auto dialers to call consumers often providing them with a recorded message. Robocalls have legal and legitimate uses (e.g., schools notifying parents of a snow day) and illegal and illegitimate uses (e.g., targeting vulnerable populations with scams and fraud).

Routers

Devices that connect autonomous networks of like architecture at the network layer (layer 3), based on IEEE 802 local area network standards.

Rural Call Completion

Problems affecting the transmission and completion of a long-distance call placed to consumers in rural areas. Issue results from originating providers utilizing "least cost routers" to terminate calls (see least cost routing).

Rural Digital Opportunity Fund (RDOF)

An auction (also known as Auction 904) conducted by the FCC in 2020 to distribute Universal Service Fund support in high-cost rural areas where larger local exchange carriers (or other providers) had not deployed broadband services at speeds of 25Mbps downstream and 3Mbps upstream, or faster. Providers placed bids to deliver voice and broadband services in these areas, with winners determined based upon the amounts of support they were willing to receive to serve an area adjusted by a formula recognizing the speed and latency levels of broadband performance each bidder was willing to provide.

Rural Health Care Program (RHC)

A Universal Service Fund program aimed at making telecommunications and broadband service affordable for rural health care clinics and other eligible health care providers. Rural Health Care USF contains two programs (1) Healthcare Connect Fund Program, which provides a 65% discount on eligible broadband connectivity, and (2) the Telecommunications Program, which provides reduced rates for telecommunications and voice services for telemedicine and telehealth.

Rural Local Exchange Carrier (RLEC)

A smaller company that historically served as the incumbent provider of local telephone service (ILEC) in rural areas that larger ILECs such as those in the Bell telephone system (subsequently known as Regional Bell Operating Companies or (RBOCs) had declined to serve. Today, all RLECs provide Internet access services, and many provide other kinds of services as well, such as video and mobile wireless.

Rural Service Area (RSA)

Areas not included in MSAs are divided into RSAs. Generally, these are the rural regions of the United States. The FCC used RSAs to license cellular carriers in areas not included in MSAs. There are 428 RSAs in the United States.

Rural Utilities Service (RUS)

A rural lending system within the U.S. Department of Agriculture made up of the Rural Electrification Administration and other similar programs.

Satellite

Device located in geostationary or low earth orbit above the earth that receives transmissions from separate points and retransmits them to cable systems, direct broadcast satellite (DBS) dishes, and others over a wide area.

Secured and Trusted Network Act of 2019

Laws that require the FCC to publish a list (Covered List) of communications equipment and services that are deemed to pose a risk to national security (Covered Equipment and Services) and prohibit the use of federal funding for the purchase, acquisition, maintenance, improvement, or modification of equipment and services on the Covered List. Certain small providers may be eligible to receive reimbursement for replacing covered equipment.

Session Initiation Protocol (SIP)

A standard protocol for initiating an interactive user session that involves multimedia elements such as video, voice, chat, gaming, and virtual reality.

Short Messaging Service (SMS)

Popularly known as text messaging. With SMS, subscribers can send short text messages (usually about 160 characters) to and from wireless handsets.

Signaling System 7 (SS7)

A specific network control system made up of protocols for the interpretation and use of an array of network control and operation signals. The system puts the information required to set up and manage telephone calls in a separate network, rather than within the same network that the telephone call is made.

Service Level Agreement (SLA)

A contract between a network service provider and a customer that specifies, usually in measurable terms, what performance specifications—quality, availability, responsibilities—the network service provider will guarantee.

Slamming

The unauthorized switching of a customer's long-distance phone service from one carrier to another without the customer's permission. Slamming violates FCC regulations.

Small Cell

Small radio antennas used for the central radio transmitter/receiver that maintains communications with a mobile telephone within a given range. Small cells are used for 5G deployment in densely populated areas for transmitting information over high capacity, low propagation spectrum.

Smart Grid

An electrical grid that uses information and communications technology to gather and act on information, such as the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity. Smart grid technology is being used to bring utility electricity delivery systems into the 21st century, using computer-based remote control and automation.

Smart Rural Community Program

A program created by NTCA–The Rural Broadband Association to recognize "best practice" models for broadband deployment and applications in rural America, as well as collaboration across various sectors.

Soft Switch

A central device in a telecommunications network that connects voice calls from one phone line to another, across a telecommunication network or the Internet, entirely via software running on a general-purpose computer system.

Software Defined Networking (SDN)

An umbrella term referring to various kinds of network technology focused on making the network more agile and flexible. SDN allows cloud and network engineers and administrators to respond quickly to changes via a central control console.

Special Access

An older term used for business data services. Business data services are dedicated point-to-point transmission of data at certain guaranteed speeds and service levels using high-capacity connections.

Spectrum

The range of electromagnetic radio frequencies used in the transmission of voice, data, and television.

Spectrum Allocation

Federal government designation of a range of frequencies for a category of uses.

Spectrum Cap

A limit to the allocated spectrum designated for a specific service.

Spoofing

The practice of causing the telephone network to display a number on the recipient's caller ID display that is not the actual originating station; the term is commonly used to describe situations in which the motivation is considered nefarious by the caller. Just as email spoofing can make it appear that a message came from any email address the sender chooses, caller ID spoofing can make a call appear to have come from any phone number the caller wishes.

Stand Alone Broadband

Broadband service without a voice component.

STIR/SHAKEN Framework

A process of authenticating traffic on networks as a means to ensure calls match their caller ID information provided over Internet Protocol. This framework was mandated as a way to help customers and service providers determine how likely it is that the call is legitimate in an effort to mitigate illegal robocalling and spoofing.

Study Area

The geographic area in which a service provider is designated as an eligible telecommunications carrier. Each study area is assigned a number, called a Study Area Code (SAC).

Study Area Code (SAC)

The number assigned by the Universal Service Administrative Company to an eligible telecommunications carrier's study area.

Subscriber Line

Also called Local Loop, a subscriber line is the physical connection from a telephone company's central office to a customer's telephone. This is an example of a last mile connection.

Subscriber Line Charge (SLC)

A monthly access charge that telephone subscribers pay to compensate the local telephone company for a portion of its costs to install and maintain telephone wires, poles, and all other facilities.

Symmetric Digital Subscriber Line

A version of DSL technology where the upload and download speeds are the same from the subscriber to the network.

Synchronous Optical Network (SONET)

An ultra-high-speed, fiber-optic transmission standard developed for large-scale, fiber-based digital transmission networks that use equipment from many different manufacturers.

Tandem Office

A switching office that connects end office switches with other Tandem Offices and other Class 5 end office switches. Tandem switches provide interconnection for voice traffic between carriers operating within the public switched telephone network (PSTN).

Telco

An abbreviated term referring to a telecommunications or telephone company.

Telecommunications

The transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received.

Telecommunications Act of 1996

Enacted and signed into law by President Bill Clinton on February 8, 1996, this act provided a comprehensive reform of the Communications Act of 1934. It was designed to promote competition between and among wireless and wireline carriers.

Telecommunications Carrier

Any provider of telecommunications services, except that such term does not include aggregators of telecommunications services. A telecommunications carrier shall be treated as a common carrier by law only to the extent that it is engaged in providing telecommunications services.

Telecommunications Relay Service (TRS)

TRS provides access to communications services for persons with hearing or speech disabilities. TRS can include text to voice, speech to speech relay, captioned telephone service, Internet protocol relay services, video relay services, etc. TRS is funded through fees on telephone customer bills.

Telecommunications Service

The offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available directly to the public, regardless of the facilities used.

Telemedicine (also Telehealth or e-health)

A method of using communications technology to bring health care patients and professionals together regardless of geographic location to provide consultations and ongoing care. Telemedicine applications include videoconferencing, remote health monitoring, email, and general web use for medical-related issues.

Telephony

A term used to describe the science of transmitting voice over a telecommunications network.

Terabyte (TB)

A terabyte is a common unit of measurement for broadband data usage, measuring the volume of data downloaded or uploaded by a device and/or customer. One terabyte is 1,024 gigabytes or 2^{40} bytes. Some providers limit the amount of data customers can download and upload each month and will list these limits in terms of megabytes (MB), gigabytes (GB), or terabytes (TB).

Time Division Multiplexing (TDM)

Transmits data by breaking the signal down into multiple segments, which are transmitted separately over a single signal. Data is then reconstructed at the receiving end using a method based on the timing of the transmissions.

Traffic-Sensitive Costs

Voice telecommunications costs that vary according to usage.

Transport Control Protocol

A widely used network protocol that supports communication across interconnected networks and between computers with diverse hardware architectures and various operating systems.

Trunking

A method for a system to provide network access to many clients by sharing a set of lines or frequencies instead of providing them individually.

Ultra Wideband (UWB)

Also known as digital pulse wireless, a wireless technology for transmitting large amounts of digital data over a wide spectrum of frequency bands with very low power for a short distance. UWB radio not only can carry a huge amount of data over a distance up to 230 feet at very low power (less than 0.5 milliwatts), but has the ability to carry signals through doors and other obstacles that tend to reflect signals at more limited bandwidths and at a higher power. Both UWB and Bluetooth are considered personal area network technologies.

Universal Service

The government's aim, as stated in the Communications Act of 1934, of providing phone service to everyone, regardless of their location or ability to pay. Expanded under the Telecommunications Act of 1996, universal service also encompasses a subsidy to public schools, libraries, and rural health care facilities for telecom services. Over the past decade, the concept of universal service has been updated to promote the availability and the affordability of broadband services as well as traditional telecom services.

Universal Service Administrative Company (USAC)

An independent not-for-profit company designated by the FCC to implement its Universal Service Fund programs.

Universal Service Fund (USF)

A series of mechanisms created pursuant to the Telecommunications Act of 1996 to promote Universal Service – that is, the availability and affordability of certain communications services, including both traditional telecommunications services and, in more recent years, broadband services. The Universal Service Fund is made up of four programs: High Cost (often called Connect America Fund), Low Income (also called Lifeline), Schools and Libraries (also called E-Rate), and Rural Healthcare.

Voice over Internet Protocol (VoIP)

The technology used to transmit voice conversations over a data network using IP. This is done by digitizing voice into discrete packets that are transferred independently over the network, instead of traditional circuit-committed protocols of the public switched telephone network (PSTN).

Voice over LTE

The standards and procedures for delivering voice communication and data over LTE networks.

VPN (Virtual Private Network)

An extension of a private network across a public network, such as the Internet, using encryption to protect data—making the network "virtually" private. The VPN allows users to send and receive information across a shared or public network as if their devices were directly connected to a private network, increasing security and functionality of the private network.

White Space

Broadcasting services, which are assigned different frequencies for specific uses and the license to broadcast over these frequencies, are also assigned white spaces between frequencies to avoid technical interferences. White Space refers to the unused broadcasting frequencies in the wireless spectrum.

Wide Area Network (WAN)

An Internet or network that covers an area larger than a single building or campus.

Wi-Fi (Wireless Fidelity)

A term promulgated by the Wi-Fi Alliance that is meant to be used generically when referring to any type of 802.11 network. There are many variations of Wi-Fi using various spectrum bands. Originally, Wi-Fi devices operated in both the 2.4 GHz (802.11b and 802.11g) and 5 GHz bands (802.11a), but as access to other unlicensed spectrum bands grew, such as access to White Space spectrum, additional variations of Wi-Fi became available (such as 802.11ac, 802.11ad, 802.11af, 802.11ah, and 802.11ax). Wi-Fi is the most common method of connecting multiple Internet-capable devices to a local area network.

Wireless Internet Service Provider

An Internet service provider (ISP) that allows users to connect to a server through a wireless connection such as Wi-Fi.

Wireless Local Access Network (WLAN)

One in which a mobile user can connect to a local area network through a wireless connection. IEEE 802.11 is a popular standard for wireless local access networks.

Wireless Local Loop

A system that connects subscribers to the public switched telephone network (PSTN) using radio signals as a substitute for copper for all or part of the connection between the subscriber and the switch. This includes cordless access systems, proprietary fixed radio access, and fixed cellular systems. Sometimes called radio in the loop (RITL) or fixed-radio access (FRA).

X, Y, Z

No X, Y, or Z words

Website Addresses
for Referenced Organizations

ACE (Association of Communication Engineers)
www.ace-engineers.org

FCC (Federal Communications Commission)
www.fcc.gov

FirstNet (First Responder Network Authority
www.firstnet.gov

FRS (Foundation for Rural Service)
www.frs.org

IANA (Internet Assigned Numbers Authority)
www.iana.org

ICANN (Internet Corporation for Assigned Names and Numbers)
www.icann.org

IEEE (Institute of Electrical and Electronics Engineers)
www.ieee.org

IETF (Internet Engineering Task Force)
www.ietf.org

NARUC (National Association of Regulatory Utility Commissioners)
www.naruc.org

NECA (National Exchange Carrier Association)
www.neca.org

NIST (National Institute of Standards and Technology)
www.NIST.gov

NREDA (National Rural Economic Developers Association)
www.nreda.org

NRTC (National Rural Telecommunications Cooperative)
www.nrtc.coop

NTCA (NTCA–The Rural Broadband Association)
www.ntca.org

NTIA (National Telecommunications and Information Administration)
www.ntia.doc.gov

RTFC (Rural Telephone Finance Cooperative)
www.rtfc.coop

RUS (Rural Utilities Service)
www.usda.gov/rus

USAC (Universal Service Administrative Company)
www.usac.org

USDA (U.S. Department of Agriculture)
www.usda.gov

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About RTFC

This project was generously supported by RTFC. RTFC is a privately funded, member-owned cooperative finance organization that provides financing exclusively to America's rural telecommunications industry. RTFC offers loans and financial services to creditworthy telecommunications systems eligible to borrow from RUS, as well as affiliates of these systems.

For more information, visit **www.rtfc.coop**.

About JSI

This project was developed in conjunction with JSI, a consulting firm that provides financial, engineering, management, regulatory, strategic planning, training, and operational support services to ILECs, CLECs, broadband providers, and other telecom companies. Established in 1962, JSI assists clients with forecasting, broadband build-out projects, network management, competitive pricing/bundling, operational reform, strategic partnerships, mergers/acquisitions and more.

For more information, visit **www.jsitel.com**.

About TCA

TCA is a full-service business consulting firm that is dedicated to supporting rural telecommunications and broadband companies across the United States as they provide cutting-edge communications services to the people and businesses in rural America. Through financial, regulatory, marketing, mergers and acquisitions, network services, and grant assistance, TCA has served as an promoter and innovator within the rural telecommunications industry since 1982.

For more information, visit **www.tcatel.com**.

FRS enriches lives by harnessing the collective power of the rural communications industry. We work in cooperation with NTCA–The Rural Broadband Association and partner with telecommunications companies to create opportunities through education, scholarships, grants, and innovative programs.

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4121 Wilson Boulevard, Suite 1000
Arlington, VA 22203

(703) 351-2026
www.frs.org

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BROADBAND TODAY:

Rural America's Critical Connection

Adapting to a World Where Connectivity is Key

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BROADBAND TODAY

As a Pandemic Changes Society, Broadband is Rural America's Critical Connection

2020: THE START OF A NEW ERA

The pandemic has changed the way we live, work and interact.

Dependence on Broadband

Broadband is now central to working from home, remote learning, telehealth, shopping, accessing government services, social connections and more.

Greater Data Usage

Average broadband network usage soared by

40%

from Q4 2019 to Q4 2020.

Performance

Rural America's broadband networks have performed well, thanks in part to infrastructure investments by rural broadband providers and an increase in fiber-to-the-home penetration.

Full Focus

Stakeholders are focused on all aspects of solving the rural broadband challenge: Access, Affordability and Adoption

The Future of Broadband

Network investment continues from and is supported by:

- Broadband providers
- Partnerships
- States
- FCC
- Federal government

FOUNDATION FOR RURAL SERVICE

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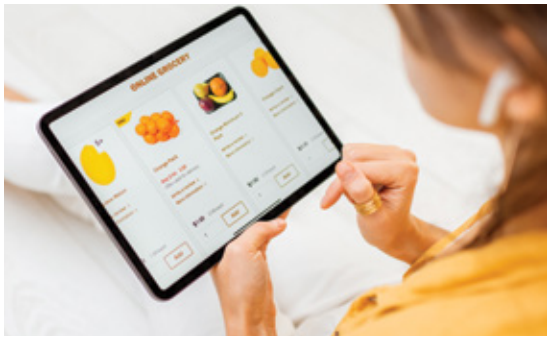

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01 Broadband: **The Common Thread**

This report is being published during a particularly tumultuous time in America's history. The excitement, hope and optimism that naturally accompany the start of a new decade met with a series of challenges as 2020 unfolded: natural disasters, a deadly pandemic, social unrest, economic hardship and political uncertainty. This publication does not seek to address the many implications of these issues. Rather, the intent of this report is to examine the technology that runs like a thread throughout every effort to overcome the challenges the nation has faced in the decade's opening chapter — broadband.

From a technology standpoint, broadband is a means of interconnecting computers and devices across the global network in a fast, reliable manner that is always on, always ready to download and upload content. On the human level, however, broadband is less about how it works and more about what it supports.

Broadband empowers people to share their voice, advocate for change and inspire others.

Broadband equips people to buy and sell, learn new skills, and work their jobs.

Broadband enables people to stay in touch with family, find communities of shared interests and explore their passions.

BROADBAND IS ABOUT:

Connecting families to one another.

Connecting citizens to their governments and communities.

Connecting people to their hobbies and interests.

Connecting employees to their work.

Connecting patients to their health care.

Connecting students to their education.

While these capabilities are certainly important across all sectors, they are especially critical in the broader conversation about quality of life in rural America. Challenges associated with health care, education, poverty, access to services, economic opportunities and more are often exacerbated in rural settings due to factors such as geography (low population density, difficult terrain for building infrastructure, distance from medical facilities and other critical services, etc.) and demographics (technology adoption rates, education levels, general population health, etc.). Broadband can be an equalizing force, helping rural communities and their citizens address, if not overcome, such disparities.

In this report, we provide a basic overview of broadband and then dive into the service as it relates to several important areas. Specifically, we look at: 1) remote learning, 2) working from home, 3) telehealth, 4) business and consumers, and 5) social connections, and explore how the pandemic has impacted each sector. We also look at the impact the pandemic has had on broadband networks and the companies that are building service into rural America. Finally, we look at issues such as the technologies used to provide broadband and policy reforms that could impact the future of broadband deployment.

The Pandemic as a Turning Point

It is important to note that the pandemic has acted less as a change agent and more as an accelerant. In his latest book, "Post Corona: From Crisis to Opportunity," professor and author Scott Galloway writes, "While it will initiate some changes and alter the direction of some trends, the pandemic's primary effect has been to accelerate dynamics already present in society." This is certainly true of broadband's role in the above-mentioned areas, especially as they relate to rural America.

Broadband use has increased in rural areas for a decade, thanks in no small part to the many cooperative and independent providers that connect millions of rural residents and a variety of federal and state programs that have supported such efforts. As outlined in this report, in 2020 the pandemic revealed the critical nature of broadband when response efforts sent millions of students and employees home to continue their education and work. With videoconferences and file sharing multiplying exponentially, demand for bandwidth soared. Broadband became more critical than at any time since its introduction, establishing not only that broadband is an important part of rural living, but also that much work remains to be done to bring broadband access within reach of every rural American.

A Different Kind of Disaster

Among the many events marking 2020 was a particularly active hurricane season. The Gulf states were visited again and again by tropical storms and hurricanes that brought flooding and strong winds — often many miles inland — that claimed lives, destroyed property and damaged critical infrastructure. Each time communications networks and electric distribution systems were laid to the ground, crews from several states drove into the damaged areas to put these systems back together. This is how a community returns to a sense of normalcy; only when basic services are restored can people begin to feel normal again. That is how natural disaster relief works — we respond, we rebuild, and we recover.

The pandemic was a very different kind of disaster. There was no one location or area affected, and there was no putting things back just like they were. Prior disaster mitigation efforts paled in the face of a threat that touched every facet of society. It was not a case of fixing what was broken and going back to normal. The pandemic would change the way we live, work and interact. It would restructure how we function, as families, as institutions, as a society. And broadband is at the core of many of these changes.

FRS: The Mission

The decision to publish this white paper is in keeping with the overall work of the Foundation for Rural Service, the philanthropic arm of NTCA–The Rural Broadband Association. The FRS mission is to sustain and enhance the quality of life in America by advancing an understanding of rural issues. We believe that the future of our rural communities is intrinsically linked to the future of our nation as a whole. FRS invests in rural students through scholarships and youth programs, enhances our communities through grants and advances an understanding of rural issues through educational materials and programming.

By publishing this report, FRS hopes to:

- Provide the public and other interested parties with information to help them better understand the importance of broadband to life in rural America, the pandemic's impact on broadband service and the state of rural broadband in the months and years ahead.
- Equip community leaders with tools to understand broadband's role in improving the quality of life in their cities, towns and counties.
- Document the pandemic's impact on various sectors of society.
- Encourage a broader national conversation on the importance of broadband to rural citizens in light of the COVID-19 pandemic and its fallout.

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4121 Wilson Boulevard • Suite 1000
Arlington, VA 22203
703-351-2026 • www.frs.org

Produced by: WordSouth — A Content Marketing Company
Lead Author, Stephen V. Smith, VP of Broadband Strategies

02 The Case **For Broadband**

Broadband in Rural America

The United States is a nation of many demographics, ideals and a geography that together weave a rich cultural fabric. As diverse as its inhabitants may be, and as great as our challenges may seem, our shared stories of yesterday and shared dreams of tomorrow unite us in a common identity.

That said, rural America faces unique hurdles and challenges. The geographic realities of living in a less populous region and spread over great distances require of its residents a degree of ingenuity, work ethic, cooperation and innovation that mark every facet of life.

Nowhere is this more evident than in the matter of connectivity. Rural America feeds our nation[1] and many others, yet millions of rural residents remain without access to sufficient broadband. Our military is disproportionately staffed with rural residents[2], yet one in four rural Americans cannot reliably participate in a videoconference from their home. Rural broadband supports billions of dollars in e-commerce and economic activity[3], yet hundreds of square miles across small towns and countrysides have no fiber lines crossing the landscape.

But that story continues to change. Providers of all kinds - mostly based in these same rural areas - are answering the call and doing the job themselves, evolving to deploy fiber and deliver some of the fastest, most robust internet service in America in the face of vast distances and low densities.[4, 5, 6, 7]

There are, in fact, two rural Americas[8], as the COVID-19 pandemic made abundantly clear in 2020. On one hand are those regions with little to no connectivity. On the other are those with fiber networks and gig-speed service available to all homes, schools, businesses and anchor institutions. With increased efforts by locally-based service providers and support from federal[9, 10] and state[11] governments, however, the gap between the two is closing.

By how much? The answer depends on the data you use. Perhaps 18 million[12] Americans remain without broadband. Or maybe that number is 42 million.[13] Or perhaps 162 million.[14] Regardless, we know there are still millions of citizens who cannot work from home, access remote learning, attend telehealth visits with their doctors or run a small business due to a lack of broadband — and that a significant number of those live in rural America.

Broadband 101

What is "broadband?" The current regulatory definition, according to the Federal Communications Commission, is a connection to the internet at speeds of 25 Mbps download/3 Mbps upload or faster. The term refers to the service connection itself, not equipment such as routers, nor in-home connections such as Wi-Fi, nor network technology such as fiber or fixed wireless. Broadband is how we load websites in browsers, watch YouTube videos, stream Netflix movies, email photos to family and pay bills online. Increasingly, it's how we connect to our job, how we visit our doctor, how our kids attend school, or complete and submit homework. We've come to view broadband as a basic, critical service much like we do telephone, electricity and public water — it should be available all the time, everywhere, to everyone at a reasonable cost.

Broadband Terms:

Bandwidth — The capacity your internet connection has for uploading or downloading data. You can think of this as a pipe that carries water. A large pipe can move big quantities of water much more quickly than a small straw. Similarly, increasing your internet bandwidth enables you to upload and download data more quickly.

Bits and Bytes — Units of measurement for data on a computer. Because bits and bytes are so small, you'll usually see data measured in megabits or megabytes, which are 1 million bits or bytes, respectively. Bytes are used to measure file size or capacity — a 10-megabyte file for example — while bits are used to measure the speed of your connection, such as 100 megabits per second, or Mbps.

Fiber — The fastest, most reliable network infrastructure available. Optical fiber is comprised of strands of glass that carry pulses of light. Fiber networks are faster and more reliable than cable or copper and can provide speeds of 1 Gbps and beyond.

FTTH — Fiber To The Home (also known as Fiber To The Premises, or FTTP). This is the connection of fiber optic cable directly to a home or business. This direct connection to a terminal at the premises supports the fastest internet speeds possible.

Gbps — Gigabits per second, a standard of measurement for very fast internet download or upload speeds. A gigabit is equal to 1,000 megabits. Most gigabit-speed internet offerings are delivered over fiber networks.

Gig — A shortened term used to describe an internet connection that can provide at least 1 Gbps of speed. This is an extremely high-speed broadband connection.

Hot Spot — A location where computers and other devices can be connected to the internet, usually over Wi-Fi.

Mbps — Megabits per second, a standard of measurement that describes how many bits of data your internet connection can upload or download per second. The higher the number, the faster you can upload or download content online.

Router — A unit that connects the devices in your home to your internet connection and to one another.

Streaming — Playing files as they download so that you can enjoy a podcast, music or video instantly. This enables you to enjoy live video in real time and to consume media without having to fully download it to your device first.

Upload and Download Speeds — Measured in Mbps or Gbps, this tells you how fast you can upload data (posting a photo or video to social media) or download data (loading a website or streaming video or music). Because most people download more than they upload, some internet packages make the most of limited bandwidth by designating more space for downloading than uploading. For example, 200/10 Mbps speed refers to 200 Mbps for downloading data and 10 Mbps for uploading data. Increases in remote learning, telework, and telehealth during the pandemic have, however, resulted In a greater focus on upload capabilities given the two-way nature of those functions.

Wi-Fi — The technology that makes wireless internet on a local area network possible. Wi-Fi allows you to connect various devices throughout your home or business to the internet without having to plug them directly into a router for access. The router is typically then connected to the broadband network using fiber, coaxial cable, copper, or spectrum-based technologies.

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BROADBAND: Connecting Our Lives

Work From Home
Broadband connects you with servers and applications to work remotely

Telehealth
Broadband connects you with doctors and health care services

Entertainment
Broadband connects you with streaming movies, TV shows, music and games

Shopping
Broadband connects you with grocery stores, restaurants and retailers for pickup and home delivery

Remote Learning
Broadband connects your children with their teachers and study resources

Smart Agriculture
Broadband connects your farm with monitoring, drones, agribots and other production technology

Small Business
Broadband connects your business with customers and suppliers

Family & Community
Broadband connects you with your people over video calls and social media

Government Services
Broadband connects you with online property records, tax payments and license renewals

Broadband ... it touches every facet of our lives.

FOUNDATION FOR RURAL SERVICE

02 Broadband: **In Real Life**

Social Connections

Sandy Brown, director of the Alexandria Senior Center in Alexandria, Tennessee, incorporates technology into her group activities. This includes providing beginner technology classes. "This generation gets shut out of so many opportunities because they don't know enough about using the internet," Brown says.

The training focuses on things like attaching a picture to an email, applying for online jobs, getting help from the Department of Veterans Affairs and seeking information about Medicare. Census jobs are one example of opportunities suited for the aging generation, but the application process is only available online, Brown says. "It's important to attract the next generation of seniors coming along to make sure they thrive in a technology-driven world," she adds.

The program relies on broadband access from DTC Communications, who also helped the center secure an FRS grant to purchase much-needed equipment for the center.

Source: DTC Connection, March/April 2020

Telehealth

For residents of rural Tennessee, an appointment with a medical specialist often requires hours of travel — particularly for veterans visiting a Veterans Administration Medical Center in a metropolitan area.

In Spencer, Tennessee, veterans can go to the Virtual Living Room® program at the local American Legion post, where they find a comfortable, private space and broadband internet access for visits with distant VA health care providers.

"Before the project, it was pretty much an all-day event for a local veteran to get health care, since they live so far away from the hospitals," says Lisa Cope, general manager and CEO at Ben Lomand Connect, the local broadband cooperative that helps support the project. "The Virtual Living Room changed that, and now our veterans are better cared for."

Source: Ben Lomand Connection Sept/Oct 2020

02 Broadband: **In Real Life**

Source: VTX1 Compass, July/August 2020

Agriculture

America's farms must compete in a global market and an often challenging economic environment. It's essential to maximize productivity, and digital tools make that possible.

Spence Pennington and his family grow cotton, grain sorghum, corn, sugarcane and sesame seed. They also raise Brangus cattle in Willacy, Cameron and Hidalgo counties in Texas' Rio Grande Valley.

"I have 10 to 12 systems — my tractors and all my equipment — and I can link them together to make them all sync, thanks to the broadband at my house," he says of the service through the VTX1 Companies. "I can run my agriculture systems, security systems, monitor my equipment. I can literally see the water temp in the radiator of one of my tractors, all from home. When I'm at home, I'm still connected to my farm."

Source: HCTC Connection, March/April 2020

Education

Families & Literacy in Kerrville, Texas, helps adult learners throughout the community and inmates of the Kerr County Jail earn their citizenship or GED, or learn English as a second language.

The in-office broadband connection provided by Hill Country Telephone Cooperative proves vital. Not every student has access to a reliable internet connection at home, so the organization provides Chromebooks on-site so they can take placement tests and register for the appropriate classes.

"It's important that not only can our students speak the language and do the work but they can also efficiently use that technology," says Families & Literacy Executive Director Misty Kothe. "It just makes them more employable in the future."

Work From Home

Aaron and Becca West moved from a Nashville, Tennessee, suburb to a rural area of the state, but that didn't require them to give up their critical internet service. Their new rural communications cooperative, Ben Lomand Connect, provided 1 Gbps internet service across a fiber optic network. This made it possible for Aaron to continue his audio and visual consulting company and Becca to connect with the GoGoKid program through which she used the internet to teach English to Chinese students.

"The fiber was so huge for the contract work," says the Wests. "It was so much easier to communicate. When we were looking for homes here, we immediately ruled them out if they didn't have high-speed internet access."

Source: Ben Lomand Connect Connection, May/June 2020

Business

Ruby, South Carolina, may be off the beaten path, but North Star Leather serves customers across the country from here thanks to its broadband internet connection. The company offers some 150 products, including wallets, money clips and belts, which are created by its 17 local employees. "We're happy to be able to make a living doing something we enjoy while at the same time providing a few jobs here in the USA," says North Star's Michael Batson.

Ninety percent of the company's business is from wholesale and white-label products for other companies who contract with North Star Leather to produce items like wallets and bracelets and stamp their own logo. Often, valued customers or corporate employees receive them as keepsakes. The company also sells retail via its website.

"It's a huge part of our business now," Batson says. "We really wouldn't get anywhere without having the online access we have through Sandhill Telephone. We're constantly interacting with our customers. It's not just the sales we get from the website, but the exposure we get with other people who get private label products. It helps them find us."

Source: Sandhill ConNEXTion, July/Aug 2019

03 The COVID Effect: **Remote Learning**

Overview

By 2019, technology had become a standard tool in childhood education. Teachers were virtually welcoming specialists into their classroom for instruction in advanced courses. Students were receiving homework assignments that required them to access online resources. Increasingly, students were required to submit assignments over school learning management systems such as Blackboard and Schoology.

The Every Student Succeeds Act of 2015[1] defined such use of technology in education as "digital learning," which included:

- access to online databases and other primary source documents,
- online and computer-based assessments, and
- access to online course opportunities for students in rural or remote areas.

A lack of broadband access at home created a challenge for millions of students trying to navigate an education that was becoming increasingly reliant on digital learning technology. In fact, research showed[2] that some 25% of school-aged children in the U.S. — an estimated 13.5 million ages 5 to 17 — were found lacking the broadband access and digital devices needed to participate in remote learning.

Impact of COVID-19

These conditions became the backdrop for the sudden and widespread shift to remote learning in the spring of 2020. In efforts to curtail the spread of the coronavirus, school officials began shutting down school systems, and "educators only had a few days — or sometimes hours — to move their classes online," according to a report[3] from the National Education Association.

This left millions of Americans at a disadvantage. That same report showed that an estimated 37% of non-metro students lacked "full access" at home (both a broadband connection and a dedicated computer). Further, 16% of teachers lacked full access, creating challenges when attempting to conduct online video instruction.

Despite inadequate access to digital tools, 43% of rural districts indicated[4] that a primary part of their distance learning strategy for grades K-5 was live virtual classes taught by the student's teacher.

The potential impact on learning is alarming. A Brookings Institution study summarized[5] that "students could begin fall 2020 with roughly 70% of the learning gains in reading from the prior year relative to a typical school year." The numbers were even worse for mathematics, where "students may show even smaller learning gains from the previous year, returning with less than 50% of the gains." Students in lower grades could be impacted most at "nearly a full year behind in math compared to what we would observe in normal conditions."

Calculating an anticipated "COVID Slide" based on established "summer slide" metrics, Stanford University estimates[6] that across 19 states it studied, in 2020 students lost on average between 57 and 183 learning days in reading and between 136 to 232 learning days in math.

"In the absence of any actual assessments, these results serve as scientifically grounded estimates of what happened to students since March," said Dr. Margaret Raymond, director of CREDO at Stanford University. "It will take extended broad-based support from all corners to address the current deficits and the ripples they cause into the future."

These impacts could continue to snowball as students move through grade levels. "When you look at (students) who are moving through that pipeline now, are they going to be prepared to make that jump to the next level?" asks Mike Romano[7], senior VP of industry affairs and business development for NTCA–The Rural Broadband Association. "And how are those coming out of school going to be looked at by a workforce that's determining whether they've got the skill sets they need based on the educational experience that they had certainly last spring and going through the next year or so?"

While the problems are national in scope, some solutions may arise from local efforts. In a joint letter[8] to their respective memberships in July 2020, Shirley Bloomfield, CEO of NTCA–The Rural Broadband Association, and Dr. Allen Pratt, executive director of the National Rural Education Association, encouraged local schools and local broadband providers to work together to identify barriers to the connectivity that supports remote learning. The letter pointed out that the issue of access is not a singular problem. In some cases, a fixed broadband connection is not available at the home, while in other cases a connection is available, but the homeowner does not subscribe to service — and that these separate issues require separate approaches toward a solution.

Digital Bridge K-12 is a national initiative that is helping states and schools districts identify students without broadband and purchase service for low-income families.[9] In September 2020, the program announced a collaboration[10] with NTCA that partners local broadband providers with local school systems, who take on bulk procurement of home internet access for students living in homes that do not already purchase broadband.

In October, a working group reporting[11] to the FCC's Broadband Deployment Advisory Committee identified several challenges that will need to be addressed moving forward for the nation to close its digital divide and "increase opportunities for all Americans to benefit from effective distance learning." These included:

- the availability of broadband;
- widespread adoption of broadband technology;
- the need for devices to access broadband;
- affordable broadband service plans; and
- digital literacy training — in native languages — for teachers, students, parents and grandparents.

Further, the National Education Association has called on the federal government[12] to provide the funding necessary to ensure all students have access to broadband, to their own devices that have the software and features to support remote learning, and to digital assistance and technical support after school hours and when school buildings are closed.

The Connected Conundrum
Lacks Full Access at Home*

37% of non-metro students **16%** of non-metro teachers

And yet **43%** of rural school districts say live virtual classes will be a primary part of distance learning strategies for K-5

*both a broadband connection and a dedicated computer

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03 The COVID Effect: **Work From Home**

Overview

For decades, the United States has been shifting from an industrial-based economy to a knowledge-based economy. Today, two-thirds of our GDP comes from the service industries, which represents four out of five private-sector jobs.[1]

With this trend has come a gradual delinking of job functions from the locations where employees must perform their duties. This has led to the opportunity for several categories of workers to perform their jobs away from their employer's centralized setting. As Citi CEO Michael Corbat summarized[2], "In an economy where farming and manufacturing as a proportion of total economic activity are in decline, and services are rapidly ascendant, the skills necessary for the workplace are being redefined."
The number of those working from home, in whole or in part, prior to the pandemic vary widely depending on survey methodology[3]:

- American Community Survey reported that in 2018, 5.9% of rural workers "usually worked from home in the last week."
- National Household Travel Survey reported that in 2017, 11.9% of all workers "usually work from home."
- Bureau of Labor Statistics reported that in 2018, 23.7% of all workers "worked some hours at home."

Regardless of how the question is approached, it is clear that the increase of broadband accessibility — over the past decade in particular — has increased opportunities for more Americans to perform their jobs away from traditional office settings.

Impact of COVID-19

This upward trend was accelerated in March 2020 as businesses across the country responded to shutdown orders designed to curb the spread of COVID-19. While this created a hardship for many in the service sector whose work is location-dependent (restaurants, hair salons, fitness centers, entertainment venues, retail), knowledge workers in particular were presented with new work-from-home opportunities (customer service, tech support, legal, human resources, creative).

A study backed and reported on by Harvard Business School[4] found that the pandemic has had a significant impact on remote work. In one study group, 45% of small-business leaders said that jobs within their companies were being done remotely at least two days per week. A second study group, comprised of business economists who are members of the National Association for Business Economics, found that 80% of their firms had adopted remote work programs.

Earlier this year, the consortium Future Forum announced its Remote Employee Experience Index as a way to better understand the impacts of working from home. The inaugural report[5] showed that 14% of knowledge workers prefer working from home to working in an office. The top reason, cited by 26% of respondents, was work-life balance. The report also identified five top challenges to working from home:

- Unstable Wi-Fi or internet access
- Maintaining and building working relationships with colleagues

- Staying focused and avoiding distractions
- Feelings of loneliness or isolation
- Keeping up with what others are working on

There are indications that the widespread adoption of work from home policies is not a short-term solution tied to the pandemic. Numerous large businesses have indicated they plan to continue allowing at least a portion of their employees to work from home post-pandemic, including Facebook, Twitter, Square, Shopify and Slack[6].

This direction appears to be influenced by more than employee preferences. A Gartner survey[7] indicated that some 75% of finance leaders across a broad range of company sizes plan to move some portion of their workforce to a permanent work-from-home arrangement as a cost-savings measure. While the overall response was that of moving at least 5% to remote status, some respondents indicated much higher rates for a post-pandemic workforce:

> ***4%*** *surveyed said 50% of their workforce would remain remote.*
>
> ***17%*** *surveyed said 20% of their workforce would remain remote.*
>
> ***25%*** *surveyed said 10% of their workforce would remain remote.*

The savings could, in fact, be substantial. The firm Global Workplace Analytics estimated[8] that the typical U.S. company could save $11,000 per worker each year if they work only half of their schedule remotely. "Our prediction is that the longer people are required to work at home, the greater the adoption we will see when the dust settles," says Kate Lister, president of Global Workplace Analytics. "Our best estimate is that 25-30% of the workforce will be working from home multiple days a week by the end of 2021."

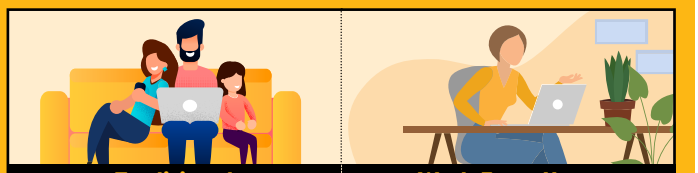
This shift results in much greater demand for residential broadband, not only in service speeds but also in types of service. In the absence of remote work, most homes are adequately served with asynchronous connections that provide much greater download than upload speeds, since most residential internet activity focuses on consumption of data (streaming movies, browsing the internet, downloading files, etc.). Working from home requires greater upload speeds, often synchronous connections, to accommodate a productivity model wherein users must upload and sync large files with their employer's computer systems.

In its October 2020 report[9], the FCC's Disaster Response and Recovery Working Group offered the following recommendations and best practices related to implementing a virtual workforce:

- Work with broadband providers to ensure sufficient enterprise bandwidth capabilities and protected VPN server access on the business side to maintain day-to-day operations.
- Consider options to facilitate necessary broadband requirements for work-from-home employees.
- Provide necessary technology to ensure remote use for employees including laptops, monitor screens, tablets, cellphones and other devices.
- Assign key contact personnel for virtual IT assistance.
- Implement network safeguards to mitigate security threats and allow employees to use encrypted passwords for sharing information electronically.

A Tale of Two Broadband Users

An estimated 25-30% of the workforce could be working from home multiple days a week by the end of 2021. This is creating a potentially permanent broadband user profile:



Traditional	Work From Home
• The speed to support typical family use	• More speed to support work
• Asynchronous connection, with higher download than upload speeds	• Synchronous speeds to provide greater upload capacity
• Basic internet browsing, streaming movies and TV shows, listening to music, playing games	• Traditional uses, plus videoconferencing, connecting to servers, transferring large files

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03 The COVID Effect: **Telehealth**

Overview

Of all the applications for broadband connectivity, telehealth has the potential for the greatest personal impact on those residing in rural America. Many of the access challenges facing rural patients and rural health care providers can be addressed by telehealth technologies that are currently available.

The American Telehealth Association outlines[1] the most commonly used telehealth approaches as:

- **virtual visits** (traditional phone calls and videoconferencing platform sessions between a doctor and a patient);
- **chat-based interactions** (back-and-forth, non-live communication and sharing of information over email, text messaging or online portals);
- **remote patient monitoring** (the use of wearable sensors and other devices to collect and transmit information regarding the patient's condition back to health care providers); and
- **technology-enabled modalities** (digital diagnostics and therapeutics, consultation between physicians, and general data transmission and interpretation).

Telehealth delivers many benefits[2] to all parties involved, according to the National Rural Health Association:

- **Rural primary care providers** — Telehealth gives them access to specialists practicing at larger medical facilities.
- **Specialists** — Telehealth opens a wider geographic area for their practice.
- **Patients** — Telehealth supports care in home or closer to home from health care providers.

Overall, a greater level of care is possible through the use of telehealth — and telehealth is supported by robust broadband service. "While not all telehealth use requires broadband capacity," researchers with the University of Iowa[3] reported, "the full potential of telehealth for rural residents and providers will not be realized until broadband is as accessible in rural areas as it is in urban areas."

Impact of COVID-19

While various options have long existed for using the technology of the day to support health care delivery, the upward trend toward broader adoption of health care delivery across modern telecommunications channels has been steady. The onset of the COVID-19 pandemic dramatically accelerated those trends, resulting in exponential growth in the percentage of visits being conducted via telehealth.

McKinsey & Company reported[4] that in September 2020, 23% of the population had started or increased use of telehealth for treatment of physical conditions since the pandemic began. This represented a 128% increase since the firm's initial survey in April. A similar trend was noted for the treatment of mental conditions, with 14% indicating they had started or increased telehealth use, representing a 133% increase from April to September.

The recognition of telehealth's importance during the pandemic, and the role it will continue to play in the aftermath, has led to a number of initiatives across the health care industry. In November, the Centers for Medicare & Medicaid Services (CMS) announced expanded flexibility in its regulations through the Acute Hospital Care At Home program.[5] With the use of telehealth technology, along with in-home visits, CMS (part of the Department of Health and Human Services) expressed a belief that more than 60 acute health conditions could be treated "appropriately and safely" in a home setting. This list of conditions includes asthma, congestive heart failure, pneumonia and chronic obstructive pulmonary disease.

Momentum is building to increase access to telehealth by removing regulatory barriers. The Alliance for Connected Care is seeking support[6] for its Consensus Principles on Telehealth Across State Lines, calling for providers and patients to be allowed to connect regardless of physical location. Legislation has been proposed[7] to encourage more states to join the Interstate Medical Licensure Compact, easing restrictions on physicians who wish to treat patients in other states via telehealth. Reporting on Medicaid policy trends, the Center for Connected Health Policy stated[8] that 27 states plus Washington, D.C. now allow a person's home to be an "eligible originating site" under certain circumstances, while 26 states plus D.C. permit Medicaid reimbursement where a school is the originating site.

As telehealth adoption expands, however, this acceleration is generating concern among health care providers over accessibility of telehealth services — particularly in rural America. In a report by the COVID-19 Healthcare Coalition[9], rural clinicians identified several barriers to patients accessing telehealth services. These included lack of patient access to technology (77.7%), lack of patient access to broadband/internet (71.6%) and lack of digital literacy in patients (67.6%).

"A successful transition to telemedicine requires the intersection of at least 3 key factors," writes University of Pennsylvania's Dr. Howard M. Julien[10]. "Access to broadband internet, an internet-capable device, and sufficient technology literacy to take advantage of the first two factors."

TELEHEALTH: Moving Care Home

Is the health care industry poised for a dramatic, technology-powered disruption? The pandemic highlighted the critical need for broadband to support telehealth services that would enable more people to receive care without visiting physician offices and hospitals. Analysis from McKinsey & Company illustrates the significant shift in services this could mean for the industry:

20% emergency room visits potentially avoided via virtual urgent care offerings

24% health care office visits and outpatient volume delivered virtually

9% health care office visits and outpatient volume delivered virtually "near-virtually." 35% regular home health attendant services virtualized

2% outpatient volume shifted to the home setting (with tech-enabled medication administration)

AND WHAT ABOUT THE DOLLARS?

*"Overall, these changes add up to **$250 billion** in health care spend in 2020 that could be shifted to virtual or near-virtual care, or 20% of all office, outpatient, and home health spend across Medicare, Medicaid, and commercially insured populations."*

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03 The COVID Effect: **Business & Consumers**

Overview

Small businesses are defined as any company with fewer than 500 employees. Almost all U.S. companies — 31.7 million of them — fall within this category. Many are single-person operations, often with no employees. Small businesses include the grocery stores, manufacturing plants, professional services firms, restaurants and retail shops that anchor the local economies of communities across America. Since the turn of the new century, small businesses have created 10.5 million net new jobs — more than 65% of all jobs created during that time. As another indicator of the economic impact of this segment, 40% of private sector payroll is generated by this class of business.[1]

As the novel coronavirus began to reach crisis stage in China, these businesses were enjoying a decade of economic growth following the Great Recession. With the stock market on a steady climb and a growth in GDP of almost 48%[2], business was good.

That was about to change.

Impact of COVID-19

The landscape shifted rapidly for America's businesses in March and April of 2020 as state and local governments took measures to quell the spread of the coronavirus. As the year came to a close, businesses reflected on 2020 when responding to the U.S. Census Bureau's Small Business Pulse Survey[3]. While 30% overall said the pandemic had a "large negative effect" on their business, some sectors were hit much more severely. For example, the numbers below reveal a much higher percentage of businesses in these sectors reporting a large negative effect:

*Accommodation and Food Services — **65%***

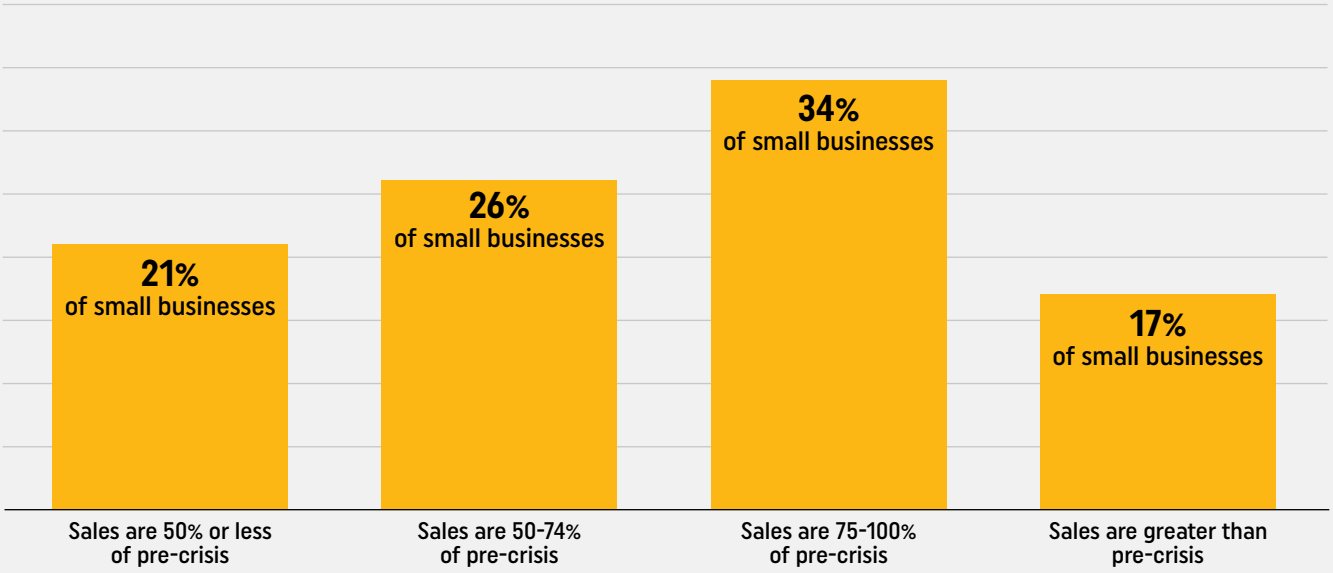
*Educational Services — **62%***

*Arts, Entertainment and Recreation — **60%***

Such businesses were forced to explore new ways of delivering products and services to consumers. Restaurants shifted to curbside pickups and delivery, supported through local and national apps such as Uber Eats and DoorDash. Gyms and other on-site fitness operations explored innovative ways to offer virtual content, with a 30% jump in hours U.S. users spent each week on health and fitness apps. As on-site learning was interrupted, online platforms such as Coursera and Udemy saw enormous surges in enrollment of 640% and 425%, respectively.[4]

In October, the NFIB Research Center reported[5] on the ongoing impact of the pandemic on small businesses. Most small businesses were impacted at some level at the beginning of the crisis, but the research pointed out that economic recovery has been less uniform as the months have unfolded.

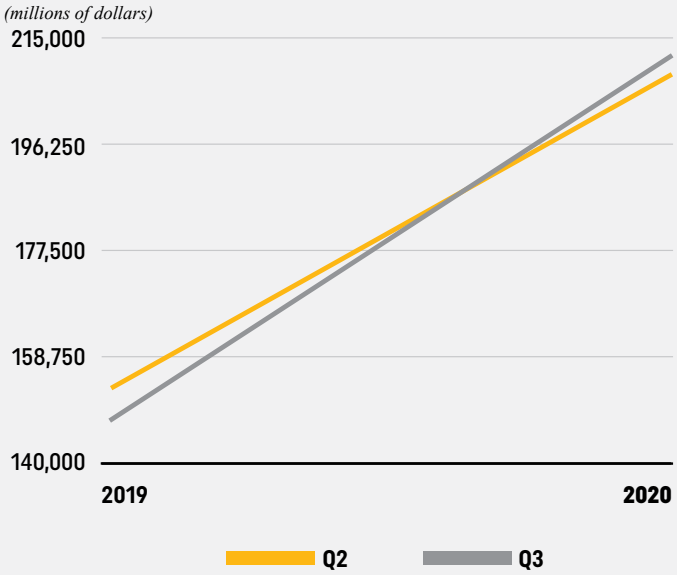
Sales Levels for Small Businesses in October 2020 Compared to Pre-Crisis



That same report shows that many of those businesses that borrowed funds through the federal government's Paycheck Protection Program (PPP) see continued difficult times in the coming months. Almost one in five said they anticipate laying off employees in the next six months, while more than half said they would need more financial help in 2021.

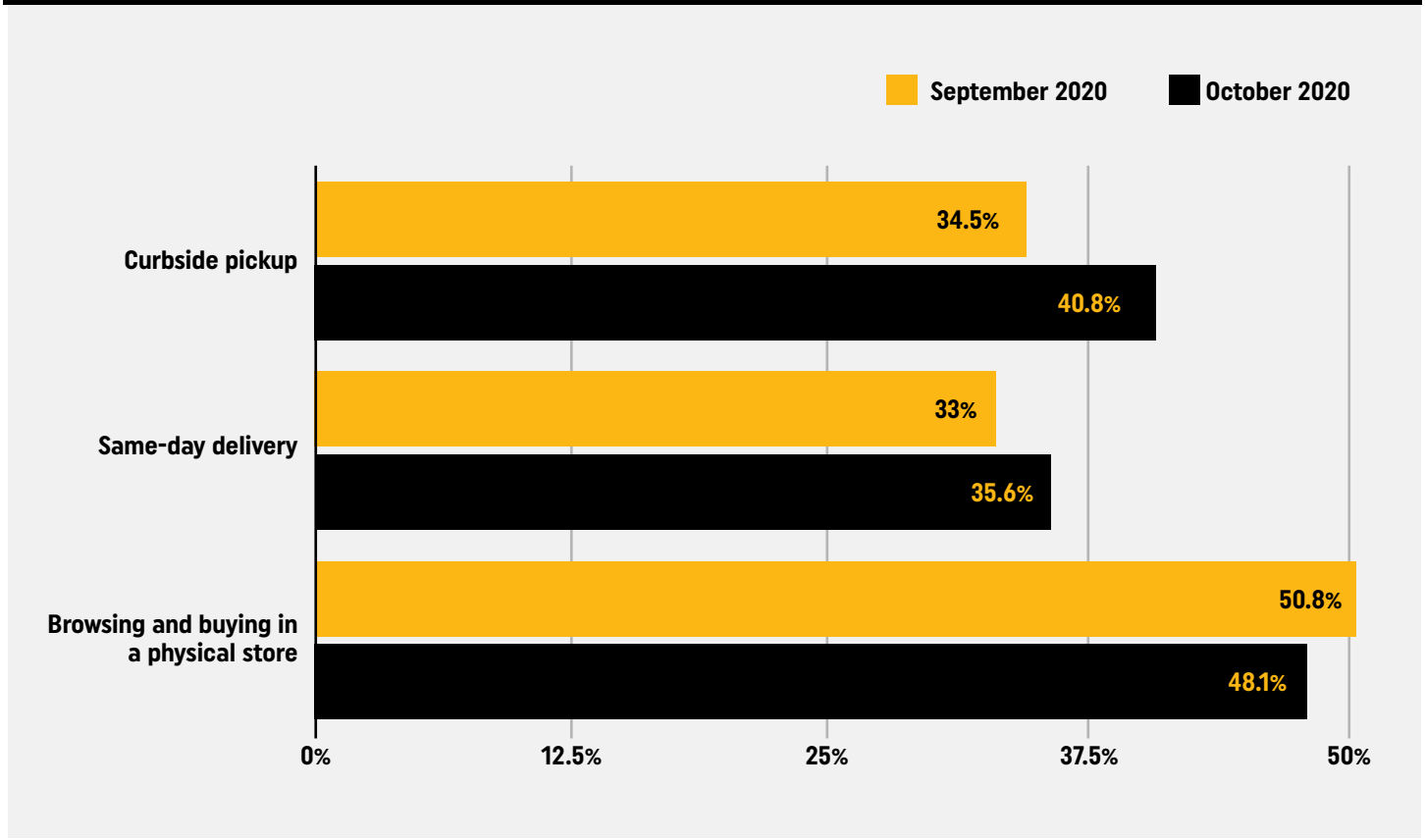
In terms of consumer behavior, online shopping was already trending upwards in the months before the pandemic. The third and fourth quarters of 2019 saw increases in e-commerce of 17.3% and 16.6%, respectively, compared to the same periods a year prior. The first quarter of 2020 followed that trend, with a 14.8% year-over-year increase[6]. However, as consumers found themselves at home more, and with brick-and-mortar stores closed for several weeks, e-commerce skyrocketed:

Retail Sales, E-commerce



Convenience and safety continue to play an important role in how consumers make purchasing decisions. Those trends are evident in the two most recent months of reporting in Win BIG Media's consumer sentiment research[7], where consumers were asked, "Which of the following shopping preferences are now important to you?"

Which of the following shopping preferences are now important to you?



Beyond the fallout surrounding the coronavirus outbreak, consumer behavior in 2020 was also influenced by how companies responded to racial injustice. A special report from the Edelman Trust Barometer[8] showed that 60% of the general population would be influenced by how a brand responded to racial injustice protests when deciding whether to buy from or boycott them in the future. This sentiment was particularly strong among the 18-34 age bracket at 70%. Sixty-one percent of those age 35-54 agreed, along with 52% of those ages 55 and over.

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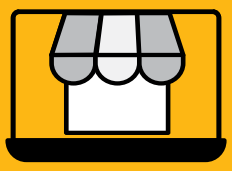
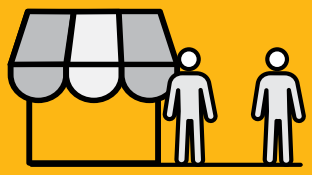
Online may really be the new normal

Shopify, the e-commerce platform that helps businesses sell online, released a study in September 2020 that showed "53% of North American buyers said that the pandemic has changed the way they will shop going forward."

How will those changes play out? According to the report:



ONLINE SHOPPING:
52% of consumers say they have shifted more of their shopping online.



SUPPORT FOR LOCAL BUSINESSES:
61% of consumers plan to continue shopping with local businesses as 2020 draws to a close.

CURBSIDE PICKUP:
40% of consumers made purchases online and picked them up curbside in the first three months of the pandemic — and **38%** say they plan to continue doing so.

LOCAL DELIVERY:
31% of consumers bought something online and had it delivered locally in the first three months of the pandemic — and **33%** say they will use local delivery as 2020 draws to a close.

VIRTUAL EXPERIENCES:
Many service businesses created online events as a way to maintain contact with and serve their customers. Some **14%** of consumers reported buying a virtual version of a service, with **63%** of those saying they did so more during the pandemic than before.

Dayna Winter, "5 Pandemic Buying Habits That Are Here to Stay—According to Shopify Research," Shopify, (September 10, 2020), https://www.shopify.com/blog/consumer-trends

03 The COVID Effect: **Social Connections**

Overview

We are social animals. Since ancient times, mankind has developed ways to stay connected. Before the invention of the printing press, we were sending handwritten stories and letters across land and sea. While connection with our local family, tribe and community are at the core of our social well-being, we have continually devised new ways of reaching beyond those physical limits to broader circles: telegraph, the U.S. Postal Service, public switched telephone networks, fax machines, the internet, social media. We are a species in continual pursuit of connectivity. Facebook serves as a good barometer of this concept. In the fall of 2016, the social media platform had more than 1.8 billion monthly active users across the globe. That number has surged to 2.7 billion.[1] Through this and similar platforms such as Twitter, Instagram, WhatsApp and TikTok, the foundation was laid for a world in which human connection was about to be significantly disrupted.

Impact of COVID-19

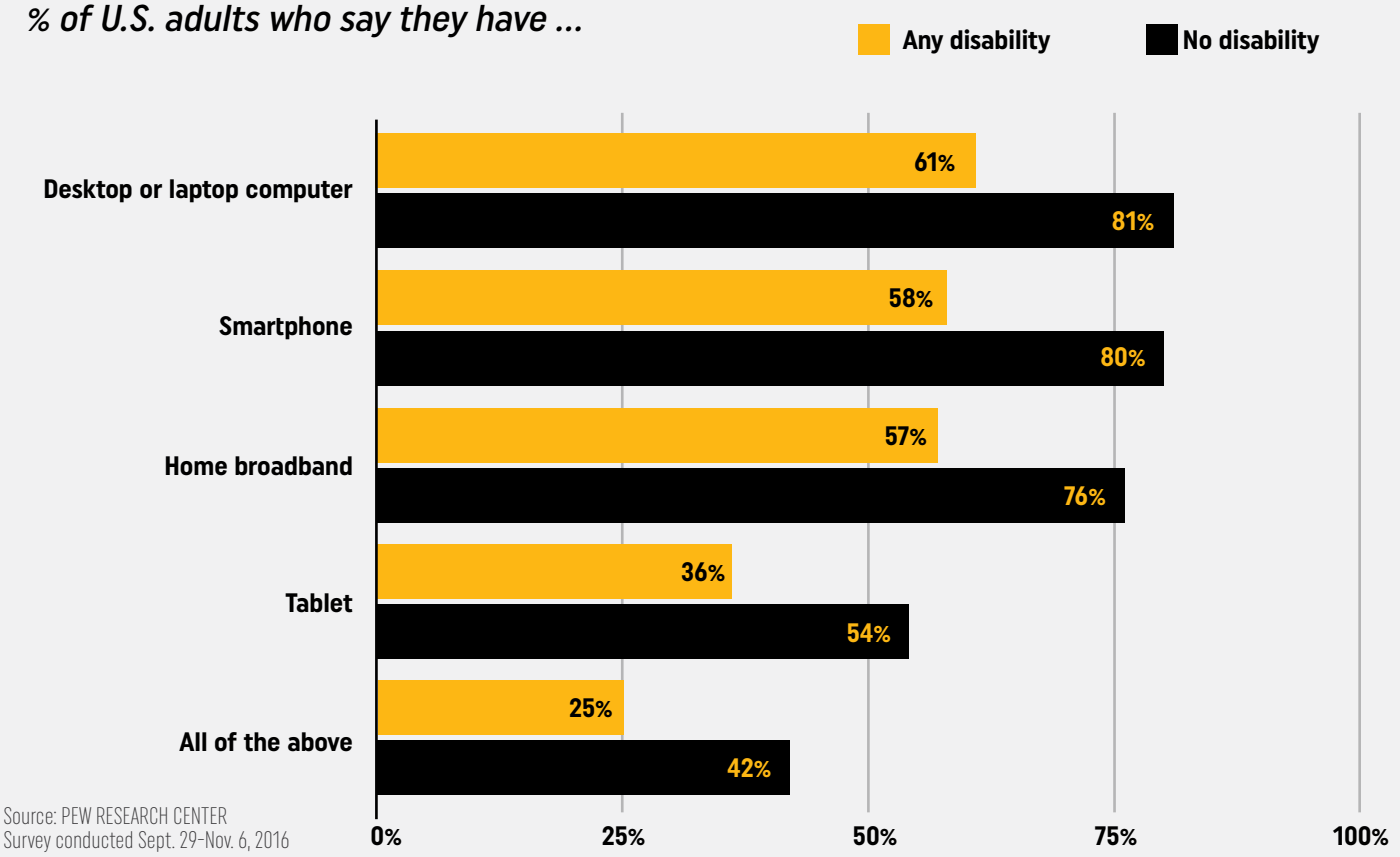
Our need to engage was met with the stark realities of a pandemic in 2020. Severe limitations were placed on in-person gatherings, particularly public assemblies such as shopping and dining, sporting events, conferences, and live entertainment. Moreover, a shared experience as far-reaching as a pandemic heightened our need to converse and connect over a global event that was impacting everyone. As author and ethnographer Simon Sinek says, "We form tribes and connections around a common vision or shared values."[2]

In its October 2020 report[3] to the FCC's Broadband Deployment Advisory Committee, the Disaster Response and Recovery Working Group pointed out that "during COVID-19, broadband connectivity was not just critical for learning, working, and getting health care; broadband provided a critical mechanism for people to stay connected." From graduation ceremonies and church services to weddings and funerals, social media and video platforms have played an important role in helping people share important moments and maintain a sense of community. Alternate means of connectivity have become especially critical for vulnerable populations. With COVID-19 hitting the elderly population hard, particularly those in group settings such as nursing homes and assisted living facilities, communicating over broadband-enabled technology can reduce the sense of isolation. Heading into the pandemic, only 8% of older adults used video chat every day, according to an AARP study[4]. Social media was popular with 42%, with 43% using email and 56% using text messaging.

Adoption of communications technology is unfortunately not as high among disabled Americans, who comprise some 26% of the U.S. population, or 61 million people.[5] In a Pew Research study[6], only 57% of disabled Americans reported having home broadband service, compared to 76% of those with no disability. In fact, the research showed that disabled Americans were three times as likely to say they never go online at all.

Disabled Americans are less likely to have home broadband, tech devices

% of U.S. adults who say they have ...



Source: PEW RESEARCH CENTER
Survey conducted Sept. 29-Nov. 6, 2016

Overall, more than half of Americans consider digital connectivity — particularly the internet — as being essential during the pandemic[7]. Another 34% say that while not essential, the service is important.

Beyond connecting with family and friends for routine socialization and for special occasions, shutdown measures to control the coronavirus also interfered with group activities. A third of U.S. adults turned to the internet in 2020 to have a virtual party or social gathering[8]. It's worth noting that a considerable gap separated urban and suburban adults (35% each) from rural adults (only 23%). Urban and suburban adults were also more likely to watch a concert or play through a streaming service (22% and 21%, respectively) than their rural counterparts (16%). In the closing weeks of the year — with months of quarantines, stay-at-home orders, shutdowns and overall significant disruptions in social connectivity — Americans reported[9] that they were most eager to return to getting together with family (42%), getting together with friends (39%) and dining indoors at a restaurant or bar (36%).

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03 The COVID Effect: **Networks**

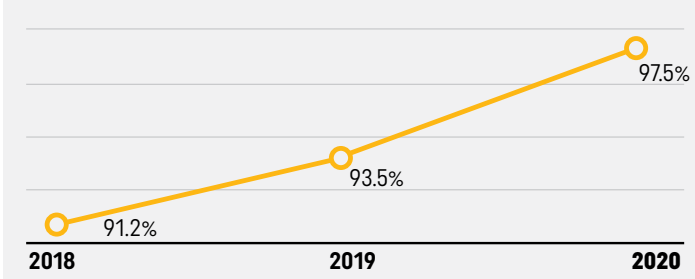
Overview

As 2020 got underway, rural broadband providers were continuing the trend of building out their networks with fiber. This growth gained momentum as the nation dealt with the fallout of the pandemic. The chart below shows the growth in fiber across the past three years, as reported by members of NTCA–The Rural Broadband Association[1].

The presence of robust broadband networks proved advantageous for providers, who found themselves dealing with a significant shift in network traffic and usage patterns. In fact, NTCA members serving more than 650,000 broadband connections across 38 states reported[2] that their networks continued to perform as designed and without disruption despite changes and increases in demand.

Fiber In The Network

% of rural broadband providers using fiber to the home to provide fixed broadband service to some portion of their service area



Impact of COVID-19

A report from the FCC's Disaster Response and Recovery Working Group[3] identified the following key conclusions in regard to the overall performance of America's broadband networks during the pandemic:

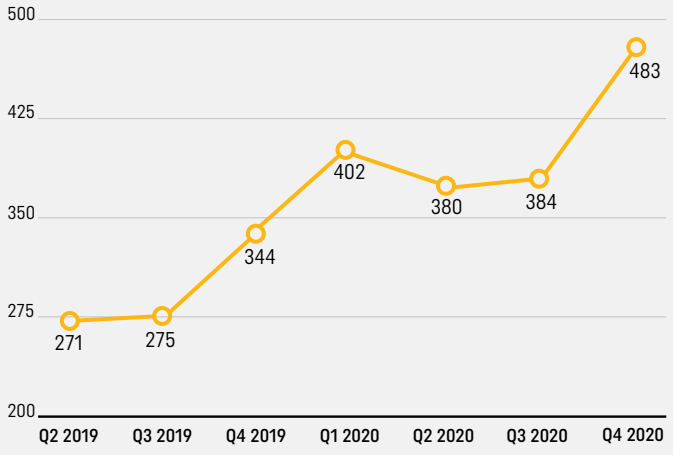
(a) networks performed well overall during the pandemic;
(b) availability and adoption challenges were intensified as critical societal functions transitioned online, almost overnight;
(c) municipalities were able to ensure that permitting generally was not an obstacle to maintaining and, as needed, expanding broadband networks during the pandemic; and
(d) the rapid and significant social changes brought on by the pandemic, such as increased teleworking, remote learning, and use of telemedicine, are becoming ingrained and will likely lead to long-term changes in broadband usage and adoption.

Supply Chain Issues

A perfect storm occurred in 2020 when three realities converged: 1) the need for broadband connectivity increased as the pandemic forced workers and students home for several weeks; 2) state and federal funds flowed to broadband providers to connect consumers and build new networks; and 3) the pandemic caused disruptions in operations for manufacturers across the globe who are part of the complex supply chain.

Quarterly Data Usage

median monthly weighted average



As reported by Openvault in its OVBI Broadband Insight Reports for 2Q20, 3Q20 and 4Q20, U.S. broadband usage rose sharply as pandemic-related shifts in work and school patterns unfolded. The numbers have not returned to pre-pandemic levels, signaling a new normal for broadband usage.

Average Broadband Household Index

Snapshot of the average U.S. broadband household - Q4 2020

483 GB Average Bandwith Usage

452 GB Average Downstream Usage

31 GB Average Upstream Usage

4 Average Number of Streaming Services*

10.37 Average # of Connected Devices**

Source: OVBI Broadband Insight Report 4Q20 – www.openvault.com
*Deloitte Insights- Digital media trends survey, 14th edition
**Statista

The result was that lead times for critical supplies to build broadband networks (including fiber, routers and other equipment) began to stretch well beyond normal delays. Anecdotally, some broadband providers were being told that delivery of fiber orders would take from eight months to a year. The NTCA survey of broadband providers revealed concerning trends:

- Almost 90% of respondents had experienced delays in procuring equipment.
- 32% reported delays of five to eight weeks from prior windows on fiber fulfillment.
- 32% reported delays of more than 12 weeks on fiber fulfillment.
- 48% reported delays for network equipment of nine to 12 weeks.
- 58% reported delays of nine to 12 weeks beyond prior estimates for customer premise equipment such as routers.

A December 2020 report[4] found that concerns over supply chain issues have risen dramatically among broadband providers; 27.7% of survey respondents said they were concerned about delays in fiber order fulfillment, up from 9.3% for the same period in 2019.

In November 2020, a cybersecurity study group issued a report[5] on the impact of COVID-19 on the information technology and communications sector. Citing "profound disruptions to the globalized model of supply chains," the report identified three key issues:

1. The pandemic has underscored the need for an approach that was already underway over the last six years: diversifying supply chains to a broader array of locations and away from single source/single region suppliers.
2. The pandemic exposed how some manufacturing companies were unprepared because of their reliance on lean inventory models, which provide great efficiency and cost effectiveness in normal environments.
3. COVID-19 also underscored the difficulties that companies face in understanding their junior tier suppliers and where they are located.

The report went on to present a number of recommendations, from developing standard methods of mapping sub-tier suppliers to exploring ways for manufacturers to keep more inventory in reserve.

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Overview of Broadband Technologies

Beyond what rural America needs — and why — it's appropriate to ask, "How do we get there?" Many broadband technologies are currently operational, and others are being developed and deployed; but not all may be equal in being ready to address tomorrow's needs or the unique dynamics of rural environments.

Broadband services can be delivered to the customer using either wireless or wireline technologies. Wireless technologies, which include satellite, use the air as a transmission medium and can be fixed or mobile. Wireline broadband is — with rare exception — delivered using copper cable (either twisted-pair or coax) or fiber optic cable. Each technology choice has its own benefits and drawbacks regarding speed, capacity, latency, reliability, mobility and other factors. As with any infrastructure — such as roads, bridges, or electric or water systems — the question often turns upon whether it is deemed more efficient and effective to build something more quickly at a lower upfront cost that will not satisfy demand for capacity over the long run or to plan ahead for the capacity that will be needed over the life of the asset and build for that capacity from the start (rather than needing to rebuild the network repeatedly). Those building networks, and policymakers as well, must make such choices in determining what kinds of broadband networks to build and support.

	Benefits	Drawbacks
Wireless		
mmW 5G	Tremendous speed and capacity over very short distances.	Very limited wireless reach makes it not suitable for sparsely populated rural areas.
Midband 4G/5G	Lower upfront costs; speeds comparable to good copper networks.	Slower speeds due to limited spectrum; frequent upgrades are costly; requires deep fiber.
Wireline		
DSL (twisted-pair copper)	Can leverage existing outside plant.	Limited speeds; not suitable for long distances; requires deep fiber; expensive upgrades.
Coax	Can leverage existing outside plant.	Not suitable for long distances; requires deep fiber; expensive upgrades.
Fiber	Future-proof; easier upgrades; lowest total cost over the life of the network; suitable for distances up to 20 miles between electronics.	Higher upfront costs; may be slower to deploy.

The Physics of Rural — The distance dilemma plagues nearly all rural broadband customers. Increasing the distance between a customer and his or her serving electronics or wireless tower has a significant deleterious impact on the broadband speed that customer can receive. Because of this, technologies that may provide adequate broadband to customers in densely populated areas face greater challenges in rural applications where large distances exist between customers. Fiber, however, has been shown to be a great distance neutralizer: The customer can be across the street from the electronics or 20+ miles away and still receive the same speeds.

Fixed Wireless (4G/5G) — "5G" is often touted as a salvation for connectivity. Certainly, evolutions in wireless technologies in recent years have increased fixed wireless broadband capability and they can offer helpful platforms for reaching customers not yet connected via other means — but they face real challenges in meeting rapidly increasing broadband demands for many rural customers. One reason for this is the vast amount of spectrum recently made available by the FCC for broadband is in the millimeter wave (mmW) band, which is in very high frequency. Unfortunately for rural customers, as wireless frequency increases, the distance the wireless signal can travel decreases — for mmW, this often means only a few hundred feet.

A fixed wireless network that would be practical for rural deployments would need to serve many customers from each tower, which due to low customer densities would need to reach several miles from the tower. This would eliminate mmW frequencies, which as discussed above have limited propagation. Under the right conditions, systems in the 2.5 GHz (BRS) or 3.5 GHz (CBRS or C-Band) "mid band" frequencies could be capable of delivering as much as 100 Mbps at a distance of 5 to 8 miles from the tower (depending on many factors, such as line-of-sight, terrain, antennas, number of customers per sector, etc.).

When compared to a fiber network, a rural fixed broadband wireless system may benefit from faster deployment and lower initial capital expenses, but the broadband speeds they can deliver are relatively modest by today's standards — and these speeds may not keep pace with ever-increasing user demand. It is also important to remember that most wireless towers need to be served by a fiber optic network to achieve these speeds, to aggregate all of the demand from the spectrum in the local area.

The only practical way therefore to improve speeds in the future to the wireless customer is to move the tower — and the fiber serving the tower — closer to the customer.

Copper & Coax Wireline Technologies — Most locations in rural America still have their fixed broadband services delivered using a wireline copper network — either using twisted-pair copper cable or occasionally coaxial cable. Twisted-pair cable technologies can provide speeds of 100 Mbps over short distances — around 1,500 feet depending upon the gauge and quality of the cable. For rural applications, it is rarely practical to place electronics within 1,500 feet of each customer, especially when there may only be two or fewer customers per mile. Similar to wireless, delivery of these speeds would also require that the field electronics be fed by a fiber network.

CATV operators have historically deployed coaxial networks to serve their customers, where broadband is delivered using Data Over Cable Service Interface Specification (DOCSIS). The most widely deployed DOCSIS is version 3.1, which allows delivery of downstream speeds that exceed 1 Gbps. However, these networks are more suited for densely populated areas and are uncommon in rural areas. As with DSL, many fiber-fed field electronics close to the customer are required to achieve these speeds. These technologies also have more limited upload capability, which has become increasingly important as users engage in more two-way online activities like remote learning, telework, and telehealth.

Fiber Optics — Nearly all broadband networks rely on fiber optic technologies at some point where the traffic of many users is aggregated and high speed and large capacities are needed. We see this not only in landline networks, where fiber connects both DSL field units and DOCSIS fiber nodes, but also in wireless networks where fiber is used to backhaul traffic from towers. For both wireline and wireless networks, the "broadband bottleneck" is the last portion of the network which is often copper, coax, or wireless.

Because of this, many operators have now extended the fiber network all the way to the customer premises and eliminated the use of copper or wireless in their networks. This is referred to as Fiber-to-the-Premises (FTTP).

There are two general types of FTTP network architectures in use today, which are Passive Optical Network (PON) and Point-to-Point (P2P). All common FTTP networks deployed in the U.S. can offer gigabit broadband services. FTTP networks are also well suited to rural areas due to the large distances possible between the provider electronics and the customer location — often 12 to 20 miles.

Additionally, fiber does not face the speed constraints of other technologies. The most widely deployed FTTP network architecture in the U.S. is Gigabit-capable Passive Optical Network (GPON), in which it is not uncommon for providers to offer customers broadband services of several hundred Mbps and even 1 Gbps. While the number of 1 Gbps services is limited in GPON due to the capacity limitations, next-generation networks such as NG-PON2 and XGS-PON are being deployed today that increase the downstream aggregate bandwidth to 10 to 40 Gbps, enabling broadband services of 1 Gbps to many more customers.

FTTP networks are also more easily upgraded to offer faster speeds as user demands increase. While other technologies may require locating more towers or field electronics closer to the customer, most FTTP upgrades can be accomplished simply by sending a command to provision a faster speed. Upgrades in FTTP central electronics and electronics on the customer home are only necessary when requirements exceed the speed of the equipment.

Satellites — Some ask if satellites might someday be the answer to rural broadband challenges. Geostationary orbit satellites (GEO) have been used to deliver broadband to some parts of the U.S. for years. These satellites are more than 22,000 miles above the equator and often offer 25 Mbps broadband service but recently have begun offering 100 Mbps service in some limited areas. However, these services have strict data caps, and because of their distance above the earth, they also suffer from high latency — often 10 or 20 times greater than a landline network. This makes them unsuitable for many modern applications.

Recently, companies have been launching a new generation of broadband satellites — Low Earth Orbiting Satellites (LEOs). These satellites are only a few hundred miles above the earth, so they do not suffer from the latency issues of GEO satellites. Because of their low altitude, they also have much smaller spotbeams on the earth and many more satellites, which should allow them to serve more customers at higher speeds. (Early beta tester speed results are between 50 to 100 Mbps downstream and 10 to 20 Mbps upstream.) These benefits come at the cost of increased complexity, which may make it difficult to provide broadband at reasonable prices. LEO satellites will still only be able to provide broadband to a very small fraction of the unserved and underserved broadband customers in the United States.

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04 Rural Broadband: **Moving Forward**

Overview

In many ways, the United States is entering a new broadband era. The technologies and practices for deploying broadband are being refined. New funding mechanisms are becoming available. A new presidential administration has listed universal broadband[1] among its top priorities. Meanwhile, the fallout from the COVID-19 pandemic has increased the sense of urgency to bring connectivity within reach of all Americans. As we move forward into this new era, several factors will impact how the broadband story unfolds.

State-Level Activity

Millions of federal dollars have been allocated in recent years, through a number of programs, toward funding broadband deployment. State governments, however, have increasingly recognized the need to become involved. Their focus has been in three key areas: 1) continuing to establish governance and funding structures, 2) clarifying who can provide broadband, and 3) addressing emerging digital issues and opportunities.[2]

In a study[3] released in October 2020, researchers with Oklahoma State University and Purdue University looked at the impact of state policies on the availability of broadband, specifically: 1) the availability of state-level funding programs, 2) the existence of a state-level broadband office or task force with full-time employees, and 3) restrictions on competitive entry into the broadband business. The study found a measurable positive impact in rural areas associated with state involvement on the availability of broadband, the presence of fiber networks and the incidence of competitive broadband offerings.[4]

More activity can be expected from states as the focus on broadband increases. Attention at the state level on broadband accessibility and affordability has been heightened by the pandemic, which has impacted public health efforts, businesses and education. Governors across the nation have jointly identified[5] strategies and best practices to guide states in expanding broadband to their citizens. These include:

- Establish robust, cross-cutting governance structures.
- Initiate partnerships with other state agencies, local and county governments, and other entities to kickstart broadband investments.
- Leverage anchor institutions to provide rapid community internet service.
- Leverage existing infrastructure projects with dig-once coordination.
- Leverage electric utilities' infrastructure and services to facilitate deployments of broadband networks.
- Coordinate and expand broadband affordability programs.
- Deploy innovative procurement strategies.
- Improve broadband coverage maps.
- Identify funding and financing sources for broadband deployment.

Broadband Funding

A major development in broadband funding for 2020 was the FCC's announcement in December of the winning bidders in phase one of its Rural Digital Opportunity Fund[6]. Preliminarily, 180 winners were approved to receive a portion of the $9.23 billion across a 10-year funding window. These winners represented projects in 49 states and one territory. FCC review of the winners to confirm they will perform as promised is currently underway in the face of questions regarding the vetting of such bidders prior to the auction being conducted.

In 2019, the USDA awarded grants, loans and grant/loan combos totaling $663,198,738 through its ReConnect program[7]. The purpose of this program was to support broadband development across rural America. The program's second round awarded $655,179,473, for a total investment of $1.3 billion. Construction for many of these projects is ongoing.

Beyond the major federal programs, there are some 50 sources of federal support for broadband projects[8]. These span dozens of agencies, including the Appalachian Regional Commission, the Department of Interior and the Institute of Museum and Library Services. Combined, this represents billions of dollars in available funding.

It is reasonable to suspect that additional broadband funding opportunities will come from the new presidential administration. Infrastructure development, including universal broadband, is listed under two of the four major priority areas for President Joe Biden: economic recovery[9] and climate change[10]. There is precedent for Biden's interest in broadband; when he served as vice president, part of the administration's response to the Great Recession was an investment of $7.5 billion in broadband projects[11] as part of the American Recovery and Reinvestment Act.

Policy Reform

The FCC in the next quadrennial will most certainly face important policy decisions that could have a major impact on broadband deployment.

What Is Broadband?

One of these is the definition of "broadband" itself. Under current FCC guidelines, broadband is defined as 25 Mbps download and 3 Mbps upload. Aside from the speeds themselves, the definition is important because it forms the basis for funding decisions — only those areas lacking 25/3 Mbps are eligible for federal "broadband" funding.

The need for more robust connectivity climbs as more services move online, education and work shift to the home, telehealth grows in importance, and streaming of movies, television, games and music increases. Many have therefore called for the current definition of broadband — which they already consider inadequate for the bandwidth requirements of many homes — to increase in order to ensure that networks funded in whole or in part by federal dollars will meet consumer demands for the foreseeable future.

This creates a difficult conflict for the FCC. If the definition of broadband shifts, millions of locations now considered served by broadband would revert back to an unserved status, wiping out years of reported progress. As the regulatory body's 2020 Broadband Deployment Report[11] states: "The number of Americans lacking access to fixed terrestrial broadband service at 25/3 Mbps continues to decline, going down by more than 14% in 2018 and more than 30% between 2016 and 2018."

Consultant and telecom industry veteran Doug Dawson frames this quandary[12] thusly: "I think that a new FCC will certainly be under pressure to relook at the definition, but they're going to have the same old dilemma of, do they have the courage to reclassify millions of homes as not having broadband anymore?."

Better Mapping

Mapping of where broadband is and is not available has long been an area of concern that the FCC is in the process of trying to fix. In 2019, the FCC took initial steps to address[13] the often-highlighted problems with its former practice of building its broadband coverage maps based on census block coverage as reported by internet service providers themselves. Providers will soon start to report their coverage areas based on geospatial maps, a move intended to provide much greater accuracy in determining what residences are truly underserved by broadband, and Congress has provided funds for the FCC to develop a "fabric" of serviceable locations against which providers can report the availability of broadband. It will still be important, however, for providers to report based upon a common set of standards, as more granular maps do not necessarily translate to more accurate maps unless all providers are reporting based upon the same sets of assumptions and assessments of network capabilities.

Net Neutrality

Finally, the FCC may well return its attention to the issue of net neutrality and the agency's authority to regulate broadband. In 2015, under the leadership of Chairman Tom Wheeler, the FCC used Title II regulations "to implement and enforce open internet protections, banning paid prioritization, and the blocking and throttling of lawful content and services."[14] Chairman Ajit Pai's FCC reversed course in its Restoring Internet Freedom[15] in

2018, returning to a deregulatory regime that focused primarily on transparency overseen by the Federal Trade Commission. It appears likely that a new FCC with a Democratic majority will choose to reexamine the policy yet again.

Adoption

As leaders at the federal, state and local levels work together to solve the challenge of broadband availability, another less obvious challenge is at work in the background: broadband adoption. Sometimes a resident is not connected to broadband because there is not a service provider in the area to connect them to broadband and sell them service. However, in many situations broadband service is indeed available and the resident has made the decision not to connect.

There may be a number of reasons behind the resident's decision. The FCC's Disaster Response and Recovery Working Group report identifies several potential barriers to adoption, including:

1. the monthly cost of the service;
2. the cost of an internet-capable device;
3. knowledge of how to use increasingly complex devices and services; and/or
4. lack of relevance from the user's perspective.

While the latter may come as a surprise, that and a lack of interest is the reason 34% of non-internet users give for why they are not online. Difficulty with using the technology keeps 32% of non-users offline, while 19% cite the expense of internet service and computers or other connected devices as a deterrent.[16]

If 15% of U.S. adults in rural America are not connected to the internet, this likely has a measurable impact on their quality of life. As the pandemic has highlighted, a lack of internet access puts citizens at a disadvantage for work, education, health care and social connections. The impact may be even more far-reaching, however, as a team of researchers reported in mid-2020.[17] A lack of broadband adoption may in fact impact job productivity in a community.

The study's authors wrote that "policies targeting adoption in rural areas may result in productivity increases" and conclude that "as more industries and business digitize and as more communities engage digitally with their citizens, ensuring that residents and businesses have the necessary resources to productively use broadband technology is essential."

The FCC Working Group recommended in its report a number of program ideas to promote broadband adoption. These include education, outreach, awareness, training and equipment, with a focus on partnerships with broadband providers and key community anchor institutions such as schools, libraries and agencies serving vulnerable populations.

As part of the Consolidated Appropriations Act of 2021, passed in December 2020, Congress set aside $3.2 billion to establish the Emergency Broadband Benefit Program.[18] The FCC is charged with implementing the program, which will provide eligible households a monthly discount of up top $50 off broadband service (up to $75 for Tribal lands), along with a reimbursement of up to $100 to broadband providers who provide a connected device to eligible households.

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ABOUT THE FOUNDATION FOR RURAL SERVICE

The Foundation for Rural Service (FRS) was established in 1994 as a non-profit 501(c)(3) by NTCA–The Rural Broadband Association. The organization plays a unique role within the telecommunications industry by supporting rural telecom companies, consumers and policymakers with educational information, products and programming. The FRS mission is to sustain and enhance the quality of life in America by advancing an understanding of rural issues. The vision of FRS is to harness the power of the rural communications industry to enrich lives in America.

With every program, FRS calls attention to rural challenges, goals and achievements, and educates the public and lawmakers on exactly why rural America is so unique and worth fighting for. Similarly, FRS is committed to educational achievement in rural communities, recognizing that tomorrow's economic and civic development depends on the involvement and success of today's students.

ABOUT RTFC

This project was generously supported by RTFC. RTFC is a privately funded, member-owned cooperative finance organization that provides financing exclusively to America's rural telecommunications industry. RTFC offers loans and financial services to creditworthy telecommunications systems eligible to borrow from RUS, as well as affiliates of these systems. For more information, visit www.rtfc.coop.

ABOUT WORDSOUTH

WordSouth — A Content Marketing Company was founded in 1996 to support the communications efforts of rural telecommunications and electric cooperatives. WordSouth partners with community-based service providers to help them tell their stories, market their services and train their people. In 2020, WordSouth was named to the Inc. 5000 list of America's fastest-growing privately held companies. Later that year it was acquired by Oregon-based Pioneer Utility Resources, a communications cooperative; the combined companies provide an array of services to broadband providers and electric distributors across the U.S.

ABOUT VANTAGE POINT

Better Broadband means Better Lives. Vantage Point Solutions help providers bring this promise to life through start-to-FUTURE engineering and consulting services tailored to the companies, Co-ops, and communities we serve. Our teams work seamlessly across disciplines to provide peerless service and expertise to our clients, and this comprehensive effort transforms the lives, businesses, and communities our clients serve. From feasibility to the field and beyond: Vantage Point's professional expertise and ethical business practices are trusted by 400+ clients coast to coast. Employee owned. We are the broadband people.

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4121 Wilson Boulevard • Suite 1000 • Arlington, VA 22203
703-351-2026 • www.frs.org