AN UPDATE ON CONNECTING RURAL AMERICA

The 2018 Microsoft Airband Initiative

EXECUTIVE SUMMARY

Our work and daily lives are increasingly becoming digital. The rise of cloud computing, combined with new productivity, communication, and machine learning tools, enables us to do more, and much more quickly. We now communicate, learn, innovate, and solve problems in ways that were simply unimaginable just a generation ago. But reaping the benefits of this exciting new digital world requires a high-speed broadband connection, a link not available to 25 million Americans, 19 million of whom live in this country's rural areas.

At Microsoft, we believe this is an urgent national problem that can be solved. It will require a focused and comprehensive solution that combines private sector capital investment in innovative technologies with strategic financial and regulatory support from the public sector. Together, we can achieve an ambitious goal—to eliminate the rural broadband gap by July 4, 2022.

The Microsoft Airband Initiative is our contribution to this national effort. Launched in 2017, it is a five-year commitment to tackle this persistent problem in innovative ways, like harnessing unassigned broadcast spectrum known as TV white spaces to bring broadband connectivity to 2 million unserved rural Americans.

In the year and a half since we announced the Microsoft Airband Initiative, we have established partnerships in 16 states that will bring broadband connectivity to more than 1 million rural residents who currently lack access. Through these partnerships, we have demonstrated that fixed wireless technologies including TV white spaces technologies, alongside traditional fiber optic and satellite coverage, can be the most cost-effective way to expand broadband availability in rural communities.

We also launched a wide range of pilot projects to test the use of TV white spaces and validate new business models and technologies. We have worked with hardware manufacturers to create an ecosystem of affordable and scalable TV white spaces devices. We've formed a partnership with the National 4-H Council to help people in rural counties gain critical digital skills to put their newfound connectivity to work. And we have worked with policymakers to create a stable regulatory framework that will drive further investment in rural broadband technology and infrastructure.

While we've made significant progress, we know there's a lot more to do to truly close the rural broadband gap. In the year ahead, we will increase the number of states with Microsoft Airband Initiative infrastructure projects and expand the work we are doing to offer skills training in rural communities. We will also continue to advocate for policies to accelerate the investment in innovative technologies needed to close the rural broadband gap.

We are excited to share this Microsoft Airband Initiative update as we deepen our commitment to bringing affordable broadband connectivity to rural communities—and to all Americans.

INTRODUCTION: AMERICA'S RURAL BROADBAND GAP

> "MORE THAN 20 MILLION AMERICANS LACK ACCESS TO HIGH–SPEED BROADBAND–A GAP THAT IS EXACERBATING THE PROSPERITY AND OPPORTUNITY GAPS ACROSS OUR COUNTRY, ESPECIALLY BETWEEN RURAL AND URBAN AREAS. AS THE ECONOMY, THE WORKPLACE, AND OUR DAILY LIVES BECOME MORE DIGITAL, IT'S CRITICAL WE CLOSE THIS DIVIDE. WE SIMPLY CAN'T AFFORD TO LEAVE ENTIRE COMMUNITIES BEHIND."
>
> **Brad Smith, President**
> Microsoft

During the past few years, how people work, play, shop, and learn about the world has changed dramatically. Industries have been reinvented. Jobs are being redefined. The way we create community and connect to people is being reimagined. New ways to treat diseases emerge almost every day.

Driving this remarkable transformation are cloud computing, advanced data analytics, and now, rapid progress in artificial intelligence. These technologies promise to speed progress in science and research, improve productivity, accelerate economic growth, strengthen communities, empower individuals, and help us find new ways to address some of the most pressing challenges we face in health care, education, sustainability, food security, and economic development.

But if technology-driven change and progress is a certainty, equitable access to the opportunities it creates is not. In our digital, cloud-enabled world, a reliable broadband connection is essential for everything from running and growing a business to completing school assignments, applying for a job, accessing high-quality health care, keeping up with the news, connecting with friends and family, and enjoying entertainment.

In short, broadband is the electricity of our age—a fundamental prerequisite for full participation in modern life and a basic requirement for access to the economic and educational opportunities that make success and prosperity possible for individuals and communities.

Unfortunately, broadband access is something millions of Americans lack today. According to the most recent statistics from the Federal Communications Commission (FCC), 25 million people in this country do not have access to a broadband-speed connection to the internet. The vast majority—more than 19 million—live in rural areas.[1] This means nearly 31 percent of rural residents in the United States are unable to take advantage of digital services and capabilities that are an everyday part of life for many urban residents. And there are strong indications that the FCC's numbers underestimate just how wide the gap between urban and rural America truly is.

Addressing this isn't just an issue for people who live in rural American communities—it is an urgent national problem. We simply can't afford to leave so many people behind as a new generation of technology breakthroughs drives new levels of opportunity and progress. Expanding access to broadband networks so that students, parents, farmers, workers, and small business owners across rural America can gain new skills, find and create well-paying jobs, increase productivity, and tap into new markets is essential for local communities to thrive and critically important to the nation's overall economic prosperity.

To begin to address the rural broadband gap, on July 11, 2017, we announced the Microsoft Airband Initiative. As we shared then, we believe advances in key technologies, changes to regulatory standards for communications, innovative business models, and the growing demand for a range of cloud services have laid the foundation for an ambitious but achievable national goal—to eliminate the rural broadband gap by July 4, 2022.

The Microsoft Airband Initiative is our contribution to this effort.

A comprehensive approach that combines private sector capital investments focused on new technologies with strategic financial and regulatory support from the public sector, the Microsoft Airband Initiative can serve as a catalyst for building the infrastructure the United States needs to ensure that broadband access is available to every American—including all who live in rural areas of this country.

The Microsoft Airband Initiative is a technology model that uses a combination of fixed wireless technologies—including unassigned broadcast spectrum often referred to as "TV white spaces"—alongside traditional fiber optic and satellite coverage. This approach can reduce initial capital and operating costs by more than 80 percent compared with using fiber optic cable alone and by approximately half compared with current fixed wireless technologies that use other spectrum bands.

At the heart of Microsoft Airband Initiative is our goal to bring broadband access to 2 million people in rural America who currently lack access by July 4, 2022. To achieve this, we shared three major initial commitments when we announced the Initiative in 2017:

1. We would provide direct investment to telecommunications companies for projects to expand access to broadband in rural areas of 12 states within 12 months.
2. We would invest in digital skills training for people of all ages in newly connected communities.
3. We would offer royalty-free access to our patents and sample source code related to TV white spaces technology.

A lot has happened since we announced the Microsoft Airband Initiative. We've made important progress and learned many lessons. All of our experiences have reinforced our belief that the rural broadband gap can be eliminated by 2022. Today, our commitment to work to ensure that all Americans have access to broadband is stronger than ever.

We are excited to provide this update on the Microsoft Airband Initiative as part of our ongoing effort to work in partnership with the public and private sectors, national and local organizations, and residents of unserved and underserved rural communities to expand access to broadband connectivity in rural America.

A NATIONAL STRATEGY FOR BRIDGING THE RURAL BROADBAND GAP

> "IT REALLY WOULD BE A GAME-CHANGER FOR RURAL AMERICA IF EVERY TOWN IN THIS COUNTRY WERE CONNECTED. . . I SEE IT IS AS AN ECHO OF THE RURAL ELECTRIFICATION EFFORTS WE SAW IN THE 1930s, ALMOST 100 YEARS AGO."
>
> **Ajit Pai, Chairman**
> US Federal Communications Commission

By the end of the 1920s, the electrification of urban America was nearly complete. Electricity to power homes, streetlights, factories, and trolleys had revolutionized manufacturing and transformed almost every aspect of people's lives in cities and suburbs across the country.

But by 1930, only 10 percent of the country's 6 million farms were connected to the electric grid and for most rural Americans, life looked a lot like it had in the 19th century. That meant the average rural resident still hauled water in buckets, cooked meals on a wood stove, and worked under the light of kerosene lamps. Modern conveniences that city residents took for granted—refrigeration, electric lights, indoor plumbing—remained a dream for their rural fellow citizens.

Over the next 20 years, a national rural electrification effort brought power to millions who had previously been left behind. By 1950, 90 percent of American farms were wired for electricity. The impact on economic opportunity and quality of life was dramatic. Automated milking machines cut the labor required to collect milk by 50 percent. The average value of crops per farm jumped more than 34 percent.[2] Farming families no longer had to heat water for cooking over wood fires, light their homes with kerosene lamps, or wash clothes by hand.

The parallels between the electrification of the United States in the first part of the 20th century and the digitization of the United States in the early decades of the 21st century are striking. According to the latest statistics from the FCC, 92 percent of Americans have broadband internet access, which the FCC defines as 25 megabits per second (Mbps) for download speeds and 3 Mbps for upload speeds.[3] In contrast, 31 percent of America's rural residents still rely on outdated technologies such as dial-up over copper wires or have no connection at all. This translates to 19 million people,[4] a number that is larger than the combined population of New York, Los Angeles, Chicago, Houston, and Philadelphia—the five largest cities in the United States. It's a number that's also equal to the combined populations of Nebraska, West Virginia, Idaho, Hawaii, New Hampshire, Maine, Rhode Island, Montana, Delaware, South Dakota, North Dakota, Alaska, Vermont, and Wyoming.

The Mismeasurement of Rural Broadband Access

The U.S. government's most current statistics on broadband come from the FCC's *2018 Broadband Deployment Report*, which states that 25 million Americans lack access to 25 Mbps/ 3 Mbps fixed broadband service. Of those, 77 percent live in rural parts of the United States.

In fact, there is strong evidence that the percentage of Americans without broadband access in America is much higher than the FCC's numbers indicate. The Pew Research Center has been tracking internet usage in this country since 2000 through regular surveys. According to their latest data, only 65 percent of Americans report that they use broadband at home.[5]

Our experience over the past 18 months through the Microsoft Airband Initiative—combined with what we have learned from our partners and through other research—makes it increasingly clear that many areas counted by the FCC as having available broadband access remain unserved.

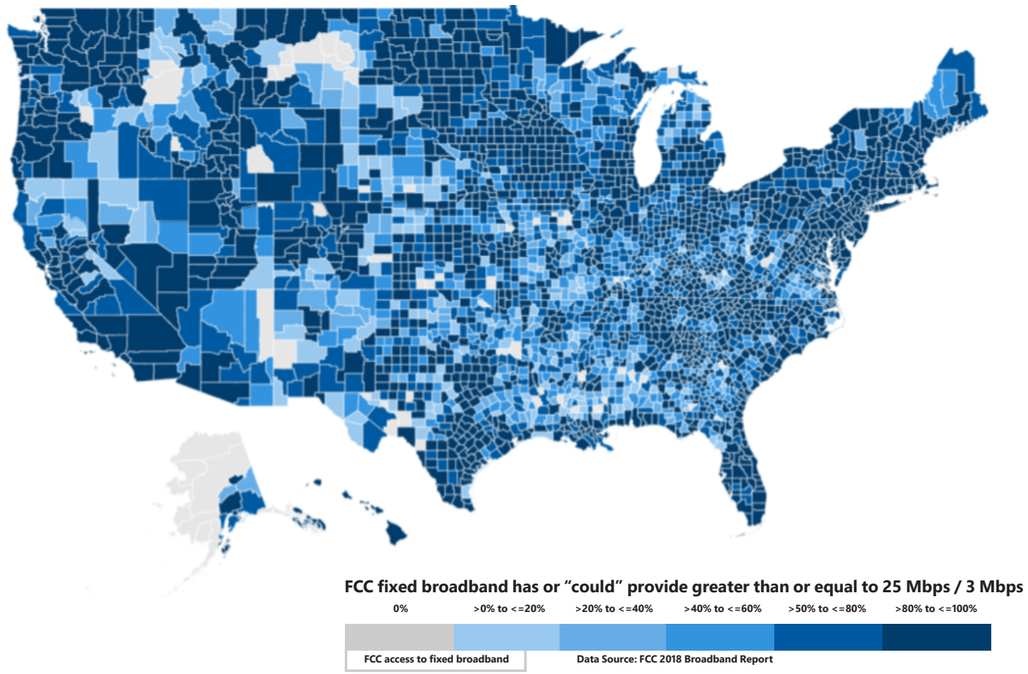
For example, we took a close look at one rural county where the FCC's data indicates that broadband access is available to every resident from at least one of the six telecommunications providers that provide service in the area. A closer analysis shows that two providers claim to offer access throughout the county—even in areas where there are no residents—but don't actually have residential customers in all areas. And if someone did want to sign up, it would cost $250 per month.[6]

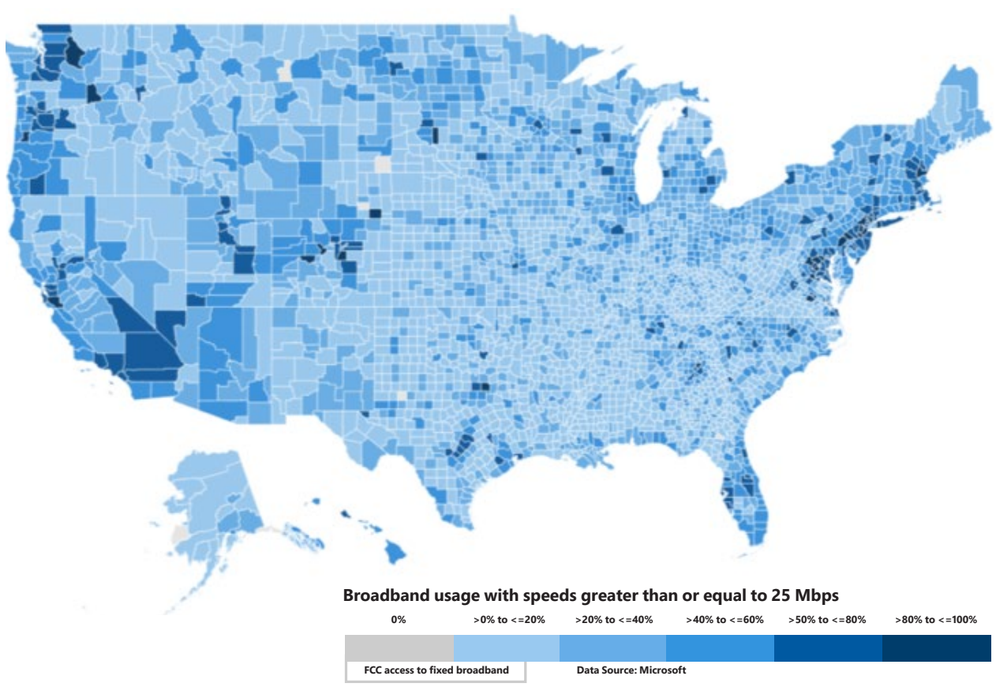
More than just a source of frustration, the lack of broadband has a significant impact on the economic life of the region. According to a real estate agent in that county, the availability of broadband plays a significant role in whether people are willing to live there. "As a realtor," he explained, "I can tell you one of the first things people ask about is if high-speed internet is available."

Another resident contributed this comment to a community chat board: "Our internet is pathetic! Literally one step above dial-up. There wouldn't be any way that you could run a business off of this service."

Research in Walton County, Florida, by Connected Nation, a Kentucky-based nonprofit that works to bring high-speed internet to communities around the country, found a significant discrepancy between the FCC's statistics and actual usage in the area. According to the FCC, 43,000 of the county's 55,000 residents have access to a broadband connection. But after cataloging telecommunications infrastructure and conducting phone and door-to-door surveys, Connected Nation found that the number of residents with access in Walton County is closer to 34,000. Instead of the 78 percent broadband access statistic reported by the FCC, a more accurate number is 61 percent.[7]

Data that Microsoft collects as part of our ongoing work to improve the performance and security of our software and services for customers provides additional evidence that the FCC overestimates broadband usage in the United States. While the FCC reports that 92 percent of Americans have access to broadband, our data indicates that the number of people who connect to the internet at 25 Mbps is probably closer to 49 percent. Largely rural states including West Virginia, Alaska, New Mexico, Arkansas, and Mississippi that rank among the lowest for broadband access according to the FCC are also among the lowest in our data.





One reason for this discrepancy lies in the fact that FCC data is based on census blocks, which are the smallest geographic unit used by the US Census Bureau (although some are quite large—the biggest, in Alaska, is more than 8,500 square miles). If an internet service provider (ISP) sells broadband to a single customer in a census block, the FCC counts the entire block as having service.

Even more problematic, the FCC asks not only if an ISP provides service to a census block, but if they "could . . . without an extraordinary commitment of resources." If the answer to that question is yes, even if service is currently unavailable, residents of that census block are counted among those who have broadband access.

These statistics are vitally important because FCC data is used by federal, state, and local agencies to decide where to target public funds dedicated to closing the broadband gap.

The Importance of Universal Broadband Access

What makes broadband so critical? And why is the lack of access in rural areas so consequential?

At a macro level, broadband has a clear positive impact on economic development and job creation. Leading universities and research institutions around the world have been working for more than a decade to understand how broadband access influences economic performance. The results show a clear correlation between expansion of broadband and higher economic growth rates. A meta-analysis conducted by the International Telecommunication Union (ITU) of six studies published in top peer-reviewed journals found that in the United States, a 10 percent increase in broadband penetration translates to an increase in GDP of 0.82 percent.[8]

The ITU also looked at eight studies that focused on the impact on jobs and found a significant relationship between increased access to broadband and higher employment rates or the net creation of new jobs.[9]

In addition, Map to Prosperity, a report from the Nebraska-based Center for Rural Affairs, cites studies that found that 80 new jobs are created for every 1,000 new broadband subscribers, that a 4 Mbps increase in residential broadband speed translates to an annual increase in household income of $2,100, and that job seekers find employment 25 percent more quickly through online searches than more traditional approaches.[10]

THESE FINDINGS SUGGEST THAT THE ASSOCIATION BETWEEN BROADBAND ACCESS AND HIGHER EMPLOYMENT IS PARTICULARLY STRONG IN RURAL AREAS.

Another recent study conducted by the Purdue Center for Regional Development assessed the potential costs and benefits of broadband in Indiana and estimated that the state would see $12 billion in net economic gains over a 20-year period. The study concluded that every dollar spent on expanding broadband generates $4 in economic benefits.[11]

The positive impact of broadband comes in many forms. For rural small businesses, it means improved access to distant domestic and international markets, the ability to compete on a more equal footing with companies of greater size, the potential to hire skilled remote workers, and the option to reduce costs and improve efficiency by utilizing cloud-based services. By providing the infrastructure for greater competitiveness, broadband increases the potential for rural businesses to attract and retain skilled workers who might otherwise look for opportunities in larger communities.

Lack of broadband access is almost certainly one reason only 6 percent of US jobs in the information, professional, scientific, and technical services sectors are located in rural areas, even though 19 percent of Americans live in rural communities.[12] And a study by the Bureau of Business Research at the University of Nebraska found that access to broadband has a significant positive influence on the likelihood that a new company will locate in a rural area.[13]

In education, online learning has become foundational for many aspects of teaching and learning in the 21st century. According to the 2016 report *The Broadband Imperative II: Equitable Access for Learning* from the State Educational Technology Directors Association (SETDA), "Schools and districts are moving towards student-centered, personalized learning approaches to increase student success—utilizing digital applications to support these deeper learning experiences. High-speed broadband access enables schools to expand learning options, allowing students to create content, participate in virtual courses that may not be available on their campuses, and to collaborate with experts or other students remotely."[14]

For students without broadband access, something as basic and essential as finishing homework assignments can be difficult. A recent study from the Pew Research Center found that nearly one in five American teenagers is "often or sometimes unable to complete homework assignments because they do not have reliable access to a computer or internet connection."[15]

By providing a way for people to connect quickly and easily with caregivers and access health information, telemedicine is another area where access to broadband can make a difference for rural communities, where the number of physicians per 100,000 people is significantly lower than it is in urban areas and where there may be no local access at all to doctors in specialties like cardiology or oncology.

In Mississippi, where 60 percent of counties are at least a 40-minute drive from specialty care facilities, the University of Mississippi Medical Center for Telehealth offers a wide range of telehealth services such as in-home monitoring, remote assessment of health data by clinicians, and the ability to connect with caregivers using videoconferencing. Researchers at this center estimate that if, for example, 20 percent of the diabetic patients in Mississippi were enrolled in the Mississippi Telehealth Diabetes Network, it would yield $189 million in Medicaid savings for the state of Mississippi every year.[16]

For farmers with broadband access, the ability to search for new customers, find buyers in more lucrative markets, and identify the most affordable sources of seeds, fertilizers, and farm equipment is boosting income. Broadband access is also essential for farmers to take advantage of a new generation of agricultural technologies built on sensors, data, and artificial intelligence that can help them conserve resources and increase yields. Having access to these new capabilities will improve rural prosperity and enable farmers to produce more food for a world that will add more than 2 billion people by 2050.

And at a time when most people use digital technology to communicate, access information, and stream videos and other entertainment, people without broadband have a much harder time keeping up with family, friends, and the latest news and cultural trends. This hurts us all because it means as a nation, we lose out on the ideas and talent of millions of rural Americans who are unable to participate fully in today's digital world.

CAUSES OF THE GAP BETWEEN BROADBAND ADOPTION IN URBAN AND RURAL AMERICA

CAUSES OF THE GAP BETWEEN BROADBAND ADOPTION IN URBAN AND RURAL AMERICA

There are a number of reasons why the broadband access gap between rural and urban America is so wide.

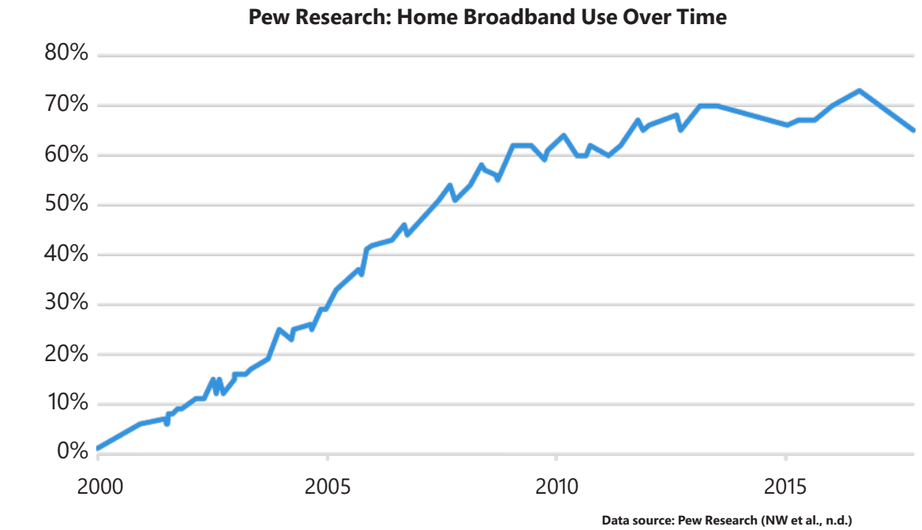
First and foremost, lower population densities and greater distances between homes and communities can make the cost of installing fiber optic cable—traditionally considered the gold standard for broadband services—prohibitively expensive in rural areas. Installing fiber optic cable can cost up to $30,000 per mile[17] and the price of connecting every home in American could run as high as $65 billion.[18]

According to the general manager of a telecommunications operator in rural Iowa, over the past two years, his company installed 72 miles of fiber optic cable to serve 75 homes at a cost of $18,000 to $20,000 per mile.[19] That translates to an estimated $1.4 million—a level of investment that is difficult for the private sector to justify.

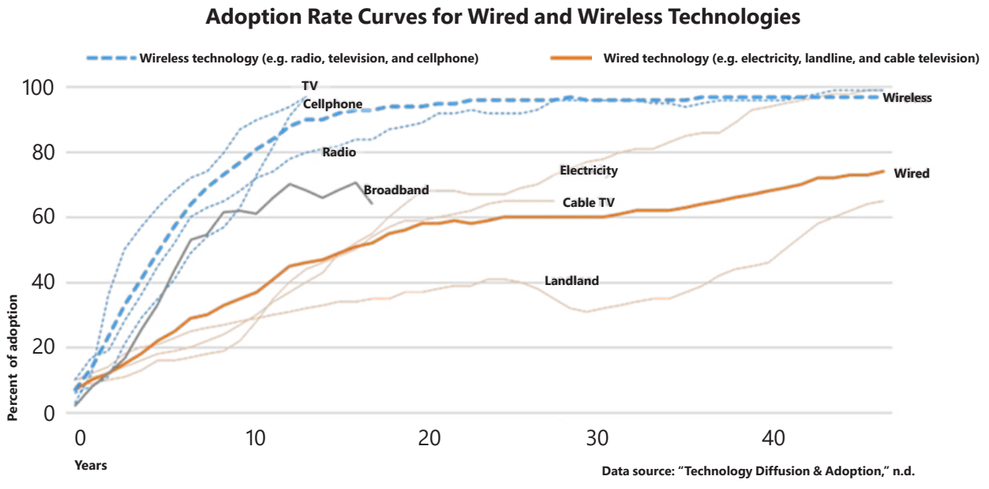
A second factor is that the development of alternatives to fiber optic cable has been slow and uneven. Mobile telecommunications technologies such as 4G LTE that provide broadband speeds on smartphones and other mobile devices are designed for densely populated urban areas and are subject to the same connectivity and capacity gaps as traditional broadband. The same will hold true for the 5G mobile technologies that are just now becoming commercially available. And while satellite broadband can be an appropriate solution in very sparsely populated areas, it is limited by high latency, lack of significant bandwidth, high data costs, and the inability to penetrate foliage.

Regulatory uncertainty is also an issue. For example, providers seeking access to rights of way for network infrastructure often face confusing federal, state, and local permitting rules that add time and expense to projects.

THESE FACTORS HELP EXPLAIN WHY BROADBAND ADOPTION IN THE UNITED STATES REACHED A PLATEAU IN 2013. ACCORDING TO THE PEW RESEARCH CENTER, HOME BROADBAND ADOPTION CLIMBED STEADILY THROUGH THE FIRST DECADE OF THE 21ST CENTURY BUT HAS REMAINED STUCK AT AROUND 65 PERCENT EVER SINCE.[20]



The adoption curve for broadband fits a larger pattern for technology adoption. Historically, adoption of wired technologies such as electricity, landline telephones, and cable television has been much slower than wireless technologies like radio, broadcast television, cellphones, and smartphones. For example, it took about 25 years to achieve near-universal adoption of radio and color broadcast television, but after 30 years, electricity and cable TV still hadn't climbed above 70 percent. More recently, the pace of adoption for wireless technologies has quickened significantly—cellphone adoption neared 100 percent in about 14 years and in just eight years for smartphones. Broadband adoption not only lags behind those two, it is even slower than it was for radio, more than 70 years ago.[21]



THE PROMISE OF TV WHITE SPACE TECHNOLOGY

We launched the Microsoft Airband Initiative because we are confident that a technology model that combines fixed wireless technologies including TV white spaces, traditional fiber-based connectivity, and satellite coverage can dramatically reduce the cost of extending broadband access to rural communities across America.

Our belief is based in part on directional findings from the Boston Consulting Group in 2017 that initial capital and operating costs for this approach would be about one-sixth that of fiber optic cable alone, and that TV white spaces would be the most cost-effective option for about 80 percent of unserved rural areas across the country. While we are still in the early stages of our efforts, our telecommunications partners report that the lower cost estimates are proving to be relatively accurate in the communities they are serving, and that TV white spaces technology will be the most cost-effective solution for about 70 percent of newly connected households in unserved rural areas.

According to the Boston Consulting Group's 2017 research, TV white spaces is the most cost-effective technology to connect areas with population densities of between two and 200 people per square mile. Where there are fewer than two people per square mile, satellite is more cost-effective because of the cost of infrastructure such as towers. In higher-density rural areas, 4G technologies become the most cost-effective option.

Cost estimates at that time suggested that reaching all unserved rural areas using fiber optic cable alone would cost between $45 billion and $65 billion. Using only fixed wireless 4G technology would be in the range of $15 billion to $25 billion. Using TV white spaces would further reduce the costs to betweeen $10 billion and $15 billion.[22]

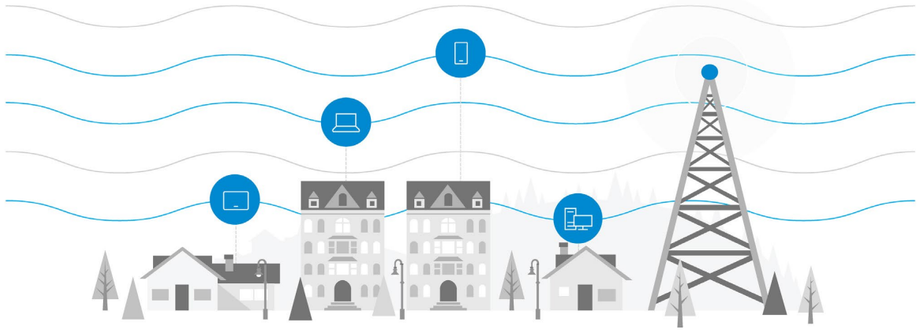
The optimal approach, however, is a mix of technologies based on specific local conditions such as population density, terrain, and existing infrastructure. With this approach, the research indicated that it would be possible to provide near-universal access across rural America for between $8 billion and $12 billion.[23]

How TV White Spaces Works

TV white spaces refers to unassigned or unused spectrum below 700 MHz historically used to transmit UHF and VHF televisions signals. This portion of the broadcast spectrum is ideally suited for rural areas because it can carry signals over much longer distances and penetrate terrain, walls, tree cover, and other obstacles better than cellular and other spectrum bands. In addition, there tends to be more TV white spaces spectrum available in smaller cities and rural areas, which typically have fewer licensed TV stations.

All of this makes TV white spaces spectrum good for last-mile wireless broadband access, in-building and in-home coverage, and Internet of Things (IoT) applications such as sensors. At the power levels and tower heights allowed by the FCC, TV white spaces radios can send and receive signals up to 10 miles in rural areas, giving consumers broadband access capable of running applications like high-definition video streaming and video conferencing. The suitability of TV white spaces to support a new generation of IoT applications will be critical as solutions based on AI technologies for public safety, transportation, agriculture, health care, energy, and the environment begin to emerge.

Use of TV white spaces became a possibility in 2008 when the FCC adopted regulations paving the way for more efficient use of underutilized portions of that part of the spectrum while protecting broadcasters and other licensees from interference. Today, the



FCC permits unlicensed access to TV white spaces through certified devices that operate under the control of a TV white spaces database that identifies available TV white spaces channels and appropriate power levels. To avoid interference with other users of TV white spaces spectrum, the database includes a list of protected TV stations and frequencies. Once available spectrum is identified, devices can use those frequencies, and even switch between frequencies as different channels become available.

Microsoft's Role in Fostering the TV White Spaces Ecosystem

Our confidence in the value of TV white spaces as a key part of the solution to the rural broadband gap is based on well over a decade of experience. Microsoft has been working with researchers, academic institutions, and other companies around the world to develop software-defined and intelligent radio systems for TV white spaces and other unused spectrum since 2002, when the FCC Spectrum Policy Task Force recommended that more spectrum should be made available on a dynamic basis.

These technologies are part of a shift from inflexible hardware-defined radios to increasingly flexible radios that use intelligent software to adapt dynamically to the changing spectrum environment and to define power levels, frequencies, channel sizes, modulation schemes, and more. This flexibility means software-defined radios can use TV white spaces and other spectrum bands with a high degree of efficiency.

Over the years, we have been involved in a wide range of research projects focused on TV white spaces and other forms of dynamic spectrum access. This includes the FCC's first field test of TV white spaces technology in 2008, which paved the way for the decision to allow unlicensed access to the TV white spaces under the control of geolocation databases. Since then, Microsoft Research has developed the first TV white spaces database research platform and conducted the first large-scale, outdoor trials using TV white spaces radios.

An important emphasis of our work on TV white spaces has been to share knowledge and form partnerships. In 2014, we released the source code for the Microsoft Spectrum Observatory, which collected and shared spectrum usage data from around the world to foster discussions with academics, governments, and other members of industry about how to make the most efficient use of spectrum. One result is the awareness that most spectrum is not used most of the time, something that was not well understood until a few years ago.

Through our research, we have extended the reach of TV white spaces signals farther than ever before. Today, our ISP partners can use TV white spaces to provide broadband that is easy for consumers and businesses to use through technologies that do not interfere with TV broadcasts or microphones, medical devices, or emergency communications that rely on the same spectrum band.

MICROSOFT AIRBAND INITIATIVE UPDATE

MICROSOFT AIRBAND INITIATIVE UPDATE

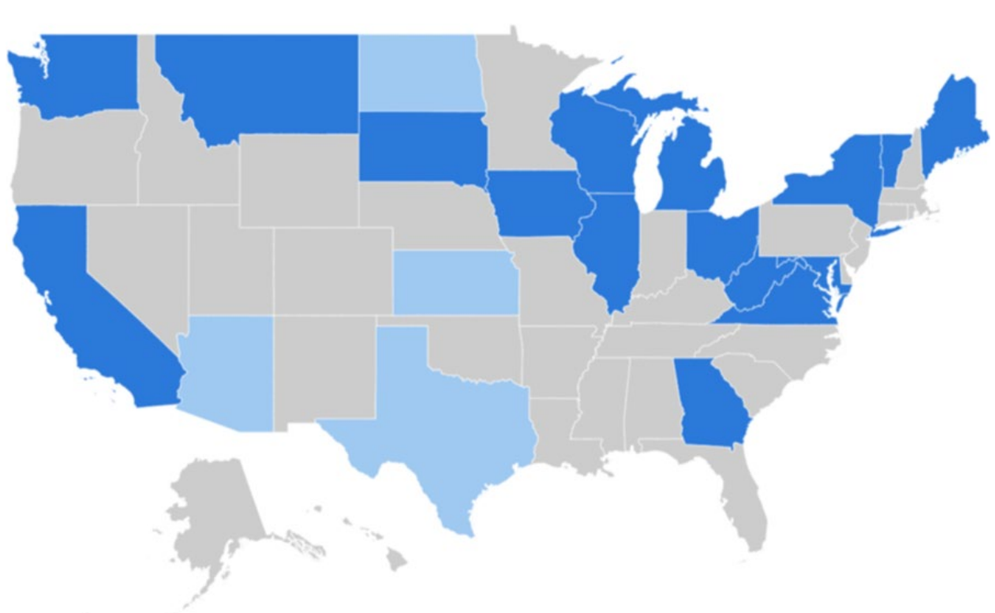
The central driving goal of the Microsoft Airband Initiative was to extend broadband access to 2 million unserved people living in rural America by July 4, 2022. As a first step toward reaching this goal, when we announced the Microsoft Airband Initiative in July of 2017, we committed to have 12 projects running in 12 states by the end of the first year of the project.

As we shared at that time, our intention isn't to directly profit from these projects. Instead, we have established a business model with ISPs in which we provide some funding support for upfront capital costs for broadband infrastructure projects with the possibility of recovering our investment through revenue sharing. We then reinvest those funds in subsequent projects to further expand coverage.

We also committed to invest in training programs to help people in rural communities take advantage of the capabilities that broadband connectivity offers to improve education, healthcare, agriculture, and transform businesses. Central to these efforts are initiatives that focus on technology access and education for young people.

And we launched a new program to stimulate investment in TV white spaces technology by offering free access to Microsoft patents related to TV white spaces and to sample source code to make it easier to implement TV white spaces technology for broadband connectivity.

States with Microsoft Airband Initiative Projects



States with Microsoft Airband Initiative commercial projects underway

States with Microsoft Airband Initiative pilot projects underway

Almost a year and a half into our five-year commitment to the Microsoft Airband Initiative, we believe we have made strong progress toward our goal.

- We launched partnerships with local and regional ISPs in 220 unserved rural counties in 16 states that will use TV white spaces to bring broadband over the next two to three years to more than 1 million people who currently lack access.
- We have numerous small-scale projects underway in rural communities that demonstrate the power of TV white spaces to close the rural broadband gap.
- We worked with hardware manufacturers to strengthen the ecosystem of component and device makers that can provide affordable, innovative TV white spaces technology for ISPs and consumers.
- We launched a partnership with the National 4-H Council to help young people and adults in counties that are gaining broadband access through the Microsoft Airband Initiative acquire the digital skills they will need to benefit from high-speed connectivity and thrive in the digital economy.
- We worked with industry partners, nonprofit organizations, and rural residents to advocate for policies that will close the rural broadband gap by updating federal regulations governing the use of TV white spaces, increasing public funding, and improving how the FCC measures broadband access.

Commercial Partnerships, Pilot Projects, and Grants

Since announcing the Microsoft Airband Initiative, we have worked with ISP partners to launch broadband projects that use a mix of technologies including TV white spaces in 16 states.

To bring broadband to customers in these states, we are currently working with eight ISPs through commercial partnerships, many of which include a return on investment for Microsoft that will be directed to future projects. The eight ISPs are:

1. **Agile Networks**
   The owner and operator of a data network composed of fiber and fixed wireless connectivity that reaches across Ohio, Agile Networks is working with Microsoft to use TV white spaces and other technologies to provide direct and wholesale broadband access to approximately 284,000 customers who currently lack access in rural areas in Ohio and West Virginia.

2. **Cal.net**
   Based in Shingle Springs, California, Cal.net is leveraging the newest technologies, including TV white spaces, to provide broadband access to over 41,000 customers who currently lack access in rural areas within the state.

3. **Declaration Networks Group**
   An alternative broadband access provider, Declaration Networks is focused on using disruptive technology to deliver high-capacity access services that offer significant cost and performance advantages. In partnership with Microsoft, Declaration Networks will use TV white spaces and other fixed wireless technologies and Wi-Fi networks to provide broadband access to 90,000 people in Accomack and Northampton counties in Virginia and Garrett County in Maryland, as well as Ferry and Stevens Counties in Washington.

4 Native Network

Based in Washington State, Native Network is dedicated to supporting Native American tribes and their lands by providing affordable hybrid and fixed wireless broadband internet access. Native Network is working with Microsoft to connect 74,000 customers in rural tribal areas in Washington and Montana through fixed wireless technologies including TV white spaces, fiber optic cable, and Wi-Fi networks.

5 Network Business Systems

An Illinois-based wireless ISP, Network Business Systems will construct and deploy wireless internet networks and develop innovative business models to provide fixed broadband wireless access to 127,000 customers in rural Illinois, Iowa, and South Dakota.

6 Packerland Broadband

Working with Microsoft, Packerland will provide broadband internet access to approximately 82,000 people living in rural regions of northern Wisconsin and the Upper Peninsula of Michigan who currently lack access. Packerland is using a combination of TV white spaces, fiber optic, hybrid fiber–coax (HFC), and wireless technologies to deliver low-cost broadband access to some of the most rural areas in those two states.

7 RTO Wireless

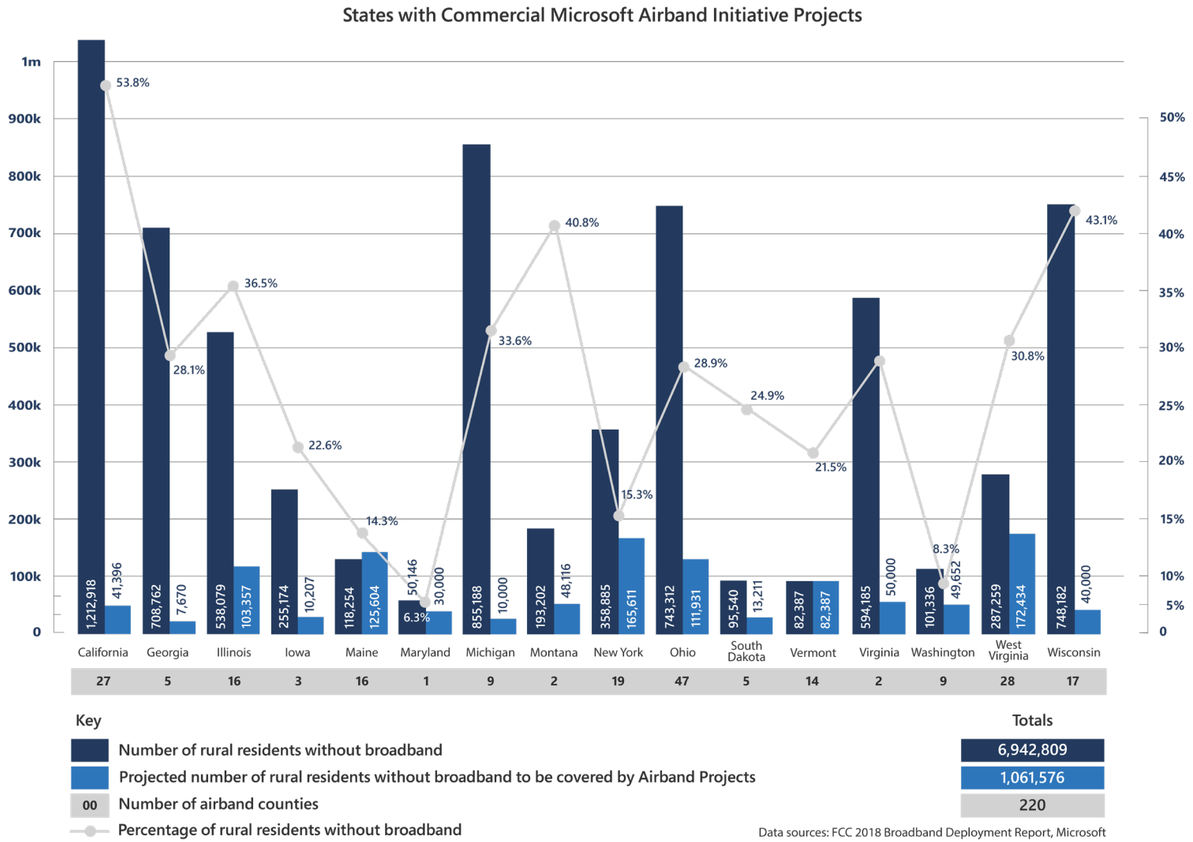
A rural broadband startup, RTO Wireless is utilizing innovative techniques and technologies including TV white spaces and Citizens Broadband Radio Service (CBRS) to deliver fixed and mobile wireless services in the Northeast. Through a partnership with Microsoft, RTO will provide broadband coverage to over 373,000 people who currently lack access in rural areas across Maine, New York, and Vermont.

8 WildFire5G

In northwest Georgia, WildFire5G is deploying a combination of TV white spaces and other connectivity technologies to deliver affordable broadband access to more than 80,000 people in five counties.

Pilot Projects and Grants

During the past 18 months, we have also worked with partners to launch a wide range of pilot and grant-funded projects. These small-scale efforts are designed to test innovative uses of TV white spaces and give ISPs an opportunity to validate new business models and new technologies as they lay the groundwork for larger commercial partnerships.



Here are just a few of the pilot and grant projects that are currently underway:

- **Adaptrum and Mid-Atlantic Broadband Communities**
  In Charlotte and Halifax counties in Virginia, Adaptrum and Mid-Atlantic Broadband Communities are working with Microsoft on a project also supported by the Virginia Tobacco Region Revitalization Commission to help close the homework gap for students who can't complete assignments at home because they don't have broadband access outside of school. The project takes advantage of existing fiber connectivity at public schools to extend broadband connectivity using TV white spaces to residential customers with school-age children.

- **Allband Communications**
  In Montmorency and Alpena counties in Michigan, Allband Communications has used an experimental license from the FCC to demonstrate that TV white spaces can be used to provide Wi-Fi access on school buses travelling in rural areas. Allband is also using TV white spaces to connect video cameras in state parks to help wildlife managers track deer and elk.

- **Axiom**
  In Washington County, Maine, Axiom is using TV white spaces to offer broadband access and digital literacy support for residences and small businesses. Axiom customers live in some of the most densely wooded and remote areas in Maine, where distance and tree density make other wireless technologies ineffective and expensive.

- **CvWireless**
  In Essex, New York, CvWireless is working to provide broadband internet access by purchasing fiber optic service and distributing the signal using fixed wireless technology including TV white spaces.

- **Dancing Crow Farm**
  In rural Washington State, Dancing Crow Farm is part of Microsoft FarmBeats, a pioneering initiative to use TV white spaces technology to take advantage of the power of cloud computing, sensors, cameras, drone mapping, and advanced analytics to help small farmers increase yields, reduce losses, and control costs.

- **Riverview Gardens**
  A nonprofit in Appleton, Wisconsin, focused on job training and employment, Riverview Gardens is using Microsoft FarmBeats technology to gain insights about farming practices, crop health, and resource utilization to develop sustainable farming program practices that can be replicated by farmers around the country.

- **Tribal Digital Village**
  Using TV white spaces and other broadband technologies, Tribal Digital Village is bringing connectivity to 20 tribal areas in California through networks that are owned and operated by local tribes, which also provide technology skills training to tribal members.

Digital Skills Training in Partnership with the National 4-H Council

At the Microsoft Airband Initiative launch in 2017, we announced a new partnership with the National 4-H Council called Tech Changemakers to help young people in rural communities gain digital skills, learn how to use digital technologies safely and securely, and identify challenges in their local communities and determine how technology can play a role in creating solutions.

Tech Changemakers programs are currently running in Georgia, Maine, Michigan, North Dakota, Virginia, Washington, Wisconsin, and Wyoming. Through Tech Changemakers, 4-H teen leaders engage with people from across their communities to develop solutions to their community's challenges by using technology in meaningful and relevant ways. While specific local issues include economic development, mental health, and food insecurity, a common thread across all Tech Changemakers projects is a gap in digital skills and limited knowledge of how to participate online safely and securely.

In response, 4-H teen leaders are learning new skills and applying them to the issues they have identified by offering training to adults, younger students, and teachers in their communities to help them take advantage of the power of digital technology. They are also building websites and community networks to distribute food to people in need, activating communities to respond to youth mental health issues, and sharing the needs of their communities with local and federal officials and agencies.

In addition, through our Microsoft TechSpark program, a national civic program launched in 2017 to foster greater economic opportunity and job creation in rural and smaller metropolitan communities, we are helping to bring digital skills and computer science education to young people and adults in rural areas that are gaining broadband access through the Microsoft Airband Initiative.

Building a TV White Spaces Technology Ecosystem

To be a viable and sustainable part of the solution to the rural broadband gap, we recognize that TV white spaces technologies must be as cost-effective as established fixed wireless technologies that are more suitable for connectivity in urban and suburban areas with higher population densities. To achieve this, it is essential to develop an ecosystem of component and device makers that can provide affordable TV white spaces technologies to ISPs and consumers at scale.

Because new communications technologies are typically designed for densely populated and more affluent urban areas, building such an ecosystem for rural markets isn't easy. But today, a TV white spaces technology ecosystem is beginning to take shape.

An important foundation is the pioneering work by TV white spaces technology and radio manufacturer pioneers such as Adaptrum and 6Harmonics. Their innovations in dynamic spectrum access and other technologies more than a decade ago demonstrated how TV white spaces radios can help governments extend broadband connections to schools, health care clinics, and government offices in underserved, rural communities.

Microsoft continues to work with hardware companies like Adaptrum and 6Harmonics to improve TV white spaces technology and develop devices that have more features, greater capacity, and better scalability—all at lower costs. Earlier this year, we announced a partnership with Redline Communications, a manufacturer of wide area network technology, to offer TV white spaces radios at prices comparable to fixed wireless technologies used for line-of-sight connections in higher population density areas.

We also announced an agreement with Radwin, a leading fixed wireless infrastructure company, to develop innovative, competitively priced TV white spaces solutions that are scheduled to be ready for market by the end of 2019. We hope these investments will inspire other manufacturers to develop their own low-cost TV white spaces products.

To truly create a large-scale market for TV white spaces technologies, the technologies must support networking applications beyond rural broadband access such as narrowband and wideband Internet of Things (IoT) applications. To help make this possible, we have entered into a partnership with Adaptrum to develop a baseband chip based on the IEEE 802.11af standard that will power TV white spaces connectivity for consumer and network devices. As part of the Microsoft FarmBeats project, we have also developed a narrowband IoT radio based on the LoRaWAN standard that can use TV white spaces spectrum for a wide range of agricultural sensors. These narrowband IoT TV white spaces radios can be used in many other industries, including oil and natural gas, mining, and natural resource management.

To ensure that ISPs can access TV white spaces in compliance with FCC technical regulations designed to protect broadcasters and other licensees from interference, we've worked with the network infrastructure technology company Nominet to develop a spectrum management database that controls how devices access TV white spaces frequencies. The FCC has certified Nominet's TV white spaces database for commercial operation.

And to stimulate demand for TV white spaces technologies, we are working with ISPs to aggregate demand so that manufacturers of TV white spaces devices can make their equipment available at volume prices to all Airband partners, regardless of size.

AS 5G IS INTRODUCED, TV WHITE SPACES CAN HELP CLOSE THE RURAL BROADBAND GAP

Typically, new communications technologies are designed for urban markets where demand and wealth concentrate. The economies of scale for these technologies make it difficult to deploy them profitably in rural areas with lower average incomes and population densities.

This should be an important consideration as 5G wireless technologies are introduced over the next few years. These high-speed, high-frequency, high-density wireless technologies are being developed in response to increasing demand for mobile wireless data in urban markets, and they will play an important role in providing the foundation for advanced capabilities built on artificial intelligence and the Internet of Things such as autonomous vehicles. But 5G technologies utilize radio frequencies that can only travel a few hundred feet and require a clear line of sight. This makes them unsuitable for broadband access in rural areas with lower population densities where signals need to be transmitted over much longer distances and pass through terrain, tree foliage, and other obstacles.

As the progression from 2G to 3G to 4G demonstrates, the adoption of each new generation of mobile wireless technology occurs first in more densely populated areas with higher average incomes, and takes years to reach rural and lower-income communities.

4G LTE was first deployed commercially in the United States in 2010. According to the research firm Strategy Analytics, 87.1% of US mobile wireless subscriptions are now on 4G LTE capable devices. Five years from now, 90.9% of US mobile wireless subscriptions are projected to be on 4G LTE capable devices. Only 6.3% of US mobile wireless subscribes are projected to be on 5G capable devices. The remainder will still be on 3G and 2G devices.[24]

5G may further widen the rural-urban digital divide unless there are complementary technologies that can make it cost-effective for ISPs to extend broadband to rural communities. With 5G residential service just now being introduced, it will be important for policymakers and communications technology providers to support complementary technologies that use a range of high-band (above 6 GHz), mid-band (1-6 GHz), and low-band (below 1 GHz) radio frequencies, including TV white spaces. This "rural 5G" strategy will give ISPs maximum flexibility to add capacity for customers who already have broadband access, while providing an affordable approach for deploying wireless broadband networks in rural areas.

MICROSOFT FARMBEATS

In a world with a finite amount of arable land and a global population that is expected to increase by more than 2 billion people over the next 30 years, one of humanity's most pressing challenges is how farmers can expand agricultural production by 70 percent. That's what experts say it will take to feed the 10 billion humans who will inhabit the earth in 2050.

An important part of the answer to this challenge is taking shape at Dancing Crow Farm in Carnation, Washington, outside of Seattle. There, on a few acres of rich agricultural land along the Snoqualmie River, a farmer named Sean Stratman is at the forefront of a new approach to agriculture that uses sensors to gather data about soil moisture, temperature, and chemistry, drones to gather aerial imagery, and cloud-based computing models to transform all that information into a precise picture of the conditions on nearly every square meter of his farm.

With this picture, Stratman can make pinpoint decisions about what each small section of his farm requires, saving labor, reducing costs, improving output, and pointing the way toward a future where farms of all sizes can operate more productively, more sustainably, and more profitably.

One of the biggest challenges for this kind of farming is how to get data from sensors in the soil to computers in the cloud. Most farms in rural America lack the kind of broadband access that is required. But at Dancing Crow Farm, Stratman is working with Microsoft researcher Ranveer Chandra as part of the Microsoft FarmBeats initiative. They've found that TV white spaces technology is ideally suited for connecting a field full of sensors to an application that can help Stratman know when it's the right time to plow, to plant, and to irrigate.

According to Chandra, data-based decisions like these will enable farmers to make the best possible use of all their resources—water, land, seeds, fertilizer, machines, and labor—in the future.

"It will help them become more profitable; they'll be able to grow more crops because their yields will go up. Whatever farming they do will be more sustainable, better for the environment, and it will help feed the world," Chandra says.

THE SOUTHERN VIRGINIA HOMEWORK NETWORK

According to the Pew Research Center, 17 percent of teens in the United States struggle to finish their homework because they lack a reliable internet connection.[25] For these students, almost every aspect of academic success is significantly more difficult, whether it's keeping up with assignments, communicating with teachers, accessing online learning material, doing research, or applying for college.

This disparity is sometimes called the "homework gap" and it is particularly acute for school-age children who are from low-income families or live in rural communities. This issue has particular relevance in Charlotte and Halifax counties in southern Virginia, where poverty rates are almost double that of the state as a whole, half of students don't have broadband at home, and the population density is less than one-eighth the state average.

To help close this gap, Microsoft, the Mid-Atlantic Broadband Communities Corporation (MBC), the TV white spaces technology company Adaptrum, and local internet service provider B2X worked together in 2017 to launch the Southern Virginia Homework Network, a pilot program to provide broadband to 200 households with children attending Charlotte County and Halifax County public schools.

It's a part of rural Virginia where TV white spaces is an ideal option. The combination of a scattered population, hilly terrain, and dense tree cover makes TV white spaces the most cost-effective way to reach remote homes without the prohibitive capital investment required for installing traditional broadband infrastructure like fiber optic cable. The Homework Network, which is now operated by Adaptrum, uses TV white spaces devices installed on 18 towers near schools that are already connected to a fiber optic network. These devices deliver long-range coverage that can penetrate hills and trees.

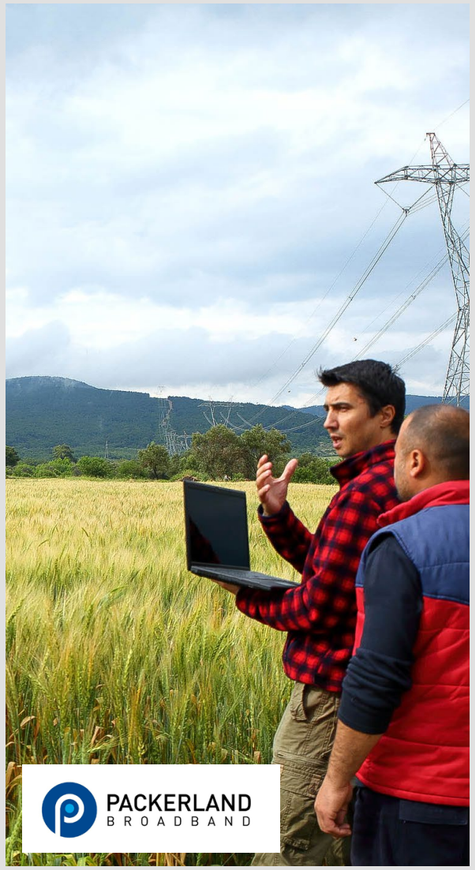
The pilot program has made a huge difference in the lives of students like Dylan Harris, who was a senior in high school when the Homework Network brought a high-speed connection to his house for the first time. Before that, he struggled with a satellite internet connection that was slow and unpredictable and often failed completely during storms.

Now a computer science major at Old Dominion University, Dylan says the Homework Network's broadband connection had an immediate impact. "My grades actually shot up," he explained. "With TV whites spaces, I got high B's and A's."

Originally planned to reach 1,000 homes, the Homework Network remains a highly successful pilot project that continues to provide broadband connectivity for 200 households with school-age children and serve as a test environment for Adaptrum's TV white spaces technology innovations.

One of the challenges for scaling the project more broadly is uncertainty over whether the FCC's E-rate program—a fund that makes communications and information technologies more affordable for schools and libraries—permits the use of TV white spaces and other wireless technologies to extend broadband coverage to students outside of school. Because the pilot project has been so successful, leaders of organizations involved in the Homework Network, including the superintendents of both the Charlotte County and Halifax County public schools, have petitioned the FCC for a clarification that would clear the way to use TV white spaces and other wireless technologies in projects like this one. That petition is still pending.

PACKERLAND BROADBAND



Citing the fact that his state ranks 30th in the country in broadband availability, in August, Michigan Governor Rick Snyder announced the Michigan Broadband Roadmap. “As technology continues to rapidly change and evolve, having access to fast, reliable internet is now a necessity for everyday life,” said Snyder at an event to introduce the new roadmap. “There are many regions of Michigan where internet is inaccessible or ineffective, and this plan works to make broadband internet available to Michigan residents in every corner of the state.”

Achieving this goal won’t be easy for a state where many of the 350,000 households that lack access are in remote rural areas where population density is low and the terrain is difficult. In those areas, the cost of building broadband infrastructure using fiber optic cable or other traditional approaches is so high that making the upfront investment often doesn’t make sense from a business perspective.

For families that live on the Upper Peninsula of Michigan, this has meant struggling with connectivity so slow at home that getting a simple web page to load is often impossible. But that is starting to change. Over the past few months, Packerland Broadband, a local ISP that uses a combination of fixed wireless and fiber optic and coaxial cable networks to serve customers in the Upper Peninsula and rural Wisconsin, has added TV white spaces and other fixed wireless technologies to extend broadband to households that lie beyond the reach of its existing network. In October, Packerland initiated service to 10 households.

The Teneycks, in Daft, Michigan, in Chippewa County, were among the first to get the new fixed wireless service. With download speeds that are 25 to 40 times faster than before, the change has been dramatic for the family of four with two school-age children. “It’s made life easier, especially homework and stuff for the kids,” said Jason Teneyck. “Everything is right there instead of having to go up the road for cell service or in closer to town to try and find internet.”

The launch of this new service received extensive coverage on local television, prompting a flood of calls from people wondering if they could sign up for the service. According to Packerland Vice President Cory Heigl, the company plans to use these technologies to bring broadband to thousands more households in the region by the end of 2019.

“Microsoft basically said it’s time to get real broadband to rural areas, and TV white spaces is a tool to get that done,” says Heigl. “Everybody deserves a high-speed connection. I believe that. We believe that as a company.”

PUBLIC SECTOR SUPPORT FOR RURAL BROADBAND ACCESS

We launched the Microsoft Airband Initiative because we recognize that there is an opportunity for the private sector to play a leading role in closing the rural broadband gap. In doing so, we can help the US government achieve one of its most important communications policy goals—making broadband available to every American, no matter where they live.

But the public sector has an essential role to play, as well. To maximize private sector investment in expanding broadband access in rural America, a stable legal and regulatory environment is critical. With the right regulatory framework and government policies, we'll have a more accurate picture of broadband availability and usage in rural America; the cost of deploying networks in rural areas will be lower; the choice of components, equipment, vendors, and broadband providers will be greater; more money will be available to invest; and, ultimately, broadband coverage in rural areas will expand.

Since we announced the Microsoft Airband Initiative, we have worked with policymakers and regulators at the state and federal levels to encourage them to take a number of steps to accelerate the deployment of broadband to rural America. We believe these steps should include:

- Updating FCC regulations to ensure that TV white spaces spectrum can be used by innovative, unlicensed wireless technologies to extend the reach of existing infrastructure to provide affordable broadband in rural areas.
- Ensuring that federal and state infrastructure investments include targeted funds for capital investments that will support private sector investment on a technology-agnostic basis so that the most effective technologies are deployed to solve the rural broadband challenge.
- Improving FCC measurement of broadband availability and adoption so that the government and the private sector can accurately assess different initiatives, technologies, and business models, and design more effective evidence-based policies and approaches.

Access to TV White Spaces Spectrum

Because providing ISPs with sustained nationwide access to TV white spaces spectrum is one of the most effective steps the US government can take to close the rural broadband gap, FCC action to finalize TV white spaces policies that promote the growth and evolution of this technology is critical.

The FCC has been a leader in this area since 2008, when it made the United States the first country to approve unlicensed use of TV white spaces. The current TV white spaces rules have been in effect since 2012. Subsequently, the FCC launched a series of rulemaking proceedings to implement a television band incentive auction that allowed broadcasters to vacate spectrum for which they held licenses so that it could be made available to mobile wireless operators. This required the reorganization of the TV spectrum band, creating regulatory uncertainty that has slowed investment in TV white spaces technologies.

ISPs and device and chip manufacturers need regulatory certainty in order to invest in TV white spaces technologies at the levels necessary to reach economies of scale. Recognizing the importance of TV white spaces, the FCC has already approved access in the "duplex gap" (the small block of spectrum between mobile service uplink and downlink) and on Channel 37. It is vital that the FCC preserve use of these channels for broadband applications.

However, there is still regulatory uncertainty over Channel 37. The FCC's technical rules allow TV white spaces devices to share Channel 37 with wireless medical telemetry systems but require additional unspecified testing before the rules can go into effect. To move the process forward, we have asked the FCC to proceed with testing. The FCC is also exploring rules that would require TV white spaces devices to protect from interference the wireless microphones that news broadcasters use.

As work continues to resolve these outstanding issues, Microsoft has suggested a number of changes that will improve the FCC's current TV white spaces regulations, accelerate expansion of broadband access in rural communities, and continue to protect current licensees—including police, fire, and other public safety agencies—from interference.

The changes we have suggested would:

- Set higher radiated power limits for TV whites spaces devices in less congested areas.
- Permit higher-power TV whites spaces devices on the first-adjacent channel, with appropriate safeguards.
- Allow fixed TV white spaces devices to operate at heights up to 500 meters above average terrain, subject to special coordination procedures.
- Modify technical rules to support the use of TV white spaces channels for narrowband IoT applications.
- Permit TV white spaces devices to operate in limited mobile environments such as on school buses or on tractors on farms.

These changes are a logical outgrowth of the FCC's current rules regulating TV white spaces and they are based on our experience working with partners to develop and deploy TV white spaces technology. They will support the expansion of affordable broadband service in rural communities and enable innovative use of TV white spaces for IoT applications. Together, these changes will improve the quality of life for rural Americans and strengthen the rural economy.

Public Funding

While we are confident that private sector investment can lead the way in closing the rural broadband gap, government spending can accelerate this work in ways that will dramatically improve people's lives. Already, federal and state investment in rural broadband initiatives has led to progress in the effort to connect rural Americans and is vital to ensuring that millions more Americans gain access.

To continue to drive progress, we suggest that the public sector should base its decisions about spending on broadband infrastructure on three basic principles:

1. Public spending should focus on capital investments that will best expand coverage into rural areas that currently lack broadband access.
2. Public funds should only be utilized in regions where the marketplace alone will not support extension of broadband access.
3. Public funds should be made available on a technology-neutral basis so that ISPs can use the most cost-effective technology, including TV white spaces, fixed wireless, and satellite connectivity.

It's important to note that not every rural broadband project requires public funding to be commercially viable.

THE GOAL OF THE MICROSOFT AIRBAND INITIATIVE IS TO USE INNOVATIVE TECHNOLOGY AND BUSINESS MODELS TO ENABLE OUR PARTNERS TO DEPLOY COST-EFFECTIVE NETWORKS IN UNSERVED RURAL COMMUNITIES WITHOUT RELYING ON PUBLIC FUNDING.

But where government support is necessary, we will support our partners' effort to obtain public funding for their initiatives to deploy TV white spaces projects in rural communities.

At the federal level, funding is available for broadband expansion in rural areas through the FCC's Connect America Fund. Among the initiatives in the FCC's Universal Service Fund, the E-Rate program has proved to be an important tool for bringing broadband connections to schools and libraries and could play an even bigger role in expanding broadband access in innovative, cost-neutral ways.

The USDA recently received a $600 million appropriation from Congress to invest in rural broadband through its Rural Utility Service over four years beginning in 2019. Microsoft has urged the Rural Utility Service to focus those funds on accelerating broadband deployment to America's farms. We believe this will speed the adoption of precision agriculture approaches that use sensors, aerial imagery, machine learning, and cloud computing. And while TV white spaces are an ideal technology for delivering broadband to farms and supporting farm-based IoT solutions, we believe strongly that this funding should be invested on a technology-neutral basis.

Many state governments have taken significant steps to promote broadband expansion as well. New York, for example, committed $500 million in state funds to its New NY Broadband Program. The California Advanced Services Fund has allocated $300 million to invest in broadband through 2022, and Colorado will provide $100 million in grants over five years beginning in 2019. Wisconsin's Broadband Expansion Grant Program has awarded more than $9 million in grants geared toward constructing broadband infrastructure in underserved areas of the state. The Virginia Telecommunications Initiative will award $4 million to eligible broadband projects in 2019.

We hope that state governments, like their federal counterparts, will focus on funding rural broadband initiatives in ways that will spark private sector investment and innovation, and on investing on a technology-neutral basis. We also see significant opportunities to speed rural broadband expansion by pairing FCC Universal Service Fund spending with state-sponsored grants and support.

In addition to funding from existing federal programs, we support legislation that would provide investments and other financial incentives for broadband deployment in rural areas, such as the proposed Airwaves Act. It would set aside 10 percent of future spectrum auction proceeds for the Universal Service Fund for wireless broadband services.

A number of other bills have been proposed in Congress this year that offer promising approaches to expanding broadband access in rural areas. Examples include a bill that would allow the Department of Agriculture to finance broadband technology for distance learning and telemedicine in rural areas; an amendment to the Rural Electrification Act of 1936 that prioritizes investment in rural areas that have fewer than 10,000 permanent residents or have a high percentage of low-income residents; and another that would amend the Communications Act of 1934 to provide universal broadband service to improve the ability of farmers and ranchers to utilize precision farming techniques.

Broadband Reporting

As described above, there are very strong reasons to believe that the FCC significantly underestimates the number of rural Americans who currently do not have access to broadband connectivity.

As Senator Roger Wicker of Mississippi said in March when he, Senator Maggie Hassan of New Hampshire, and Senator Jerry Moran of Kansas introduced the MAP Broadband Act, "The FCC's seriously flawed mobile coverage map threatens to exclude many rural communities from much-needed wireless broadband support. The FCC should address Americans' concerns and fix this inaccurate map."

Accurate broadband data is critical because it plays a vital role in decisions about how to allocate federal and state investments in expanding rural broadband. The ability to accurately assess whether an area has broadband access may ultimately determine whether its residents are able to participate in the 21st century economy because places considered to be served are ineligible to receive Universal Service Funds or grants and investment from many other government programs.

The starting point for improving how the FCC measures broadband access and generates its service maps is to revise Form 477, which is the Commission's principal tool for gathering data on communications services, including broadband deployment and subscribership. The form currently counts census blocks as having access to fixed broadband if an ISP reports that it currently provides broadband service or could provide it. Revising the form so that only census blocks where broadband access is actually currently available is an important step toward improving the accuracy of FCC broadband maps.

Our own research and the work of our partners and other organizations suggests that there are methods for measuring broadband access in rural areas that would provide more accurate results. We look forward to working with the FCC and the National Telecommunications and Information Administration as they consider how they can collect data that creates a more complete picture of broadband access in rural areas.

CONCLUSION: A DEEPER COMMITMENT TO BROADBAND ACCESS FOR RURAL AMERICANS

CONCLUSION: A DEEPER COMMITMENT TO BROADBAND ACCESS FOR RURAL AMERICANS

Almost a year and a half into the five-year Microsoft Airband Initiative, we are pleased to report clear, measurable progress toward our goal of extending broadband access to 2 million unserved rural residents by July 4, 2022.

Just as important, through our work with a wide range of private sector partners including ISPs, technology developers, and device manufacturers, we are helping to create a vibrant TV white spaces ecosystem that is already delivering affordable broadband service to rural communities that have not been reachable in a commercially viable and cost-effective way until now.

And, through our ongoing collaboration with policy leaders in state and federal government agencies, we continue to work to achieve regulatory clarity and advocate for the smart use of targeted funding that will promote innovation and accelerate the expansion of broadband services to rural Americans.

At the same time, we know we have a lot more work to do. Nineteen million rural Americans—probably more—still lack access to broadband. This means there are millions of school children in rural communities who have a significant disadvantage when it comes to the quality of their education. Too many rural businesses lack the digital tools they need to be competitive in our connected, global economy. Farmers are missing out on important opportunities to improve productivity and operate more sustainably and more profitably. Digital capabilities that most people who live in urban and suburban communities take for granted remain out of reach for a significant portion of people who live in rural America.

Our experience through the Microsoft Airband Initiative over the past 18 months has deepened our belief that an approach that combines private sector investments focused on new technologies with strategic financial and regulatory support from the public sector can, in fact, build the infrastructure to provide universal broadband access for rural America. Our commitment to this effort is stronger than ever.

In the year ahead, we look forward to continuing the work that we started in July of 2017. In addition to the 16 states where we have projects underway, we plan to launch new projects in regions of the country that have the highest concentration of rural residents without access to broadband.

We'll continue to work with technology developers and device manufacturers to make TV white spaces devices more powerful, more scalable, and more affordable. We'll share our technical expertise with ISPs that serve rural communities and work with them to help them utilize cloud services and create new revenue streams so they can build prosperous, sustainable businesses providing broadband to their rural customers.

We'll expand our efforts to offer digital skills training where Microsoft Airband Initiative partnerships are increasing access to broadband. We'll extend the work we started with the National 4-H Council to enable teens in 80 counties to address local challenges and help people in their communities learn digital skills so they can be full participants in today's technology-enabled world. We'll work with the Public Library Association to enable up to 50 libraries in rural communities to provide foundational digital skills and online safety training. And, through our partnership with the National FFA Organization, we'll help modernize learning opportunities to prepare students in FFA chapters across the country for digital jobs and enable those who are interested in the future of farming to gain the skills and knowledge to thrive as agriculture and technology continue to evolve together.

And we'll continue to work with federal and state policymakers to create a stable regulatory environment for broadband expansion in rural areas, and to help our partners obtain public sector funding and take advantage of incentives that will enable them to create sustainable business models that will allow them to provide affordable broadband services to their customers.

We have entered a time when access to broadband connectivity is a prerequisite for full participation in modern life. It is indispensable for education and health care, essential for business, the foundation for revolutionary techniques that will transform agriculture, and the key to participating in the cultural, social, and political life of the nation. As a new generation of solutions and capabilities built on artificial intelligence and the Internet of Things make their way into our day-to-day lives, broadband access will only become more important.

IN A WORLD LIKE THIS, WE BELIEVE WE ALL HAVE A RESPONSIBILITY TO ENSURE THAT NO ONE IN AMERICA IS LEFT BEHIND.

We're confident that with the right level of commitment, investment, and innovation from the private and public sectors, we can bridge the rural broadband gap.

We look forward to continuing to work in partnership with government leaders, companies that have the expertise to develop and deliver affordable solutions, and local community members to extend the opportunities and benefits digital innovation can deliver to rural communities across America.

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