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RURAL BROADBAND—EXAMINING INTERNET CONNECTIVITY NEEDS AND OPPORTUNITIES IN RURAL AMERICA

HEARING

BEFORE THE

COMMITTEE ON AGRICULTURE
HOUSE OF REPRESENTATIVES

ONE HUNDRED SEVENTEENTH CONGRESS

FIRST SESSION

APRIL 20, 2021

Serial No. 117–4

Printed for the use of the Committee on Agriculture
agriculture.house.gov

U.S. GOVERNMENT PUBLISHING OFFICE
47–123 PDF WASHINGTON : 2022

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RURAL BROADBAND—EXAMINING INTERNET CONNECTIVITY NEEDS AND OPPORTUNITIES IN RURAL AMERICA

TUESDAY, APRIL 20, 2021

HOUSE OF REPRESENTATIVES,
COMMITTEE ON AGRICULTURE,
Washington, D.C.

The Committee met, pursuant to other business, at 10:11 a.m., via Webex, Hon. David Scott of Georgia [Chairman of the Committee] presiding.

Members present: Representatives David Scott of Georgia, Costa, Adams, Spanberger, Hayes, Delgado, Sablan, Kuster, Bustos, Maloney, Plaskett, O'Halleran, Carbajal, Khanna, Lawson, Craig, Harder, Axne, Schrier, Panetta, Thompson, Austin Scott of Georgia, Crawford, DesJarlais, Hartzler, LaMalfa, Davis, Allen, Rouzer, Kelly, Bacon, Johnson, Baird, Hagedorn, Jacobs, Balderson, Cloud, Mann, Feenstra, Miller, Moore, Cammack, Fischbach, and Letlow.

Staff present: Lyron Blum-Evitts, Emily German, Prescott Martin III, Anne Simmons, Ashley Smith, Paul Balzano, Caleb Crosswhite, Erin Wilson, and Dana Sandman.

OPENING STATEMENT OF HON. DAVID SCOTT, A REPRESENTATIVE IN CONGRESS FROM GEORGIA

The CHAIRMAN. All right. Now, ladies and gentlemen, we are here to deal with one of the most important issues that our nation is faced with, and that is bringing rural broadband internet connections to everyone, including our rural communities. And I want to make it clear how important this is, and this is a number one issue facing our Committee. And I honestly believe that we are up to the task of getting it done now. Our rural communities have waited long enough. We want to be that galvanizing force to say let's do it now without delay.

Ladies and gentlemen, 24 million of our American citizens, 24 million in our rural communities have no access to the internet at a time when it is critical. Ladies and gentlemen, let me tell you another reason why this is so dear and important to me. I was born in a rural area, grew up there on my grandparent's farm back in the day when we had no running water, but the urban cities had running water. We had to get it out of the well, get it out of the pump for everything. I was there when we had no electricity. We had the kerosene lamps when in the cities and the urban areas, they had electricity. Television was coming in. They could have the TV, radio, all of that. We in the rural areas did not. We are in that

same situation now because our rural communities don't have access to the internet. And I am telling you, we have talented and gifted Members on this Committee, both Democrats and Republicans, who have talked to me. We have shared our passion, and I am convinced that we here on the House Agriculture Committee can be the vanguard to now pass the money we need, get it out there in our communities now.

To help us solve this issue, we have assembled expert witnesses to come and tell us how we can do it now. They are experts in constructing and maintaining broadband networks in rural areas. And as I said, we are blessed to have the talented Members of Congress. I can think of no Committee that has more talent on it than ours. We can do the job because we are committed to do it.

But in our rural areas where they have no internet, there is no telemedicine. There is no rural healthcare there. And what healthcare they have is at a disadvantage without the technology and the internet. Students in our schools in the rural areas are at a disadvantage without access to broadband. And ladies and gentlemen, this is where our wonderful world of agriculture produces the food we need, the clothing we need, our timber for shelter. All the basic necessities are done in the rural areas, and if we are not able to get our farmers technologically up to date, we will gradually, and maybe even quicker than gradually, fall behind our current position, which we are hanging on by our fingernails, as being number one in the world in agriculture. We won't be able to keep this much longer if we don't put internet connections into our rural communities.

Let me just tell you, the benefits of what we call precision agriculture technologies that our farmers use, they have to have the access to the broadband to do it. Our fight for climate change, our farmers are moving with no-till farming, cover crops, but they are also moving into an arena now where a plethora of carbon markets are being established. We won't be able to manifest our movements in the climate change fight if our rural communities do not have that for more accurate planning, pest and nutrient management, for harvesting, for identifying new markets to sell their crops.

And so, this meeting is designed to help me and our Ranking Member, Mr. Thompson, as well as those of you on this Committee, to find out what we can do and what we must do. We can do it, gang. We are here in the right place at the right time to be the leaders in Congress to finally make sure that everybody in our nation, including these 24 million in the rural communities, finally have rural broadband internet connections.

[The prepared statement of Mr. David Scott follows:]

PREPARED STATEMENT OF HON. DAVID SCOTT, A REPRESENTATIVE IN CONGRESS FROM GEORGIA

Good morning, we are here today to discuss the critical issue of rural broadband and to hear from our witnesses about their experiences constructing and maintaining broadband networks in rural America. As always, I'd like to thank my Ranking Member for his bipartisan cooperation and willingness to work with me on this issue. I think we have a fantastic opportunity to seize this moment and take meaningful action to close the digital divide.

Rural broadband is critical for the growth and development of our rural communities. It's essential we act to finally close the digital divide that has kept so many

of our rural communities from reaching their full potential. As we have seen laid bare throughout this pandemic, we cannot delay in our efforts.

Rural broadband offers answers to many of the toughest issues facing rural communities today. The COVID–19 pandemic further highlighted the scarcity of health care resources in rural America. Access to quality high-speed broadband can not only provide rural residents with options for telemedicine, for health care facilities that require access to broadband it also allows for health care facilities to establish their operations in rural areas, bringing quality jobs and increasing the overall health and development of the community.

Our nation's students and businesses also experienced many changes during the pandemic, with many becoming fully remote at some point in 2020. Students without access to broadband, or the internet connected devices remote work relies on, were severely disadvantaged in their ability to learn and succeed. Many businesses also relied on their broadband connection to continue operating and stay afloat during the pandemic.

Broadband also provides opportunities to help us reach our climate change goals. The benefits of precision agriculture extend far beyond the farm, but to use these technologies farmers must have access to broadband. Precision agriculture provides farmers with information that allows for more accurate planting, pest and nutrient management, harvesting and provides farmers with opportunities to identify new markets to sell their crops.

I am excited to hear from the panel of witnesses that are before us today. Their experiences with building, expanding, and maintaining broadband networks in rural areas will help us identify how we can improve current broadband programs and target our investments to ensure communities have access to the resources they need to establish quality broadband services. I look forward to their important testimony.

I'd now like to welcome the distinguished Ranking Member, the gentleman from Pennsylvania, Mr. Thompson, for any opening remarks he would like to give.

The CHAIRMAN. And now, I certainly yield to my distinguished Ranking Member for any remarks he would like to make.

OPENING STATEMENT OF HON. GLENN THOMPSON, A REPRESENTATIVE IN CONGRESS FROM PENNSYLVANIA

Mr. THOMPSON. Absolutely, Mr. Chairman. Thank you so much.

Mr. Chairman, for years, the digital divide has left many Americans unable to access reliable, high-speed internet service with sufficient bandwidth to support all of the different programs or needs that we know that we have out there, from precision agriculture, to healthcare, to education, to commerce, and it has resulted in lost opportunities to expand businesses, to learn new skills, or even participate in daily activities.

I see this constant frustration every day. I am fortunate to live in the service territory of a rural electric cooperative which offers quality internet service to my home, but just a few miles away, my neighbors are on the wrong side of the digital divide. I represent 14 counties in rural Pennsylvania, and I can tell you it is like this all across my district, with digital haves and have nots just down the road from one another. It is a checkerboard of connectivity.

In the height of the pandemic, I heard one too many homeschooling horror stories that were the result of not having reliable access to the internet. A number of families were driving to the local library, sitting in a parking lot, and hoping to connect with the public WiFi within that building in hopes of completing assignments. COVID–19 laid bare the urgency of rural broadband, but the connectivity struggles in rural communities predate this pandemic, and they will not ease as we return to normal. As more of American life is being put online, more of it is being put out of

reach for Americans without high-speed internet access with sufficient bandwidth, and those without are falling further behind.

Despite years of effort and billions of dollars spent, too many communities are being left behind, and that is why today's hearing is so important.

Broadband is not just needed in our homes; it is desperately needed on our farms as well. The demands of a 21st century farm economy depends on reliable connectivity. This Committee has done tremendous work on a bipartisan basis to address the digital divide, most recently with the broadband provisions in the 2018 Farm Bill. Those changes reflected 2 years of work to develop policies and design programs which meet the unique challenges of rural communities. Unfortunately, those policies and programs are languishing. Changes and improvements championed by the Members of this Committee regarding eligible areas, long-term network viability, assistance for our most rural communities, program integrity and more, remain unfunded and unimplemented more than 2 years after they were signed into law. This is unacceptable, and it should be unacceptable to every Member of this Committee. We simply cannot do that if our best ideas are discarded.

So, Mr. Chairman, today I am going to renew my request to the Appropriations Committee to move past the ReConnect Pilot Program and finally fund the programs which we wrote together in the last farm bill. ReConnect has served its purpose as a pilot program, and now it is time to deliver on policies and programs that we promised the American people 2 years ago.

Now, I look forward to working with you as we engage our colleagues to tell the story of the 2018 Farm Bill and the improvements that we made. Now we have a great panel of witnesses today who understand the challenges and the complexity of operating rural broadband networks, bringing innovative solutions to life, and most importantly, serving their communities. So, welcome, Ms. Prather, Mr. Johnson, Ms. Robinson, and Dr. Park. Each of you has a remarkable story to tell of your work on behalf of rural communities across the country. I thank you for spending your time with us today, and I certainly look forward to your testimony.

Mr. Chairman, 100 years ago, if the electrification of rural America was done with the same piecemeal and silos that we experience today in our work with broadband, I fear that many communities would still be in the dark.

So, I would like to close on a personal note, Mr. Chairman. There was a lot of frustration on this side of the dais during the reconciliation markup, but you committed then to making broadband a priority, and making it bipartisan. And we are here today making it bipartisan and a priority. So, thank you for being true to your word. I look forward to working with you and Chairman Delgado, Ranking Member Fischbach, and all of our Members as we strengthen the case for the broadband investments needed in rural America and our rural communities.

Thank you so much, and I yield back.

The CHAIRMAN. Yes, thank you, our Ranking Member Thompson. I appreciate that.

The chair now would request that other Members submit their opening statements for the record so our witnesses may begin their testimony now.

We have such a distinguished panel that is here, and I would just want to take a few minutes to tell you about them.

First, I am pleased to welcome our first witness, Ms. Jennifer Prather. Ms. Prather is the Vice President and General Manager of Totelcom Communications, a rural broadband and telecommunications company headquarters in De Leon, Texas. Totelcom Communications is a community-based provider that employs fiber, wireless, and traditional copper-based facilities to deliver quality broadband to its customers.

To introduce our second witness, I am pleased to yield to our distinguished colleague, the gentleman from New York and the Chairman of our Subcommittee on Commodity Exchanges, Energy, and Credit, Congressman Antonio Delgado. You are now recognized.

Mr. DELGADO. Thank you. Thank you, Chairman Scott, Ranking Member Thompson. It is my privilege to introduce our next witness and my constituent, Tim Johnson. Mr. Johnson is the CEO of OEConnect, LLC, and Otsego Electric Cooperative. Now, Tim and I have had many conversations back home in the district, both in person and virtually of late, about the critically important work of Otsego Electric Cooperative. He is a true leader in our community and has extensive knowledge about rural broadband access and affordability. Otsego Electric Cooperative provides broadband service to thousands of households in the most rural and underserved parts of upstate New York. The cooperative is located within the community it serves, and understands that broadband access empowers our rural communities. The cooperative also understands that rural broadband access and affordability go hand-in-hand. It has made these services available at a fair price. The COVID–19 pandemic has made even more clear that having reliable internet connection is a necessity, and Otsego Electric Cooperative has worked tirelessly to expand broadband access, making sure healthcare workers have service, helping students attend remote learning, and ensuring small businesses can enter the e-commerce marketplace. I am proud that New York District 19 is represented here today by Mr. Johnson. Mr. Johnson, I look forward to hearing your testimony and learning more about how Congress can best support you in making sure that rural areas have equitable access to broadband. Welcome.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you.

And now to introduce our third witness, I would like to yield to Congresswoman Kim Schrier, our distinguished colleague from Washington.

Ms. SCHRIER. Thank you, Mr. Chairman. I am delighted to introduce Vickie Robinson, the General Manager of Microsoft's Global Airband Initiative, as one of our witnesses this morning.

Ms. Robinson joined Microsoft in January of 2018 after nearly 2 decades in the service of the FCC in multiple leadership roles. At Microsoft, Ms. Robinson leads the Airband Initiative, which aims to close the digital divide and bring high-speed internet connectivity to unconnected communities in the U.S. and around

the world. Ms. Robinson, I am so excited to listen to your testimony this morning, and I am looking forward to discussing the work Microsoft is doing to expand broadband access in our home State of Washington later on.

Thank you.

The CHAIRMAN. And, I thank the gentlewoman for her remarks.

To introduce our fourth and final witness today, I am so pleased to yield to our colleague on the Agriculture Committee, our distinguished gentleman from Indiana, Mr. Baird.

Mr. BAIRD. Thank you, Mr. Chairman and Ranking Member Thompson. I really appreciate the opportunity to introduce our next witness. He is a member of the Congressional District 4. He is a product of Purdue University and the Research Park—and the skills that he has, I think you are going to really enjoy his testimony.

I want to give a little of his background, because I think that helps understand how well he understands the need for broadband at the last mile or in the agricultural arena, as well as advanced manufacturing. But he is currently the CEO of Wabash Heartland Innovation Network, or the short version of that is WHIN, and that is a consortium of about ten counties in north central Indiana, and they are devoted to developing the region into a global epicenter of digital and agriculture next generation manufacturing. And they are going to do that by harnessing the power of the Internet of Things, IoT.

Anyway, prior to serving WHIN, Johnny found and he scaled up and led a successful exit of an ag company, Spensa Technologies, and he produced smart Internet of Things devices that were able to analyze the data and help growers better manage agronomic pests such as insects, weeds, and disease. So, Spensa was named by Forbes as one of the top 25 most innovative ag startups in 2017. So, Johnny has a lot of experience and a lot of knowledge in this arena. He has a B.S. and a master's and a Ph.D. from Purdue University in the School of Electrical and Computer Engineering.

So, it is with great pleasure that I welcome Dr. Park to serve as a witness to our Agriculture Committee. Welcome.

Mr. Chairman, I yield back.

The CHAIRMAN. So, I am so pleased to have such a distinguished panel of witnesses before us today and I know we are all excited to hear what they have to say. Each of our witnesses will have 5 minutes and the timer should be visible on your screen and will count down to zero at which time your time will have expired. Ms. Prather, you are now recognized for our first 5 minutes. Please begin when you are ready.

STATEMENT OF JENNIFER L. PRATHER, VICE PRESIDENT AND GENERAL MANAGER, TOTELCOM COMMUNICATIONS, LLC, DE LEON, TX; ON BEHALF OF NTCA—THE RURAL BROADBAND ASSOCIATION

Ms. PRATHER. Thank you, Chairman Scott, Ranking Member Thompson, and Members of the Committee. Thank you for this opportunity to testify about one of my favorite topics, the importance of broadband infrastructure and how rural networks are deployed and sustained.

I am Jennifer Prather, Vice President and General Manager at Totelcom Communications in De Leon, Texas. My remarks today are on behalf of Totelcom, as well as NTCA—The Rural Broadband Association, which represents 850 rural community-based providers of high-speed broadband and other advanced services throughout the most sparsely populated areas of the country.

While high costs are the most imposing obstacle to deploying and maintaining broadband in rural areas, other barriers remain, too, to supply chain concerns and time consuming and expensive right-of-way and access delay issues. As Congress considers proposals to bridge the digital divide, we offer several specific recommendations with respect to any broadband infrastructure plan.

First, we should build networks that are built to last. Over the last year, Totelcom saw an increase of more than 200 percent in both download and upload demand. That represents almost 2 years of projected growth almost overnight. Fortunately, our fiber-based networks were built to meet that demand. Given that such demands keep growing over time, a smart infrastructure plan should aim for the best return on such long-term investments that meet future needs of consumers, and enable the deployment of a variety of broadband technologies. Putting resources towards infrastructure that must be substantially rebuilt in only a few years' time will be a waste, and risks leaving rural America behind.

Second, we must coordinate broadband programs and direct funding to unserved areas to limit overbuilding of existing network investments. Any new broadband program must coordinate with existing Federal broadband programs at the FCC, Department of Agriculture, NTIA, and state broadband programs. Additionally, existing programs that have a proven track record of success and promote accountability should receive additional support to build upon those successes. For example, USDA financing and Universal Service Funds support have long worked in concert, directing all programs, both old and new, to model on this history of success not only avoids duplication and helps deliver high-speed reliable broadband, but it also recognizes the hard realities of both deploying networks and then delivering services in the most remote, sparsely populated areas of the nation.

Third, it cannot be lost that networks must be maintained after they are built. No provider can deliver high-speed, high-capacity broadband in rural America without the ability to justify and then recover the costs of sustaining broadband in high-cost areas. Funding should be provided for this purpose as well, to make sure rates for services in rural areas remain affordable to consumers on these networks.

Fourth, there should be clear standards for what will be expected of providers looking to leverage Federal resources to meet the real-world needs of consumers and avoid using rural America as a test lab for unproven technologies. Those receiving any support should be required to show clearly that they meet those standards, and then use those resources to deliver better, more affordable broadband that will satisfy consumer demand over the life of the network in question.

Fifth, any plans should promote local partnerships. Service providers, like Totelcom, are based in their communities and have

deep, longstanding relationships with our local governments and anchor institutions. The best results can often be achieved when operators with significant experience in building networks and delivering communication services work together with stakeholders in the community to identify and respond to specific needs. Regardless of whether a provider is a cooperative or a commercial operator, we strongly urge policymakers to look local when it comes to identifying broadband solutions in rural America, and to leverage the expertise and experience of smaller, community-based providers like Totelcom, regardless of corporate form, in overcoming these challenges.

Finally, barriers to broadband deployment must be addressed as any part of a holistic plan to promote and sustain infrastructure investment. Supply chain shortages and access, particularly with respect to Federal lands and pole attachments, can present significant obstacles to deployment of rural broadband infrastructure. Permitting roadblocks, access delays, and increased costs are especially problematic for broadband operators.

Thank you for the opportunity to testify today, and for the Committee's commitment to broadband infrastructure investment in rural America. Our industry is excited to participate in this national conversation regarding broadband infrastructure initiatives, and we look forward to working with policymakers on a comprehensive infrastructure strategy to ensure that all Americans will experience and continue to enjoy the numerous agricultural, economic, educational, health, and public safety benefits of broadband.

I look forward to answering any questions the Committee may have for me. Thank you.

[The prepared statement of Ms. Prather follows:]

PREPARED STATEMENT OF JENNIFER L. PRATHER, VICE PRESIDENT AND GENERAL MANAGER, TOTELCOM COMMUNICATIONS, LLC, DE LEON, TX; ON BEHALF OF NTCA—THE RURAL BROADBAND ASSOCIATION

Introduction

Chairman Scott, Ranking Member Thompson, and Members of the Committee, thank you for this opportunity to testify about the importance of broadband infrastructure to rural areas and how rural broadband networks are deployed and sustained. I am Jennifer Prather, Vice President and General Manager at Totelcom Communications in De Leon, TX. My remarks today are on behalf of Totelcom, as well as NTCA—The Rural Broadband Association, which represents approximately 850 rural community-based carriers that offer advanced communications services throughout the most sparsely-populated areas of the nation.

NTCA members and companies like them serve approximately ⅓ of the U.S. landmass; in most of these sparsely populated rural areas, they are the only fixed networks available, providing essential communications services to just under five percent of the U.S. population and critical connections for businesses, anchor institutions, and providers of wireless services across rural America. Indeed, small telecommunications providers connect rural Americans with the world—making every effort to deploy advanced networks that respond to consumer and business demands for cutting-edge, innovative services that help rural communities overcome the challenges of distance and density. Fixed and mobile broadband, video, and voice are among the services that many rural Americans can access thanks to the commitment of small, local providers to serving sparsely populated areas.

Totelcom is a community-based telecommunications provider with 45 employees serving a $1,182^2$ mile area with an average of 3.4 customers per square mile. Nineteen percent of our customers reside in just 2^2 miles, while the remaining 81 percent reside in the other $1,180^2$ miles—so the population density of the more rural areas is just 2.75 customers per square mile. We provide more than 4,500 total con-

nections to customers, delivering voice services and broadband using a variety of methods. Using every available "tool in the toolkit," we employ fiber-to-the-home technology and traditional copper-based facilities to provide broadband to most customers, and we also leverage fixed wireless point-to-point broadband to reach customers in some of the most remote portions of our service area.

Our networks allow agricultural producers and other rural businesses to communicate with suppliers and sell to new markets, they enable education of our children on par with opportunities in urban areas, and they make our communities attractive destinations for people and businesses to relocate. Throughout the pandemic, our networks connected the local hospitals, supported health care delivery, and enabled thousands of Americans to work or learn from home. In rural America, that translates into economic development that produces and preserves jobs, not only in agriculture, energy, and other industries with a strong rural presence, but also in the healthcare, education, and other retail industries.

Unique Challenges of Rural Broadband Deployment

Building broadband networks is capital-intensive and time-consuming; building them in rural areas involves a special further set of obstacles. The primary challenge of rural network deployment is in crossing hundreds or thousands of miles where the terrain is diverse. The costs of constructing networks in areas where there are only a handful of customers per route mile or square mile are significant, and the ability to recover those costs is difficult when these communities and rural areas are so sparsely populated. To complicate further the unique rural challenges of distance and density, when crossing Federal lands or railroad rights-of-way in rural America, network operators must address environmental and historical permitting concerns or contractual obligations that can delay construction projects and increase their already high costs.

Then, once networks are built, they must be maintained over those hundreds or thousands of miles—this requires technicians who regularly travel long distances to make service calls and customer service representatives trained to deal with questions about things like router and device configurations. Even the best local networks in rural markets are then dependent upon "middle mile" or long-haul connections to internet gateways dozens or hundreds of miles away in large cities. Reaching those distant locations is expensive as well, and as customer bandwidth demands increase—moving from Megabytes to Gigabytes to Terabytes of demand per month per customer—so too does the cost of ensuring sufficient capacity to handle customer demand on those long-haul fiber routes that connect rural America to the rest of the world. Indeed, especially as applications like video streaming increase and place greater strains on these connections, we incur these costs and make the investments that make it possible for firms like Amazon and Netflix and others to reach their customers in rural America.

Small rural providers like Totelcom are eager to meet and overcome all of these challenges for the rural communities in which they live and serve, but it is important that they have the resources and regulatory stability to do so considering the importance of broadband to the current and future success and quality of life of rural America. Again, the delivery of broadband involves not only the one-time act of deploying a network, but the ongoing challenges of delivering services and keeping pace with user demand over the decades that the network will be operational. There is a great deal of understandable focus on the challenges associated with connecting every American to broadband in the first instance—and companies like Totelcom are front and center in this effort—but it cannot be lost that we need to take steps as well to make sure that these networks remain sustainable and that the services offered atop them remain affordable and relevant to customers for years to come.

Broadband Is Essential Rural Infrastructure

Rural broadband has far-reaching effects for both urban and rural America, creating efficiencies in health care, education, agriculture, energy, and commerce, and enhancing the quality of life for citizens across the country. Totelcom serves many important community anchor institutions, including a rural hospital and related emergency medical services, a medical clinic that serves low-income populations in three area towns, five school districts, three public libraries, and nine public safety entities, including police and rural volunteer fire departments. In recent years, Totelcom has built broadband to a number of dairies in the area to provide the bandwidth necessary for state-of-the-art smart dairy and farming practices, including radio-frequency identification, or RFID, tags on cows to track production and health. Totelcom also operates our own "genius bar" in the form of the Totelcom Learning Center, open weekly to assist customers in a one-to-one setting in a com-

fortable environment. Customers can bring in their electronic devices and seek assistance with email, saving and sending pictures, and even social media.

During the pandemic, we took the Federal Communications Commission (FCC) Keep Americans Connected Pledge to keep customers connected, regardless of their ability to pay. Totelcom stepped up to help our community, and in the beginning of the lockdowns, worked evenings and weekends to accommodate the sudden and intense increase in demand for new connections—many at no additional cost to the consumer. We set up several rural WiFi hotspots for anyone to use; upgraded area medical and educational facilities' bandwidth at no charge; provided free installs to any customer with a K–12 or college student in the household; partnered with the local schools to provide free service for students in need; and assisted the county emergency management center in setting up a communications center free of charge. NTCA estimates that on average, small, rural providers incurred $80,000 in uncollectibles during the pandemic due to customers' inability to pay. For Totelcom, we estimate our uncollectibles and lost revenue as a result of all of these efforts to keep customers connected to be more than $300,000.

As we look to future data needs of our customers and our communities, we have taken aggressive steps to focus on the anticipated increase in usage, including establishing a robust and reliable connection to a statewide fiber network that provides our "middle-mile transport" between our local communities and the rest of the world. We have also added a second connection to a separate internet point-of-presence as part of our network resiliency plan in case of an outage or damage to our network's backhaul infrastructure. This puts our customers in a great position as data needs grow, as we have seen our average data usage increase over 750% in recent years. Due to this demand, we continue to pursue fiber deployment as fast as possible, even as we also look to employ new technology in our copper and wireless networks to increase the pace of bandwidth upgrades to our customers.

The pandemic has highlighted the need to continue these investments as demand for bandwidth increases. Over the last year, while everyone began to work and learn from home, we saw an increase of more than 200% in usage, both download and upload. Due to our investments in our networks, we had the capacity to meet that demand. The speed and sustainability of deployment, however, will depend on both reasonable access to capital to finance construction and the availability of Universal Service Fund (USF) support to make sure user rates on these rural networks, once upgraded, are not astronomical and unaffordable. Again, while so many focus on the up-front financing aspects of this debate—which is important, to be sure—it is equally important that we not overlook the long-term viability of networks in these sparsely populated rural areas and the kinds of support mechanisms needed to sustain them and keep services affordable on them.

Much Progress, but Much More Work to Do

Despite the progress discussed above, many parts of rural America still need better connectivity. The good news is NTCA members have led the charge in getting rural America connected. Nearly ⅔ of NTCA member customers have access to 100 Mbps or better broadband and, on average, roughly the same proportion of customers are connected by fiber despite the very rural nature of the areas in question. But even as we believe the data show that there has been no better sector of the telecom industry when it comes to advancing rural broadband, seven percent of their customers still lack access to 10/1 broadband. In a country where the FCC has indicated that 94 percent of Americans already have affordable access to 25/3 Mbps service and many urban consumers and businesses benefit from 100 Mbps or Gigabit speeds, broadband access in rural America lags behind urban areas despite the best efforts, innovation, and entrepreneurial spirit of NTCA's members.

And, as I have noted earlier in this testimony, there is more to the equation than just building a network. It does no good to build a network if the provider cannot afford to operate it and repay the capital used to construct it—and even the very best network is certainly of little use if no one can afford to make effective use of the services offered atop it. Services must be activated and delivered, maintenance must be performed before troubles arise, "middle mile" capacity must be procured, and upgrades must be made to facilities and electronics to enable services to keep pace with consumer demand and business needs. In addition to these ongoing operating costs, networks are hardly ever "paid for" once built; rather, they are often built leveraging substantial loans that must be repaid over a series of years or even decades.

All of these factors make the delivery of broadband in rural America an ongoing effort that requires sustained commitment, rather than a one-time declaration of "success" just for the very preliminary act of connecting a certain number of locations. Particularly when one considers that even where networks are available many

rural Americans pay far more for broadband than urban consumers, it becomes apparent that the job of really connecting rural America—and, just as importantly, sustaining those connections—is far from complete. Federal law mandates that the Federal USF ensures reasonably comparable services are available at reasonably comparable rates in rural and urban areas alike. This mission cannot be lost as we focus on deployment. The rural broadband industry and our nation as a whole has a great story of success, but we also have much more work to do in both deploying and operating networks—and this is where public policy plays such an important role in helping to build and sustain broadband in rural markets that would not otherwise justify such investments and ongoing operations.

Aiming Higher and Doing Better

When it comes to solving broadband challenges, we as a nation can aim higher and do better than we have to date. Too many programs end up funding broadband that becomes irrelevant and unhelpful for consumers in short order. Instead of creating programs where the goal is simply that "every provider can play" on a "technologically neutral" basis, we must focus on the consumer experience and require the deployment of networks that in a decade or more will still deliver speeds and other performance capabilities that customers can rely upon in working or learning from home and that businesses feel will be worth the effort in considering relocation to a rural market.

If broadband is the critical infrastructure of the 21st century, we should aim to build sustainable infrastructure rather than stitching things together in ways that require starting the effort all over again just a few years later. Put plainly, when we are choosing what kinds of new networks to build, we need more fiber to help promote better broadband and to further a 5G future. Driving adoption should also become an express complementary goal of any efforts aimed at tackling availability—we are not building networks for their own sake but for the use of as many consumers as possible, and providers should be charged specifically to promote digital equity and inclusion on networks as they deploy them.

A Holistic Approach to Broadband Infrastructure

The critical role of communications infrastructure is as necessary to the present and future needs of rural America as is electricity and other infrastructure that enables the ordinary course of a thriving society. President Biden expressly recognized the importance of advanced communications networks by including broadband within his broader infrastructure initiative. NTCA applauds the apparent consensus that Congress is also making broadband an infrastructure priority and welcomes the opportunity to participate in a further discussion on how best to tackle this priority. Before turning to specific thoughts on paths forward, it may make sense first to outline a few key objectives for consideration with respect to any broadband infrastructure plan:

- ***Future-Proof Networks:*** Any resources provided as part of an infrastructure plan should look to get the best return on such long-term investments. For networks with useful lives measured in decades—especially private investments that leverage Federal dollars—this should mean the deployment of infrastructure capable of meeting consumer demands not only of today and tomorrow, but for 10 or twenty years. Putting resources toward infrastructure that needs to be substantially rebuilt in only a few years' time could turn out to be Federal resources wasted—and would still risk leaving rural America behind.
- ***Coordinate with and Leverage Existing Broadband Programs:*** The plan should leverage what is already in place and has worked before. Creating new programs from scratch is not easy, and if a new broadband infrastructure initiative conflicts with existing efforts, that could undermine our nation's shared broadband deployment goals. Any new Federal broadband program must coordinate with existing Federal broadband programs at the FCC, United States Department of Agriculture (USDA), and National Telecommunications and Information Administration, and also state broadband programs. Additionally, existing programs that have worked well and are successful in promoting both accountability and proven results should receive additional support to build upon their successes rather than having all new funds directed only to new programs that may duplicate efforts.
- ***Direct Funding to Unserved Areas:*** Prioritize funding for new construction to unserved areas to limit overbuilding of existing networks that are meeting Federal broadband standards. We should focus funding on the areas most lacking in broadband and seek to build the best kinds of networks in those areas—and we can then turn our attention to the areas next most in need once that

is complete. This approach will ensure the best possible use of Federal resources in the form of targeting funds for new networks to the consumers that need help most and ensuring that the networks then built to serve those consumers will last for decades thereafter.

- ***Hold Providers Accountable:*** There should be clear standards for what will be expected of and achievable by providers looking to leverage any resources made available through such an initiative. Looking to providers with proven track records in delivering real results makes the most sense, but whoever receives any support should be required to show clearly that they used those resources to deliver better, more affordable broadband that will satisfy consumer demand over the life of the network in question.
- ***Networks Must be Maintained:*** Any broadband infrastructure plan needs to be carefully designed and sufficiently supported to tackle the challenges presented. This is a question of both program focus and program scope.
  - From a focus perspective, any infrastructure plan should aim toward getting broadband where it is not and sustaining it where it already is; deployment of duplicative infrastructure in rural areas that are uneconomic—and may not even support a single network on their own—will undermine the sustainability of existing network assets.
  - From a scope perspective, deploying and sustaining rural broadband is neither cheap nor easy; we need to recognize that finite resources are available to address any number of priorities, but any plan that calls for broadband deployment—especially in high-cost rural America—should match resources to the size of the problem to be solved.
- ***Leverage Community-Based Providers:*** Providers like Totelcom live in or very close to the areas they serve—we know our customers, we know the geography, and we know the business of delivering communications services in these areas. As policymakers look for solutions to deliver broadband in unserved parts of rural America, small businesses based in or near those areas offer the greatest promise for achieving results quickly and effectively. Regardless of whether a provider is a cooperative or a commercial operator, like Totelcom, we strongly urge Congress and the Biden Administration to "look local" when it comes to identifying broadband solutions—and to leverage the expertise and experience of smaller community-based providers like Totelcom, regardless of corporate form, in overcoming these challenges.
- ***Promote Local Partnerships:*** Based in the small rural communities they serve, service providers like Totelcom have deep long-standing relationships with their local governments and anchor institutions. The best results can often be achieved when private operators with significant experience in building networks and delivering communications services work together with stakeholders in the community to identify and respond to specific needs. Creating programs that encourage and incentivize such partnerships and collaboration could unleash broadband investment and help sustain those networks once built.

Rural Utilities Service (RUS) Telecom Financing

The Strength of RUS Experience

Deploying a communications network in a rural area requires a large capital outlay due to the challenges of distance and terrain. The number of rural network users (as compared with more densely populated urban areas) is too small to justify investment in many cases and pay the costs of deployment and ongoing operations through customer charges. As Congress considers the details of legislation to promote infrastructure deployment, the crucial role that USDA's Rural Utilities Service has long played in addressing rural broadband challenges must not be overlooked. Since the early 1990s, the RUS telecom programs have financed advanced network plant at a net profit for taxpayers and helped deploy state-of-the-art networks to rural Americans left behind by providers unable or unwilling to serve low-population-density markets. With rare exception, RUS, CoBank and Rural Telephone Finance Cooperative are the primary lenders that small, rural providers can turn to for outside financing. Not only does RUS help rural America remain connected, but its various telecom programs make loans that must be paid back with interest—creating a win/win situation for rural broadband consumers and American taxpayers.

RUS and USF Work in Concert

While RUS lending programs finance the substantial up-front costs of network deployment, the USF High-Cost Fund helps make the business case for construction and sustains ongoing operations at affordable rates. More specifically, USF by law

aims to ensure "reasonably comparable" services are available at "reasonably comparable" rates. Not to be confused or conflated, RUS capital and ongoing USF support serve distinctly important, but complementary rather than redundant, purposes in furthering rural broadband deployment. Ensuring that USDA financing and USF support continue to work in concert not only avoids duplication and helps deliver high-speed reliable broadband to the consumer, but it recognizes the hard realities of both deploying networks and then delivering services in the most remote, sparsely-populated areas of the nation.

Farm Bill and Other Considerations

Apart from infrastructure legislation, the pending expiration of the current farm bill affords opportunity to review the Farm Bill Rural Broadband Program—previously referred to as the Rural Broadband Access Loan and Loan Guarantee Program—that was first authorized in the 2002 Farm Bill. Each subsequent farm bill has made extensive reforms to the program with the goal of greater accountability, efficiency, and effectiveness. Extensive rounds of program reforms in less than 20 years means that the Rural Broadband Program has been almost continuously "under construction" since its inception, rendering the program inaccessible to borrowers for long periods of time. While the program is not perfect, it may be helpful to simply let borrowers use the Rural Broadband Program in current form with minor updates—and full funding—before undertaking another extensive reform effort. NTCA urges the Committee to continue to support the Rural Broadband Program that is subject to the farm bill reauthorization process at full funding levels as you formulate recommendations. Furthermore, we urge the Committee to continue its history of support for all RUS telecom programs, which are also vital to the ongoing deployment and maintenance of advanced communications infrastructure throughout rural America. While more resources for rural broadband deployment are needed, involving more government entities and programs in broadband financing should be undertaken cautiously to avoid duplicating efforts and undermining a coherent, cohesive approach to financing and then sustaining rural broadband networks.

Infrastructure Investment and Barriers to Deployment

Infrastructure investment depends not only on financing but also on prompt acquisition or receipt of permissions to build networks. Barriers or impediments to broadband deployment must also be addressed as part of any holistic plan to promote and sustain infrastructure investment. Such roadblocks, delays, and increased costs are particularly problematic for NTCA members, each of which is a small business that operates only in rural areas where construction projects must range across wide swaths of land. Permitting and access, particularly with respect to Federal lands and pole attachments, can present significant impediments to the deployment of rural broadband infrastructure. Navigating Byzantine application and review processes within individual Federal land-managing and property-managing agencies can be burdensome for any network provider, but particularly the smaller network operators that serve the most rural portions of the U.S. landmass. The review procedures can take substantial amounts of time, undermining the ability to plan for and deploy broadband infrastructure—especially in those areas of the country with shorter construction seasons due to weather. Additionally, obtaining reasonable terms and conditions for attaching network facilities to poles that are owned and operated by other entities can result in long delays and costly fees charged to providers seeking to build out networks to rural communities lacking service.

The lack of coordination and standardization in application and approval processes across Federal agencies further complicates the deployment of broadband infrastructure. From my experience at Totelcom, I can attest that when building new fixed wireless towers for deployment, the cost of the various permits and approvals normally runs higher than the actual construction of the tower. We have seen much agreement for some time now on solutions to simplifying the administrative barriers to deployment. The standardization of application, fee and approval policies and procedures across Federal land-managing and property-managing agencies to the extent possible should be a high priority.

Finally, though small rural providers have long enjoyed productive working relationships with RUS, there is always room for improvement. Small carriers typically spend about 2 years and about $250,000 securing loan approval from RUS. Some providers would love to take advantage of RUS's low financing rates, but the procedural barriers to borrowing from RUS send them to private lenders that offer higher rates. In particular, we look forward to working with this Committee to address some of the more time-consuming processes in the various RUS programs that could expedite approvals and deployment.

Addressing Supply Chain Concerns

As numerous broadband infrastructure programs work now to help fill gaps in coverage across our country, and as additional programs are considered to help finally overcome persistent digital divides, it is important to monitor the status of the communications supply chain. We are currently hearing of shortages and increasing delays in order fulfillment—ranging from several weeks to up to 1 year—for critical communications equipment like fiber, routers, antennas, network terminals, and customer premise equipment due to a mix of pandemic-related impacts and increased demand for broadband investment. To ensure that existing and new infrastructure initiatives are as successful as possible in responding to consumer needs and demands, we believe it is important that the Federal Government play a central role in working closely and directly with manufacturers, distributors, and other suppliers to avoid disruptions in the communications supply chain. Just recently, we placed an order for fiber pedestals that has a 365 day lead time to delivery. As Congress is poised to make future investments to solve the digital divide once and for all, supply chain shortages must be addressed—or else the billions of dollars in funds intended for immediate broadband deployment risk being tied up in held orders and delayed shipments.

Conclusion

Robust broadband infrastructure is crucial to the current and future success of rural America. But the characteristics that enable the unique beauty and enterprise of rural America make it very expensive to deploy advanced communications services there. Our nation's small, rural, community-based telecom providers are deploying faster broadband throughout their service areas, but no carrier—whether cooperative or commercial, and regardless of size—can deliver high-speed, high-capacity broadband in rural America without the ability to justify and then recover the initial and ongoing costs of sustaining infrastructure investment in high-cost areas.

A legislative infrastructure initiative offers a unique opportunity to provide the resources needed to make these investments, and mechanisms that ensure efficiency and accountability in the expenditure of funds are already in place. Our industry is excited to participate in this conversation regarding broadband infrastructure initiatives, and we look forward to working with policymakers and other stakeholders on a comprehensive infrastructure strategy to ensure that all Americans will experience the numerous agricultural, economic, health, and public safety benefits of broadband. Thank you for the opportunity to testify, and for the Committee's commitment to broadband infrastructure investment in rural America.

The CHAIRMAN. Thank you very much, Ms. Prather.

And now, we will hear from Mr. Johnson, and you can begin when you are ready.

STATEMENT OF TIMOTHY R. JOHNSON, CHIEF EXECUTIVE OFFICER, OECONNECT, LLC AND OTSEGO ELECTRIC COOPERATIVE, INC., HARTWICK, NY

Mr. JOHNSON. Thank you, Mr. Chairman. Good morning, Chairman Scott, Ranking Member Thompson, and Members of the Committee. Thank you for the opportunity to testify today.

I am Tim Johnson, as I was introduced, the CEO of Otsego Electric Cooperative and OEConnect here in Hartwick, New York.

Broadband is very personal to me. I had painfully slow DSL service at my home before my co-op entered the fiber business, and now I have 1 gigabit service and no spinning blue wheels.

Otsego now provides broadband service to almost 3,000 locations in our area. These are locations that were similarly ignored when Otsego began offering electric service over 75 years ago.

In 2017, Otsego announced plans to build a fiber-to-the-home broadband system, and now we offer 100 percent of our members symmetrical speeds of up to 1 gigabit with no data caps. This project has been vital for our members during the worst pandemic, of course, in 100 years, and many services were activated at the height of the pandemic. We connected medical professionals, tele-

workers, teachers, and students, including a family whose kids were doing virtual school in a neighbor's unheated garage, and electric cooperatives are playing a critical part in this effort, with more than 200 electric cooperatives deploying broadband solutions, and 100 more exploring the feasibility of projects.

The electric cooperative industry, represented by the National Rural Electric Cooperative Association, serves one in eight Americans and covers 56 percent of the U.S. landmass. Electric cooperatives are member-owned, so we are uniquely suited to best understand and solve rural broadband needs. We believe you can provide critically needed flexible funding and policies to support broadband in rural areas across the nation.

The job is not done. We still have many locations that cannot access the internet with anything better than data-capped, high latency prone satellite service. OEC would not have entered the broadband business without grant funding. Lower population density means construction and ongoing operational costs cannot be met without public funding sources. However, OEC and electric cooperatives in general have great advantages in expanding broadband. We have served these communities for over 75 years, and we have skilled manpower, equipment, and vehicles, and we own the rights-of-way and the infrastructure so we can control some of our construction costs.

Balancing accountability and usability in all Federal programs is very important. It is critical to ensure that all award recipients are actually capable of deploying a network at the speed and latencies they promised. In the case of how the FCC distributes funds, vendors should be vetted before the auctions are held. When it comes to usability, programs like ReConnect and Community Connect have some positive attributes, but they can be slow and administratively burdensome for small organizations like Otsego. One fellow electric cooperative had to wait 517 days between finding out that they received a ReConnect award and the first construction approval. Broadband program rules should give greater weight to technologies that are expandable and proven to reliably provide at least 100/100 megabits per second. For example, fiber-to-the-homes systems are more robust, time-tested, and future-proof than others. Additionally, consideration should be given to prioritizing community-based providers with existing presence in the communities they serve.

Affordability is a critical issue, and programs like the Emergency Broadband Benefit Program are desperately needed by some of our members, but they are also needed on a permanent, ongoing basis. From the consumer perspective, there is no difference between having no access to broadband service and having access, but not being able to afford it.

In addition to these points, my written testimony expands on several aspects related to improving broadband infrastructure, including improving our nation's broadband maps, the importance of building networks that can keep up with increasing speed and quality demands, and the critical need for a smart grid. Otsego is currently working on an innovative fiber-based metering system which could save us money and greatly increase metering functionality in the smart grid.

In conclusion, national and state broadband programs already offer an opportunity to promote broadband development. As part of this effort, our cooperative is eager to continue the conversation about broadband programs, and we look forward to working with you to expand all the benefits broadband has to offer so rural New Yorkers and rural Americans will not be left behind.

Thank you for the opportunity to testify, and for your commitment to rural broadband. I look forward to working with you and answering any questions you may have.

[The prepared statement of Mr. Johnson follows:]

PREPARED STATEMENT OF TIMOTHY R. JOHNSON, CHIEF EXECUTIVE OFFICER, OECONNECT, LLC AND OTSEGO ELECTRIC COOPERATIVE, INC., HARTWICK, NY

Chairman Scott, Ranking Member Thompson, and Members of the Committee. Thank you for this opportunity to testify about rural broadband and its importance in our nation's rural areas. I am Tim Johnson, Chief Executive Officer of OEConnect, LLC and Otsego Electric Cooperative, Inc. (collectively "OEC"), headquartered in Hartwick, New York. OEConnect is a wholly-owned subsidiary of Otsego Electric Cooperative, Inc. which is a member-owned and democratically controlled tax exempt nonprofit organization under IRC Section 501(c)(12).

Otsego Electric Cooperative provides electric service to 4,900 rural locations that investor-owned utilities initially ignored or bypassed many years ago. We serve some of the poorest, most rural parts of our state in what was formerly a thriving dairy farming area with an average of only about 6 meters per mile. History repeated itself in a sense when it became apparent over the past decade or so that adequate broadband service was not being made available to our members so, in early 2017, OEC announced plans to begin offering high-speed, affordable broadband service. This project now allows our members to fully participate in the 21st century economy and to continue to work and go to school during the worst pandemic in 100 years. OEC now has service available for 100% of our members with state-of-the-art fiber-to-the-home service at speeds up to 1 Gigabit per second download and upload with no data caps at a very fair price. OEC has fiber passing more than 5,000 locations over a 700 mile fiber network. Every one of these locations is being offered the same superior level of service. To date we have activated almost 3,000 broadband and voice services and our subscribers have been ecstatic that we took the initiative to build this project when we did. It has provided blessings in many ways during the COVID–19 crisis. We immediately prioritized new service connections to doctors, nurses, other health care professionals and support personnel, teleworkers, and students when our state was shut down. While we are off to a great start, we have also faced many challenges and we believe you can provide critically needed funding and policies to support broadband in our area and in rural areas across the nation.

OEC is part of a broader electric cooperative industry, represented by the National Rural Electric Cooperative Association (NRECA) that serves one in eight Americans and covers 56% of the U.S. landmass. Electric cooperatives are owned by the members whom we serve and we are uniquely suited to best understand and serve our members' and our neighboring rural residents' needs. Most electric cooperatives are small businesses; they don't have investors or access to significant capital to help defray the costs of building and maintaining their infrastructure. These costs are borne directly by the farmers, ranchers, small businesses and other residents of the nation's rural communities—including those in 93 percent of the nation's persistent poverty counties.

Electric Cooperatives Play a Vital Role in Transforming Communities

While our priority at OEC has historically been to provide reliable, clean, and affordable electricity to our members, our commitment to our communities extends well beyond that service. We also provide services that empower local communities to improve their quality of life. As mentioned, that includes participating in efforts to make sure they have access to a robust communications infrastructure including access to quality and affordable broadband that enables rural communities to thrive and compete in an increasingly connected, global marketplace. Economic development, the education of our students to compete with children from urban areas, agriculture, and healthcare all require robust broadband access in the 21st century.

Many comparisons are drawn between the lack of access to robust broadband service today and the need for electrification in rural America 80 years ago—with the urban areas of the country well-served, and rural areas being left behind. In part because cooperatives are led by, and belong to, the communities they serve, there is an increasing number of electric cooperatives studying whether they should be part of the solution to close the digital divide. More than 200 electric co-ops in 37 states, including Otsego, are currently deploying diverse broadband solutions and as many as 100 more are exploring feasibility of broadband either on their own or through partnerships to bridge the digital divide and jump-start local economies. This cooperative commitment is vital for the ¼ of all rural Americans who still lack access to broadband, compared to less than two percent in urban areas.

Keys to Rural Broadband Expansion

We need continued public funding immediately to help broadband expansion. OEC would not have entered the broadband business without grant funding and this is true for most electric cooperatives. The costs of construction, due to the lack of customers per mile, would not be recoverable within commercial lending requirements. The costs of operations are also much more difficult to cover due to the lack of density and therefore lower revenues. However, it is very important to point out that OEC and rural electric cooperatives in general have great advantages in expanding broadband. We are located in these areas so we are familiar with the terrain and existing infrastructure, and we are stable organizations that have served these communities for over 75 years. Cooperatives have skilled manpower, equipment, and vehicles and we own the poles and rights-of-way so we can control some of our make ready costs—the process of ensuring poles are ready and in proper condition to have fiber hung on them—through planning and proactive maintenance schedules. Cooperatives have generally done a very good job of maintaining their poles, right-of-ways, and infrastructure so make ready costs—which can be 50% of the cost of building networks—can be greatly reduced. OEC treats all attachers equally for make ready purposes and pole attachment rates. In OEC's experience, total construction costs within our system were over 50% lower than the costs of building outside of our electric footprint on investor-owned electric utility systems. Further, there is no cross subsidization between OEC and our subsidiary, OEConnect, because that could create problems for our tax-exempt status. OEConnect leases fiber from OEC on commercially reasonable terms. While there is no one-size-fits-all business model for providing broadband, it is an area that has required a lot of time, resources and outside counsel to ensure we are doing it all correctly. Making funding available to cooperatives will help ensure that public funds will be used more efficiently. OEC has built over 100 miles of fiber beyond our electric system and make ready in those areas is double the cost of building inside the cooperative's electric service area. Cooperatives are member owned systems with elected directors so we are able to democratically decide where and how to build a broadband system that will best serve our members over the long-term.

OEC was just awarded $7.18 million under the Federal Communications Commission (FCC) Rural Development Opportunity Fund (RDOF) to extend service into more areas. This funding will accelerate our ability to provide fiber-to-the-home service to more unserved locations that currently lack 25/3 Mpbs fixed, terrestrial service. We have been inundated with requests for service beyond our territory since the start of the pandemic so we know there is huge unmet demand and now we will be able to provide it to some of these folks. We need more flexible funding as the job is not done in our area and is desperately needed right now. We have had school kids sitting in neighbors' unheated garages and medical doctors who cannot access the internet with anything better than data-capped, high latency-prone satellite service. We have lists for many of these unserved and underserved homes and businesses and there are many more to get to. Without grant funding, however, we would not have extended service to our members or to most of these nonmember locations, if at all. Being a cooperative restricts our options to raise money and we are required to operate as an independent entity governed solely by our members. Cooperatives cannot issue equity or accept equity contributions from other partners and still maintain control over our projects.

One of the major reasons that OEC entered the broadband business was for rural development to stem population loss from rural areas. If we did not address the problem, nobody else was going to do it and we would continue to experience decline. We believed that if we built fiber to these homes, people would decide to move here; or, if they had a second home already, they would stay longer; or, they would be able to engage in e-commerce and education while still living in our rural areas. This proved to be prescient. Our cooperative members and a good number of their neighbors—though hard hit by the pandemic just like everyone—have been able to

continue to go to school, work, engage in e-commerce, and obtain healthcare when they would not have been able to otherwise.

Existing Programs

OEC would like to see that the FCC is held accountable for valuable broadband funding by ensuring that the winners of all RDOF funds (including RDOF Phase I) are responsible bidders and capable of actually deploying a network at the speed and latency they promised to their awarded areas on time. Bidders should be vetted before the auctions are held and funds are awarded, not after. In addition, it is a mistake to group all technologies that can reach a certain speed threshold as equal. Certain technologies like fiber-to-the-home systems are more robust, time-tested, and future proof than others and public funds should be allocated accordingly. Otsego would also like to see the RDOF Phase II auction ("RDOF II") accelerated and put into motion as soon as possible or, if other programs can be made available sooner, then use the RDOF II funds to supplement the funding. A reverse auction format should ideally be used for awarding funds but it is difficult to put auctions of this nature together fast enough with proper rules and controls. We need to incentivize and give greater weight to technologies that are expandable and proven to be capable of reliably providing at least 100/100 Mbps and the technology needs to be based on resilient assets that will last for the long-term to future-proof service. Additionally, thought should be given to prioritizing community-based providers with existing presence and ties to and near the communities they're seeking to serve. Unfortunately, this was not the case in the recent RDOF I reverse auction. Our national association, NRECA, has expressed concern with specific subsets of initial winning bidders in the RDOF I Auction. Specifically, NRECA issued a white paper expressing concerns regarding the substantial subset of bids in the RDOF Phase I auction awarded to fixed wireless Gigabit tier bidders and low-earth-orbit (LEO) satellite providers bidding at the 100/20 Mbps tier.[1] These technologies are not proven to deliver reliable service at these speed tiers, especially in rural areas. There is a high likelihood that some of these questionable bids will be deemed unqualified by the FCC. More thorough up-front vetting should be required in future auctions.

Programs to address rural broadband deployment also exist at the United States Department of Agriculture's (USDA) Rural Utilities Service (RUS), including the ReConnect (grants/loans & loan/grant combos) program, Community Connect and others. These programs have some very positive attributes, such as the ability for an applicant to establish boundaries for its proposed funding area. However, the programs have limited funding compared to the FCC and they can be administratively onerous and burdensome which is why some, including my cooperative, have not participated in them. The onerous nature of the programs stem both at the agency and statutory level. Recently, our national association, NRECA, submitted comments to RUS laying out concerns with the ReConnect program and recommending changes before the funding window opens for Round Three of the ReConnect program.[2] NRECA has also submitted comments[3] to USDA for the rulemaking process to implement the USDA RUS Farm Bill Broadband Loan and Grant program, which was retooled when Congress reauthorized the Farm Bill in 2018 but has not been funded. Electric cooperatives participated in and appreciated the efforts taken to learn from some previous challenges by reshaping this program. In addition to representing a bipartisan, bicameral compromise, there are components of the farm bill broadband program that are more appealing including increased speeds (from 10/1 Mbps to 25/3 Mbps) for areas to be eligible and prioritizing lowest density areas for grant funding. We support a plan to transition from ReConnect to the farm bill program, or otherwise exploring how to combine the two to ensure that USDA

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[1] NRTC & NRECA, *The Rural Digital Opportunity Fund: Rural America's Broadband Hopes at Risk,* filed February 2, 2021, available at: *https://www.fcc.gov/ecfs/filing/10202734510982.*

[2] NRECA Comments on *The Rural Utilities Service (RUS) Final Rule and request for comment on the Rural eConnectivity (ReConnect) Program. The Rural eConnectivity Program provides loans, grants, and loan/grant combinations to facilitate broadband deployment in rural areas* (RUS–20–Telecom–0023) (RIN: 0572–AC51), filed March 23, 2021, available at: *https://www.cooperative.com/programs-services/government-relations/regulatory-issues/pages/nreca-files-comments-with-rus-on-rural-econnectivity-boadband-program.aspx.*

[3] NRECA Comments on *The Rural Utilities Service (RUS) Interim Rules for the Farm Bill Broadband Loan and Grant Program* (RUS–19–Telecom–0003) (RIN number 0572–AC46), filed May 11, 2020, available at: *https://www.cooperative.com/programs-services/government-relations/regulatory-issues/Documents/NRECA%20Comments%20RUS%20Broadband%20IFR%205-11-20%20FINAL.pdf.*

broadband programs are accessible to providers and meeting the goals of reaching rural Americans with broadband.

Another recent change within USDA programs was enacted as part of the 2018 Farm Bill. Section 6210 of the Agriculture Improvement Act of 2018 (Farm Bill) allows recipients of any loan, grant, or loan guarantee from Rural Development (RD) to use up to ten percent of the amount provided to construct broadband infrastructure in areas not fully served by a minimum acceptable level of broadband service. This provision will not only speed deployment of smart grid but will also help bring desperately needed vital broadband to unserved rural communities. It correctly recognizes the vital role of communications in managing the electric grid and the ongoing technology convergence between the utility and telecommunications industry.

Affordability

The new Emergency Broadband Benefit Program at the FCC is a very positive approach to the high-cost low-income services across the nation but it will need to be made permanent. Once a network is constructed and broadband is available, there is also the issue of affordability for many who have had their employment income disrupted, or even worse, eliminated during the pandemic and otherwise. There are many who simply cannot afford to pay for service due to unemployment, underemployment, illness, disability or other conditions and we need to provide ongoing sustainable help for them. Students—especially minors who are too young to work—who live in these households cannot access equal educational opportunities and adults cannot work remotely at certain jobs without assistance that is more than the current monthly Lifeline Benefit of $9.25 through one of the FCC Universal Service Fund programs. The Lifeline program needs to be increased permanently and the funding for it needs to be revised to a level that moves the needle on affordability. The low-income, high-cost households are also being deprived of telemedicine and valuable consumer research opportunities when buying or selling goods and services. The marketplace is on the internet more than ever these days. From the consumer perspective, there is no difference between having no access to broadband service and having access but not being able to afford it. The result is the same and therefore affordability is a key component.

Data and Mapping

The FCC has launched the Digital Opportunity Data Collection process to improve mapping and identify gaps in coverage as required by the Broadband Deployment Accuracy and Technological Availability (DATA) Act, signed into law in March 2020. Congress needs to monitor these efforts closely to ensure that improvements to the broadband data collection and mapping are granular enough to get an accurate picture of where service is available and where it is not. Congress must also insist that this data be made available as soon as possible.

Building Broadband Networks for the Future

Broadband is as needed in rural America as other infrastructure systems to support a healthy economy and community. Policymakers in Washington, D.C., have recognized the importance of rural broadband networks by including increased funding and new programs to promote rural broadband infrastructure.

It is our strong belief that fiber service is the best and longest-term technological solution for these households and businesses. Satellite, cellular, and fixed wireless, and other unproven solutions are inferior to fiber for various reasons and our rural residents deserve the same level of service that others in more urban and suburban areas have available.

One of the key objectives for consideration with respect to using the limited resources made available is that any broadband funding plans should include clear expectations for whomever receives Federal or state support. Recipients should be required to construct networks capable of meeting consumer demand over the long-term and not just today's minimum speed. In other words, resources should be used to build networks which will be useful for decades. Spending Federal or state dollars on broadband networks that are still in experimental phases or will be obsolete in a few years doesn't make financial sense and will leave rural areas behind again. The highest speed and capacity solutions such as Fiber-to-the-Home projects should be given preference over other less robust technologies. Other considerations affecting the end-user experience, such as latency and data cap limits which lead to a higher cost and diminished ability to utilize the service, should also be considered in all broadband funding programs.

The Role of Public Investment in Reliable Rural Broadband Service

As a nonprofit cooperative, we operate at cost and our access to capital is limited by what we ask our consumer member-owners to contribute through the rates they

pay. Additionally, our rural nature lends itself to sparse population densities which means we have smaller groups of consumers to spread the costs of deploying service. Because OEC, similar to other electric cooperatives across the country, is a small nonprofit that operates at cost, we entered this business with no extra cash to spend on the project. This means we financed our portion of the broadband infrastructure investment with borrowed funds. We had resources to invest—mostly labor, infrastructure, and equipment—but we would not have been able to proceed with the project without public funds. We also will not be able to extend our service area to reach additional rural Americans who don't yet have robust service without additional public funds. Therefore, continued government funding to reduce the up-front capital investment and help make the business case to deploy robust broadband is necessary to achieve wide-spread expansion of high-speed access throughout rural America.

As previously mentioned, there are currently Federal funding programs operating and geared toward this purpose at the USDA's Rural Utilities Service (RUS) and at the FCC. Programs at these agencies are complementary and equally important. Electric cooperatives have witnessed both success stories and challenges within these programs in pursuit of bridging the digital divide throughout rural America. Additionally, a few new targeted programs are to come online soon at the National Telecommunications Information Administration (NTIA) at the Department of Commerce, and we may see states and localities direct a portion of their Coronavirus Flexible Recovery Funds or the Coronavirus Capital Infrastructure Funds toward broadband.

While there has been a lot of investment and activity, it is important to remember that the FCC estimated in 2017[4] that it would cost $80 billion to bring high-speed internet to remaining parts of the country that do not have access, and a 2019 U.S. Department of Agriculture report[5] estimated it would require "between $130 and $150 billion over the next 5 to 7 years, to adequately support rural coverage and 5G wireless densification." Sustained investment is required to truly close the digital divide. It is also very likely that new more granular broadband data and maps will find the broadband gap to be wider than currently estimated, requiring additional funding.

Rural electric cooperatives are uniquely suited to partner with the government for these projects because of the existing infrastructure we have in place throughout our service areas and unique local control. As member-owned, locally operated, and democratically controlled entities we feel we can best determine the needs of our local service areas because our consumer-members have a direct say in the services we provide, and we will continue serving these areas we call home long after other companies have reduced the quality of their service or ceased investment altogether.

Conclusion

As I have described, broadband is vital to the survival and growth of both the communities OEC serves and all of rural America. Much progress on broadband deployment has been made over the last few years and it's important that we address the public policy challenges I've shared to ensure that progress may continue. Electric cooperatives are well suited for this task and we are committed to deploying broadband in rural America and investing in these difficult to serve areas where other providers are not willing to deploy robust broadband networks.

National and state broadband programs offer an opportunity to promote broadband development. As part of this effort, our cooperative is ready and willing to continue the conversation about broadband programs and we look forward to working with you to expand all the benefits broadband has to offer so rural New Yorkers will not be left behind.

Thank you for the opportunity to testify, and for your commitment to rural broadband. I look forward to working with you and answering any questions you may have.

TIMOTHY R. JOHNSON, *CEO,*
Otsego Electric Cooperative and OEConnect.

The CHAIRMAN. Mr. Johnson, thank you for that very informative testimony that you gave. You and Ms. Prather are really opening up with some very, very significant and important information.

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[4] Federal Communications Commission Study: *Improving the Nations Digital infrastructure: https://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0119/DOC-343135A1.pdf.*

[5] United States Department of Agriculture: *A Case for Rural Broadband: https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf.*

And now, I would recognize Ms. Robinson for your 5 minutes. Please begin.

STATEMENT OF VICKIE S. ROBINSON, ESQ., GENERAL MANAGER, MICROSOFT GLOBAL AIRBAND INITIATIVE, WASHINGTON, D.C.

Ms. ROBINSON. Chairman Scott, Ranking Member Thompson, and Members of the Committee, my name is Vickie Robinson, and I am the General Manager of the Microsoft Airband Initiative. It is an honor to testify here today.

My life's work focuses on extending broadband to unserved and underserved communities. Prior to joining Microsoft, I served at the FCC for nearly 15 years in multiple leadership roles, and as acting CEO and General Counsel of the Universal Service Administrative Company, which manages the Federal Universal Service Fund.

Microsoft's Airband Initiative is a mix of innovative technologies to extend broadband's reach to the last mile, and to give communities access to the skills needed to use it. We have committed to extending broadband access to three million people in unserved rural areas in the United States by July of 2022. So far, we have extended broadband service to more than two million people in 26 states and Puerto Rico.

I would like to share some insights from our experience. First, we have learned that one size does not fit all. We must use the right technology tools to reach Americans and meet the individual needs of their communities.

Second, government funding is critical to bridging the broadband gap. Many internet service providers, including Airband partners, receive funding from the FCC, U.S. Department of Agriculture, and state broadband programs. Funding streams must be made available on a technology-neutral basis so that broadband providers can use solutions that are tailored to meet the specific needs of communities, and government must continue to gather and share data to provide accurate information about which communities lack access to broadband, and what the key barriers are to that access.

Third, connectivity alone is not enough to bring people online. Even when a community has access to broadband, impediments remain for some populations to adopt and realize the benefits of it. These include the inability to afford service, the cost of a device like a laptop or desktop computer, or a lack of digital skills to fully make the most of new connectivity.

To address affordability and adoption challenges, our Airband partners will use new Federal programs like the Emergency Broadband Benefit, which offers support for those that cannot afford broadband service or devices. They also look forward to leveraging the Emergency Connectivity Fund to help students, school staff, and library patrons stay connected. However, these are temporary programs to bridge the gap. A permanent solution is needed to address these challenges.

According to the National Skills Coalition, as many as one in three Americans have few to no digital skills. To foster digital skilling in rural communities, we and our Airband partners are working with nonprofits like the National 4–H Council and Future

Farmers of America to provide critical digital skilling resources to the community. Funding to support digital literacy and skilling is important to increase broadband adoption as communities come online.

In closing, I want to emphasize that the power of broadband connectivity is not simply about connecting homes; it is about transforming communities. We transform communities by using the power of connectivity and technology to create new opportunities to work or start a business, open new doors to education, improve access to healthcare, and unleash the power of precision agriculture. As you work to make broadband funding available, we ask that you target funding to unserved and underserved communities, prioritizing the speed of deployment and allocating funding in a cost-effective manner to stretch Federal dollars as far as possible. We also ask that Congress and policymakers prioritize funding for deployment for people who are income-insecure, and ultimately find a permanent solution to address the cost of broadband service and devices. Finally, we ask you to support efforts to increase digital literacy and skilling to ensure that Americans can use their broadband service to transform their communities for the better.

Thank you so much for this opportunity.

[The prepared statement of Ms. Robinson follows:]

PREPARED STATEMENT OF VICKIE S. ROBINSON, ESQ., GENERAL MANAGER, MICROSOFT GLOBAL AIRBAND INITIATIVE, WASHINGTON, D.C.

Chairman Scott, Ranking Member Thompson, and Members of the Committee, thank you for the opportunity to share our perspectives on broadband, particularly efforts to address longstanding connectivity needs in rural America. My name is Vickie Robinson, and I am the General Manager for the Microsoft Airband Initiative, which is focused on efforts to close the digital divide in the United States and around the world. Prior to joining Microsoft, I served at the Federal Communications Commission (FCC) for nearly 15 years in multiple leadership roles and served as Acting CEO and General Counsel of the Universal Service Administrative Co., an independent not-for-profit organization designated by the FCC as the administrator of the Federal Universal Service Fund. I'm here today to share our thoughts on broadband and closing the rural digital divide.

Broadband is critical to everything we do, and we deeply appreciate the importance of broadband in enabling everyone to do more. Access to broadband is essential to meaningful participation in society, providing the foundation for enormous social and economic opportunity. For many, high-speed internet access is as ubiquitous as electricity and running water. From the comfort of our own homes, those of us with connectivity can attend courses and earn degrees, shop for countless products from around the world, and collaborate seamlessly with colleagues in different time zones. Less than a generation ago, those things were impossible.

The challenge, however, as this Committee so rightly highlights, is that not everyone has access to a broadband connection and as a population, some haven't benefitted equally. This gap disproportionately affects communities that are traditionally marginalized, including but not limited to, people experiencing income and housing insecurity, racial and ethnic minorities, and people with disabilities. Rural areas are especially disadvantaged, as telecom infrastructure often fails to go as far as needed in low population density regions.

The COVID–19 crisis has laid bare the fact that many people in rural and other under-connected communities are without broadband and unable to access distance learning, telemedicine, e-commerce, and other tools necessary for modern life. This challenge is heightened in rural areas: according to the FCC, more than 11 million Americans in rural areas do not have access to a fixed broadband connection. Of the Americans who do not have broadband access, rural Americans constitute 78 percent. Microsoft's data analysis suggests that the numbers of unserved Americans in rural areas is even higher. Congressional passage and funding of the Broadband DATA Act should help to pave the way to accurately identify and address existing gaps in broadband coverage.

As I discuss further below, Microsoft believes we can—and we must—do our part in the private-sector to help extend broadband coverage. There is also an important role for the Federal Government and Congress based upon our experience and insights with Microsoft's rural broadband initiative. With this in mind, we would recommend the Committee consider the following issues:

- **Funding is critical.** Broadband is costly to deploy in rural areas and providers need funding to help to defray the cost of the capital investment and extend networks into unserved and underserved areas.
- **One size does not fit all.** Not all solutions are suitable for all areas and it is best to rely on internet service providers (ISPs) to determine what solution works best for the communities they are working to serve. Microsoft Airband ISP partners use a tool kit approach, and we rely on them to identify what solutions work best. This requires a technology-neutral approach to funding broadband, which affords providers the flexibility to tailor technology to the community providing broadband quickly and cost effectively and without sacrificing speed. The concept of technology neutral funding is not new or novel. The Agriculture Appropriations reports highlighted the concept when it appropriated funding for broadband for Fiscal Years 2019–21.
- **Pursue digital transformation.** Communities embrace broadband more quickly when doing so will help them to solve challenges. For example, enabling telehealth or precision agriculture is more likely to prompt further community use of broadband and deliver transformational value. As such, policies that help to unleash the power of connectivity and technology are critical.
- **Digital skilling, broadband service and broadband devices can drive adoption.** Having access to a broadband connection is essential to tackling the digital divide, but many Americans also need digital skills to take full advantage of broadband as well as a monthly broadband service and a broadband device in the home.

Microsoft's Airband Initiative: Partnering with Other Stakeholders to Close the Digital Divide

In July 2017, Microsoft launched the Airband U.S. Initiative as both a call to action and our programmatic effort to help close the rural broadband access gap in the United States. The Microsoft Airband Initiative is not an initiative that we do on our own, and Microsoft is not itself a direct connectivity provider. We address the digital divide by working with a network of people and organizations toward the same goal—connecting people and bringing with that connectivity the opportunity for a better life. We partner with internet access providers, telecom equipment makers, nonprofits, and local entrepreneurs to advance digital equity: access to affordable internet, affordable devices, and digital skills.

Our goal is to extend broadband access to three million people in unserved rural areas by July 2022. This marks an increase from our initial commitment of two million. Our partners include 14 internet service providers with projects in 26 states and Puerto Rico. As of January 2021, the projects extended broadband access to over nine million people, including more than two million people residing in previously unserved rural areas. As we bring communities online, we also are very focused on delivering technology solutions to expand access to virtual healthcare, help increase revenue and reduce costs in agriculture, facilitate online learning, and enable small businesses to reach more customers. These digital transformation efforts can help level the playing field for billions of people.

Our partnerships typically involve a four-part approach focused on connectivity, digital skilling, digital transformation, and policy advocacy. This work has provided insights into closing the broadband gap.

- **Connectivity.** First, we focus on connectivity through our ISP partners to accelerate access to broadband among unserved and underserved communities. These projects are designed to be commercially sustainable and are intended to scale.
- **Digital Skilling.** Second, digital skilling, from basic digital literacy to leveraging computer applications and job training, is a key component to broadband adoption. Therefore, we provide digital skilling resources to support all our Airband communities. These opportunities are spearheaded through a collaboration with Microsoft Philanthropies, which partners with nonprofit organizations that are focused on serving rural communities, such as the National 4–H Council and Future Farmers of America.
- **Driving Solutions through Digital Transformation.** Next, we partner with private and public sector organizations, nonprofits, and others to provide rel-

evant solutions that are enabled by broadband networks. Our objective is to help improve productivity and livelihood within newly connected communities, while driving sustainable development. For example, connectivity enables healthcare facilities to deliver critical telehealth solutions throughout the community at a time when physical access to rural health facilities is diminishing.

- **Policy and Advocacy.** Last, our work is undergirded by policy and advocacy efforts designed to address the immediate and longer-term digital divide challenges, and in so doing, promote a more inclusive world, where everyone has an opportunity to participate in the digital economy.

Connectivity

We have learned a lot from our work on broadband issues over the years and our more recent efforts to help bridge the digital divide through our Airband Initiative. Rural communities are left behind without broadband service, often because it is too costly to deploy and operate broadband networks in sparsely populated communities. Recognizing this, policymakers have perennially appropriated funding or established mechanisms to fund broadband deployment. Without funding from the government to address the cost of extending the network into unserved areas, we will not be able to quickly close the rural digital divide. We have also come to understand that broadband deployment funding should be made available in a technology neutral manner empowering broadband providers to craft the solutions that work best for the community and balance factors such as speed of network deployment and speed of broadband service as well as the cost of network build out and service to the consumer.

The financial challenges of deploying broadband networks in rural underserved and underserved areas often demand that our Airband partners leverage government funding. Many of our partners are recipients of the FCC's Connect America Fund Phase II Auction and the Rural Digital Opportunity Fund, as well as other funding mechanisms from the U.S. Department of Agriculture and state broadband programs that are funded through the Coronavirus Aid, Relief, and Economic Security Act (CARES Act).

Choosing the best technology solution is key to quickly expanding connectivity in unserved rural communities. In constructing projects across 26 states and Puerto Rico, our Airband ISP partners make use of a multi-technology and multi-frequency portfolio to connect the unconnected and determine technology choices based on the requirements of the various locations as well as the relevant broadband and narrowband use cases. Airband ISP partners embrace a multitude of technologies from fiber to wireless technologies leveraging multiple frequency bands like TV Whites Spaces (TVWS), Citizens Broadband Radio Service (CBRS), Educational Broadband Service (EBS), a wide range of mid-band fixed wireless, WiFi 6E on 6GHz, and millimeter waves. For example, Airband ISP partner Nextlink Internet uses a combination of fixed wireless and fiber optic technology to deliver high-speed broadband to rural customers across their growing footprint in the central region of the United States.

The Airband Initiative and its partners are continuing to be creative and flexible to meet short-term and long-term connectivity needs. In response to the COVID–19 pandemic, the Initiative launched a public WiFi hotspot grant program to provide immediate relief where in-home installation might not be possible in the short-term. Airband ISP partners and partner organizations like the Public Library Association and the University of Washington Extension campuses built over 300 public WiFi hotspots across the United States. In the Central Valley of California, Airband partner Cal.net is working with school districts, community college systems, and other educational entities to provide affordable fixed wireless in-home broadband access to students who would not otherwise have access during the pandemic.

Digital Skilling Efforts in Newly Connected Communities

Connectivity alone is not enough. There is a whole host of skills that many of us take for granted that are needed to navigate the digital world. These range from how to connect a device to the internet, basic skills in navigating the internet (conducting searches, using a mouse, setting up passwords and logins), to cyber safety. Yet as many as one in three Americans have few to no digital skills. Moreover, rural schools are less likely to have advanced computer science classes. That is why it is critical for broadband access to go hand-in-hand with useful digital skills that meet people where they are.

To foster digital skilling in rural communities, Airband ISP partners are working with the National 4–H Council, the Public Library Association and Future Farmers of America to provide digital skilling resources to the community. Many partners host Microsoft digital skilling content on their website to provide access to content

and online training that provides digital literacy, computing, and AI skills. For example, a collaborative effort between 4–H staff, after-school mentors, and Airband partner Declaration Networks Group led to providing internet access and the tools needed for students to engage in virtual learning. As a result of the partnership, half of these students received internet service within 1 week. Now, they can connect with their after-school peers and mentors, while still accessing their schoolwork at home.

Our partnership with PCs for People expands the breadth and depth of our digital skilling program and creates a hotline that will be available in English and Spanish to the customers of all our Airband partners. The hotline will answer basic digital literacy requests, as well as help partners navigate Microsoft online digital skilling training and LinkedIn employability training. This training can lead to remote job opportunities in ten career paths. On April 8th, Microsoft and LinkedIn announced that we are extending our global skills initiative through the end of 2021, providing free LinkedIn Learning and Microsoft Learn courses and low-cost certifications that align to in-demand jobs. Areas of focus include customer service, project management, data analysis, software development and more.

Our work with the U.S. Department of Veterans Affairs (VA) to improve broadband access for our nation's Veterans and expand digital skilling opportunities to Veterans living in rural areas highlights the opportunity that skilling can offer. Last Fall, we held our first joint workshop with the VA for Veterans living in Decatur and Dubois Counties, Indiana, as an extension of new broadband connectivity made available in these counties by Airband ISP partner Watch Communications. The workshop included an introduction to Microsoft and LinkedIn's digital skilling and employability training as part of our cooperative effort to leverage new connectivity as a vehicle for training and workforce development.

Driving Digital Solutions in Rural Communities

As we focus on the challenges of broadband deployment, we must not lose sight of the fundamental promise of connectivity—the benefits that come with digitally transforming our communities. As Airband partners bring communities online, we work to provide solutions that improve outcomes in education, healthcare, agriculture, and small businesses.

For example, in rural Washington State, we have supported an Airband partner's efforts to help one of its customers, a local lumber company, increase its operational efficiency by leveraging connectivity and technology to make data driven decisions. Now, the company's operations are more efficient, and it is saving money due to the improved use of resources. In Texas, another Airband partner has connected dozens of schools to their respective Education Service Centers that offer distance learning courses such as English as a Second Language (ESL) and teacher instructional resources as well as access to Microsoft, Google Classroom, and filtering services.

TechSpark is a Microsoft civic program designed to foster greater economic opportunity and job creation in rural and smaller metropolitan communities. In TechSpark regions, our Airband partners work to address the broadband needs of local businesses and the related needs of the surrounding community. For example, in North Dakota, we are collaborating with the Dakota Carrier Network on a pilot project to deploy a narrowband, Internet of Things (IoT) network that uses TV White Space and other wireless technologies to support precision agriculture solutions in the state, including supporting the North Dakota State University Agronomy Seed Farm.

We're also excited to partner with Land O'Lakes, Inc. as part of our shared commitment to drive economic development and innovation for farmers and within rural communities. As part of our partnership, we are connecting member agriculture owners and Land O'Lakes facilities with Airband ISP partners to increase broadband speeds at these facilities, while providing broadband to the surrounding communities. To date, we've launched projects in Scircleville, Indiana and Uniopolis, Ohio; these pilot projects use fixed wireless broadband technology at speeds up to 100 Mbps, demonstrating the power of fixed wireless to close the rural digital divide. We will deepen our engagement in these projects by using the Microsoft FarmBeats platform for precision agriculture, and IoT applications for propane tank monitoring as part of these deployments.

Extending Access to Underrepresented Communities Often Involves More than Building the Network

Even when a community can obtain broadband connectivity, impediments remain for some populations to adopt and realize the benefits of broadband. These impediments could include an inability to afford monthly broadband service or the cost of a broadband device (and as noted earlier it could be a lack of digital skills). Our

Airband partners encounter these challenges in the populations they serve and have sought to creatively address them. Their actions though, in most instances, offer only short-term solutions and these needs will ultimately go unmet if a permanent solution is not implemented.

To encourage all community members to get onto the network, our Airband ISP partners are leaning into the new Federal broadband programs, like the Emergency Broadband Benefit Program, that offer support for those lacking the ability to pay for broadband service and devices. Our partners participating in the Federal Universal Service Fund's School and Libraries Support Mechanism (commonly referred to as the "E-Rate program") are gearing up their operations in anticipation of fulfilling the needs of schools and libraries from the upcoming changes to the E-Rate program. In response to the pandemic, Airband ISP partners took action to ensure that customers experiencing financial difficulties due to the pandemic remained connected, signing on to the FCC's Keep Americans Connected pledge, while at the same time working feverishly to meet increased demand for service in the face of supply chain challenges. However, these are temporary programs to bridge the gap. A permanent solution is needed to address these issues.

Tribal lands and Native American communities also face specific challenges when it comes to broadband access and use: remote locations, challenging terrain, and historical lack of service providers compound existing challenges. In addition, many of the residents on Tribal lands are income-insecure and particularly sensitive to the affordability challenge and therefore are reliant upon programs like the Federal Lifeline Universal Service Support Mechanism to secure broadband service. To drive adoption in these communities, access to affordable connectivity and devices, paired with digital skilling will be critical. Two of our Airband partners, Sacred Wind Communications and Native Networks, are squarely focused on serving Tribal communities. They have rapidly deployed broadband using a mix of technologies (2.5 GHz, 5.8 GHz, CBRS, FTTH, *etc.*) to unserved and underserved Indigenous communities in Arizona, Washington, and New Mexico in response to the dire need due to the pandemic. Funding to address affordability challenges in Indigenous communities is critical.

Building upon a recent partnership between Microsoft Philanthropies and the 1890 Universities Foundation, a 501[(c)(3)] organization created in 2016 by the nineteen 1890 Land-Grant Historically Black Colleges and Universities (HBCUs), we are partnering with the University of Arkansas Pine Bluff (UAPB) to use connectivity in support of precision agriculture and digital skilling. Through our Airband partner Aristotle Unified Communications, we will bring connectivity to UAPB's demonstration farms to showcase precision agriculture for local growers and support research opportunities and members who do not have stable internet access once they leave the UAPB campus. In so doing, we will help unlock the power of connectivity for historically marginalized communities, but affordability will remain a challenge in the absence of permanent solutions.

Recommendations for the Committee

The work of our partners highlights the importance of:

- providing funding for broadband deployment;
- taking a technology neutral approach to funding deployment;
- imparting digital skills;
- partnering to drive digital solutions; and
- ensuring that low-income consumers have access to a broadband service and a broadband device at home.

As we work together to design creative solutions to make broadband more accessible and affordable for all Americans, I'd like to put forth a few additional recommendations for consideration by this Committee.

- First, as permanent broadband funding mechanisms are designed, we must ensure they are targeted to address a known market need; for example, the need to deliver broadband access to unserved rural areas and connect students without broadband access for remote learning. Funding should be prioritized to reach unserved or underserved communities. This will require comprehensive and accurate broadband availability data and mapping as we cannot solve a problem we do not understand.
- Second, funding amounts should be cost-effectively allocated to technologies and deployments that provide the maximum value through efficient use of funds. Through our learnings, we know that there is no-one-size-fits-all solution to net-

work deployments and therefore encourage a technology-neutral approach where a mix of technologies can be leveraged to deliver broadband speeds.

- Third, broadband funding should provide a long-term meaningful benefit to make in-home broadband service affordable for income-insecure households.
- Last, given the urgency of the issue, preference should be given to broadband solutions that will provide rapid deployment of broadband networks and services. History has taught us that technologies are deployed at different speeds, with wireless technologies (*e.g.,* mobile phones) being deployed much faster than wireline technologies (*e.g.,* electricity). We cannot leave another generation behind. Speed of deployment must be a part of the policy calculation.

The term digital divide was coined over 2 decades ago. So, we have long known that communities are being left behind without access to broadband and unable to benefit from the multitude of services offered through the internet. The pandemic has made clear the value of broadband and the internet in our new digital world where, in many cases as we live our lives socially distant, there is no access to school, healthcare, commerce and jobs without broadband. At this moment in time, there is a unique opportunity to permanently fix the broadband deployment gap through leadership and smart investments maximizing the opportunity for all Americans.

Thank you for the opportunity to participate in this broadband discussion. I look forward to your questions and welcome the opportunity to discuss how Microsoft can assist in advancing broadband access and adoption in rural America.

The CHAIRMAN. Excellent, excellent testimony. Each of you have just given us valuable information. Thank you so much.

And now, our final witness, Dr. Park, you may begin for your 5 minutes now.

STATEMENT OF JOHNNY PARK, PH.D., CHIEF EXECUTIVE OFFICER, WABASH HEARTLAND INNOVATION NETWORK, WEST LAFAYETTE, IN

Dr. PARK. Thank you. Good morning. My name is Johnny Park. I am the CEO of the Wabash Heartland Innovation Network, or WHIN. I would like to thank Chairman Scott, Ranking Member Thompson, and Members of the Committee for this opportunity to speak with you today.

This invitation came about after a recent conversation we had with Congressman Baird. We shared that we recently had a successful test flight of a unique technology called the aerostat to serve rural broadband needs in our ten-county region in Indiana. He was struck by how valuable such alternative technology could be to helping solve the digital divide. He asked me to share this story with you.

You see, WHIN is not an internet service provider, and broadband is not our primary business. In fact, we are a 501(c)(3) nonprofit community organization, and our overarching goal is to build a regional ecosystem that can help our rural region attract globally competitive businesses to plant and grow in our Wabash Heartland region.

Towards that goal, our principle strategy has been to accelerate the adoption of digital technology in our region, especially digital agriculture and smart manufacturing. As you might expect in Indiana, agriculture and manufacturing are mainstays of our rural economy.

We began to develop our region as a very large Living Laboratory for IoT. Very simply, we introduced innovative and vetted commercial and near-commercial technology into the region, incentivized the local farmers and manufacturers to accelerate their adoption,

and drive innovation from the real usage of technology. And it is working. After just over 2 years, many farmers and manufacturers of all sizes in our region have adopted various technologies that they had not used before. But the spotty and inconsistent connectivity in our rural region was hindering our efforts, not to mention limiting all kinds of economic development and quality of life, as we all know.

Which brings us to broadband. We began to recognize that we can approach broadband with the same Living Lab model. That is, introduce innovative, highly impactful technology, put it to real use, and drive innovation from real usage by sharing results so that solutions can be improved.

So, as a first step, WHIN is launching an aerostat developed by RTO Wireless headquartered in Massachusetts. WHIN's aerostat is an 80′ tethered balloon that is approved by the FAA to fly 1,500′ in the air from a farm field in White County, Indiana. It is tethered with fiber connection and it has a payload capacity of 200 pounds that allows it to carry multiple wireless communication devices. Our single aerostat is expected to have a 50 mile radius coverage with LoRaWAN, which is a network protocol suitable for IoT sensor connectivity. For high-speed internet, we will utilize CBRS, which is going to take some testing, but we expect it to provide high-speed internet within a radius of 10 to 15 miles.

The aerostat has many features that make it very attractive for rural broadband. Its transmissions are low latency. Aerostats can be deployed typically in 3 to 5 months from start to providing services. It is cost effective. It has excellent line of sight, solving the problem of difficult terrain and barriers that traditional solutions can't reach. It functions well in high winds, and environmentally, the aerostat is quite friendly, as there are no engines, just helium and the tether.

So, you might wonder how WHIN's network will be put to real use as we are not an ISP. Our network is a resource that will be available to any ISP or WISP in the region who wants to use it to better serve their own customers, or attract new customers. Note that this is actually a way to accelerate adoption of state-of-the-art broadband in our region, and that is always our main goal. We are using innovation to close gaps quickly.

So, how can this model help you? We know that with very large expenditures proposed and already made for rural broadband, you would prefer to get it right the first time. But technology evolves quickly, and so does the need in the marketplace. And while innovation is necessary, it adds uncertainty and complexity. WHIN's Living Lab model is a model for taking out some of that risk by testing and validating novel solutions in real conditions. We suggested to Congressman Baird that setting aside a portion of rural broadband funding for innovation and for models of advancing innovation could really help solve the digital divide sooner and more cost effectively.

Thank you for your time today, and we deeply appreciate your work on behalf of rural America.

[The prepared statement of Dr. Park follows:]

PREPARED STATEMENT OF JOHNNY PARK, PH.D., CHIEF EXECUTIVE OFFICER, WABASH HEARTLAND INNOVATION NETWORK, WEST LAFAYETTE, IN

I would like to thank Chairman Scott, Ranking Member Thompson, and the Committee for the opportunity to speak with you today.

This invitation came about after a recent conversation we had with Congressman Baird to catch him up on WHIN activities. He found out that we recently had a successful test flight for the aerostat we are deploying to serve rural broadband needs in our ten-county region of North Central Indiana. Ours is the first aerostat, by the way, to be deployed long-term for commercial rural broadband in the U.S.

As we explained why we had included an aerostat in our network, Congressman Baird was struck by how valuable such innovative alternative technologies could be to helping solve the digital divide. We greatly appreciate his introduction on our behalf to Ranking Member Thompson.

1.0 Revisiting the Rural Broadband Problem To Make Room for Innovations Like The Aerostat

The aerostat is indeed a fascinating and potentially game-changing contribution to solving rural broadband and we are happy to tell you all about it. It is, however, but one innovation among many that will be needed to solve the digital divide.

And innovation for rural broadband is in full swing. It is high on university research agendas. U.S. Ignite and the NSF are due to announce who will build out the next Platform for Advanced Wireless Research (PAWR), this one dedicated to rural broadband. The FCC has made CBRS and TV White space available, both high bandwidth spectrum eminently suited to rural applications. Industry, from Big Tech to gear companies to Elon Musk, are developing new products accordingly.

And so is funding pouring out. Just about every major funding bill that has been signed into law in the past several years has included substantial dollars for rural broadband.

But the digital divide remains: we can't get over the hump. The finish line is ever out of reach. So far, the innovation value chain that leads to solutions, even with help of major Federal investment, is not delivering, or at least not delivering fast enough.

We also sensed from reading the report for the last farm bill a certain frustration on the part of Members with how to reconcile huge Federal investments with infrastructure that can become obsolete even before it is built. There is a quite natural longing for solutions, if and when they come, to be "future proof" and to be "built right the first time."

Somehow, the enormous effort to solve rural broadband doesn't seem to be satisfying anyone, and that is certainly true in the very rural ten-county WHIN region of north central Indiana.

In part, this could be a problem of unrealistic expectations that arise out of unchallenged assumptions and conventional wisdom. For example, that word "infrastructure" can lead to the misperception that telecommunications infrastructure should have the same kind of long and stable future as physical roads and bridges.

There are indeed solidly physical aspects to telecommunications infrastructure, but unfortunately they are nothing like roads and bridges. Even the lowest, most physical layer in a network, like the glass of fiber, has intelligence built into it, such as the ability to transmit multiple wavelengths. This allows a physical medium to interface with the higher layers in a transmission whose functions are even more abstract, such as data, addresses, protocols, logic and so forth. In other words, there is no "dumb," neutral, physical—only, part of a network, including fiber, that carries data inertly the way a concrete road carries cars.

That is one reason that fiber is so expensive. And while it has a relatively long useful life, at least in the telecommunications world, fiber is fabricated to allow certain bandwidth limits that meet current standards. Standards have a purpose and value in extending useful life. But they can also limit innovation and make it harder to meet a growing need. Eventually, something has to give because the spectrum on which telecommunications depends is a fixed, limited resource. The only way to get more of it is to innovate technology to get more performance out of what is already there. This means standards have to change and replacement of infrastructure must follow.

And by the way, the future of roads is that way, too. They are becoming smart as they are equipped with sensors. All infrastructure is going to look more and more like telecommunications infrastructure as the Internet of Things (IoT) barrels toward us from the future.

Another expectation that deserves a hard look is the one around fiber being not only stable, but the key to solving the rural broadband problem. Wherever it is de-

ployed, fiber is utterly necessary to broadband, but it is not sufficient to accomplish broadband service. This is because fiber rarely, if ever, delivers service directly to user equipment (UE). All mobile and most non-mobile network use requires some amount of wireless transmission, and however much fiber we lay, what the user experiences in service is only as good as the weakest link in the network. That link is wireless technology, which is historically weaker than fiber. Wireless technology is indeed a complex partner to fiber, embodying strength, weakness, opportunity and threat.

Finally, there is the related and subtle expectation that what works for dense urban areas just needs to be stretched out to fit less dense, rural areas. In this view, rural areas are vast swaths of digital deserts: a lot of digitally-irrelevant empty space between users, as if a city had been attached to a rubber mat and stretched out over the countryside.

The danger is that seeing rural America that way leads to implementing rural broadband that way. For one thing, rural terrain is not homogeneous, and it can be very unfriendly to terrestrial solutions of all sorts.

Rural areas are also digitally diverse. There are small communities that are oases of density. Dense use can develop spontaneously when a festival pops up and tourists arrive, or at a Friday night football game when most of the population that is normally spread out across a county finds itself packed into an acre or 2, with cell phones ablazing. Rural residents tend to do a lot of driving and rely on mobile phones en route.

Then there is the fact that rural areas are no longer digital deserts at all, because those seemingly empty farm fields are increasingly populated by sensors that need wireless service. Sensors that serve digital agriculture are typically low power and operated by batteries that must last for years. This means that traditional broadband won't work because it draws too much power and that is okay: sensors don't need broadband for their uplink. Their transmissions do, however, need backhaul. So IoT needs something different to complement broadband, and that service is going to be just as important to rural development as broadband.

Rural broadband is also not starting from scratch. Recent investment has resulted in very useful and important deployment of fiber. That it hasn't always closed the gap to the user doesn't mean it was a poor investment. And some fixed wireless providers are upgrading to newly available spectrum like CBRS. They are also taking advantage of grain legs and other built structures typically found in rural areas to avoid building expensive towers.

But in the WHIN region alone, there are 30 service providers, with widely varying levels of service, a multitude of technologies, and inconsistent plans to upgrade. A huge challenge to consistent rural broadband service is to incentivize the marketplace to provide the consistent, high-quality service the region needs.

The bottom line is that rural connectivity needs are not always what they seem to be: they are complex, dynamic and don't lend themselves to one-size-fits-all solutions. Rural telecommunications will have to be solved creatively and strategically, with a variety of flexible and dynamic solutions that take into account not only the distances in rural areas, but also environmental and terrain conditions, the jumble of existing technologies, the variety and unpredictability of connectivity usage patterns, and the need for different kinds of spectrum for different problems.

Among other things, this puts a lot of pressure on wireless technology to fill gaps and go where fiber can't without compromising service. Accordingly, as noted above, wireless technology has been enjoying a lot of attention. Notably, at the physical level at least, wireless technology is a less problematic target of investment because it is also less expensive to fabricate, deploy and redeploy than fiber.

There is still plenty of room for even more innovation as the new spectrum, which is very different from conventional broadband spectrum, becomes operational. Wireless transmission is still affected for better and worse by physical issues like positioning, and in some bands, it is always going to be hampered by obstacles.

And there is an opportunity to innovate fiber with different models of deployment.

So what does this complex, vibrant view of rural broadband mean for this Committee and others who are trying to find traction to justify major investments in broadband infrastructure?

First, the notion of rural broadband infrastructure must expand to include not only fiber but also whatever it takes to deliver performance and solutions to users, including fiber.

For example, a percentage of fiber investment could be set aside to support innovation of wireless technology for rural applications including IoT; strategic and integrated use of fiber in conjunction with wireless technologies to achieve optimal performance; middle and last mile solutions that are sustainable; and, attention to en-

sure that rural connectivity solutions are designed to solve complex problems like e-learning, remote work, and telehealth beyond just providing a lot of bandwidth.

We were very impressed to see the note in the House farm bill report that an Innovative Broadband Advancement Program had replaced the former Rural Gigabit Program, and to learn that it was signed into law. Even though the provision was not funded, it hit the high points of practical and cost-effective innovation, demonstration, methods of deployment in addition to technology, and flexibility. We commend the Committee for that vision.

We realize that encouraging innovation in a complex technology like broadband, and in a complex service area like rural America, poses a different and difficult set of challenges to funding than are usually faced in infrastructure-related legislation. How, among all of the choices that are emerging, is an investor, including government, to know whether a solution works as intended? Whether it is necessary? Whether it solves the problems users care about? How much value will it return? Is there a sustainable business model? What are its unintended consequences? What will come closest, fastest, to solving the digital divide?

How, in short, can we get innovation funded? And what makes an innovation in rural broadband a good investment? How is that determined? And by whom?

WHIN's aerostat is an example of wireless innovation that can benefit rural broadband. It is being deployed with private grants funds and no public investment. That approach works because WHIN is itself an innovation: a community-based nonprofit with a regional development mission built primarily around scientific and educational purposes.

Though aerostat technology is the reason we are testifying, it is but one example of innovative technologies that can accelerate rural broadband. WHIN is technology-agnostic. The model it has developed organizes innovation around cost effective, efficient, sustainable, rapid results and it has demonstrated the ability to accelerate digitalization, including both Internet of Things (IoT) and its enabling technology, broadband, in the vital rural economic sectors of agriculture and manufacturing.

Private funding is flexible enough to fuel the development of such an innovative model and to demonstrate its value. But what WHIN is doing has useful lessons for others who are trying to solve the problem, including the Federal Government. For example, WHIN's model addresses "future-proofing" to some degree. It is a project worth continuing with public help, strengthening and scaling up the bold experiment that WHIN's private grant dollars have enabled. That is how public-private partnerships should work, aligning investment with the stages of a project's life-cycle that best fit what a funder is able to do within its purpose.

We begin with a brief description of WHIN. Then we describe the aerostat as an example of how WHIN's unique Living Lab model is demonstrating innovation. We then conclude with a fuller explication of the model and its power to generally organize innovation around results.

2.0 About WHIN

WHIN is the Wabash Heartland Innovation Network. With very generous initial funding from Lilly Endowment Inc., our task is to build a regional ecosystem that can help our rural region attract globally competitive businesses to plant and grow in the Wabash Heartland.

The WHIN region consists of Benton, Carroll, Cass, Clinton, Fountain, Montgomery, Pulaski, Tippecanoe, Warren and White counties in North Central Indiana. Its area is 4,321[2] mile and includes a 90 mile stretch of the Wabash River. The region's population is 391,476 (2019E).

The region's average BEA Per Capita Income in 2019 was $42,276, about 75% of the national average. About 85% of the region's land area is farmland, primarily in corn and beans.

The economic and population center of the WHIN region is in Tippecanoe County, and especially in Greater Lafayette, home of Purdue University in West Lafayette and a regional campus of Ivy Tech Community College in Lafayette. Greater Lafayette hosts vibrant manufacturing including Subaru's North American production plant; Wabash National, North America's largest producer of semi trailers and liquid transportation systems; a metals cluster including Arconic, Nanshan America, Oscar Winski, and ProAxis; a Caterpillar large engine plant; Evonik pharmaceuticals, and an aviation cluster including GE Aviation and Rolls-Royce, with SAAB on the way. About half of the region's population resides in Tippecanoe County.

WHIN is not an ISP, and broadband, rural or otherwise, is not our primary business. And though, as a regional development organization WHIN has a very close working relationship with Purdue University and Ivy Tech Community College, it

is a community-based 501[(c)(3)] whose own purposes are scientific and educational, as well as charitable.

The WHIN innovation in regional development is that it not only has the 501[(c)(3)] purposes of science and education that are unusual in a community organization, those purposes structure its strategic framework. WHIN does serve the charitable purpose of supporting the quality of life projects and workforce development that are usually expected from organizations like ours. But the organization mainly has the not-so-modest and very specific grant obligation of making our region a globally-recognized center of IoT, the Internet of Things. WHIN is developing its region as a Living Laboratory for all of the technology related to IoT.

Aerostat technology serves the I in IoT, which is to say the internet. As a means of accessing the internet, it is a prospective technology for rural broadband.

3.0 WHIN's Aerostat: A Case Study In Using WHIN's Living Lab To Address Rural Broadband

3.1 How WHIN Chose Aerostat Technology for Its Living Lab

WHIN identifies innovative IoT technology, puts it to real use in its regional Living Lab, and generates research and educational support from that use. The process begins with an extensive vetting process that examines both the prospective technology and the prospective tech partner that produces it.

WHIN looks for promising technology that is commercial or near-commercial, has a sustainable business model, can be deployed rapidly, will have immediate impact, and that can offer interesting test cases to move IoT adoption forward.

WHIN began its association with RTO Wireless through connections both have in Silicon Valley. The company is headquartered in Massachusetts with a research office in California. It offers fixed wireless service on the east coast, but its principals are very interested in wireless innovation, specifically for rural broadband. RTO is a Microsoft Airband partner. It has strong connections with the military. When WHIN met RTO, it had begun a new venture to adapt military aerostat technology that has a long and successful record serving telecommunication needs on battlefields, for use in domestic applications, including rural broadband.

The company was far enough along in the adaptation to be nearing a contract with AT&T to utilize an RTO aerostat for FirstNet services. FirstNet is the government-funded program developed after 9/11 to ensure that first responders can communicate when commercial communications are down because of a national emergency or natural disaster. AT&T has the contract and it, in turn, contracted with RTO to do the work necessary to prepare an aerostat for flight, including its payload of radios and antennas, as well as to provide flight operations support until AT&T's crew could be trained.

Over time, that contract was executed and an RTO aerostat successfully tested at the famous Tuskegee Air Force base in Alabama. This test was conducted twice and closely tracked by the FirstNet program and the FAA. AT&T and RTO demonstrated that the aerostat could be operated safely, and earned the FAA's support for these emergency deployments. During Hurricane Laura in Louisiana, AT&T and RTO deployed the RTO aerostat and provided communications to emergency personnel.

RTO previously conducted successful flight and telecom tests in Baltic, North Dakota, demonstrating a propagation map that far exceeded the reach of terrestrial towers in the WHIN region.

Based on that information, WHIN recognized the disruptive potential of the aerostat and decided to deploy an RTO Wireless AeroSite™ in its Living Lab, making it the first long-term deployment of the technology in the U.S. for commercial rural broadband.

3.2 Aerostat Technology and the RTO Wireless AeroSite™ in Particular

3.2.1 History and Use

Aerostats have been in service since the early 1900s. Since 1978 the United States has maintained eleven tethered aerostats sites along its southern borders on a 24/7/365 basis, operating as high as 18,000′ and carrying radar units for drug interdiction purposes, persistent surveillance and other applications. Aerostats have also been used for decades by the military for communications on battlefields.

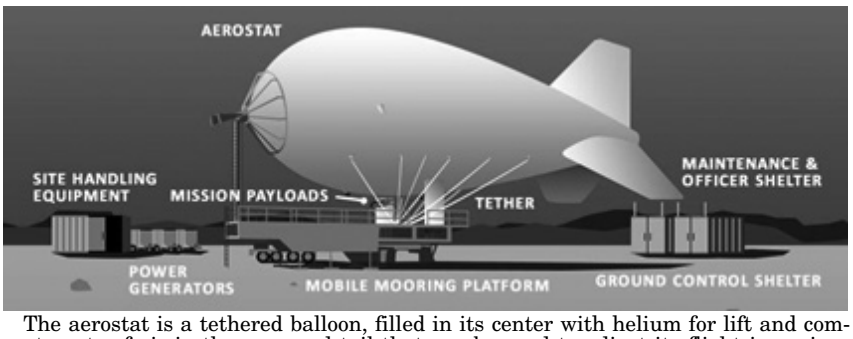
The demonstrated use of aerostats in these situations suggests that they would be an ideal technology for rural broadband because rural terrain, user density, and user mobility have much in common with military service areas.

Beyond communications, aerostats could be an IoT solution for rural needs including forestry management (hyperspectral), fire and hot spot detection (thermal), im-

aging for precision agriculture, environmental monitoring, and livestock tracking and monitoring.

Aerostats can be used for emergency and law enforcement situations, like the FirstNet service mentioned above. WHIN envisions the potential for aerostats to serve as an immediate solution for deploying rural broadband connectivity, as telehealth and remote learning needs are immediate. In the event that fiber or other networks overbuild the aerostat coverage area over time, then the permanent aerostats can be switched to emergency networks that get deployed during massive natural disasters or acts of terrorism or war.

3.2.2 Equipment



The aerostat is a tethered balloon, filled in its center with helium for lift and compartments of air in the nose and tail that can be used to adjust its flight in various weather conditions. The aerostat's aerodynamic design helps stabilize it in flight.

The aerostat is deployed in a fenced, secure, graveled compound located and sized to allow for a 45° cone of operational space around the tether that ensures the aerostat easily clears other vertical structures during launch and landing.

The full AeroSite™ system includes a mooring trailer that is custom designed to anchor the aerostat in flight, allow it to be launched and landed safely, and connect it with power and fiber.

The mooring trailer also contains avionics to assist flight, launch and landing, as well as remote monitoring.

The trailer remains on wheels and is portable but is anchored to concrete pylons for long-term deployment. The compound that serves the aerostat contains a telecom cabinet, generator, equipment storage shed, and the helium truck. The compound needs fiber service and commercial power.

3.2.3 Performance Advantages and Constraints

The aerostat's tether contains fiber as well as power and its payload consists of radios and antennas. It can therefore provide both access and backhaul.

At an altitude of 500–2,500′, depending on model and payload design, the aerostat's altitude offers two significant performance advantages. First, it can position radios and antennas at an optimal altitude to provide line-of-sight communication that exceeds that of typical terrestrial towers, while maintaining low latency that avoids the lag and other problems associated with high latency at higher altitudes. High latency is a problem with satellite technology, for example. Greater line-of-sight benefits rural broadband by enabling signals to reach behind treelines and other obstacles in often-difficult rural terrain.

Second, the aerostat's higher altitude means that its radios and antennas operate in free space, which gives them greater range than they have on the ground. Aerostats generally extract more value from gear.

The main performance constraint is weight: unlike terrestrial towers, the number of radios and antennas an aerostat can carry in its payload is capped. That means that capacity, the number of customers a single aerostat can serve, is also capped, making aerostats unsuitable for high-density areas like cities. But as long as the payload capacity of an aerostat is aligned with the density of its intended service region, which is typically low in rural areas, this constraint is not a disadvantage: a single aerostat can serve a much larger area than a single terrestrial tower. This CapX/OpX efficiency is what gives aerostats their business model advantage.

The other main performance constraint has to do with up time. Aerostats must be brought down monthly for a few hours for service and helium top-off. Though designed to fly in winds up to 80 mph, depending on the model size and actual payload, aerostats may have to be grounded in exceptional weather conditions. Also, as

tethered balloons, aerostats fly under Section 101 of FAA regulations, meaning that they are subject to visual flight rules and must stay below the cloud ceiling.

With their low carbon footprint, minimal soil disturbance, and relatively quiet operation aerostats are environmentally friendly. Aerostats would not be typically deployed closer together than 20–25 miles, and at flight altitudes of 500–2,500′, they are not visually distracting.

3.2.4 Operational Considerations

Though the aerostat itself is unmanned, it requires 24/7 remote monitoring on the ground. Manned operations contribute to the aerostat's OpX, but that is mitigated if aerostats are deployed in a network, allowing a single operator to serve multiple aerostats.

Launch and landing require a team that is well-trained, but only needed occasionally. Though this also contributes to OpX, the team is mustered infrequently. An analogy would be volunteer firemen. In WHIN's case, Purdue University is close by and has an aviation program. It is eager to supply student interns to assist, as they will benefit from a unique opportunity to gain skill in this technology.

Helium is expensive and deflation is to be avoided to keep OpX in line. Normally, only a top off should be required month to month

3.2.5 What Is Involved in Deploying an Aerostat

The overarching consideration for deploying an aerostat is that it is regulated by a variety of entities, including local ordinances governing zoning and land use, the FCC controlling telecommunications, and the FAA controlling use of airspace. There are two main differences in the process for aerostats compared to terrestrial towers. First, aerostats are new and the governing mechanisms don't always account for them. Second, the FAA has much more to say about aerostats than it does about terrestrial towers.

For regulatory approvals, it is very important to become familiar not only with requirements but timelines. The permits often depend on each other, and not taking steps in the right order will cost time.

That said, WHIN, which had no experience standing up a commercial network, coordinated with RTO on the site selection and permitting process. RTO brought experience standing up commercial towers but had only deployed aerostats in emergency situations where much permitting is waived. WHIN and RTO used their collective resources to work through the ordinances and processes that agencies required to construct a communications site and a "tethered balloon" deployment. Even with these challenges, WHIN still managed to go from needing to select a site to maiden flight in 6 months. That time frame is not possible for a terrestrial tower, which can take well over 1 year to construct and require the ground frost to be thawed.

Specific aerostat ground needs are modest compared to a tower, with no structure construction required. Most of the construction is in grading and finishing the compound and access road, and fencing. The site must have access and easements for power and fiber. An ideal location is a farm field where the compound can be distanced from power lines and vertical structures.

3.3 WHIN's Specific Configuration

In selecting both site and aerostat model, WHIN's goal was to be able to at least touch the edges of six counties with broadband service and provide LoRaWAN to the entire region with a single aerostat. The intended spectrum is CBRS, with the ability to swap in other spectrum, including very high frequency. The performance goal is 100 Mbps/20 Mbps within a 15–20 mile radius, with capacity to be determined, but sufficient to support a business model

The recommended model was an AeroSite™ 800, which is an 80′ balloon with a 200 lb payload capacity, and tether for a flight altitude of 1,500′.

3.4 WHIN Plan for Operations

As of the end of March, WHIN's aerostat had completed a successful test flight. The LoRaWAN payload is presently being configured, and that will be tested in early June. The next radios to be added to payload will be 5.8 GHz radios that have been used for many years in rural broadband networks. After 5.8 GHz testing is completed, WHIN will replace the 5.8 GHz radios with CBRS radios and begin testing. WHIN will be testing various antennas on all the wireless technologies on the aerostat.

In the meantime, WHIN is contracting with local service providers to provide retail services for the aerostat. WHIN is working with a service provider to provide sufficient backhaul and radio equipment for multiple wireless service providers to be able to utilize the aerostat.

3.5 WHIN's Research Plan

Over the next year, WHIN will test and produce use cases including business plans to determine:

1. The propagation maps that are possible from the aerostat for LoRaWAN, 5.8 GHz and CBRS networks
2. Service capacity for each configuration
3. Use of the aerostat for backhaul
4. The motion of the aerostat and its influence on performance and compliance with any wireless standards, such as CBRS restrictions on movements of certain antennas that are cause by the aerostat
5. How operational considerations impact the business model

WHIN is also deploying terrestrial assets in conjunction with existing commercial terrestrial assets to facilitate testing and provide a variety of real world network configurations and ground-truthing.

WHIN is seeking funding for a second aerostat to both elaborate the business model and to do technical testing with a network of aerostats.

4.0 The WHIN Living Lab Model

WHIN is able to deploy the aerostat in real operations and test its performance thanks to a model it has developed called Living Lab. The model has its roots in a problem WHIN had to solve for itself. In order to meet its grant requirements, it had to find a way to accelerate the adoption of IoT, and, even more specifically the sensor side of IoT, by growers and manufacturers in its ten-county region.

But of course it turned out that IoT is an all or nothing proposition. It can't solve problems unless all of its parts are present: data measurement (sensors), data transmission (broadband), and data analytics/applications (the component that integrates the data into an action plan or solution).

Because commercial sensor technology comes equipped with data analytics, we were left with a two-part problem.

1. Sensor technology is at the stage of development where its next customers, especially in rural markets, don't know yet that they need it, or at least not with the urgency that would lead to rapid adoption.
2. Broadband, on the other hand, is already at urgency and beyond in rural markets. The problem with broadband isn't adoption, it is a combination of affordable availability and slow deployment.

Technology is always in a process of continuous improvement, or the addition of value, by its stakeholders. At different points along this innovation value chain, there are different stakeholders. Early on, it may be a university and the NSF. At another, it is a startup and a VC. At another it is a user with her wallet. Each addition of value involves investment.

We aren't accustomed to thinking of users as adding value, but as noted in the introduction, they have perhaps the most value of all to contribute because only they are the arbiters of whether a technology should stay or go. Of whether it has any value at all.

What WHIN's two IoT problems have in common is that somewhere in their value chains, there is a barrier to real use. For sensor-technology the barriers are related to adoption. For broadband, they are related to being available and accessible. Looked at that way, WHIN's problem was to eliminate barriers.

4.1 Connecting Products to Real Use

Lowering the barriers to adoption is such an important need for WHIN that it has its own part of the Living Lab called WHIN Alliance, consisting of the growers and manufacturers who are willing to adopt if WHIN makes it easy.

A key barrier to easy adoption is the time and effort it takes to identify and assess not only a technology but the company itself. As we saw with the aerostat, WHIN has a process for vetting that is very thorough.

We lower another barrier by subsidizing the initial cost of adoption, requiring tech partners to also provide a discount. If WHIN has done a good job of vetting, the users will benefit and be willing to assume future costs. Once a technology is in wider use, the Alliance serves as a community of users helping each other learn to solve problems in a new way, reducing yet another barrier to adoption. And WHIN remains in the picture to facilitate and advise.

The good news is that lowering these barriers is indeed accelerating the adoption of IoT in the WHIN region. Thirty-nine growers representing nearly 155,000 acres have become Alliance members in the last 2 years, benefiting from WHIN's weather

station network, automated optimization of ag operations, robotic soil sampling, remote grain health monitoring, and aerial imaging. Seventeen manufacturers of all sizes have benefited from automated preventive maintenance technology in a little over a year. Additional technology is in the pipeline for both agriculture and manufacturing members and the Alliances are growing.

WHIN tends to measure the success of its model by the willingness of Alliance members to stay active and begin to invest their own dollars in WHIN's vetted IoT. That won't happen unless farmers and manufacturers are seeing value. The majority of members are being retained in the Alliances from year to year and they are adding new technology.

4.2 Connecting Tech Companies to Real Use

One key barrier to innovation is when there is no way to do product validation, which requires real use. And the more expertise that can be brought to bear on resolving problems the validation uncovers, the better the result in both quality and speed.

Purdue University's presence in the WHIN region is of immeasurable value to discovery and innovation. They are leaders in sensor development, and in creating the next generation of digital agriculture and digital manufacturing. They are a tremendous source of expertise.

WHIN's Alliance model brings tech partners into the region who are learning from the real use of their products, whether that is early stage product validation or later stage mature product innovation.

Purdue and the Alliances give tech partners every reason to develop a permanent physical presence in the WHIN region: it is there that they can develop and innovate most quickly and effectively. We have already seen this to be the case. Digital ag company and WHIN tech partner, Solinftec, moved its global headquarters from Brazil to West Lafayette because of the WHIN relationship and proximity to Purdue. All of the other tech partners have also added jobs because of increased business in the Alliance. Some had no previous employment presence in Indiana at all.

The tech partner relationship also leads to accelerated commercialization of promising near-commercial technologies, helping startups succeed, plant and grow. Two of WHIN's tech partners began as startups in the Alliance and are now further along in their lifecycle.

Thus the Alliance model fulfils another WHIN goal: helping globally-competitive businesses plant and grow in our region, which is to say, to create good jobs.

4.3 Connecting Researchers and Educators to Real Use

Funding for university research is highly competitive. WHIN's Living Lab offers Purdue faculty something no other university enjoys: access to a wealth of real world data. The Living Lab actually reverses the conventional science-to-practice model.

A key aspect of WHIN's 501[(c)(3)] status is that our scientific and educational purposes must also be fulfilled for the public good. WHIN accomplishes these purposes by requiring its Alliance members and tech partners to license data to WHIN. WHIN maintains the data in anonymized form in a data lake, with a data portal that makes it accessible to interested faculty and students.

The intent of WHIN's data sharing is to spur the contribution of university research and innovation toward making the region a global center for IoT. In fact, WHIN data that is generated from sensors can help inform research that is not specifically related to the sensor side of IoT. Because IoT is a complex of data measurement, data transmission, and data analytic technologies, researchers in any one of those areas can benefit from real world data. And because IoT is about the physical world, researchers interested in what the physical world has to say for itself could benefit from real world data. And because IoT is changing and guiding human experience, there is a sociological, ethical, communicative, and even philosophical interest in what is actually, objectively, happening. IoT will increasingly touch most of human experience.

4.4 Connecting Products to Real Use—the Broadband Challenge

The digital divide points to a different problem with connecting technology to real use. There is a third variable as the economics of technology innovation and deployment works against adoption.

But building a network doesn't have to be a billion dollar project. It is possible to build small scale networks and connect them to a commercial network with the right technology, incentives, and relationships.

The Living Lab has all of those. As the aerostat story shows, a single piece of gear can make a difference, and WHIN's model is able to incentivize industry partners to come together to help, from fiber to retail operations.

5.0 Urgency

Just how important is WHIN's digitalization project?

According to the pivotal 2019 USDA report, "A Case for Rural Broadband: Insights on Rural Broadband Infrastructure and Next Generation Precision Ag Technologies." (*https://www.usda.gov/sites/default/files/documents/case-for-rural-broadband.pdf*), the digitalization of agriculture can help growers by:

- *Integrated decision-making* based on actionable data and information=better decisions, more precise supply chain and resource allocation
- *Automation of processes* through the Internet of Things=increased efficiency, reduction of repetitive manual tasks, improved precision
- *Technology to support human tasks*=improved speed, accuracy, ability to access information and control remotely
- *Better connectivity*=e-commerce, access to more markets, online platforms that are not limited to geography, ability to differentiate products
- *Quality of life applications*=telehealth, distance learning (including workforce development like developing coding skills)

The report concludes, "While digital technologies are already creating value within the agriculture industry today, realizing the full potential of these technologies, according to USDA, could create $46–$65 billion annually in additional gross benefit for the U.S. economy. In other words, if broadband internet infrastructure, digital technologies at scale, and on-farm capabilities were available at a level that met estimated producer demand, the U.S. could realize economic benefits equivalent to nearly 18 percent of total production, based on 2017 levels."

The impact of increased digitalization in manufacturing has also been found to be critically important. "State of renewal: Charting a new course for Indiana's economic growth and inclusion." (*indianagpsproject.com*) was released in February 2021, by the Brookings Institute, in collaboration from the American Enterprise Institute and is the outcome of the Indiana GPS project.

The GPS study was commissioned by the Central Indiana Corporate Partnership (CICP) with funding from Lilly Endowment, Inc., to identify data-driven strategies to promote growth and prosperity in the state. Specifically, those strategies were to be focused on increasing the number of good jobs so that every Hoosier can support a family.

The study picked up on some very important and interrelated data points. A leading indicator of the potential for good job growth is productivity. The most impactful variable for lifting productivity is technology, specifically information technology, which since the mid-1990s accounts for ⅔ of productivity growth nationwide. The number one recommendation in the report for creating new good jobs is therefore to accelerate digitalization, including closing broadband gaps as broadband is critical infrastructure both for itself and for digitalization.

This is of utmost importance to Indiana, a state that has suffered from negligible growth in productivity between 2007 and 2019, and whose 2019 productivity gap relative to the nation was 20%. Not surprisingly, given the interrelationship between productivity and digitalization, Indiana's firms are found to be investing too little in IT, ranking the state 37th in the U.S. in annual per worker IT expenditures in 2016, the most recent year for which the data is available.

The report concludes that digitalization leads to economic dynamism, productivity, and competitiveness, with productivity a kind of first among peers as it affects competitiveness and, because of multiplier effects, economic dynamism.

Thus WHIN's model of accelerating digitalization in jobs-rich manufacturing has only become more urgently needed. And WHIN's inclusion of product-rich agriculture in its digitalization project gives ag a new role in impacting jobs as well. The ag tech companies WHIN is working with to digitalize agriculture are creating new, good jobs in Indiana. As part of the advanced services sector, those companies are just as important to Indiana's growth and prosperity as manufacturing.

WHIN now finds itself in the position of being the pilot for the number one recommendation in front of Indiana policy makers and officials for moving the state forward. It is a responsibility we do not take lightly.

6.0 WHIN's Value Propositions and Why It Is So Important to Strengthen and Grow Its Model

One of the great gifts of the LEI grant that created WHIN is that it meant that WHIN is a 501[(c)(3)]. Being a not-for-profit organization enables WHIN to function as an agnostic problem solver, with no allegiance to any particular technology except that it has to be IoT or related to IoT. This enables us to work holistically, with

the purpose of problem-solving, whatever it takes, and not simply validating that something works.

That makes us a very new kind of stakeholder in technology innovation that, from a position outside of the innovation value chain, is able to disrupt the chain in the interest of both adoption/digitalization and innovation simultaneously to get problems solved.

WHIN may be outside of the innovation value chain, but its way of disrupting adds great value. WHIN disrupts by separating real use from adoption and then accelerating the use ahead of adoption.

Real use, which is normally delayed until adoption, is the only way to answer the questions that measure real value: does the technology work as intended? Is it something the market needs? Does it solve a problem users care about? How much value will it return and how quickly? Are there any unintended consequences? And most of all, will someone pay to use it?

This last point is key. WHIN describes itself as accelerating adoption and it is. But it doesn't do that with its initial investment in reducing the cost of adoption. Adoption doesn't really happen until the user is paying for the technology, until they have literally bought in. In the first years a technology is deployed in the region, WHIN assumes the risk that adoption may not ultimately occur. Indeed, for technology laggards like farmers and manufacturers, for whom seeing is often the shortest route to believing, what WHIN offers is basically an extended road test.

WHIN's ability to take on the risk is enabled by its own investors.

And the risk is worth it. Real use is what uncovers problems, and WHIN's model of doing that earlier can mean the difference between an inexpensive adjustment and complete failure of the product. The earlier a problem is found, the less likely it is to damage the trajectory of product development. Indeed, even failure can be innovation's best friend, as long as it occurs early. Failure is the source of much critical learning. This is called "fail fast" in technology development and it helps ensure that companies adapt quickly and move on without spending more time on something that isn't working.

Another trend in tech development is to send products to the market early, when they are ready to do a meaningful task but could still benefit from additional features. The products can often be easily updated through software updates and, in the meantime, the user has the benefit of the features that are available, and the tech company can ensure the product is keeping pace with user needs. This solves the problem of long development cycles aimed at perfection which can mean that, by the time the product is perfect, user needs have changed and the product is obsolete before it gets out of the lab. The principle is to not let the perfect get in the way of the good.

More generally, these trends reflect how the private-sector is adapting to the rapid pace of technological change during the development phase, which also requires substantial investment. In effect, the companies are protecting their investment in development by accelerating real use.

Indeed, the strategies can be seen as a form of "future proofing." The concept of useful life that is the usual target of "future proofing," is based on a rigid innovation value chain model that positions the user at the end of product development, after all of the value has been built in. When users need change, which is the main source of obsolescence, the product loses use value.

But if real use is distributed all along a product's value chain, the product can better keep pace with need and, as a bonus, uncaught problems are less likely to interfere with future development and value. Distributing the risk all along the value chain makes it more likely that, barring a revolutionary shift in technology, the product will last longer.

That is what is proven in the private-sector to handle accelerated change for single technologies.

WHIN's Living Lab model takes those strategies further. First, it creates a community of users in a very large lab with diverse conditions that enables a much more robust test for even single products.

And, because it is operated by WHIN, which is agnostic to any particular technology, the model is able to accommodate complex technologies like broadband, which depend on entire systems of products to solve a problem. WHIN is able to help design and test complex solutions, in the quest for what is cost-effective and sustainable, beyond simply knowing whether an individual component performs according to spec.

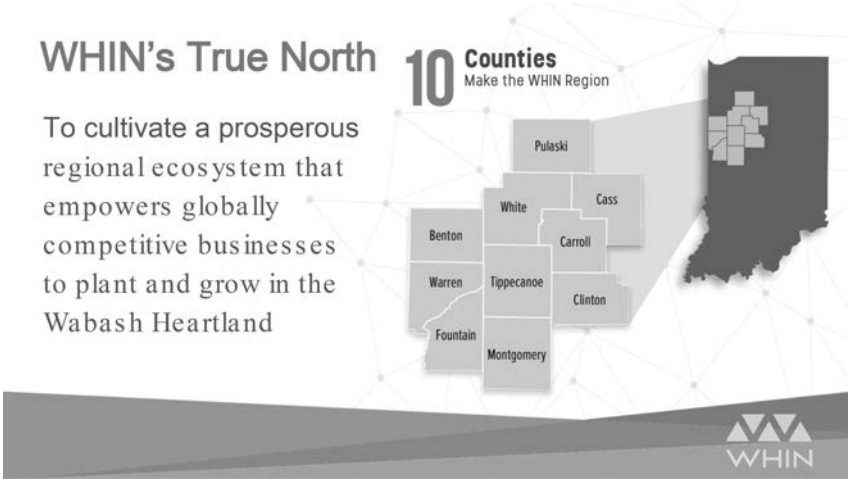
For investors all along the innovation value chain from the NSF to VCs to the USDA investing in broadband deployment to users themselves, early certainty—in whatever degree—reduces risk, and makes it possible to release investment earlier

throughout the innovation value chain. This keeps innovation and digitalization moving forward.

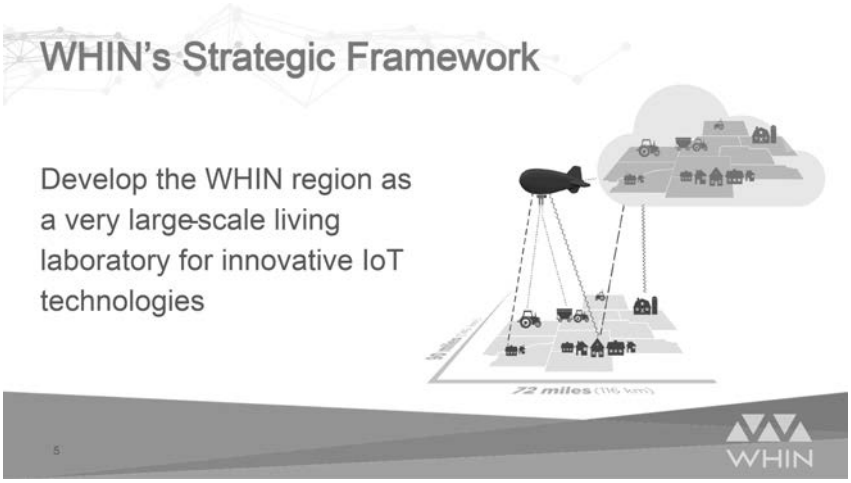
Finally, and most important, it should not be lost that WHIN's Living Lab, by being Living, necessarily includes the community itself in finding the right solutions. Grounding the innovation of technology in real use also keeps it grounded.

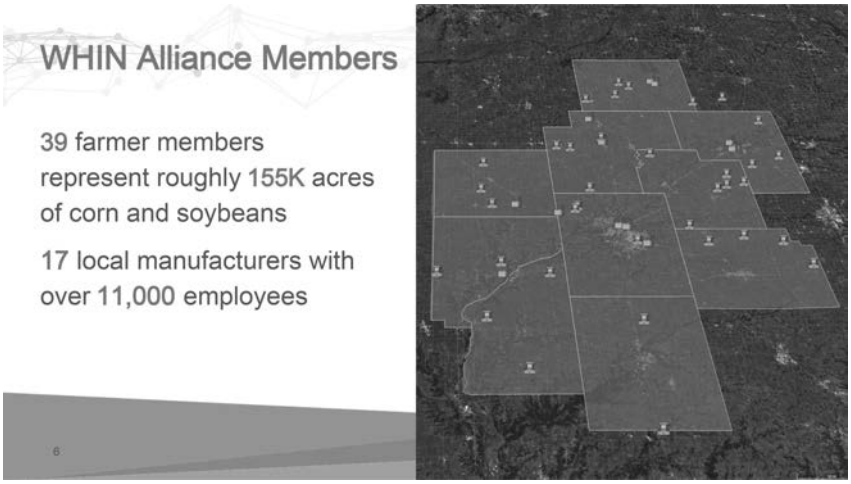
The Living Lab is the right model for the right time: a way to manage both complexity and rapid acceleration of change in broadband and all of the aspects of digitalization, and a way to connect technology to what is humane and real.

POWERPOINT PRESENTATION


WHIN's True North
To cultivate a prosperous regional ecosystem that empowers globally competitive businesses to plant and grow in the Wabash Heartland
10 Counties
Make the WHIN Region
Pulaski
White
Cass
Benton
Carroll
Warren
Tippecanoe
Clinton
Fountain
Montgomery
WHIN

Digital Agriculture
Smart Manufacturing





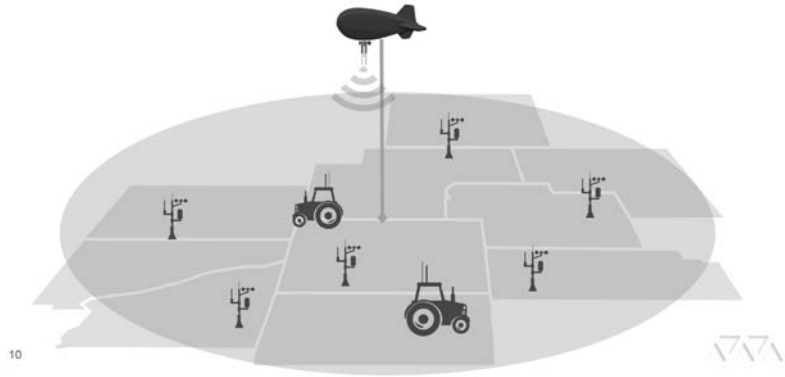
[Ron Burns, Matt Gremelspacher, Blain Hizer—Grain and Hog farmer.]

Unserved and Underserved Areas

- Total # of households: 150,040
- # households with **no access to 25/3**: 18,128 (12%)
- # households with **no access to 100/10**: 99,291 (66.2%)
- # businesses with **no access to 100/10**: 16,752 (34.2%)

WHIN

50-mile radius coverage of LoRaWAN for sensor connectivity



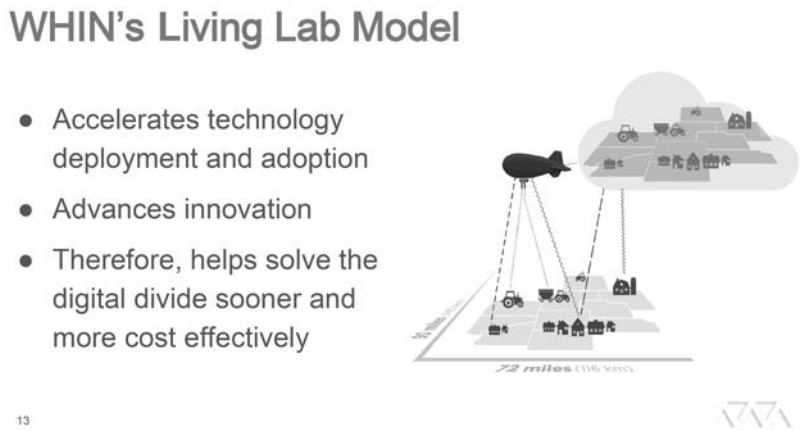
10

Fixed wireless for broadband applications

11

Attractive Features of Aerostat

- **Low latency**: unlike satellites, supports mobile communications and low -power IoT devices
- **Fast deployment**: typically 3-5 months
- **Cost effective** : 10-20% of cell tower network
- **Excellent line-of-sight**: solves the problem of difficult terrain and barriers
- **Functions well in high winds:** up to 80 mph
- **Environmentally friendly**



The CHAIRMAN. Very good. Thank you.

As I said, Committee Members, as you can see, what a bountiful amount of very valuable information we have already heard. And now, we are going to get into our questions for our panelists. At this time, Members will be recognized for questions in order of seniority, alternating between Majority and Minority Members. You will be recognized for 5 minutes each in order to allow us to get as many questions in, and my goal is to make sure we hear from each and every Member here. So, please cooperate with me when I have to bring the hammer down so we can be fair to everyone, because everybody has something to say here.

Also, please keep your microphones muted until you are recognized in order to minimize the background noise.

And now, I recognize myself for 5 minutes.

Panelists, as Chairman of this Committee, my goal is to see if we can not get rural broadband out to these 24 million people that don't have it. We can do it, and I want you all to help me and advise me on how we can do it to reach my goal of having internet rural broadband in place for access for these 24 million of our fellow Americans in rural areas by December the 31st. Sometimes you have to set a deadline, measure what you want to do.

So, please, each of you, if you could just tell me what it is we need to do. You all know how much money it would take. Give us what you think the amount of money we need, and tell me, can we do that? That is our goal.

And, I will start with Ms. Robinson—no, Ms. Prather first. I am sorry.

Ms. PRATHER. Thank you, sir.

The CHAIRMAN. How much money would it take? What must we do to get rural broadband to these 24 million people by the end of this year, December?

Ms. PRATHER. Thank you, sir.

First of all, you are right. This is an extremely expensive issue. I do want to state, too, that it is a two-fold issue. It is not just the initial deployment, which is very much necessary and where these

programs can be very beneficial, but it is also a matter of being able to maintain those networks over the life of those assets that we are putting into the ground.

I do want to be certain that while we have communities that have waited this long for broadband infrastructure, that we don't cheapen what we give them. If it has taken this long to get broadband, we want to put something in the ground that will last many, many decades because I don't know when we would get back to them to upgrade that. So, I think using these sure methods of providing sustainable broadband, and then the government using programs that can help sustain the network in an area where there are just not enough customers to do so is what will get us there.

Thank you.

The CHAIRMAN. Ms. Robinson, how much money would it take? I need you all to help us guide this. Nobody knows better than you. If we wanted to say we could get this to these 24 million, how much money are we talking about? You are the experts, and you would know. Give us an estimate so when we go and put our bill together, we will know how much money we need to have allocated to put broadband up to reach these 24 million. That is the question.

Ms. ROBINSON. Thank you, Mr. Chairman.

There are estimates that suggest that the cost to actually reach those who are unserved is anywhere from $60 to $80 billion. I submit, however, that it is hard to rely on such estimates because we haven't first done the hard and necessary work to accurately map where those gaps exist. And so, that is the first order of business is actually mapping the gap, and Congress has enabled the FCC to be able to do that by funding the Broadband DATA Act (Pub. L. 116–130). So, that is the first step is actually mapping and getting a clear sense of where gaps exist.

I would then submit that once you have that, you will have a number. You then need to think about how do you stretch those Federal dollars as far as possible. In giving your deadline, think about which technology tools can be used to actually move quickly. So, as you are thinking about funding for deployment, it is important that the policymakers prioritize what is cost effective to actually stretch Federal dollars, and then second, the myriad of technology solutions that are available in the market can be brought to bear to move quickly.

The CHAIRMAN. Thank you. Dr. Park?

Dr. PARK. So, our expectation is about $150 billion, but again, that is without laying out, as Ms. Robinson said, various novel technologies that are emerging nowadays.

So, our recommendation, again, is to promote innovation and deploy those emerging technologies, gather data quickly, and replicate those success stories in other regions in the nation. And it is not a one-size-fits-all solution for sure. Rural is very diverse, and we need to embrace the diversity by making sure the right type of technology is deployed in those situations.

The CHAIRMAN. Thank you, and now I recognize our Ranking Member for his 5 minutes.

Thank you all.

Mr. THOMPSON. Thank you, Mr. Chairman.

Ms. Prather, in your testimony you said that: "We must require the deployment of networks that in a decade or more will still deliver speeds and other performance capabilities that customers can rely on." Can you talk more about the importance of long-term performance and perhaps discuss some prior funding failures the Committee should be aware of?

Ms. PRATHER. Yes, sir, thank you so much.

You are right. We have every indication that demand is only going to continue to grow at really intense rates of expansion. We currently provide service with numerous technologies today. I utilize fiber, I utilized fixed wireless, and while we are deploying maybe some of those other ways to get speeds out faster, we see those as stepping stones. We do not see them as the end game.

If you look at any wireless infrastructure out there, it also tries to get back to a fiber backbone as fast as possible, because they have to offload that data somewhere that can handle it. As we are looking at building networks, we also look at reliability. Just as an example, last week we had a fixed wireless tower that got hit by a bolt of lightning. That happens out here. We lost every single piece of equipment on it. So, when we are looking at deploying infrastructure, that creates a lot of customer disruption as well. Out here, we get a lot of hailstorms, high wind, things like that. So, we want to look at infrastructure that can handle those issues as well. We obviously lost a lot of customer units in that storm as well. We have to replace those. We didn't have any problems with our fibers.

So, we look at what can take the capacity that is going to be needed, and then also what will be reliable once it is built.

Thank you.

Mr. THOMPSON. Thank you.

Dr. Park, you have a different take in your written testimony, expressing a preference for flexibility in network design and rapid turnover technology. How can we make sure that planning for obsolescence doesn't become settling for obsolescence, especially when building networks through necessary bureaucratic government programs?

Dr. PARK. Thank you.

So, our suggestion is that we promote a Living Lab model, such as WHIN, where, certain parts of progressive regions, we use that as a test case. Without trying out this emerging technology put to real use, it is really, really difficult to assess how valuable, how reliable, and how scalable and how cost-effective those technologies are. And we often find really great, innovative ideas to move forward beyond that.

So, we would recommend, again, having a portion of the funding dedicated to innovations like WHIN to promote use of emerging technologies as a way to advance this innovation in much-needed technology in broadband.

Mr. THOMPSON. Thank you, Dr. Park.

Ms. Prather, in your testimony you also encouraged full funding of the Rural Broadband Program authorized in the 2018 Farm Bill. Why is it important to stakeholders to get the Rural Broadband Program up and running before the next farm bill?

Ms. PRATHER. Great question, I think two-fold. There are some very good ideas in that program. Tying the speed to the length of

a grant, and then also, we want to see what that would do. Since it hasn't been fully funded, we haven't got to see how well it works. So, I think it is important to see how well it works currently before more changes are made.

Mr. THOMPSON. Very good. Thank you.

Mr. Johnson, congratulations and thank you for your leadership of your electric cooperative.

You had mentioned in your written testimony the number of advantages rural electric co-ops have, including the governing body who really—I mean, it is customer-owned, so you know the area, you know the topography, you know the customers are there. And I was—can you just expand just briefly on—you had noted that 50 percent of the cost of building out networks, you already have covered with employees and equipment and vehicles and rights-of-way, those kinds of things.

Mr. JOHNSON. Right. I was referring to—thank you, Ranking Member Thompson.

Yes. We were referring to make ready costs, which can constitute a large portion of expense in construction. We own rights-of-way, currently maintain electric rights-of-way for the purpose of electric service. Adding fiber to those rights-of-way is not as big a lift for us as it is for other entities. We already are there. We have the poles and we know where problem areas are, and the right-of-way is clear and trimmed so that we can get in quickly and string a robust network. We have skilled workers. Our linemen can easily be cross-trained, if necessary, and we can bring in workers who can use their skills to run the strand. We strand all of our fiber with steel strand to make it more resilient in the event of outages and——

Mr. THOMPSON. Thank you, Mr. Johnson.

My time has expired.

The CHAIRMAN. Thank you very much, and now, the gentleman from California, Mr. Costa.

Mr. COSTA. Thank you very much, Mr. Chairman. This is, as you noted, an important hearing, not just for our Agriculture Committee, but for rural America. And I think most, if not all of us, have portions of our Congressional district, as has been noted, that are challenged when it comes to having access to broadband. About 15 percent of my district does not have access, and it is a problem, to say the least.

Some of the witnesses, I would like to ask you. As we are talking about whether it is $60 to $70 billion as one has noted, or as much as $150 billion, that is a big discrepancy and difference in terms of cost for implementation. I would like to understand that better.

But how can Federal efforts complement existing focus that our states and in some cases, our local governments are pursuing to get connected to broadband? Who would like to take that?

Ms. ROBINSON. I am happy to respond.

Mr. COSTA. Thank you, Ms. Robinson.

Ms. ROBINSON. Thank you for the question.

To the first part of your question in terms of the discrepancy, a lot of that is going to be based on what kind of technology solution you are talking about using. Everyone recognizes that fiber is the gold standard in terms of speed, but one tradeoff for fiber can be

cost. And so, while you are talking about the estimate from $60 to $80 billion to the $150 billion estimate, a lot of that is going to be driven on what technology solutions that you are bringing to bear. So, I wanted to raise that point.

And to the second——

Mr. COSTA. So, your recommendation on that point in terms of to ensure the broadband strategy is tech neutral, how do we include an effort to make it inclusive both for fiber and for wireless broadband technologies?

Ms. ROBINSON. I think that the Agriculture Appropriations Committee has already kind of baked this in terms of the appropriation by recognizing that technology neutrality is an important concept to bake into funding. So, that is critical and we see that the existing Federal programs that are in existence today are also technology neutral by virtue of who the awards have gone to. So, I think continuing to do that is important.

It is also important to have coordination, to your second point, amongst what is being done at the Federal level, what is being done at the state level and the local level so that the policymakers can have an aggregate view of the various programs that can be brought to bear. There may be grants, loans, tax credits or other mechanisms to ensure that you can get broadband access deployed, but then also ensure that affordability is addressed as well.

Mr. COSTA. What is a realistic timeline in closing the gap?

Ms. ROBINSON. The first step——

Mr. COSTA. Twenty-five percent, yes.

Ms. ROBINSON. I think the first step is, again, understanding the scope of the problem. If that work can wrap up fairly quickly, then we can be in a position to actually move quickly to close the gap. But moving quickly will require that toolkit approach that we referenced—I referenced in my testimony and that has been brought up through witnesses as part of our opening statements. Recognizing that if you want to move quickly, say, we started the Airband Initiative, we had a bold goal of closing the gap in its entirety by July of 2022. If we bring all of our resources to bear using all technologies at our disposal, it is possible, but you first need to understand the real scope of where those gaps exist.

Mr. COSTA. This is really a part of a worldwide competition, but in terms of the technology, is it important to note that we are still at the cutting edge and that the United States has the best technology to deploy broadband on these hard to serve areas, the 25 percent of rural America that doesn't have it?

Ms. ROBINSON. Absolutely, I believe that we are first, and we should continue that spirit of innovation to bring all resources to bear to quickly and completely close the digital divide. We are absolutely poised to do that as a country.

Mr. COSTA. Does anyone else care to comment?

Dr. PARK. I absolutely agree. Again, this innovative broadband investment program is really the spirit, right. We were really impressed to see the note in House farm bill report that had replaced the former Rural Development Program. It really hit the high points of practical cost-effective note in innovation, demonstrating the technology, and methods of deployment in addition to tech-

nology and flexibility. So, we really commend the Committee for that vision.

Mr. COSTA. Thank you, Mr. Chairman. I yield back the balance of my time.

The CHAIRMAN. Absolutely. Thank you very much.

The gentleman from Arkansas, Mr. Crawford, you are now recognized for 5 minutes.

Mr. CRAWFORD. Thank you, Mr. Chairman.

I have a question for Ms. Prather. More attention and Federal funds have been dedicated to broadband deployment in recent years, but districts like mine and many others that look like mine still don't have access. I am just wondering how we can more quickly and efficiently deploy those resources? Can you talk about that a little bit?

Ms. PRATHER. Sure, thank you.

I think that is a very good point, and to some of the credit of my other witnesses, we know that some of those problems deal with the maps that are currently out there showing where is served and where is unserved. To piggyback on an earlier question, that is a great place for the state and local offices to step in as well, to do some of that more granular help where there is a problem at the Federal level to show what is served and what is unserved.

I think these programs—there is also a lot of money that has already been put to the FCC that has not actually gone out the door yet, so we have areas that have maybe been appropriated to, but the money has not gone out yet. ReConnect funds haven't gone out yet. There are holdups in some of those processes that the work has been planned but is not actually getting done yet.

I know a lot of my colleagues have had challenges with some of that Federal funding, and I don't know if that, the log jam seems to be sitting with some reviews and some processes. Things that we can do at the Federal level to get that money out the door much closer to when it has been promised will help in those situations.

Mr. CRAWFORD. While I have you, let me ask you this.

You mentioned supply chain disruptions in your testimony. Can you talk a little bit more about those challenges that you are experiencing? How are your supply chains arranged, and what can the Federal Government do to help improve that?

Ms. PRATHER. Sure. That is a very real problem, both with our fiber optic cable and with the electronics used at the customer level and at our level. All of those things have some pretty serious delays. Last week, we ordered some fiber pedestals that have a 365 day lead time. And I know some of my fellow colleagues in Iowa see that with fiber as well.

It may be a little above my pay grade to know what government could do, but I will say any sort of incentives to produce that domestically would definitely help in those situations.

Mr. CRAWFORD. Excellent, thank you.

Let me ask Ms. Robinson, we know that rural areas are diverse in their topography. Some might be mountainous, some might be heavily wooded, some might be flat, some might be all of those. I have a very diverse geography and topography in my district, and given the diverse landscape, how do you think we should think about technology solutions for broadband deployment, and what do

you think the best technology—what technologies do your Airband partners use to connect Americans in rural areas and remote areas?

Ms. ROBINSON. Thank you for your question, Congressman.

I can give an example by an Airband partner who will be deploying in their area—WISP [inaudible] internet access company. They are actually using a bevy of different technologies, including fixed wireless, but also fiber. And so, I think the key to your point, recognizing that rural areas are not homogenous, they vary, continuing to support policies and funding that allow providers to use whatever technology tool is going to work best in a given scenario is really key to closing the broadband gap once and for all. So, I would say more of the same.

I do think it is also important, as you are thinking about these technologies and the companies that are deploying them to meet the need, that they show that they can meet not only the needs of today, but the needs of tomorrow. So, have a guide path, as it were, to being able to continue to be useful in meeting the needs of modern life.

Mr. CRAWFORD. Thank you so much. I appreciate the witness's testimony. Mr. Chairman, I will yield back.

The CHAIRMAN. Thank you very much, and now, I recognize Ms. Spanberger for 5 minutes.

Ms. SPANBERGER. Thank you very much, Mr. Chairman. I appreciate you holding a hearing on a topic that is so near and dear to my heart, and that is rural broadband access.

Broadband access or a lack thereof is as vitally important as access to electricity was a century ago. And I believe it is really imperative that we meet the challenges of ensuring universal broadband access this century with the same urgency and determination that our country met that challenge of electrification a century ago.

A lack of broadband connectivity hurts the ability of students to complete their homework, businesses to recruit new employees, farmers to take advantage of the latest precision agricultural technology, and the list goes on and on. And, I am delighted that we have the witnesses here today who understand and have lived that perspective.

So, my district is one of the districts across the country that has been able to benefit from the USDA's ReConnect Program, with multiple communities and rural co-ops in my district receiving millions of dollars in funding to expand high-speed internet connectivity to previously underserved areas. While ReConnect has helped to expand broadband access for severely underserved areas, many communities in my district still lack internet service that meets the FCC's minimum speed standard for broadband, 25 megabits per second for downloads, 3 megabits for uploads. And the COVID–19 pandemic has really proven that high quality broadband access needs to keep pace with technology and increased demands for services, such as video conferencing, for example.

As we make investments in our digital infrastructure, it is important that we do so with that in mind. So, on that note, Ms. Prather, I would like to begin with a question for you, a slight follow-up to the question that my colleague, Mr. Crawford asked.

From your perspective, would you say that communities receiving at least that 25 megabits download, 3 megabits upload are underserved, and would a household utilizing the service of 10 megabits per second downloads and 1 megabit per second upload be able to utilize some of the technologies that have proven so vital during this pandemic, such as video conferencing?

Ms. PRATHER. Thank you. That is an excellent question, and I am going to give you a real-world example.

So, we serve a bunch of dairies in my area. Obviously, dairies take up a lot of space. That is going to be a very rural place. Also, a lot of them here are kind of at the far ends of some really rough dirt roads, okay? So, we know that they are doing a lot of smart dairy practices, too, some really cool stuff. They put radio tags on the cow's ear. It can tell them a lot about the health and the production of the animal. They upload all of that to the vet. We are currently serving these dairies with 25/3 fixed wireless. We are doing that because to get fiber down those rough country road rights-of-way is a long process. So, in the intermediary, we have deployed fixed wireless to them.

Now, this year you have kids coming home, doing their schoolwork from home. You have other family members trying to work from home. The dairies trying to upload all of that information to the vet, and it is simply not enough. During the pandemic, we spent pretty much 24 hours a day giving more bandwidth to schools, hospitals, these dairies, all of our customers. We had really an unprecedented amount of growth between people moving to rural areas to get out of the cities and then the ones already here, we were increasing bandwidth as fast as we could. Those people on those 10/1 services were upgrading every single day because it simply wasn't enough.

Ms. SPANBERGER. Thank you very much, Ms. Prather, and I have visited dairies in my district where we witnessed the exact same thing, that incredible use of technology that is really only as valuable as their ability to upload or download the data.

Mr. Johnson, I have a brief question for you as follow-up. In your testimony, you discussed the many advantages of the Section 6210 of the 2018 Farm Bill compared to the existing ReConnect Program, including increasing the speed thresholds for eligibility to 25/3. In your opinion, regardless of which program is funded or how we proceed with delivering this broadband internet, how important is it for USDA to ensure that funds are available to communities that have broadband speeds above 10/1 but below 25/3?

Mr. JOHNSON. I mean, we are strong believers in the fact that for future resiliency, we need to exceed 25/3 and go to 100/100; 25/3, we feel, may be inadequate. We have seen since the advent of the pandemic increases in volume demands of up to 40 percent overall among our membership. Some of our members are exceeding 1 terabyte per month, which is extreme. This is because most are on Zoom calls almost all day long, the students are, those who are going remotely. So, we feel strongly that the push should be towards 100/100.

Ms. SPANBERGER. Wow. Thank you very much, Mr. Chairman. I have gone over. Thank you for the additional 25 seconds, and I yield back. Again, thank you to our witnesses.

The CHAIRMAN. Thank you, Ms. Spanberger.

Now, Mr. DesJarlais from Tennessee.

Mr. DESJARLAIS. Thank you, Mr. Chairman, and I thank our panel.

I worry that President Biden's infrastructure plan, including the Administration's proposal for broadband, will undermine the system of private competition that our country thrives on. Ms. Prather, the President had indicated that he believes that Americans pay too much for broadband, and that private providers, like you, might be subject to rate regulation. How would Federal regulation of broadband rates affect your ability to serve your customers?

Ms. PRATHER. Thank you. I think my biggest concern there would be how that type of legislation would interact with current programs. As you may be aware, the FCC is about to introduce the Emergency Broadband Benefit Program that gives $50 a month to consumers to help pay for broadband. My company is going to participate in that, and I think it is going to be a great thing for providers and consumers.

I think the biggest factor is also going to be the sustainability and predictability. When we can plan for what all programs we are utilizing and how long they are going to last, that is what makes the competition between our companies benefit the consumer the most.

Mr. DESJARLAIS. Okay. Well, I don't necessarily agree with the President's approach to rural broadband. I do believe there are things that Congress can do to lower the cost of broadband.

Ms. Prather, in your testimony, you mentioned a tower where Federal permits cost more than the tower itself. Can you explain what happened and what can we do about it?

Ms. PRATHER. Absolutely. So, as we are deploying especially things dealing with spectrum—and this also happens in Federal lands. I don't have as much of that, but when we are dealing with spectrum, there are a lot of reviews that have to be done, and those are not bad things. But sometimes the cost of that and the time of that can sit on someone's desk for months or even years. And so, when we are trying to deploy these networks, we have to plan these large, large asset investments.

I am lucky that where I am at, we can construct year-round. Some of my northern neighbors can only construct 4 to 6 months. So, it is even more critical for them. But the time can take years to be approved. I don't know if that is just too many papers sitting on someone's desk, and then you are right. Sometimes the cost can absolutely exceed the cost of building that tower. The time is longer than the construction, the cost is more, and I don't think that was ever anyone's intent.

Mr. DESJARLAIS. All right. Thank you for your testimony.

Mr. Chairman, that is all I have, and I yield back.

The CHAIRMAN. Thank you very much, and now, I recognize Mrs. Hayes from Connecticut, 5 minutes.

Mrs. HAYES. Thank you, Chairman Scott, and thank you to the witnesses today for your attendance and your expertise in this area.

Connecticut is no stranger to the digital divide, especially my district. A 2018 survey found that 23 percent of Connecticut residents did not have internet access at home. Twenty-one percent of those homes without access were White households, 35 percent were Hispanic households, and 34 percent were African American households. These problems are especially acute in the northwest corner of Connecticut. In fact, there are 100 miles in our state's northwest corner that have no access to high-speed internet providers. This is especially troublesome, as our district tries to rebuild from the economic impacts of COVID–19.

Since the onset of the pandemic, Litchfield County in Connecticut has seen an influx of new residents, primarily from New York. These new residents represent a tremendous opportunity for our state, which in past years has seen an exodus of young families, threatening our long-term economic impact and employment base, particularly in rural areas. State and municipal leaders are hoping these new families will make northwest Connecticut their permanent home, but it is hard to imagine how these families can stay if telework is not an option for them.

Ms. Prather, can you speak to the importance of rural broadband connectivity in ensuring young families can live and work in rural areas like Litchfield, Connecticut?

Ms. PRATHER. Yes, ma'am. Thank you.

I think you bring up a great point. We are really seeing a rural renaissance, and you may be seeing the same thing, of these young families coming back to the rural areas for the quality of life. However, if they can't Netflix, if they can't work from home, if they can't do their online college education, they are not going to come back.

I think another important part of that is also the digital education that sometimes is necessary in some of these communities. For example, we started a Totelcom learning center in our community to help teach people how to stream and how to do some of these things online. I think without that, they don't understand how maybe to even utilize the access that is there.

Mrs. HAYES. Thank you.

But availability is not the only problem. The choice of broadband providers is also a persistent problem in my home State of Connecticut. Roughly 18 percent of Connecticut residents have only one option of a provider, despite the fact that 84 companies operate in Connecticut. In Cheshire, a community in my district, the choice for high-speed internet comes down to two providers. For some, while there maybe surface level choice of providers, it is cost prohibitive, with only 30 percent of people in Connecticut having access to a plan that is below $60 per month, which is 20 percent lower than the national average of 51.5 percent of Americans who have access to a low-price internet plan.

Can you talk about how rural broadband programs and ReConnect loans and grant programs enhance broadband options for Americans in rural areas, and is there anything we can do to further incentivize services to rural areas with very few or limited options?

Ms. PRATHER. Yes, that is a great question.

So, it is two-fold. One, the Federal programs can help deploy those networks, but then in order to maintain an affordable service over the life of that network, that is why programs like Universal High-Cost Funds step in and help make the business case for a provider to be there. In order to sustain that maintenance and keep their rates low, that ongoing support is needed.

Mrs. HAYES. Thank you so much for your time today, and this is something that is very close to constituents in the northwest corner of my state who have no access or limited access. Even myself, when I travel throughout my district, I have to plan around the fact that I know that I will be offline for several hours the farther out in my district I go. So, this is very important.

Again, Mr. Chairman, thank you for having this conversation, and with that, I yield back.

The CHAIRMAN. Thank you, Mrs. Hayes, and now, Mrs. Hartzler from Missouri.

Mrs. HARTZLER. Thank you, Mr. Chairman, and thank you for holding this very important hearing.

Like many of my colleagues, I would add and say that this is probably one of the highest priorities and needs in my district in rural Missouri is that we have to get rural broadband. But as we have heard here in Congress over the years, we have been investing in this program for years. There are multiple programs with multiple funding streams, different speeds, different requirements, and I think it is—and it would behoove us to have a time of analysis and making smart investments, going forward, rather than just quickly passing another funding bill. And I really appreciate the comments from you, Ms. Robinson, about the first step should be to receive the information from the FCC DATA Act, the Broadband DATA Act, and could you talk about that a little bit, about why it is so important that we determine really where the needs are first before we act and establish a new program?

Ms. ROBINSON. Thank you for your question, Congresswoman. We can't begin to solve the problem unless we understand the extent of the problem. And so, from our perspective, getting clear guidance around what exactly is the scope of the problem we are trying to get our arms around is a condition precedent, or at least needs to be done in parallel as Congress and policymakers consider funding options.

And so, for us, we know that there are gaps based on Microsoft's own usage data, which is publicly available, where we look at the speeds at which our services are being downloaded and see that there is a considerable gap between what the FCC's numbers suggest and what our data—and not just our data, but other data sources like Broadband Now suggest that the scope of the problem is.

And so, doing that work has to happen quickly, and should happen at least at minimum in parallel with any consideration and all considerations about how to solve the problem from a deployment standpoint in terms of getting the necessary resources to once and for all close the digital divide.

Mrs. HARTZLER. Sure, thank you so much.

So, in the 2018 Farm Bill, I led the initiative to increase the standard of service rural Americans should receive through the

USDA farm bill broadband programs, and making sure that they have 25 megabits download and 3 megabits upload in the speed. Yet, we have heard and we have the current program—the ReConnect Program only has 10 megabits and 1 megabit requirements, and yet, Mr. Johnson, you had shared that you think, going forward, we actually need 100 megabits and 100 megabits should be the standard. And I agree with the Chairman that we should let the ReConnect Program pilot expire, and fully fund the program that we authorized in the 2018 bill, which has higher speeds.

But Mr. Johnson, could you just once again reiterate what you think the standard should be and why you think it should be 100/100 now, not 25/3?

Mr. JOHNSON. The standard of 25/3 with heavy usage, multiple—we ran our household during the shutdown and the pandemic, four Zooms going on at once, and I never saw a spinning circle, and that is in a 1 gigabit household. Granted, I believe in a 100 megabit/100-megabit household, you will have the same standard applied. These are fiber-based technologies, and other technologies have not been proven to be able to carry this amount, this load and demand on the networks.

Mrs. HARTZLER. Thank you.

And being a CEO of a rural electric cooperative, I wanted to switch gears and ask you to share a little bit about the importance of the ability to refinance the RUS loans. And you may or may not have those loans, but I know a lot of rural electric cooperatives in my district do, and I am cosponsoring a bill that during this pandemic would allow rural electric cooperatives to refinance those loans and take advantage of that lower interest rate and to waive the fee for the refinancing. Because we know many of our rural electric cooperatives have lost service. It has been expensive for them, and so, if this passes and you have that ability, do you think co-ops could perhaps use that additional revenue, not only to make up their losses, but perhaps to have more capital to be able to invest in rural broadband?

Mr. JOHNSON. Absolutely. There are—as we know, there are 200 cooperatives operating broadband systems now or deploying them, and 100 more looking at it. The feasibility of these projects would be pushed forward with the opportunity to reprice outstanding debt so that new capital would be freed up. So yes, it would be very beneficial.

Mrs. HARTZLER. Thank you.

I yield back. I appreciate it.

The CHAIRMAN. Thank you, Mrs. Hartzler, and now, I recognize Mr. Delgado of New York.

Mr. DELGADO. Thank you, Mr. Chairman. It is good to be with all of you virtually, and I appreciate the testimony of all the witnesses today.

I do want to spend a little time talking to my friend and constituent, Mr. Johnson, about your work at OEC and Otsego Electric Cooperative.

I think the big picture of what I want to start off with is I know you announced plans to offer high-speed affordable broadband service back in 2017. Could you speak a little bit more about just the demand within the community? I think it is important to just hear

a little bit about the demand and how great the actual need is for this basic necessity at this point, as COVID has made plain. Can you just speak a little bit to the demand within the community?

Mr. JOHNSON. Thank you, Congressman.

The demand that we—we operated a satellite business, broadband business before we got into the fiber business. We could see when we were operating that business that there was huge unmet consumer demand for better service. So, we had numerous customers buying hundreds of dollars of additional data cap space monthly. It was a very profitable business for us, actually. We have now gone out—completely out of that business because we could see that when a customer is paying $300 a month in additional data cap demand, we can provide that service for $49.95. So, we saw the pockets where the service was needed and were able to design and deploy a system very quickly that filled those gaps.

Mr. DELGADO. Excellent.

Mr. JOHNSON. And actually, to add to that, during the pandemic, during the shutdown, fortunately we were able to work as essential workers, and we were absolutely inundated with phone calls, praying, asking for immediate service if we could get it to people. As a result of that, we have accumulated quite a list of people in our service territory—well, outside of our service territory, but adjacent to us that are in extreme need.

Mr. DELGADO. Right. So, that list is significant. That list is significant, and extreme need, as you put it.

Mr. JOHNSON. Yes.

Mr. DELGADO. I do want to speak—I think in your testimony you highlight some of the challenges and opportunities for Congress to support rural broadband access, and you mentioned that some cooperatives haven't fully utilized rural broadband programs through the USDA Rural Utilities Service. Can you speak more about how Congress can make that process easier? What some of the challenges might be when it comes to our cooperatives utilizing the Rural Utilities Service?

Mr. JOHNSON. Right. I think the simplicity of the application process could be improved. There is a point system that is used for desirability of projects. Many of these territories that we were looking at had no favorable points. We had households that didn't have service, but we didn't have libraries and community service centers and hospitals. These are literally—as Ms. Prather mentioned, these are people at the end of dead-end roads and dirt roads where nobody else goes. So, those point systems are not helpful. Awards have been known to be slow to arrive, so time passes as you wait to see whether your application has been approved, and then even after approval, you wait a long time, over a year for money.

Mr. DELGADO. Yes, good to know. Last, on the question of mapping, I have introduced the Community Broadband Mapping Act (H.R. 2400) which would go a long way in getting us better, more accurate data, and it would make funding available to co-ops, among other local groups, for broadband data gathering.

Can you speak a little bit about, in your experience, the challenges that we confront in the absence of accurate broadband data collection? What, from your vantage point, would be the best approach to collecting this data?

Mr. JOHNSON. GPS is the best way to go to find these and identify these locations, and funding to help with the expense of doing that would be extremely useful. That is a—and also feasibility programs. The funding to pay for feasibility programs would be very helpful as well. Cooperatives are nonprofits. We don't accumulate capital. We cannot accumulate capital, so anything that we do in this space, we go to a lender and ask for permission to use funds for this purpose. So, any funding to help with that is very useful.

Mr. DELGADO. Excellent. I yield back. Thank you.

The CHAIRMAN. Thank you. Thank you, Mr. Delgado, and now, Mr. Allen of Georgia.

Mr. ALLEN. Thank you, Mr. Chairman, and I do appreciate you continuing to hold hearings. Obviously, I believe this is the most important hearing in our Committee in this Congress.

I would like to highlight two of the most important broadband issues in my district. One county in my district, Jenkins County, has faced many challenges with AT&T for years now. According to the RDOF maps, well over 80 percent of the county is unserved. However, when Planters Telephone Cooperative attempted to service this area, they eventually had to suspend their efforts due to AT&T. This is unconscionable. Every year that my constituents do not have internet service, they and their children are falling further behind in both economic and educational development. What is worse is that these constituents have absolutely no recourse. If another company attempts to provide internet service to these people in Jenkins County, all AT&T would have to do is prove that one single household has internet service at a 1 to 10 upload/download speed, and they would continue to have exclusive service rights. Meanwhile, 99 percent of the county remains living with less internet access than many third world countries.

Another cooperative in my district, Altamaha EMC has had a nightmare experience with the USDA ReConnect Program over the past 2 years. They originally applied for funding under the ReConnect round 1, but were wrongfully deemed ineligible because of an incomplete service area validation survey. Once they applied again for round 2 funding, after waiting over a year, through no fault of their own, USDA refused to prioritize their second service area validation survey. It seems to me that with mapping of broadband access currently under the FCC's purview, we may have the wrong people in the wrong seats on the bus. I don't believe the FCC's original purpose was ever to serve as a mapping agency. Perhaps we should consider moving the responsibility of mapping broadband access to a Federal agency that is actually built for that purpose. USDA's National Agricultural Statistics Service is one that comes to mind, or the National Oceanic and Atmospheric Administration is another option.

Dr. Park, could you explain the marginal advantage of satellite internet access *versus* fiber optic, and in what scenario is it more feasible or practical to use?

Dr. PARK. Thank you, Congressman.

So, fiber is the gold standard. There is no question about it. It is reliable; it is proven. But it is costly, and it is also—it takes time. And I don't believe rural regions that have such a diverse geography and patterns can be served all by fiber. So, we really need

to think about how other wireless technology can complement the broadband technology.

No question, broadband is a necessary infrastructure for serving rural broadband. We must think about other complementary technologies, such as CBRS and other LTE standards that really allows other providers to take advantage of technologies to rapidly deploy these technologies to a region.

Mr. ALLEN. Dr. Park, obviously I have one county next to Jenkins County where every household is served by EMC, and each household can get fiber optic run to their home through the Universal Fund. Yet, in Jenkins County, because AT&T is for-profit, they can't get internet service.

So, Ms. Prather, I would like to ask you and any of the other panelists that would like to speak to the point I made in my comments, that as far as mapping, it seems like we are running up against a wall every time we try to do something with broadband. And this government is spending tons of money, yet this is probably the biggest economic engine available to rural America in the history of the country. Ms. Prather, would you like to comment on that?

Ms. PRATHER. Sure, I would. Thank you.

I think that you make some very, very good points. One thing I would say is that the FCC has been undertaking more and more mapping initiatives, but they want to wait until it is perfect to get it out the door. Instead, the information that they have, we need to get out and start utilizing it.

And you make a great point about it is no good if we don't have some way to verify what is there. I will say that is one good thing from the USDA, what they do is that they can bring people to the local level and actually test that. So, if you have an area that is deemed served, we can go out and test to see if that is really the case and then update that. Because we don't want to build just to those minimum standards today. If we are going to put money forth and build a project, we want to use those futureproof technologies and build for the future.

Mr. ALLEN. Well, thank you, and I am out of time. I yield back. If any of you would like to comment further on what I have said, please submit those to us in writing. Thank you.

The CHAIRMAN. Ms. Kuster of New Hampshire, you are now recognized.

Ms. KUSTER. Thank you, Mr. Chairman, and I appreciate the Committee holding this important hearing.

This past year has brought countless challenges, but one of the many that stands out is the critical need for universal, affordable broadband access all across America. This need was understood long before COVID–19, but the pandemic brought this issue to the forefront in stark terms. Internet access was critical for successfully quarantining at home and staying healthy, for attending work and school remotely, to talking with your doctor through telemedicine appointments. But unfortunately, far too many Americans, including many in my district, rural parts of my district, still must deal with low quality, slow speed internet connections, or some have lack of internet access at all.

The most recent USDA Census of Agriculture found that 13 percent of New Hampshire farms did not have internet access, and we know that that lack of connectivity inhibits farmers from fully engaging in the important USDA programs.

Even looking beyond these challenges facing farmers and producers, we know that broadband connectivity is critical for everyone who lives in a rural region, and that is why I am proud to be a member of Majority Whip Jim Clyburn's Rural Broadband Taskforce. Last month, our task force introduced the Accessible, Affordable Internet for All Act (H.R. 1783), authorizing $94 billion to build out our broadband infrastructure nationwide with a special focus on areas with little or no access. Additionally, as a Member of the House Energy and Commerce Committee, I have worked with Chairman Pallone on the LIFT America Act (H.R. 1848), including over $100 billion to develop broadband infrastructure to guarantee 100 percent of Americans can connect to secure, high-speed broadband.

We have a lot of work ahead of us in order to reach our goal, but I firmly believe that we can make bipartisan progress. So, let's use the hard lessons of the pandemic as the impetus to close the digital divide and ensure that every American will have a reliable connection.

Mr. Johnson, I appreciate hearing about your work and challenges in upstate New York. I think there is a lot of commonality with my district in New Hampshire. From your perspective, how can Congress be most helpful to cooperatives like yours in getting us to 100 percent broadband access, and are there particular challenges that we should triage before others?

Mr. JOHNSON. Yes, thank you, Congresswoman.

Yes, Otsego sees—as I mentioned, we know where the gaps are, and we are submitting as a provider information and data to the FCC now that they have on hand. So, accelerating their process of data mapping, and then distributing those for funding opportunities. FCC RDOF auctions are very useful. They take time to put together, but if they can be accelerated, that is what we need. That is the simplest, in our opinion, funding and the fastest funding that can be made available out there to get the job done. Now that is—co-ops are uniquely positioned to be able to do this.

Ms. KUSTER. Terrific. Thank you.

Ms. Robinson, I am glad to hear about the Airband Initiative that is doing to increase the pace of broadband access. Could you comment on the importance of broadband map accuracy, and how more accurate data can help you identify target areas of greatest need?

Ms. ROBINSON. Thank you for your question.

To your point, Microsoft has been at the forefront of really challenging this issue and challenging us as a country to get the maps right so that we can understand the scope of the problem. We think that there is a lot of good that is on path to be able to get us to that point with the implementation of the Broadband DATA Act, action dictated by the FCC to actually begin to start help coordinating. That needs to happen quickly. We need to have multiple sources of other information, be it at the Federal, state, or local

level, and pulling them all together in order to understand the scope of the problem.

It is also important to leverage the power of technology to ensure that what we are seeing in these maps is actually accurate. Use the power of the Cloud, use machine learning to validate what is being seen, and then actually make sure that this information is publicly accessible so that, again to the point that is being raised as part of the hearing, is that there could be an error between what the FCC or some other map is saying in terms of an area being served and unserved, and what is the truth on the ground. And so, you need a way to validate and make sense of that disconnect, and so, doing things to bring in multiple data sources to do that is the key to addressing this issue in a meaningful way.

Ms. KUSTER. Thank you so much. My time is up, and I yield back, Mr. Chairman.

The CHAIRMAN. Mr. Baird of Indiana, you are now recognized.

Mr. BAIRD. Thank you, Mr. Chairman, and I can't tell, Dr. Park, how pleased I am to have him here.

But one of the things that you do in your testimony and that we have heard a lot about is the cost of going that last mile. You make reference to what you are talking about, the aerostat as being a Living Laboratory. You encourage us to invest a certain portion of our research dollars in innovative kinds of things. So, you are not—or WHIN is not an internet provider. In fact, you must work with internet providers, and I think that is a point here that needs to be understood, because it is a way to get out to those more rugged geographic areas, those last miles.

So, I would appreciate just having you elaborate on that, because you are working with internet providers. So, I would appreciate your perspective on that.

Dr. PARK. Thank you, Congressman Baird.

So, again, just to remind everybody, WHIN is a nonprofit organization. We are a community, regional organization, and we are not an ISP. But our goal is to accelerate the adoption of technology in our region. And in that vision, broadband was a necessary and very difficult challenge that we had to face. So, we are using the Living Lab model of vetting new and commercially available technologies, bring them to put to use in our region, and really drive innovation and adoption out of the usage, and by sharing the data with others so that the solutions can be improved.

And this model has really worked well with agriculture and manufacturing sectors, as we have developed many partnerships with tech companies who are providing innovative solutions in digital ag and precision ag and next generation manufacturing. And we are approaching this, the broadband, because we believe broadband is also a technology that needs to be deployed, adopted, and have a business model for sustainability.

So, we are using our region as a way to accelerate the innovation and adoption, and so that we can share the information with other regions so they can learn from each other.

Mr. BAIRD. So, if you would continue on in that conversation, so if there were cooperatives in the region or in that ten-county area that was providing landlines or providing fiber, they could be on the end of the line or you could be on the end of their line and try

out some of these other technologies without investing in a lot of towers or a lot of fiber. Is that true?

Dr. PARK. That is correct. In fact, we are working with a local fiber company, and we are also working with a wireless internet service provider to provide the end-user customer services. So again, WHIN is not an ISP. We bridge the gap. We bring those technologies. We work with local ISPs and WISPs that perhaps have not had a chance to fully leverage and utilize the new technologies. So, we are really lowering the risk by vetting first and have them utilize these new technologies to see how these technologies can help serve their existing customers better, and also attract new customers in our region.

Mr. BAIRD. And so, it is a way to get the—you mentioned the high-speed internet, a 10 or 12 mile radius, and then a 50 mile radius for some of the other technologies.

Dr. PARK. That is correct. Yes. I just want to mention one quick thing. We have a saying that we not only want every home in our region to have broadband access, but we also want every stalk of corn to have connectivity as well. Rural broadband is a very complicated issue, and I think one of the biggest barriers, in my opinion, is that there hasn't been a viable business model for providing broadband in rural America. I think the emerging IoT application in agriculture will really drive the economic incentive for the private-sector to invest in rural connectivity, and we really want the private-sector to be incentivized for sustainability.

So, it needs to be both the high-speed internet, also the connectivity for sensors. And while we are building this infrastructure, I encourage people to consider building it together so that we can incentivize this next generation operations to be incentivized.

Mr. BAIRD. Thank you, and I see I am out of time. I really wanted to get to Mr. Johnson, but I appreciate all the witnesses being here. I think this is a very important subject, and I yield back my time.

The CHAIRMAN. Thank you very much, Congressman.

And now, Mrs. Bustos of Illinois, you are now recognized.

Mrs. BUSTOS. Thank you, Mr. Chairman, and thank you so much for holding this hearing today.

There is no doubt that every single Member of Congress on this Committee, we are all on the same page as far as agreeing that rural broadband is extremely important to the regions we serve, to our nation. And I think we are probably—we see it similarly, and we also want to make sure that we are spending taxpayer dollars as efficiently and as effectively as possible. Something that is very important—I am on the Appropriations Committee also, and this is something very, very important to me, and I know to the Members as well.

So, to be efficient and effective with these essential resources, something that we need to make sure that we are keeping an eye on is to make sure that we are looking at what is most needed out there to minimize the Federal agencies from competing against one another in terms of funding rural projects. It is nice to be in demand that there is kind of this universal feeling that we got to address broadband, but we do have to make sure that we are not overlapping what is going on.

So, Ms. Prather, I have a question for you. As a community-based provider who has benefitted from Federal programs, can you talk a little bit about the importance of coordination between broadband deployment programs?

Ms. PRATHER. Absolutely. Thank you, ma'am.

You are absolutely right. We have to build these things efficiently and using the most effective use of taxpayer dollars. I mean, that is why it is important to remember that these different programs sometimes do serve different purposes, and they are all needed. We do need RUS and USDA to provide that up-front financing for these really expensive asset builds. I think it is important to note that we want to build it once. If we are going to build something, we don't want to have to redo it in a few years. We know what the growth projections look like. That is not a question to anyone. So, we want to build networks that are going to be able to sustain that growth for the life of that network.

It is also important to note that if you are in an area where without Federal support one network can't survive due to the lack of people in the area, it is important that there is a program like Universal Service to maintain affordable rates over the life of that network as well. All of these programs can work in concert.

I think it is important to note, too, that like you said, whoever has the data on what is needed and where it is currently being used, other agencies should coordinate. I am not here to say who should be in charge of that, but whoever has the best data is the one that we should look to, to seek what is available and what is still needed.

Mrs. BUSTOS. Dr. Park, I see you nodding your head. Do you have any other thoughts along these lines?

Dr. PARK. Thank you, Congresswoman.

I think WHIN is a unique organization that can serve as that coordination effort that you just mentioned about, because we are neutral. We don't provide internet service to end-customers. We are in the best interest to bring this technology to services to our regional folks as quickly as we can. So, we work with 30+ ISPs in the region. We work with Federal Government. We work with state agencies. We work with local, regional economic developers. We work with farmers and manufacturers who are main stakeholders in the region.

So, there is a unique place for an organization like WHIN to play to coordinate this massive effort that is going to happen across the United States.

Mrs. BUSTOS. Dr. Park, how do you see increased investments in rural broadband through fiber-to-the-home and fixed wireless impacting our growers and our producers? You said that that is among who you are working in your part of Indiana, but can you talk a little bit about how you see that impacting especially their bottom lines?

Dr. PARK. Well, the recent USDA report was clear that the impact of connectivity in farmland is going to tremendously increase the bottom line for agricultural production, no question about it. So, again—but we have to be careful. Having internet to residential applications *versus* having connectivity to sensors in the farmland, they are two different infrastructures. So, we—but if we build it to-

gether, it is much more cost effective. We are not going to have millions of people in rural areas, but we are going to have a vast amount of farmland that is ripe for digital agriculture, precision agriculture revolution, and that is where, in my mind, where tremendous opportunity lies.

So, we cannot forget the opportunity of precision agriculture in conjunction with meeting the needs of our rural American residents.

Mrs. BUSTOS. All right, and the clock is at 0. Very well done. Thank you so much, Mr. Chairman. I yield back.

The CHAIRMAN. Yes, thank you.

Now, Mr. Jacobs of New York, you are now recognized.

Mr. JACOBS. Thank you, Mr. Chairman, and thank you for all those that testified today. Very helpful and insightful.

In the eight counties I represent in western New York State, this is the issue that is the common denominator of need for each and every one, and a lot of good issues have been raised already.

I agree with what has been said in terms of this time during COVID, highlighting our dependence on rural broadband or internet and that it is no longer an amenity but a necessity, and certainly, we have seen it in telehealth. I have certainly heard it, the challenges that many of my constituents have had and their children in terms of having to learn from home and remote learning and hybrid learning that they have gone through, and I think unfortunately we will see in the years to come those communities, many of whom I represent in rural America, will have suffered more by the absence of being in the classroom because they did not have sufficient internet access at home to really be able to learn to the level that they needed to, and there was learning lost this year.

I would also say that a former colleague mentioned the opportunity I see here in terms of a rural renaissance and a small-town America renaissance through investment in high-speed internet, because I think people are appreciating again the value in space, the value in small community, the value in quality of life, and I think that we have a lot of that to offer. I think people are wakening again to it.

I had first just a question regarding the Biden infrastructure proposal prioritizes support for broadband networks owned and operated or affiliated by local governments, nonprofits, and cooperatives, providers with less pressure to turn profits, *et cetera.* However, many communities like mine are not—most of my communities are not served by providers like cooperatives. So, I just was curious if anybody wanted to weigh in on whether this policy is the right way to go to prioritize nonprofits *versus* the broad-based providers that do this sort of thing.

Ms. PRATHER. Yes, I will answer that. Thank you.

I do think we are missing a big piece here. For example, my company is a small community-based telecommunications provider. We were formed as a community-based shareholder-owned company. We are now privately held, but we are in this community because we want to be here. As the current plan stands, my company would not be able to participate whenever we do the exact same things as other co-ops across the state. Texas has 43 small providers.

About half are co-ops, half are commercial entities like mine. I am not here because I am trying to increase my stock price. I don't have one. I am not here because I am seeing what kind of VC multiples I can get. We are here because we live in this community. We serve our friends and neighbors, and so, no matter the corporate structure, I think those local community-based providers really provide a great benefit in putting broadband in these communities.

Mr. JOHNSON. If I may, Congressman?

Mr. JACOBS. Yes, go ahead.

Mr. JOHNSON. I just wanted to add, I think cooperatives are partnered with many of these other entities as well, so it hasn't excluded everyone else and should provide the impetus, I should say, for cooperation among many different entities.

Mr. JACOBS. Could you elaborate what would be an example of how you would partner?

Mr. JOHNSON. In discussions with it, and I am sure Ms. Prather has run into this as well. Some of the cooperatives across the country have made partnerships with private providers, small town telcos are a very good example that are privately held. Small organizations, somewhat nimble have very similar roots in their communities, very long-term roots, and/or perhaps they just partner on the basis for fiber transport where they buy their wholesale access to the internet, so to speak.

Mr. JACOBS. Thank you very much.

Dr. PARK. If I may?

Mr. JACOBS. Yes, go ahead.

Dr. PARK. Just really quickly, again, I just want to reemphasize my earlier statement that WHIN, again, non-internet service provider, nonprofit organization that is focused on regional development, because we are technology agnostic, we are product agnostic, our end goal is to provide services to our regional stakeholders. So, I believe there is a unique role that organizations like WHIN can play by leveraging our community partners and their resources and putting them together.

Mr. JACOBS. Thank you all very much for those answers. Mr. Chairman, I yield back.

The CHAIRMAN. Mr. O'Halleran of Arizona, you are now recognized. Mr. O'Halleran.

Mr. O'HALLERAN. Yes, I am now unmuted.

The CHAIRMAN. You are unmuted. There you go.

Mr. O'HALLERAN. Thank you, Mr. Chairman. I want to thank the panel for their great conversation today.

I greatly appreciate this Committee's focus on closing the digital divide, which still impacts far too many Americans in rural America and Indian Country. In rural Arizona, only 66 percent of the population has access to broadband at the FCC's minimum speed standard, which is way too low for us. Consistently, constituents across Arizona note that access to reliable high-speed broadband is a top priority for them. Inequities in broadband access results in poorer health and educational outcomes for those of us who live in rural and Tribal communities. There is clearly more work to be done to expand broadband access nationwide. We must continue

working together and across the aisle to help implement these new programs and improve existing programs as well.

I am pleased to see that today's witnesses include various sectors of the rural telecommunications sector, who are offering different solutions to providing access to high-speed internet.

I will say this. If we don't get it in rural America, we are going to continue to have a problem with losing residents instead of keeping them where we need to make sure we produce the food of America, the transportation links of America, the natural resources of America, and most importantly, the quality of life of people that live there, whether it is healthcare and telemedicine, because of the lack of specialists; whether it is the ability to get a competitive education for our children; and whether it is being able to have an active economic development process that can compete across our nation.

Ms. Robinson, it is my understanding that Microsoft has been working with Sacred Wind Communications to bring broadband to 57,000 Navajo families. Could you discuss how USDA can play a role in promoting the development of new technologies to serve large numbers of rural communities?

Ms. ROBINSON. Thank you for your question, Congressman.

Yes, we are working with Sacred Wind, and what we have noted is that their role in reaching Tribal communities has become even more important now. I think in terms of what the Department of Agriculture could do to continue to support a company like Sacred Wind with a unique mission to close the digital divide is to ensure that its application processes are clarified and streamlined. I know that Sacred Wind has previously sought funding from the Department of Agriculture and Rural Utilities Services, and they have spoken to us about some of the challenges inherent in that process. So, continuing to find ways to clarify that critical plan that can be leveraged to close the digital divide in Indian Country is critical for companies like Sacred Wind, clarifying and streamlining.

But then I would invite the Committee to continue to think about ensuring the funding of deployments can be done in a technology neutral way. Companies like Sacred Wind are using fiber and fixed wireless to meet these needs in Navajo Country, but also I would encourage the Committee to consider and recognize the importance of adoption. When you are talking about access on Tribal lands, you have a disproportionate amount of people on the reservation who are income-insecure. And so, just getting access to these areas is not enough. We need to also ensure that we have mechanisms in place so people can actually adopt the service.

Mr. O'HALLERAN. Thank you.

Mr. Johnson, you had mentioned that you do not use any of USDA's programs. Can you expand upon the barriers, and what do you believe would be most helpful in expanding broadband access to co-op membership?

Mr. JOHNSON. Right. We do not—the administrative application process was daunting and expensive, time consuming, survey necessities, *et cetera,* and the point system didn't fit our areas that we needed to serve. In addition, if we were already receiving funding for particular areas, we were disqualified from receiving ReConnect. Not that we would want to be paid twice for the same de-

velopment, but there were overlaps in mapping that would have prevented us from competing for some of the funding that was available. The slowness of the funding, the slowness of the process, that is always difficult for small organizations such as cooperatives to deal with. We are asked because of that to perhaps once we are awarded funding, our members come to us and say all right, we heard you got your funding. You have been approved. Why haven't you started spending money? So, we have to go out and borrow it.

The CHAIRMAN. Time has expired.

Mr. O'HALLERAN. Thank you, Mr. Johnson.

Mr. Chairman, I thank you and have a good day, everybody.

The CHAIRMAN. Thank you.

Mr. Mann of Kansas, you are now recognized.

Mr. MANN. Mr. Chairman, thank you, and thank you for making this a priority for the Committee, Mr. Chairman. Certainly, in this town there are a lot of areas that people are divided on, but there seems to be bipartisan support for doing better when it comes to rural broadband and connectivity. We all know that is a priority for everyone here. It certainly is a big priority for me and the big 1st District of Kansas. We cover a large swath of the rural part of my state, and we hear a lot of concerns a lot of time.

It is not just concerns with how it is, but what it prevents us from doing be it telehealth, be it taking the next steps in production agriculture and all of those things, so thanks for the panel and our witnesses for being here today.

My question is for Ms. Robinson. Is it my understanding that Microsoft's Airband Initiative is working in Kansas to connect rural underserved communities to broadband, so I especially appreciate that work. It is also great to see your experience addressing rural broadband in the public-sector at the FCC and administering the Universal Service Fund. Based on your variety of experience, how do you think we can involve more private-sector investment in our rural communities, and what limits more involvement in the private-sector today as you see it?

Ms. ROBINSON. Thank you for your question, and we are proud to work with NeXT Link as they expand broadband access to rural consumers in the great State of Kansas.

I think that the key to solving this problem is doing more with public and private partnerships. This is not something that any one sector or one part of the country can tackle by itself, and so, being able to provide more certainty around business models that are required to actually—that can incentivize private-sector to actually do investments to show that this is something that the business model can pencil out in rural America will be key.

A part of that business model penciling out will be making sure that there is actual funding in place to support, and that can be leveraged alongside private-sector investments. So, those two things need to work together, and it is certainly part of our formula as we approach these issues in trying to tackle the rural digital divide.

Mr. MANN. Okay, well wonderful. Thank you.

My second question, different vein, is for Dr. Park.

Dr. Park, can you talk more about the performance and weather capabilities of an aerostat? As we discuss the vital importance of

broadband, we have to consider that high winds, lightning, those sorts of natural disaster sort of things are prevalent in Kansas and in other areas as well. Any perspective that you would have on how those would perform under those kinds of conditions?

Dr. PARK. Thank you for that question.

Yes, so aerostats can withstand high wind up to 80 miles per hour, and if there is a major, major storm, aerostats can be lowered within hours, so it can be pretty safe. And while it is down also, Congressman, aerostats can be deployed to overlap coverage and provide redundancy. So, in areas where storms are localized, any aerostat lowered will have adjacent aerostat provide the redundant coverage in its area.

Mr. MANN. Okay. Okay, that makes sense. No further questions, Mr. Chairman. I yield back, and thank you all very, very much.

The CHAIRMAN. Thank you very much.

Mr. Carbajal, of California.

Mr. CARBAJAL. Thank you, Mr. Chairman.

Ms. Prather, you mentioned in your testimony that your networks connected Americans to vital institutions and services which help drive economic development and produce and preserve jobs in rural America. Specifically, in response to COVID–19, you noted that Totelcom took action to increase broadband availability, to lower installation costs for students who were remote learning. Access to broadband has been a barrier for many families during this pandemic to ensure kids can continue to attend school remotely.

In my district, this has been no different. For example, the Martinez family was driving around from parking lot to parking lot to find access to WiFi. It has shown us the digital divide that exists in our country, and the work we have ahead to bridge these gaps. Can you please explain how Totelcom's experience responding to the pandemic will impact its future operations, and what innovations and partnerships were particularly helpful for you to meet the increased need for remote learning in rural America?

Ms. PRATHER. I would love to. Thank you, Congressman, for the question.

So, we did a couple of things. First of all, any customer that called in and had a student K–12 or college in the household got free installation. We got them connected as fast as possible. But the bigger thing that we did was we partnered with all of our local school districts. We told them we know you have students who are learning at home and cannot afford a connection. If you will just give us an address, we will go connect those students. We won't make them sign anything. We won't bother the family. We will work with you to provide access for any students who needs it. Even when the schools went back to in-person learning, if we have students who are in a home with someone at high risk or the student was at high risk, we kept that going. We are seeing a lot of funds go out to the FCC's E-Rate Program right now, and we would love to continue those kinds of partnerships. We did that through no cost to the school. We really just ate all those services, because it was the right thing to do for our communities that we serve. But we would love to see that on an ongoing basis to partner with those schools, to serve their students that need access at home and cannot afford it.

Mr. CARBAJAL. Thank you, Ms. Prather.

Ms. Robinson, in your testimony, you discussed the importance of and the need for basic digital literacy in bridging the digital divide. Can you please explain what Microsoft and its partners are doing to make sure these programs and opportunities can be accessed by minority communities, particularly those where English may not be a first language?

Ms. ROBINSON. Thank you so much for the question.

We believe that digital skilling is critical to driving adoption. You can't assume that if you build it, people will come. People need to know and be informed about how to use connectivity as a tool for empowerment.

So, working closely with our philanthropy group and various nonprofits, we are providing digital skilling resources that actually meet the needs of community, including providing access to materials that are bilingual in nature, so that you are able to shift and meet the needs and provide skilling resources that are responsive to the needs of the specific community. We don't have a one-size-fits-all approach, but they are very much tailored by working with people on the ground, and also focusing on historically marginalized communities specifically where research shows that there tends to be larger gaps from a skilling and literacy perspective.

Mr. CARBAJAL. Thank you.

Just to note, that nice orchid next to you probably comes from my district where most of the flowers in the United States are grown domestically. So, thank you very much.

Mr. Chairman, I yield back.

The CHAIRMAN. Thank you very much, and now, Mr. Feenstra of Iowa, you are now recognized.

Mr. FEENSTRA. Thank you, Chairman Scott and Ranking Member Thompson.

Mr. Chairman, first I ask to submit for the record a letter from NTCA—The Rural Broadband Association, which discusses some considerations the Federal Communications Commission should take in considering for its review of a long-form application for the Rural Digital Opportunity Fund. Could I submit this for the record?

The CHAIRMAN. So ordered, Mr. Feenstra. Thank you.

[The letter referred to is located on p. 113.]

Mr. FEENSTRA. Thank you, Mr. Chairman.

I want to thank each of our witnesses for their testimony today. We all know that in today's world, access is key to reliability, affordability, and high-speed internet is critical to daily life and necessary for rural Americans to not fall behind. Whether it be telehealth, running a small business, education, precision agriculture, all require connectivity.

In rural Iowa, I constantly hear about the need for better connectivity in many areas. However, we also have a good story to tell in other parts of rural Iowa where carriers have been able to deploy futureproof networks that have closed the digital divide for the communications that serve, like the one being completed by Premier Communications throughout northwest Iowa.

I am glad that we are taking the time today to examine what has worked successfully in deploying rural broadband, and where there are opportunities to make improvements.

Ms. Prather, as I stated, I believe it is imperative that rural Iowans have the same quality of internet service as people that live in cities. Like your company, many carriers in Iowa have been able to deliver this type of service in rural Iowa. You mentioned in your testimony that you use various types of technology to serve your customers, but that you prefer fiber, given its reliability to meet customer needs now and into the future. Some claim that certain technologies can perform at speeds that have not yet been proved, or based on that claim, many folks, including me, worry that not all providers who were awarded funding under the FCC's Rural Digital Opportunity Fund will have the technical, financial, and operational capabilities to deliver the services they have pledged to deliver, regardless of the technology they are using. This is why I joined a letter earlier this year to the FCC to ensure that money from the Rural Digital Opportunity Fund is used wisely and effectively.

Ms. Prather, as a provider who utilizes multiple types of technology in your networks, can you talk about the constraints to using other types of technology besides fiber in rural areas, and how they might have concerns? Additionally, can you talk about the scalability of futureproof capabilities of fiber networks as demand for faster speeds and more capabilities increase?

Ms. PRATHER. Absolutely. Thank you for the question, Congressman, and thank you for your support regarding that letter and that initiative.

I, too, have worries about some of the money that has gone out the door and what is going to be able to be provided. As you said, we utilize multiple technologies. I know what I can get out of those different technologies today. You make a great point about the reason that we like fiber the most is that it can meet those demands. When we were hit with this sudden surge and intense surge in demand due to COVID, our fiber network was ready to handle it.

You make a great point about the reliability and scalability. I have already talked today about how weather affects our fixed wireless assets. We don't have that same problem with fiber optics.

Another point is that whenever we need to change out and upgrade some of those radios on our fixed wireless towers, we then have to also upgrade every single customer unit. That is a lot of disruption for the customer. It is also a lot of expense that you may not think about when you initially deploy that type of technology, but the ongoing maintenance is much greater in some of those other networks.

Mr. FEENSTRA. Thank you, Ms. Prather. I have one more question for you, Ms. Prather.

So, when we look at Federal dollars that are going to be used for rural broadband, my concern is that we use them in an efficient way that we can put in the ground or use that one time that they can serve for the next 20 or 30 years, because I look at it as infrastructure. When we look at speeds, what speeds are critical when you think out 10 or 20 years? I mean, I am looking at 100 upload and download speeds. What are your thoughts on the speeds, and

when we start looking out 10 to 20 years from now, when we are investing all these dollars federally, what do you think is the best speeds for those dollars?

Ms. PRATHER. That is a great question.

I think we know how to predict this a little bit. Currently, our speed and our capacity doubles with my customers about every 14 to 16 months. So, when you look at 10 to 20 years, that creates a great amount.

Mr. FEENSTRA. Thank you, Ms. Prather.

I yield back. Thank you, Mr. Chairman.

The CHAIRMAN. Sure.

Ms. Craig of Minnesota, you are now recognized for 5 minutes.

Ms. CRAIG. Thank you so much, Chairman Scott, for yielding and for holding this really important hearing here today.

I would first like to briefly ask unanimous consent to insert into the hearing record a copy of the American Connection Project Broadband Coalition's *What We've Done: Accomplishments.* The American Connection Project Broadband Coalition represents more than 140 companies and organizations who are working together to bring high-speed internet access to all Americans. It is comprised of a number of Minnesota-based companies and institutions, such as Land O'Lakes, the University of Minnesota, and the Mayo Clinic. Mr. Scott, unanimous consent?

The CHAIRMAN. Yes, unanimous consent.

[The fact sheet referred to is located on p. 110.]

Ms. CRAIG. Thank you so much, Mr. Chairman.

Addressing the issue of rural broadband deployment expansion and funding is one of my top priorities as a Member of Congress from Minnesota's 2nd District. I am also a member of Whip Clyburn's Rural Broadband Taskforce, and I am strongly pushing for us to include a version of the Accessible, Affordable Internet for All Act in our upcoming infrastructure package. The proposal would invest over $94 billion to build high-speed broadband infrastructure in unserved and underserved communities to close the digital divide, and ensure Americans have internet connectivity to start businesses from anywhere, learn and work from home, access virtual healthcare, and stay, of course, connected to our loved ones. It is my hope that Whip Clyburn's bill will again be included in this infrastructure package.

With these comments in mind, I would like to direct my first question to our panel on the topic of healthcare, which we have seen during the pandemic is increasingly dependent upon access to the internet. All four of you mentioned healthcare in your testimony to us, and Ms. Robinson, you mentioned specifically how connectivity enables healthcare facilities to deliver critical virtual solutions throughout the community at a time when physical access to rural health facilities is declining.

Can you expand upon these thoughts just a little bit more, and provide the Committee with a few more policy ideas you might support to expand access to healthcare in our rural communities?

Ms. ROBINSON. Thank you so much for the question. I want to also mention that Microsoft is a member of the American Connection Broadband Project, and so we support it because it is super

important as a way to ensure that we can continue to invest in rural economies.

So, healthcare is critical and broadband is an enabler of that, as referenced in my testimony and your question, we know that many healthcare facilities are actually leaving rural America, and people should not be penalized or suffer because they happen to choose to live in a specific place and not have access to first-class medical services. And so, from our perspective, continuing to provide funding to enable use of telehealth applications is critical, as the Committee and policymakers think about how best to use and to amplify funding that is going towards deployment of broadband. Really thinking about innovations and applications in that space is critical to ensuring that we can continue to meet the healthcare needs of all citizens, including citizens living in rural areas.

Ms. CRAIG. Thank you so much, and of course, thank you to Microsoft for being a part of that wonderful program.

I would like to just follow up with you a little bit more. I know one of my colleagues really asked about how we improve our broadband mapping. You argue that funding should be prioritized to reach those unserved and underserved communities, but that is going to require comprehensive and accurate broadband availability data and mapping. I also happen to sit on the Energy and Commerce Committee, and the Communications and Technology Subcommittee, and I have sort of gone around asking why we have had such challenges mapping accurately in the past.

But I have introduced the Broadband MAPS Act (H.R. 1044), which would establish a taskforce at the FCC to help with providing us accurate maps so we can make sure that the dollars we are appropriating are getting to exactly the right places.

What else, in your opinion, do we need to do to help improve the quality of our maps, and to really and honestly determine which areas lack access to broadband?

Ms. ROBINSON. Thank you for the follow-up question.

So, continuing implementation of the Broadband DATA Act is important, and we support your Act and anything else that is going to get us in the direction of getting more accuracy in those tools. I think critical to this effort is leveraging multiple sources of data. It can't just be one data source. States and local governments are great labs to show, and oftentimes, they are close to the problem and can be an important resource as policymakers try to map the gap, as it were.

I would also say use the power of technology, the Cloud and machine learning to be able to validate data sources that are being used to evaluate the problem are critical.

Ms. CRAIG. Thank you so much, Ms. Robinson.

And my time has expired, so with that, I will yield back.

The CHAIRMAN. Now I will recognize Mrs. Fischbach of Minnesota.

Mrs. FISCHBACH. Thank you very much, Mr. Chairman, and I just want to thank the chair for having this meeting today on such an incredibly important subject, and thank you to all of the witnesses for taking the time to join us today.

Access to broadband internet has become so much of a necessity, and even more so important right now during COVID. But also, it

is important to the ag industry, healthcare, as Congresswoman Craig was just pointing out, and to education and to everyday life. And it is a necessity now, and high-speed internet is a key to the world, and you need it to succeed in today's modern world.

Farmers need the connectivity for their machinery and their field work. Families need the connectivity for doctor's appointments and schoolwork. Small businesses need the connectivity to engage with suppliers and customers around the world. And in my large rural district, the need for broadband connectivity is very, very real. One in five farms do not have access to high-speed internet connection. I even have constituents that are out of range for both reliable cell service and broadband connection. That is why I am glad this Committee is prioritizing broadband, and I hope we focus not only on investing in the infrastructure, but also making sure broadband makes it right to people's doors. And it is up to us to make sure that the programs are actually doing what they are intended to do, and the taxpayer dollars are used wisely and efficiently.

With millions of Americans still lacking high-speed internet connection, this issue transcends politics, and so, I appreciate that we are all here today hearing about what the needs are for broadband.

But I do have a couple of questions, Mr. Chairman, and Ms. Prather, I have heard delays between when providers are awarded the RUS funding and when they receive those dollars for broadband deployment. Can you speak to some of the issues and problems that may have been causing those delays?

Ms. PRATHER. Yes, ma'am, thank you for the question.

So, not being behind the curtain, I am not sure I know exactly what some of those causes are. However, you made good points about there is quite a lag, sometimes, between when awards are given *versus* when they are actually dispersed. We do feel like sometimes that has to do with reviews of the applications, and so maybe the reviewing applications beforehand can go a little faster. I am not sure if that is because there is not enough staff to review the numbers that they get in now that broadband has become such a hot topic, but anything that could be done to maybe put a deadline on when some of that money has to go out the door or those reviews can be done. Anything that helps the planning of when we can receive those funds would be very beneficial.

Mrs. FISCHBACH. Thank you, and Ms. Prather, so that's streamlining the approval process, are there other suggestions that you might have, because that is one of the big concerns I have is that making sure that we have those dollars, let's make sure we are using them properly.

Ms. PRATHER. Yes, yes, anything to be done to streamline permits, anything that is done in an area that has been disturbed before, I think there are streamlines that could be done to maybe—to utilize past work and not have to reinvent the wheel.

Mrs. FISCHBACH. And Ms. Prather, you mentioned in your testimony the challenges of acquiring access to Federal lands and obtaining the required review permits. We talked a little bit about that for construction, but access to those lands and construction. Can you elaborate on those challenges, those particular challenges?

Ms. PRATHER. So, I don't actually have a lot of Federal land in my territory, but other NTCA members do have those challenges.

Just the access, the permitting process, it is very expensive as well from what I understand, and so, those delays are just difficult, especially when they are trying to plan for a shortened construction season.

Mrs. FISCHBACH. Well, and thank you, and maybe Mr. Johnson has something to add on those issues?

Mr. JOHNSON. No, she made the point very well. That is very true that these are costly, take a lot of time, and delay projects.

Mrs. FISCHBACH. Okay. Well, Mr. Chairman, I thank the witnesses for their information, and I yield back. Thank you.

The CHAIRMAN. And now, we recognize Ms. Schrier of Washington.

Ms. SCHRIER. Thank you, Mr. Chairman, and thank you for convening this particular hearing. Broadband access is a critical issue in my district, and in Washington State. In fact, my district has a lot of rural territory, and these areas do not have the same access to broadband as urban and exurban parts of the district, or there may be a possibility that you can't afford it.

In small Washington State communities, limited rural connectivity for both internet and telephones means that residents and public agencies can't reliably hold meetings or meaningful public discussions. It creates a two-tiered system like we have been hearing about where part of our country has access to everything, information, technology, jobs, and the rest is kind of left behind. And lack of broadband access has exacerbated it by based on wealth or geography or even between the haves and the have nots, and the pandemic has made this digital divide even more transparent.

So, the free market didn't get electricity to every home. It was the Rural Electrification Act in 1936 that brought electricity to rural America, and likewise, we can't count on the free market alone to get broadband to rural areas. It is really Congress's responsibility to act, and that is why we are here.

So, during this pandemic, we have seen how the divide has played out in terms of education, remote work, and telemedicine. It has hit harder in rural areas. So, that is why I will soon be introducing legislation to create a year-long competitive grant program available to established state broadband offices with a goal of improving and rolling out broadband connectivity. And the idea is to find the best ideas and then roll them out to the rest of the country. And these are things like mapping and data collection that we have heard about, evaluating broadband costs and local community needs, ways to use different technologies, increasing network resiliency from natural disasters, and most relevant to today's hearing, assisting underserved farmers and growers with access to technology to increase productivity.

And so, I have a question for Vickie Robinson from Microsoft. Can you share some of the partnerships that you, that Microsoft has developed to expand rural broadband and advance precision agriculture research and deployment?

Ms. ROBINSON. Absolutely, and thank you for the wonderful introduction earlier, and thank you for the question.

For us, it has never been about connectivity, it is very much about what connectivity can enable. And one of the great things

and what we see is a marriage between connectivity and technology is to the precision agriculture opportunity.

So, by way of one example, I would like to talk about our work in Washington State with Nelson Farm, where we have leveraged the power of a Microsoft platform, FarmBeats, to really provide data-driven smart farming by bringing together the power of the Cloud and machine learning to actually enable farmers to do better farming, so they can know how to monitor soil—soil monitoring, and other planning, and it is all driven by data. So, for us, this work is critical in rural America, and we believe that not only farming, but other Internet of Things applications are critical in order to meet the needs of farmers, which are really the lifeblood of our community, if we think about it, in terms of the food that we eat and the jobs that are created.

And so, we would say do more of the same. We support your proposed legislation as another tool in the toolkit as a way to meet the needs of this constituency, and we appreciate the space and your commitment in this work.

Ms. SCHRIER. Thank you. Ms. Robinson, I am so glad you mentioned FarmBeats, because I know everybody on this Committee is excited about precision ag as a way to really limit the resources, whether that is inputs, fertilizer, water that we need to have successful agriculture.

I have one more question, and I wanted to touch on the important work going on in Washington State to provide free temporary emergency internet access for Washingtonians who don't have broadband service to their homes, and I know Microsoft Airband has partnered with the Washington State Department of Commerce and Washington State University on this. Can you talk about this initiative and its success in Washington State?

Ms. ROBINSON. Absolutely, happy to do so.

So, for us, in-home broadband connectivity is always the gold standard, but in the pandemic, we wanted to be nimble and be able to meet immediate need. And so, through the partnership that you referenced, we were able to deploy hundreds of WiFi hotspots so that you can use, what our anchor institutions like libraries in order to get access that was vitally needed during the pandemic.

They are also good from a resiliency standpoint, and so, we will continue to do investments and believe it is a good tool to complement broader in-home broadband access activity.

The CHAIRMAN. Thank you very much. I appreciate that.

And now, we will hear from Ms. Letlow, our newest Member from Louisiana, for her very first question.

Ms. LETLOW. Thank you, Chairman Scott, Ranking Member Thompson, Members of the Committee, and witnesses. I am honored to join this distinguished Committee and to have the opportunity to represent the farmers, ranchers, and loggers of the 5th District of Louisiana.

Agriculture is the backbone of my district, and is one of the largest economic engines for the area. From rice to cotton to soybean to corn, my district has been blessed with the fertile soil to grow just about anything.

It is fitting my very first hearing is on an issue so important to the 5th District and my state. In this day and age, having a reli-

able and affordable internet connection is crucial to success for businesses and schools, especially in rural America. Bridging the gap on rural broadband connectivity is a top priority that Congress should address on a bipartisan basis.

Broadband access affects everyone, Republicans and Democrats alike. In fact, I live in a rural area and see firsthand the major challenges of not having high-speed internet. The congressional district I represent makes up close to 20 percent of the Louisiana population, covers the largest geographic area, and represents a diverse economic base. Recently, the Louisiana Governor created a purposeful, statewide office of Broadband Development and Connectivity, headed by Veneeth Iyengar. Veneeth and I have been communicating about some of the most pressing issues facing rural Louisianans.

In April 2019, a report to USDA was drafted evaluating rural broadband infrastructure and next generation precision agriculture technologies. In that report, the convergence of broadband and agriculture was cited in reducing water usage by 20 to 40 percent for farmers, reducing chemical application up to 80 percent, and making farmers more competitive in our markets.

The USDA ReConnect Program can play an important role in bridging the broadband gap. It is my understanding the rules, like many Federal broadband grants, are being rewritten to reflect the pandemic and the importance of increasing broadband access. However, I have heard that the application process is quite cumbersome.

My question is to Ms. Prather and the other witnesses. What specific actions can Congress and the Department take to ease the application process so it can be more accessible for all?

Ms. PRATHER. Thank you, Congresswoman, and first of all real quick, congratulations on your new committee appointment.

Ms. LETLOW. Thank you so much.

Ms. PRATHER. Like you, my area is very agriculturally based, and every day we wonder about how we can help that agriculture community thrive.

We did work on some ReConnect applications, and to be honest, the biggest problem for us was that some of the mapping of what speeds were available in certain areas was not accurate. We did not have the time to do the necessary work to prove what was available and not available, so for us, we were unable to participate in those programs because of some bad data that we didn't have a chance to fix.

So, anything that promotes a validation process would at least help with that.

Ms. LETLOW. Thank you so much.

Any of the other witnesses?

Mr. JOHNSON. I have added a couple of comments earlier on yes, the application process could be simplified and accelerated, perhaps by adding more staffing at RUS and USDA.

I also commented on the fact that I don't believe that the speed requirements for the funding is adequate and future-proof.

I also forgot to mention, the loan grant combination. Grants are essential. The loan funding already having pretty low interest rates is not as attractive as getting a grant, to be real honest.

Dr. PARK. Congresswoman, if I may, from my perspective, it is very essential to have adequate speed, no doubt about it. But think of the quality of life increased from having no access to 25 meg *versus* increasing 25 to 100. And I believe we should prioritize serving currently unserved regions. So, if there is a choice between serving unserved to 25 and from 25 to 100, I believe we should prioritize the former.

Ms. LETLOW. Great. Thank you so much to the witnesses.

Mr. Chairman, I yield back my time.

The CHAIRMAN. Thank you very much, and now, Mr. Panetta of California.

Mr. PANETTA. Outstanding. Thank you, Mr. Chairman, and thanks to all the witnesses for your time and your preparation, and of course, your testimony.

Look, ever since—well, in my limited time in Congress, I can tell you one of the most bipartisan issues that I have come across is rural broadband. I got to say, though, it is very unfortunate that it took a pandemic to get it to this far along in Congress, and I have to say that it is unfortunate that it has taken a pandemic to highlight many of the issues we are experiencing in my Congressional district. Obviously, we are taking plenty of steps to try to address these challenges, from San Benito County and looking at fixed wireless, to a small town in southern Monterey County, San Gerardo. They gave them hotspots but they can't do it because of the geography. Then you have a place like Big Sur in which they can't necessarily lay down fiber or wires, so they are pivoting to look at satellites. And then you have a small town of Happy Valley up in Santa Cruz county that were using the already previously installed telephone lines, but those things are getting degraded and dilapidated, and they are losing internet services at this time. And then you have a town like Salinas that has a lot of internet service, but not enough, especially for certain communities, and that is why there was a picture that went viral of a couple of kids outside a parking lot in Taco Bell trying to link up their wireless to do homework, according to them.

Look, I think we have to continue providing hardware to schools for our students, but unfortunately, hardware is useless when you can't have a signal. So, I also appreciate the USDA for what they are doing in the ReConnect Program to bridge the gap, especially in rural areas. However, the definition of *rural* doesn't apply to a lot of areas not just in my district, but in the State of California.

So, I think it is important that we have these types of conversations because I do believe we are at a point right now where we are going to see major investments in the next farm bill, in the American Jobs Plan as well. But obviously, it takes more momentum and this type of hearing adds to it, so I appreciate that.

So, Mr. Johnson, let me talk to you. Obviously, 80 years ago Americans decided that rural America needs to be electrified, needs electrification. Give me your opinion as to how you feel basic universal broadband would equal that sentiment of the electrification of rural areas that we had 80 years ago.

Mr. JOHNSON. I think the sentiment is there, as you mentioned in your earlier remarks. Thank you, Congressman. This is a critical

issue and I think generally agreed upon by everyone involved and affected by it.

The need for it is immediately seen by electric cooperatives. We are located in these spaces. We have poles, infrastructure, rights-of-way that are already here, and our members have come to us. In our case, our members came to us immediately when I took this job in 2016. That was job number one for me was what are we doing about losing our population? What are we doing about getting access for teleworkers? And with the onset of the pandemic, we saw that this was something that was not just a like to have, it was a need to have, and we were able to respond quickly. And I believe most electric cooperatives are in that position.

Mr. PANETTA. Great, thank you.

Ms. Robinson, my next question is for you. I introduced legislation recently called the BOOST Act (H.R. 1362) to provide tax credits for next generation broadband equipment to receive wireless and satellite internet signals. However, there are still obviously some questions about the reliability and speed of those signals. How can we ensure new technologies are reliable, and what have you found to be the most promising outside of wired fiber when it comes to this type of reliability and that technology?

Ms. ROBINSON. Thank you for your question, Congressman.

So, in the first instance, I think doing things like Dr. Park has alluded to, like test beds, is a great way to kind of vet out and explore technologies. I think providing tax credits to support that kind of effort to vet out technology is critical to this space.

In terms of what is promising and what we see our partners using, I would note that one of our partners, RTO Wireless, is working with Dr. Park to use technologies like aerostats. We believe that does hold a lot of promise for being able to close the digital divide, but we also see things like Citizen's Broadband Radio Service, low-Earth-orbiting, the possibilities are endless. It is really about using the right tool for the right use case, be it broadband or narrowband.

Mr. PANETTA. Thanks again. Thanks again to the witnesses. I yield back, Mr. Chairman. Thank you.

The CHAIRMAN. Thank you, and now, Mr. Hagedorn from Minnesota.

Mr. HAGEDORN. Mr. Chairman, thank you for holding this hearing, and thanks to the witnesses, and also, thanks to our Ranking Member, Mr. Thompson of Pennsylvania.

This is a very important hearing. I mean, when I was running for Congress and then wanted to be on this Committee, one of the main reasons was simply to sustain rural America. There are a lot of disadvantages out there in the rural communities as compared to the bigger cities, and I think we need extra attention and focus, and this is certainly one of them.

Having access to the internet and broadband services like this is just a basic infrastructure issue. I think we have heard from many of the Members and witnesses that would say it is nothing different than electricity or water or sewer or anything else, roads and bridges. Because if we don't have this access in rural communities—and I live in a small town of 3,000. We have a lot of rural folks in the farming community around me. You don't have that op-

portunity for education, business, and then, of course, telemedicine, which has become so important, particularly to some of our elderly residents that can't get out and about as much. So, I think if we want to continue to preserve rural America and our rural way of life, this is something that we have to tackle.

Now, I am very, very interested in the fact that these witnesses have talked about the differences in some of the broadband capabilities. I want to talk about that in just a second. I do appreciate my colleagues on both sides of the aisle really stepping up. This is a pretty bipartisan committee, and this is a very bipartisan issue, and it is great that we are all working together for this common goal.

But I guess I will start with Ms. Prather. If you need broadband for really important things, telemedicine, education, businesses that can't—have to be online all the time, should we be striving for the fiber to get that last mile to the home through fiber, and what are the basic differences between that and the wireless that is available today?

Ms. PRATHER. Thank you, Congressman, and I just want to say, I am coming to you today from rural America from a town of 2,500 people, so much like you described where you are from as well.

That is a great question, and I do think there is a place for all of these technologies. When we talk about test beds, I think that is a great way to test these things out, but I would be concerned about testing that out in a place that doesn't have connectivity today, because should it not work out that well, should it not be as reliable as a fiber optic technology, we don't want to leave those customers behind even longer than they have already been left behind.

You know as well as I do, in rural America, we don't have a metro area covering our weather, for example. So, when we have spring storms coming through, our customers are reliant upon their internet service. I use Twitter to see what storms are coming in the storm chaser reports. There is no other way to get that information. So, I think it is really—it is public safety and to have a reliable connection like that.

We also know that every sector of rural America is using more and more connectivity, whether it is agriculture, education, telehealth, everyone is expanding all at once. And so, when you have a limited amount of resources to put towards rural America, you want to use something that will last for decades.

Mr. HAGEDORN. I appreciate that. I mean, my experience in getting around the district and talking with folks and some of the companies that provide these services, and right in my hometown of Blue Earth, you have Bevcomm and I know how important they are to the local community and how they help out. So, I think if we have an opportunity to choose whether or not we are going to go with our local providers, the people that can deliver that very, very high quality, I think we should do that as opposed to maybe a company that is from far away that really doesn't have that much interest in the community, other than providing a service.

I mean, I think of Christensen Communications that was in the Daily Minnesota about 8 months ago, and when all the kids had to go to digital learning, all of a sudden there were a lot of people

in town that didn't have access to the internet. They were capable of getting it, but they didn't. And that company stepped up and actually provided it to them.

So, I think sometimes the rural electric cooperatives, the local cable companies, and others are really going to look out for what is going on in our small communities and our rural areas, and the jobs that they provide are also important, too. So, hopefully if it comes down to either/or, we can go as local as possible. That would be my recommendation.

But thank you for your testimony. Mr. Chairman, I yield back.

The CHAIRMAN. Thank you very much, and now, we will go to Mrs. Axne from—Mr. Sablan from the Northern Mariana Islands, you are recognized.

Mr. SABLAN. Yes, thank you very much, Mr. Chairman, and I thank the witnesses as well.

Thank you, Mr. Chairman, for holding this hearing on this very important issue. As many of you know, and maybe some of you don't know, I represent the Northern Mariana Islands, which is situated approximately 6,000 miles from San Francisco, and maybe 8,000 miles from Washington, D.C., which receives broadband through undersea fiber optic cables, actually two fiber optic cables. The Department of Commerce, the Commonwealth government Department of Commerce, published a survey in 2014, a rather old survey, but about broadband usage on Saipan, Tinian, and Rota. These are the three populated islands. And at that time, even approximately 53 percent had access to broadband, but seven in ten of the households without broadband claimed the monthly cost is the biggest impediment or deterrent to their having broadband.

This has actually been made worse in the pandemic when schools had to go into virtual. We were able to locate money and have MoFi or MiFi—the first time I heard of this word—MoFi or MiFi secured them on boxes and they would go out to the villages and that is when students were able to access the internet.

But so now in 2021, cost remains the biggest deterrent to broadband access, along with dark spots in connectivity and the threat of typhoons disrupting the undersea cables and therefore interrupting service. And as a matter of fact, a storm did damage to one of the fiber optic cables, and we were with no connection at that time for days actually.

So, of the five active USDA broadband programs in Fiscal Years 2019 and 2020, the Northern Mariana Islands did not receive any funding, and as you can imagine, we are talking here about rural. We are talking, in my district, we are just talking about completely rural, completely removed.

So, Ms. Robinson, your testimony focused on the fact that one size does not fit all, and I agree with you. So, the Northern Mariana Islands, along with other territories or the States of Hawaii and Alaska, have unique challenges when it comes to broadband. So, what can the U.S. Department of Agriculture do to not only bolster infrastructure in the Pacific, but also make it affordable, fill the dark spots of connectivity, and provide futureproof—strengthen the undersea cable?

Ms. ROBINSON. Thank you for your question.

I think it is super important that the Committee think about tackling this issue from two different angles, first from a deployment standpoint, making sure that you use a variety of different tools in order to meet the needs. You talked about the fact that the cables went down. Having access to different technologies is important from a redundancy standpoint so that if something goes down, you have competition within the market, you are able to meet that need and continue to ensure people have critical access to broadband connectivity. And so, as you think about funding deployments, doing so in a way where it is technology neutral and optimizing first technologies that are cost effective, that has a benefit of providing more tools within a given geography, but also, it should help on the side of the affordability, the actual service itself.

And so, I think it is important that the Committee think about both sides of the coin for both the deployment itself being cost effective, but also ensuring that you can build upon things that are now focused on addressing things like you talked about, the homework gap. And you now have a temporary benefit and thinking about how to attack affordability from a long-term, permanent perspective will be really critical as the Committee thinks through, and we as a nation really think through, how we get people not just access to the internet, but actually connected to the internet.

Mr. SABLAN. Yes, thank you. It is just, one of the islands I represent is just 30 miles from Guam, and Guam, of course, besides having more economic activity, Guam has the military, and therefore, there is more ways for Guam to connect with fiber optics through the ocean. As a matter of fact, our fiber optics come from Guam.

But my time is up, so thank you, Mr. Chairman, and thank you for holding this hearing.

The CHAIRMAN. Thank you, Mr. Sablan, and as you know, I am well aware of your unique crisis and challenges in Northern Mariana Islands, and certainly appreciate Ms. Robinson for pointing out how we can approach your unique situation.

Now we—I believe it is Mrs. Cammack. You are now recognized, 5 minutes.

Mrs. CAMMACK. I appreciate that. Thank you, Mr. Chairman, and thank you to all the witnesses for being here virtually. I know it has been a little bit of a lengthy day, but thank you for hanging in there with us.

One of the first action items that my office took on this year was in-depth discussions with constituents throughout the district and various stakeholders about this very topic of rural broadband, and constituents have really shared with me over the years how the gaps in broadband and technology have impacted almost every aspect of their daily life. Farmers struggle to implement precision technology. Our teachers and students have struggled on the education front. People have struggled to work from home. Doctors have struggled to stay in touch with their patients, and small businesses have struggled to deliver goods and services due to a lack of connectivity.

Now, at this time, Mr. Chairman, I would like to enter into the record the following FCC broadband deployment map illustrating my district's gaps in fixed wireless service.

Now, you can see here——

The CHAIRMAN. So ordered, thank you.

[The map referred to is located on p. 130.]

Mrs. CAMMACK. Oh, there we go.

The CHAIRMAN. No, I said so ordered.

Mrs. CAMMACK. Thank you.

As you all can see from the yellow and lime green basically covering this whole area that is my district in north central, northeast Florida, that we lack connectivity pretty much across the entire district and region. And according to the FCC's latest broadband deployment report, over 90,000 constituents across my district struggle to obtain basic access of speeds of 25/3. In fact, the town of McIntosh in my district has sadly been recognized as the worst connected city in Florida. And in 2021, it is just simply unacceptable.

So, jumping in to some of the questions, I wanted to start with Ms. Robinson, and I know you have answered this before, but just if you could recap and maybe expand a little bit. In your view, what are some of the key steps being taken to produce maps that more accurately reflect broadband service across the country? Because that is one of our biggest challenges is just identifying the very basic baseline of how can we get a starting point and measure success and quantify it, moving forward?

Ms. ROBINSON. Thank you for your question.

I think the first step has happened. Congress has passed the Broadband DATA Act, which is a critical first step in the journey to get a better view around what is actually the scope of the problem that we are dealing with. Not only did you pass the Act, you actually funded it. Congress has actually funded that, and so now, the FCC is doing the important work of actually implementing that Act, and we understand that they have put together a task force that is really—will be really critical to ensuring that they have multiple data sets to inform their view around sizing the properties of the gap, be it at the Federal, state, local level. So, that is important work doing that coordination. And I would also submit coordinating with Tribal entities and other actors as well.

There are also data sets that could be leveraged from the private-sector. Microsoft itself has looked at this problem based on our usage data, meaning the speeds at which our customers are being able to have from a customer experience perspective, download, or have interactions with our products in the marketplace. And we see that there are gaps there. And so, as we as a country try to get our arms around that, it will be critical to bring these various data sets together, use the power of the Cloud and machine learning to actually validate inaccuracies, and then make that available to the public for comment as well.

So, things are moving in the right direction, so I would say more of the above, but also challenge to continue to use resources from the private-sector as well as part of this exercise.

Mrs. CAMMACK. Excellent. Thank you Ms. Robinson.

The next question that I have is for Dr. Park. A common complaint that I hear over and over again is grants have been received by different stakeholder entities within our district and our region, and for one reason or another, the service just never seems to reach

its intended audience. So, these municipalities, these different groups get stuck with this program, and they are still left with no service. So, how can we make sure that Federal programs don't trap customers with ineffective technology?

Dr. PARK. That is a great question.

I would say that, previously some of the technologies, I mean, specifically with wireless technology, I don't think it was lack of standard, first of all. There was no standard established, and there was really no dedicated spectrum or frequency for serving residents. But now that has changed, so there is now LTE standard that allows wireless technology to be upgradeable without doing further improvement on the customer premises equipment, and with the CBRS, there is now a dedicated spectrum that allows wireless technology providers to provide services without interference.

So again, I think those innovative technologies——

The CHAIRMAN. Thank you. Your time has expired, but thank you very much.

Mrs. CAMMACK. Thank you.

The CHAIRMAN. And now, we have Mrs. Cindy Axne of Iowa—oh, and it is her birthday. Happy birthday to you. Well, Frank Sinatra I am not, but happy birthday to a dear friend, Mrs. Cindy Axne of Iowa. You are now recognized for 5 minutes.

Mrs. AXNE. Thank you so much, Mr. Chairman, and thank you for our witnesses for being here today.

No better topic to be discussing on my birthday than broadband, something that Iowa is desperately in need of. I am so glad we are having this.

I don't need to rehash exactly what all of my colleagues are saying about the fact that we need to make sure that everybody in this country has broadband. Listening to Representative Cammack there in northern Florida, it is no different than it is in Iowa, and of course, this pandemic only exacerbated the issues that we are facing when we don't have connectivity across this country.

I have had the opportunity to spend the last couple of years working with the Rural Broadband Task Force to put together our bill that is being included in the infrastructure package to bring broadband investment of $100 billion across this country and to address my colleague, Kat Cammack's concern, also getting to those mapping issues. So, a very solid bill.

One thing we have spent a lot of time talking about in this task force is that we have to futureproof it to make sure that we have got agreement with providers to continue to support it so that nobody falls behind again.

As we look to investments like this, I would like to focus a bit on how we can better coordinate and share information across the Federal broadband programs. I think we have about 50 different programs right now, and we have state programs. I spent a decade in state government actually talking about this way long ago, and I am glad we have the ACCESS BROADBAND Act (H.R. 1328) which we passed last year, of course, to help us with this. But we have a lot more work to do.

And when I was working at the state, as I mentioned, the lack of coordination across those programs was literally one of the big-

gest issues that was so frustrating for us, to make sure everybody had broadband, and I am glad that the task force that we put together points out that we have to have required coordination between Federal and state programs.

So, Mr. Johnson, I believe you said in your testimony that your co-op has used FCC broadband funding, but not USDA's programs. I am wondering if you could share one thing that you think the FCC does well that we could bring over to the USDA, and *vice versa?*

Mr. JOHNSON. Yes, thank you, Congresswoman.

The simplest answer to that, and most direct, is that it is easier. It is simpler. The maps are generated in the RDOF program by the FCC. They distribute them to everybody. They specify available grant dollars that will be available, and they conduct a reverse auction according to strict rules. It is a fair playing field for everybody. We feel that fiber and 100/100 service should be favored as it is, but the fact is the application is much simpler. The process is simpler.

Mrs. AXNE. So, you are—any thoughts on what the USDA is doing or could be doing better, or is that the one suggestion we should be taking from the FCC?

Mr. JOHNSON. Yes, I mean, there are others. Their loans grant packaging is, relatively speaking, not as desirable to us. The applications themselves give a point system allotment to passing libraries, community centers, things of this nature, and we are talking about rural here, so that is where—our libraries are in the communities that are already served, so putting extra points into a system where that type of farm should be—perhaps get extra points, if you understand what I mean.

Mrs. AXNE. I like that idea.

Mr. JOHNSON. And I think the process is slow. The funding that is granted, once it is awarded, it takes—we have a specific co-op that it took over 500 days to get their first money. That is too long.

Mrs. AXNE. Okay. Thank you.

Ms. Prather, I would ask the same question to you. You talked about providers spending 2 years and I think $250,000 just to get a loan from the USDA. Is that one of the biggest things that we need to address is the efficiency of it, or do you have other suggestions that we could move from one program to another to help us?

Ms. PRATHER. That is another great point, and I would second what Mr. Johnson said. It is a much more difficult application process. We actually have some private loans because those were much easier to get than going through the full RUS process, absolutely.

Mrs. AXNE. Well, thank you.

One thing I think everyone in broadband has heard a ton about is the issues with mapping. Rep. Cammack brought it up. The FCC is currently updating their maps, and there are other efforts in states like Iowa as well.

Last question. Ms. Prather or Mr. Johnson, do you think we could benefit from improving the coordination of maps we use to determine where to put the funding, and could we get a really good set of maps there that both the USDA and FCC and NTIA could all use together?

Ms. PRATHER. Very quickly, I think using one definition for *underserved* or *unserved* would go a long way in helping that coordination, too.

Mr. JOHNSON. I agree. Yes. I think one agency perhaps could be the clearing agency for all the data.

Mrs. AXNE. So, if I am hearing you all correctly, we need coordination in moving this forward. It will create a more efficient and effective structure to roll this out across the country. Is that correct?

Mr. JOHNSON. Yes.

Ms. PRATHER. Yes.

Mrs. AXNE. Thank you. I yield back.

The CHAIRMAN. Thank you very much, and now, Mr. Austin Scott, my friend from Georgia.

Mr. AUSTIN SCOTT of Georgia. Thank you, Mr. Chairman, and I want to say thank you to the people who are testifying here. I am sorry that I had to step off briefly. I am on the Armed Services Committee, and we are having a lot of discussions about Afghanistan, as you can imagine, and I know other Members are in those meetings as well, so just—thank you for understanding what—some of the other things going on up here.

Dr. Park, you alluded to something that I think is going to be a big part of our debate, going forward, and it is the 25 megabits *versus* 100 megabits. We have some extremely influential people who have legislation to change the definition from 25 to 100. Could you allude on what you were talking about a little bit more, zero to 25 *versus* 25 to 100, and the importance for rural America of keeping it at the 25?

Dr. PARK. I am not advocating to keeping it 25, but my point was that if we had a choice between serving a person with nothing to 25 and improving——

Mr. AUSTIN SCOTT of Georgia. Okay.

Dr. PARK.—the speed from 25 to 100, it should absolutely be the former. We do not want to set a policy to hinder some operators and providers to reach currently unserved people from providing 25. Yes.

Mr. AUSTIN SCOTT of Georgia. Fair enough.

Okay. So one of my concerns is we have watched an extreme population shift from rural America to urban America, and part of that has got to do with industry and jobs. I mean, people are moving closer to where they work, and obviously, if you are manufacturing in the United States today, if you are in any type of industry in the United States today, access to the internet is just as important as access to water, access to power, access to labor, and so my concern is if you change the definition from 25 to 100, then all of a sudden a lot of people who are already served at that 25 megabits will take precedence over people who currently have little to no service at all.

And so I think that is just a definition that we, as the Agriculture Committee, those of us who represent rural America, need to be very careful of, in that it seems like it is not a big change, but when it comes to the money that is set aside for rural America, and broadband for rural America, it is going to make a lot of other people eligible for it, and my fear is that it shifts the focus from

rural America to areas which are already served with the 25 megabytes a second. But thank you for clarifying that. I think you have very interesting technology with the blimps. And the tether—is the tether—does the tether actually have fiber in it, or are you linking wirelessly to a tower?

Dr. PARK. Yes, it is tethered by the cable—fiber, so it is fiber is connected to the aerostat, and from the aerostat there is a wireless antennae—radios that is transmitting signals down.

Mr. AUSTIN SCOTT of Georgia. Okay. Fair enough. And so, Ms. Prather, you talked about the middle mile. The Agriculture Committee, in the last farm bill, we put language in there to support the middle mile, and that build-out. Unfortunately, the Appropriations Committee did not put funding in there for the additional build-out of the middle mile. Could you speak to how important it is in the build-out of the wholesale infrastructure to rural broadband?

Ms. PRATHER. Yes. Thank you, Congressman, that is a great question, and a very important part that we have not talked about very much today. While it is important to serve those last mile consumers, if you don't have enough backhaul to get back to the internet at large, you are going to hit a roadblock there, and they are still not going to get that service. And not only that, but allowing companies to build-out maybe even a redundant middle mile network can be very beneficial. We actually hopped onto a benefit from another provider through a different program that allowed us to have multiple accesses to different internet presences. We go to Dallas, and we go to Austin. So things happen, fiber gets cut. If something happens between us and Dallas, all of our traffic can go to Austin. So that is a very important part of the puzzle too.

Mr. AUSTIN SCOTT of Georgia. Thank you all for what you are doing, and, again, we need to watch the definitional change from 25 to 100. I think that would shilf some of the funds that have been set aside for rural America to have that build-out to 25 from the truly rural areas to the more metropolitan areas. And with that, Mr. Chairman, I will yield the remainder of my time.

The CHAIRMAN. Thank you very much. And now, Ms. Alma Adams of North Carolina. You are now recognized.

Ms. ADAMS. Thank you, Chairman Scott, and Ranking Member Thompson, for hosting the hearing today, and thank you to all our witnesses for their testimony. While my district is substantially urban and suburban, I understand the urgency and importance of this issue. Even in Charlotte-Mecklenburg, and particularly in low-income areas of my district, we have broadband deserts which don't have access to quality high-speed internet. Our work here in Congress is helping to address this. The City of Charlotte recently announced that it will be using $3 million in funding from the CARES Act to make important investments to promote digital inclusion and equity across our city, so I know how important it is that we bridge these divides, and ensure that all Americans have access to broadband. And so, Mr. Chairman, I appreciate you and Ranking Member Thompson for convening the hearing today to talk about how we can tackle these troubling disparities facing rural communities.

According to the Census Bureau, about 30 percent of rural America is comprised of historically marginalized communities, and, as we know, the COVID–19 pandemic has laid bare inequities across our country, and one such inequity is the disparity in Americans' access to dependable and affordable broadband. This particularly impacts our students, who have had to learn from home, and our universities, specifically our HBCUs, and our minority serving institutions, who had to get equipped quickly to operate in a virtual world. So, given that so many of our HBCUs are in the South, and are a part of rural America, it is vital that they be included in any rural broadband conversation.

Ms. Robinson, is there anything that Microsoft and your Airband ISP partners are doing to address the needs of these groups in rural America? In particular, I am interested to hear more about the recent partnership between Microsoft Philanthropies and the 1890 Foundation. So could you speak more about that partnership?

Ms. ROBINSON. Absolutely. Thank you so much for the question. From our perspective, working to connect anchor institutions is a key way to actually extending out and meeting the needs of the whole community, particularly when you are talking about working and trying to reach historically marginalized groups, and that is a key priority for us as we build out and do this work in rural America. And so, as a part of our recent partnership with the 1890 Foundation through Microsoft Philanthropies, I am pleased to share that we, as a—from an Airband perspective, will be working with the University of Arkansas Pine Bluff to extend connectivity for precision farming. And that is really exciting to think about how—thinking about the mission of that—of land-grant universities, like University of Arkansas at Pine Bluff, to show the power of connectivity, and support related research in that space.

But not only are we working to provide connectivity to enable precision agriculture, as part of that work, from an Airband perspective, we also want to ensure that when staff, members, and faculty leave the campus that they also have access to conductivity because we understand that often it is the case they may have connectivity on campus, but when they get home, they are in a broadband desert, as you talk about. And so, working through our partner, Aristotle Unified Communications, we are excited about that work, and the learnings that we will be able to take to replicate that across the country.

Ms. ADAMS. Okay. Well, thank you very much. Let me move on quickly. To the rest of the panelists, what role do you think 1890 land-grant institutions can play in helping to provide connectivity in rural communities?

Dr. PARK. Well, thank you for that question. So one of the unique roles that WHIN plays is by working very closely with Purdue University. As we gather data, and as we work with these innovative technologies and put them to use, we have access to how it is performing, the data we are collecting, and we share that with researchers and educators in the university, again, to advance the innovation further. So I think it is a critical partnership, as we move forward, to solve this digital divide together.

Ms. ADAMS. Okay. We have about 45 seconds. Is there another response from another panelist? Okay.

Mr. JOHNSON. We have cooperated with research that is being conducted at Cornell University regarding the feasibility of nonprofit developments in some of the hard-to-reach areas, and we feel these partnerships, and this data, and this research is very valuable.

Ms. ADAMS. Okay. Ms. Robinson, Native American communities on Tribal lands have lacked reliable access, so can you speak a little bit about that? You just have about 15 seconds.

Ms. ROBINSON. Absolutely. It is a key issue, and we have various partners that are stepping up to meet the to expand connectivity on Tribal lands, including Sacred Wind Communications, who is serving access to Navajo Country in the State of New Mexico, as well as Native Network, who is extending broadband access in the States of Arizona and Washington, again, specifically focus on closing the gap for indigenous communities.

Ms. ADAMS. Right.

Thank you, ma'am. I am out of time. Mr. Chairman, I yield back.

The CHAIRMAN. Thank you. Thank you very much, Ms. Adams. And I thank you for lifting up the important role that our 1890 land-grant African American colleges and universities are playing. They are playing a very important role, and certainly will be playing an important role in our efforts to bring broadband to all of our rural communities. Thank you for that. And now, Mrs. Miller of Illinois, you are now recognized for 5 minutes.

Mrs. MILLER. Yes. I would like to thank the Chairman, the Ranking Member, my colleagues on this Committee, and our witnesses for coming together to discuss such a critically important topic. As a farmer myself, I know how important rural broadband is to advance the future of American farming. The agricultural industry continues to become more technologically sophisticated, and reliable connectivity is essential to make sure American farms can utilize new technology. I know this firsthand.

Of course, American farmers aren't the only ones who need better rural broadband. As our world becomes more technologically centered, the digital divide becomes more stark in rural America. The COVID–19 pandemic has particularly highlighted this digital divide. In healthcare, Americans increasingly use telehealth to access healthcare. Those who are lacking reliable internet connections struggle to access this option. Additionally, many schools closed their doors, and started online instruction, and families found themselves struggling to get their children online to do their work. Eventually the pandemic will end, but the need for reliable broadband connectivity will continue. I am committed to working toward expanding broadband access, and I am glad to be discussing this issue today.

Dr. Park, you described rural areas as digitally diverse in your testimony. Can you explain that? It is a notion that I think a lot of people might not understand if they have not spent time in rural communities. How does that make rural networks different from urban networks?

Dr. PARK. Thank you for that question. So we all know that urban is obviously uniformly dense, and can support high concentrations of towers. The urban problem for broadband is congestion of the network, right? In rural areas, broadband service is

challenged by areas that are sparsely populated, with a few areas that have high numbers of population. And density within the area could also change over time. For example, county fairs last a couple of weeks, creating temporary pockets of density that need service. There are—migrant and seasonal workers come and go, and they bring kids, and they need education. So, to solve this in the urban way, rural networks would have to greatly overbuild to handle the worst-case scenario. So we think a technology like an aerostat can help, because it covers a large area with a fixed capacity, but really does not care where the people are in the area, as long as that total count remains fairly constant.

I would also say, again, IoT is another very important source of diversity in rural areas, because agriculture is such an important part of the rural community, and with the sensor-based technology that needs its own connectivity on the farmland. So the bottom line is that the rural connectivity needs are not always what they seem to be. They are complex, dynamic, and then don't really lend themselves to one-size-fits-all solutions.

Mrs. MILLER. Thank you. And, Dr. Park, towards the end of your testimony you mentioned the Indiana GPS study, and shared some interesting insights from it, mainly that closing the digital divide and accelerating digitalization are keys to prosperity. Can you talk more about that report, and more about what digitalization means to rural communities, please?

Dr. PARK. Sure. So, that report came about in a very critical time in the State of Indiana, and the key finding of that report was that Indiana is actually lagging its productivity compared to the national average, and its number one recommendation to resolve that issue was digitalization, meaning more of adopting technologies in farms and advanced manufacturing sectors. How do we accelerate the adoption of technologies so that these industry sectors can grow quickly and increase productivity? And so, obviously, in order to digitalize these industry sectors, we need connectivity, so they come very much hand-in-hand with our state's new priority of digitalization, and really making this infrastructure as robust as possible.

Mrs. MILLER. Thank you, Dr. Park, and I yield back the balance of my time.

The CHAIRMAN. Thank you very much. And now Ms. Plaskett of the Virgin Islands.

Ms. PLASKETT. Thank you very much to the Chairman and to the Ranking Member for convening this hearing, and I really want to thank our guests for being here as well, and sharing some incredible information with us. This has been really helpful as we continue the discussion of broadband deployment, and how it fits in with the Biden Administration, and the jobs bill that we are all working on right now to move America forward, and to build back better.

I wanted to ask Ms. Prather or Mr. Johnson, can you talk about the cost of broadband network deployment *versus* maintenance? What are the resources most helpful to communities or providers to ensure good network maintenance? I think especially about, in my district of the Virgin Islands, maintenance is so key when we have tremendous issues of natural disaster and weather that may

cause broadband deployment—and not just the deployment, but eventually the maintenance of broadband, to be problematic.

Ms. PRATHER. That is a great question, and I will take a crack at it from our perspective. You bring up a great point that there are two distinct costs with deploying quality broadband network, that initial investment to get the network to the consumer, and then that ongoing maintenance. These networks are built to last for decades, and so if we have the ability to make the business case for a service provider to be there, and to continue to make those investments in the customer service and the maintenance, that is what creates the ability for a network to last as long as it should.

Mr. JOHNSON. I could add, if I may, thank you, Congresswoman, that the startup costs for construction are the heaviest lift. Operations, of course, will be ongoing. Hopefully the business model will support by pricing, and having the availability of extra benefit programs, like the emergency programs and Lifeline, which should be enhanced, would also help cash flow to these businesses. We operate at cost to an electric cooperative, so, as a nonprofit, we have a slight advantage in that respect.

Ms. PLASKETT. Can I ask you, Mr. Johnson, in talking about the startup, I know that this Committee has talked quite a bit about how to extend broadband, but when I think about places like the Virgin Islands, or my colleague also on the Committee, Mr. Sablan, one of the concerns we have is that we really need to support—incentivizing companies and others, particularly private-sector, to deploy in communities in which payment costs are not going to be as robust. What are some of the mechanisms that we as legislators can put into some of this legislation to incentivize, and to support service providers and others to go into areas where it may not be as cost effective or profitable?

Mr. JOHNSON. Right, and I think that the grant approach is the way to go in these situations, where high costs and low revenue potentials are out there in the region that is to be served. So grant availability is critical, and operational expense subsidies as well. Otherwise, it can't be sustained. As I mentioned, the affordability options, such as the emergency broadband project, that should be made permanent, perhaps in the form of enhancing the Lifeline benefit that is available now.

Ms. PLASKETT. Thank you. One last—another question I had was the relationship between, in areas in which municipal broadband exists, and it is there with ISPs, with internet service providers, have you seen instances in which that conflict sometimes, which naturally may exist, has been overcome? And, before answering that question, I just want to reach out to Ms. Robinson with Microsoft. It is been so good to hear your testimony. I am excited about some of the work that you are doing in Indian Country, and hopeful that you could potentially have a conversation with those of us from the Territories about how Microsoft can be supportive in areas outside of the mainland. That would just be a fantastic discussion.

Ms. ROBINSON. I would love to have that discussion, and thank you for the question. I will point out that we are working in Puerto Rico, so we are—and we are keen to work outside of the mainland, in terms of solving this problem, because we realize that it is a national problem, and it is not restricted to the mainland, so we

would love to continue the conversation around what more we could do to expand broadband access to the Territories.

Ms. PLASKETT. Thank you. Thank you so much, Mr. Chairman.

The CHAIRMAN. All right. Thank you, and now we will hear from Mr. Balderson of Ohio.

Mr. BALDERSON. Mr. Chairman, thank you very much, and thank you for everyone being here. My first question goes to Dr. Park and Mr. Johnson. Dr. Park, you may answer first, then Mr. Johnson can follow. Are there technologies that we should deploy in specific areas? Are there technologies we should not deploy in certain areas? And final is, is it more effective to use a one-size-fits-all approach, or should we be more granular with our technology deployment?

Dr. PARK. Thank you, Congressman, for the question. I think it comes down to really balance, right? Fiber certainly has a lot of advantages, as we talked about, but it does have disadvantage of being costly, and also it takes time, longer time, to deploy, typically. And so it is really about is it more important to deploy in areas that are currently unserved rapidly, right—I think the key is *rapidly*—to perhaps provide 25 mbps service, 50 mbps services using alternative technologies like aerostat. And I am—I am not proposing, again, one technology is—solves everything, so I think there is a way to coordinate with local partners, because each region has its own unique profile, its regional partners, and so we have to let the regional partners work together to provide adequate technologies to provide the service that is needed.

Mr. JOHNSON. Thank you, Congressman. Yes, I would urge deployment of fiber. The FCC's approach has been to give additional credit in bidding processes to those entities that can provide faster service. We also need to look at the reliability of the network that is being built. Many of these other technologies, cellular as well, are dependent upon fiber access. So, as the old saying goes, cellular follows fiber. So that is the proven and robust tech that is out there. Would be very long-term, and easily expandable for future needs.

Mr. BALDERSON. Thank you. My next question is for you, Mr. Johnson. Your network is fiber network to some pretty rural country. How did you decide that fiber was the right fit for your needs, and what role did Federal systems play in that decision?

Mr. JOHNSON. Right. Thanks, Congressman, again. Our experience here was that fixed wireless was inadequate. We have rolling hills, and lots of deciduous trees with leaves, so we had latency and service interruptions, and the same applied for satellite. We had weather issues. We ran a satellite broadband business. We had people buying data—additional data, so they were spending $200–$300 a month in some cases, those who were high-tech workers, and those high-tech workers are exactly who we want to keep in our region. So fiber became the default decision, and the long-term decision, so that we could support these other—perhaps other cellular towers, and other things that may develop.

Mr. BALDERSON. Okay. Thank you very much. Mr. Chairman, I yield back my remaining time. Thank you.

The CHAIRMAN. Thank you. And now I recognize Mr. Lawson of Florida for 5 minutes.

Mr. LAWSON. Thank you, Mr. Chairman, and I would like to welcome everyone to the Committee. In the staff report, they said that if millions of farmers, I guess in the rural areas, had access to the internet and broadband, that it could increase their bottom line by maybe $40, $45, $60 billion. And to the staff, I need someone to explain that to me, because I know for the last several years we have had issues with hurricanes and so forth, and as Congresswoman Axne talked about in the area about how they needed access.

I understand a great deal that—a little bit about education, giving education outlets to them, but I am trying to see if someone there can tell me, because most farms are located quite a distance from other farms in certain areas in what some people consider to be remote areas besides rural. How is this access going to increase the bottom line of farmers? And that is open to the panel.

Ms. PRATHER. Well, without actually seeing a farmer, I can't tell you maybe the very specifics of it, but I will give you an example. Like I talked about earlier, we have a lot of dairy farmers in the area, and I know other agriculture happens the same way. They are able to upload information to their providers to make things happen much more efficiently than—like you said, they are a long way from town—having to go into town to talk about what they need. They can do all of that electronically, and have instant access to their vets, to their other consultants, to other resources. So they are not spending as much time trying to do an information trade, but could make it happen automatically. We also have cattle ranchers who are able to participate in online auctions, so they can stay on their farm, and do other chores and things that they need to do, while still participating in the auctions of their cattle.

Mr. LAWSON. Well, does anyone else want to comment on that from the panel?

Ms. ROBINSON. I would be happy to comment on that, and I appreciate the question. I think when we think about how having access can be transformative for farmers is that, if you are able to connect the farm, but also the farmlands, it enables farmers to lean in to use technologies like Internet of Things to do things like smart farming, data driven farming, that—if there is—if you are able to do that by pairing connectivity and technology, that can translate into improved productivity, and your bottom line, because you are able to use the power of data to marshal your resources as you go about doing the work of farming. So I would say that in a very specific way, and then just more generally, there is lots of scholarship on—anecdotal information to suggest that broadband connectivity is directly correlated to growth and improvement from a socioeconomic standpoint when you have it in communities. So I would offer these things as datapoints that may be relevant to your question.

Mr. LAWSON. Okay. Thank you. And I have a question for Mr. Johnson. Mr. Johnson, you can recall how rural electric came about all over the country, and the significant impact that it had on many of them. And I guess I might have been one, living in a rural area, because I could remember when we got electricity, when my brother and I were staying up all night to see what—when the light was going to go out, because we weren't really used to having

electric light, and it came because of rural electric. What is the significant cost is going to be to get broadband into all of these particular areas? Now, there was a cost in getting electricity out into rural areas. And I know my time is—but what is going to be the cost to get it into a rural area, broadband, on the average person who participates with——

Mr. JOHNSON. I guess I am not real clear on the question, what the cost would be on a monthly basis, you mean, or an aggregate basis nationwide?

Mr. LAWSON. Well, it would be on an average basis for the actual person, the same as rural electricity, how it came down.

Mr. JOHNSON. Right, yes. I mean, electric cooperatives, as you know, operate as nonprofits, so we offer service at cost, and that is our objective with our pricing, and that is why we pursue as many grants as we possibly can to fund this opportunity. Low interest loans are helpful, and that is what funded REA, but this is a grassroots movement. Our members demand the service, they demand comparable service to what is available in urban and exurban areas, so we address their needs, and do the best we can to get to them.

Mr. LAWSON. Okay. Thank you, Mr. Chairman. With that, I yield back.

The CHAIRMAN. Thank you. And now Mr. LaMalfa of California.

Mr. LAMALFA. Thanks, Mr. Chairman, I appreciate it, and for our panelists here today. As is the craziness around here, I had to step out for a while here, but I appreciate your information you can impart to us here, just for a second, Ms. Prather was—I think mentioned earlier about the—we were talking about the challenges of acquiring the access to Federal land in order to move broadband infrastructure in, and the reviews, and permits, da da-da da-da, it takes forever. Like doing stuff, as far as trimming trees on Forest Service land. It is just a terrible process. So if you have any input you would like—with us on how we can further streamline that in the future, but I think that question has been posed today, so I also wanted to talk about the—building things correctly the first time, okay? Now, in the 2008 Recovery Act, we had some missteps back then, so this is both for Mr. Johnson and Ms. Prather, and—sorry about that.

So the Federal Government has spent billions to build broadband, some of whom are still operating right now, and—so we know that service could be substandard, and we know that many are only a little—halfway—about halfway through their agreements. So how do we step it up and make sure that broadband, when it is not only on the way—that it will stay in place, and at a good quality of service, through the lifetime of the loan and the grant process? So Ms. Prather and Mr. Johnson?

Ms. PRATHER. That is a great question, thank you, Congressman. I think it is very important, like you said, to try to tie that service to the life of the asset. If we are going to put these assets in play, we want to make sure that they are still available for their useful life over decades. I think there are some really great ideas out there about tying the length of loans and grants to what you are providing. That goes along in hand with—what speed we consider unserved may be very different from a speed that we want to build

to. Just because we have a certain minimum standard of speed—we may not need to change that from what is being served, but why would we want to build to that minimum threshold? So making sure that, as we make more grants and funds available, that we really are looking to the future, and building towards what we need.

I think your second point is excellent, about—we want to make sure that those networks can sustain themselves. That is an important component of Universal Service, and that that is what affords an affordable rate over the life of that network. Mr. Johnson mentioned Lifeline, the High-Cost Program, all of those programs affect a different component, but work in tandem to keep those rates affordable, and those networks sustainable.

Mr. JOHNSON. I would only add, Congressman, that I think that—especially in the example of the FCC, regarding the Rural Development Opportunity Fund, we need to vet bidders before they bid. It is too late in the process to make an award to a bidder that is unqualified, and is subsequently denied access to the funding. We need it to be done ahead of time, ReConnect, same thing, be it ReConnect, all the USDA funds, need to have vetting before awards are made.

Mr. LAMALFA. All right. Thank you on that, both of you. Mr. Johnson, previously there was a discussion about—a member-led decision process could be perhaps more productive, or efficient, so why would the members want to shoulder more of this investment, especially as complex as this can be?

Mr. JOHNSON. Thanks, Congressman. Yes, the members see that this is an essential service now, that—it has now gone from what we previously thought maybe was a luxury to an absolute necessity, especially with the onset of the pandemic. Many of the kids were at home schooling, workers were put back home out of work, unless they were able to telework. Patients needed access for telemed, *et cetera.* So it is a grassroots—in our case we saw grassroots. My directors spoke to me when I first came on board and said, look, we have to solve this problem. People are—tourists are coming to our area, are getting out of their cars, and looking at their phones, and saying, good Lord, I don't have a single bar here. So we knew that there was an issue, and that is—the members demanded the action. We took on what we thought we could handle, in terms of financing, and our members have been ecstatic that we have made that effort.

Mr. LAMALFA. Let us stretch back on—Mr. Johnson, for a moment to the USDA, and the Rural Utilities Service kind of touches on one of my hot points with dealing with agencies. Procedural barriers to working with them, can you elaborate a little more on the barriers, and how we can address them, and if there is still time, Ms. Prather too?

Mr. JOHNSON. Yes. We have seen procedurally barriers—entity barriers in that we need more flexibility on the type of entities that would qualify for financing. Most cooperatives, of course, qualify, but we work with subsidiaries and partners also that may not be the traditional form of a rural utility, or a rural electric cooperative. And I pointed out some of the application issues, that they are quite burdensome, and work on a point system, require a lot of doc-

umentation and data gathering that make those options quite expensive, and somewhat prohibitive for small organizations.

The CHAIRMAN. Thank you very much.

Mr. LAMALFA. Do you have anything to add on what you see as those procedural barriers?

Mr. JOHNSON. On, procedurally, I don't have a lot more to add on that, no. I don't.

Mr. LAMALFA. I am sorry, sorry, I was throwing that to Ms. Prather. Sorry, Mr. Johnson. Thank you.

Ms. PRATHER. I think—nothing to add.

The CHAIRMAN. Just submit your question for the record.

Mr. LAMALFA. Yes, okay. Thank you, Mr. Chairman.

The CHAIRMAN. I have given you a little extra time here, but we want to be fair to everyone. Now I recognize Mr. Johnson of South Dakota for 5 minutes.

Mr. JOHNSON of South Dakota. Thank you much, Mr. Chairman, and this is an issue of great interest to me. Before coming to Congress I was the Vice President of a broadband engineering and consulting firm based out of Mitchell, South Dakota. We did a lot of wireless builds, we did a lot of fiber builds, about 8,000 miles a year of fiber optic cable, serving the most rural communities in the country, so I have listened with interest to what our witnesses have said today.

What is interesting is we talk about $80 or $100 billion in some of these packages to deploy toward broadband. Obviously, at the conceptual level, that is good news. It is welcome news. We want to get America connected. As somebody who has been in the industry, I have a little bit more concern about our ability to actually deploy that in a time- and cost-efficient manner, and so I want the take on some of the—from some of the panelists about that. And just to give my colleagues on the Committee some context, I mean, the first RDOF auction, which really transformed the rural broadband industry, put a tremendous amount of money on the street, more than $9 billion, that really had an impact on people's ability to get a hold of fiber optic cable, get a hold of wireless parts. It really flooded the zone with a tremendous, and, of course, much needed investment. I mean, as we talk about an investment, perhaps ten times that large. Should we keep particular things in mind, panelists, about the timeframe that should be deployed over, and whether or not that is the most efficient, effective way to do it? And I suppose I could probably call you guys in order, or you will be talking all over one another. Ms. Prather, do you want to go first? Go ahead.

Ms. PRATHER. Sure, thank you, Congressman. I think you bring up some very good points, and you are right, the RDOF auction has done a lot of good, but also does cause a lot of concern. You are right in—we need to do everything we can to get the money out the door so it can be put to use. One of the concerns I think we have is that if you want accountability, you have to have some sort of verification. I think we need more verification on the front-end, that what providers are promising to do we think they can actually do, and then we also need that verification on the back-end to ensure that what we have put out there to be done is actually getting done.

Mr. JOHNSON of South Dakota. Do you have any concerns, ma'am, about—I will be honest, I don't believe we could spend $100 billion on broadband in the short-term without a degree of waste, fraud, abuse, and inefficiency that I don't know that Congress has the appetite for. Am I wrong about that?

Ms. PRATHER. No, I completely agree with you. I think not knowing where money is going, and sending so much of it out at once will cause duplication. I also think that a timeline issue is going to be that supply chain, that if we can't get the fiber and the electronics in to do it—or the radio equipment, whatever it is, all of it is in a crunch now, and if we can't get it, we won't be able to deploy it.

Mr. JOHNSON of South Dakota. Yes. Very good. Just going down the witness list, and Mr. Johnson, your thoughts?

Mr. JOHNSON. I agree with much of what Ms. Prather said. There are definitely supply chain issues, with your follow-up question, that could affect everything. But I do know that many of us have pre-ordered. Regarding, like, RDOF, we had already ordered a lot of our—and have our equipment available and ready to go, and that is really why we ask for faster application processes, faster programming review, vetting of bidders, and then let us say, for instance, RDOF, although we were awarded RDOF money, and we knew we won our bids back in November, we still don't have a dollar. So we need those things to move on.

Mr. JOHNSON of South Dakota. Yes. Well said, Mr. Johnson. Ms. Robinson?

Ms. ROBINSON. Thank you for the question. So in terms of how you structure the actual programs from a funding perspective, I think it is important, if you want to talk about being cost-effective, that you use a toolkit approach. And we have seen that done—to your remarks, and based on your own experience in the FCC's work as part of the Rural Digital Opportunity Fund, but also the Connect America Fund II auction, so that is important, using the right tool for the right use case will be critical, because we are talking about finite dollars. We have seen figures thrown out there, but we don't even know if that actually reflects the real scope of the problem, so being laser focused on being cost-effective, in terms of the funding that is going out, and prioritizing speed of deployment will be key.

I would also say, to your second point about concerns about the sheer amount of dollars that are going out, it is important to structure these programs in a way where you are ensuring accountability, and not just on the audit side, but on the application side, which has been raised by other panelists. And so, I think if you are able to kind of bring those two things together, those various factors together, that there is a way to do it, but we do need to be mindful that the dollars are not infinite, they are finite, and so we need to be precise as to meeting the need—prioritizing unserved areas first, in terms of where funding is going.

Mr. JOHNSON of South Dakota. Thank you, Mr. Chairman, for your indulgence, and, Dr. Park, if you have comments to add, please submit them for the panel in writing. Thank you, Mr. Chairman. I yield back.

The CHAIRMAN. Thank you very much, Mr. Johnson. I understand Mr. Cloud is here from Texas. If so, you are recognized.

Mr. CLOUD. Yes, sir, Mr. Chairman. Thank you so much. I appreciate the opportunity to be a part of this hearing. I appreciate this topic, and one that we can find broad bipartisan support on in general. Of course, the Constitution provides for us, as the Federal branch of the legislature, to make investments in infrastructure, so this is critically important to what is going on, especially in these areas where the initial investment is just going to be prohibitive, when it comes to the free market, to make that initial investment. I do think it is important, as it has been talked about quite a bit, that we talk about the discussion of defining what it means to be *rural broadband.*

Too often—we have the ReConnect Program, where 10/1 is still considered broadband. I don't know anyone who would consider that as broadband. Of course, you talk about going 25/3, and it makes a big difference when it comes to grant programs. Here, I will show you. This is basically where I live. The blue is what is considered broadband, according to 25/3, but most people wouldn't consider that broadband. Their experience at 25/3 is that, if you have a student who is doing distance learning, someone running a business from home, and maybe your ag workers trying to upload data, or whatever, that you are going to—or if you have a neighbor who is streaming Netflix, it is going to put a weight on what is going on. And so this is the difference it makes when you consider what most people would consider broadband today.

[The maps referred to are located on p. 129.]

Mr. CLOUD. It is quite a difference, and I think it is also important to note that when we are talking about 25/3 or 100/10, that is really kind of the aspirational benchmark, in a sense. That is what people are getting on a good day, when the bandwidth is there, and often the daily experience is not that, and—as was mentioned, because of the lack of accountability, often, in providing service to meet those. And I know we have indeed had major issues with that with our lone provider of broadband in our community. They have become renowned in our community for poor service, and poor customer service, and very inconsistent technical service.

I am wondering how we can better prioritize the economic sustainability of this, as been mentioned. Of course, coming up with a business model that works—once we make that initial investment, anything we can do to turn this over to the business sector ensures sustainability. If they are able to have a business model that makes it work, that is better. As we all know, we are $28 trillion in debt, our interest spending is about to outpace our military spending, so our discretionary spending is getting smaller and smaller as each day passes. So, first, to make that initial infrastructure investment, but then there has been talk about turning this into a program that would continue to be a burden on the Federal Government. I am not sure if that is going to be sustainable nearly as well as the private-sector would be if they are able to produce some sort of sustainable business model. So I am wondering what ideas that you all have for that. I know there are a number of technologies that have been discussed when it comes to satellite, when it comes to aerial sat balloons, when it comes to, of

course, the gold standard of us having fiber optic cable. But could you speak to the technologies that are available, and what we can do to—and empower a sustainable profit motive in the industry? And maybe we start with Ms. Prather?

Ms. PRATHER. Sure, thank you, Congressman. I think you make a good point, and what we are dealing with here are rural areas that do not have enough density of population, regardless of the technology used to sustain that business case. That is where programs that have proven successes, like the Universal Service Fund, come into play.

Mr. CLOUD. Right.

Ms. PRATHER. That is a self-funded program. And, yes, it does need tweaks, but that helps provide that business case to be there, regardless of technology, to maintain that [inaudible] work over the life of the asset.

Mr. CLOUD. Dr. Park, I believe you spoke to different technologies that are available. Could you enlighten us as to maybe some other options that are coming online? What should be in that mix as we are weighing the landscape?

Dr. PARK. Yes. So we talked about aerostat, but it is one technology out of a lot of interesting and innovative technologies coming in the pipeline, each of which have a different strength and weaknesses, but one that is going to prove out in the marketplace is the one that really is sustainable economically. So I agree that we need to search for the technology that is incentivizing private-sector that allows the most for the rural region residents, as well as the precision ag applications, to be there so that those incentives are aligned to really make this business model possible.

Mr. CLOUD. Thank you very much. I wish I had time to get around to everybody, but, Mr. Chairman, I appreciate the opportunity. Thanks so much for having this hearing. I yield back.

The CHAIRMAN. Thank you. Thank you so very much. What a hearing. Thank you. I think we have reached our all of our Members. Is there anyone else before we adjourn? All right. I can't thank you enough. I have so much to say, but what I want to do is I want my Ranking Member to give his concluding remarks, what a hearing. Ranking Member, I know you agree.

Mr. THOMPSON. I agree, Mr. Chairman. I want to thank you for convening this hearing. It could not have come at a better time. I thought our witnesses were outstanding, and quite frankly, I think our Members were asking insightful questions.

The CHAIRMAN. Yes, they were.

Mr. THOMPSON. And, before I go too much further, I want to thank all of our staff for the preparation, working to help us prepare to have this hearing. They have done a great job. Now, what we heard from our witnesses today is that the need across rural America is great. We also heard about ways we can simplify complex programs to improve access, and participation by those providers and communities who we are desperately trying to reach. Today's panel has left me with a lot of good ideas for improving access to the assistance USDA provides, and I hope we are able to work on those together.

As this debate on an infrastructure package heats up, there is going to be a lot of debate around these halls around what is in

and what is out, which policies will save the world, and which ones will ruin America. Now, just this morning I was reading an article about the "war over how to fix the internet" that talked about the lobbying and the jockeying that is starting to happen here in Washington. Unfortunately, this discussion happening light years—this discussion is happening light years away from the people that we are actually trying to help, the men and women in rural communities across our districts. Truth is, we can't effectively make those choices here. I want us to put the tools in the hands of people like Mr. Johnson, Ms. Prather, Ms. Robinson, and Dr. Park, who are living and working in rural communities, who are shaking hands with the people they serve every day. They are the ones who know best about what their communities need today, tomorrow, and 10 years from now. I think the USDA has the right framework. We built broadband programs during the last farm bill which promote fast, future-proof networks that will stand the test of time, but still recognize that every community has unique geography and diverse needs, and that is why I am pushing so hard for them to be funded. I believe their work will meet the moment.

Mr. Chairman, as I said in my opening, you have been a man true to your work, and I believe you called yourself the Broadband Chairman, and I look forward to working with you as the Broadband Ranking Member on the Committee that perhaps we should rename the Rural Broadband Committee. And I look forward to working with you, and all of our colleagues, in the coming weeks and months to meet these challenges. Thank you, Mr. Chairman, I yield back.

The CHAIRMAN. Thank you, Ranking Member. And, first of all, Ms. Jennifer Prather, Mr. Tim Johnson, Ms. Vickie Robinson, and Dr. Johnny Park, thank you, thank you, thank you, for you all have really opened out eyes to much of what we were only dimly aware of what we must do, but we must do it. And I want to thank my Ranking Member, I want to thank our Republican Members, our Democratic Members, for their attentiveness, for now, over a 4 hour hearing, and you all can see the enthusiasm that our House Agriculture Committee has for this. And we are doing a fantastic and marvelous job thanks to a great, marvelous staff. And, Ranking Member, can you and I, and Members who are left, give our staff a resounding round of applause for bringing these witnesses to us?

Now, let me just say at the outset, folks, we have to move on this. We have 24 million of our people not connected to the internet, which means, in the rural area, we have our farmers not connected to the internet. That has to change. Let me tell you, I was just on a phone call last week with our friends overseas in the European Union, and they are moving ahead. They are looking at how we are lagging behind. And not only that, I have done research. China is moving at a more rapid pace than we are, in terms of internet connection. And let me tell you something, China is after us. There is no mistake about it. China wants to take our place as having the foremost leading agriculture industry in the world. We cannot let that happen. But the key to it, if we do not connect our farmers with access to internet, they are not going to be able to compete. These are not just any 24 million people. They are our

farmers, the heart and soul of our agriculture industry. We will not be able to solve climate change. We will not be—our food insecurity will be heightened. The quality of life in our rural communities will continue to go downward.

Now, we must get together, and this is why I appreciate my Ranking Member, because we know that we have to put together a piece of legislation that addresses everything that we have heard. There is nobody in Congress better suited right now to provide this. With all due respect to our President, to the infrastructure bill, that is wonderful, but that bipartisanship is vital. We have that here, and that is why this is important for us to lay the foundation. We have heard from you on the level of money it is going to take. I think we should put that deadline there to say that we can do this by the end of the year, and put it out there so the American people can see.

I don't know what is going to happen with the President's infrastructure bill, but I do know this. If we do not move ahead right now and put together this plan, bring the money in—we brought the experts in to tell us what to do, and what it is going to cost. We have monies already out there that we can consolidate, I believe. For example, President Trump has put out $6 billion with the FCC. Where is it? We have money going through the various pockets of the appropriation process. All I am saying, folks, is that we have to understand the critical nature that our nation is in with our situation, where our rural communities are not connected to the internet, and we are deciding right here today to be the answer for that. And I want to thank everyone for coming and giving—the questions that our Members asked were so on time, so everybody can see this House Agriculture Committee is totally committed to doing everything we can to make sure that these 24 million people in our rural areas are connected. And my own personal goal is I believe we can do this by the end of this year. It gives us 8 months, but we can do it, believe you me. With that, I will end my remarks with a great thank you, and God bless you, and we are going onward and forward. And I believe I have some things to say to end, is that correct? All right.

Under the Rules of the Committee, the record of today's hearing will remain open for 10 calendar days to receive additional material and supplementary written responses from the witnesses to any questions posed by a Member. This hearing of the Committee on Agriculture is adjourned. Thank you.

[Whereupon, at 2:16 p.m., the Committee was adjourned.]

[Material submitted for inclusion in the record follows:]

SUBMITTED LETTERS BY HON. DAVID SCOTT, A REPRESENTATIVE IN CONGRESS FROM GEORGIA

LETTER 1

ON BEHALF OF STEVEN K. BERRY, PRESIDENT & CHIEF EXECUTIVE OFFICER, COMPETITIVE CARRIERS ASSOCIATION

April 20, 2021

Hon. DAVID SCOTT,
Chairman,
House Committee on Agriculture,
Washington, D.C.;

Hon. GLENN THOMPSON,
Ranking Minority Member,
House Committee on Agriculture,
Washington, D.C.

Dear Chairman Scott and [Ranking Member] Thompson:

Competitive Carriers Association[1] ("CCA") commends the Committee for holding today's hearing on "Rural Broadband: Examining Internet Connectivity Needs and Opportunities in Rural America," and respectfully requests that this letter be included in the hearing record. As Congress considers a generational investment in our nation's infrastructure, CCA commends policymakers for including access to broadband as a top priority. CCA strongly urges Members to recognize that the digital divide cannot be closed by fixed broadband services alone, and to support ubiquitous access to mobile broadband services.

Mobile networks and technologies support scores of everyday uses by Americans today, with access becoming even more essential in the future. As technology continues to advance, we are on the cusp of innovations only imagined by previous generations. Mobile wireless connectivity will be the technology that brings those innovations to life. American agriculture, like so many industries, has been revolutionized by technology and the growth of the Internet of Things (IoT), which can only be supported by advanced mobile wireless networks. Precision agriculture is creating opportunities for farmers once unthinkable only a generation ago. Every stage of the American food chain, from cultivation to consumer, will be enhanced by IoTs. Smart farming, supported by widespread mobile wireless connectivity, has the potential to change nearly every facet of farm life, boosting yields, reducing costs and waste, and adding billions in value: from planting and seeding, irrigation observation and management, pest maintenance, and offer live-streamed crop fields viewing, real-time data analysis, and remote livestock health monitoring.

Wireless-connected farm equipment is more precise in its abilities, using mobile broadband connections to yield more accurate work product in fields, structures, and pasturelands, providing the ability for farmers to intervene remotely and immediately as they manage their operations. It offers technological solutions to critical seasonal labor shortages, allowing farmers more freedom and flexibility to maximize their time and resources. Connected tractors and other farm machinery can be remotely serviced by technicians trouble-shooting from afar, rather than requiring in-person visits, saving time and even identifying maintenance issues before they become disruptive problems. Drones utilize mobile connections to monitor crops, irrigate and spray fields, paddies, and orchards. Mobile telehealth is not just a service for humans—the vital signs of herds and flocks can be remotely monitored across ranchlands, in milking parlors, grazing fields, or coops, offering real-time health and well-being statistical data to farmers. Narrow-Band IoT (NB-IoT) sensors are being used to provide more detailed weather forecasts, with data from the sensors compiled into "hyper-local" weather forecasts giving farmers greater certainty while conducting their operations and the ability to tailor their crop management, labor, and supply chain more acutely. Autonomous vehicles such as self-driving cars and trucks, will one day transport commodities off the farm and on to processing and storage centers, grocery stores and restaurants, relying on a seamless mobile wireless connection to more safely and efficiently traverse from rural America and onto urban and suburban centers, with tracking devices making sure products reach markets with demand in peak condition. Farming in America is quickly becoming as high-tech as any manufacturing assembly line or distribution center, yet too

[1] CCA is the nation's leading trade association for competitive wireless providers and stakeholders across the United States, and our members range from small, rural carriers serving fewer than 5,000 customers to regional and nationwide providers serving millions of customers, as well as vendors and suppliers that provide products and services throughout the wireless communications ecosystem.

often, America's farmers are lacking the key element of this technological revolution: mobile broadband connectivity.

Specifically, a lack of *mobile* broadband connectivity will hinder the agricultural IoT revolution from being realized. The machines, tools and devices being created for the future of farming, from the massive to the handheld, are not intended to be static in nature. They cannot run solely on a fixed connection, at any speed; rather they will operate on the advanced mobile technologies being deployed by wireless carriers. Even now, mechanized farm equipment is being adapted to operate on mobile 4G LTE networks which can support many IoT applications and will be the technological bridge to 5G.

Failing to invest in the technology needed to advance rural America's agriculture operations just as we are on the cusp of a technological revolution threatens to negate much of the investment the Federal Government and private companies have conducted and committed to in rural America. Policies that do not advance wireless deployment in rural America curtail the future, because the future of products and services across every aspect of American's lives will depend on robust and ubiquitous wireless connections. Advanced wireless services that connect the IoT will enhance education, medicine, finance, entertainment, travel, manufacturing, homes, businesses, and especially, agriculture. Mobile wireless is the only service with the potential to connect all Americans with these innovations and can have the benefit of providing immediate connectivity in areas lacking service until other technologies are deployed.

Further, consumers are demonstrating that given the opportunity to embrace these new technologies brought on by advanced wireless services, they will do so. A Nokia market survey of thousands of IT decision makers across the United States and the United Kingdom revealed 77% percent of respondents find the idea of connected machinery appealing and 5G mobile wireless is the preferred connectivity by consumers for these technologies. **Mobility will continue to be a catalyst driving economic growth in rural America, and any infrastructure efforts that do not ensure ubiquitous mobile broadband could create a new digital divide of technological denial for consumers as the latest innovations that rely on mobile broadband will not function in rural America without connectivity.**

The goal of connecting all Americans with broadband is commendable and is rightly a bipartisan priority as Congress considers infrastructure policies. To meet the moment of this extraordinary opportunity to spur broadband development and provide all Americans with services needed to compete for the next generation, Congress should support mobile connectivity in addition to fixed services.

CCA appreciates the opportunity to submit our views and looks forward to working with you and the entire Committee on these important issues.

Sincerely,

STEVEN K. BERRY,
President & CEO,
Competitive Carriers Association.

LETTER 2

ON BEHALF OF JONATHAN SPALTER, PRESIDENT AND CHIEF EXECUTIVE OFFICER, USTELECOM | THE BROADBAND ASSOCIATION

April 20, 2021

Hon. DAVID SCOTT,
Chairman,
House Committee on Agriculture,
Washington, D.C.;

Hon. GLENN THOMPSON,
Ranking Minority Member,
House Committee on Agriculture
Washington, D.C.

Dear Chairman Scott and Ranking Member Thompson:

Thank you for holding today's hearing focused on rural broadband and expanding connectivity in rural America.

USTelecom proudly represents broadband providers, suppliers and technology innovators in every corner of the country. Our broadband networks have been resil-

ient and fully capable of carrying the surge in high bandwidth traffic during the last year, but this means little to the millions who lack broadband access or simply cannot afford service in the first place. We all must recognize the digital divide is not solely an issue of access, but of affordability and adoption as well.

Like you, we believe there is still much work ahead to achieve our shared goal of universal and affordable connectivity for all in America. Even as the cost of broadband in the United States is decreasing—too many still remain without broadband connectivity. That is why we applaud the initial emergency broadband program that Congress has passed—and urge you to pursue even bolder and bigger steps to provide support on a long-term basis after the pandemic passes.

It is critical to engage across all sectors—public, private, and nonprofit—to ensure support to help all unserved communities get and stay connected. We can start with the estimated 17 million school-age children who have no broadband connection at home.

USTelecom and our members are staunch advocates for the critical direct spending on broadband infrastructure, as well as the important Federal investments in broadband over the past few months that can help achieve our shared goal of universal connectivity. This will only happen if funding is spent with precision and coordination among all Federal and state government agencies.

As Congress considers additional resources in high cost and otherwise unserved parts of our country, we respectfully believe more can be done to avoid waste and prevent overbuilding existing support programs so that every new dollar reaches truly unserved communities in rural America as efficiently and quickly as possible.

Three areas where we encourage the Committee to continue to focus include:

Updated and Data Driven, 21st Century Broadband Maps

Thanks to the Broadband DATA Act, updating and modernizing our nation's broadband coverage maps is currently underway and incremental results should be available from the FCC later this year. We know many of the Americans that lack broadband do not appear on any map today, simply because their neighbor has service available. This updated map must guide the distribution of all of the historic and essential funding Congress has approved to reach the unconnected—including those carried out by the states. Duplicative mapping efforts are counterproductive and costly.

Stringent Interagency Coordination

The Department of Agriculture, the Department of Commerce and the Federal Communications Commission, along with various stimulus grants over the years, have prioritized serving the highest number of eligible locations possible through their broadband programs. While this goal seems like a good one, the reality is it often results in funding the same locations over and over again while leaving remaining unconnected locations without connectivity.

To "avoid" overbuilding, each program continually changes the definition of unserved, based on an ever increasing minimum speed requirement. By doing so, new programs can essentially overbuild the same locations covered by previous programs by simply upgrading speeds to the locations that are less expensive and easier to serve. The fast connections get faster while the unconnected stay unconnected.

Truly closing the digital divide means first connecting the unconnected. To accomplish this goal, we must ensure that all government broadband programs, both Federal and state, are using the same sets of data and uniform minimum speed requirements when identifying unconnected locations. Explicit and binding interagency coordination is critical in this regard, as is ensuring the efficient allocation of funds by avoiding funding duplication.

Public-Private Partnerships

We hope the Committee will focus on what we know is the most efficient and proven way to allocate our finite resources and produce connectivity results: public-private partnerships to connect communities, particularly in rural parts of our country. Recent policy proposals are pushing a bigger role for government, municipalities and certain nonprofit cooperative organizations in solely running the country's networks—even beyond areas where there are recognized access gaps.

Putting government's thumb on the scale in favor of government-run networks is the wrong approach to universal connectivity. Broadband deployment is hard and expensive work, and the cost of maintaining and upgrading state-of-the-art communications networks to meet modern performance demands can strain taxpayer funds. The surest way for government to help finish the connectivity job is by deepening its partnership with private broadband innovators to serve communities (already happening everyday all over the country, by the way) while lowering the barriers to deployment that saddle projects with red tape and wasteful delays.

Broadband plays an essential role in any plan to lift our families, neighbors, and enterprises up and move our nation forward. USTelecom members are committed to continuing to work side-by-side with you, and with partners throughout government to build and invest in these networks, and bring high-speed broadband deeper into all corners of America. We look forward to working with you and the Committee to ensure all in America are connected to the power and potential we know our world-class communications infrastructure delivers.

Sincerely,

JONATHAN SPALTER.

JOINT SUBMITTED LETTER BY HON. DAVID SCOTT, A REPRESENTATIVE IN CONGRESS FROM GEORGIA; HON. GLENN THOMPSON, A REPRESENTATIVE IN CONGRESS FROM PENNSYLVANIA; ON BEHALF OF JAMES D. OGSBURY, EXECUTIVE DIRECTOR, WESTERN GOVERNORS' ASSOCIATION

April 21, 2021

Hon. DAVID SCOTT,
Chairman,
House Committee on Agriculture,
Washington, D.C.;

Hon. GLENN THOMPSON,
Ranking Minority Member,
House Committee on Agriculture,
Washington, D.C.

Dear Chair Scott and Ranking Member Thompson:

In light of the Committee's April 20, 2021 hearing on internet connectivity needs and opportunities in rural America, attached please find Western Governors' Association (WGA) Policy Resolution 2020–08, *Broadband Connectivity.*

In the policy resolution, Western Governors highlight the importance of high-speed internet for rural communities and discuss infrastructure challenges that complicate broadband deployment in the West. To address these issues, the Governors recommend improvements in broadband data and mapping and investments in scalable infrastructure.

I request that you include this document in the permanent record of the hearing, as it articulates Western Governors' policy positions and recommendations on this important issue.

Thank you for your consideration of this request. Please contact me if you have any questions or require further information. In the meantime, with warm regards and best wishes, I am

Respectfully,

JAMES D. OGSBURY,
Executive Director.

ATTACHMENT

Policy Resolution 2020–08

Broadband Connectivity

A. Background

1. High-speed internet, commonly referred to as "broadband,"[1] is the critical infrastructure of the 21st century and a modern-day necessity for businesses, individuals, schools and government. Many rural western communities lack the business case for private broadband investment due to the high cost of infrastructure and the low number of customers in potential service areas. This has left many rural businesses and citizens at a competitive disadvantage compared to those urban and suburban areas with robust broadband access.

[1] The Federal Communications Commission defines fixed "broadband" as service offering minimum speeds of 25 Megabits per second (Mbps) down and 3 Mbps up.

2. Broadband connectivity promotes economic prosperity and diversity. Broadband connectivity is a key element of innovations in precision agriculture, telehealth, remote work and distance learning across the West.
3. Many broadband applications that promote rural, economic and community prosperity rely on speeds greater than 25/3 Mbps. This is especially true for functions that upload large amounts of data, such as telehealth, e-learning and business applications.
4. Western states have unique factors that make planning, siting and maintaining broadband infrastructure especially challenging and costly. These include vast distances between communities, challenging terrain, sparse middle mile and long-haul fiber-optic cable, and the need to permit and site infrastructure across Federal, state, Tribal and private lands. Alaska, Hawaii, and the U.S. territories face particular broadband deployment challenges due to factors involving distance, cost and applicable technologies.
5. Western Governors and states are taking significant action to accelerate broadband deployment in rural communities. These actions include direct investment of state funds, reduction of regulatory hurdles, and promotion of public-private partnerships to deliver digital connectivity to unserved and underserved areas.
6. Many western states have sought to expedite broadband infrastructure deployment by adopting "Dig Once" policies, granting non-exclusive and non-discriminatory access to rights-of-way and facilitating efficient "co-location" of new broadband infrastructure on existing structures.
7. A number of Federal agencies directly support rural broadband deployment projects and data collection in western states. These include the Federal Communications Commission (FCC), U.S. Department of Agriculture (USDA), National Telecommunications and Information Administration (NTIA) and Economic Development Administration.
8. Federal land management agencies, particularly the U.S. Forest Service (USFS), Bureau of Land Management (BLM) and Bureau of Indian Affairs (BIA), play a crucial role in permitting and siting broadband infrastructure in western states.
9. Both the Department of the Interior (DOI) and USFS recently launched online mapping platforms identifying telecommunications infrastructure sites on Federal lands. This information can be used to inform private and public broadband infrastructure investments.
10. High-quality data is necessary to ensure that public broadband deployment efforts are cost-effective and prioritize areas that either wholly or significantly lack access. Under its current Form 477 reporting protocols, the FCC considers a census block "served" if a single residence in the block has access to broadband. This practice overstates broadband availability in larger, rural census blocks common in western states. The FCC's use of "maximum advertised," not "actual," speeds when mapping broadband coverage further distorts reporting on the service customers receive.
11. Whether or not an area is considered "served" has significant effects on its eligibility for Federal broadband infrastructure support. Inaccurate or overstated data prevents businesses, local governments, and other entities from applying for and securing Federal funds to assist underserved or unserved communities.
12. S. 1822, the Broadband Deployment Accuracy and Technological Availability (DATA) Act (Pub. L. 116–130), was enacted in March 2020. This law requires the FCC to change the way broadband data is collected, verified, and reported. Specifically, the FCC must collect and disseminate granular broadband service availability data from wired, fixed-wireless, satellite, and mobile broadband providers. The FCC is required to establish the Broadband Serviceable Location Fabric, a dataset of geocoded information for all broadband service locations, atop which broadband maps are overlaid, to report broadband service availability data.
13. Given the number of Federal agencies and programs involved in supporting rural broadband deployment, it can be challenging for small, rural providers and communities to identify and pursue appropriate deployment opportunities. Businesses, local governments, electric and telephone cooperatives, Tribes and other rural entities can also face burdens in applying for and managing Federal funds. These barriers include areas being incorrectly identified

as "served" on broadband coverage maps, excessive application and reporting procedures, and significant match or cash-on-hand requirements.

14. Wireless spectrum is a valuable resource that can help support innovative and cost-effective connectivity solutions in western states.
15. Internet Exchange Points (IXPs) are vital elements of Internet infrastructure that enable networks to exchange traffic with each other. IXPs help promote low-cost data transmission and improved overall local Internet performance in the areas in which they are located.
16. Electric and telephone cooperatives have invested in broadband infrastructure across the West. In certain states, these cooperatives are the entities principally providing broadband to rural communities, often at relatively low costs to their members.
17. The FCC's 2020 Broadband Deployment Report estimates that 27.7 percent of Americans residing in Tribal lands lack fixed terrestrial broadband coverage, compared to 22.3 percent of Americans in rural areas and 1.5 percent in urban areas. A 2018 Government Accountability Office (GAO) Report[2] asserts that the FCC overstates broadband coverage on Tribal lands.
18. Tribal Nations, the majority of which are in western states, face many barriers to the deployment of communications services. These include rural, remote and rugged terrain; areas that are not connected to a road system; minimal access to middle mile and long-haul fiber-optic cable; and difficulty in obtaining rights-of-way to deploy infrastructure across some Tribal lands. These factors can all increase the cost of installing, maintaining, and upgrading infrastructure.
19. Tribal Nations also face challenges securing funds through Federal broadband deployment programs. A separate 2018 GAO Report[3] included a review of four Federal broadband programs (three FCC, one USDA), and found that from 2010 to 2017, less than one percent of funding has gone directly to Tribes or Tribally owned providers.
20. Access to wireless spectrum is another crucial issue for Tribal Nations. In February 2020, the FCC opened a priority filing window for rural Tribes to access 2.5 GHz spectrum in advance of an upcoming spectrum auction. This spectrum is well-suited to provide low-cost broadband service in rural areas.
21. Federal programs often direct broadband infrastructure funding to community anchor institutions such as schools, libraries and health centers. These anchor institutions can help leverage additional public and private investments in surrounding rural areas. Holistic funding approaches that support infrastructure deployment "to and through" community anchor institutions can help promote connectivity for students, patients and community members.
22. Western Governors appreciate USDA Rural Development's efforts to promote broadband connectivity across the rural West. USDA's many offerings, including the ReConnect Program, Community Connect Grants, and Distance Learning and Telemedicine Grants, all help promote prosperity and quality of life in western states.
23. Western Governors have provided significant feedback on the design of the ReConnect program, launched in December 2018. Notably, Western Governors recommended that the ReConnect Program, "prioritize communities that either wholly or severely lack access to broadband," and, "reward project applications that will deliver speeds that ensure rural communities can prosper now and into the future as their data transmission needs expand."
24. The ReConnect Program contains a requirement that areas designated to receive support through the FCC's Connect America Fund Phase II (CAF–II) can only pursue ReConnect funding through the entity that is receiving CAF–II support. This restriction limits deployment of adequate broadband capability in many rural areas.
25. The COVID–19 pandemic has amplified the importance of reliable broadband connectivity as businesses, schools and health care systems have transitioned to digital platforms and practices. The transition to digital learning has been particularly difficult for many rural and low-income communities and K–12 schools due to lack of broadband connectivity at home. Western states have

[2] Government Accountability Office: *FCC's Data Overstate Access on Tribal Lands.* September 2018.

[3] Government Accountability Office: *Few Partnerships Exist and the Rural Utilities Service Needs to Identify and Address Any Funding Barriers Tribes Face.* September 2018.

employed creative strategies to address student connectivity and "homework gap" issues within our communities. These efforts include using parking lots and school and transit buses to launch public [WiFi] hotspots.

B. Governors' Policy Statement

1. Western Governors encourage Congress and Federal agencies to recognize that the current definition of broadband—25/3 Mbps—does not correspond with the requisite download and upload speeds necessary to support many business, education and health care applications that promote economic and community prosperity. We support efforts to adopt a higher, scalable standard that more accurately reflects modern innovations and bandwidth demands.
2. Regulations affecting broadband infrastructure permitting and siting vary by state and can create additional obstacles to private and public investment. Where possible, Western Governors should work together to minimize this barrier.
3. Western Governors recommend the FCC, USDA and other Federal agencies involved in broadband deployment pursue strong partnerships with Governors and state agencies. Improved coordination related to broadband coverage data collection and verification and public investment can help ensure that public funds are directed to areas in most need of assistance.
4. Western Governors encourage the BLM, BIA and USFS to pursue strategies to prioritize reviews for broadband infrastructure permits on Federal lands. We support efforts to improve permitting timelines for broadband infrastructure co-located with existing structures and other linear infrastructure, such as roads, transmission lines and pipelines. We encourage improved planning and permitting coordination between public lands management agencies, as telecommunications projects in western states can cross multiple Federal lands jurisdictions. DOI and USFS's online mapping platforms identifying telecommunications infrastructure sites on their lands will be helpful tools to accomplish this goal.
5. Western Governors are encouraged that new data and mapping platforms established by the Broadband DATA Act (Pub. L. 116–130) incorporate state-level data wherever possible. State broadband offices and representatives can offer invaluable information and on-the-ground perspectives regarding broadband coverage in western states. We encourage Congress to provide the FCC with the necessary funds to implement the Act.
6. Western Governors encourage Congress and Federal agencies to address application barriers for businesses, local governments, cooperatives, Tribes and other entities involved with broadband deployment in rural communities.
7. Western Governors appreciate the USDA and the FCC's efforts to promote on-farm connectivity and the growth of the precision agriculture sector. We encourage both agencies to engage with Governors' offices, state broadband representatives and state departments of agriculture as they pursue policy and program initiatives to support advanced agriculture technology development and adoption.
8. Western Governors recommend that adequate wireless spectrum be allocated to support advanced and emerging agricultural technologies.
9. Western Governors emphasize the growing importance of IXPs in promoting cost-effective, reliable broadband service in rural areas. We encourage Congress and Federal agencies to promote investment in rural IXPs via applicable broadband deployment programs, legislative proposals addressing infrastructure, and other methods.
10. Western Governors encourage Federal agencies to continue expanding the eligibility of electric and telephone cooperatives to pursue USDA and FCC broadband deployment program support, as cooperatives' existing infrastructure and access to rights-of-way can help promote low-cost connectivity solutions for rural communities.
11. Western Governors urge Federal agencies and Congress to pursue policy, programmatic and fiscal opportunities to improve broadband connectivity on Tribal lands. This includes designing Federal programs in a way that promotes partnerships between Tribes, states and various broadband providers. We recommend that Federal broadband programs allocate a designated portion of their available funding to supporting projects on Tribal lands.
12. Western Governors encourage Congress and Federal agencies to leverage community anchor institutions in rural communities to spur connectivity to sur-

rounding areas. We support efforts to advance "to and through" policies that provide flexibility to incentivize additional private or public broadband infrastructure investment beyond connected community anchor institutions.

13. Western Governors encourage USDA to address the ReConnect Program eligibility criteria related to areas designated to receive satellite support through the FCC's CAF–II auction. This will enable many communities to pursue ReConnect connectivity solutions that will support increased data transmission needs into the future.
14. Western Governors request that FCC, USDA and other Federal entities prioritize scalable broadband infrastructure investments that meet communities' increased bandwidth demands into the future. Funds for equipment maintenance and upgrades are essential to ensure Federal broadband investments continue to provide high-quality service.
15. Western Governors request that Congress and the FCC leverage states' on-the-ground expertise by providing substantial block grant funds to address rural connectivity challenges. We support the use of state block grant funds to address general broadband infrastructure issues and respond to connectivity challenges raised by the COVID–19 pandemic.
16. Western Governors support efforts to promote flexibility within the FCC's E-Rate Program in order to deliver home connectivity solutions for unserved and underserved students, and respond to connectivity issues associated with the COVID–19 pandemic. We encourage the FCC to support bus [WiFi] and other creative efforts that seek to address the homework gap.

C. Governors' Management Directive

1. The Governors direct WGA staff to work with Congressional committees of jurisdiction, the Executive Branch, and other entities, where appropriate, to achieve the objectives of this resolution.
2. Furthermore, the Governors direct WGA staff to consult with the Staff Advisory Council regarding its efforts to realize the objectives of this resolution and to keep the Governors apprised of its progress in this regard.

Western Governors enact new policy resolutions and amend existing resolutions on a bi-annual basis. Please consult *www.westgov.org/resolutions* for the most current copy of a resolution and a list of all current WGA policy resolutions.

SUBMITTED STATEMENT BY HON. JIM COSTA, A REPRESENTATIVE IN CONGRESS FROM CALIFORNIA; ON BEHALF OF HON. JONATHAN S. ADELSTEIN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, WIRELESS INFRASTRUCTURE ASSOCIATION

The Wireless Infrastructure Association (WIA) is the principal organization representing the companies that build, develop, own, and operate wireless facilities in the U.S. and throughout the world. Our members include infrastructure providers, wireless carriers, equipment manufacturers, and professional services firms. WIA is focused on ensuring that the infrastructure is in place to make 5G a reality. Our mission is to enable wireless broadband access everywhere. The wireless industry is committed to making 5G wireless broadband available to more Americans than ever before and appreciates the support of Congress to expedite deployment, especially given the unprecedented COVID–19 crisis.

The United States has led the world in mobile wireless communications, having won the race to 4G. This victory was made possible by a strong, unified commitment between industry and government to deliver greater connectivity across the country and spur American technological innovation. Now, it will again take continued, dedicated efforts by both the wireless industry and the Federal Government for the U.S. to ensure that all communities are able to reap the benefits of robust wireless services. Congress and the FCC have already taken great strides to promote the deployment of mobile broadband, but additional help is needed.

I commend this Committee for its focus on rural connectivity. Rural access continues to be a challenge, and I know this all too well having previously served as the Administrator of the U.S. Department of Agriculture's Rural Utilities Service. During my tenure, we made historic investments for deploying broadband in rural America, but much work remains. Increased investments, developing accurate coverage maps, and reducing regulatory costs will all help to bring better broadband to more communities.

This Committee has an extraordinary opportunity to ensure connectivity to all communities. As Congress drafts an infrastructure bill, it should ensure that funds

can be used for operational expenses, such as leases, as well as capital expenses; infrastructure can be deployed expeditiously; and recipients are held accountable for outcomes. It should be truly technology neutral with the end in mind: building infrastructure with the most cost-efficient means to get the most bandwidth to the most consumers.

Most critically, it needs to include mobile 5G broadband, or Congress could inadvertently grow a rural mobility digital divide in which many rural residents would be limited to accessing the internet through a wired connection in the home or farmhouse. This situation would lead to many of the same problems we are seeing in rural communities today. All broadband technologies, including wireless, are needed to ensure that rural communities have robust connectivity. Defining broadband as a connection offering symmetric, 100 Mbps download and 100 Mbps upload bandwidth (100/100) is not technology neutral as it excludes 5G mobile service from being delivered to rural consumers. With currently technology, only fiber to the premise supports that 100 Mbps uploads speeds, which few consumers ever use or need given current applications. But it does preclude mobility, which nearly every rural consumer wants and needs, given the long distances they must traverse.

Robust wireless connectivity enables one of the most important and innovative applications: precision agriculture. By increasing the use of precision agriculture, the U.S. can, among other things, improve food security, meet the growing demand for food, reduce the environmental impact of agricultural practices, reduce food waste, improve the profitability of U.S. agriculture, increase skilled labor demand to support the farm, and increase U.S. competitiveness internationally. Not incidentally, precision agriculture technologies and the data they generate are also the key to farmers' participation in carbon markets, an important objective of this Committee.

WIA member John Deere has been delivering leading-edge technologies to agricultural producers since its inception and continues to do so today. John Deere says that its innovations and technologies have been shown to improve agricultural productivity by as much as 15 percent.

Clearly, precision agriculture is critical to the future of agriculture operations. The key point this Committee needs to consider is that to enable precision agriculture, it is essential that mobile wireless broadband coverage is extended to all areas of the U.S., including the most rural and remote portions of the country. It is imperative to have reliable connectivity across operations on farmlands and ranches. The 100/100 standard would preclude broadband infrastructure legislation from enabling precision agriculture directly because it would only provide fiber to the farmhouse and not the fields.

In June 2019, the FCC created a task forced to provide recommendations on policies aimed at delivering connectivity so American agriculture producers can use and benefit from precision agriculture. The Connectivity Working Group within the task force has made several very important preliminary recommendations thus far. One recommendation is for the FCC to include up to $500 million in incentives and subsidies from the $9 billion allocated for the 5G Fund for Rural America. These incentives and subsidies would be used for the creation of edge computing, private 5G systems, and precision agriculture applications so that the critical infrastructure and tools needed to deploy precision agriculture can be developed and deployed. In addition, the task force recommended that the FCC provide incentives to network service providers for high-speed, low latency, and mobile coverage of agricultural fields and pasturelands as a provision within the 5G Fund for Rural America. The Working Group made many other important preliminary recommendations, and I urge all Committee Members to read the full report.*

Thank you again for your focus on these important issues. There is undoubtedly more work ahead, and we look forward to working with this Committee to advance the connectivity that has become so essential in all our lives.

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* **Editor's note:** the March 12, 2021 Federal Communications Commission Precision Agriculture Task Force report entitled, *Accelerating Broadband Deployment on Unserved Agricultural Lands Working Group Interim Report,* is retained in Committee file; and is also available at: *https://www.fcc.gov/sites/default/files/precision-ag-accelerating-deployment-wg-interim-report-03122021.pdf.*

SUBMITTED FACT SHEET BY HON. ANGIE CRAIG, A REPRESENTATIVE IN CONGRESS FROM MINNESOTA

updated 03.23.21

AMERICAN CONNECTION PROJECT

ABOUT US

American Connection Project Broadband Coalition

The American Connection Project Broadband Coalition represents more than 140 companies and organizations who are working together to bring high-speed internet access to all Americans. The coalition understands that digital connectivity is not a luxury, but rather is a lifeline for education, health, modern food production and economic growth. Drawing from their cross-sector expertise and experience in rural communities, the members are making private investments to bridge the digital divide while advocating at the state and federal levels for permanent solutions. More information can be found at **americanconnectionproject.com**.

WHO WE ARE

Our Members

This coalition convenes an incredibly diverse group of stakeholders. The group represents companies and organizations from many sectors and geographies across the United States and beyond—including agriculture, health care and technology as well as education and energy. The coalition is continually adding members who share a desire to connect the country.

Together, we are advocating to bring high-speed internet infrastructure to areas that do not have service today. In addition to advocating for policies, members are contributing their own resources to facilitate remote education, health and mental health services, job opportunities and more, with the goal of connecting and lifting up all American communities through access to modern digital technology.

We believe broadband connectivity is an enabler to help solve critical issues facing our country, such as climate change, better education access for students and families, and jobs and economic opportunities in rural communities.

For more information, please contact
Michael Daniels at **mdaniels@landolakes.com** or Matthew Wohlman at **mwohlman@landolakes.com**

WHAT WE DO

Coalition Priorities

1

Increased funding

Federal funding of at least $80 billion is needed to fill the gap in poor infrastructure, an investment supported by both FCC and USDA reports.

2

Better mapping

More accurate and granular reporting of broadband coverage data is necessary to highlight service gaps and efficiently deploy scarce government resources to the areas that need it most. The Broadband DATA Act is a great start to address this problem, and Congress and the federal agencies should swiftly implement this law.

3

Coordination

Stronger government coordination must occur at the federal level, as well as with states and localities, to effectively deploy these limited resources. We support efforts to provide leadership and coordination across the executive branch in the federal government, to position our country as a technology leader, ensure our economic competitiveness and maintain strong national security.

4

Expanding telehealth access

We support the continued expansion of telehealth access, with an emphasis on quality and equity, so that patients can continue to receive the right care at the right time in the right setting.

For more information, please contact
Michael Daniels at **mdaniels@landolakes.com** or Matthew Wohlman at **mwohlman@landolakes.com**

WHAT WE'VE DONE

Accomplishments

April 15, 2020 | A letter from the original five members of the coalition to all 50 of the nation's governors in mid-April

April 2020 | Land O'Lakes, Inc. and many of its rurally located retail-owners begin to offer free and open Wi-Fi access to local citizens outside more than 140 of their company locations, manufacturing facilities, along with other businesses in 19 states

June 16, 2020 | A telehealth letter to the Senate Health, Education, Labor, and Pensions Committee leadership

June 25, 2020 | A letter that we helped coordinate with 11 of the nation's governors to the president and congressional leadership

July 8, 2020 | In conjunction with our July launch, submitted a letter from the coalition to the president and congressional leadership

October 20, 2020 | American Connection Project organizations launch an interactive tool for users to locate new, free public Wi-Fi now available at more than 2,800 locations in 49 states

January 28, 2021 | A letter to President Biden and congressional leadership calling for immediate action to enact groundbreaking broadband connectivity legislation and to continue the advances we have made in telehealth

For more information, please contact
Michael Daniels at **mdaniels@landolakes.com** or Matthew Wohlman at **mwohlman@landolakes.com**

SUBMITTED COMMENT LETTER BY HON. RANDY FEENSTRA A REPRESENTATIVE IN CONGRESS FROM IOWA; AUTHORED BY MICHAEL R. ROMANO, SENIOR VICE PRESIDENT—INDUSTRY AFFAIRS & BUSINESS DEVELOPMENT, NTCA—THE RURAL BROADBAND ASSOCIATION

February 1, 2021

MARLENE H. DORTCH,
Secretary,
Federal Communications Commission,
Washington, D.C.

RE: *Rural Digital Opportunity Fund,* WC Docket No. 19–126; *Connect America Fund,* WC Docket No. 10–90; *Auction 904,* AU Docket No. 20–34

Dear Ms. Dortch:

NTCA—The Rural Broadband Association ("NTCA") hereby submits the attached whitepaper, "*Evaluating the Capabilities of Fixed Wireless Technology to Deliver Gigabit Performance in Rural Markets,*" to aid the Federal Communications Commission (the "Commission") in its review of long-form applications in the Rural Digital Opportunity Fund ("RDOF").

Consumers in areas to be served by winners of the RDOF auction have waited too long for the opportunity to receive high-performance broadband service. As they sit on the cusp of finally realizing the benefits of better broadband, it is important that the Commission take careful steps now to ensure this happens. As one example, prior to the RDOF auction, the Commission acknowledged in particular that those proposing to offer Gigabit-level performance in rural areas using fixed wireless or DSL technologies faced a "high burden" to demonstrate they could do so. Even as the Commission may have allowed certain parties to bid in the auction at such levels using these technologies based upon a preliminary review, the Commission rightly noted that "distance limitations, spectrum bands attributes, channel bandwidths requirements, backhaul and medium haul requirements, tower siting requirements, capacity constraints, required upstream speeds, required minimum monthly usage allowances, and other issues raised in the record" required evaluation to confirm a provider's capability to offer broadband at the Gigabit level in rural areas like those in the RDOF auction.[1] Since the auction, parties ranging from Members of Congress to reputable and experienced wireless internet service providers have called upon the Commission to undertake a careful review of such proposals and to ensure that winning bidders promising such levels of performance can in fact deliver to rural consumers what has been promised.[2]

As the Commission moves now to examine winning bidders' capabilities to perform through the long-form application process, the attached whitepaper is presented as a roadmap to help the agency in articulating and then employing technical standards to assess the very kinds of factors noted above in discrete service areas. This kind of disciplined due diligence by reference to sound engineering principles and transparently stated objective standards will be essential to ensure that projects moving forward are capable of performing as promised for the benefit of those consumers waiting for better broadband.

Specifically, the attached whitepaper sets forth a series of parameters for reference in evaluating the proposals of winning bidders to use fixed wireless technologies for delivery of Gigabit-level services in RDOF markets. Of particular note, as the paper describes and justifies in further detail:

- **Mid Band Offerings:** Although mid band spectrum holds promise for better rural broadband generally, there is no viable path currently to use such spectrum for the offering of Gigabit-level service specifically in rural markets and for meeting other RDOF performance requirements (such as the offering of voice telephony and access to 911) in light of: (a) the limited amount of capacity available in most of these bands; and/or (b) the potential for interference from devices such as home WiFi routers because most of this spectrum is unlicensed or subject to shared use. Any long-form applications proposing to rely upon mid band spectrum specifically for delivery of Gigabit-level service in the context of RDOF should therefore be rejected.
- **High Band Offerings:** In more densely populated areas, some high band spectrum (*e.g.,* millimeter wave (mmW) deployments have been reported as being capable of delivering Gigabit-level service. These deployments, however, do not easily translate to rural environments such as those at issue in the RDOF auction for the reasons the Commission itself has previously noted. To determine whether a given long-form application proposal based upon use of such mmW spectrum can indeed deliver Gigabit speeds, the following factors must therefore be carefully evaluated and verified in light of specific conditions in the area to be served:
    - Each and every location must be within approximately 500 feet of its specific serving tower/antenna.

[1] *Rural Digital Opportunity Fund Auction Scheduled for October 29, 2020 Notice and Filing Requirements and Other Procedures for Auction 904,* AU Docket No. 20–34, WC Docket Nos. 19–126 and 10–90, 35 FCC Rcd 6077, 6115–16 (2020), at ¶106.

[2] *See, e.g.,* Letter from Reps. James E. Clyburn and Tim Walberg, Sens. John Thune and Amy Klobuchar, and 156 other Members of Congress to Chairman Ajit Pai (dated Jan. 19, 2021); *Ex Parte* Letter from Skyler Ditchfield, Chief Executive Officer, to Chairman Ajit Pai, *et al.,* WC Docket No. 19–126 (dated Jan. 14, 2021), at 1–3.

- Each and every location must have a clear and unobstructed line-of-sight to that serving tower/antenna, and the transceiver must be mounted outside (rather than indoors) at each customer premises.
- The capacity of the serving tower/antenna or sector must be adequate to accommodate the downstream and upstream capacities of all users served by that tower or antenna.
  - In assessing capacity in that area, it will be essential to measure the ability to perform in light of the RDOF requirement that a provider engineer its network to serve at least 70% of locations as if subscribed by the final milestone.
  - A reasonable oversubscription ratio on the order of 4:1 or less should be applied, consistent with how many wireless internet service providers and others architect their networks today.
- Each tower/antenna or sector must have sufficient backhaul capacity to accommodate the number of RDOF customers anticipated, taking into account again the reasonable and realistic oversubscription ratio.
- Congestion that would occur between nodes of a mesh network will need to be assessed in addition to the potential for radio frequency and backhaul congestion.

Thank you for your attention to this correspondence. We hope that this paper provides a useful ready-made roadmap of technical standards and sound engineering principles upon which the Commission can rely as it reviews long-form applications to confirm that proposals will deliver Gigabit-level services promised to consumers leveraging ratepayer resources.

Sincerely,

/s/ Michael R. Romano

MICHAEL R. ROMANO,
Senior Vice President—Industry Affairs & Business Development,
NTCA—The Rural Broadband Association.

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ENCLOSURE

Evaluating the Capabilities of Fixed Wireless Technology to Deliver Gigabit Performance in Rural Markets

February 2021

LARRY D. THOMPSON, PE
Chief Executive Officer
Vantage Point Solutions, Inc.
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Introduction and Summary

The current pandemic has accelerated the profound impact that the Internet is having on nearly every area of our lives, including education, retail, healthcare, public safety, and entertainment. The Internet continues to transform how we communicate, the size and scope of our global economy, and even our political system. We are on the cusp of the next Internet evolution—the Internet of Things (IoT). Over the next 10 years, the Internet will evolve into a network that overwhelmingly connects "things" rather than people. Customers will continue to demand faster speeds and higher capacities as telehealth becomes more commonplace as a means of medical care, as education increasingly migrates online, as Ultra High-Definition television (UHDTV) becomes commonplace, and with the dramatic growth of connected devices of all kinds needing Internet access.

The Federal Communications Commission's (FCC) Tenth Measuring Broadband America Report [1] shows that the average speed was determined to be 146.1 Mbps in October 2019. This speed has increased by an average of 54% annually since the FCC's Eighth Report just 2 years ago.[2] Over the past four MBA reports, the average annual increase has been over 35% in both the download and upload speeds. At this rate, the average broadband download speed will exceed 1 Gbps within the next 6 years as shown in *Figure 1.* In January of 2019, NCTA—The Internet & Television Association claimed that 80% of all households can currently order gigabit service.[3] This is largely because over 80% of the United State population is urban.[4] However, the FCC believes there are 23.1 million Americans that cannot receive the FCC's currently-defined minimum broadband standard of 25 Mbps down and 3 Mbps up.[5] The researchers at Broadband Now believe this number could be as high as 42 million.[6] Whatever the precise number, it is clear that millions of Americans have been stuck on the wrong side of the digital divide despite a decade of programs intended to reach them, which makes it all the more important that new funding programs verify that recipients will deliver the services promised for these users.

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[1] FCC's Tenth Measuring Broadband America (MBA), Fixed Broadband Report, January 4, 2021.

[2] *Ibid,* page 7.

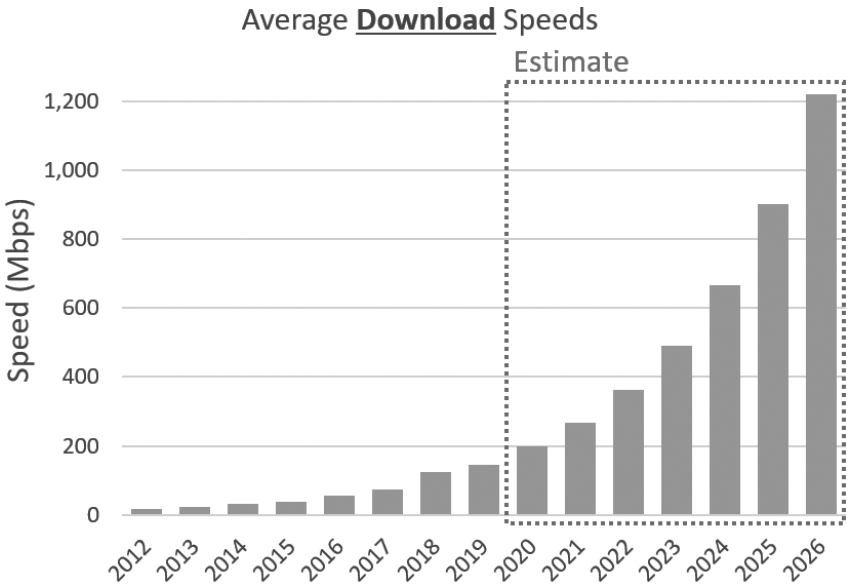
[3] *https://www.ncta.com/whats-new/america-is-now-a-gigabit-nation#.X_vnzVAGcIc.link.*

[4] *https://www.census.gov/programs-surveys/geography/guidance/geo-areas/urban-rural/ua-facts.html.*

[5] FCC's 2019 Broadband Deployment Report, May 29, 2019.

[6] *https://broadbandnow.com/research/fcc-underestimates-unserved-by-50-percent.*

Figure 1. Average Upload Speeds—Based on FCC MBA Reports



The FCC should be applauded for recognizing the trend toward higher speed broadband services and developing a weighting system that favored the networks that have higher speeds and greater capacity in the Rural Digital Opportunity Fund (RDOF) auction (FCC Auction 904). On its face, the auction could be seen as an overwhelming success, since more than 85% of the locations awarded were awarded at gigabit speeds. However, as the layers are peeled back and the technical underpinnings of varying proposals are analyzed, there is substantial question as to whether these speeds will actually be delivered in some cases and applications.

As one example of such analysis, this paper considers specifically the extent to which fixed wireless services may be capable of delivering Gigabit-level services in the kinds of sparsely populated rural areas that the RDOF auction primarily seeks to serve. Most of the RDOF winners that were successful at the Gigabit tier[7] proposed using Fiber to the Premises (FTTP) technology—although many of them left the door open to use fixed wireless services. Others appear to have contemplated using, and received permission to bid using, fixed wireless technology specifically to deliver Gigabit level services. While current FCC Form 477 data (among many other resources) confirms that FTTP networks have been delivering gigabit services to urban and rural customers for many years, there is no comparable track record with respect to fixed wireless technologies. This makes it all the more important to take a careful look, based upon objective engineering criteria, at whether and to what degree fixed wireless networks can deliver Gigabit level services—especially in rural areas where serviceable locations can be several hundred feet to miles apart. This paper concludes that there are significant technical (and related economic) questions that must be confronted in delivering Gigabit broadband using fixed wireless technologies in the predominantly rural areas covered by RDOF and the FCC therefore needs to perform a careful analysis pursuant to objective and well-accepted technical engineering criteria during the long-form process prior to approving such claims of capability.

More specifically, as explained further herein, engineering analysis by reference to objective technical standards indicates that fixed wireless networks will face difficult, if not insurmountable, challenges to provide RDOF Gigabit services[8] in very

[7] For RDOF purposes, a Gigabit service is 1,000 Mbps downstream and 500 Mbps upstream (RDOF Gigabit-Level Service).

[8] See FCC 19–104, Order on Reconsideration—FCC Takes Steps to Enforce Quality Standards for Rural Broadband, adopted October 25, 2019, available at *https://www.fcc.gov/document/fcc-takes-steps-enforce-quality-standards-rural-broadband,* ("FCC Quality Standards Order on Re-

Continued

select circumstances when attempting to service distant, non-town rural subscribers that were primarily the subject of the RDOF auction. U.S. Senators John Thune (R-S.D.) and Amy Klobuchar (D-Minn.), as well as 46 of their Senate colleagues, have previously highlighted the need for such analysis in a Letter to Chairman Ajit Pai, whereby they observed that, "If a party is incapable of delivering broadband as promised, the American ratepayer loses twice over—first for having contributed sums that did not go toward the deployment of broadband as hoped, and then again as those ratepayers who reside in the area that ended up not receiving the promised service . . . It is important for the FCC to be responsible for USF resources and ensure that those parties receiving support can deliver on the commitments they make."[9]

During the review of the long form applications, we believe it essential for the FCC to consider technical and related economic criteria such as those analyzed herein to determine whether and to what degree each applicant will be capable of delivering Gigabit level service based upon its proposed network design. When considering any proposed wireless network designed based on ***mid band spectrum,*** it would be difficult or impossible to conceive a scenario where a wireless network in this band could reliably provide RDOF Gigabit-Level Services. The only band that would have enough capacity to accommodate even just a small handful of gigabit users would be the 5 & 6 GHz unlicensed bands. When using these bands, the wireless provider is not protected from interference from other wireless users and devices such as common home WiFi routers. This is not an acceptable solution, especially when considering the RDOF broadband services must also provide voice services and access to emergency services such as 911.

Meanwhile, when considering any proposed wireless network designs based on ***millimeter wave (mmW) technologies*** for any RDOF bidder to satisfy their Gigabit service commitment, the FCC should verify the following:

1. All customers must be within about 500′ of their specific serving tower/antenna.
2. All customers must have clear line-of-sight to that serving tower/antenna.
3. The capacity of the serving tower/antenna or sector must be adequate to accommodate the downstream and upstream capacities of all users served by that antenna or tower.
    a. The RDOF 70% subscription requirement must be considered in analyzing the capacity of the service tower/antenna or sector.
    b. A reasonable oversubscription ratio on the order of 4:1 or less should be applied.
4. Each antenna and/or sector must also have adequate backhaul capacity to accommodate the number of RDOF customers anticipated with a reasonable oversubscription ratio such as 4:1. In most instances this will require the towers/antennas to be served with a fiber network.
5. When considering mmW mesh networks, in addition to the preceding factors, the FCC should also evaluate the congestion that would occur between the nodes of the mesh network as well as the potential radio frequency congestion and the backhaul congestion.

Gigabit Broadband and RDOF

When considering the most effective and efficient use of resources for broadband network investment, it is necessary to understand current and future user demands to ensure the planned network can meet these increasing demands over its economic life. In addition to cost, performance factors such as speed, latency, capacity, and reliability are of course important factors. Some networks may have lower initial cost but be less reliable and less scalable to meet future customer demands or have higher operational expenses. Some technologies meanwhile may not be able to meet certain performance levels altogether—or maybe only under limited or ideal circumstances. Such is the case for those proposing to use wireless technologies to meet the gigabit speed tier in the kinds of rural areas subject to the RDOF auction.

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consideration"), on the Order, DA 18–710, WC Docket 10–90, adopted July 6, 2018, available at *https://docs.fcc.gov/public/attachments/DA-18-710A1.pdf*, ("FCC Quality Standards Order"). ¶51 of the Order states: "For speed, we require that 80 percent of download and upload measurements be at or above 80 percent of the CAF-required speed tier (*i.e.,* an 80/80 standard)."

[9] Thune/Klobuchar RDOF Senate Letter of December 9, 2019 to Chairman Pai, available at *https://www.thune.senate.gov/public/_cache/files/ec9ab287-8920-4353-b46e-1396ccdf103e/F68789196918856CBDF441B3B801C99E.rdof-letter-12.9.19.pdf*, ("Thune/Klobuchar RDOF Senate Letter"), p. 1.

The FCC has defined the gigabit speed tier for purposes of the RDOF auction as 1 Gbps downstream and 500 Mbps upstream with 2 TB of monthly usage allowance (defined hereafter for purposes of this paper as "RDOF-Level Gigabit Service").[10] From a network engineering perspective, the only logical interpretation of this requirement is that the end-user should be able to simultaneously use 1 Gbps in the downstream direction and 500 Mbps in the upstream direction. The Wireless Internet Service Providers Association (WISPA), however, appears to believe that Gigabit service could be half-duplex (meaning it would be acceptable to limit customer use by permitting communication in only one direction at a time at full capacity).[11] In this scenario, only 1 Gbps of total network capacity would be needed to serve this end-user, since one would assume that the same capacity could be used for the upstream as with the downstream. Considering the large number of users and devices in a home today that are actively using the Internet and the FCC's desire for broadband services that will meet and keep pace with user demand, we presume that the FCC's intent was not to approve "one way at a time" service and limit use to "upstream or downstream only" and that the channel should therefore have an aggregate throughput of 1,500 Mbps (upstream plus downstream), which would allow the required capacity to be utilized in both directions at the same time.

All successful bidders in the RDOF gigabit tier must provide RDOF-Level Gigabit Service to all customers in the awarded Census blocks within 6 years.[12] While this time frame is necessary to accommodate construction, it means that the FCC, affected customers, and other stakeholders may not know whether RDOF-Level Gigabit Service will actually be delivered as promised for years to come. By the time it is apparent that an RDOF recipient cannot meet its FCC commitments, these customers—already languishing in unserved areas—will be left behind once again, and it may very well be too late to include these areas in a second phase of the RDOF auctions. Because of this, it is important for the FCC to ensure, prior to distributing funds (or ideally prior to even making awards), that every RDOF awardee, regardless of technology choice, has a reasonable chance of success based upon its technical and operational capabilities evaluated against a backdrop of objective engineering criteria.

The FCC conducted only a limited review of the technology during the short-form process because it did not have "more information about exactly where the applicant will win support and how many locations it will serve."[13] At the same time, the FCC's own data indicate whether and to what degree certain technologies are and are not being used to deliver certain tiers of service today in varying kinds of rural and urban applications. Indeed, WISPA argued that "The record also indicates that equipment that may support RDOF Gigabit speeds under certain conditions has since been developed and is being commercially deployed today."[14] This statement may be true (subject to the conditions and contingencies contained within it), but even just a cursory examination confirms that the "certain conditions" to which WISPA referred that "may" permit fixed wireless service to deliver gigabit speeds rarely exist when considering residential broadband deployments in the kinds of rural areas included in the RDOF auction. This makes it all the more important that the FCC only award RDOF support where an objective review against published and well-accepted standards of conditions on the ground confirms that there is a reasonable expectation of meeting the RDOF requirements based on the technology proposed.

The FCC should therefore continue its policy of awarding RDOF areas only to those that can be "reasonably expected to be capable of meeting the relevant public interest obligations."[15] Using this as a standard and based upon a review of commonly accepted engineering standards, we conclude in this paper that fixed wireless technologies will face serious challenges at best to deliver RDOF-Level Gigabit Serv-

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[10] In the Matter of Rural Digital Opportunity Fund, WC Docket No. 19–126, Released Feb. 7, 2020 ("RDOF Order"), ¶31.

[11] In an June 2, 2020 *Ex Parte* entitled, "Rural Digital Opportunity Fund, AU Docket No. 20–34, WC Docket No. 19–126, WC Docket 10–90, Notice of *Ex Parte* Presentations," WISPA argues in response to technical concerns raised by one of its most prominent members, "First, GeoLinks suggests that 1 Gbps/500 Mbps service needs at least 1,500 Mbps aggregate throughput. That assumes simultaneous or inflexible uploading and downloading."

[12] RDOF Order, ¶45.

[13] Rural Digital Opportunity Fund Phase I auction Scheduled for October 29, 2020, Notice and Filing Requirements and Other Procedures for Auction 904, June 11, 2020 ("RDOF Auction Procedures Order"), ¶125.

[14] WISPA *Ex Parte* titled, "Rural Digital Opportunity Fund, AU Docket No. 20–34, WC Docket No. 19–126, WC Docket 10–90, Notice of *Ex Parte* Presentations," June 2, 2020.

[15] Comment Sought on Competitive Bidding Procedures and Certain Program Requirements For The Rural Digital Opportunity Fund Auction, Released March 2, 2020, ¶53.

ice in the kinds of areas subject to the RDOF auction. At the very least, the FCC should utilize published criteria and analyses like those employed herein to review the long form applications and ultimately articulate in detail why it believes any given auction winner will be capable of delivering RDOF-Level Gigabit Service using fixed wireless technologies given what the standards otherwise indicate.

The Wireless Sandbox

Immutable laws of physics permit only three primary ways to improve wireless throughput. This can be done by (1) improving the signal-to-interference-plus-noise ratio; (2) improving the efficiency of the spectrum by using higher order modulation and coding techniques which can be leveraged when the signal is strong and largely free of noise and interference; or (3) increasing the amount of spectrum available to a customer through adding more spectrum, segmentation (cell splitting), or using sophisticated and expensive techniques such as high-order multi-input multi-output (MIMO) and/or beamforming.

All wireless providers share the frequency spectrum or "airwaves" with many other wireless providers—even some that may be operating in the same frequency band. In addition, all wireless spectrum transmitted from a given antenna or sector is "shared" amongst all customers served by that sector. Because of this, there are strict rules that govern how the wireless operator can use this spectrum. Some of the rules include:

- **Frequency Band**—A wireless operator is authorized to operate in specific frequency bands. These frequency bands may be licensed ("licensed spectrum") to this operator for their sole use within a defined area or the spectrum may be unlicensed ("unlicensed spectrum") which is shared by many users or devices. More recently, the FCC has allowed the use of "lightly licensed spectrum" which can be shared by many users in a more controlled environment where each provider must coordinate their use of the spectrum with others using the same spectrum.
- **Radiated Power**—The maximum transmit power allowed is also controlled by Federal regulation. The radiated power must be closely controlled to allow the wireless provider enough power to provide service to a customer, but not so much to interfere with another provider that may be operating in an adjacent area. Generally, higher powers are allowed when operating in licensed spectrum rather than unlicensed spectrum. Higher transmit powers generally increase the signal-to-noise ratio (SNR) of the radio frequency signal, which allows faster throughput, but may also cause the signal to continue propagating into neighboring areas causing interference that pollutes the desired signal in these areas and impairs the throughput other customers.
- **Modulation and Other Factors**—The type of modulation, coding, and other factors are also often governed and controlled by the FCC or other standards bodies.

The importance of both wireless spectrum and radiated power of a wireless system can be understood with a simple analogy. If we assume the transmit power of the wireless system is like the water pressure in a garden hose (*i.e.,* the higher the water pressure, the farther the stream at the end of the hose) then the wireless frequency spectrum would be like the diameter of the hose. In order to deliver more water (similar to more speed in a wireless system), one can either increase the water pressure or increase the size of the hose. Since the FCC closely regulates the amount of radiated power (water pressure) then the next logical thing to consider for increasing wireless speed and throughput is to increase the amount of spectrum (size of the hose).

To enable wireless providers to offer faster broadband, the FCC has been aggressively making more spectrum available for broadband use. New technologies, such as beamforming, higher-order MIMO, and higher order modulation and coding techniques have helped providers use the spectrum more efficiently. Nonetheless, despite the infusion of additional spectrum capacity into the broadband marketplace and more sophisticated techniques, the physics of radio wave propagation is always a limiting factor to realizing a solid connection, much less an advanced connection capable of delivering higher performance, especially in rural areas with trees, hills and customers thinly spread out—like those in the RDOF auction.

Wireless Network Design Considerations

As mentioned previously, wireless networks transmit their signals over airwaves that are shared by many providers and users. There is a fixed and finite amount of network capacity for the users sharing the same spectrum, so as more users demand more capacity, data on the network will travel slower for each user. Most

have experienced slower Internet on their wireless devices when in a crowded city or at a large-scale event like a concert where many people are trying to use the wireless network in that area at the same time. In simple terms, the wireless signal from an antenna or "beam" is used by all users served by this antenna, such that the wireless capacity is necessarily divided amongst all these users and leaving less capacity for any one user than would otherwise be the case.

The importance of oversubscription to wireless network design (or the design of any network with elements of shared capacity, for that matter) cannot be overstated. Understanding the concept of oversubscription is essential to understand the actual broadband capability of a wireless network. If there are 20 users sharing an antenna, and each user has subscribed to 100 Mbps service, even as simple math would indicate the potential for 2 Gbps of capacity use (20 * 100 Mbps), it is unnecessary to design the system for that level of capacity because experience confirms that not all users will typically require their full speed at the same time. To account for this, network engineers use the concept of "oversubscription." In essence, oversubscription defines how many times you "resell" the same network capacity where it is shared among multiple users of that network. Over the last 20 years, acceptable oversubscription ratios have been declining as network traffic migrates from its once "bursty" nature of short web browser sessions to more continuous applications like video. Today, it is not uncommon to design a wireless network with an oversubscription ratio of 4:1 or less. Applying an oversubscription ratio of 4:1 to the example above, only 500 Mbps of capacity rather than 2 Gbps would be needed (in that antenna or sector) to serve the 20 customers (each subscribed to a 100 Mbps broadband package). When fewer customers share the same antenna resources it is less likely that customers will experience problems from spectrum sharing.

To increase the wireless speed and capacity that can be offered to their customers, wireless operators often try to reduce the number of customers served by an antenna (or sector or beam). This is often done by increasing the number of towers serving a given area which is often referred to as "network densification." Network densification in rural areas can reach a point of diminishing returns, however, since the transmitted power from tower manifests itself as noise and interference in a neighboring area serviced by a different tower. To help minimize the interference in the neighboring areas, the power must be reduced, the antenna height reduced, or additional downtilts applied to the antennas. Reducing the power often results in decreased speed and signal quality. Reducing the antenna height may put the signal at the mercy of obstacles found in rural areas such as hilly terrain, trees, buildings, or other obstacles, which most likely will block the signal altogether or, at a minimum, decreases speed and signal quality. This means that any effective wireless network design in a rural area must take careful account of the trade-offs between power, potential for interference, antenna height, and topography.

Three basic architectures are used in wireless network design. These are Point-to-Point (PtP), Point-to-Multipoint (PtMP), and mesh. PtP systems are generally used for applications such as wireless backhaul or connecting two buildings together. They often rely on directional antenna on each end to focus the signal and typically consist of more expensive equipment. Because of the focused beam, they can often achieve longer distances than PtMP systems. PtP systems are not generally used for residential broadband, however, since each user would require its own dedicated antenna on the central tower, which is impractical for technical and economic reasons. Residential wireless broadband is therefore most often provided using PtMP systems (a signal antenna at a central site that serves multiple end-user terminals) and occasionally mesh systems.

Mesh systems can often extend the reach of a wireless network since each "node" on the mesh network acts as a relay point to extend the signal before the next wireless "hop." This can provide benefits, especially when operating in the mmW bands where the distance is very limited and there is a need for the intermediate mesh nodes to boost the signal for the more distant users. These mesh nodes are often placed on rooftops of houses in a neighborhood. Since mmW cannot penetrate objects (trees, buildings, *etc.*), if you cannot see your neighbor's roof from your roof, then neither can a mmW signal "see" the next node. There may be some instances where the neighbor's roof is visible, most rural locations are not within sight of other locations—being out of sight of neighbor is, in fact, a bragging point for many rural citizens.

In the instances where a mesh network could gain some distance, the overall network capacity suffers since each node on the mesh must not only carry the capacity of the user which it serves, but also all the other users that are transmitting their signals though that node. When the capacity for several users is aggregated through a signal mesh node, the speed of each user is reduced. Those customers closest to the fiber backhaul connection point could possibly achieve the desired speeds, but

the customers added farther out on this "daisy chain" to meet build-out requirements, could experience degraded service as the links between the mesh nodes become congested. Another downfall of mesh is that they rely on continued support of mesh nodes at neighboring locations. Situations and sentiments change about technology and neighbors may come and go. A new occupant may want nothing to do with the mesh node on their roof and can instantly cripple multiple end-users downstream by removing it.

It is against this backdrop that we can review the conditions under which it may or may not be practical to deliver RDOF-Level Gigabit Service using a wireless network.

Delivering Gigabit Service over Wireless

Since an adequate amount of spectrum is critical to deliver gigabit services to end-user customers and the wireless spectrum is highly regulated, we must first determine if an entity proposing to deliver RDOF-Level Gigabit Service via a fixed wireless solution has access to adequate spectrum to do so. Without the needed spectrum, its efforts will be futile.

How Much Spectrum is Needed?

When considering the amount of wireless spectrum needed, one must consider both the upstream and downstream needs. For RDOF Gigabit-Level Services, this is 1 Gbps downstream and 500 Mbps downstream. This would mean that the wireless channel would need to support 1.5 Gbps for a single user. Since the network will need to be designed to support more than one user, the sector or antenna capacity would need to be greater. If we assume, for example, that a provider would need to support a modest eight users at the RDOF Gigabit level with a 4:1 oversubscription ratio,[16] then the sector or antenna would need to support 3.0 Gbps (1.5 Gbps × 8/4). This is 3.0 Gbps of actual throughout, not "Over the Air" (OTA) capacity as often quoted on vendor datasheets. Actual throughput is much lower than OTA throughput as will be discussed later.

The broadband speed that a frequency band is capable of is often referred to in terms of "spectral efficiency." Spectral efficiency is measured in "bits per second per hertz" (bps/Hz). A wireless system with an average spectral efficiency of 2 bps/Hz would be capable of delivering 20 Mbps, on average, to an end-user in 10 MHz of spectrum (10MHz * 2 bps/Hz = 20 Mbps).

The most advanced MIMO techniques enable modern wireless networks to achieve an average of 2 to 4 bps/Hz across their coverage areas. Giving the wireless system the benefit of the doubt and assuming that the deployed wireless system could achieve a spectral efficiency of 5 bps/Hz, a provider would need 300 MHz of spectrum for a single user and approximately 600 MHz for eight users with a 4:1 oversubscription ratio. The challenge then becomes finding 600 MHz of spectrum to use. (It is also worth noting how highly conservative these assumptions are; to support twice this number of customers, for example, approximately twice this amount of spectrum would be required.)

Available Wireless Spectrum for Gigabit Services

There are three general areas of spectrum are used to deliver wireless broadband services. These are the low band, mid band, and high band (often referred to as the mmW band). The spectrum available for broadband in the low band is so limited that it would not be possible to deliver RDOF Gigabit-Level Services, so we will focus only on the mid band and mmW bands. The portion of the mid band of interest here ranges from 2 to 6 GHz and the portion of the mmW frequencies range from approximately 30 to 80 GHz.

The frequency bands that can be used for broadband can be seen in *Table 1.* The FCC has made a variety frequency bands in the mid band available over the years and is taking significant steps to make more available. However, as can be seen in *Table 1,* the broadband operator may be the secondary user of the spectrum (such as CBRS and C-Band) or is unlicensed which is shared with many other users and devices (such as the U–NNI band). The broadband provider also rarely has access to the entire spectrum in the band and often must operate in smaller blocks of spectrum within that band (shown in the "Allocation" column). As we will see later, this presents challenges when attempting to use mid band spectrum for high-capacity broadband services.

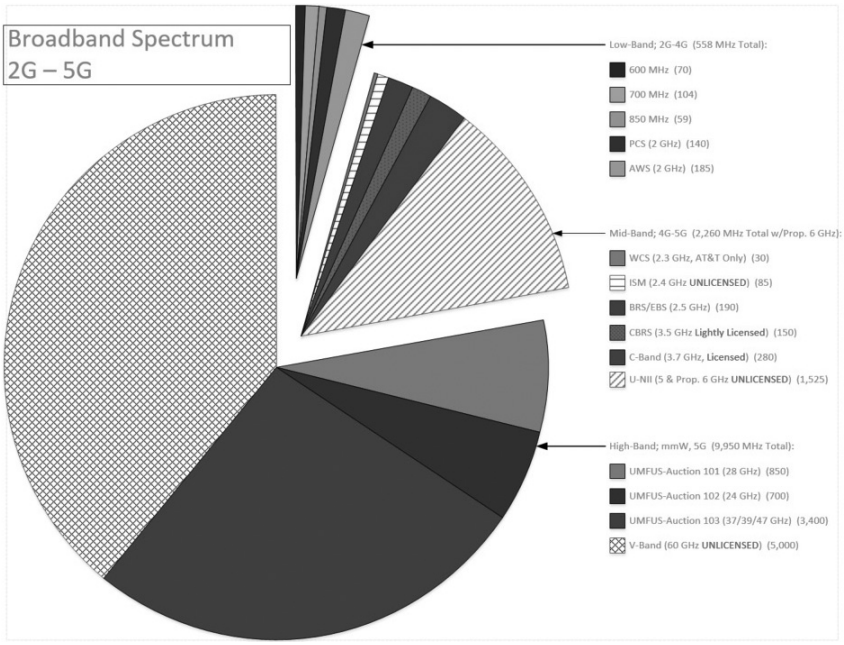
[16] Preseem's "Fixed Wireless Network Report", Fall 2020 Edition shows that approximately 75% of all WISP networks employ an oversubscription ratio of 4:1 or lower.

Table 1—Portion of Radio Spectrum Available for Broadband

Band Name	Frequency	Total Spectrum	Allocation	How Licensed
Low Band Spectrum				
600 MHz	600 MHz	70 MHz	2x5 MHz Blocks	Licensed
700 MHz	700 MHz	104 MHz	2x[1, 5, 6, or 11] MHz Blocks	Licensed
Mid Band Spectrum				
WCS	2.3 GHz	30 MHz	2x5 MHz Blocks	Licensed
ISM	2.4 GHz	85 MHz	10, 20, or 40MHz Blocks	Unlicensed
BRS/EBS	2.5 GHz	190 MHz	6, 16.5, 49.5, 50.5 MHz Blocks	Licensed
CBRS (secondary use)	3.5 GHz	150 MHz	10 MHz Blocks (PAL)	Lightly Licensed
C-Band (secondary use)	3.7 GHz	280 MHz	20 MHz Blocks	Licensed
U–NII	5 & 6 GHz	1,525 MHz	10, 20, 40, or 80 MHz Blocks	Unlicensed
mmW Spectrum				
UMFUS—Auction 101	28 GHz	850 MHz	425 MHz Blocks	Licensed
UMFUS—Auction 102 (secondary use)	24 GHz	700 MHz	2x40 MHz Blocks	Licensed
UMFUS—Auction 103	37/38/47 GHz	3,400 MHz	100 MHz Blocks	Licensed
V-Band	60 GHz	5,000 MHz	2,160 MHz Blocks	Unlicensed

Figure 2 graphically shows the relative amount of available spectrum in the various bands. The pie sections in *Figure 2* are to scale and include all the available spectrum in that band. In most instances a single provider would have access only to a relatively small portion of the larger band. Frequencies in the mid band were generally allocated to providers as small channels. While some providers may have several of these channels in the mid band for a given geographical area, they are not always contiguous in the frequency spectrum which makes it more difficult or even impractical to combine the channels for achieve higher throughputs.

Figure 2. Broadband Spectrum



RDOF Gigabit-Level Services Using Mid Band Spectrum

In the conservative examples discussed earlier, one would need at least 300 MHz (single wireless customer), but more likely 600 MHz or more, to serve a small handful of customers with RDOF Gigabit-Level Service. It would be difficult to find that much frequency in the mid band that would have enough spectrum available for a broadband provider to deliver RDOF Gigabit-Level Services to even a modest num-

ber of customers. The only band with possibly enough spectrum would be the 5.8 GHz and proposed 6 GHz bands which are expected to have 1,525 MHz available. But even if these bands might offer enough capacity to deliver RDOF Gigabit-Level Services to a confined number of customers, they present other challenges—these bands are unlicensed and thus shared with others with no interference protection, including nearly all common WiFi routers. When considering options to satisfy the RDOF requirements, sound engineering principles must be applied along with equipment that can be deployed in a cost-effective and practical manner. This widespread shared unlicensed use would make it impractical for a provider to deliver RDOF-Level Gigabit Services on a consistent basis. The 5.8 and 6 GHz bands are part of the Unlicensed National Information Infrastructure (U–NII) service where higher power is permitted for PtP[17] networks, but these require large parabolic dishes (or equivalent antennas) at both ends to provide service farther than a few kilometers. However, these antennas and power levels are not available to PtMP operations, which would be needed to serve residential customers in rural areas, and large-scale use of point-to-point for point-to-multipoint applications would be absurd. Costs of employing PtP or PtMP networks in rural areas would resemble the costs of FTTP drops—but providing only a fraction of the capacity in the process.

Aside from these two bands, there is nowhere else within the mid band spectrum that a wireless provider could amass enough spectrum. Sometime in the future, it may be possible to aggregate enough spectrum across multiple licensed bands to provide higher speeds approaching a Gigabit consistently, but the technology has not yet been deployed to do so and it is unclear when it will in fact become available. Furthermore, even if it were available, the distances over which a customer could be served would be limited by the shortest reach of all the aggregated frequencies.

Much attention has been giving to the recent CBRS and C-Band auctions with respect to rural broadband. We agree that these bands will be critical to providing improved broadband to rural customers that have been on the wrong side of the digital divide. However, our purpose here is to identify the mid band spectrum that can deliver RDOF Gigabit Services, which is significantly more challenging than a couple hundred megabits per second that might be achievable under certain conditions using the CBRS and C-Band. The total amount of spectrum available in the CBRS band, when including both the licensed and lightly licensed portions is only half of what would be needed to deliver RDOF Gigabit Services to a *single* customer. Furthermore, the maximum amount of spectrum that could be secured by any one bidder was only 40 MHz. Because of this, CBRS is not a realistic option for delivering RDOF Gigabit Services.

C-Band, on the other hand, may have enough spectrum to deliver RDOF Gigabit Services to a very small pocket of customers that are very close to the tower if a provider had access to the entire C-Band spectrum (280 MHz). However, it would be very unlikely that one of the RDOF winners could have secured enough of the 280 MHz in any given area. Furthermore, the RDOF areas are generally outside of the top 46 PEAs, so there is no requirement for this C-Band spectrum to be cleared until December 5, 2023. This would likely not be soon enough for the RDOF awardee to deploy a wireless network using C-Band spectrum in time to meet their first build-out requirement.

Likewise, the EBS band consists of only 116.5 MHz of spectrum if the bidder were able to secure all three of the EBS licenses. Not only is this not enough to deliver RDOF Gigabit Services, but the auction has not yet occurred. It would not be appropriate to award RDOF areas to a bidder that was counting on the possible success in a future FCC auction. It is important that any spectrum that a bidder is relying on to deliver any RDOF services be secured prior to the FCC awarding them the RDOF areas.

Some believe that additional mid band spectrum will be released by the FCC and eventually stem this inevitable capacity insufficiency. However, it is important to recall again that over 85% of the mid-band spectrum currently available, or even contemplated for use for fixed wireless broadband, is *shared-use.* Shared-use spectrum has been allocated by the FCC to two or more different purposes and fixed

[17] *Per* 47 CFR § 15.407(a)(3), "fixed point-to-point U–NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power. Fixed, point-to-point operations exclude the use of point-to-multipoint systems, omnidirectional applications, and multiple collocated transmitters transmitting the same information." There is good reason for this—allowing high power without these exclusions, even if automatically frequency coordinated, will raise the noise floor for everyone and will only lead to limiting of available channels for everyone and further overcrowding of the band.

wireless uses are often the secondary user and must protect the existing services of the incumbent. To do this, fixed wireless providers have modest permissible power limitations. To compound these mid band problems, nearly ⅔ of the spectrum is governed by the U–NII[18] (generally, "Unlicensed" or "Part 15") service rules, and thus comes with *much* lower permissible power[19] and lower associated range.

There is also no guarantee that enough of this shared-use spectrum will *continue* to become available, especially in the exponentially increasing volumes necessary to support future demand demands. Despite the efforts of the FCC to free-up scarce mid-band spectrum such as in C-Band and 6 GHz, it is far-fetched to believe that unimpaired bands in a necessarily shared-use arrangement among primary and other secondary users in such coveted spectrum can be found and freed-up *indefinitely,* and in the exponentially increasing volumes necessary within the narrow and *finite* mid-band range, to match *exponentially* increasing fixed demand volumes—and that is even if one accepts that the coverage range limitations of mid-band spectrum could suffice for non-town, rural fixed applications.

In short, for Gigabit level service to become viable as a widespread commercial broadband solution in rural areas over fixed wireless technologies, there are at least four important technical barriers that must be addressed first: (1) more mid band spectrum would be needed (even beyond that identified as being in the pipeline now); (2) more contiguous channels of capacity would be needed for individual providers within those bands; (3) new equipment would need to be developed to aggregate spectrum within or across those bands; and (4) power and range limitations arising out of shared uses of such unlicensed spectrum.

RDOF Gigabit-Level Services Using mmW Bands

If such technical challenges persist in the offering of Gigabit services in rural areas leveraging mid band spectrum, it is logical to ask whether mmW spectrum, which is already being used to achieve higher speeds in densely populated, more urban environments, might be extended to offer Gigabit speeds in rural areas instead? While vendor claims and product specifications in the lead-up to the RDOF auction sought to justify promises of capability to deliver Gigabit speeds in rural markets based upon limited deployments in urban areas, careful engineering analysis against objective technical standards shows where these claims fail.

We showed previously that a few hundred MHz would be required to support just a handful of customers receiving RDOF Gigabit-Level Services. While, as discussed above, there is no such capacity readily available and acceptable for use within mid band spectrum, there would appear in theory to be enough spectrum available to do RDOF Gigabit-Level Services in the mmW band. More specifically, the bands that could be used include:

- Upper Microwave Fixed Use Service (UMFUS)
  - "24 GHz band"—24.25–24.45 GHz and 24.75–25.25 GHz (Auction 102)
  - "28 GHz band"—27.5–28.35 GHz
  - "37 GHz band"—37–38.6 GHz
  - "39 GHz band"—38.6–40 GHz
  - "48 GHz band"—47.2–48.2 GHz band (Auction 103)
- V-Band
  - "60 GHz band"—57–71 GHz (Unlicensed)

These mmW bands have channel widths ranging from several hundred MHz of spectrum to a few GHz of spectrum, which is in theory more than enough needed to provide RDOF Gigabit-Level Services.

But a rigorous and disciplined technical analysis cannot and must not stop there. An essential and immutable characteristic of spectrum is that the higher it is in frequency, the less propagation and penetration power it will have. Frequencies in the mmW band can only propagate to very short distances before decaying to unusable levels when used in wireless networks. In addition, these frequencies are highly susceptible to fading due to diffraction by rain and moisture, and even to absorption by oxygen molecules. The result is that their usable reliable range—even on a clear day—is measured in the hundreds of feet, not in miles. This, along with the fact

[18] *See* 47 CFR § 15[.]

[19] Compared to up to a few thousand Watts (depending upon sector arc) that is permissible for 2.5 GHz EBS/BRS—which represents only 13.4% of mid-band spectrum potentially available to independent operators, and of which the large majority of current licenses are controlled by T-Mobile, only up to 50 Watts per channel is permissible for "lightly licensed" 3.5 GHz CBRS, and only up to 4 Watts is permissible for Unlicensed.

that they do not penetrate buildings or other obstacles such as foliage and must have an unobstructed Line-of-Sight (LOS) path makes high frequencies very undesirable for serving rural customers. Because mmW cannot penetrate walls, it is necessary that the customer install an antenna on their house or a nearby structure (such as a pole) that has clear LOS to the provider's transmitting antenna. Using indoor customer equipment similar to what can be used at low and mid band frequencies is not possible when using mmW bands. Because of this, customer installs are typically more challenging and often require a professional installation. They can also become unreliable or stop working altogether if the LOS is partially or fully lost due to an obstruction such as new building or tree growth.

Applying such considerations to the areas auctioned off in the RDOF highlights the technical impediments to any proposals or vendor claims of capability based upon use of mmW bands. The areas to be served through the RDOF awards are some of the most rural areas in the country. Many of these census blocks are a few miles across and were auctioned off as part of larger census block groups, which could have been 10 miles across or more. Some of these census blocks or census block groups have smaller clusters of homes within them, but most of the Census block groups have multiple Census blocks that contain sparsely populated customer locations. Because of this, it is likely that the wireless equipment will need to provide broadband service several miles from central tower sites; otherwise nearly every customer would require his or her own tower given propagation limitations.

Realities on the ground in rural America only compound the challenges of using mmW spectrum to deliver high-speed broadband and confound the claims of vendors based upon laboratory or limited urban conditions. To make it more difficult to deploy mmW wireless systems in rural areas, it is also common for homes to be behind a "shelterbelt." Shelterbelts are lines of tall trees planted around one's property to block prevailing winds from wreaking havoc on one's home, and in colder climates, to prevent drifting snow on the downwind side. Customers living in rural areas must intentionally plant shelterbelts to protect their homes, especially necessary during the colder months. Consequently, where there is not already dense tree and foliage growth we often find shelter-belts. In either case, there is a strong possibility that trees will obstruct the radio path—which is especially devastating for higher frequency bands like mmW. This is a realistic example of the less than perfect conditions that will be encountered by many RDOF awardees which will further reduce the distance at which a single user may expect wireless broadband service.

In its RDOF auction comments arguing for the ability for fixed wireless providers to submit gigabit-level bids, WISPA identified equipment from four vendors that claimed to be "producing and distributing inexpensive equipment that can enable Gigabit service."[20] Yet, the very vendor data sheets included with the comments in fact highlight some of these challenges that companies will face when used to serve customers in rural markets. As described previously, the equipment would need to support a minimum of 1.5 Gbps (to account for both the downstream and upstream to provide RDOF Gigabit-Level Services) for a *single* user, which some of the equipment is unable to provide. In addition, the short distances over which the materials indicated that the equipment *can* provide broadband reveals the challenges these vendors will have providing services in the kinds of rural areas presented in the RDOF auction.[21] More specifically:

- Siklu Multihaul—Operates in the 60 GHz band. The base station has an aggregate throughput of 1.8 Gbps and end-user terminals have an aggregate throughput of 1.0 Gbps. Not only is that not enough total capacity available to provide the needed 1.5 Gbps to meet the RDOF Gigabit-Level Service requirement but the equipment has a typical reach of only 900–1,300′ (approximately ¼ mile), which even putting aside LOS concerns, hardly squares with densities in many rural markets.
- Adtran Metnet—Operates in the 60 GHz band and others. Has a range of 1,640′ (approximately ¼ mile) at a capacity of 1 Gbps at the end-user in a mesh configuration.
- IgniteNet MetroLinq—Operates in 60 GHz band and others and claims to enable an Over the Air (OTA) rate of 4 Gbps per sector. However, as one of the most prominent wireless Internet service providers itself has noted, it is not uncommon for the actual equipment data capacity to be ⅓ to ½ of the OTA line

[20] WISPA "Comments of the Wireless Internet Service Providers Association", AU Docket No 20–34, WC Docket No. 19–126, WC Docket No. 10–90, March 27, 2020.
[21] *Ibid, Appendix A.*

rate.[22] In addition, even with its highest gain and largest CPE antenna available (35 cm) the range is limited to only 2,270′ (0.43 miles).

- RADWIN TerraWin—Operates in the 60 GHz band. Operates in a mesh network configuration and claims to have up to 3.6 Gbps throughput per user. No distances are given but does not claim to be a solution for rural areas.

This kind of equipment is often used for 5G small cell wireless backhaul or connectivity in densely populated areas where a single base station can reach several customers within a short distance (typically around 1,000′). In addition, as noted previously, there must be clear line of sight between the tower and each customer, which is often difficult, if not impossible, in rural areas due to the terrain, trees, and shelterbelts. Even though the vendors above quote longer distances, they are not able to RDOF Gigabit Service on a PtMP basis to even a small number of customers at these distances. When using mmW PtMP systems, the distance the customer could be from the provider antenna would be limited to only be a few hundred feet—likely around 500′ if they are to ensure reasonable reliability.

These are not theoretical difficulties; practical experience in deploying mmW networks illustrates these challenges: Scott Mair, President of AT&T Operations, referred to AT&T's experience with its mmW deployment at a recent conference[23] by saying, ". . . millimeter wave provides unique characteristics in terms of bandwidth and speed. And that is going to play a part. But the millimeter wave and the propagation properties of that, take your pick anywhere, 200, 300, 350 yards, is really not going to fulfill a coverage layer need for 5G."[24] Even after deploying in 36 cities, Mair went on to say, "And for the most part, it's enterprise use cases and maybe what I would call venue-specific use cases that we're using it for at this point."[25] These venue-specific places were not rural areas, but Mair said they were "Entertainment districts and stadiums, health care and manufacturing plants are kind of the business side, if you will, the enterprise side, with a lot of promise. And in those areas, I mean, the economics work really well, dense traffic specific use cases."[26] In short, AT&T has found that mmW-based services work well in dense traffic areas, but not in the kinds of rural areas at issue in RDOF. Neville Ray, President of Technology at T-Mobile has said regarding the mmW deployments currently underway for 5G, "Verizon's mmWave-only 5G plan is only for the few. And it will never reach rural America" he added, "Some of this is physics—millimeter wave (mmWave) spectrum has great potential in terms of speed and capacity, but it doesn't travel far from the cell site and doesn't penetrate materials at all. It will never materially scale beyond small pockets of 5G hotspots in dense urban environments."[27] Qualcomm, which makes many of the underlying hardware used for 5G and mmW equipment has similarly indicated, "mmWave best accommodates dense urban areas and crowded indoor environments . . ."[28] Hans Vestberg, Verizon Communications Chairman and CEO, has likewise said of mmW, "We all need to remind ourselves this is not a coverage spectrum because we will do it as far as the economic is sustainable, of course."[29]

Summary/Conclusions

Wireless networks play an important role in connecting customers—but when it comes to assessing the justification for expending public or private funds for broadband deployment, it is equally important to take a realistic picture of the capabilities and limitations of such networks. The broadband speeds promised by future wireless technologies may sound promising, but marketing claims and tests under ideal conditions are no substitute for a rigorous and disciplined technical analysis of what such networks can and cannot deliver.

The promise of wireless solutions deliver RDOF Gigabit-Level Service appears difficult to justify in most rural applications. Apart from some very limited circumstances presenting ideal conditions as summarized herein, the technical and related economic hurdles will be substantial, if not insurmountable.

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[22] Geolinks *Ex Parte,* "Competitive Bidding Procedures and certain Program Requirements for the Rural Digital Opportunity Fund," AU Docket No.20–34, May 29, 2020, page 2.

[23] AT&T Inc at Barclays Global Technology, Media and Telecommunications Conference, December 9, [2020].

[24] *Ibid,* page 6.

[25] *Ibid,* page 6.

[26] *Ibid,* page 7.

[27] Neville Ray blog post, April 22, 2019, *https://www.t-mobile.com/news/network/the-5g-status-quo-is-clearly-not-good-enough*.

[28] *Understanding mmWave: Faster connectivity highways for 5G,* The OnQ Team, November 28, 2018, *https://www.qualcomm.com/news/onq/2018/11/28/understanding-mmwave-faster-connectivity-highways-5g*.

[29] Q1 2019 Verizon Communications, Inc. Earnings Call, April 23, 2019.

Mid band spectrum may have adequate reach to provide service to customers in rural areas, but there are significant challenges with current technologies and spectrum to provide even 100 Mbps service to sparsely populated areas, much less the Gigabit services promised in the RDOF auction. The spectrum is very desirable for wireless broadband services but there simply is not enough of it available to accommodate most RDOF winners. Use of the crowded unlicensed bands, such as 5.8 GHz, should be rejected due to reliability issues associated with unlicensed frequencies, especially when considering the RDOF voice requirements that must provide reliable access to emergency services such as 911. In short, considering objective engineering criteria, there is no viable path currently available to offer reliable RDOF-Level Gigabit Services in rural America leveraging mid band spectrum.

Providing RDOF Gigabit services in the mmW band presents different challenges—but challenges nonetheless. The mmW band has adequate spectrum to deliver RDOF Gigabit-Level Services, but the spectral characteristics are not well suited to provide rural broadband as was the subject of the RDOF auction. In most areas, using mmW would require each rural resident to have his or her own wireless tower. Most of these towers would be required to have fiber connections to deliver the needed broadband capacity to the network connection point.

When considering any proposed wireless network designs based on mmW technologies for any RDOF bidder to satisfy its Gigabit service commitment, the FCC should verify the following:

1. All customers must be within about 500 feet of their specific serving tower/antenna.
2. All customers must have clear line-of-sight to that serving tower/antenna.
3. The capacity of the serving tower/antenna or sector must be adequate to accommodate the downstream and upstream capacities of all users served by that antenna or tower.
   a. The RDOF 70% subscription requirement must be considered in analyzing the capacity of the service tower/antenna or sector.
   b. A reasonable oversubscription ratio on the order of 4:1 or less should be applied.
4. Each antenna and/or sector must also have adequate backhaul capacity to accommodate the number of RDOF customers anticipated with a reasonable oversubscription ratio such as 4:1. In most instances this will require the towers/antennas to be served with a fiber network.
5. When considering mmW mesh networks, in addition to the preceding factors, the FCC should also evaluate the congestion that would occur between the nodes of the mesh network as well as the potential radio frequency congestion and the backhaul congestion.

Author Biography

Larry D. Thompson, PE, Chief Executive Officer

Larry Thompson is a licensed professional engineer and has been designing satellite, wireless, and broadband wireline networks for more than 30 years. Larry received his bachelor's degree in physics from William Jewell College and his bachelor's and master's degrees in Electrical Engineering from the University of Kansas. Prior to founding Vantage Point Solutions in 2002, Larry held several engineering and management positions with TRW's Space and Defense sector, CyberLink Corporation, and Martin Group. Larry is currently the CEO of Vantage Point Solutions, which has over 400 employees and is a national provider of engineering and consulting services. Over the years, he has assisted many wireless and wireline companies successfully manage their technical, regulatory, and financial challenges.

Larry serves on the FCC's Broadband Deployment Advisory Committee (BDAC), he is a frequent speaker at state and national conferences and a frequent expert witness at utility commission and legal proceedings relating to telecommunication technology and regulatory matters.

About Vantage Point Solutions

Better Broadband means Better Lives. Vantage Point Solutions, Inc. helps providers bring this promise to life through comprehensive engineering and consulting solutions tailored to the unique needs of the companies, Cooperatives, and communities we serve.

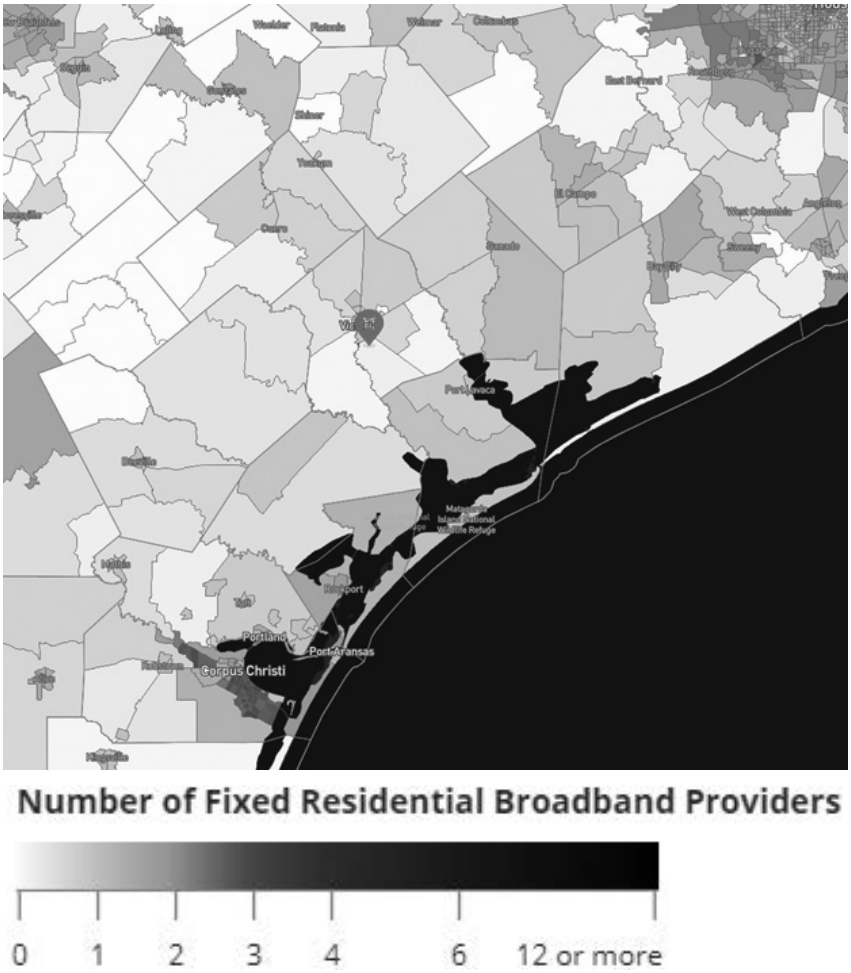
Headquartered in Mitchell, South Dakota and with six additional offices across the country, Vantage Point works with broadband and telecom providers in more than 40 states. Our 400+ employees include ten licensed professional engineers, three attorneys, and industry leaders in technology and advocacy. With professional engineers and regulatory experts under the same roof, we are able to understand the big picture for any individual company decision or broader industry policy.

Vantage Point is an employee-owned company. As such, we hold ourselves to a high standard for both service delivery and business ethics. These high standards extend to our industry involvement, where we are staunch advocates for the broadband deployment everywhere tied to the responsible use of broadband investment.

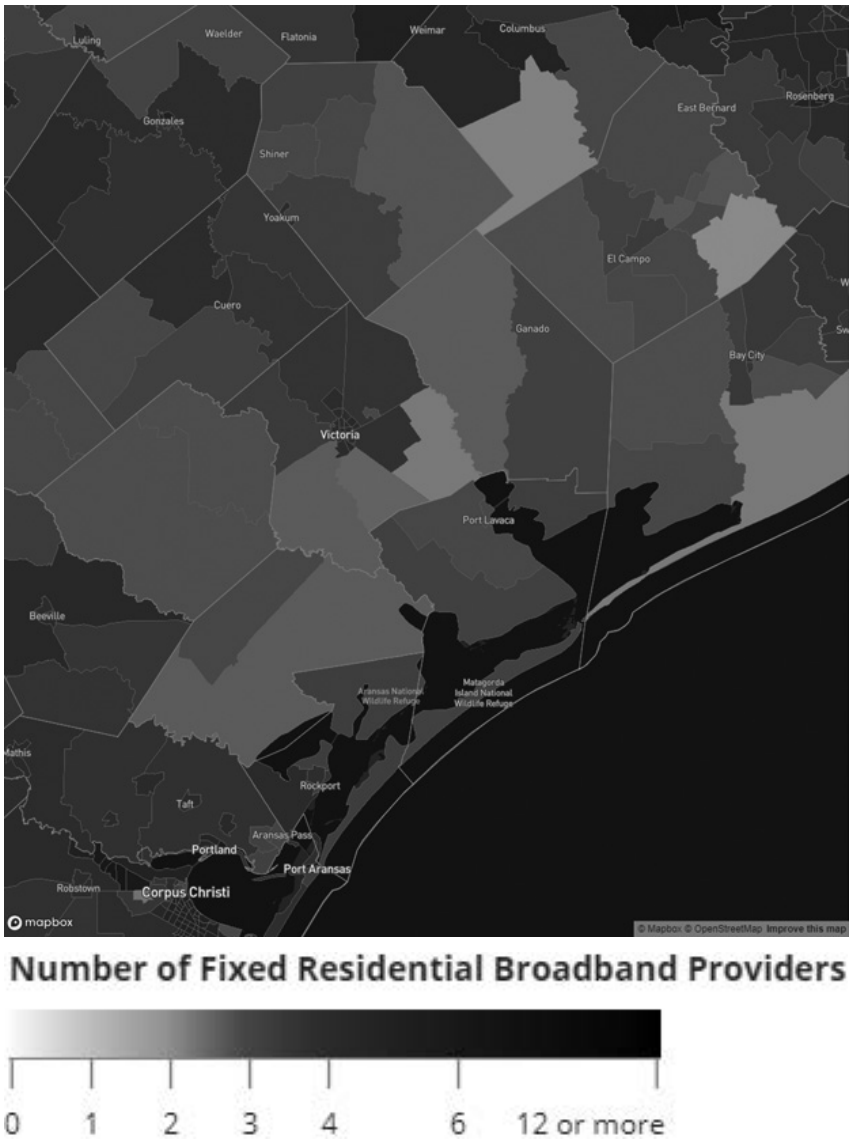
SUBMITTED MAPS BY HON. MICHAEL CLOUD, A REPRESENTATIVE IN CONGRESS FROM TEXAS

[*https://broadbandmap.fcc.gov/#/area-summary?version=jun2020&type=nation&geoid=0&tech=acfosw&speed=100_10&vlat=28.80600185677126&vlon=-97.13230612770428&vzoom=7.323845130384493*]

Broadband Connectivity in East Texas—100/3 megabits per second (mbps)



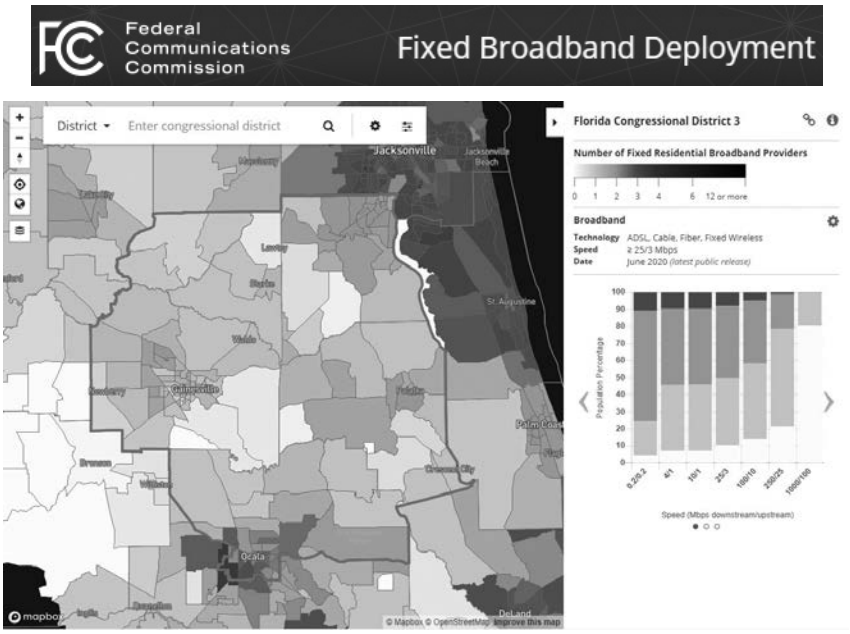
Broadband Connectivity in East Texas—25/3 megabits per second (mbps)



Editor's note: the interactive map data could not be retained for these maps as the supplied hyperlink did not contain the location information.

SUBMITTED MAP BY HON. KAT CAMMACK, A REPRESENTATIVE IN CONGRESS FROM FLORIDA

[*https://broadbandmap.fcc.gov/#/area-summary?version=jun2020&type=cd&geoid=1203&tech=acfw&speed=25_3&vlat=29.71954418351038&vlon=-82.04261442386144&vzoom=8.360689971205383*]



Editor's note: this is an interactive map. The sidebar chart information shows the statistics when hovered over by pointer. The charts' data is retained in Committee file.

SUBMITTED QUESTIONS

Response from Jennifer L. Prather, Vice President and General Manager, Totelcom Communications, LLC; on behalf of NTCA—The Rural Broadband Association

Questions Submitted by Hon. Don Bacon, a Representative in Congress from Nebraska

Question 1. Two-thirds of my home state is rural and more and more dependent on enhanced broadband connectivity. Anecdotally, there are broadband connection gaps in rural areas where the FCC shows coverage. University of Nebraska researchers developed a simple plug-in device and survey to scientifically measure and map household broadband connectivity over time, but have not found Federal funding or programs that support broadband mapping.

Could this approach help measure and map connectivity in rural Nebraska and other frontier states that have become so reliant in recent months on enhanced broadband connections for education, health care and rural economic expansion including on-farm applications?

Answer. While these measures may help with gathering data, there are a number of important caveats to consider. As an initial matter, simply plugging such a device into a laptop or tablet will not in and of itself necessarily render an accurate performance test. If the laptop or tablet is old, if the test is conducted distantly from the router on a bad WiFi connection, or if there are multiple users within the home all at the same time making significant use of it, these factors can all render a result that does not accurately reflect what is provided to that location. Thus, such efforts at "crowdsourcing" information can be helpful, but they do not provide dispositive or conclusive indications of what is actually available at any given location.

Moreover, it is important that all efforts to map broadband connectivity do so in coordination with the Federal Communications Commission (FCC), which is tasked with developing a national broadband map under the Broadband DATA Act passed by Congress to address this issue. Congress just provided millions in funding to the FCC for this very purpose, and work is underway to use that funding to develop better maps. It is important that all broadband programs use the same map so that

we efficiently use limited funds and do not risk undermining investments made in rural areas, many of which are federally supported through the FCC's Universal Service Fund.

Question 2. As we consider deploying more resources to address rural broadband challenges, how can we be certain that the resources provided to USDA are being put in communities which are truly underserved, given the current service gaps?

Answer. USDA has carefully administered its programs, specifically the ReConnect program, to minimize the potential duplication of the work of other RUS programs, the FCC's Universal Service Fund High-Cost program, and other Federal and state programs. However, we support USDA taking further steps to ensure close coordination between all broadband network support programs, so that it avoid deploying duplicative government-funded networks in rural areas that will not even support one provider on its own. We recommend that USDA's Rural Utilities Service formally establish a rule to clarify the ways in which its program funds may interact with funds already awarded under other programs.

Question Submitted by Hon. Michael Cloud, a Representative in Congress from Texas

Question. Ms. Prather, you commented on the "procedural barriers to borrowing from RUS" programs.

Can you describe how these barriers affect NTCA members in greater detail and offer suggestions to the Committee for how to address those "time consuming processes" and to "expedite approvals and deployment?"

Answer. Carriers must secure approvals to cross government and privately-owned lands, and the processes for doing so can be very time consuming and expensive—further delaying broadband installation. NTCA is aware of a number of ReConnect awards that have sat for months, and in some cases well over a year, awaiting clearance of historical preservation requirements. This is particularly frustrating as, in many cases, the approval relates to placement of communications facilities along roadways in previously disturbed land. In such cases where the network is being placed in areas where other construction of some kind has already occurred, there would appear to be no good reason for the sizeable delays associated with approvals. Addressing this problem should be of the highest priority if Congress wants to see more accelerated deployment through RUS programs.

Moreover, the standardization of application, fee, and approval policies and procedures across Federal land-managing and property-managing agencies should be a high priority, and Congress should ensure that agencies have the resources to timely complete reviews and are given reasonable but firm timelines for doing so. Furthermore, Congress should look to implement the recommendations of the Federal Communications Commission's Broadband Deployment Advisory Committee's final report issued in January 2018. NTCA—The Rural Broadband Association participated in the development of these recommendations, which address streamlining of environmental and historical reviews and application review periods, among other pertinent recommendations in removing further regulatory barriers to broadband deployment.

Question Submitted by Hon. Michelle Fischbach, a Representative in Congress from Minnesota

Question. Ms. Prather, you noted that operating on or crossing Federal lands poses challenges that can delay construction and drive up costs. In particular, you noted the Byzantine application process for permitting and access on Federal lands.

Can you elaborate more on those challenges for NTCA members and what the Committee might do to streamline delays and reduce construction costs for rural network operators, particularly with respect to lands and processes controlled by the Department of Agriculture?

Answer. Carriers must secure approvals to cross government and privately-owned lands, and the processes for doing so can be very time consuming and expensive—further delaying broadband installation. NTCA is aware of a number of ReConnect awards that have sat for months, and in some cases well over a year, awaiting clearance of historical preservation requirements. This is particularly frustrating as, in many cases, the approval relates to placement of communications facilities along roadways in previously disturbed land. In such cases where the network is being placed in areas where other construction of some kind has already occurred, there would appear to be no good reason for the sizeable delays associated with approvals. Addressing this problem should be of the highest priority if Congress wants to see more accelerated deployment through RUS programs.

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Questions Submitted by Hon. Julia Letlow, a Representative in Congress from Louisiana

Question 1. The USDA ReConnect Program can play an important role in bridging the broadband gap. It is my understanding the rules, like many Federal broadband grants, are being re-written to reflect the pandemic and the importance of increasing broadband access. However, I have heard that the application process is quite cumbersome.

What specific actions can Congress and the Department take to ease the application process so it can be more accessible for all?

Answer. While Totelcom is not currently a USDA borrower, many NTCA members participate in its various telecommunications programs and report delays throughout the application and approval process generally, but particularly as they relate to environmental and historical reviews. One solution would be for USDA's Rural Utilities Service, given its expertise and history of success in advancing rural communications networks, to play a more active role in working with State Historic Preservation Offices and Tribal Historic Preservation Offices to ensure timely completion of required reviews. NTCA offered further recommendation to USDA in its comments regarding the matter of USDA's ReConnect regulations (RUS–20–Telecom–0023 RIN No. 0572–AC51), including recommendations to improve the contract bidding approval processes and implement a timeline by which reviews must be completed.

Question 2. At least 350,000 households in Louisiana do not have high-speed internet as defined by the Federal Communications Commission. Most of these households are in my district. Equally important, we have an acute affordability challenge and many individuals lack digital skills. While focus on infrastructure investments to address access is important, it is also important we ensure that access is affordable.

For all witnesses, please share with the Committee your recommended best practices to help address the affordability challenge in bringing broadband to rural areas.

Answer. We recognize that even where services are available, that does very little if a consumer cannot afford to pay for those services. It is worth noting in the first instance that the FCC's High-Cost USF program, while mission-critical in promoting both availability and affordability of services in rural areas, aims for baseline voice and broadband rates pursuant to a formula that sets the target rates much higher in rural areas than what urban users pay on average. This almost-always-overlooked fact means that even with USF support and subsidies, as a matter of long-settled Federal policy, *every rural resident is paying more on average for voice and broadband services to start than urban Americans.* Moreover, low-income consumers obviously face additional challenges when it comes to adoption. While the FCC's Lifeline USF program is available to help such consumers purchase broadband, the subsidy is too low to make a meaningful difference on most broadband bills, especially in rural areas where it costs more to deliver broadband services. Totelcom is supportive of the FCC's Emergency Broadband Benefit (EBB) that was enacted in December 2020 to provide eligible consumers with at least $50 a month to purchase broadband service. We are participating in the program so that every consumer in our service area who wants broadband service will have it.

As its name makes clear, however, the EBB is a temporary program designed to help consumers pay for service during emergencies. The EBB will provide good opportunities to learn what works best to overcome challenges to adoption by low-income consumers, and those lessons will hopefully then be applied to permanent solutions with more predictable and sufficient funding.

Response from Timothy R. Johnson, Chief Executive Officer, OEConnect, LLC and Otsego Electric Cooperative, Inc.

Question Submitted by Hon. Doug LaMalfa, a Representative in Congress from California

Question. Mr. Johnson, the 2018 Farm Bill included significant updates to communications application process at the Forest Service.

Can you comment on the implementation of these reforms and any additional changes the Committee or the Forest Service should consider to further improve timely access to Federal land for NRECA members and other broadband providers?

Answer. In 2020, NRECA generally supported the improvements made by the Forest Service to streamline the communications application and permit approval process. However, electric co-ops continue to experience unreasonable delays. A few examples of these delays and potential solutions are below.

Several co-ops with existing powerline rights-of-way crossing Federal lands are facing a year or more to obtain approvals to attach fiber cable to already authorized and permitted electric facilities. Simply put, electric co-ops are seeking approval to hang a single fiber cable onto existing power poles. However, the Forest Service is considering this activity a new special use, outside of the original permit for the utility rights-of-way. Therefore, electric co-ops must undertake a new, full environmental review and permitting process with no end in sight. This is happening in the George Washington, Huron-Manistee, and several other National Forests. These delays are having a significant impact on the ability to provide and expand broadband access to rural communities. The irony is that in some cases, the new fiber will provide improved internet access to the local Forest Service field office, which they desperately need.

Part of the issue is that there are no existing categorical exclusions (CE) within the agency's environmental procedures to cover fiber installation within existing easements. Some projects may beneficially fall within the November 2020 Forest Service's expanded categorical exclusion if the installation occurs on less than 20 acres of National Forest System lands. However, given this administration's review and potential rewrite of the overarching Council on Environmental Quality's NEPA rule, there seems to be a considerable amount of confusion and reluctancy of Forest Service staff on whether and if this applies.

This is my long way of saying that the agency should establish and implement a CE for fiber installation along existing rights-of-way on an accelerated permit issuance timeframe and ensure staff are given clear applicability guidelines to streamline the approval process. Waiting over a year for a permit to attach a single fiber wire to an existing pole unnecessarily impedes the ability to bridge the digital divide, provide equitable opportunities, and jump-start local economies of rural communities.

Questions Submitted by Hon. Don Bacon, a Representative in Congress from Nebraska

Question 1. Two-thirds of my home state is rural and more and more dependent on enhanced broadband connectivity. Anecdotally, there are broadband connection gaps in rural areas where the FCC shows coverage. University of Nebraska researchers developed a simple plug-in device and survey to scientifically measure and map household broadband connectivity over time, but have not found Federal funding or programs that support broadband mapping.

Could this approach help measure and map connectivity in rural Nebraska and other frontier states that have become so reliant in recent months on enhanced broadband connections for education, health care and rural economic expansion including on-farm applications?

Answer. Collecting the necessary data to truly gauge the extent of the digital divide has been elusive and has been a hindrance to meeting our national goal of universal broadband access. This has been exasperated by the FCC's focus on "advertised" speeds *versus* the "actual speed" a consumer experiences, which is often lower. While actual speeds can sometimes be lower due to valid factors such as customers' computers or routers, internet traffic, *etc.,* we are aware of countless experiences where some providers are overly reliant on "advertised" speeds that their networks actually cannot deliver to all their consumers on a reliable basis. Last year Congress adopted the DATA Act requiring the FCC to implement more granular and accurate broadband data collection and mapping. Unfortunately, funds were not appropriated until the December 2020 end of year funding and stimulus bill. The agency is moving forward with implementation and Acting Chairwoman Rosenworcel is aiming for adoption of a new data collection program by the end of the year. As proposed, the new system would improve upon the current system in several ways. In addition to requiring providers to submit more granular data, the FCC will seek to verify data by comparing it against other data sets, such as state broadband data. Most importantly, The FCC will implement a challenge process by which a consumer, or a nonprofit or even locality on behalf of residents and businesses, can challenge a broadband provider's claim of service at their location. Third party speed testing services, such as those run by Ookla or Mlabs, will play an important role in this challenge process and ensuring consumers receive the level of service promised by

providers. We are hopeful this new broadband data regime will provide the level of specificity needed. Congress should exercise ongoing oversight to make sure that the data collected is of sufficient granularity and accuracy.

Currently, carriers that receive Federal Universal Service Funds (USF) from the CAF II and recent RDOF Phase I broadband auctions are required to run speed tests on a regular basis, starting in about year 3, until the end of their funding obligation. Early on, such devices were a separate add on. Many co-ops have found customers hesitant to permit their broadband provider to add a device that will allow testing that will be shared with the government. As a result, there has been investment in integrating speed testing mechanisms into customer premise equipment, such as modems and routers. The FCC has discussed sharing the testing data collected from USF program recipients with state agencies so they can benefit from the data. While this would only be a subset of providers it would still be very useful to policymakers.

Question 2. As we consider deploying more resources to address rural broadband challenges, how can we be certain that the resources provided to USDA are being put in communities which are truly underserved, given the current service gaps?

Answer. All USDA broadband programs currently include extensive rules and in the field verification and challenge processes to ensure areas/applicants that are awarded funds are eligible and in need of broadband funds. We understand the need and desire to ensure efficacy of Federal broadband program. However, the intense focus put on seeking out hypothetical bad actors in programs can make them cumbersome, bureaucratic, and unattractive, especially to small businesses such as cooperatives. One challenge that can prevent communities from benefiting from these programs is the asymmetrical challenge process that exists in the current ReConnect program. The current challenge process disadvantages applicants because they never get to learn what provider or where the challenger is saying there is adequate existing service. This makes it next to impossible to modify an application so that it would qualify, which further emboldens incumbent providers to continue filing challenges that overstate their service quality and coverage abilities, and results in unserved areas being denied vital robust broadband for years. Congress should ensure the challenge process is not asymmetrical in this way and implement adequate flexibility in the programs to allow program administrators to consider and respond to new situations that arise.

Question Submitted by Hon. Troy Balderson, a Representative in Congress from Ohio

Question. Mr. Johnson, your testimony described USDA programs as "administratively onerous and burdensome."

Can you elaborate on how regulatory and procedural burdens fall on NRECA members who seek assistance through USDA's broadband programs, both those who are considering applying and those who have applied? What can the Committee do to help alleviate these burdens for applicants and streamline participation in USDA's programs?

Answer. Since my cooperative, OEC, is not participating in USDA broadband programs, NRECA helped with the following answer to provide the broader electric cooperative experience. Before going over some of the main regulatory and procedural burdens, let me say that USDA has been responsive to concerns in many cases. In each round of the ReConnect program USDA has made improvements. The agency recently sought comment and updated the program rules for Round three and we anticipate updated rules to be released in late summer. Discussions with USDA officials have left NRECA and member co-ops are cautiously optimistic that additional positive changes will be implemented.

Approved applicants face varied environmental and administrative burdens, including contracting, construction, and material challenges. For example, under current rules, environmental approvals are required to be done sequentially. ReConnect awardees can spend up to a year or more obtaining required environmental approvals. Allowing a winning applicant to file for approvals concurrently would allow for parallel evaluation thus speeding the process along and leading to faster deployment.

Broadly, a good amount of administrative challenges may trace back to CFR 1753, most of which haven't been updated since the 1980s and 1990s. Because of this, they are largely written specifically for small telcos. The result is they keep RUS from having appropriate leeway responding to nonstandard situations or requests, causing delays and added costs and electric co-ops not being able to participate. In this case, "nonstandard" means literally anyone that isn't organized or run like a small telephone company/co-op.

- One simple compliance example: RUS Telecom compliance reports require "standalone" financials from 'xCo-op', which only show lease revenue for the fiber from 'xCo-op subsidiary' and no retail internet customers. The report then flags awardee as out of compliance.
  - Co-ops are subject to state laws in how they set up their retail broadband business, which vary from state to state. There are mixed business case reasons for having fiber in their system—it's not 100% for smart grid or 100% for retail broadband. Some co-ops may lease to their own subsidiary, others may lease or trade with other business entities to help get service to those who don't have it.
- Flexibility in using 515 contracts for contractors.
  - Current rules require at least 50% of the employees working on the project be employed by the lead contractor. Many electric co-ops rely heavily on outside contractors, and often subcontractors, particularly for fiber deployment and installation. This is especially critical when under program build-out deadlines.
- Construction: difference between telecom and electric programs
  - Example: "Their [telecom program] construction contracts require that the contractor provide all materials. The electric program allows electric co-ops to purchase its own materials and provide them to contractors for projects, which lowers our cost and controls quality for us. For the ReConnect contract, we have to issue the materials to the contract and have their bond cover the materials we provided them, which creates issues for the contractor bonding company who is bonding against defective materials and any shortage of materials among other things."

Fellow cooperatives hear about the myriad challenges and delays, combined with the expensive up-front costs to apply for and comply with grant reporting requirements that they determine it is not feasible or worth it to apply.

Questions Submitted by Hon. Julia Letlow, a Representative in Congress from Louisiana

Question 1. The USDA ReConnect Program can play an important role in bridging the broadband gap. It is my understanding the rules, like many Federal broadband grants, are being re-written to reflect the pandemic and the importance of increasing broadband access. However, I have heard that the application process is quite cumbersome.

What specific actions can Congress and the Department take to ease the application process so it can be more accessible for all?

Answer. The application and review process for ReConnect is cumbersome. As was mentioned in response to an earlier question many USDA program regulations were written in the 1980s and 1990s. As such, many of the application processes and software also are out of date making the process more cumbersome. I will go through a few examples of specific challenges that could be updated to streamline and simplify the application process, some of which are potentially software issues. Applicants are required to input extensive financial data to show they have the financial viability to complete the proposed project. However, the current application user interface requires financial information to be entered line by line instead of using an upload function like for an excel document.

There are also difficulties in the ability of the application software to accept applications from equal partnerships. Despite rules that encourage partnerships, the system requires one entity to be the lead applicant which contradicts the letter and spirit of a partnership. Partnership negations can be complex and agreements delicately worded. These agreements can be upended by a lack of flexibility in the software that can upset the partnership balance. Partnerships should be allowed to apply as true and equal partnerships.

USDA has made many improvements since the ReConnect program was launched. In the first round the portal repeatedly crashed and interested entities couldn't submit applications and some missed the application deadline as a result. One recommended solution was to accept paper versions of the applications and [are] a 'just in case' option.

Question 2. At least 350,000 households in Louisiana do not have high-speed internet as defined by the Federal Communications Commission. Most of these households are in my district. Equally important, we have an acute affordability challenge and many individuals lack digital skills. While focus on infrastructure in-

vestments to address access is important, it is also important we ensure that access is affordable.

For all witnesses, please share with the Committee your recommended best practices to help address the affordability challenge in bringing broadband to rural areas.

Answer. Collectively, electric cooperatives serve 92% of persistent poverty counties as identified by the U.S. Census Bureau so we are acutely aware of affordability. Affordability must be a consideration in closing the digital divide. The current FCC administered low-income program, Lifeline, provides a nominal subsidy of $9.25 a month. This amount does not move the needle to address affordability for low-income consumers. Otsego is participating in the temporary Emergency Broadband Benefit Program (EBB) established in the December stimulus. The EBB provides qualifying low-income households with $50, $75 on tribal lands, towards their monthly service bill. The significantly higher subsidy in the temporary EBB program will prove informative in whether this level of subsidy is effective in addressing affordability. What we already know for sure is that a permanent program to address affordability will be required.

We feel the better approach would be to update and enhance the existing FCC Lifeline program to make it more effective in addressing affordability.

Response from Vickie S. Robinson, Esq., General Manager, Microsoft Global Airband Initiative

Question Submitted by Hon. Julia Letlow, a Representative in Congress from Louisiana

Question. At least 350,000 households in Louisiana do not have high-speed internet as defined by the Federal Communications Commission. Most of these households are in my district. Equally important, we have an acute affordability challenge and many individuals lack digital skills. While focus on infrastructure investments to address access is important, it is also important we ensure that access is affordable.

For all witnesses, please share with the Committee your recommended best practices to help address the affordability challenge in bringing broadband to rural areas.

Answer. Thank you for this important question which gets to the heart of the digital divide. In our efforts to address this challenge, the Microsoft Airband Initiative has adopted three important pillars: (1) access to affordable broadband, (2) access to affordable devices, and (3) access to digital skilling. Each of these pillars are essential to ensuring that everyone is able to participate in the digital age. However, before addressing these pillars, it is important that we have accurate data that reflects the state of the broadband gap, and Congress makes sufficient funding available to extend broadband networks and connections to rural and other areas that are unconnected and unserved. Such funding should be distributed on a technology neutral basis allowing broadband providers and communities to determine which technologies best meets their deployment and service needs and preference should be given to broadband solutions that provide rapid deployment of networks and services.

In order to address the three adoption challenges noted above, the Federal Government should establish a permanent program that provides annual funding. While the Federal Communications Commission's Emergency Broadband Benefit (EBB) program authorized by Congress is a temporary program, it provides a meaningful example of the needed elements of a permanent program. The EBB provides internet service providers with a monthly reimbursement up to $50 for broadband service provided per eligible household and up to $75 for households on Tribal lands as well as a discount on laptops, desktops, or tablets. A permanent program will help to ensure that consumers can afford a broadband subscription and device. Permanent Federal funding must also include funding for digital skilling to ensure that everyone has the ability to use their broadband connection and device. Also, we believe that a successful permanent program will be easy for consumers to access and use.

Response from Johnny Park, Ph.D., Chief Executive Officer, Wabash Heartland Innovation Network

Question Submitted by Hon. Julia Letlow, a Representative in Congress from Louisiana

Question. At least 350,000 households in Louisiana do not have high-speed internet as defined by the Federal Communications Commission. Most of these households are in my district. Equally important, we have an acute affordability challenge

and many individuals lack digital skills. While focus on infrastructure investments to address access is important, it is also important we ensure that access is affordable.

For all witnesses, please share with the Committee your recommended best practices to help address the affordability challenge in bringing broadband to rural areas.

Answer. This is an excellent question and gets to heart of the issue for low density rural areas. The problem is the business plan, which is especially challenging if fiber is the only option being considered. Wireless solutions can be quicker, much less expensive to deploy and offer options for difficult terrain.

Our overall recommendations to reduce cost are (1) be proactive in deployments, (2) use fiber strategically, (3) take advantage of new options and innovation in wireless technology.

Be proactive in deployments

Even if all service is provided by the private-sector, parishes and counties should still pay attention to deployments, especially after Federal auctions that award funds to companies who bid to provide services in the parishes. Know the rules, get to know the service providers that will be coming, work with them and existing providers to help them stand up networks efficiently, using existing fiber and wireless networks, existing vertical assets, and other resources when possible. Also make sure the deployments happen timely.

Find ways to incentivize service providers to work together.

Use fiber strategically

Fiber's business plan depends on density, and there are often high-density pockets even in rural areas. This can be leveraged. For example, fiber-to-the-home in a small town, or run to a large anchor tenant like a grain operation, can work affordably. That fiber can then be used to backhaul a wireless solution to the surrounding countryside where density is low.

Fiber doesn't have to be buried: it can go up on lines. Engage partners with assets that can be used to reduce the capital cost (*e.g.,* rural energy and telephone co-ops.)

Don't be afraid of wireless: it can be great for middle and last mile solutions, and even backhaul

Though fixed wireless has historically struggled to match the performance of fiber, this has been due in large part to the wireless industry having no access to the high-quality bands that support LTE and 5G-quality solutions. Lower quality spectrum has also meant lower quality gear. The best gear goes to better bands because that is where the mobile business is.

The FCC has recently made new, very high quality spectrum available, including CBRS, that is ideally suited for rural areas. This has not only helped with bandwidth and performance, it has created a new market for higher quality wireless gear companies: they can adapt their gear easily to the fixed wireless industry, creating affordable high quality gear.

This opens the door to strategic, mixed use of fiber and wireless to solve specific problems as described above.

As well, wireless gear can go on existing vertical assets like grain legs, saving capital cost.

There is also a lot of innovation happening right now in the wireless world. The aerostat that WHIN described in its testimony is designed for rural applications. Its altitude also allows for wireless backhaul to small towns.

And there are other companies that are offering affordable last mile solutions with creative use of spectrum and network design.

WHIN's Living Lab is testing new approaches to affordable rural broadband that utilize these strategies, and we are happy to share results.

○