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EXPANDING BROADBAND INFRASTRUCTURE IN THE GRANITE STATE

FIELD HEARING

BEFORE THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

OCTOBER 13, 2017

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SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED FIFTEENTH CONGRESS

FIRST SESSION

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EXPANDING BROADBAND INFRASTRUCTURE IN THE GRANITE STATE

FRIDAY, OCTOBER 13, 2017

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Keene, NH.

The Committee met, pursuant to notice, at 10:09 a.m. in Centennial Hall Alumni Center, Keene State College, Keene, New Hampshire, Hon. Maggie Hassan, presiding.

Present: Senator Hassan [presiding]

STATEMENT OF MELINDA TREADWELL, PH.D., INTERIM PRESIDENT, KEENE STATE COLLEGE

Dr. TREADWELL. Good morning. Welcome, everyone.

I am Melinda Treadwell, the Interim President here at Keene State College, and I am honored to offer a welcome on behalf of this incredible academic community in this beautiful campus on a sunny, fall day. So I am very glad the weather cooperated with us to have you join us on a day that really shines for Keene.

Senator Hassan, thank you so much for your commitment to the important issues for this region of our state. I am so grateful for it.

As you all know, we are here today for Senator Hassan's field hearing. This is an official field hearing with regard to broadband access, and as we all know, when we think about economic mobility for communities, there are very few issues as important as high speed Internet connectivity.

Certainly for our region, one of the main reasons Keene State is thrilled to host this event—and support you in this—is we appreciate deeply that our economic access for the future, and our future success, will be tied to high speed Internet connectivity. I believe rural communities will be left behind if we cannot guarantee high speed connectivity.

So again, thank you again, Senator Hassan, and I will step aside for the rest of your hearing.

So thank you and welcome.

OPENING STATEMENT OF HON. MAGGIE HASSAN, U.S. SENATOR FROM NEW HAMPSHIRE

Senator HASSAN. Thank you very much, President Treadwell, and thank you to the entire Keene State community for hosting us today.

The first thing I will do is call this hearing to order.

This is an official hearing that will be recorded for the Congressional Record.

It is my distinct pleasure to be here today to call this hearing of the Commerce Committee to order.

I will start by also thanking Senator John Thune, who is the Chairman of the Commerce Committee and Senator Bill Nelson, our Ranking Member, for allowing this field hearing today. They, and their staffs, have been absolutely instrumental in orchestrating this hearing, and I am really grateful for their efforts.

I would also like to thank Keene State College, again, for hosting this event, and a special thank you to President Melinda Treadwell for her remarks just now, and for all the work that everybody here did to make this happen.

Thank you, as well, to our witnesses and everyone in attendance for being here this morning, and for their attention and commitment to an issue that is absolutely critical to New Hampshire and communities across our country.

A strong telecommunications infrastructure is critical to our State's economy, as well as the safety and prosperity of all Granite Staters. But too many communities face challenges in getting access to broadband. I know that connecting communities to broadband is a goal that we all share, and the Commerce Committee can do important work in this field.

But as we continue our efforts in Congress and at the FCC, it is critical that we have conversations outside of Washington to be successful. That is why I am really pleased that you all could join us here in New Hampshire today and that so many members of the public are here as well.

As I travel across our state, I talk to businesses about their priorities and their challenges. And time and again, I hear from businesses here in the Monadnock region, and up in the North Country in particular, about the urgent need to strengthen our broadband infrastructure.

Our people and businesses simply cannot compete in the 21st century innovation economy without broadband, and we must act now to address what is an urban-rural divide that has persisted in our country, and in this state, for far too long.

Today's field hearing will serve as a forum to continue to inform our on-the-ground efforts here in New Hampshire. Your voices and your priorities will help provide critical evidence and context for me, and for FCC Commissioner Rosenworcel, as we make important decisions about rural connectivity.

During my time as Governor, I was proud to start a partnership aimed at enhancing access to high speed broadband in New Hampshire's schools. In the Senate, I have joined with my Republican colleague, Senator Gardner, in authoring the AIRWAVES Act, which would create a spectrum pipeline for our country to avoid what experts call a spectrum crunch.

Spectrum is the finite resource that powers broadband connectivity and we will need a lot more of it to meet the needs of the 21st century economy.

Beyond spectrum, we also must make meaningful and immediate investments where it counts. There is bipartisan discussion in Washington about a possible infrastructure package coming for-

ward from this Administration. It is essential that any infrastructure package must include broadband buildout and investment.

Finally, we have to work to ensure that our networks are resilient. As we have seen with the storms that devastated Puerto Rico, Florida, and Texas, there is an immediate need to ensure that when networks go down, we have solid plans in place to build them back up, or have backup power sources, so that individuals can connect to resources and to their loved ones.

I hope this hearing will provide a platform to discuss these important issues and hope to learn more about the challenges currently facing our state when it comes to broadband.

I know that we have many experts from our state who have provided written testimony, including Chris Rand from Granite State Communications; Joshua Meehan of Keene; and State Senator Jay Kahn. I look forward to continuing to work together.

I would also like to acknowledge that all of today's remarks, and this written testimony, will become part of the Congressional Record.

So with this in mind, I would like to introduce our first witness, FCC Commissioner Jessica Rosenworcel, for her statement.

Welcome, Commissioner.

STATEMENT OF HON. JESSICA ROSENWORCEL, COMMISSIONER, FEDERAL COMMUNICATIONS COMMISSION

Commissioner ROSENWORCEL. Good morning.

To everyone here, especially Senator Hassan, thank you for having me here in the Granite State. I am a New England native, so the opportunity to come up here and join you is both an honor and a treat.

Now, back in Washington, I have the privilege of serving as Commissioner at the Federal Communications Commission. I have a front row seat at the digital revolution and every day, I see how technology is changing every aspect of our civic and commercial life.

Every day, I am reminded that the future belongs to the connected. No matter who you are or where you live in this country, you are going to need access to modern communications for a fair shot at 21st century success.

But the fact of the matter is that too many Americans lack access to broadband. This includes 23 million Americans living in rural communities and includes 15 percent of those living in rural New Hampshire. This is unacceptable and we need to do better.

But I do not think statistics like those tell the whole story. To get a picture of just what it means to be consigned on the wrong side of the digital divide, I want to talk for a moment about something that may be unexpected. I want to talk about kids and homework.

Today, 7-in-10 teachers assign homework that requires broadband access, but data from the FCC shows that 1-in-3 households do not subscribe to broadband service, and where those numbers overlap is what I call the Homework Gap.

According to the Senate Joint Economic Committee, the Homework Gap is real. By their estimate, 12 million children all across

the country live in households without Internet access. I am certain that some of them are right here in New Hampshire.

I have heard from students in Texas who do homework at fast food restaurants with fries because it is the only place they know where they can get a free Wi-Fi signal.

I have spoken to high school football players in New Mexico who linger in the school parking lot after their games in the pitch black dark holding their devices because it is the only place they know to get a reliable connection.

These children have grit, but it should not be this hard because today, no child can be left offline. Developing digital skills is flat out essential for education and the modern economy. So I hope that adds a human dimension to what it means to not have access to broadband.

And now, let us talk a little bit about what we can do about it.

First, if we want to get serious about addressing our broadband problems, we need to know exactly where those problems are most pronounced. We need better mapping.

Nearly 9 years ago, in the American Recovery and Reinvestment Act, Congress had a good idea. It created a National Broadband Map identifying where deployment had and had not occurred.

But if you check that map out right now online, you will find that it was last updated more than 3 years ago. I do not have to tell you that in the Internet Age, three years is an eternity.

So I think it is time for a National Broadband Map that offers an honest and current picture of wired and wireless broadband all across the country.

Now, we can build that map in Washington with a whole bunch of data, but I also think it would be great if we had a clearer picture on the ground. I am a big believer in the wisdom of crowds, so I think we should put it to the public.

If you have not been able to get service, or live in an area that lacks it, help us at the FCC make a map that reflects your experience and write us at *BroadbandFail-at-FCC.gov*. I have set up that e-mail account to take in ideas, and I am going to share every one of them with the Chairman, and my colleagues, and put on the pressure to do something about it.

Finally, I want to point out that connectivity matters not just on the ground, but in the skies. Wireless service is an essential part of our Digital Age infrastructure. For decades, the FCC has led the world with its auction models for the distribution of spectrum licenses.

We have made a lot of progress powering the mobile devices that so many of us have come to rely on every day. But take a drive along some rural roads, probably not that far from here, and you will know that there is room for improvement.

It is one reason why the AIRWAVES Act, that Senator Hassan and Senator Gardner have put forward, is so important. It helps identify more licensed and unlicensed spectrum, and makes sure we bring it to market in a timely way because it has deadlines.

On top of that, it sets up a fund whereby auction revenues will help support wireless broadband infrastructure in rural communities. That is the kind of creative effort that would help, in time,

lead to more coverage on a broadband map and also help close the Homework Gap.

So thank you for having me here today.

I look forward to any questions you might have.

[The prepared statement of Commissioner Rosenworcel follows:]

PREPARED STATEMENT OF JESSICA ROSENWORCEL, COMMISSIONER, FEDERAL COMMUNICATIONS COMMISSION

Good morning, Chairman Thune, Ranking Member Nelson, Members of the Committee and in particular, Senator Hassan. Thank you for the opportunity to appear before you today in the Granite State. I am a New England native so joining you here—back in the part of the country I call home—is an honor and a treat.

In Washington, I have the privilege of serving as a Commissioner at the Federal Communications Commission. I have a front row seat at the digital revolution. Every day I see how technology is changing every aspect of civic and commercial life. Every day I am reminded that the future belongs to the connected. No matter who you are or where you live in this country, you need access to modern communications for a fair shot at 21st century success.

But the fact of the matter is that too many Americans lack access to broadband. This includes 23 million Americans living in rural areas. This includes 15 percent of those living in rural New Hampshire. This is not acceptable. We need to do better.

But statistics like these don't tell the whole story. To get a picture of just what it means to be consigned to the wrong side of the digital divide consider kids and homework. Today, seven in ten teachers assign homework that requires broadband access. But data from the FCC show that as many as one in three households do not subscribe to Internet service. Where those numbers overlap is what I call the Homework Gap. According to the Senate Joint Economic Committee, the Homework Gap is real. By their estimate, it affects 12 million children across the country.

I am sure it affects some of them right here in New Hampshire. Because I have heard from students in Texas who do homework at fast food restaurants with fries—just to get a free Wi-Fi signal. I have heard from high school football players in New Mexico who linger in the school parking lot after games with devices in the dark because it is the only place they can get a reliable connection. These kids have grit. But it shouldn't be this hard. Because today no child can be left offline—developing digital skills is flat-out essential for education and the modern economy.

I hope that adds a human dimension to what it means to not have access to broadband. So now let me tell you what we can do about it.

First, if we want to get serious about addressing our broadband problems, we need to know exactly where those problems are most pronounced. We need better mapping. Nearly nine years ago, in the American Recovery and Reinvestment Act, Congress had a good idea. It created a National Broadband Map, identifying where deployment has and has not occurred. But if you check that map online now you will see that it was last updated over three years ago. In the Internet age, three years is an eternity.

You cannot manage what you do not measure. So I think it's time for a National Broadband Map that offers an honest picture of wired and wireless broadband across the country. Too often the FCC cobbles together data for each individual rulemaking and report without a comprehensive and updated snapshot of where service is and is not.

We can build this map in Washington, but it would be great if we had a clearer picture on the ground. I'm a big believer in the wisdom of crowds, so I think we should put it to the public. If you've not been able to get service, or live in an area that lacks it, help us make a map and write me at *broadbandfail@fcc.gov.* I've set this account up to take in your ideas. I will share every one of them with the agency Chairman—and put on pressure to do something about it.

Mapping is important because it can improve FCC work under the Communications Act. Section 254 directs the FCC to ensure "consumers in all regions of the Nation" have access to communications, with rural rates reasonably comparable to urban rates. To do so we have more ongoing universal service proceedings than I have time to talk about today. But one thing is clear: with better data we will do a better job.

Finally, I want to point out that connectivity matters not just on the ground, but in the skies. Wireless service is an essential part of digital age infrastructure. For decades, the FCC has led the world with its auction models for the distribution of

spectrum licenses. We've made a lot of progress powering the mobile devices that so many of us rely on every day. But take a drive along some rural roads and you will know there is room for improvement.

It's one reason why the AIRWAVES Act from Senator Hassan and Senator Gardner is so important. It helps identify more licensed and unlicensed spectrum that can be brought to market to improve wireless broadband. On top of that, it sets up a fund whereby auction revenues will help support wireless broadband infrastructure in rural America. It's the kind of creative effort that would in time lead to more coverage on a broadband map and also help bridge the Homework Gap. It's good stuff.

Let me close by thanking you for having me at this hearing. I look forward to answering any questions you may have.

Senator HASSAN. Thank you very much, Commissioner.

Now, it is my pleasure to introduce Mr. Joshua Cyr, who is the Director of Education and Acceleration at Alpha Loft.

Welcome, Mr. Cyr.

STATEMENT OF JOSHUA CYR, DIRECTOR, EDUCATION AND ACCELERATION, ALPHA LOFT

Mr. CYR. Good morning and thank you.

Thank you, Senator Hassan, for convening this field hearing and inviting me.

Again, my name is Joshua Cyr. I am the Director of Education and Acceleration at Alpha Loft, a nonprofit that aids founders of innovative startups here in New Hampshire.

My job includes developing and running our education programs for early stage startups, as well as running our startup accelerator. Previously, I have been a software developer for a tech company and I am now a technology advocate in the Seacoast area.

I regularly run tech meet ups, symposiums, and other events promoting education around new tech for both technologists and the general public.

I have also been able to experience just a little bit of politics and policy over the last 2 years, as I am finishing my first term as a City Councilor for the City of Portsmouth.

I ponder the topic of broadband in New Hampshire quite a bit primarily from a perspective of business and consumer needs, State health, and a vision of what is and what is to come. I would like to relate to you three areas of concern that I have.

First is, a lack of broadband turns away those who we are working the hardest to attract. New Hampshire, like other states, has an aging population and it is creating numerous, critical issues for our state. Lack of high speed Internet exacerbates the problem and frustrates our efforts in attracting and retaining the younger generations.

When it comes to making a decision on where to live, broadband plays a key role. Comcast recently surveyed apartment managers about the most important amenities for decisionmaking. A highlight of the report was that high speed Internet and Wi-Fi are among the most important factors for apartment dwellers when making a decision, even more than in-room laundry facilities.

In addition to highly valuing broadband, broadband use is also dramatically higher with younger generations. In 2011, the average 18 to 24 year old Millennial consumed 25 hours of traditional television per week; today, they consumer closer to 14. Ages 17 and

under, watch between 2 and 4 hours of YouTube and less than an hour of traditional television per day.

People are not just consuming video. Remote work has become a viable option for many. Frequently, this requires use of bandwidth intensive tools such as Google Hangouts, FaceTime, Skype, WebEx, et cetera. This is required for professionals and it means that they must move to where broadband is adequate and rule out the many areas in our state that is not.

Finally, more and more people are streaming their own personal activities as video for others to watch. This is in the form of streamed videogame playing, performances, talk shows, Facebook Live, and more. This interactive format requires reliable upload speeds as well.

Today, it is not unusual for a family to be consuming multiple bandwidth-intensive applications at the same time in many rooms of the home, and we simply cannot measure bandwidth needs by the use of just one application or even a few.

Secondarily, what I am concerned about is that consumers are confused that mobile broadband is not adequate. It may seem like the answer to rural broadband is mobile access. However, the current unlimited plans are not really unlimited in the sense the consumer would likely expect.

Mobile plans will de-prioritize data after a user hits a certain threshold in a given month. This varies by carrier in the 20 to 30 gigabyte range, as I have seen recently. This cap can hit very quickly on mobile devices; after that, the speeds slowdown. Speeds also change when tethering to desktop television that is far slower. Mobile speeds, availability, and reliability are simply not adequate as a primary source for Internet for consumers.

And finally, our future is full of heavy bandwidth uses not yet considered in places we do not expect. Humans are not good at planning for the future. Most are not aware that autonomous cars are literally just around the corner. We have not done a good job in taking into account the many changing dynamics that come into play with this hugely disruptive event.

For example, once we are no longer focused on the task of driving, entirely new forms of auto entertainment will emerge. The cars are remarkably well created as an entertainment hub: a captive audience, lots of speakers, plenty of room for screens.

We do not yet know the kind of entertainment consumption that will be popular, but strong contenders include live video, movies, AR/VR. We can guess, however, that much of it will be bandwidth intensive while the car is in motion.

Another example of anticipated future demands is the explosion and interest in the implementation of IoT, the Internet of Things. IoT is common enough now that it is not a term used by consumers. As consumers, we simply expect that our devices are smart and can communicate with each other.

While much of our current IoT devices consume and produce very little data, that does not mean the future will be the same with numerous efforts underway for smart cities, as we leave our less urban infrastructure behind.

For these reasons and more, when thinking about broadband availability, we should be thinking about complete coverage, not simply covering destination zones.

In summary, we are not meeting today's needs for many citizens in New Hampshire. Our planning for the future must take into account that the needs in the future will be significantly greater in terms of both data consumption and creation.

The geographic areas covered must be profoundly greater than are covered today. If people cannot get what they need, they will move to areas that can serve them furthering the migration to urban centers. This will make the economics of serving rural areas even more difficult.

Thank you.

[The prepared statement of Mr. Cyr follows:]

PREPARED STATEMENT OF JOSHUA CYR, DIRECTOR, EDUCATION AND ACCELERATION, ALPHA LOFT

Good morning. Thank you Senator Hassan for convening this field hearing and for inviting me.

My name is Joshua Cyr. I am the Director of Education and Acceleration at Alpha Loft, a nonprofit that aids founders of innovative startups here in New Hampshire. My job includes developing and running our education programs for early stage startups, as well as directing our startup accelerator.. Previously I was a software developer for a tech company and I am now a technology advocate in the seacoast area. I regularly run tech meetups, symposiums, and other events promoting education around new tech for both technologists and the general public. I have also been able to experience a bit of politics and policy over the last two years, as I am finishing my first term as a City Councilor for the City of Portsmouth.

I have pondered the topic of broadband in New Hampshire quite a bit. Primarily from a perspective of business and consumer need, state health, and in a vision of what is to come. I'd like to relay three areas of concern that I have.

Lack of broadband turns away those who we are working hardest to attract.

New Hampshire, like other states, has an aging population and that is creating numerous critical issues for our state. Lack of high speed Internet exacerbates the problem and frustrates our efforts in attracting and retaining younger generations.

When it comes to making a decision on where to live, broadband plays a key role. Comcast recently surveyed apartment managers about the most important amenities for decision making.

A highlight of the report was:

"High-speed Internet and Wi-Fi are among the most important factors to apartment dwellers when making a rental decision—even more than in-room laundry facilities " (1)

In addition to highly valuing broadband, broadband use is also dramatically higher with younger generations. "In 2011, the average 18–24 year old millennial consumed about 25 hours of traditional television per week—today, they consume closer to 14 hours." Ages 17 and under "watches between two and four hours of YouTube and less than an hour of traditional television per day" (2)

People are not just consuming video. Remote work has become a viable option for many. Frequently this requires the use of bandwidth intensive tools such as Google Hangouts, FaceTime, Skype, WebEx etc. This is required for professionals and means that they must move to where broadband is adequate and rule out the many areas in our state that are not.

Finally, more and more people are streaming their own personal activities as video for others to watch. This is in the form of streamed video game playing, performances, talk shows, Facebook Live, and more. This interactive format requires reliable upload speeds as well.

Today it is not unusual for a family to be consuming multiple bandwidth intensive applications at the same time, in many rooms of the home. We can not simply measure bandwidth needs by the use of just one application, or even a few.

Consumers are confused and mobile broadband isn't adequate.

It may seem like the answer to rural broadband is mobile access. However the current unlimited plans are not really unlimited in the sense that a consumer would expect. Mobile plans will de-prioritize data after the user hits a certain threshold of usage in a month. This varies by carrier in the 22gb to 30gb range. (4) This cap can be hit very quickly on mobile devices. (5) After that the speeds slow down. Speeds also change when tethering to desktops or a TV, becoming far slower. (6)

Mobile speeds, availability, and reliability are simply not adequate as a primary source of Internet for consumers.

Our future is full of heavy bandwidth uses not yet considered, in places we do not expect.

Humans are not good at planning for the future. Most are probably not aware that autonomous cars are just around the corner, for example. (3) We haven't done a good job taking into account the many changing dynamics that come into play with this hugely disruptive event.

For example once we are no longer focused on the task of driving, entirely new forms of auto entertainment will emerge. The car is a remarkably well created as an entertainment hub. A captive audience, lots of speakers, and plenty of room for screens. We don't yet know what kinds of entertainment consumption will become popular. Strong contenders include live video streaming, movies, VR/AR, for example. We can guess, however, that much of it will be bandwidth intensive. While a car is in motion.

Another example of anticipated future demand is the explosion in interest and implementation of IOT. The Internet of Things. IOT is common enough now that it isn't a term used by consumers. As consumers we simply have and expect that our devices are smart and can communicate with each other. While much of our current IOT devices consume or produce very little data, that doesn't mean the future will be the same. With numerous efforts underway for smart cities, are we leaving our less urban infrastructure behind?

For these reasons and more when thinking about broadband availability we should be thinking of complete coverage, not simply covering destination zones.

Summary

We are not meeting today's needs for many citizens of New Hampshire. Our planning for the future must take into account that the needs in the future will be significantly greater in terms of both data consumption and creation. The geographic area covered must be profoundly greater than that covered are today. If people can't get what they need, they will move to areas that can serve them, furthering the migration to urban centers. This will make the economics of serving rural areas even more difficult.

Appendix:

(1) *http://corporate.comcast.com/news-information/news-feed/comcast-survey-internet-is-a-more-important-amenity-than-laundry-for-apartment-dwellers*—April 2017

(2) *http://www.visualcapitalist.com/chart-netflix-generation/*—April 2017

(3) *https://www.youtube.com/watch?v=2b3ttqYDwF0&feature=youtu.be*—June 2017

(4) *https://www.whistleout.com/CellPhones/Guides/Sprints-unlimited-plans-everything-you-need-to-know*—April 2017

(5) *https://help.netflix.com/en/node/43701*

(6) *https://www.wired.com/2017/08/verizons-unlimited-data-plan-back-heres-compares-carriers/*

Senator HASSAN. Thank you very much, Mr. Cyr.

Now, it is my pleasure to introduce Mr. Mike Reed, who is the State President for Consolidated Communications.

Mr. REED. Thank you.

Senator HASSAN. Welcome, and thank you for participating today, Mr. Reed.

STATEMENT OF MICHAEL C. REED, PRESIDENT, NORTHERN NEW ENGLAND REGION, CONSOLIDATED COMMUNICATIONS

Mr. REED. Good morning.

I am Mike Reed. As the Senator said, I am the State President for Northern New England for FairPoint Communications, now Consolidated Communications. In that role, I am responsible for government, regulatory, public relations, and economic development in Maine, New Hampshire, and Vermont.

I really appreciate the opportunity to testify today on the importance of broadband in New Hampshire.

Senator Hassan's assertion is undisputed. Access to the Internet is vital in today's economy.

Consolidated Communications may be a new name to some of you, but together with its recent acquisition of FairPoint, both companies have a long history of providing and delivering service to rural communities. The combined companies, FairPoint and Consolidated, employ 4,400 employees, is the ninth largest fiber optic provider in the country, spanning 36,000 fiber route miles in its 24 State network.

We applaud Senator Hassan's goal to further investment in broadband deployment in rural communities through efforts like the introduction of the AIRWAVES Act. The advancement of wireless broadband access will still need to be supported by a very robust wireline backbone infrastructure.

We have a very robust network backbone in this State and Consolidated-FairPoint operates that backbone. In New England, Maine, New Hampshire, and Vermont, we have about 19,000 miles of fiber in service today.

My goal of speaking with you today is to describe some of the expansion and technology upgrades that have already occurred in rural New Hampshire, including the North Country and the Monadnock Region, to meet the growing demands.

At the same time, we want to ask that your efforts to stimulate broadband investment be focused on how best to spend limited Federal dollars to provide service to the still un-served, especially in the most rural areas, making sure we do not overbuild existing networks to provide more options to people who already have the access.

Just as a couple of examples, or a few examples, of what has been going on in New England, or in New Hampshire specifically. We have, New Hampshire has, FairPoint New Hampshire has 7,200 miles of fiber across the state. We have increased maximum residential broadband speeds to about 25 meg in most markets, 50 in some selected markets, and in the Portsmouth area a gig.

We have upgraded our switching offices, switching our central offices, switching offices. We have about 120 in New Hampshire. We have Ethernet service to each one of those offices where we can offer business, education, government, healthcare up to 10 gig of service.

We have increased Internet available to locations in our footprint from 63 percent back in 2008 to about 96 percent today. And we build fiber to the wireless towers. There are about 400 wireless towers in New Hampshire that are served by FairPoint-Consolidated.

In addition to this construction, we have accepted the Connect America Fund II money. That is very important to rural New Hampshire, rural New England. We have accepted a little over $4

million a year to build and maintain 13,131 locations in areas of New Hampshire identified by the Federal mapping.

I am very happy to report that we are right on schedule. We are right on schedule with that. The goal, the milepost is 40 percent complete by the end of 2017 and we are right on target for that. Well, we are ahead of target on that.

We also agreed as part of the FairPoint Consolidated acquisition, the commitment to spend the capital expenditure dollars, the average that we have had for the last few years for the next 3 years. And in addition to that, we have targeted an extra million dollars specifically at improving service quality in areas of the state. That also is for the next 3 years.

One thing I am very proud of, we established a Community Broadband Development Team. We have worked with 45 communities here in New Hampshire. That totals about 200 communities across Maine, New Hampshire, and Vermont actually with the Keene community.

The goal of this team, they work with the communities to provide information about broadband, what the community's needs are, what they have for existing service, and we map it for the community, where the fiber is, what speeds are available in what areas of their community, and share with them everything we know about what is coming in our company. "Here is a CAF project that is coming to you, and we think it is going to be built approximately this time period."

The un-served locations we have are not un-served because we like to deny service. It is because they are harder to serve and they are more expensive. We know where the locations are and with that information, we can identify where resources and collaboration is needed.

It is imperative that the Federal dollars that we may find are used to expand our network and be very careful not to duplicate something that is already there. Unnecessarily overbuilding existing facilities can actually hinder Tier 2 investment in the private sector. That is critical.

Private sector provisioning of broadband clearly demonstrates that worthwhile investment can and is being made in the Nation's broadband infrastructure. These private sector efforts should be fostered and complemented by whatever we need now from local, State, or Federal policy.

Overall improvement of broadband infrastructure will require spending government funds wisely and providing incentives and support to help move the private investment along.

In conclusion, I want to thank Senator Hassan for inviting me to testify today and assure you that Consolidated is committed to moving broadband expansion further in New Hampshire.

Thank you.

[The prepared statement of Mr. Reed follows:]

PREPARED STATEMENT OF MICHAEL C. REED, PRESIDENT, NORTHERN NEW ENGLAND REGION, ON BEHALF OF CONSOLIDATED COMMUNICATIONS

Good morning, I am Mike Reed, President of the Northern New England region for Consolidated Communications. Thank you for the opportunity to testify before you today as to the importance of expanding broadband infrastructure in New Hampshire, especially in rural areas. Senator Hassan's assertion is undisputed—

"access to the Internet is vital in today's 21st century economy." Access to high speed broadband is no longer a luxury; it is a necessity for American families, businesses and consumers. High-speed Internet access fuels the economic engine that unlocks new ways to be more productive, compete for business, enable learning in and beyond the classroom and provide high-quality healthcare to rural communities. Network expansion and infrastructure projects provide immediate benefit for those in more rural and remote areas by enabling them to take full advantage of the digital age.

Consolidated Communications, together with the recently acquired FairPoint Communications, has a long history of delivering service to rural areas in the 24 states that we serve. The combined companies employ 4,400 employees, and is the 9th largest fiber provider spanning 36,000 fiber route miles in its 24-state fiber network. In the "old days" it was plain old telephone service (POTS). Today it is high speed broadband Internet service. Our team is dedicated to completing broadband projects and embracing new technologies that bring critical improvements to the "last mile" of Consolidated's network that will increase broadband speeds to unserved and underserved areas.

We applaud Senator Hassan's goal to further investment and broadband deployment in rural communities through efforts like the introduction of the AIRWAVES Act. As technology advances, improvements in wireless broadband access may prove to be part of the solution to the problem of ubiquitous, nationwide broadband availability. However, the old adage "wireless needs wires" will continue to hold true. The network is all connected—whether wireline, WISP, CLEC, cable or wireless, it all needs wires and wireline carriers (incumbent telecom or cable). The advancement of wireless broadband access will need to be supported by robust wireline backbone infrastructure. As alternative methods of funding broadband deployment to high-cost, hard-to-reach areas of the country are contemplated, we must be certain to efficiently use limited Federal resources by making sure all parts of the broadband ecosystem are capable of accommodating the anticipated new users and uses of the internet.

Our goal in speaking with you today is to describe some of the expansion and technology upgrades that have already occurred in rural New Hampshire (including the North Country and the Monadnock region) to meet the growing demands. In addition, we ask that your efforts to stimulate broadband investment be focused on how to best spend limited Federal resources and taxpayer dollars to provide service to the still unserved, especially in the most rural areas, rather than overbuilding existing networks to bring more options to those already served.

On a local level, Consolidated Communications is already in the rural community. Formerly as FairPoint Communications, in New Hampshire we serve over 215 towns and territories. We operate the largest fully-owned and managed fiber-based network in northern New England with approximately 19,000 miles of fiber. We have a demonstrated commitment to investing in our networks to meet the leading edge of communications services.

The following is a summary of our expansion and upgrade investments in high-speed Internet in New Hampshire. Since April of 2008, FairPoint has:

- Invested more than $75M million in communications upgrade and expansion,
- Over 7,200 miles of fiber all across the state,
- Increased maximum residential broadband speeds from 3Mbps to 25Mbps in most markets, 50Mbps in select markets, and 1Gig in Portsmouth,
- Increased Internet availability from 63 percent to over 96 percent of addresses in our territory,
- Upgraded 95 percent of central offices to enable Ethernet services of up to 10 Gbps speeds for business, education, government and healthcare needs,
- Built fiber to nearly 400 cell towers, enabling wireless services in the region,
- Accepted $4,376,606 in annual CAF II funding to reach 13,131 locations and exceeded the YE17 completion metric of 40 percent of funded locations (reported 69.71 percent on 7/1/17 for YE16),
- Accepted, as a result of the CCI–FRP acquisition, incremental capital expenditure obligations of $1M annually for 3 years for areas of the New Hampshire network that have service quality issues and/or higher than average trouble reports in order to improve basic and wholesale service,
- Established a community broadband development team who has worked with more than 45 communities in NH. The team has demonstrated the availability of broadband and the overall network infrastructure in their town or region,

known upcoming broadband expansion such as CAF II and provided a glimpse of broadband demand.

Today, Consolidated and other wireline providers have the ability to identify their remaining unserved residential locations. These locations remain unserved not out of a desire to deny service but because they are harder, and more expensive, to get to. Information about the remaining unserved locations should be used to identify where resources and collaboration are needed. It is imperative to understand the network infrastructure that is already in place and to make sure that Federal resources and taxpayer dollars are being used to expand—not duplicate—broadband network access. Unnecessarily overbuilding existing facilities can hinder vitally important private investment in broadband network infrastructure. The American Recovery and Reinvestment Act of 2009 demonstrated that such inefficient use of funding ultimately did not serve areas or expand mobile service as Congress anticipated.

Conversely, utilizing existing network resources, working together with alternative providers to get to that last mile—for example by providing necessary backhaul to support new cell tower deployments, and capitalizing on those efficiencies—for example upgrading end user bandwidth "as we go by", will result in a more expedient and cost effective expansion to those who have been without broadband for too long.

Private sector efforts show that worthwhile investment can be made in the Nation's broadband infrastructure. But instead of being competed against, private sector efforts should be fostered and complemented by local, state and Federal government policy. Overall, improving broadband infrastructure will require spending government funds more wisely by providing incentives and support for private investment.

In conclusion, I would like to thank Senator Hassan for inviting me to testify today and offer Consolidated's assistance in the furtherance of expanding high-speed Internet to the unserved and underserved in rural New Hampshire.

Senator HASSAN. Thank you, Mr. Reed.

And next, we will hear from Mr. Brian Shepperd, the Director of Broadband Services for the University of New Hampshire.

Welcome, Mr. Shepperd, and thank you for participating.

STATEMENT OF BRIAN SHEPPERD, DIRECTOR, BROADBAND SERVICES, UNIVERSITY OF NEW HAMPSHIRE

Mr. SHEPPERD. Thank you, Senator Hassan and thank you for the opportunity to speak before you on this committee.

In my role at the University of New Hampshire, I am responsible for the University System's fiber-based Wide Area Network that serves all of the USNH institutions, the community college system, as well as a number of community anchor institutions.

I will share that New Hampshire's broadband providers have made significant progress over the past few years, but we still have a lot of work to do to make sure that all of our community anchor institutions, businesses, and residents have access to fast, reliable, and affordable necessary broadband.

My past work in this area has provided some insights into ways that we can improve access and streamline deployment. So I am here to recommend improving pole attachment rules, continued funding for broadband mapping and planning, and leveraging the E-Rate program.

The first topic is pole attachments. So New Hampshire's Public Utilities Commission's Chapter 1300 rules regulate the pole attachment process in New Hampshire. As a component of the BTOP project that I managed, we hung fiber on over 24,000 poles in the state which highlighted a significant area requiring improvement.

Once that pole attachment fee has been paid to the pole owners, the make-ready process consists of the pole owner lowering their

own cable plant and then coordinating with each of the existing third-party attachers to move their own cable plant in a lengthy, and potentially costly sequential process. I have attached a diagram on Page 4.

The PUC rules require the pole owners to complete their make-ready work within 150 days and each one of the third-party attachers is allowed to set their own just and reasonable rates for their individual moves based on make-ready rules that are not really clearly defined.

As we prepare for the next decade of technology, it is critical that we streamline the pole attachment process. The upcoming transition to 5G LTE will likely place even greater demand on the poles. In the pole attachment process as microcells, we utilize both the top of the poles and the communication space for backhaul.

While the pole attachment issues exist in most states, they can be minimized by implementing the concept of One Touch Make-Ready. Certified construction crews are allowed to simultaneously make all the necessary changes to a utility pole to make it ready for a new attachment. This streamlines the make-ready process, shortens the timeline, and reduces the costs for both existing and new entrants, since it only takes one truck roll, one police detail, and one scheduler to accomplish that work.

Like New Hampshire, a number of the states also legislate their own pole attachment rules. Perhaps the FCC rules should be amended to require that those states meet or exceed the FCC timetables for pole owners and third-party attachers.

The next topic is broadband mapping and planning, which the Commissioner spoke to. We have found that our work in this area has been challenged by the low resolution of the data that is collected as part of this as one home served in a census block shows that the entire census block has been served.

We propose the providers be required to submit address-level service data so that the estimates of availability are not overstated.

In addition, there is considerable delay between when the data are submitted to the FCC and when they are made publicly available. This has resulted in efforts to enhance broadband in some areas where the providers claim has already been served because of that delay.

We also find there is a lack of full participation by some providers and we are not sure why there is no recourse for them not having to provide that data.

The planning and outreach component of our broadband mapping and planning program is challenged by a lack of resource since these programs offer data and resources which are critical to making informed decisions around broadband issues.

Ideally, there would be funds made available to continue that type of program in each state going forward.

The next topic is E-Rate and over the past 2 years, the FCC's E-Rate modernization program has placed an emphasis on high speed connections in schools and libraries.

However, there is still some ambiguity related to the providers trying to add additional strands and hitting other community anchor institutions and businesses along the path to that school.

Allowing the utilization of an E-Rate funded project to be the catalyst for further broadband expansion is a win for everybody. So I recommend that the USAC legislation be reviewed and clarified to allow, and even encourage, providers to be allowed to pay the uplift costs should they decide to provide fiber to additional community anchor institutions along the way.

Finally, I recommend that any future Federal funding be focused on the construction of high capacity, scalable networks. Fiber clearly has the greatest long term scalability. So funding projects that push fiber out closer to the rural neighborhoods and then leverage existing copper infrastructure and wireless infrastructure to complete the last mile would provide a suitable interim plan until fiber is ultimately deployed every place.

So I thank you for the opportunity to present here today.

[The prepared statement of Mr. Shepperd follows:]

PREPARED STATEMENT OF BRIAN SHEPPERD, DIRECTOR, BROADBAND SERVICES, UNIVERSITY OF NEW HAMPSHIRE,

Good morning Senator Hassan and members of the Committee. Thank you for the opportunity to appear before you to speak on this important topic.

My name is Brian Shepperd and I am the Director of Broadband Services at the University of New Hampshire. I am responsible for the University System's fiber-based wide area network, which serves all of the System's institutions, the Community College System of New Hampshire, as well as some public safety entities. I have been a member of the Governor's Telecommunications Planning and Development Advisory Committee since 2001.

I serve on the NH School Connectivity Initiative (NHSCI), created by former Governor Hassan and now continuing under Governor Sununu. Working in collaboration with the national non-profit EducationSuperHighway, NHSCI's goal is to help facilitate fiber connectivity to all of our K–12 schools, enhance utilization of E-Rate dollars, and expand the use of Wi-Fi to increase the impact of digital learning.

From 2011–2014, I was the program director for New Hampshire's National Telecommunications and Information Administration (NTIA) Broadband Technology Opportunities Program (BTOP) grant, which constructed over 850 miles of fiber optic communications cable in all 10 counties of New Hampshire. It also included a 19-site public safety broadband microwave network shared by five agencies, and a last mile fiber project in the western part of NH.

New Hampshire's broadband providers have made significant progress over the past few years, but still have a lot of work to do to ensure that all of our community anchor institutions, businesses, and residents have access to fast, reliable, and affordable broadband. My work in this area has provided insight into ways to improve access and streamline deployment. I am here to recommend improving pole attachment rules, continued funding for broadband mapping and planning, and leveraging the E-Rate program.

Pole Attachments: The NH Public Utilities Commission Chapter 1300 rules regulate the pole attachments process in New Hampshire. As a component of the BTOP project, we hung fiber on over 24,000 poles in the state, which highlighted a significant area needing improvement.

The pole attachment process begins with an applicant paying a fee for a new attachment. Once that fee is paid, the pole owners oversee the make-ready process to make room for the new attacher. This typically consists of the pole owner lowering their own cable plant and then coordinating with each of the existing third-party providers on that pole to move their own cable plant in a lengthy and potentially costly sequential process (see Attachment 1). The PUC 1300 rules require the pole owners to compete their make-ready work within 150 days and each of the third-party attachers is allowed to set their own "just and reasonable" rates for their individual moves based on make-ready rules that are not clearly defined.

During the BTOP construction process, we experienced one provider who simply refused to move their cable plant and the pole owners were unwilling to move it for them under threat of a lawsuit. The hearings related to this revealed that the PUC 1300 rules never envision a third-party attacher purposely "blocking" a new attacher from accessing the legally-obtained space on a utility pole and therefore provided no relief in the matter.

As we prepare for the next decade of technology, it is critical that we streamline the pole attachment process. The upcoming transition to 5G LTE will likely place even greater demand on the pole attachment process as microcells and distributed antenna systems will utilize both the top of the poles for antennas as well as the communications space for backhaul.

While pole attachment issues exist in most states, they can be minimized by implementing the concept of One Touch Make-Ready (OTMR). Several local governments have passed One Touch Make Ready legislation (Louisville, San Antonio, Nashville) and, while specific portions of the local statutes vary, all carry a unifying theme. Certified construction crews chosen either by the pole owners or local governments are allowed to make all the necessary changes to a utility pole to make it ready for a new attachment. This streamlines the make-ready process, shortens the timeline, and reduces costs for existing and new entrants since it only takes one truck-roll, one police detail, and one scheduler to accomplish the work.

Like New Hampshire, a large number of states also legislate their own pole attachment rules. Perhaps the FCC rules should be amended to require those states to meet or exceed the FCC timetables for pole owners and third-party attachers.

Broadband Mapping and Planning: The NH Broadband Mapping & Planning Program (NHBMPP) was established within the University of New Hampshire Earth Systems Research Center in 2010 under the auspices of the NTIA State Broadband Initiative (SBI). The Program works to improve broadband access and use in the state by assessing and mapping broadband availability, and by engaging with communities and other stakeholders around planning, technical assistance, capacity building, and training initiatives. The mapping component involves regularly accessing Form 477 provider data posted by the FCC and analyzing it to determine areas of the state that are served, underserved, or unserved by broadband.

This work is challenged by the generalized resolution in the provider data as one home connected at the census block level makes it appear as though the whole census block is served. Instead, we propose that providers be required to submit address-level service data so that estimates of availability are not overstated. In addition, there is a considerable delay between when the data are submitted to the FCC and when they are made publicly available. This has resulted in efforts to enhance broadband in areas that the providers claim are already served. We also find that there is a lack of full participation by some providers with no apparent recourse for not submitting their broadband connectivity data.

The planning/outreach component is challenged by a lack of resources. A state broadband fund and state broadband authority could provide much-needed support to regional planning commissions and municipalities in support of broadband expansion and utilization. The NHBMPP offers an important service by delivering data and resources, which are critical to making informed decisions around broadband issues in the state. Ideally, there would be funds made available to continue this type of program in each state.

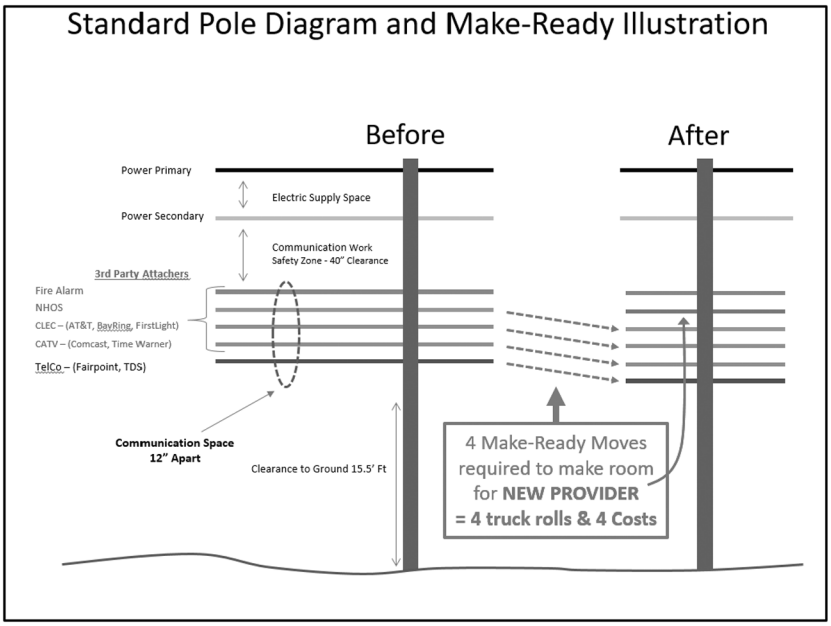
E-Rate: Over the past 2 years, the Universal Service Administrative Company (USAC) Schools and Libraries (E-Rate) Program has placed an emphasis on high-speed connections. However, there is some ambiguity related to allowing a provider to add fiber strands to a funded construction project for the purpose of serving other CAIs or businesses along the same path. At a Schools, Health, Libraries, and Broadband (SHLB) conference attended by both FCC and USAC representatives, one agency indicated it is acceptable to do so as long as the provider pays the uplift for the additional strands that are not part of the E-Rate project. In another session, attendees heard that the cost of construction for the E-Rate project should be divided proportionally between the total number of organizations served by that fiber build.

Allowing the utilization of an E-Rate funded project to be the catalyst for further expanding broadband in an area is a fiscally sound practice and should be encouraged. I recommend that the USAC legislation be reviewed and clarified to allow and encourage providers to pay the uplift costs should they decide to provide new fiber service to other CAIs or commercial interests along the way. The USDA Rural Utility Service telehealth programs allow for this type of project enhancement so perhaps that language could provide guidance to USAC.

Federal Funding: Finally, I recommend that any future Federal funding be focused on construction of high capacity, scalable networks. Fiber has the greatest long-term scalability so funding projects that push fiber out closer to the rural neighborhoods and then utilize the existing copper-based infrastructure to complete the last mile would provide a suitable interim plan until fiber is ultimately deployed everywhere.

I thank you for this opportunity to testify before you today. With permission of the Chair, I am available to answer any questions.

ATTACHMENT 1



Senator HASSAN. Thank you very much, Mr. Shepperd.

Next, we will hear from Mr. Grant Spellmeyer, who is Vice President for Federal Affairs and Public Policy at U.S. Cellular.

Welcome.

STATEMENT OF GRANT B. SPELLMEYER, VICE PRESIDENT, FEDERAL AFFAIRS AND PUBLIC POLICY, UNITED STATES CELLULAR CORPORATION

Mr. SPELLMEYER. Thank you, Senator.

I am going to attempt to talk today a little bit about the wireless side of the equation in broadband deployment.

U.S. Cellular has served New Hampshire since 1988. We employ more than 100 people and have several hundred towers constructed across the state.

My written testimony has a lot of stuff in it about the benefits of broadband and the job not being done. I am not going to spend a lot of time dwelling on that here today. You can read that.

I, instead, would offer three major points.

The first one is that the job of broadband deployment is expensive and it is not much more complicated than that. U.S. Cellular has used Universal Service Funding over the last decade to deploy more than 1,000 towers across the United States, many of them in rural areas like New Hampshire.

I will tell you that the cost to construct a tower, on average, exceeds $400,000 for us. That is expensive.

When you focus on a state like New Hampshire, and the experiences that we have had, it is quite common for us to spend more

than $1 million to construct a tower in a mountainous area. A lot of that is driven by cost to put roads in, to bring in fiber backhaul. It is an extremely expensive proposition and in many areas the customer density simply is not high enough to warrant $1 million investment, and we need to make those choices very carefully.

If you look at Page 8 of my written testimony, you will see a map and I know you cannot really see it here today. But it shows the FCC's estimate last year of the areas of the country that still lack 4G broadband service from wireless providers.

If you could see New Hampshire, you would see that the FCC identified that there was a problem in the very northern part of the state, but that is it. The data that has been there to date shows that the job is done. I know that is not true. I saw it this morning as I drove over from Manchester carrying phones from multiple providers.

I applaud Commissioner Rosenworcel's call earlier in her testimony to solicit consumer input. I know that the consumers know that the job is not done.

Let me talk for a minute about the job that remains.

Assuming this inaccurate map is, in fact, accurate, we know that the job needs at least $20 billion to finish it across rural America, and that is an awful lot of money.

Now, the good news is that the FCC has created something called Mobility Fund II. They have devoted $4.5 billion over the next decade to try to fix that gap. But $4.5 billion falls far short of the $20 billion that we believe is needed to do the job.

I hate to tell you, but it is going to get worse. There was a reference to 5G, the next generation of mobile technology, that is going to make those autonomous cars a reality.

The challenge, in most experts' opinion, is that you are going to need a whole lot more towers to deliver 5G and this rural-urban divide is only going to get worse. I think, at that point, it will be unacceptable to everyone.

I hate analogies, but somebody was reminding me of the famous scene from the movie "Jaws," where Roy Scheider is on the boat, and he looks at the captain after seeing the shark, and he says, "Captain, you are going to need a bigger boat."

I believe that is what we are dealing with here. Fundamentally, we need a bigger boat.

Bold action is needed. First, as I call for in my testimony, we need to pass the AIRWAVES Act, Senate bill 1682. It will bring that spectrum that is needed by the wireless industry and it will set aside 10 percent of the proceeds to help deal with the cost issues that I have talked about. And I hope the Senate moves quickly to adopt that bill.

In addition, the second half of that is the infrastructure package. Senator, you talked about it in your opening; certainly a significant portion of that needs to go to broadband deployment. Estimates have been that there will be a trillion dollars in that package. If we can get a small portion of that set aside for broadband deployment, it will go a long ways to getting that boat.

The third item I wanted to talk about briefly, and I will not dwell on it, is something kind of arcane but it is called contribution reform. The Universal Service System is in trouble. It is funded

based upon interstate revenues. Those revenues continue to decline as the world has moved to Internet.

For a bunch of technical reasons, it is going to run out of money in the next few years if somebody does not deal with it. And so, we certainly support efforts at the Commission. I know Commissioner Rosenworcel has been involved in those for a long time trying to fix that. We urge Congress at some point to pay attention to it as well.

So thank you.

[The prepared statement of Mr. Spellmeyer follows:]

PREPARED STATEMENT OF GRANT B. SPELLMEYER, VICE PRESIDENT, FEDERAL AFFAIRS AND PUBLIC POLICY, UNITED STATES CELLULAR CORPORATION

Mr. Chairman, Senator Hassan, and members of the Committee, my name is Grant B. Spellmeyer, and I am the Vice President, Federal Affairs and Public Policy at United States Cellular Corporation. Thank you for the opportunity to discuss ideas for expanding broadband in New Hampshire's rural areas.

I. Introduction

U.S. Cellular provides mobile wireless telephone and broadband services in nearly 200 markets across 23 states located in regional clusters across the country, including one here in New England, comprising New Hampshire, Maine, and Vermont. We serve overwhelmingly rural areas in many states represented on this committee, such as Missouri, Nebraska, Kansas, Washington, West Virginia, Oklahoma, Wisconsin, and Illinois.

Much of our business involves finding ways to build cell towers in small towns and on rural roads, areas where population density, income levels, and commercial development are often well below those in our Nation's urban areas. Consequently, we are constantly thinking about ways to address the economics of providing vital services to areas that present financial challenges to build, maintain, and upgrade.

Earlier this year, our Chairman, Ted Carlson, testified before the Senate and House of Representatives, noting that much of our Nation's business success in the 20th Century was built upon our backbone infrastructure—our rail network, our interstate highway system, our electrical grid, and our fixed line telephone system—all of which blossomed with the active engagement of the public and private sectors. This hearing is an important step toward making all of the United States more competitive in the 21st Century. While we are today focused on New Hampshire, all of rural America is racing to build super-fast broadband networks that can compete with our urban/suburban areas, as well as many other countries openly seeking to lead this information revolution.

Sparsely populated rural areas are a perfect illustration of the rule that capital flows to areas with the best conditions for investment. Nearly forty years after cell towers began sprouting up across America, some rural citizens still can't get high-quality mobile wireless coverage to make and hold a telephone call or data session, or connect to wired speeds that are comparable to urban areas in price and quality. In many areas, service exists at all only because of the various universal service support mechanisms that have improved the investment case for carriers willing to take on the challenge. According to Cisco's Visual Networking Index, there will be 12 billion mobile connected devices worldwide in 2021.[1] This challenges policymakers to foster high-quality mobile networks to ensure that these devices are all productive tools, wherever citizens need to use them.

Consumers' and businesses' reliance upon high-quality, ubiquitous mobile broadband deepens every day. For example:

- Public Safety. The ability to use 911/E–911/Text-to-911 and eventually NG911, depends 100 percent on high quality coverage, to fully enable location-based services.[2] When disaster strikes, first responders depend on mobile wireless and broadband networks, which are the first to return to service.
- Health Care. Mobile devices and applications capable of diagnosing, monitoring and treating various conditions are exploding into the marketplace and revolu-

[1] *See, https://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/vni-infographic.html.*

[2] The FCC estimates that 70 percent of 911 calls are placed from wireless phones, and that percentage is growing. *See, https://www.fcc.gov/consumers/guides/911-wireless-services.*

tionizing health care.[3] These advances improve patient outcomes, and increase efficient delivery of services, saving millions of dollars. It is now possible for a diabetic patient to continuously monitor, store, and transmit glucose levels to health care providers through a mobile device.[4] Mobile video conferencing is increasingly important to emergency medical services and in delivering health care to remote areas where facilities are not easily accessible.[5] These applications are but a small fraction of the incredible health care tools enabled by mobile broadband.

- The Internet of Things. Soon, almost any object will be capable of connecting to the Internet. Gartner expects nearly 21 billion IoT devices to be deployed by 2020.[6] According to General Electric, the Industrial Internet, defined as the combination of Big Data and the Internet of Things, may be responsible for $15 trillion (not a typo) of worldwide GDP by 2030.[7]
- Education—the Homework Gap. Students are increasingly using mobile devices to access learning materials, do homework, create presentations, and communicate with teachers. Students with connectivity throughout the community are more likely to meet educational goals, especially in an age where learning through the Internet is essential.
- Agriculture. Connected tractors, irrigation systems, livestock management, commodity tracking, and many more applications depend upon mobile wireless connectivity. By definition, these services require networks that are not measured by "road miles covered" but by actual services reaching their acreage.
- Low-income households. For households that cannot afford to purchase a desktop computer, a router, a WiFi access point, and subscribe to both mobile and fixed networks, a single mobile device is capable of meeting voice communications and Internet needs.

None of the benefits described above will be available to rural Americans unless high-quality mobile broadband coverage is available everywhere people live, work, and travel. In areas where emergency calls cannot connect, or where medical devices cannot transmit data, lives will be lost. In areas where tablets and laptops don't work, educational opportunities will be foreclosed. The enormous power of the Internet of Things cannot be fully realized without ubiquitous mobile broadband.

Below, I discuss several matters that bear on the Federal and state government's efforts to improve broadband infrastructure and services in rural New Hampshire and other places where traditional market forces have not been sufficient to deliver high-quality broadband.

II. The AIRWAVES Act Can Accelerate Broadband Deployment

U.S. Cellular was happy to see Senators Hassan and Gardner introduce S.1682, the "Advancing Innovation and Reinvigorating Widespread Access to Viable Electromagnetic Spectrum Act." U.S. Cellular has long been a proponent of an "all of the above" strategy for broadband deployment, with fiber, mobile wireless, fixed wireless, licensed spectrum, unlicensed spectrum, and satellite all having an important role in knitting together broadband networks that meet the needs of every American.

The AIRWAVES Act requires the FCC to release a steady stream of mid-band and high-band spectrum, and to move quickly to complete the Spectrum Frontiers proceeding, which will free up several blocks of high-band spectrum key to small cell deployments. By giving the FCC specific deadlines for completing auctions, it allows the FCC to put spectrum to use promptly, removing external pressure on the Commission to schedule auctions to maximize revenue while providing potential bidders with increased certainty to plan for future auctions. This is the right policy choice

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[3] An updated list of hundreds of approved mobile medical applications can be found at: *https://www.fda.gov/MedicalDevices/DigitalHealth/MobileMedicalApplications/ucm368784.htm.*

[4] *http://www.dexcom.com/g5-mobile-cgm.* Someday soon, patients may wear a contact lens that constantly measures glucose level through tears, transmitting the data to attending physicians. *See, https://verily.com/projects/sensors/smart-lens-program/.*

[5] The FCC's Connect2HealthFCC initiative is a powerful example of how broadband data can be used to improve health care. *See, https://www.fcc.gov/about-fcc/fcc-initiatives/connect2healthfcc; https://www.fcc.gov/reports-research/maps/connect2health/#ll=39.909736,-95.039063&z=4&t=insights&inb=in_bb_access&inh=in_diabetes_rate&dmf=none&inc=none&slb=90,100&slh=10,22;* and *https://www.fcc.gov/document/commissioner-clyburn-continuation-connect2health-task-force.*

[6] *See, https://www.gartner.com/doc/3558917/forecast-internet-things—endpoints.*

[7] *See, http://www.ge.com/digital/sites/default/files/industrial-internet-insights-report.pdf.*

because the economic and long term societal benefits of putting spectrum to use far exceed whatever short-term auction revenues might yield.

U.S. Cellular is also pleased to see that ten percent of AIRWAVES Act auction proceeds will be set aside for deployment of rural infrastructure. This reflects a Congressional policy priority—to develop a steady stream of auction proceeds that can target places most in need of infrastructure development. As discussed below, Federal and state governments have not sufficiently funded universal service and other mechanisms to meet the demand for broadband networks in rural America. Congress has set aside proceeds in the past for spectrum clearing and other salutary purposes; this is a smart policy choice that will have lasting benefits. U.S. Cellular supports the AIRWAVES Act, and welcomes other opportunities to make additional spectrum available for use in rural America.

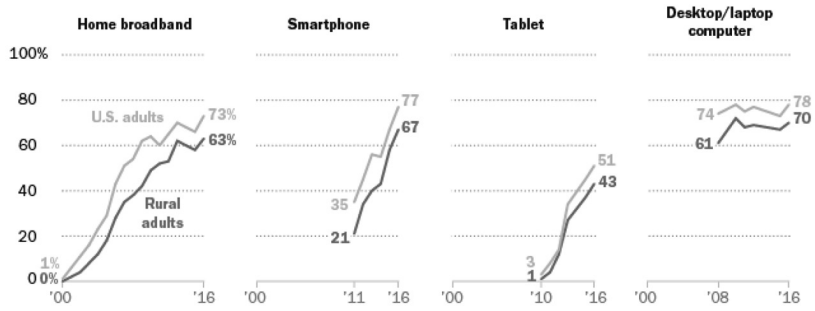
III. Congress, the FCC, and the States Must Attack the Digital Divide

A. Expand Universal Service to Meet an Urgent Need

Building infrastructure in America, whether it be roads, electricity, water, or broadband, is a really big job. The past forty years have seen dramatic growth in our Nation's capabilities, with multiple fixed, mobile, and satellite technologies being deployed, and more on the near-term horizon. Yet, at a time when 5G and the Internet of Things are just around the corner, many rural Americans remain significantly behind, limiting opportunities for education, economic development, health care, and much more. Recently, the Pew Internet Survey found that the persistent Digital Divide remains, with rural Americans lagging eight to ten points behind their urban counterparts in four different categories.[8] Americans living on Tribal lands are much farther behind.

Despite growth, rural Americans have consistently lower levels of technology adoption

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



Source: Survey conducted Sept. 29-Nov. 6, 2016. Trend data from other Pew Research Center surveys.

PEW RESEARCH CENTER

From U.S. Cellular's perspective, the cost of leaving rural Americans behind has not been sufficiently studied. There is an enormous productivity and economic cost to the Nation from lost educational opportunities, poor health care outcomes, and business and population migration out of rural areas. Moreover, only recently do we get a sense that Federal and state policymakers are fully embracing a sense of urgency must be brought to bear with respect to broadband.

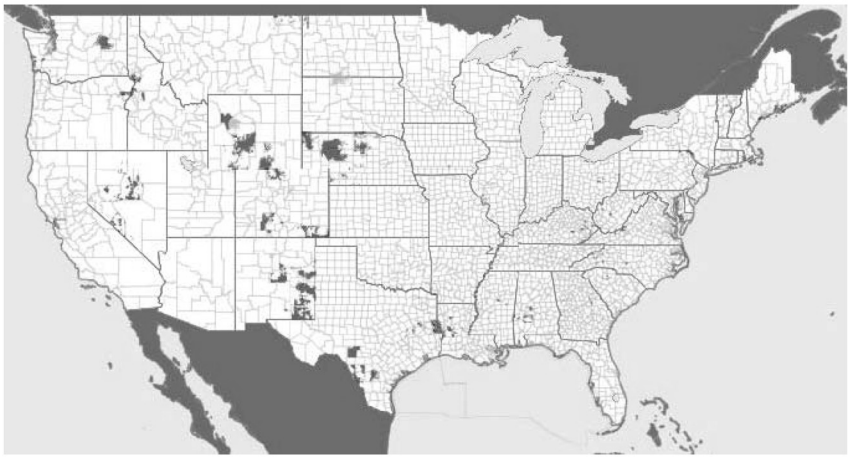
And urgency is what is needed. While the FCC's universal service mechanism is the best tool for attacking the Digital Divide, as a tool I would describe it as a shovel, when what is needed is a dump truck. To illustrate, CostQuest Associates recently did a study to identify areas of the country that lack 4G LTE service. Their map, identifying areas lacking 4G, is below (purple areas lack 4G):

[8] *See, http://www.pewresearch.org/fact-tank/2017/05/19/digital-gap-between-rural-and-non rural-america-persists/.*



CostQuest's model predicted that it will cost $12.5 billion in capital expense to improve our Nation's mobile network to 4G, with an annual maintenance capital expense of $1 billion and an annual operating expense of $1 billion.[9]

In its Mobility Fund Phase I program, the FCC allocated $300 million to improve broadband in rural America, about two-thirds of which was actually disbursed. The FCC's auction methodology awarded support to the lower-cost areas first and the higher-cost areas last. As a result, auction funds were exhausted before mountainous terrain such in New Hampshire were reached, that is, there were no winning bids awarded in New Hampshire in Mobility Fund Phase I. The resulting coverage can be seen on the map below.[10] The blue represents winning bids in rural areas and the green represents winning bids on Tribal lands.



For Mobility Fund Phase II, the FCC proposes to invest up to $4.53 billion, spread over a ten-year period. If CostQuest's estimate is accurate, it is not close to covering a $12 billion construction cost, plus $20 billion more in operating expenses. We should reach agreement on what it will cost to reach ubiquitous 4G, and how much

[9] CostQuest Associates, *Cost Study for Unserved 4G Areas* (2017) at: *https://ecfsapi.fcc.gov/file/10218108506527/2017%200216%20CQ%20Cost%20Study%20for%20Unserved%20Areas%20FINAL.pdf.*

[10] *See, http://apps.fcc.gov/auction901/map/auction_result_ext.html.*

of that should be borne by our universal service support mechanism, divide that amount by five years, and get it done.

We have a sense of urgency because if the FCC stays on the same trajectory, in ten years rural Americans will likely suffer a wider Digital Divide in a 5G (or 6G) world than they do today in the 4G world, especially as 5G is expected to build upon 4G networks. CostQuest has estimated several 5G deployment scenarios for the US, with total capital investment ranging from $61 billion to achieve ubiquitous coverage to $250 billion to deploy a network capable of autonomous vehicle support and future demand.[11] In rural areas, private and public investment will be required to achieve a service level reasonably comparable to that which will come to urban areas. If you're watching what Google, Tesla, and all major auto manufacturers are doing with autonomous vehicles, it is not too early to be considering these issues. In fact, this Committee advanced major autonomous vehicle legislation just last week.

The good news is, we don't need a new law to make progress. Congress gave the FCC an unequivocal goal, to use its Federal universal service mechanism to ensure that rural Americans have access to advanced telecommunications and information services that are reasonably comparable to those available in urban areas, both in quality and price.[12] Congress ordered the FCC to deploy universal service funds sufficient to do the job, and it never capped what the FCC could invest.

And yet, at a time when rural areas need to catch up, the FCC's Mobility Fund II plan is not big enough—it is not visionary. Mobile broadband networks in rural America are not prepared to deliver the volume of traffic that is coming. Any area lacking the necessary capabilities will not be a candidate for business growth, nor will it be a place with world class health care or educational opportunities.

B. Include Direct Investments in Broadband in any Infrastructure Bill

The current administration has discussed an infrastructure bill, with as much as $1 trillion in investments in all manner of roads, bridges, airports, electrical grids, and broadband. We urge the Commerce Committee to take the lead and bring forth direct spending measures that improve our Nation's fixed and mobile broadband infrastructure. New investments in mobile broadband infrastructure each year will have multiplier effects, creating jobs and stimulating economic growth.[13] One wireless industry job supports over six additional jobs in the economy, almost one and one half times higher than U.S. manufacturing sector jobs support.[14] Each dollar of investment in wireless results in $2.32 of economic activity.[15] We hear directly from our employees and customers that managers and educated professionals no longer consider rural areas that lack high-quality mobile broadband services attractive enough to relocate to, or to stay in.

In U.S. Cellular's experience, an infrastructure bill that focuses only on streamlining tower siting regulations and lowering overall barriers to entry, while salutary, is not nearly enough. In our experience, with the exception of lands controlled by government agencies such as the U.S. Forest Service or Bureau of Indian Affairs, rural communities want service so much that getting permits is usually a non-issue. These communities need an infrastructure bill that targets investment in towers, telecommunications equipment, electronics, fiber, backup facilities, and related material. Nothing short of a "Marshall Plan" for broadband in rural America is required.

If we want to maximize our Nation's capability and to complete globally, all sorts of investment in "public works" projects are required. Let's make sure broadband leads that list. It is a fundamental investment in our future.

C. Fix the Broken Contribution Mechanism

A big problem hindering the FCC from effectively attacking the Digital Divide is the broken universal service contribution mechanism, which takes a bigger bite out of a smaller pie every year. The levy is now almost 20 percent of a consumer's

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[11] *See,* Cost Quest Associates, *The 5G Mobile Ubiquity Price Tag Costs for Full U.S. Deployment Of 5G—With and Without Support for Autonomous Driving* (2017), at: *https://www.costquest.com/uploads/pdf/5g-mobile-ubiquity-costs-summary.pdf.*

[12] *See,* 47 U.S.C. § 254(b)(3).

[13] *See, http://www2.deloitte.com/content/dam/Deloitte/us/Documents/technology-media-telecommunications/us-tmt-impactof-4g-060612.pdf.*

[14] *See,* Coleman Bazelon and Giulia McHenry, *Mobile Broadband Spectrum, A Vital Resource for the U.S. Economy* (May 11, 2015) at pp. 19–20: *http://www.brattle.com/system/publications/pdfs/000/005/168/original/Mobile_Broadband_Spectrum_-_A_Valuable_Resource_for_the_American_Economy_Bazelon_McHenry_051115.pdf?1431372403.*

[15] *Id.*

"interstate telecommunications revenue," which revenue could fall to zero in the near future.

This issue is a creature of a statute written 21 years ago, when our communications services were separated into two buckets. In an all-IP world where we are headed, we need a statute that upholds all of Commissioner Rosenworcel's four pillars of telecommunications policy—public safety, universal access, competitive markets, and consumer protection.[16] We need to recognize that an effective universal service mechanism is critical to achieving the other three for rural Americans.

If we as a society value universal access to broadband, then it makes sense to assess all connections. Indeed, this is the core concept of universal service, that everyone contributes to the network, which is far more valuable to our society when everyone has high-quality service. That said, contributions in an all-IP world is politically difficult for the FCC to implement. For well over a decade, the Federal-State Joint Board on Universal Service has been wrestling with how best to reform the contribution mechanism and we hope to see a recommendation soon.

Over the past several years, both the House and Senate have begun drafting various reforms to the 1996 Telecom Act. If a bill moves, fixing contributions must be a part of it, to convey to the FCC clearly our Nation's priorities for funding rural infrastructure.

D. Tax Adjustments, Siting on Federal Lands, and "Dig Once" Can Increase Universal Service Investments

Congress can make all universal service fund support go farther by passing legislation to exclude universal service support from taxable income, similar to funds provided under the American Recovery and Reinvestment Act. By excluding support from taxation, we will be able to use 100 percent of the support received for investments in rural areas, and not just the net amount after taxes. If enacted before the Mobility Fund II auction, this change would stretch available Federal support further, as bidders will be able to target their bids based on the cost of providing service, without including a multiplier for tax payments.

In addition, "dig once" policies for any Federal infrastructure investment that supports installation of underground conduit and fiber when building or renovating roads, railways, pipelines, utility infrastructure, and energy distribution channels. I understand that dig once can reduce the cost of fiber installation by as much as 90 percent.

Over three decades after the inauguration of cellular telephone service, the ability to obtain rights of way on Federal lands continues to be a significant burden for carriers. Legislation that standardizes requirements for obtaining rights of way, such as that contained in S. 19, the MOBILE NOW Act, co-sponsored by Senators Thune and Nelson, can help to reduce costs and delays involved in operating on Federal lands and is an important first step. We would be happy to see that language incorporated into any infrastructure bill or promptly passed by the House of Representatives where it sits today.

In closing, we believe that infrastructure investments multiply opportunities. For example, when we build a rural tower that is served by fiber, the surrounding community benefits from being able to use our mobile wireless network. Other mobile carriers, including public safety networks, can co-locate on our tower, increasing competition and improving public safety. In addition, the newly deployed fiber can branch off to deliver fixed broadband to homes, businesses, hospitals, and schools. Every business in the coverage area instantly becomes more competitive, having tools they need. All of our citizens have a strong desire to access high-quality modern telecommunications and information services, and we ask policymakers to help us make these rural networks reasonably comparable to those in urban areas.

Thank you for the opportunity to testify here today.

Senator HASSAN. Thank you very much, Mr. Spellmeyer.

And now, to Mr. Tom Strickland, who is President and Co-owner of Sequoya Technologies.

Good morning, and again, thank you for joining us and thank you for being a great business in New Hampshire.

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[16] *See, e.g., https://apps.fcc.gov/edocs_public/attachmatch/DOC-318723A1.pdf.*

STATEMENT OF TOM S. STRICKLAND III, PRESIDENT AND CO-OWNER, SEQUOYA TECHNOLOGIES GROUP, LLC

Mr. STRICKLAND. Good morning.

Senator Hassan, thank you for this opportunity to come before you and the U.S. Senate Commerce Committee to share my experiences as a technology provider helping other businesses in northern New England succeed in the Information Age.

I am President and Co-owner of Sequoya Technologies Group in Peterborough. I have been in the technology industry since 1978 in roles ranging from software development, to infrastructure management, and consulting.

I also served on the Board of New Hampshire FastRoads, which built a fiber optic open network to provide middle mile and last mile services in rural areas of western New Hampshire.

Sequoya was formed in 2002 and provides comprehensive technology services to businesses headquartered in northern New England and to their regional offices throughout the country. For most of our clients, we manage every aspect of their technology and are often directly involved in recommending, procuring, and managing broadband services for our clients. Thus, we are intimately familiar with the challenges of obtaining these services in our area.

Quality, high speed broadband has become as essential to business growth today as rivers were in the 18th and the 19th centuries, and as interstate highways were in the 20th.

Some of the largest and most successful businesses in the U.S. do not sell any physical products. Virtually everything that Google and Netflix sell is delivered over the Internet. These businesses could be located anywhere that people want to live and work, and where quality broadband is available.

While it is true that these established businesses have the resources to build high speed Internet virtually anywhere they choose, the next Google or Netflix will only locate where high speed Internet already exists. My own business could not exist without the Internet.

Even businesses that ship physical products depend on the Internet to connect with their customers, their suppliers, and the advanced cloud technologies that can give them a competitive advantage.

Over the last 30 years, the Internet has evolved from a science network used only by geeks to a utility service that businesses depend on. Unfortunately, that rapid evolution of technology has outpaced the regulatory framework needed to keep it running efficiently and ensure that all businesses compete on an equal footing.

I want to recount specific instances where the lack of broadband regulation has caused significant problems in obtaining service.

During the New Hampshire FastRoads network deployment, we frequently encountered sluggish responses to pole permit requests when those poles were owned by competing services. Regulations to prevent this type of obstruction would encourage network growth and competition.

Lack of Universal Service for broadband has resulted in the balkanization of the market and leaves small towns at a disadvantage when negotiating service agreements with carriers.

For example, one of my employees lives in Rindge, New Hampshire in an area with about 100 homes. His area is separated from most of Rindge by a lake and there is no land route to the rest of Rindge where cable Internet is provided by Argent Communications. However, he is one-half mile from Comcast service in Jaffrey.

My employee will not be served by either of these carriers because Argent cannot cross into Jaffrey and Comcast cannot cross into Rindge. As a result, he and his 100 neighbors are limited to DSL service that performs poorly.

Lack of transparency makes it difficult to determine which carriers can serve a particular location and delays installation. Most carriers consider their network maps to be intellectual property and do not share them. Thus, we must inquire of each carrier and wait for field surveys to be completed.

One of our clients is a power plant in the center of Berlin, New Hampshire. When the plant came online in 2013, we had to wait several months for a fiber optic line to be extended to them. During that time, the plant had to rely on cellular Internet service that was expensive and slow.

This same lack of transparency impacts the cost of construction when infrastructure must be extended. I have received quotes ranging from $0 to $50,000 to extend cable Internet less than one-quarter of a mile along a State highway. These quotes were from the same carrier in locations 2 miles apart. Just this morning, we received a quote of $6,700 to extend service about 200 yards.

Kimball Physics was started in Wilton, New Hampshire 40 years ago by a group of physicists from MIT and employs 70 well-paid, high tech workers. They produce electron optics that are used to manufacture most of the high density integrated circuits worldwide.

When they started the business, Internet service was not necessary. Today, it is essential, but because of their rural location, they are faced with spending $250,000 to extend fiber optic service to their facility.

An established, successful business can afford that and might choose to do so in order to stay here and keep the quality of life they value. New businesses will look elsewhere and these high pay, low impact businesses are the ones we want.

Businesses need high quality, low latency connections with service level guarantees and symmetric bandwidth delivery. Unfortunately, many in rural areas have no choice other than consumer grade service, which is inadequate for access to the cloud services their competitors in other areas take for granted.

In the state of New Hampshire, towns are prohibited from bonding to build broadband infrastructure. A community that wishes to solve the broadband problem for itself cannot reasonably do so.

The lack of a regulatory framework at the Federal level to ensure universal and equitable service for everyone, combined with State level prohibitions on bonding, leaves the people and businesses of New Hampshire at an unfair disadvantage when competing with the rest of the Nation.

In conclusion, I encourage the Committee to act quickly to establish the regulatory framework needed to encourage the deployment

of broadband infrastructure to New Hampshire and to the rest of the United States.

Our businesses need these services to flourish and compete with the rest of the world.

[The prepared statement of Mr. Strickland follows:]

PREPARED STATEMENT OF TOM S. STRICKLAND III, PRESIDENT AND CO-OWNER, SEQUOYA TECHNOLOGIES GROUP, LLC

Senator Hassan, thank you for this opportunity to come before you and the U.S. Senate Commerce Committee to share my experiences as a technology provider helping businesses in New Hampshire and northern New England obtain quality broadband Internet service to support and grow their businesses.

I am Tom Strickland, President and Co-owner of Sequoya Technologies Group in Peterborough, NH. I have been in the technology industry since 1978 in roles ranging from software development to infrastructure management and consulting. I studied electrical engineering at the University of Oklahoma and received a BS in Computer Science from Franklin Pierce University.

From 2011 to 2015 I also served on the board of New Hampshire FastRoads, which built a fiber optic open network to provide middle-mile and last-mile service in rural areas of western New Hampshire.

Sequoya Technologies Group was formed in 2002 and provides comprehensive technology services to businesses headquartered in northern New England and to their regional offices throughout the country. For the majority of our clients, we manage every aspect of their technology, including on premises infrastructure, helpdesk, and management of 3rd party technology vendors. In this role, we are often directly involved in recommending and procuring broadband services for our clients so we are intimately familiar with the challenges of obtaining these services in rural New Hampshire.

Quality, high-speed broadband has become as essential to business growth today as rivers were in the 18th and 19th centuries and as interstate highways were in the 20th. Some of the largest and most successful businesses in the United States don't sell any physical products. Virtually everything that Google, Netflix, and many others sell is delivered over the Internet. These businesses could be located anywhere that people want to live and work and where quality broadband is available. And, while it is true that these established businesses have the resources to build high speed Internet virtually anywhere they choose, the *next* Google or Netflix will only locate where high speed Internet already exists. My own business would not exist without the Internet communications infrastructure that connects my office to each of my clients. Even more traditional businesses that ship physical products depend on the Internet to connect with their customers, their suppliers, and the advanced cloud technologies that can give them a competitive advantage.

Over the last 30 years, the Internet has evolved from a science network used only by geeks to a utility service that businesses depend on. Unfortunately, that rapid evolution of technology has outpaced the regulatory frameworks needed to keep it running efficiently and ensure that all businesses compete on equal footing.

There have been specific instances where the lack of broadband regulation has caused significant problems in obtaining service.

In my role with New Hampshire FastRoads, we frequently encountered sluggish responses to our pole access permit requests when those poles were owned by competing services. Delays were not excessive when the poles were owned by entities like PSNH, who did not offer competing services. Regulations to prevent this type of obstruction would encourage network growth and competition.

Lack of universal service for broadband has resulted in balkanization of the market. For example, one of my employees lives in Rindge, NH, in an area with about 100 homes. This particular area is separated from most of Rindge by a lake so there is no land route from Rindge proper to his area. However, he is ½ mile from the town line with Jaffrey, NH. Rindge has a franchise agreement with Argent Communications. Jaffrey is served by Comcast. My employee won't be served by either of them because Argent can't cross into Jaffrey and Comcast can't cross into Rindge. As a result, he is limited to DSL service at the distance limit of that technology and, at best, gets 1.5Mbps service.

Lack of transparency makes it difficult to determine which carriers can serve a particular location and delays procurement of service. Most carriers consider their network maps to be intellectual property and do not share them. Thus, we must inquire of each carrier and wait for field surveys to be completed. One of our clients

is a power plant in the center of Berlin, NH. When the plant came online in 2013 we had to wait several months for an Internet line to be extended to serve them. During that time, the plant was forced to rely on cellular Internet service that was expensive and slow.

The opening of my own new office in 2012 was almost delayed due to lack of Internet service. The carrier that had surveyed our location and assured us of service months in advance, neglected to tell us that the actual delivery of their service would take 6 months rather than the 2 weeks that is typical.

This same lack of transparency impacts the cost of construction when infrastructure must be extended. I've received quotes of over $50,000 to extend consumer-grade cable Internet for ¼ mile along a state highway and offers to build similar extensions at no charge and for comparable services. These quotes were from the same carrier in locations 2 miles apart.

Kimball Physics was started 40 years ago by a group of physicists from MIT in Wilton, NH. They manufacture ultra-high vacuum electron optics that are used on the International Space Station and around the world. When they started the business, Internet service wasn't necessary. Today, it is essential and, as a result, they spent $100,000 to extend fiber optic service to their location. An established business can afford to do that and might choose to do so to stay here and keep the quality of life they value. New businesses will look elsewhere.

Businesses need high quality, low latency connections with service level guarantees and symmetric bandwidth delivery. A consumer connection that provides 25Mbps down and 5Mbps up with 80ms latency and 99 percent uptime is fine for watching Netflix at home, but it is not sufficient for a business that needs to upload large files or access cloud hosted servers. Mission critical applications and bandwidth-sensitive services like VoIP don't work reliably on consumer-grade Internet service. Unfortunately, most businesses in rural areas have no choice other than a consumer-grade service at business-grade prices. And, while DSL is still considered broadband, our experience is that DSL technology rarely, if ever, delivers the kind of service businesses need today. The lack of business-grade Internet services means that businesses in our region cannot make use of the cloud services their competitors in other areas take for granted.

In the State of New Hampshire, towns are prohibited from bonding to build broadband infrastructure. A community that wishes to solve the broadband problem for itself, cannot reasonably do so. If towns could not issue bonds to build roads or water lines, we would find that unacceptable. The lack of a regulatory framework at the Federal level to ensure universal, and equitable, service for everyone combined with state level prohibitions on bonding leaves the people and businesses of New Hampshire at an unfair disadvantage when competing with the rest of the Nation.

In conclusion, I encourage the committee to act quickly to establish the regulatory framework needed to encourage the deployment of broadband infrastructure to New Hampshire and to the rest of the United States. Our businesses need these services to flourish and compete with the rest of the world.

Senator HASSAN. Thank you very much, Mr. Strickland.

I do have a number of questions that are really intended to help us delve a little bit deeper into the topics that you all have raised so well, and I am very, very grateful for such comprehensive and thoughtful testimony.

What I will do, as I raise questions, is I will tend to direct the question to a panelist or two, but I will try also to give you all an opportunity, if there something you want to add, after I have asked a couple of people. So if, for some reason, I do not notice that you are interested in addressing something, feel free to be vigorous and we will make sure that we hear from everybody.

And people should know too that because this is a congressional hearing, we will limit the questioner to me, but we have asked people from the community for questions as well, and I will be raising some questions on behalf of community members, so that we can get those in the record. You will hear at the end of the hearing the process for keeping the record of this congressional hearing open for 10 days so people can comment further.

I want the community to know I started in public life in the New Hampshire State Senate, and what we would do in the New Hampshire State Senate is members of the community would sign in and be asking questions themselves. So this is an adjustment for Granite Staters.

I am very appreciative of everybody who is here and hope very much that if you have follow-up questions, you will submit them to us.

My first question concerns the AIRWAVES Act that Senator Gardner and I have cosponsored, and I will start with this question to you, Commissioner Rosenworcel. First of all, again, thank you for coming.

I wanted to get your feedback on the importance of the AIRWAVES Act, which I introduced earlier this year with Senator Gardner. This bipartisan legislation would enact a spectrum pipeline to meet the needs of a 5G America. It would provide additional unlicensed spectrum to benefit our Nation's entrepreneurs and innovators, and the AIRWAVES Act would make meaningful investments in rural broadband.

Can you elaborate on what this bill can do for the United States, and particularly for rural America?

Commissioner ROSENWORCEL. Again, thank you for having me here. Coming home is not a hardship assignment.

The most important infrastructure we have today is invisible. You do not see it. It is the airwaves all above us. It is how we are building our wireless future, and Congress and the Federal Communications Commission participate in the zoning of those airwaves.

If we figure out how to organize them in a way that we can cram more activity into our skies, we will all be better off. Our devices will work in more places. We will have more things that are connected in ways that will make us more effective and efficient.

The first thing we need to do to make that happen is get more spectrum to market. It might seem to be a simple thing, but I think the greatest benefit of the AIRWAVES Act is the fact that you put deadlines on getting that spectrum to market.

Just talking about it is nice, but putting deadlines on getting that spectrum into the market will make an enormous difference in rural and urban America.

Senator HASSAN. Well, thank you.

Mr. Spellmeyer, can you talk a little bit about your company's work to begin to plan for and deploy 5G? How does the wireless industry generally view the importance of 5G to our Nation's wireless networks?

Mr. SPELLMEYER. Thank you, Senator.

Certainly U.S. Cellular, and all the major wireless carriers are busily working and preparing for the arrival of 5G. Testing is underway. U.S. Cellular has done some testing and has extensive discussions with the manufacturers. Some of the largest carriers actually have field tests underway.

So we need equipment that works. We need access to the spectrum. Some of that has been auctioned. Some of it will be auctioned. If the AIRWAVES Act gets passed, more of it will become

available on tight timeframes. That is all going to have to come together.

As I said in my oral comments, I think the biggest challenge for the arrival of 5G in rural America is the significant need for new towers; five, ten, fifteen-fold over what exists today.

The economics of that are really going to be the biggest barrier to its arrival in most of New Hampshire.

Senator HASSAN. Thank you.

One of the purposes of the AIRWAVES Act is to make sure that the United States can maintain its leadership in advanced wireless networks.

Can you comment on why that is so important?

Mr. SPELLMEYER. Well, it is important for a number of reasons, but I think the biggest of which is for device availability.

We have been active. There is a whole set of global standards setting bodies that deal with the operation of spectrum across the globe. We need international harmony with what is going on around the world so that device manufacturers like Apple can build affordable devices that work everywhere.

Senator HASSAN. Thank you.

Mr. Cyr, I wanted to touch base with you because as we know, 5G networks will bring with them lower latency and higher capacity. Many believe these benefits will be particularly important for the Internet of Things and other sensing technologies.

Do you expect startups to take advantage of these networks in the near future?

Mr. CYR. Well, absolutely. I think for any startup, you find what the problem is and then you create a solution for that.

And so, there are so many problems that have been identified and we are just simply waiting for the technology to catch up so that we can produce that solution. So I have no doubt that there is going to be strong demand for that.

Senator HASSAN. Thank you.

Would anybody else on the panel like to comment about the AIRWAVES legislation?

Mr. REED. I will just add, Senator, that as Mr. Spellmeyer needs more towers, we have to make sure that we have the internal infrastructure in the state to serve those towers.

Mr. SPELLMEYER. Those towers require fiber, and they are on the mountain, and they are not inexpensive to build.

Mr. REED. We have the core base in our state available today. We will just continue to enhance that and expand it as needed to serve those towers.

Mr. SPELLMEYER. That is a critical piece.

Senator HASSAN. Thank you.

Anyone else?

I will move onto the subject of network resiliency. Again, I will start with you, Commissioner.

We had an unbelievably difficult and challenging hurricane season and while the impacts of those recent hurricanes are still weighing very heavily on many of our hearts and minds, I would like to talk a little bit about emergency preparedness and network resiliency.

What is the FCC doing to ensure that our networks are resilient and that the cable, telephone wires, and fiber are secure?

Commissioner ROSENWORCEL. Thank you. This is an important question.

We are doing some things. I think we should be doing more because if you have seen those images of what the wind and rain have done in Texas, Florida, Puerto Rico, and the Virgin Islands, you realize Mother Nature can be awfully destructive.

Senator HASSAN. Yes.

Commissioner ROSENWORCEL. And I think it is incumbent on the FCC now to understand what the impact of these weather events has been on our Nation's networks because one thing is clear to me, we do not have recovery if we do not recover communications.

And so, I have asked for the agency to hold field hearings in these locations so that we can learn from these events. And make sure we take that knowledge about best practices for network resiliency and recovery, and put them to work. Because one thing is for sure, we are definitely going to have other weather events in the future, and what we can learn from these events that have just occurred is really important.

Senator HASSAN. Thank you.

I know from our office's perspective, dealing with constituents who had medical emergencies after these hurricanes hit—and the limitations of communications because of the devastation on the networks—really prevented absolutely critical communication about medical events, among many other things.

So I agree with you that field hearings would be a really important way for the Commission to begin to understand the impact of these weather events.

What do you hope as a regulator, Commissioner, that communication companies are doing about resiliency as they design and build their networks?

Let me just add, what do you expect from the communications companies? And then also, what kind of consumer education do we need along with that about resiliency issues?

Commissioner ROSENWORCEL. Yes. There is so much in that question. Let me just point out something, though, that is simple and fundamental.

More of our networks now rely on commercial power than ever before. It used to be that if we had a hurricane or a big snowstorm and everything failed, you could pick up your copper line and your telephone, and it would work.

Senator HASSAN. Yes.

Commissioner ROSENWORCEL. But now, we have to charge. We have to stay charged. We have to make sure that our cell towers have power too.

Senator HASSAN. Right.

Commissioner ROSENWORCEL. And so, what we have is a more powerful communication system, but it is more reliant on commercial power.

So figuring out how we all better prepare for it with solar charger backup batteries is important from the consumer perspective.

From the provider perspective, we need to figure out, especially in storms and the like, how we make sure that there are backup

generators that are available, and that those providers of service get priority for getting fuel when there is an emergency and we need recovery.

Senator HASSAN. Thank you.

Mr. Reed and Mr. Spellmeyer, how do you build resiliency into your networks as you deploy and maintain connectivity in New Hampshire?

Mr. Reed, why do you not go first?

Mr. REED. I can start that.

I mean, our network originated in the original Bell System and it is built to be very resilient. The improvements in the technology——

I mentioned in New Hampshire, we have 120 switching offices. They all have backup, emergency backup, immediate battery power, and then a generator that will last for as long as it needs to.

Many of the remote locations, as we are expanding our network further and further out, if you need faster speeds, we have to move that switching equipment closer to you. And as the speeds improve, increase, for example, 25 over, 50 over 20 is about 1,600 feet on copper, 1,650 feet.

So as these remotes move further and further out, many of them have battery backup power as well. Some have permanent generators. Some have portable generators that we move as needed.

More important than that is the design of the network for the resiliency. Self-healing rings. Maine, New Hampshire, and Vermont are all tied together. Somebody mentioned Berlin, I think. We go right up through Rangeley, Maine over through Errol into Berlin. That is part of the network that ties those three states together, as well as diverse routes.

Once we have service in the state, we have to get to the world. So we go to Boston. We go to New York City. So there are multiple avenues.

But design of the network for that redundancy, and then the emergency backup power has always been a very key issue in our business.

Senator HASSAN. Thank you.

Mr. Spellmeyer.

Mr. SPELLMEYER. So for U.S. Cellular, we are lucky enough, I can say that we were not directly impacted by any of the recent hurricanes that hit the southern states. However, we certainly have dealt with hurricanes in the past.

The flooding last year in West Virginia and the wildfires that are going on in the West right now, it is a continuing challenge for wireless carriers.

Following Hurricane Katrina, the FCC adopted rules that required wireless carriers to provide backup battery and power to cell sites. Those rules were subsequently challenged in court.

While that court challenge was ongoing, U.S. Cellular made the decision that we would, nonetheless, proceed and put backup battery power on each and every one of our cell sites across the country. And I think that number is in excess of 6,000.

So we have what we think is an industry-leading backup plan in place and we see it when we experience outages, that they are

minimized, and we are very proud of that. It has served us well and I think that is why we are able to attract and maintain customers.

That said, there certainly are challenges even to that. I know when Hurricane Sandy hit a couple of years ago, there were plenty of stories about carriers, mainly in urban markets, running on diesel generators, but those diesel generators require fuel. And there were plenty of stories about carriers not being able to get fuel to backup power sources in some instances because it was commandeered by the National Guard for other purposes and all kinds of stuff.

Senator HASSAN. Yes.

Mr. SPELLMEYER. So it is a very complex equation, but we are proud of the work we have done.

Senator HASSAN. Well, thank you.

I will follow up a little bit just because it strikes me that states like New Hampshire can pose some particular challenges on the resiliency front just in terms of the wide range of weather events that we can have.

So on the one hand, we are talking about hurricanes right now. On the other hand, blizzards can also present a particular kind of challenge.

Are there differences in terms of what you have to prepare for in these various kinds of weather challenges? And do states with this kind of variation in weather pose particular problems?

Mr. SPELLMEYER. Yes, they do. I am not sure I am equipped to give you the world's best answer on all of those differences.

Senator HASSAN. Yes.

Mr. SPELLMEYER. We serve Oklahoma where the tornadoes come out of nowhere with no notice. We serve mountain areas where you may have 3 days' warning that a storm is coming, and you will see our network guys go out and deploy fuel to generators and put things in place.

Senator HASSAN. Right.

Mr. SPELLMEYER. So it is a variety of different factors. Certainly, these hurricanes that hit the Caribbean look like they just wiped the ground clean.

Senator HASSAN. Yes.

Mr. Reed, do you want to add?

Mr. REED. Sure. I can add to that.

We talked about, Mr. Shepperd here, mentioned poles. That is one of the reasons that we have very strict rules about poles and attachments. We have to design to the weather. They have to be designed so that if there is an ice storm, there is a load factor that is built-in to this.

So we have to be sure that every one that is on those poles follows those guidelines.

Preparation is key. Making sure our generators, we test our generators every week in our switching offices, make sure they are all set. We have 24-by–7 monitoring on all of our equipment. We know when we lose power in Errol, and we can dispatch a technician up there while the equipment is still on battery.

So preparation in advance, we know when blizzards are coming pretty well now, so. Preparation is key.

Senator HASSAN. Thank you.

And to the Commissioner's point, too, is always making sure that we are prioritizing power needs; the greatest bang for the buck in many ways. I thank you all for those comments.

I want to turn now to a little bit more of a discussion on the social and economic benefits of broadband. I think it is intuitive for many of us, but maybe I can start with you, Mr. Shepperd.

You have long worked to connect this state to broadband. I would love it if you could talk a little bit more about some of the unique challenges our state faces in terms of deployment and what are the social and economic benefits that accompany connectivity?

Mr. SHEPPERD. That is an interesting question.

So from the connectivity side, I spoke to them in my testimony, really, that there are definitely challenges.

I did not say as part of the hearing today, but we literally had one provider that refused to move their cable plant even though all of the pole attachment agreements say you need to do that. They just refused to because they did not want the competition. So that was an extreme challenge for us.

But it goes back to your previous question. It is a little ironic that we are talking about trying to expand broadband into rural America and un-served areas, but at the same time, we are asking the providers to make sure their network is resilient and how do they prioritize?

Senator HASSAN. Right.

Mr. SHEPPERD. The funding between those two because, as Mr. Spellmeyer said, it is expensive. So I do not know if there is a great answer and I think they just have to weigh that in their own business plans.

Senator HASSAN. Well, and it may be that as we further these conversations that Congress has to get involved, too, in identifying where we think investments should go and trying to help strike that balance with the industry.

Mr. Strickland, I see you are interested in commenting.

Mr. STRICKLAND. Well, my own personal story, I think, is kind of an example of the social and economic benefit.

I was fortunate enough 20 years ago to be able to move to New Hampshire by choice. My family grew up in Oklahoma with the tornadoes, but I had a portable career and one that telecommunications allowed me to live wherever I wanted. And so, we specifically chose New Hampshire as the place we wanted to be and we have never regretted that. This is an amazing place.

I eventually started a business here and so I have a number of families now that depend on what we are doing. Again, the Internet makes that possible.

I think that recognizing that the New Hampshire advantage may be New Hampshire itself. It is an amazing place. It is a place where people want to live their lives, and broadband can really enable a lot of them to come here and be part of that experience.

You talked a moment ago about the AIRWAVES Act and what is that going to do in terms of devices? I think it is hard to envision the innovation that will occur once the infrastructure is in place.

It is hard to see beyond the technology horizon, but I guarantee you, there are a million good ideas out there that will blossom once the infrastructure is in place. People say, "Oh, I could do this."

So I think we have to build it and they will come.

Senator HASSAN. Thank you.

Mr. Cyr, do you want to comment on that? And then I will come back to Mr. Strickland.

Mr. CYR. Sure. I think like many things that we do, the first 90 percent of what we do is remarkably easy compared to the last 10 percent of getting it done.

Senator HASSAN. Yes.

Mr. CYR. And so there are so many areas in our country where economically it is easy. The math is easy. The business plan is easy to serve populations.

That is where it is time for the Government to step up is to help support the other areas of our country where we have that social obligation to make sure that it is served as well. And it is not just purely about the business fundamentals and the economics to say whether or not a place should be served or not. And so, I think it is critically important purely for that perspective.

If you think about it, we want people to be moving up north. The people that are up north desperately need businesses to be formed up there.

Senator HASSAN. Right.

Mr. CYR. But if you are a business and you are trying to decide where you are going to be, you have two primary reasons to be there. Well, three. You could do it because you live here and you love it.

Senator HASSAN. Yes.

Mr. CYR. But otherwise it is all about, "I am going to be where my customers are."

Senator HASSAN. Right.

Mr. CYR. Or, "I am going to be where the talent is."

And if the customers are not going to be up north because they cannot get access to the Internet, or the talent is not going to be up north because they cannot get access to the Internet, the businesses are not going to follow and it is a perpetual cycle.

So sometimes, it just needs to be jumpstarted because as we said earlier, remarkable things can happen once we get the infrastructure in place. They can jumpstart and revitalize the entire economics.

Senator HASSAN. So you are really articulating here that the reality for new businesses and entrepreneur, which is if there is not good access to broadband, to connectivity—both for purposes of connecting to customers, but also attracting talent and giving talent the tools it needs to do the work—it is really a nonstarter for those folks.

Mr. CYR. Sure. For many, many industries. And so I think you could pretty well guess in our North Country, the industries that flourish up there and those that are not present and there is a good reason why.

Senator HASSAN. Yes.

Mr. STRICKLAND. Briefly, Senator. Two things that come to mind for me as you were asking the question. The law enforcement officer in the back of the room, his radio went off, and he stepped out.

I think that is the best reminder for me of the importance of the basic level of connectivity. If we brought him back in the room, I am sure he could tell plenty of stories about where it is still needed and why it is still needed, and we see that in Puerto Rico today.

The second one is a health benefit. If you look at things like the Apple watch that is on my wrist, they continue to make tremendous advances in terms of medical monitoring; the ability to pick up the fact that you are going into cardiac arrhythmia before you do.

We are not too far away from the point where, I think, that watches are automatically going to reach out and alert your doctor to the fact that it is going on. You want to have connectivity when you do that.

So there are just innumerable examples and 5G will multiply it.

Senator HASSAN. Yes, and not to mention that when you have certain areas in the healthcare system where you have a shortage of providers, the capacity to do telemedicine is increasingly important, as it is for people who live far away from providers.

And so, one of the challenges we continue to consider here in New Hampshire is we would like so many people in our rural areas to be able to access medicine through a tele-connection. Right now, that is an idea, but it is still very hard to actually make a reality because of our connectivity issues.

Yes.

Mr. SHEPPERD. I would like to add that whole workforce development side in the STEM pipeline is critical. We need this infrastructure to make sure that our children are trained properly, have access to the tools they need, get rid of the Digital Divide, and have the workforce available for our New Hampshire companies.

And then related to that, some of the work that our broadband mapping and planning program has done, and is continuing to do, as part of the Northern Borders Regional grants, is to hold workshops.

We have one next Wednesday in Claremont that presumes, if you already have access to broadband, are you using it properly? Do you know how to get yourself onto Yelp and make sure that when people are looking for restaurants, they know that you are there?

Senator HASSAN. Right.

Mr. SHEPPERD. And so, I think that is critical to expanding this.

Senator HASSAN. Yes, a very good point and especially as we think about different ways to do workforce training.

People will need to probably update their credentials now on a regular basis in a very fast moving digital economy, and the importance of being able to do that in a way and at a time that makes sense, given people's busy lives, is really increasingly important.

I want to turn now to some of the local issues that were raised from folks in anticipation of today's hearing.

I recognize that the panelists may not have had the opportunity yet to read the written testimony that has been submitted, but I would like to share some of what has been submitted from some folks in this part of the state.

I will start with what we heard from State Senator Jay Kahn. He notes that it is estimated that 25 percent of Cheshire County, which is the county in which we sit right now, 25 percent of Cheshire County residents are un-served or underserved when it comes to broadband access.

Senator Kahn relates several stories from his constituents, one who needs broadband for their job and their livelihood, and one family who subscribes to two DSL companies so that way they have a backup if one company's service is too slow on a particular day.

Mr. Joshua Meehan, a Keene resident, also submitted written testimony in which he described at length his battle with a cable provider in trying to get broadband service for his home and his neighbor's home in Keene.

For people in our state, a lack of affordable access to broadband continues to be a real and serious challenge, as some of these comments and testimony reflect. So I want to start just by talking with Mr. Spellmeyer and Mr. Reed.

What is your message to the people in Keene, and Cheshire County, and other densely populated areas of our state? How can we attract companies like yours and others to provide high quality and affordable service?

Who wants to go first?

Mr. SPELLMEYER. I will go ahead.

So U.S. Cellular does serve Keene. We have a store here in town. We do our best to try to provide quality service.

We went from 3G to 4G quickly. We will try to go from 4G to 5G quickly. It is easier to go from one level to another than to bring that fundamental base service to an area because you have to construct a tower in order to do that. So the good news is for places where we are already at, the ability to upgrade comes quicker.

As I said, I saw it coming over. What we struggle with is if we are not there, we have to figure out how to construct a tower at, let us say, $400,000 to $500,000 and then bring in backhaul, pay for that backhaul every month from a provider like FairPoint. It becomes a question of, how many of those places can we go to in a given year?

Prices in the wireless industry have fallen dramatically, which has hurt revenues. It is just a really tough business equation to bring service beyond where it is today. It is a density factor for us.

Senator HASSAN. Right, and so what we are hearing from residents of Cheshire County, and in the North Country—and really even in other pockets of the state where people assume everything is well-connected—is that even in dense areas, there are some barriers.

I want to give Mr. Reed a chance to answer this, too, and then I want to follow up with you all.

One of the questions that your answers help us focus on is if the private sector cannot, for some reason, get to everywhere it needs to get, then the issue of whether municipalities should be somehow empowered to becomes another question.

So Mr. Reed, why don't you start and then we will follow up on that issue?

Mr. REED. We will follow up on that issue. It is really important to me.

I apologize. I did not have the opportunity to read the testimony.

Senator HASSAN. Right.

Mr. REED. But I do have a little bit of data here. I do want to just level set for a second because it almost feels like we are sitting here saying, "Everything is stagnant. What are we going to do?"

Broadband is improving every day and construction is going on every day. I do not want anyone to think that it is not. And I am not just going to speak for my company, but my competitors as well.

Just improving broadband speeds from what it was like 3 meg up to 25 meg. That is a technology issue. Technology has allowed us to do that. We have changed our technology for every CAF-II project and every remote we build so that if you are all the way out at the end of the line, like at 16,000 feet, 12,000 feet, 12,500 feet, you are going to get 10-over-1. If you are in closer, you are going to get up to 50-over-20.

So I just want to make sure that work is going on while we are sitting here. So I just want to capture that.

The Federal Government recognized Cheshire County. I actually, totally by accident, brought a piece of paper with me that might be helpful.

This is what the mapping shows and this is what FairPoint accepted in Cheshire County in New Hampshire, the CAF map. The Federal Government is going to support 2,145 locations. They felt that it was worth $566,000. So the Federal Government is putting that much money in that we are going to build those locations and some are in progress.

I took a look at just what our projects are going on now. Since 2008, we have added 700 remote locations in New Hampshire moving our switching equipment out closer to the customer to allow for broadband. But right now, we have, say, 50 projects in the works. Twenty-two of them are around the Monadnock area, a bunch more are in the North Country. That is no surprise. That is what showed up on the Federal Government's map.

So there is work going on, Senator, and that work is going to continue.

Mr. Spellmeyer and I were talking. It is really just money. So we have to make a business case. I am not a firm believer in "build it and they will come." It is, "Build it and let us figure out how we are going to get people to use it."

Digital literacy is a key factor in how it will improve our business models. It will improve the private sector and it will get more people on the Internet. So we need to include that, too, in our forecast.

Senator HASSAN. Mr. Strickland wants to comment on this. So why do we not start with that? And then I have a follow up.

Mr. STRICKLAND. So to the commercial providers on this panel, they have cited a number of times the need to make the ROI case for a build out, and that is perfectly understandable. I am a businessman too.

I think this is a case where private enterprise does not necessarily work as well as we wish. We have a model that has been

very, very successful. We have universal telephone service and have had for a long time.

I do not think we can afford to treat broadband differently than that anymore. It was a luxury for a long time, but it is not anymore. There are people now that have broadband that do not have a copper phone line.

Senator HASSAN. Right.

Mr. STRICKLAND. And I think the time has come to treat this like the utility that it really is and address it that way.

Senator HASSAN. So that brings us to this question if a service provider either, to put it one way, cannot because the business model does not work for them to get out to that last mile of connectivity or for some other reason refuses to, should municipal options be available?

Anybody can answer that. I see Mr. Strickland is nodding.

Mr. REED. I am happy to talk about it simply because we have worked with so many municipalities on this issue in the three states, a couple hundred of them, Keene being one of them.

The very first thing we do is to map what FairPoint has. We do not always know what our competitors have. We map what FairPoint has.

I do not want to generalize, but I would say the vast majority of the groups we have spoken with—it does not mean it was municipal government. It may have been a group within the town that is trying to improve broadband—were surprised by how much fiber there is, and what speeds were available.

In some cases, it is only a small piece of the town that they decided they wanted to address. Or, "We can afford to address this." Or, "What is it going to cost to do this industrial park that we are planning?"

So education upfront is really critical before we just blanket say, "Yes, it is a good idea to overbuild an existing network."

Senator HASSAN. I do want to say that I think for people in this part of the state, people in the North Country, the notion that they should be worried about overbuilding right now would seem——

[Laughter.]

Senator HASSAN. Part of what we are dealing with here, and maybe in a moment we can talk a little bit more about broadband mapping, is that there does seem to be this ongoing different understanding of the level of connectivity for people in so many parts of our state.

It is of deep concern to me because I will often have one conversation with providers and industry about the levels of connectivity and then I am out. I drive all over the state and as Governor there were parts of the state where I would have to say to people, "You are not going to be able to call me between X and Y because I am going to be on Route 9."

And so, I want to perhaps just say that we should commit to each other to continue this discussion and really drilldown on this issue.

I am seeing motion over here and then Mr. Cyr, do you want to go and then Commissioner, I do not know if you had a comment, and then we will go back down to Mr. Spellmeyer?

Mr. CYR. Great. Thank you. Just to add a little bit of color to both the deployment side as well as the municipal interest in broadband.

I live in Portsmouth, city councilors here in Portsmouth. My business, I am actually a FairPoint customer, fair disclosure——

Senator HASSAN. Yes.

Mr. CYR.—for fiber right now, and enjoy it, and have for many years.

Our business in the past has been a FairPoint customer with gigabit Internet speeds. We moved two blocks away and we are no longer able to be a FairPoint customer for any speed that was going to be acceptable for our business, and we had to move providers. It has happened twice while I have lived in Portsmouth just in broadband Internet. Even though we have considerable——

We actually have options in Portsmouth, which is unusual for many areas of the state. Even then, it is actually difficult for businesses to pay cancellation fees and all the other things that are, but related to that.

Although it has not got up to the city council level, there have been discussions among residents about this very topic of, "Should we be looking at providing Internet services on a municipal level?"

So I know it is even in places like Portsmouth, without gigabit Internet speeds in the city for at least some places is all still a conversation is being had.

Senator HASSAN. Thank you.

Commissioner and then Mr. Spellmeyer.

Commissioner ROSENWORCEL. I am going to just try to take this up a level.

I think there is no knowhow like New England knowhow that our forbearers here when we did not have bridges, we did not have roads, we did not have barns. Our communities came together and we figured out how to get things done.

Senator HASSAN. Right.

Commissioner ROSENWORCEL. And the truth is, I think with broadband, it is an expensive proposition in rural America. And the map shows it is hard for financing, deploying, and operating these networks.

But at the same time, I think it is fundamentally true that it is small "D" democratic that communities should be able to come together, if they feel the private sector is passing them by, and try to explore if they can do it for themselves.

I think that is part of our history, and I think it should be allowed. The challenge is that there are many State laws that tend to prevent that from happening.

So what bothers me about that is those communities do not even get the right to explore and have that conversation. And I think, as a democratic community governance matter, it is something they should be allowed to do.

Senator HASSAN. Thank you.

Mr. Spellmeyer.

Mr. SPELLMEYER. Just briefly on the issue raised before about mapping accuracy and multiple providers. It is one of my really hot button issues.

What goes on with these maps, when they make maps of where there is coverage and is not coverage, particularly in the wireless industry is you come to Keene, and U.S. Cellular has coverage. And so, they check off the map and they say, "Keene is done."

Senator HASSAN. Right.

Mr. SPELLMEYER. And then you go four counties to the north, U.S. Cellular may not have any coverage there and let us say that AT&T does. Well, they check off that part of the map and they say, "The job is done."

The problem is the only way as Governor you could experience traveling around the state is you have to carry a U.S. Cellular phone, and an AT&T phone, and a Verizon phone in order to make your way across the whole state. That gets completely ignored in this mapping process.

It has been a problem. I tried to argue it to FCC Chairman Wheeler last year, and he looked at me, and he said, "Do not go around telling people we need to get multiple phones from multiple providers."

[Laughter.]

Mr. SPELLMEYER. And I understand, and he probably will not appreciate me mentioning that, but it is the truth. I am carrying devices from three carriers. I live in Washington, D.C. I travel the whole country.

Senator HASSAN. Yes.

Mr. SPELLMEYER. And I need to do that in order to get connectivity. But that does not work for the average American and somebody has to carry that message to policymakers at the FCC.

Senator HASSAN. Thank you, which is a very good segue into a question I was going to have on the whole issue of mapping.

Commissioner, the FCC is now responsible for maintaining the National Broadband Map. It is my understanding, though, that the agency has not updated that map in years.

So is the FCC taking this responsibility related to the map seriously and how can we improve it?

I take it that your e-mail site for people to report in is part of your effort.

Commissioner ROSENWORCEL. Sure. I think this is a big problem. You cannot manage problems you do not measure. Our maps are now 3 years out of date.

More than that, I think most of us are familiar with the experience where we are told we have service, and you are standing there, and you say, "No, I do not."

Senator HASSAN. Right.

Commissioner ROSENWORCEL. I know that experience happens more in rural communities than anywhere else. So we are going to have to figure out how to make sure our maps operate at a level of precision that is meaningful to people on the ground.

And so that is why we just set up an e-mail inbox *BroadbandFail-at-FCC.gov* because I think we have to start asking people to help us. Asking people to tell us where they have service and where they do not.

You can tell me that that is not the most scientific method. I think we are past the point, though, where just combing over data in Washington conference rooms is the way to get this done.

So we are going to try to suggest to everyone, and we are starting here with you, New Hampshire. But if you write us at *BroadbandFail-at-FCC.gov,* we will take your stories and aggregate them, and I will share them with my colleagues, and see if we can use that to inform our next generation of data and mapping efforts.

Senator HASSAN. Well, thank you.

It is my understanding, too, that there is a lack of standardized reporting from different providers in terms of what qualifies as connectivity on the ground and what does not. Would that help as well?

Commissioner ROSENWORCEL. You are right. We are going to have to come up with Digital Age standardization for what we consider served and not served. I feel like we are working off of old Analog Era models.

Senator HASSAN. Yes.

Commissioner ROSENWORCEL. We are going to have to do it with a level of precision that is new, and different, and more meaningful.

Senator HASSAN. Thank you.

Mr. Spellmeyer.

Mr. SPELLMEYER. Senator, if I could just say maybe a word of thanks to you and your colleagues in the Senate.

Three or four years ago, the FCC staff prepared a draft order that had a whole bunch of conclusions in it about the fact that wireless coverage was everywhere in rural America. The job was done. We looked at it. We said, "We know that is not true."

Senator HASSAN. Right.

Mr. SPELLMEYER. We set about fighting it, but I would say we made the most progress because if there were 100 people in this country that understood the problems that were actually going on, on the ground, it was the 100 members of the Senate.

And on a bipartisan basis, you have made a lot of noise and it has had a lot of impact in moving us in the right direction toward fixing that mapping. So thank you.

Senator HASSAN. And I will transfer the thanks to constituents of the 100 senators——

[Laughter.]

Senator HASSAN.—because they are the ones who make sure we really know.

Mr. Shepperd.

Mr. SHEPPERD. I just wanted to add, and sort of reinforce, that that reporting at the census block level is never going to cut it either.

Senator HASSAN. Right.

Mr. SHEPPERD. There is such a gap there and I do not know why in this day of Big Data, we cannot have an online, live database that all the providers are required to respond to.

Senator HASSAN. That is a great idea.

Mr. Strickland.

Mr. STRICKLAND. And I would just extend the Commissioner's comment about establishing some standards for service.

As somebody who is in the role of acquiring service for a variety of different needs and at different levels, I would love to see at least three levels of classification of service so that I could look at

the map and know that, "Yes, I can get service for this business. They do not need gigabit service, but they need reliable 50 megabit service."

Senator HASSAN. Thank you.

I want to change the focus just a little bit to a more complete discussion of what the Commissioner has referred to as "the homework gap."

Commissioner, you have worked diligently to find ways of ensuring that our Nation's students can access the Internet to complete assignments, and gain the social and economic benefits of being connected so that they can compete in a global economy. You have coined the phrase, "closing the homework gap," to refer to this endeavor.

What are the greatest challenges and opportunities you see for us in being able to close the Homework Gap and how can we better utilize the Universal Service Fund to do that?

Commissioner ROSENWORCEL. Thank you. I appreciate you asking me about this.

I think kids not being able to do their homework is probably the cruelest part of our Digital Divide.

Senator HASSAN. Right.

Commissioner ROSENWORCEL. It is necessary for success in school and in the economy right now.

And so, we should be pouring every resource we have to fix it. That includes Universal Service programs at the FCC that help with deployment and help low income households in getting connected. I think every way we can scrub those programs and see how they can help the Homework Gap is important.

I also think we should consider how the E-Rate program might be able to help fund wireless routers on school buses because in rural America, kids spend much more time on a school bus getting to school in the morning and going home at night. And if we turn that ride time into connected time for homework, that can make a big difference.

I also think communities can do a lot because there are communities right now that are mapping the safe spaces they have for kids to do their homework. It might be a coffee shop or the library, but we have some places where the hotel in town kicks in or the big store decides that they will set aside some connectivity that can be used by students.

If we can map those places as a community, I think that we will all contribute to solving this problem faster.

Senator HASSAN. Thank you.

Mr. Shepperd, can you explain how New Hampshire has used Federal support to build out broadband coverage in the State schools and work to close some of that Homework Gap?

Mr. SHEPPERD. Absolutely. As you are aware, you created the New Hampshire School Connectivity Initiative.

Senator HASSAN. I really did not mean it that way.

[Laughter.]

Senator HASSAN. But thank you.

Mr. SHEPPERD. At the time, the Telecom Advisory Board and the Governor's Office were both looking at the same thing. We were doing a connectivity assessment of our schools. Again, you have to

have the data to know where to go next. You were approached by Education Super Highway.

Senator HASSAN. Right.

Mr. SHEPPERD. So we have been working collectively with them and over the past 2 years, we went from 32 percent of our K through 12 schools not being connected down to 24 percent, and this year, we hope to connect the remaining 39 districts to get fiber.

And it is all based on the E-Rate program and making sure that those schools who have never filed E-Rate before know that it is available.

As part of the New Hampshire SCI Initiative and Education Super Highway, we got the state to appropriate $4 million matching, which will be matched by the FCC E-Rate program. So we are cutting down the cost of the local community by doing that.

Senator HASSAN. Great.

I will add that just one of the reasons that we ended up focusing the way we did in the Governor's Office on this, again, has to do with leadership at the community level.

Because one of the things you learn if you travel New Hampshire and visit a lot of schools—even in our very smallest towns way up north—you find that when they have cracked the conundrum of how to connect to get the right kind of speed, the educational opportunities that are then opened up to students in very small communities just are amazing.

And so, to walk into a classroom, as I have done, in a very small town in the northern part of our state and see students looking at scenes of Chinese urban areas in real time to begin to understand how the Chinese organize certain kinds of economies and other things was just really amazing because these kids were getting real time visuals from a part of the world that they would never be seeing in any other way.

So there are great examples throughout our state of what you can do, how you can leverage that connectivity for our students, and it was a real impetus for me to try to find ways to make sure that all students had that kind of access. And when you ask students, even at very young ages, what being connected means to them, they can articulate it incredibly well.

So thank you for your work on that and I look forward to continuing to work with you as we get the last group of schools connected.

Mr. SHEPPERD. Senator, I have a follow up to that.

Senator HASSAN. Yes.

Mr. SHEPPERD. So there are two interesting things. So part of it is about getting connectivity to the school and fiber to all the schools. Part of it is education because unfortunately, we have run into some schools that have very low bandwidth and say, "It is perfectly adequate for what we need today."

Senator HASSAN. Yes.

Mr. SHEPPERD. So that is another scary place that we are trying to work on.

And then the other piece was that there are rumblings about some of the E-Rate Modernization Act being rescinded. Our New Hampshire SCI Initiative was first about school connectivity and

then we were going to move into Wi-Fi in the schools to make sure that you could actually use that connectivity.

Senator HASSAN. Right.

Mr. SHEPPERD. And I understand that that is in jeopardy. So whatever we could do to help with that certainly we'll do.

Senator HASSAN. A number of us in the Senate are very concerned that there may be a rescinding or elimination of the E-Rate program and some restrictions on the other Universal Service programs.

And so, we have been advocating for the continuation of them and we will continue to reach out to the public because I think it is really important for the public to weigh in on how important connectivity is and how important the E-Rate programs have been.

The other thing that the Super Highway program really helped with is it is not just about having the connectivity and getting the right speeds. It is also working with local school districts, for instance, so that they know how to get the best deal and how to understand what they should be paying, what is reasonable, what is not. And that is where the expertise of people in your shop and the Super Highway shop has been so important too.

Anybody else want to comment just on the Homework Gap or have anything?

Mr. Spellmeyer.

Mr. SPELLMEYER. The only thing I was thinking of, I was remembering last year.

I know U.S. Cellular participated in a pilot project in the state of Maine to put wireless, the small wireless routers, into the hands of schools where they could be checked out in the library and taken home by students who needed it at home.

And I recognize there are challenges with watching hundreds of hours of video, but there are other applications as well that that kind of speed still works very well for.

I know that some of your colleagues, including Senator King in Maine, were working on getting that funded in the education bill—and I, frankly, lost track of where that ended up—but trying to expand those types of efforts.

Senator HASSAN. Anyone else want to comment?

Well, I want then to turn to the topic of direct spending here for broadband infrastructure.

Commissioner, even with everything the FCC is doing with the Universal Service Fund, many believe that an additional infusion of direct funding is needed to close the digital divide and to make broadband access truly universal.

Senate and House democrats recently unveiled an infrastructure plan that included $40 billion in direct broadband infrastructure spending.

Now, I am still evaluating the plan, but Commissioner, do you agree that direct spending is necessary to eliminate the Digital Divide and to make broadband truly ubiquitous?

Commissioner ROSENWORCEL. Yes. That is the simple answer. I will add to that just a little bit.

Senator HASSAN. Yes.

Commissioner ROSENWORCEL. And tell you that we have some places in this country that are at risk of falling behind. By and large, they are rural.

So the more funds that we can get to those communities to make sure that they are connected and the faster that we can do that, the more likely that they are going to be able to participate in 21st century economic success.

Senator HASSAN. Thank you.

Anybody else on the panel want to comment on what direct investment in infrastructure would help us do?

Mr. SPELLMEYER. Well, I certainly believe it is crucial. I think it was Mr. Strickland that talked about how we got basic telephone service out to everybody in this country, and that was a direct Government investment to get it done and the same thing is needed in the broadband area.

We strongly support any, and all, efforts including the package that you referred to.

Senator HASSAN. Thank you very much.

We are getting close to the end of our time here. We wanted to wrap up by noon, and I am going to ask one more question, and then if any of you have any closing thoughts, I will ask for those. But the last topic I wanted to touch on today was about broadband speeds.

Recently, the Federal Communications Commission requested public comment on a Notice of Inquiry which raised questions about whether mobile broadband can be substituted for fixed broadband.

This would lower broadband speeds from the current standards by almost two-thirds. It would have a devastating impact on rural Americans in New Hampshire and beyond for us to begin to say, "Your mobile speed is the best that we are going to do," and rural America will just have to live with a speed that is two-thirds less than the rest of the country.

Commissioner, what is your response to this Notice of Inquiry and what would be the further impacts of replacing fixed broadband service with mobile across the country?

Commissioner ROSENWORCEL. My response is that that idea is crazy and I will tell you why.

We need big bandwidth and we need it everywhere. Right now, the agency has a 25 megabit standard and if you have a household with a few people in it who want to watch video, look some things up, you will understand that is necessary.

Rolling it back to 10 megabits does not make any sense. The future is bigger than that. I think our standard should be 100 megabits because I think you have to set big goals if you want to do audacious things.

Senator HASSAN. Thank you.

Would anybody else like to comment?

Mr. Strickland.

Mr. STRICKLAND. I would wholeheartedly agree. I may be the oldest one on here and I remember starting my career on a 300 baud modem. So I come from a long way.

I think that the ways that we consume bandwidth are growing very rapidly. So you have to aim very high and even that will not

be enough. But certainly, 100 megabits is not at all unreasonable for home use.

And I want to point out that when we talk about bandwidth for home use, it is mostly down stream use. It is Netflix and so forth. For businesses, it needs to be symmetric.

Senator HASSAN. Right.

Mr. STRICKLAND. So I make the distinction between consumer grade and business grade bandwidth as a business grade connection is a symmetric connection with low latency and an SLA, so that we know that it is going to work.

Businesses need to be able to upload large amounts of data just as well as to download it.

Senator HASSAN. Thank you.

Yes, Mr. Spellmeyer.

Mr. SPELLMEYER. One of the things that people lose track of is that there is already a law about this. It was in the Telecommunications Act.

It requires that the Commission work to ensure that consumers in rural areas have access to reasonably comparable services to folks in urban areas. And there certainly are plenty of folks in urban areas that are getting very high speed on wireline and wireless. The law already says that it should be delivered to folks in rural areas and, frankly, regardless of cost.

And so, we are supportive of every effort to try to drive the speeds as high as possible.

Senator HASSAN. Thank you.

Mr. REED. If I could just add a bit of a note of caution. Broadband speed and everyone's definition of served and underserved is very wide. Upload speeds are becoming more and more important.

If you take a look at the current CAF or CAF-I was 4-over-1. CAF-II is 10-over-1. That is simply mathematics of how much we can get done for how much money. And I do not disagree with the Commissioner. We are headed toward 100 meg. That is going to be extremely, extremely expensive.

But our technology, everything is heading in that direction. Simple things like the example I had of going from 3 meg to 25 meg. No rocket science there. We added another remote and the technology allowed us to do that. So the industry is moving that way. The needs of the consumers are moving that way and we just keep on that path.

I am very sensitive to people saying, "Oh, you are building 10-over-1. The Federal Government has cast us aside. They do not know what we need out here."

So we just have to be careful of our message.

Senator HASSAN. Thank you.

Mr. Shepperd.

Mr. SHEPPERD. I would just add to that, and it is what I put in my testimony that whatever Federal funds, if we got $40 billion, that would be a wonderful thing. We need to make sure that we put it toward the future technology.

Senator HASSAN. Right.

Mr. SHEPPERD. And not keep expanding on copper-based technology. Utilize it and get the best of it we can.

I look at just UNH's service. Our Wide Area Network in 2008, we were buying 1/2-a-gig of Internet. We are now buying 40 gig of Internet and we have multiple 10 and 20 gig channels between our institutions.

Senator HASSAN. Right.

Mr. SHEPPERD. So that ramp looks like this and that is going to be true for the consumers and the businesses as well.

Senator HASSAN. Thank you.

Mr. Cyr.

Mr. CYR. So just—and this is for those that do not follow technology very well—we might think the technology growth goes along a traditional ramp like this. This is how we, as humans, think.

The reality of technology at option is what we just heard. It curves like this and so we do not anticipate until it is way too late the radical change in demand, radical change in consumption.

And so, by doing something like this, it would be literally setting a tone which would enable even more of a Digital Divide and it would be telling our residents that they simply do not matter.

Senator HASSAN. Well, I thank you for that. One of the things that I think a lot about, too, is that looking towards the future, trying to make sure that we are building out for the technology that has not been created or refined yet, is critically important.

There is also a real potential, it seems to me, of recognizing real savings in terms of what the United States Government does or what State governments do if we have the technology to get the kind of data we need, that helps us make our really important investment, and programmatic, and policy decisions.

What programs work and what do not? Well, sometimes we do not really know that without data, and it is very hard for Government, sometimes, to get data if we do not have access to this kind of technology and speed.

And so, just as there is a real value added for businesses now—and just as there is a really critical value in terms of the kind of innovation that we can spur if we have this kind of access to high speed, high quality broadband everywhere—there is also a real value, it seems to me, to Government efficiency and decisionmaking moving forward.

And so, I think the investment that we are talking about is really critical in any number of areas. And I have to tell you how grateful I am to all of you, not only for being here this morning and being willing to take so much time to talk about these issues, but also just in the work you do, and in the leadership roles you have taken on in trying to make sure that we are addressing the connectivity issues that we are facing which are challenges, but they are also obviously provide great opportunities for us moving forward.

Do any of you have any further closing comments you would like to make before we wrap up?

Mr. Strickland.

Mr. STRICKLAND. I know that what we are hoping to accomplish here is expensive on the order of $40,000 to $50,000 a mile for fiber, sometimes more. I would point out that a mile of asphalt costs more than a mile of fiber. We do not hesitate to build asphalt roads.

Senator HASSAN. Right.

Mr. STRICKLAND. We can solve this.

Senator HASSAN. Thank you.

Anyone else?

Mr. REED. Just quickly, I would like to say thank you for this. We need to talk about this and we need to talk about it in this type of forum; a nice balanced forum. It was very helpful.

We are really, I think, at the point of we need private-public partnerships be it at the Federal level, or the State level, or the municipal level. We had a partnership with a municipality here in New Hampshire, Moultonborough. Very successful.

Senator HASSAN. Yes.

Mr. REED. So we are there. I think we can do this. I know we can do this. But thank you for this opportunity and I hope we can get that awareness out there, Senator.

Senator HASSAN. Thank you very much.

Anyone else?

Well, I cannot thank you enough, all of you, again, for attending today, and for the work you do.

One of the great privileges of sitting on the Commerce Committee, too, is learning about the emerging technologies that are so dependent on connectivity and access to high speeds. And so, I am excited by what is possible, but I am also continuing to be concerned about having the infrastructure we need to leverage the emerging technology and innovation. So I will continue to work on the issue.

I thank everybody so much for attending today.

The hearing record for this hearing will remain open for 2 weeks. During this time, Senators are asked to submit any questions for the record. And upon the receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible.

If there are people who are attending today or who see this during this open period, if it is replayed on video, and want to submit questions through my office, I can certainly then submit them to the witnesses.

You can contact my office. My central office in New Hampshire is in Manchester. We also have offices in Portsmouth, Berlin, Concord, and Nashua.

So with that, I will close the hearing and thank very much, the witnesses again, for you participation.

Thank you.

[Whereupon, at 11:55 a.m., the hearing was adjourned.]

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