WINNING THE RACE TO 5G AND THE NEXT ERA OF TECHNOLOGY INNOVATION IN THE UNITED STATES

HEARING
BEFORE THE
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION
UNITED STATES SENATE
ONE HUNDRED SIXTEENTH CONGRESS
FIRST SESSION
FEBRUARY 6, 2019

Printed for the use of the Committee on Commerce, Science, and Transportation

Available online: http://www.govinfo.gov

U.S. GOVERNMENT PUBLISHING OFFICE
WASHINGTON : 2023
## CONTENTS

<table>
<thead>
<tr>
<th>Hearing held on February 6, 2019</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement of Senator Wicker</td>
<td>1</td>
</tr>
<tr>
<td>National Cancer Institute information</td>
<td>67</td>
</tr>
<tr>
<td>Statement of Senator Cantwell</td>
<td>3</td>
</tr>
<tr>
<td>Statement of Senator Fischer</td>
<td>41</td>
</tr>
<tr>
<td>Statement of Senator Schatz</td>
<td>43</td>
</tr>
<tr>
<td>Statement of Senator Blackburn</td>
<td>45</td>
</tr>
<tr>
<td>Statement of Senator Udall</td>
<td>47</td>
</tr>
<tr>
<td>Statement of Senator Moran</td>
<td>49</td>
</tr>
<tr>
<td>Statement of Senator Markey</td>
<td>51</td>
</tr>
</tbody>
</table>

| Letter dated October 11, 2018 to President Donald J. Trump from Edward J. Markey, United States Senator; Sherrod Brown, United States Senator and Catherine Cortez Masto, United States Senator | 53 |
| Statement of Senator Sullivan    | 56   |
| Statement of Senator Sinema       | 57   |
| Statement of Senator Lee          | 59   |
| Statement of Senator Thune        | 61   |
| Statement of Senator Blumenthal   | 63   |
| Statement of Senator Tester       | 64   |

## WITNESSES

| Brad Gillen, Executive Vice President, CTIA | 5 |
| Prepared statement of Meredith Attwell Baker | 6 |
| Steven K. Berry, President and Chief Executive Officer, Competitive Carriers Association | 11 |
| Prepared statement | 12 |
| Shailen P. Bhatt, President and Chief Executive Officer, Intelligent Transportation Society of America | 15 |
| Prepared statement | 17 |
| Michael Wessel, Commissioner, U.S.-China Economic and Security Review Commission | 25 |
| Prepared statement | 26 |
| Kim Zentz, Chief Executive Officer, Urbanova | 33 |
| Prepared statement | 34 |

## APPENDIX

<p>| Letter dated February 20, 2019 to Hon. Roger Wicker and Hon. Maria Cantwell from Morgan Reed, President, ACT | The App Association | 79 |
| Response to written questions submitted to Brad Gillen by: |  |
| Hon. Roger Wicker | 81 |
| Hon. Jerry Moran | 82 |
| Hon. Dan Sullivan | 82 |
| Hon. Shelley Moore Capito | 83 |
| Hon. Amy Klobuchar | 85 |
| Hon. Jon Tester | 86 |
| Response to written questions submitted to Steve Berry by: |  |
| Hon. Roger Wicker | 87 |
| Hon. Jerry Moran | 88 |
| Hon. Dan Sullivan | 88 |
| Hon. Shelley Moore Capito | 89 |
| Hon. Amy Klobuchar | 91 |
| Hon. Jon Tester | 91 |</p>
<table>
<thead>
<tr>
<th>Response to written questions submitted to Shailen P. Bhatt by:</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hon. John Thune</td>
<td>91</td>
</tr>
<tr>
<td>Hon. Jerry Moran</td>
<td>92</td>
</tr>
<tr>
<td>Hon. Shelley Moore Capito</td>
<td>92</td>
</tr>
<tr>
<td>Response to written questions submitted to Michael Wessel by:</td>
<td></td>
</tr>
<tr>
<td>Hon. Jerry Moran</td>
<td>94</td>
</tr>
<tr>
<td>Hon. Edward Markey</td>
<td>94</td>
</tr>
<tr>
<td>Hon. Jon Tester</td>
<td>95</td>
</tr>
<tr>
<td>Response to written questions submitted to Kim Zentz by:</td>
<td></td>
</tr>
<tr>
<td>Hon. Shelley Moore Capito</td>
<td>96</td>
</tr>
</tbody>
</table>
OPENING STATEMENT OF HON. ROGER WICKER,
U.S. SENATOR FROM MISSISSIPPI

The Chairman. We have three minutes of Executive Session work to do, but we don’t have a quorum just yet, so the Ranking Member and I have decided to proceed with opening statements. And unless someone else walks in, in the next—let’s just start off, then we’ll vote on the business we have to tend to.

We are delighted to welcome everyone to the first Senate Commerce Committee hearing of the 116th Congress. I’m glad to convene this hearing with my colleague Ranking Member Cantwell. I look forward to working with her and all members of this Committee to advance a legislative agenda that creates jobs, promotes innovation, protects consumers, and strengthens our Nation’s technological leadership throughout the world.

We start today with a discussion on 5G, the fifth generation of wireless communications technology. 5G is one of the most important technological developments facing the United States in the 21st century. The anticipated impact it will have on the future of our Nation’s economy, and its global competitiveness is significant.

Current estimates project that 5G will create more than 3 million new jobs, generate $275 billion in investment, and add $500 billion to the U.S. economy. In addition, 5G promises to usher in a new era of connectivity that has the potential to propel our Nation into the fourth industrial revolution we are told. By bridging the connection between the physical and digital worlds, 5G will ultimately transform how we use technology and spur the development of applications and services beyond anything we can fully conceptualize today.
So what does this mean for Americans? In relation to existing wireless, 5G will provide significantly faster connections. This means that health care providers, such as the University of Mississippi Medical Center, can extend the reach of life-saving telemedicine and support more cutting edge medical services. As a result, people around the country will enjoy increased access to a better quality of care at reduced costs.

For the agricultural industry, 5G will enable the use of more precision agriculture technologies. This will allow our Nation's farmers and growers to be more competitive, maximize resources, and boost crop yields for a growing global population.

For the transportation sector, 5G will enable greater mobility, access, and, most importantly, safety on our Nation's roads.

The consumer benefits of 5G are limitless. In fact, the excitement surrounding this new technology stems from its potential to generate economic and social benefits across every industry and every sector. The ability to support other groundbreaking technologies, such as artificial intelligence and virtual reality, makes 5G even more valuable and revolutionary.

In order to fully realize all of these benefits, the United States must win the global race to 5G. China and others have seen the benefits America gained from leading the world in 4G, so they are challenging the U.S. for dominance in 5G. By some important measures, they have significant advantages. Failing to win the race to 5G would not only materially delay benefits for the American people, it would forever reduce the economic and societal gains that come from leading the world in technology. Achieving U.S. leadership in 5G will require dedicated and coordinated efforts by all levels of government and industry.

We have an excellent and knowledgeable panel of witnesses today, and they are: Mr. Brad Gillen, of Washington, D.C., Executive Vice President of CTIA; Mr. Steve Berry, of Washington, D.C., President and CEO of the Competitive Carriers Association; Mr. Shailen Bhatt, of Washington, D.C., President and CEO of Intelligent Transportation Society of America; Mr. Michael Wessel, of Washington, D.C., Commissioner, U.S.-China Economic & Security Review Commission; and Ms. Kim Zentz, of Spokane, Washington, CEO of Urbanova.

There is a quorum, and I’m about to finish my statement, so we’ll see what the Ranking Member would like to do at that point.

During today’s hearing, I hope our witnesses will address many of the critical issues that this Committee will need to consider. What are the opportunities and impediments to the prompt allocation of spectrum, mid-band in particular, that are critical to 5G deployment? Which of our infrastructure laws and regulations need to be modified to achieve fast deployment of 5G? How do we ensure that while we do all of this, we guarantee that our networks are secure? What best practices and resources do our Nation’s law enforcement and security agencies need to protect that security?

So I look forward to a thoughtful discussion on how to move the United States ahead in 5G to ensure that all Americans, including those in rural areas, can experience its benefits now and for generations to come.
Madam Ranking Member, would you like to make your opening statement now?

Senator CANTWELL. Mr. Chairman, I will delay my statement and move that Agenda Item Number 1, the Budget Resolution for the Senate Committee on Commerce, Science, and Transportation be reported favorably.

[Recess to proceed to the Executive Session.]

The CHAIRMAN. The distinguished Ranking Member of the Committee is now recognized for whatever opening statement she would like to make for whatever time she would like to consume.

STATEMENT OF HON. MARIA CANTWELL,
U.S. SENATOR FROM WASHINGTON

Senator CANTWELL. Thank you, Mr. Chairman, and thank you for holding this important hearing today on 5G. I welcome all the witnesses who are here today, especially our witness from Spokane, who is going to talk about smart city innovation.

But we are here to talk generally about how the United States maintains its competitive advantage in 5G and how we use this new technology to help us in growing our digital economy. Already in the State of Washington, a lot of 5G investments are being made to continue the growth of what our country knows is a trillion dollar opportunity and a continuation of the innovation economy. So I’m all in for 5G.

We know that, along with various applications that you already mentioned, Mr. Chairman, on artificial intelligence and quantum computing, that we will really reshape our economy for the future, that the innovation that 5G will help us unleash will help us in many, many important aspects of our national agenda, national defense, and important partnerships for the future.

But the push for 5G, we need to make sure we’re not blind to some of the very important policy issues. Put simply, 5G networks must be secure, and that starts with having a cybersecurity strategy that focuses on shoring up our defense against hackers and state-sponsored actors of cyberterrorism.

Protecting national security means making sure that America’s economy is strong and that we remain a global leader. Cybersecurity is one thing I wish I would have heard more from the President on last night. We know that with artificial intelligence and quantum computing, that applications made possible 5G, can transform innovation, change our modern warfare, creating military advantages through integrated military operations, but we need to make sure that this network is safe. So the more that we rely on these networks to drive productivity and efficiencies and sustainability, whether it is our businesses or our military applications, we need to make sure that the promise of a 5G network does reach that level of security.

So a few things I think we need to think about. First, we must be certain that there is a secure supply chain backing up our 5G system. We cannot tolerate a leaky valve or a back door into these networks. Second, the administration should provide us with a real quantifiable 5G threat assessment so that we can work fully to make sure that our network is secure. And, three, we need to have
a serious conversation about what level, if any, of foreign components we are going to allow into the 5G network.

I know that there are state-sponsored actors who have hacked our networks, and I want all of us to work more closely together to call out on an international basis those wrong actors and work together to try to prevent them in a broader coalition. We need to make sure that we are all hands-on-deck. I want the FCC to use its existing authority to make sure these networks are safe and secure and to know that Congress is watching.

So I know if we roll up our sleeves, get serious about the cyber issues, and continue to make the right investments, that the innovation economy and the race to win in 5G, the United States will do very, very well.

More importantly, we need to continue to talk about the great applications that 5G will empower. That is why I'm so happy today that we have a witness from the smart cities and innovation area to talk about exactly what this can do for our local governments. Local governments are always cash strapped, so to know that they can make smart technology infrastructure upgrades that can help save money in the future is something I think is very important.

I especially want to welcome Kim Zentz, the CEO of Urbanova, who is on the panel today and to talk about how that cutting-edge collaboration between Washington State University, the city of Spokane, and a group of innovators are already exploring ways to leverage technology and data analytics to move our cities toward a more sustainable future. This is something that I know many of my colleagues on this Committee have already sponsored legislation related to this.

Mr. Chairman, I know that we'll have a chance at a future hearing to talk about again how we access rural broadband and do a better job, but as we're talking about 5G, I think that we need to put as much enthusiasm into the discussion of what will 5G investments do for us in the area of rural and underserved areas like Tribal communities into broadband.

And, last, Mr. Chairman, I should just mention, since you mentioned the value of the mid-band and how important that was, that as we talk about how we move forward on capitalization of this effort, that valuable mid-band spectrum licensed to satellite providers years ago is a very valuable commodity, and I think we need to make sure that the U.S. taxpayer is involved in getting the best out of that as possible.

So with that, Mr. Chairman, I look forward to hearing from our witnesses and look forward to what our colleagues have to say about this issue during the Q&A.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Senator Cantwell.

Now I'll call our witnesses forward at this point to take their places at the table. I think it's clear from the Ranking Member's opening statement that there is much bipartisan consensus around this issue, and I particularly appreciate her bringing the witness from Spokane to talk about the problems facing local governments.

We have our witnesses at the table now. We'll just begin on my left and proceed to the right and recognize every witness, each wit-
ness, for 5 minutes, for no more than 5 minutes, for an opening statement.

Mr. Gillen, you are recognized.

STATEMENT OF BRAD GILLEN, EXECUTIVE VICE PRESIDENT, CTIA

Mr. Gillen. Thank you, Chairman Wicker. Thank you, Member Cantwell, and members of this Committee.

I am not Meredith Baker. With Meredith’s apologies and on behalf of the wireless industry, I thank this Committee for their continued leadership and focus on 5G. Since your hearing in July, our industry and our Nation have made giant strides in ensuring U.S. leadership in state-of-the-art and secure 5G. Most notably, we have seen the initial launch of 5G. Consumers in 10 states, including Mississippi, Mr. Chairman, the consumers in 10 states are the first to experience 5G, which will ultimately be 100 times faster and 5 times more responsive than your service today.

Accenture has projected 3 million new jobs and $500 billion to the economy thanks to 5G. Those numbers somewhat undersell 5G’s promise. Pick a challenge in your state you want to solve, from health care to transportation to my complete lack of a voice, 5G has the potential to help solve it and to foster new smarter communities throughout your states. 4G made our lives easier. 5G offers the promise to make our lives safer and better.

We have never been more excited about what’s next as we start to see companies invest in their own 5G vision. Ford has announced that all new Ford cars starting by 2022 will have 5G built in. Disney and the New York Times have launched their own new 5G-connected hospital. But it isn’t just big names. Like 4G before it, many 5G innovations will come from startups. Ten years ago, no one imagined Uber or countless other companies that are dependent upon and relied upon the 4G platform.

Our job is to build the wireless networks that support the visions of 5G entrepreneurs both big and small, and we will. The wireless industry invested in this Nation over $25 billion just last year, and our networks will be safer thanks to 5G standards with security baked in.

While more and more Americans will experience 5G this year and next, we are just scratching the surface. How far we go, and how quickly we get there are closely tied and dependent upon our Nation’s spectrum policy. Spectrum is the invisible building block for everything that we do.

There are three types of spectrum, three legs to our 5G stool. Low-band spectrum, it goes miles, it’s what your wireless service relies on today and what you’re most familiar with. High-band spectrum, it packs a punch. It will be really important for bandwidth-intensive applications, but only travels a block or two. The FCC, to their credit, just successfully concluded the first of three planned high-band options. That leaves mid-band. We are very encouraged to hear both the Chairman and the Ranking Member allude to mid-band and its importance. Meredith likes to call it the “Goldilocks of spectrum” that mixes both capacity and coverage just right.
Our key global rivals will have four times the amount of mid-band spectrum as we will next year, four times. The good news is that the FCC and the administration identified the right target bands to help us catch up. We'll need to act now to free up hundreds of megahertz of spectrum, and if we do, research this week revealed it will generate over $250 billion to our economy. The good news is we can do that thanks to this Committee’s AIRWAVES Act. Senator Gardner, Hassan, and other bipartisan cosponsors, we thank you for your leadership, and we urge the swift reintroduction of AIRWAVES to provide a multiyear auction schedule.

As this Committee has rightfully made clear, for us to win the 5G race, 5G also cannot be a New York- and L.A.-only solution. One of the best parts of AIRWAVES is that 10 percent of the proceeds of future spectrum auctions will go to build networks in unserved areas. This rural dividend will help shrink the digital divide, ensuring more communities benefit more quickly from advanced wireless. The Committee can ensure our Nation’s 5G and spectrum leadership with passage of AIRWAVES this year. I’d miss if I did not also applaud the Committee’s other spectrum-related work, including SPECTRUM NOW and the Government Spectrum Valuation Act. These provisions would drive government users to be more efficient stewards of their own spectrum.

Thank you, and I look forward to your questions.

[The prepared statement of Ms. Baker follows:]

PREPARED STATEMENT OF MEREDITH ATTWELL BAKER, PRESIDENT AND CEO, CTIA

Chairman Wicker, Ranking Member Cantwell, and members of the Committee, on behalf of CTIA and the U.S. wireless industry, thank you for the opportunity to testify today.

CTIA applauds this Committee’s bipartisan focus on advancing U.S. spectrum policy, and securing U.S. global leadership in the mobile marketplace. From the perspective of the wireless industry, it is fitting that your first hearing in the 116th Congress is discussing 5G and what it means for our country, our economy, and American consumers.

The good news is thanks to significant policymaker and industry collaboration in the past year the United States is well-positioned for success. To deliver on the full promises of 5G, we need to redouble our national efforts to promote 5G-friendly policies. The main building block required is spectrum and we need more of it—specifically mid-band spectrum—to maintain our global leadership role in wireless.

5G is Being Deployed Right Now

Thanks in large part to the leadership of this Committee and ongoing efforts at the FCC, the first American 5G deployments are happening today. American network and technology companies are investing aggressively to ensure that equipment, handsets, and devices are ready for American innovators and consumers to leverage the power of the new 5G platform.

Since I last testified before this Committee in July, CTIA’s members have taken significant steps forward. All national carriers have announced 5G deployment plans. The rollout of the next generation of wireless is occurring right now in 10 states in places like Harrison County, Mississippi, Atlanta, Raleigh, Indianapolis, and Sacramento. 5G will be coming this year to Nashville, Oklahoma City, Phoenix, Kansas City, Houston, and D.C., among dozens of other cities.

Additionally, 5G devices and equipment are being introduced alongside the 5G network, including mobile device chipsets for mobile devices and connected cars, advanced laptops, and VR and AR equipment. Qualcomm announced that over 30 new 5G devices will be introduced in 2019, while Intel has plans to make a 5G wireless modem chip available in the second half of this year. These advanced chip-sets are key to 5G speeds and connectivity. Sprint, AT&T, and Verizon announced their upcoming Samsung 5G phone, which will offer dual-connectivity for both 4G and 5G networks, and T-Mobile confirmed it rolled out 5G network equipment in 30 cities, including New York, Los Angeles, Las Vegas and Dallas.
U.S. wireless providers will invest some $275 billion in 5G-related networks—creating three million new jobs and adding $500 billion to our economy, according to Accenture. As you can imagine, the U.S. is not the only country to recognize the transformational impact of 5G. There is international consensus: the nations that lead on 5G will capture millions of new jobs and billions in economic growth.

5G Will Usher in a More Secure Era of Technological Innovation

5G is the next generation of wireless, and these new networks will offer speeds up to 100 times faster, enable 100 times the number of devices, and be five times more responsive than today’s 4G networks. 5G will be more than just fast, it will also be the most secure generation of wireless service.

Today’s 4G LTE networks have the most advanced security features to date, and 5G will further improve upon them. As 5G networks start to be deployed, wireless providers are leveraging new and advanced measures—after years of research, investment, and contributions to standards bodies—to secure the networks. The Federal Communications Commission’s (FCC) September 2018 Communications Security, Reliability and Interoperability Council (CSRIC) report highlights the security advances and innovations offered by 5G. The wireless industry is committed to working with Congress and the Department of Homeland Security to ensure a secure platform for tomorrow’s innovations.

The Positive Impact of 5G on Other Industries

Coupling 5G capabilities and security, I’m excited by the possibilities offered by 5G to drive transformational improvements in health care, agriculture, education, transportation, and nearly every industry in America.

From making healthcare more accessible and making us more energy efficient to expanding the ways we educate our children, 5G will revolutionize how we live our lives. The promise to add connectivity to smart communities will be powered by 5G.

As we start to see new 5G networks and devices launch, there is a growing list of companies and industries investing in their 5G future. Let me share with you some recent examples where we are already seeing 5G solutions be put into practice:

Rush University Medical Center in Chicago is creating the first 5G-enabled hospital in the U.S., where 5G will support telemedicine, smart scheduling, and enhanced patient care through artificial intelligence and augmented reality training sessions for doctors. Dr. Shafiq Rab of Rush Hospital has said, “We strongly believe 5G is a game-changing technology that when fully implemented will help us... provide the highest quality patient and staff experience.” Jeremy Marut, the hospital’s chief enterprise architect explained, “5G will give us the speed, the low latency as well as the ability to connect many more devices.”

Samsung announced their 5G “Innovation Zone” in Austin, Texas, a testbed to provide a real-world understanding of how 5G can impact manufacturing and help create Smart Factories. Some of the new technologies they are exploring include 4K video as a sensor to improve plant security and detection response, industry IoT sensors to monitor for environmental and equipment conditions, AR and VR for employee training, and enhanced location services for plant safety.

Verizon launched the Verizon 5G EdTech Challenge, a nationwide challenge calling for enterprise organizations, start-ups, research groups, and universities to create education solutions that leverage 5G connectivity to solve for challenges in under-resourced middle schools throughout the U.S. Dr. Ken Perlin is developing ChalkTalk, a 5G augmented reality learning tool that renders multimedia objects in 3D.

5G is fundamentally changing our entertainment experiences. For instance, AT&T Stadium, home of the Dallas Cowboys, will offer fans mobile 5G services with faster speeds and potential services like AR and VR to enhance the fan experience, while Walt Disney Studios is exploring the possibilities of 5G connectivity for media and entertainment at Disney’s StudioLab. “We see 5G changing everything about how media is produced and consumed,” says Walt Disney Studios chief technology officer Jamie Voris.

As we get closer to fully autonomous vehicles, 5G will be a key ingredient. Ford announced its plans to connect every new vehicle sold in the U.S. to 5G which will allow vehicles to send and receive information about their surroundings. This real-time interactivity will ease congestion and boost the safety of drivers on the road.

The City of Peachtree Corners, Georgia is also taking advantage of 5G by building a 1.5 mile intelligent vehicle test track within a 500-acre technology park where new intelligent mobility technologies can be tested. “Creating an environment for developing smart mobility technology will be a tremendous asset for our city... Our young city is living up to its innovative and remarkable’ tagline as future intel-
ligent mobility technologies are developed here in Peachtree Corners," says Mayor Mike Mason.

More broadly, 5G promises to unlock the promise of smart cities. Accenture has projected benefits of $160 billion. Specifically, Accenture’s Managing Director Tejas Rao concluded that “5G-powered smart city solutions applied to the management of vehicle traffic and electrical grids alone could produce an estimate of $160 billion in benefits and savings for local communities and their residents. These 5G attributes will enable cities to reduce commute times, improve public safety, and generate significant smart-grid efficiencies.”

The exciting news is that we are beginning to see cities adopt these solutions. Recently, Las Vegas officials started an innovative partnership to test a smart lighting solution aimed at improving public safety and enhancing energy efficiency. By outfitting existing streetlights with routers and connecting them to existing wireless networks, the city can monitor energy usage and outages in real time. This saves money and gets the lights repaired more quickly after an outage, helping with public safety. The platform can also be used to monitor air quality and temperature.

These are all just a sample of the initial investments in 5G from the past few weeks and we are just scratching the surface as to how 5G will make our lives better and safer.

5G Spectrum Policy Is Key to U.S. Leadership

Although I am pleased to report on these positive 5G developments across the U.S., we cannot take our foot off the accelerator. To fully realize the technological breakthroughs we are talking about, we need more spectrum, and we need it as soon as possible.

CTIA commends this Committee, the FCC, and the Administration for the ongoing work in identifying and repurposing spectrum for 5G. With your support, the wireless industry has invested hundreds of billions of dollars in private capital in acquiring and building out spectrum.

But the need for additional spectrum remains pressing. A predictable pipeline of spectrum will do much to advance U.S. 5G interests, and help us match the efforts foreign governments are taking to allocate spectrum for 5G services. This Committee, the FCC, and the Administration have identified all the right bands. Now we need to finish the job fast.

The future of 5G is going to require a mix of spectrum, including low-, mid-, and high-band spectrum. Low-band offers robust spectrum waves that travel long distances, high-band spectrum has big capacity but travels short distances, while mid-band is a nice complement of both capacity and coverage. To offer 5G across all areas of our country, we need a healthy mix of all three.

CTIA commends Chairman Pai and the FCC Commissioners for their commitment to promoting American leadership in 5G and the significant steps taken to address our Nation’s lack of access to high-band spectrum. The FCC recently completed its first successful auction of high-band spectrum, the 28 GHz band, and Chairman Pai has announced the auction of four additional high-bands of spectrum by the end of this year. Additionally, Congress and the FCC are to be applauded for pushing low-band spectrum into the marketplace through the broadcast incentive auction, and last year, Congress directed the FCC to identify 30 MHz of low-band spectrum for wireless services by 2022.

Mid-band Spectrum Is Key. Where the U.S. needs to make quick progress in the near term is on mid-band spectrum. Policymakers and industry worldwide have coalesced around the importance of mid-band spectrum, which basically refers to fact that this spectrum is located in the middle of the frequency bands currently in use for mobile services, roughly 3 to 24 GHz.

Mid-band spectrum will be a workhorse band for 5G—it represents the “sweet spot” of spectrum innovation. That’s because it leverages both capacity and coverage opportunities—meaning it can handle the increased traffic that 5G will bring, and this spectrum travels distances, which is helpful in more rural settings. Mid-band spectrum has great potential to facilitate the deployment of 5G services because it will accommodate the wide bandwidths necessary to facilitate the faster connections and low latency that 5G technology promises.

For this reason, freeing up mid-band spectrum will create a positive impact on the economy. Analysis Group recently estimated the economic impact of U.S. policymakers freeing up mid-band spectrum. Its key finding: 400 MHz of mid-band spectrum will drive $274 billion in GDP and 1.33 million new jobs. This report underscores what we already know: that Congressional directives to auction spectrum have significant positive economic and societal benefits.

Because this mid-band spectrum is critical to 5G and economic development, other nations are moving quickly to allocate its use to wireless services. A study last year
found the U.S. 6th among countries in mid-band spectrum allocations. Japan, South Korea, Spain, and the United Kingdom have all auctioned or assigned mid-band spectrum since April 2018. Several other countries, including Australia, Germany, and Japan, have confirmed that mid-band spectrum will be assigned by June 2019. Recently, China announced that its three existing state-owned operators will receive a total of 460 MHz of mid-band spectrum for 5G.

The U.S. is making progress on mid-band, and Chairman Pai deserves credit for working hard to catch up with foreign governments. The FCC recently finalized rules for the 3.5 GHz band for mobile broadband, which will result in 70 MHz of licensed spectrum to be auctioned soon. We also welcome the FCC’s proceeding to evaluate repurposing up to 500 MHz of mid-band spectrum between 3.7 and 4.2 GHz, known as the “C-Band.” And last year, under the leadership of NTIA Administrator Redl, the Commerce Department initiated a review of the 3.45 GHz band, which is another critical piece of mid-band spectrum that could open new possibilities for 5G services in the U.S.

There is real bipartisan support behind swift U.S. action on mid-band spectrum. Commissioner O’Rielly noted it became apparent that “the world was eyeing mid-band spectrum as a component for 5G deployment. Thus, it became vital for the United States to have available a serious mid-band play to complement our spectrum work in the low and high bands.” Commissioner Jessica Rosenworcel also said it well in her statement supporting the FCC’s inquiry into opening more mid-band spectrum: “We need to get started. Right here, right now.”

This forward momentum is critically important, but we need to continue to press for additional action. The reality is wireless carriers in many countries have access to mid-band spectrum, and U.S. operators do not today. In December 2018, Analysys Mason released a report focused on mid-band spectrum plans in key foreign countries for 5G. It found that by the end of 2020, an average of nearly 300 MHz of mid-band spectrum will be available per country. The FCC’s 3.5 GHz item will open up 70 MHz of licensed mid-band spectrum, but to lead the world in 5G, the U.S. focus needs to be on securing hundreds of megahertz of mid-band spectrum. We have the right policy proposals, now we need to focus on following through and getting assets in the hands of our innovators swiftly with a clear schedule of auctions. The best available option is the 3.7 GHz band of spectrum under current FCC review.

Key Congressional Role in 5G Spectrum Policy

Congress has the ability to shape U.S. spectrum policy and take the steps we need to deliver on the full promise of 5G. This Committee should also be fully apprised on key efforts internationally and in the Administration to advance U.S. spectrum interests.

AIRWAVES. Last year CTIA strongly supported the Advancing Innovation and Reinvigorating Widespread Access to Viable Electromagnetic Spectrum (“AIRWAVES”) Act, which establishes a much-needed pipeline of future spectrum auctions critical to U.S. global leadership in 5G. During the 115th Congress, the bill—authored by Senators Gardner and Hassan—enjoyed broad bipartisan backing in both the Senate and the House and attracted widespread praise from a diverse array of organizations, including the Consumer Technology Association, Connected Nation, the African American Mayors Association, and Public Knowledge.

Critically, the AIRWAVES Act set a timeline for auctioning a series of key low-, mid-, and high-band frequencies over the next five years. By recognizing that we need different types of spectrum to unlock the full complement of 5G services, the AIRWAVES Act identifies our core challenge: the lack of access to sufficient mid-band spectrum. AIRWAVES remedies the mid-band deficit by providing access to the same spectrum bands that are being made available throughout Asia and Europe. By matching up our mid-band spectrum with global bands, we unlock economies of scale and reduce the costs—and time—to deploy.

Congressional deadlines, like those in AIRWAVES, have always been an essential tool to enable U.S. spectrum leadership by ensuring timely access to new spectrum. This five-year auction schedule will allow wireless providers to plan and build their 5G networks to maximize efficiency and robustness.

CTIA is hopeful that an updated version of the AIRWAVES Act will find its way into law in the 116th Congress. Passing the AIRWAVES Act is the most important step this Committee can take to ensure that our Nation has the spectrum resources it needs to move full speed ahead with our 5G deployments and ensure American leadership. We stand ready to assist in any way we can towards that goal.

Other Key Legislation. Last Congress we strongly supported the Supplementing the Pipeline for Efficient Control of The Resources for Users Making New Opportunities for Wireless (“SPECTRUM NOW”) Act, introduced by Sens. Wicker, Schatz, Udall, and Moran. This bipartisan legislation helps government agencies more effi-
ciently and effectively manage spectrum resources. SPECTRUM NOW allows use of the approximately $8 billion in existing Spectrum Relocation Fund monies to support research into the feasibility of Federal spectrum users either relocating or sharing spectrum with non-Federal users. We are hopeful this legislation will be reintroduced and move forward in this new Congress.

National Spectrum Strategy. Last October, the Administration issued a Presidential Memorandum and is currently developing a comprehensive National Spectrum Strategy. CTIA strongly supports this effort and appreciates the recognition that spectrum impacts our “economic, national security, science, safety, and other Federal mission goals now and in the future” and that the “

This Presidential Memorandum indicates the urgency—shared by the U.S. wireless industry—that spectrum should be quickly identified and made available to ensure our 5G leadership. Many nations are vying to lead on 5G, and the U.S. cannot wait. The Administration has moved in the right direction with important steps, and we urge the FCC and the Administration to commit to a clear auction schedule as soon as practicable. Congressional support and encouragement for a proactive, 5G-centric spectrum strategy would be beneficial, and would be strongly bolstered by passage of an updated AIRWAVES Act.

World Radio Conference. Maintaining U.S. leadership in wireless services will also require that its actions on the international stage support 5G leadership here at home. As the U.S. government prepares for the upcoming 2019 World Radio Conference, the overarching goal should be to ensure that our efforts are directed at promoting 5G deployment across the U.S. Specifically, Congress should encourage the Administration to ensure that its positions reinforce our 5G leadership and do not undermine access to critical spectrum bands that have already been identified for 5G use in the U.S.

Deploying the Wireless Infrastructure to Leverage 5G Spectrum

5G services will require much denser networks to utilize new spectrum assets. To handle growing mobile data demands and unlock new 5G applications, wireless providers will need to install hundreds of thousands of small cells—small antennae the size of backpacks—in the next few years. Estimates have projected we will need over 800,000 small cells by 2026. To put that into perspective, our industry has over 150,000 cell towers in operation today, built over 35 years. Those installations are ongoing right now bolstered by reforms by 21 states and the FCC to modernize siting rules to reflect the needs of tomorrow’s wireless networks as opposed to 200-foot cell towers. The FCC and the states have provided updated guidance to cities’ approval processes for small cell applications. We thank Communications and Technology Subcommittee Chairman Thune and Ranking Member Schatz for their joint effort last Congress to develop the STREAMLINE Small Cell Deployment Act which included many process reforms similar to those adopted by the FCC in its recent decisions. We also appreciate efforts by Chairman Wicker and Senator Cortez Masto for their leadership on the SPEED ACT, and Senator Moran for his work on the RAPID Act.

Delivering Mobile Broadband to More Americans

I’m proud of our industry’s commitment to building mobile service across America, driven by over $226 billion investment in our networks since 2010 alone. Just since December 2016, we were able to cover more than 318,000 additional rural consumers with LTE services. Nevertheless, there are communities across the country that still do not have access to the benefits of wireless, and we need Congress’s and the FCC’s help to ensure these unserved areas get connected.

One of the most promising proposals for reaching more Americans is the “rural dividend” provision included in the AIRWAVES Act. That provision sets aside 10 percent of the proceeds from new spectrum auctions for deployment of wireless networks in rural America. If this provision had been in place during the AWS-3 and broadcast incentive auctions, the rural dividend would have made available an additional $6 billion to build out wireless in rural America and unserved communities. CTIA urges this provision to be included in a new AIRWAVES Act.

This Committee has also placed renewed focus on the role the FCC and Administration can play in expanding access to broadband services. The FCC’s Mobility Fund will provide nearly $500 million in annual support, which can also provide much-needed universal service funding dedicated to wireless coverage across the country. Additionally, ensuring that broadband mapping is accurate will help better inform broadband infrastructure planning.

The wireless industry also wants to see the promise of 5G realized in underserved communities, including communities of color. The Brookings Institution recently re-
leased a report authored by Dr. Nicol Tuner Lee that examined the connection between 5G, the Internet of Things, and communities of color.

With 54.9 percent of households now being wireless-only homes, in her paper Dr. Turner Lee notes that "for communities of color...5G represents increased economic opportunity through improved access to social services, such as health care, education, transportation, energy, and employment." Dr. Turner Lee advocates that a robust supply of low-, mid-and high-band spectrum is required to broaden capacity and coverage in all communities to "promote both ubiquity and some level of digital equity for marginalized populations and their communities."

Thank you for the opportunity to testify today. CTIA looks forward to working with you to promote 5G deployment and urges swift reintroduction and adoption of the AIRWAVES Act.

The Chairman. Thank you very much.
Mr. Berry, you are recognized.

STATEMENT OF STEVEN K. BERRY, PRESIDENT AND CHIEF EXECUTIVE OFFICER, COMPETITIVE CARRIERS ASSOCIATION

Mr. Berry. Thank you, Mr. Chairman. Chairman Wicker, Ranking Member Cantwell, and members of the Committee. Thank you for the opportunity to testify about how to preserve and expand broadband opportunities in rural America as the next generation of wireless technology evolves.

CCA is the Nation’s leading association of competitive wireless carriers composed of nearly 100 carrier members ranging from small rural providers serving fewer than 5,000 customers to regional and nationwide providers serving millions of customers, and also the vendors and the suppliers.

We’re on the verge of a new era, and it’s hard not to get excited about the potential of 5G wireless networks. Just as applications that are literally household names today seemed unimaginable in the days of 3G. 5G networks will spur innovation and will come in a variety of flavors, including mobile, fixed, fiber, and converged technologies and solutions. 5G precursors, such as narrow-band Internet of Things, will provide new business opportunities while expanding connectivity, and rural America stands to benefit the most from enhanced connectivity.

But the very existence of 5G is not inevitable, particularly in rural America. While the 5G buzz always grabs the headlines, rural areas are at a crossroads. Decisions made by policymakers today can either launch innovation, economic growth, education, and public safety benefits across all of America, or they will broaden the digital divide. I am pleased that this Committee is already at work to ensure that all Americans have access to the latest broadband technologies.

The race to 5G will not be won if rural America is left behind. I prefer to look at the 5G race as a cross-country team event. The first to cross the finish line may get more points, but the race is not over until the entire team finishes, and rural America is a key member of that team, and we must ensure the connectivity gap is bridged. 5G network deployments will build upon today’s 5G and 4G coverage areas.

We cannot close the digital divide if we do not know where and the size of the country’s existing coverage gap. As a nation, we need to know where broadband coverage exists and where it does not. I thank this Committee for its steadfast leadership to fix the coverage maps. CCA and our members are committed to work with
Congress, the FCC, and other stakeholders to accurately identify coverage in rural America.

Armed with better data, there are three policy priorities to expand connectivity. First, Congress must reinvigorate Universal Service Fund policies to ensure that the 5G services become widely available. The Mobility Fund is critically important to preserve and expand 4G services, but if Congress believes that all Americans living in rural, Tribal, low-income communities deserve the same digital opportunities as their peers, the fund must be sustainable. USF contribution policies must be updated for a 5G world.

Second, spectrum. 5G wireless demands spectrum access. All carriers must have this opportunity to access low-, medium-, and high-band spectrum to serve their customers and support innovation and applications. I commend the Committee for its dedicated efforts to allocate spectrum for wireless use. Also, let us not forget that we need to keep the 600 megahertz incentive auction repack process on schedule and continue to provide mid-band spectrum opportunities for carriers, including 3.5, the C-band, the L-band, and ensure that millimeter-wave spectrum is also accessible to all, including the small carriers serving rural areas.

Third, infrastructure deployment policy must support 5G services. Streamlined physical infrastructure deployment is a vital part to close the digital divide and to complete the generational upgrade of 5G wireless, and for many rural carriers, permitting and siting approval for macro cells on Federal lands is a particular important issue.

Finally, the telecommunications industry is on the precipice of a significant new investment to power 5G services. It’s critical that government and industry define a clear pathway for enhanced security and a process to provide resources to secure networks and sustain national security priorities.

Yes, 5G holds great promise for everyone. However, policymakers must ensure that rural areas are not left sidelined from a connected future. Let’s make sure that rural America remains in the race as part of the 5G Team USA.

Thank you for the attention, and thank you for this hearing, and I look forward to answering your questions.

[The prepared statement of Mr. Berry follows:]

PREPARED STATEMENT OF STEVEN K. BERRY, PRESIDENT AND CHIEF EXECUTIVE OFFICER, COMPETITIVE CARRIERS ASSOCIATION

Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to testify about how to preserve and expand broadband opportunities in rural America as the industry evolves to the next generation of wireless technology.

I am testifying on behalf of Competitive Carriers Association ("CCA"), the Nation’s leading association for competitive wireless providers. CCA is composed of nearly 100 carrier members ranging from small, rural providers serving fewer than 5,000 customers to regional and nationwide providers serving millions of customers, as well as vendors and suppliers that provide products and services throughout the mobile communications ecosystem.

The communications industry is on the verge of new era of technology, and it is hard not to get excited about the potential benefits and capabilities of 5G wireless networks and the services they will power. Just as applications that are household names today seemed unimaginable in the days of 3G, the potential of 5G networks will welcome a new chapter for innovation and expand connectivity. 5G networks will be deployed in a variety of ways. Fixed 5G services will introduce new fixed
competition without disturbing streets and land. 5G precursors, such as Narrowband Internet-of-Things ("NB IoT"), will provide new business opportunities while expanding low-power connectivity for sensors, tracking, and other uses, that can later be upgrad ed to more advanced services. Mobile 5G services will power the latest telehealth, precision agriculture, distance learning, autonomous vehicles, augmented and virtual reality, and public safety services. The possibility of a connected world is groundbreaking and exciting.

But the unfortunate reality is that the very existence of 5G is not inevitable, particularly in rural America. While the 5G buzz grabs the headlines, rural and hard-to-serve areas are at a crossroads. Decisions made by policymakers today can either launch new innovation, economic growth, and education and public safety benefits across all of America, or they will broaden the digital divide, leaving rural America behind. I am pleased that, at the start of this Congress, the Committee is already at work to ensure that all Americans have access to the latest broadband technologies. The race to 5G will not be won if rural America is left behind.

Reliable Coverage Maps are Necessary for Policies to Spur 5G Deployment

Tomorrow's 5G network deployments will build upon today's 4G coverage. Unfortunately, too many areas throughout the country lack 4G coverage, or indeed any network coverage at all. We cannot close the digital divide if we do not know the size of our country's existing coverage gap. More reliable data is necessary to determine where broadband coverage exists, and I thank this Committee for its steadfast leadership pushing to fix the coverage maps.

Based on your own experiences, members of this Committee know that coverage has been overstated—in some cases, substantially overstated. Coverage areas in the Federal Communication Commission ("FCC")'s recent mobile coverage map are unreliable. Based on this mapping data, the FCC is set to distribute $4.53 billion in support to preserve and expand mobile broadband over the next ten years. To ensure funding goes to areas in need, CCA members have spent millions of dollars, untold hours of staff time, and significant additional resources to challenge overstated coverage in advance of the Commission's funding decisions. Fortunately, shortly after the challenge window closed last Fall, the FCC announced that, based on a preliminary review of more than 20 million speed tests, it too, noted increased concerns that current data is fatally flawed. The FCC accordingly launched an investigation into the proceeding, and CCA stands ready to work alongside the Commission and this Committee to ensure that future information collections provide an accurate and reliable foundation upon which to base critical funding decisions.

Connectivity for millions of Americans living in rural areas depends on using reliable, real-world coverage data to determine policy positions. Congress must remain engaged as the investigation into flawed data continues, and work beyond current FCC efforts to produce a map that more closely reflects your constituents' experiences. CCA and our members are committed to continuing to work with Congress, the FCC, and other stakeholders to ensure that the parameters for identifying actual coverage in rural America will properly drive advanced network deployments instead of cementing the coverage status quo.

Universal Service Policies Must Support a 5G Future

Congress created the Universal Service Fund ("USF") to ensure that all consumers, including those in rural areas, would have access to reasonably comparable telecommunications and information services as those provided in urban areas. I strongly urge Congress to reinvigorate this policy as 5G services become widely available. As discussed above, the FCC has allocated $4.53 billion to support the deployment of 4G LTE network service over the next 10 years through Mobility Fund Phase II ("MF II"). As we've seen, a "generation" often finds its peak in its tenth year. While MF II is critically important to preserve and expand 4G services, absent additional support, rural America risks falling further behind in the digital divide as carriers serving rural areas constantly work to catch up to comparable urban services.

The USF program devised in the 1996 Telecom Act, groundbreaking as it was, was predicated on a 2G telecom industry—not 4G and certainly not 5G. Policymakers must recognize that the contribution base for all USF programs is insufficient and unsustainable. If Congress continues to believe that Americans living in rural, Tribal, and low-income communities deserve the same digital opportunities as their peers, USF contribution policies must be updated to account for a 5G world.

5G Wireless Demands Spectrum Access

Spectrum is the lifeblood of the wireless industry, and is a finite resource only available from the government. All carriers must have access to spectrum at low-, mid-, and high-bands to serve their customers and provide the capacity necessary
to support innovative applications. All spectrum is a public resource, owned by American citizens. Spectrum licenses can be obtained only through auction from the FCC or from private market transactions approved by the FCC and other government actions. I commend the Committee for its ongoing work to reallocate spectrum for wireless use, and ask for continued focus on this critical issue, especially if the United States is to catch up to spectrum allocations available for wireless use in other countries that strive to assume global leadership for 5G networks. Ensuring that every carrier must have an opportunity to bid, buy, and access critical spectrum resources is key to competition and expanded broadband service, especially in rural America.

**Low-Band Spectrum**

Low band spectrum, or spectrum below 1 GHz, has propagation characteristics that carry signals across long distances and through impediments such as walls or trees. This spectrum is particularly important for coverage in rural areas with lower population densities and vast areas to connect. It provides the base layer of coverage for today’s networks, and 5G services deployed on low-band spectrum will have similar coverage advantages with upgrades to both latency and speeds.

The Committee deserves credit for enacting the first-ever incentive auction in the Middle Class Tax Relief and Job Creation Act of 2012. Provisions in the Act established a process by which television broadcasters could voluntarily elect from a range of options to relinquish, move, or share their spectrum assignment in exchange for a portion of the auction proceeds, using a market-based mechanism to reallocate the spectrum needed to keep up with insatiable demands for wireless access. Revolutionary in its inception, the incentive auction was a resounding success, netting billions of dollars for broadcasters and the Treasury for deficit reduction.

While the auction was a success, work is continuing to deploy this spectrum to serve consumers. We are 21 months into the “repack” process, in which remaining broadcasters are moved in the band to clear the way for the carriers that bid over $19 billion to gain access to the frequencies to serve consumers. Nearly a year ago, Congress allocated an additional $1 billion on top of the original allocation of $1.75 billion to cover relocation costs for broadcasters and to keep the repack time-frame on schedule, and to fund consumer education as the process moves forward. Congress should closely monitor the repack process and ensure that spectrum is expeditiously cleared for winning bidders to put to use as soon as possible and no later than the July 2020 deadline.

**Mid-Band Spectrum**

Mid-band spectrum balances distance travelled with speed capabilities, making it particularly well suited for providing the latest generation wireless services in rural America. CCA members appreciate the compromise adopted by the FCC last year in the 3.5 GHz band and eagerly await its auction. Looking ahead, the C-Band spectrum, particularly the 3.7–4.2 GHz portion of the C-Band, shares favorable characteristics of mid-band spectrum, while presenting the opportunity for the larger blocks of spectrum that enhance network capabilities. Additionally, incumbent satellite users have identified capacity that can be reallocated for wireless use. It is critically important that policymakers adopt policies that both reallocate as much of this spectrum as possible to support 5G networks and ensure that competitive carriers and those serving rural America have a meaningful opportunity to gain access to this spectrum. Although it is encouraging to see some momentum in the C-Band proceeding, another mid-band proceeding seems to have stalled within the Department of Commerce. Policymakers should complete work on the L-Band to provide competitive carriers with another source of prime mid-band frequencies to help deploy advanced, next-generation networks.

**High-Band Spectrum**

High-band spectrum makes up for lower distance propagation by enabling ultra-fast speeds. I am pleased that the FCC is moving forward with several millimeter wave spectrum auctions, including the recently concluded auction for the remainder of the 28 GHz band, and the 24 GHz band auction set to begin on March 14, 2019. These bands present opportunities for significantly larger swaths of spectrum, a force multiplier for the wireless services that will ride on them. The FCC must ensure that all carriers can access these important spectrum bands for 5G services, particularly after the largest two carriers were permitted a significant head start in these bands through private market transactions. As additional high-band spectrum allocations are considered for wireless use, policymakers should preserve the opportunity for licensed use and provide certainty on service rules, such as power levels, needed to spur research and development to use this spectrum to serve consumers.
Infrastructure Deployment Policies Must Support 5G Services

The right policies to deploy, maintain, and upgrade physical infrastructure are a vital part of both closing the digital divide and completing the generational upgrade to 5G wireless technologies. Unnecessary costs and delays for deploying new infrastructure are exponentially more problematic for deployments in rural America. While CCA commends steps taken so far, work remains to ensure that carriers have certainty as they navigate the approval process. For rural carriers, additional certainty regarding permitting on Federal lands is particularly important.

New macro-towers are necessary to expand existing coverage and provide 5G services. 5G also will require significant network densification by deploying scores of small cells. Small cells are not only for big cities, as I have seen firsthand how carriers serving rural areas are using small cells to better serve their customers. For 5G deployments in particular, it is important to note that infrastructure deployment is not limited to cell towers and small cells. 5G networks will exist on a high-fiber diet, with estimates as high as 8 miles of fiber per square mile to provide 5G service in urban areas. Forward-thinking infrastructure deployment policies will ensure that backhaul does not become a choke point in the latest wireless networks. It is increasingly clear that 5G will be a mix of several converged technologies and different methods of communication.

5G Networks Must be Secure

CCA and its members fully support efforts to protect and harden networks from cybersecurity and other national security threats. As carriers continue to deploy next-generation wireless services, policymakers should continue to provide guidance to all carriers regarding risks and potential threats. It also is imperative to ensure that all carriers have access to equipment that is secure, particularly for smaller and rural carriers that lack economies of scale.

With the telecommunications industry on the precipice of significant new investments in equipment and software to power 5G services, it is critically important that Federal authorities charged with national security decisions provide clear, unambiguous directions regarding the national security needs for all communications networks. With this direction, government and industry can define a clear pathway for enhanced security and a process to provide adequate resources to secure networks and sustain national security priorities.

5G services promise an immediate and expansive impact on the lives of Americans living in rural areas; however, absent smart and swift action from policymakers to close the digital divide, those in rural areas will be sidelined from a connected future. With today’s latest networks, telehealth services are providing monitoring and treatment options that are increasing healthcare offerings, lowering costs, and saving lives. Precision agriculture technologies are increasing yields and using fewer resources, while transforming farmers into agricultural engineers. Distance learning over broadband is allowing any student to travel the world in their studies, expanding their educational opportunities far beyond the traditional classroom. The potential of 5G networks can supercharge these technologies and unlock unprecedented economic, educational, health, and safety opportunities in rural America, if policies are in place to make sure networks are being deployed by carriers serving rural, regional, and nationwide customer bases.

Congress should prioritize preserving and expanding wireless broadband services in rural America, through reliable coverage data, sufficient USF, expanded spectrum access for all carriers, streamlined infrastructure deployment policies, and secure 5G networks. Thank you for your attention to these issues and for holding today’s important hearing. I welcome any questions you may have.

The CHAIRMAN. Thank you very much, Mr. Berry.
Mr. Bhatt, you are recognized.

STATEMENT OF SHAILEN P. BHATT,
PRESIDENT AND CHIEF EXECUTIVE OFFICER,
INTELLIGENT TRANSPORTATION SOCIETY OF AMERICA

Mr. BHATT. Chairman Wicker, Ranking Member Cantwell, members of the Committee, good morning. My name is Shailen Bhatt, and I’m honored to be here representing the Intelligent Transportation Society of America. ITS America’s members are public agencies, private sector companies, and research institutions united in our vision of a better future transformed by intelligent mobility,
one that is safer, greener, and smarter. This hearing comes at a critical time because 5G connectivity has the potential to deliver a transportation system that is safer, offers more choices, and provides more accessibility.

You know, in the mid-90s, I used to sell computers, and we had 2-gigabyte hard drives, and I would tell everybody that this will hold all the information you ever need. I was wrong. Today, autonomous vehicles give off 4,000 gigabytes of data every 90 minutes. The world is awash in a sea of big data. 5G has the speed and the bandwidth to take all the data from all of those cars and all the transportation users, process it, change it into actionable information, and communicate it back at a speed that will enable us to reduce crashes, improve the choices we make, and operate our systems more effectively. That's why we believe 5G connectivity will be transformational for transportation.

Let me start with safety, which has been our number one priority. First and foremost, it is critically important that we preserve the spectrum that has been dedicated for transportation safety critical communications in the 5.9 gigahertz band for Vehicle-to-Everything technologies, or V2X. This allows us to communicate with all users of the system. And to be clear, I'm referring to all V2X technologies, DSRC as well as C-V2X.

In 2018, there were 2 million crashes on U.S. roadways that resulted in either an injury or a death. About 30 percent of those are due to impaired driving, and according to NHTSA, V2X communications can address about 80 percent of nonimpaired crashes. So that means more than 1.2 million crashes could have been eliminated or mitigated last year alone. So those numbers are one thing, but this is about real lives.

There's a family of five from Michigan that was killed in Kentucky by a wrong-way driver, a crash that killed five young children on their way home from Disneyland in Florida—Disney World, excuse me—and last year a twin brother and sister in Indiana killed by a pickup truck that ran through a stop bar on a school bus. These are all crashes that are completely preventable today with V2X technology, and it only gets easier with 5G and other next-generation wireless technologies. These technologies will also allow these vehicles to act as real-time sensors, which means we will know instantly about the state of our system. It will allow us to protect the most vulnerable users of the system: pedestrians, bicyclists, motorcyclists. This is the number one area in which we are seeing an increase in fatalities across the system. With high-speed communication among devices and vehicles, we can create a much safer environment in which everyone can see all users. For all of these reasons, 5G and other next-generation wireless technologies will be transformational and critical for the U.S.

It's also going to change the way we experience transportation. As we move from the 20th century model of moving cars to the 21st century model of seamlessly moving people, data, and freight, the same data that helps us operate our system more safely will also help us operate it more efficiently. This new connectivity and the level of data we can exchange at a high rate of speed is an underpinning of our Mobility on Demand efforts. It means we can give
people real-time information that will allow them to make more intelligent transportation choices.

Now, while many people think of Mobility on Demand as strictly an urban phenomenon, a telecom network, much like a road network, allows you to connect communities. As you build out the system providing more telecommunication capabilities, this will only enhance and strengthen remote communities. This merging of road and telecom infrastructure to provide broadband and technology solutions to rural communities is something I’ve worked on in Delaware and Colorado and Kentucky, and something I believe is important moving forward.

There’s a whole new horizon of how to use data AI and analytics to operate our system. I’d like to share just one quick example. In the Denver area when you drive, you will get information on mobility choices, but as you drive into the mountains, you will get real live information on the weather. On I–70, this is critical because the weather can change drastically from one mountain pass to the other. We can get people real information about, Is there snow? Have people deployed an airbag?

5G connectivity is incredibly exciting. While there are many examples around the country of public and private sector organizations working on this, we must recognize we are in a global race, and I’m glad that the Committee has seen that. I spoke last year at the Beijing Auto Forum, and the folks in China were very clear on their intent to dominate the automotive and information technology sectors in the coming years. ITS America is looking at ways to keep pace with the evolving nature of competitive threats, cybersecurity risks, and the threats to U.S. infrastructure.

I’m very appreciative of this hearing so that the United States can maintain our leadership role and provide safer and more inclusive communities.

Thank you very much, and I’m happy to answer your questions.

[The prepared statement of Mr. Bhatt follows:]

PREPARED STATEMENT OF SHAILEN P. BHATT, PRESIDENT AND CHIEF EXECUTIVE OFFICER, INTELLIGENT TRANSPORTATION SOCIETY OF AMERICA

Testimony

Chairman Wicker, Ranking Member Cantwell, and Members of the Committee, thank you for the opportunity to provide the Intelligent Transportation Society of America’s (ITS America) perspective on “Winning the Race to 5G and the Next Era of Technology Innovation in the United States.”

My name is Shailen P. Bhatt, and I am the President and CEO of ITS America. Before joining ITS America last January, I served as Executive Director for the Colorado Department of Transportation (CDOT). In that role, I oversaw the launch of the RoadX program, which is focused on deploying innovative technology solutions—including connected vehicles—and teaming with the private sector to shape the future of transportation. While at CDOT, I also served as the national Chair of the Vehicle-to-Infrastructure Deployment Coalition and the Chair of the National Operations Center of Excellence. Before CDOT, I served as Cabinet Secretary with the Delaware Department of Transportation and Deputy Executive Director of the Kentucky Transportation Cabinet. I also had the pleasure of serving as Associate Administrator at the Federal Highway Administration under U.S. Department of Transportation Secretary Ray H. LaHood.

It is an honor to testify on behalf of ITS America and our members who have been researching, developing, testing or deploying intelligent transportation technologies. Founded as an official advisory board on road technology to the U.S. Department of Transportation, ITS America represents state and city departments of transportation, metropolitan planning organizations, automotive manufacturers, technology
companies, engineering firms, automotive suppliers, insurance companies, and research and academic universities. Our Board Chair is Malcolm Dougherty, Senior Vice President and Practice Lead, Transportation, Michael Baker International, and former Director of the California Department of Transportation, and our Vice-Chair is Jennifer Cohan, Secretary, Delaware Department of Transportation. Our members come to one table—ITS America—to shape the next generation of transportation and infrastructure driven by intelligent transportation technologies.

ITS America is united around a shared vision of a better future transformed by intelligent mobility that is safer, greener, and smarter. Our mission is to advance the research and deployment of intelligent transportation technologies to save lives, improve mobility, promote sustainability, and increase efficiency and productivity.

For nearly 30 years, ITS America has been educating policy and decision makers at every level of government and in the private sector on policy that supports intelligent transportation technologies. Our focus is policy that accelerates seamless mobility technology, connected and automated vehicle technology, and smart infrastructure; policy that breathes new life into our transportation infrastructure by expanding investments in technologies that support smart communities; and policy that encourages new models and modes of transportation including micro-transit, rideshare, carshare, bikeshare, and unmanned systems. That said, our first and foremost priority has been, and continues to be, safety.

I want to take a moment and commend the Committee for its leadership, which made deployment of intelligent transportation technologies an eligible activity in the Fixing America’s Surface Transportation Act (FAST Act). With FAST Act funding, commitments from state and local governments, innovative partnerships with the private sector and research institutions, we see firsthand how the deployment of technology is saving lives; reducing crashes; extending the life of transportation infrastructure; improving capacity; reducing the rate and growth in congestion; moving more people in fewer vehicles; improving travel times and reducing greenhouse gas emissions.

A Better Future Transformed by Intelligent Mobility: Introduction

In the mid-90s, I used to sell computers with a 2 GB hard drive. I told people that a hard drive could handle all the data they would ever need. I was wrong. It is estimated that an autonomous vehicle will generate four terabytes (TB) of data in about an hour and a half of driving. The world is awash in a sea of big data. Fifth-generation wireless technologies (5G) have the speed and bandwidth to take all the data from cars and all transportation users, process it, transform into actionable information, and communicate it back at levels of speed that will enable us to reduce crashes, improve the choices we make, and operate our systems more effectively. That is why we believe 5G connectivity will be transformational.

Just as transportation was critical to the development of our economy in the 20th century, 5G will transform the way we experience transportation today. 5G and other next generation technologies will enable transformative transportation benefits in a wide range of areas. With data speeds of 100Mbit/s or more, ultra-low latency of a few milliseconds or less, extremely high reliability, and massive capacity, 5G, and other next generation technologies can spur the development of mobility innovations that will revolutionize the way people, goods, services, and information move in the 21st century. It could allow greater freedom of movement for those who have limited mobility access, such as people with disabilities and older adults, and can positively affect both the safety and operations of our transportation system. Moreover, most importantly, 5G and other next generation technologies can finally help us begin to reduce the epidemic of fatalities on our roadways.

---

1The ITS America Board is represented by the following companies: AAA, AECOM, Arizona Department of Transportation, California Department of Transportation, California PATH UC Berkeley, Conduent, Central Ohio Transit Authority, Crown Castle, Cubic, Delaware Department of Transportation, District of Columbia Department of Transportation, Econolite, Ford Motor Company, General Motors, Gridsmart, HELP, Inc., HNTB, Iteris, Kapsch TrafficCom North America, MCity, Michael Baker International, San Francisco Bay Area Metropolitan Transportation Commission, National Renewable Energy Lab, New York City Department of Transportation, Panasonic North America, Pennsylvania Department of Transportation, Qualcomm, Southwest Research Institute, State Farm Insurance, Toyota, Texas Transportation Institute, Utah Department of Transportation, Washington State Department of Transportation.

A Better Future Transformed by Intelligent Transportation Technologies:
Safety

Safety is the top priority of the Nation’s transportation system, and 5G and other next generation technologies can help us transform the current tragic state of affairs. According to the U.S. Department of Transportation’s National Highway Traffic Safety Administration (NHTSA), 37,133 people lost their lives in motor vehicle crashes in 2017, which roughly breaks down to just over 100 fatalities per day. Every year there are more than six million crashes, two million of which result in either an injury or, in the worst case, a fatality. Assuming around 30 percent of those are impaired crashes, that leaves 1.4 million crashes, of which Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications can address—more than a million fatality or injury crashes eliminated or mitigated every year. V2V and V2I communications are allowing us to finally address the scourge of lives lost and ruined on our Nation’s roads. V2V deployments available today include systems that provide emergency braking. Another benefit of connected vehicles is their ability to be the “eyes and ears” of other vehicles. Non-Line-of-Sight awareness means that drivers and vehicles will be able to see around corners and receive information about hazards in the roadway, even if they cannot see the hazard.

In addition to V2V communications, there are other examples of connectivity that benefit the transportation system. Vehicle to Infrastructure (V2I) communications helps move traffic more efficiently with demand responsive traffic signaling and allow emergency response vehicles to preempt signals. The concept of V2I is to provide the vehicle and the driver information about infrastructure operations—weather and pavement condition, how signals are directing traffic, and even the location of potential hazards at intersections and other critical road safety hotspots. V2I applications include red light violation warnings, reduced speed zone warnings, curve speed warnings, and spot weather impact warnings. V2I soon may also support other applications that will disseminate the condition of the infrastructure, such as bridge integrity, and may even collect data from cars that describe pavement condition. According to NHTSA, V2I technology helps drivers safely negotiate intersections and could help prevent 41 to 55 percent of intersection crashes. Another connected vehicle safety application that helps drivers with left turns at intersections could help prevent 36 to 62 percent of left-turn crashes, according to NHTSA. In addition to the lives saved, just these two applications alone could prevent up to 592,000 crashes and 270,000 injuries each year.

Public sector agencies can also reap the benefits of V2I deployments. Increasingly, vehicles will rely on digital formatting of roadway information to process roadway rules. ITS America member Regional Transportation Commission of Southern Nevada recently became the first in the world to put roadway information into a digital format. As connected and automated vehicles drive over the actual roadway, they can pick up differences between the “digital” road and the actual road. This could eliminate the need for agencies to manually examine roadways for striping or automatically report potholes instead of waiting for enough drivers to incur tire damage before fixing them. These vehicles will also give an up-to-the-minute snapshot of the system—how it is performing, are there any incidents, live weather conditions, etc.

Millions of dollars have already been invested in this effort, including incorporating connected vehicle technologies into infrastructure by states and cities. Eighty-four communities in the United States are deploying or planning to deploy connected vehicle technology. Of that number, 54 sites are operational, and 30 are in development. Nearly every state has at least one connected vehicle deployment. V2I deployments include expansions of the Safety Pilot Model Deployment in Ann Arbor (MI), large pilot deployments in New York City, Tampa (FL), and Wyoming, and the Smart City Challenge in Columbus (OH).
5G and other next generation technologies will enable us to deploy safety solutions to protect vulnerable users of the system, which will be transformational. Vehicle to Pedestrians (V2P) is an extremely important component of communications. In Colorado, where the largest increase was in vulnerable users of the system, fatalities increased from 484 in 2014 to nearly 700 in 2017. By allowing vehicles to communicate with these users through sensors or vehicle to device communication, we can significantly reduce the number of pedestrians killed on our roadways.

Finally, Vehicle to Network (V2N) will be critical to operating the system more efficiently. Weather data or traffic conditions can be broadcast to the network allowing for better planning and dynamic routing.

These technologies can also enhance automated driving systems, which hold the promise to provide numerous economic, environmental, and societal benefits, such as decreased congestion and fuel consumption, and increased access for older adults and people with disabilities. Older Americans and people with disabilities are demographics that are impossible to ignore. According to the U.S. census, residents age 65 and over grew from 35.0 million in 2000 to 49.2 million in 2016, accounting for 12.4 percent and 15.2 percent of the total population, respectively; and nearly one in five people have a disability. They also represent a significant demand for transportation services, and with explosive growth in travel, should fully automated vehicles succeed in expanding mobility access. V2V, V2I, V2P, and V2N—collectively referred to as Vehicle-to-Everything (V2X)—have incredible potential to dramatically improve the safety, accessibility, and operational performance of our road infrastructure and vehicle safety.

5G and other next generation technologies will help unlock the full potential of self-driving technology by serving as an additional source of data about infrastructure, traffic, construction, and emergency vehicles that will solve for some of the more challenging road interactions. 5G enables location data platforms (“maps”) to support the wide availability of fully autonomous vehicles by providing large capacity and ultralow latency data transmissions. Today, auto OEM’s are already using existing LTE networks to share sensor data on roadway conditions across auto brands through the use of neutral location platforms—human driver in Car A learns, for example, of icy road conditions ahead through sensor data collected by windshield wipers, temperature gauges and stability controls in Car B. In a future 5G environment, these types of data transmissions—and many, many others—will be massively crowdsourced and available in milliseconds, which—in an environment where cars are driven by machines—will lead to safer vehicles and a more efficient transportation systems.
A Better Future Transformed by Intelligent Transportation Technologies: Saving the Spectrum for Transportation Critical Safety Communications

ITS America strongly supports preserving the entire 5.9 GHz band for V2X. We also support Congressional oversight of the Federal Communications Commission (FCC) to ensure all phases of testing for the 5.9 GHz band are completed before the FCC rules on whether the spectrum can be shared between V2X operations and unlicensed devices like Wi-Fi. Continued Congressional oversight is beneficial to ensure that the FCC and the National Telecommunications and Information Administration continue to recognize the safety benefits of the 5.9 GHz band.

Any unlicensed use in the band should be done without harmful interference to the incumbent technology or other intelligent transportation systems technologies. With all the advancements and technology deployments, we are finally on the cusp of turning the corner to reduce deaths, but we need the spectrum to do that. These safety innovations require dedicated spectrum to ensure they work every time without signal interference.

The new world of connected vehicles is creating a massive amount of data that must be exchanged at low latencies. As more and more vehicles on the roadway begin broadcasting data with other vehicles, bicyclists, pedestrians, and smart infrastructure, 5G and other next generation technologies will be critical to ensure that the network can handle the data loads.

A Better Future Transformed by Intelligent Transportation Technologies: Mobility on Demand

5G connectivity will be critical as we move from the 20th century model of moving cars to the 21st century model of moving people, data and freight. The same data that helps us operate the system in a safer manner also helps us operate it more effectively.

New forms of mobility are being deployed even as others are being developed. A century ago with the invention of the car, Departments of Roads were created to deal with this new form of transportation. Those agencies became Departments of Transportation. Now those same agencies need to evolve again to provide seamless mobility. Long-existing silos among cities, states, counties, and transit agencies are disappearing. The next generation of mobility is a collaboration of the public and private sectors. More choices exist now, but for travelers to fully realize the benefits of this new world of mobility, it must be easier to choose which option best meets their needs.

The way we travel in cities, suburbs, and rural areas are changing rapidly due to wireless communications and other technology innovations. New mobility concepts and solutions, from bike-and car-sharing systems to demand-responsive bus services, are providing travelers with flexible and convenient transportation options. From private, shared, and public transportation options, or a combination thereof, people want a transportation ecosystem where they can research, book, and pay for all parts of their daily journeys—no matter the form of transportation—on a seamless mobile platform accessible on request.

Developing the policy conditions for Mobility on Demand (MOD) to flourish will better enable consumers to identify and use the transportation options that best meet their mobility needs at any time. In addition, MOD promotes societal benefits such as a less congested, less costly, and more sustainable transportation system. Leveraging the insights gained from MOD data, new business models can be developed to enhance mobility and address unmet transportation needs. The rapid development of 5G connectivity can offer new opportunities for MOD. Increased data throughput will bring many new possibilities for MOD, including better coverage, availability, and reliability. This will allow MOD to better reach underserved areas such as first mile/last mile and transit deserts.

Augmented Reality (AR) is another example of where the delivery of underlying real-time data could be enhanced by 5G connectivity to make MOD more useful. AR can be used to create interactive maps to help people navigate transit systems. By using the camera in a traveler’s mobile device and superimposing digital information on what the camera is capturing, AR can make it easier for the user to make more informed decisions based on up-to-date information. Holding a mobile device on top of a subway map, for example, would allow you to see real-time movement of trains and buses near your location.

In cities, MOD offers convenient, affordable, and (in the case of bikeshare and rideshare) sustainable alternatives to driving within congested environments. For suburban areas, MOD offers first mile/last mile accessibility, alleviating/reducing the need for locals to park at a station or drive into the city.

MOD is seen too often as an urban/metro transportation solution, but it also presents opportunities for rural areas as well. It provides benefits to those living in
rural or more remote communities by connecting them to a bus, train, or transit/commuter station. Fleet operated ride-hailing services, for instance, could help older adults age in place and improve general accessibility to long-distance transportation, car-pooling, groceries, and medical centers. Examples of rural MOD could include bikeshare (docked or dockless) and scooter share deployments on college campuses, in both rural and urban settings. New and improved transit and paratransit services also can help rural America.

Tompkins County, NY, is an excellent example of a rural community pushing carshare (Ithaca Carshare), rideshare (ZimRide), and transportation network companies (TNC) (Lyft/Uber) services, and it received funding through Shared Use Mobility Center MOD On-Ramp Program. MOD examples could also include Waze Carpool/Scoop (app-based carpools), microtransit such as VIA, micromobility services like Lime, maybe even delivery services like DoorDash/UberEats/PostMates.

ITS America created the Mobility on Demand Alliance in 2018 to help determine what the future of mobility should look like, striving for a world that is safer, greener, and more efficient. The Mobility on Demand Alliance brings public, private, and academic sector stakeholders together to promote the benefits of MOD and address obstacles hindering its development. Focused on fostering an environment for a scalable, repeatable MOD model that allows for metropolitan and regional differences, the ITS America Mobility on Demand Alliance will: 1) address common challenges including defining terminology, data access, payment systems, accessibility and equity issues, privacy/cybersecurity, and regulatory/legislative outlook; 2) facilitate metropolitan and regional MOD efforts; and 3) educate policymakers and the public about the benefits of Mobility on Demand.

Regardless of where you live, MOD services and seamless integration of mobility platforms have the potential to better enable users to understand their transportation options and make personalized, efficient, and cost-efficient travel decisions.

Mobility on Demand Use Cases

Regional Bikeshare Programs: Increasing Mobility Within a Community: The City of Reno, City of Sparks, Reno-Sparks Indian Colony, University of Nevada-Reno, and Washoe County have worked together with the Regional Transportation Commission of Washoe County and Lime (formerly LimeBike) to launch Nevada’s first dockless bikeshare program. This one-year pilot will eventually include nearly 1000 LimeBike bicycles and is the first bikeshare to launch on a Native American reservation. Bikes can be borrowed anywhere within the Reno-Sparks service area via the LimeBike app. Rides cost $1 per half hour for standard users, and $50 per half hour for students, seniors, and low-income individuals. This collaborative effort aims to provide the Truckee Meadows region with a healthy and sustainable alternative for mobility.

Rideshare to Bus Stops: Filling Transit Gaps: Capital Metro (TX) has partnered with Austin-based rideshare service provider, RideAustin, to offer on-demand transportation to select bus stops following cuts to bus service in the Exposition area of west Austin. Through this six-month pilot program, individuals who live or work in an area that has lost bus service can request rides via the RideAustin app to/from one of two local Capital Metro bus stops. These rides are free of charge, so those who participate in the program do not have to pay any more than their usual bus fare to complete their commute. Capital Metro hopes that this partnership will help to efficiently fill transit gaps by serving as an innovative, effective solution to first/last mile needs.

Connecting Residents to Jobs and Healthcare: Delaware Transit Corporation (DART) has a contract with ITN-Southern Delaware to subsidize trips for older adults (55+) and those with visual impairments in Sussex County, Delaware, which is predominately rural. Their service is available 24/7 and provides eligible customers with access to local trips and to the DTC’s (DART) transit network. This network includes three transit hubs in Sussex County (Rehoboth, Lewes, and Georgetown) that connect people to the largest towns and cities, including Dover and Wilmington. Wilmington provides connections to Amtrak and Greyhound. DTC will subsidize $5 a trip up to $12,000/year.

DART also offers three Flex Routes in Sussex County. These routes run a fixed route but also allow customers to call up to two hours in advance to schedule a deviation up to one mile from the fixed route. The deviation costs an additional $1 (base fare is $2) and helps close the first and last mile challenges or the rural area that lacks a pedestrian network. The fixed route alignments include key state facilities, shopping, medical offices, residential areas, and major employers.

Utilizing Ridesourcing for Special Needs: Connecting Users with Critical Services: Chesterfield County has partnered with Uber and Goodwill of Central and Coastal Virginia to launch a pilot program providing free, treatment-related transportation
to individuals trying to overcome opioid addiction. Through this program, those undergoing treatment through the county’s Mental Health Support Services Department who do not own a personal vehicle can take an Uber, free of charge, to any pre-approved location. Participants can reserve rides from 6 am-6 pm, Monday through Saturday, by calling Goodwill. Goodwill contacts Uber and oversees trips taken. Rides can also be reserved in advance. The pilot was funded through a state grant and aims to make it easier and more affordable for recovering participants to seek treatment.

Improving/Supplementing Paratransit Service: The Regional Transportation Commission of Southern Nevada (RTC) in Las Vegas has partnered with Lyft to launch a six-month paratransit pilot program. Through this program, Southern Nevada Transit Coalition (SNTC) paratransit riders can opt-in to receive Lyft rides instead of their standard SNTC paratransit service. Unlike the existing service, participants can book Lyft rides not only in advance but also on-demand. The first $3 of each ride is covered by the customer, and RTC subsidizes the next $15. Rides can be booked via the Lyft app or by calling RTC Customer Care. Wheelchair accessible vehicles are also available. This pilot aims to provide an efficient, flexible, cost-effective travel option for RTC paratransit customers.

Mobile App/Multimodal Integration: Making Trip Planning and Travel More Seamless: The Pinellas Suncoast Transit Authority (PSTA) has selected the Transit app as the official trip planning application of Pinellas County, FL. The Transit app offers an easy-to-use, multi-modal platform, through which users can access real-time information regarding PSTA’s transportation options and arrival/departure times. The application also integrates information on MOD services, so that transit riders can, for example, check local bikeshare availability or request an Uber ride as needed, from within a single app. As part of this partnership, PSTA will officially advertise the Transit app, and the Transit app will share anonymous data regarding users’ trip behavior, which can help to inform PSTA planning and operations better.

A Better Future Transformed by Intelligent Transportation Technologies: 5G, the Cloud, and Transportation

In addition to the ability for 5G and other next generation technologies to enable and improve on V2V and V2I communications, the low-latency of 5G allows for computing on the edge and in the cloud. This provides a list of advantages to municipalities, states, and private companies that include cost savings, improved security, seamless data sharing, reduced congestion, reduced energy usage, and reduction of fatal crashes. Cloud computing continues to be the most secure means for enterprises to secure and safeguard data. Centralized monitoring, anomaly detection, and dedicated cyber intelligence resources continue to provide a more robust security platform than most organizations can provide for themselves. In addition to security, access to the cloud provides the ability for more robust applications and more complex analytics. Data can be mined and shared across platforms and regions, allowing rapid analytics that merges infrastructure, vehicle, and other sources in real-time.

The introduction of 5G cellular could speed live video and other sensor feeds from automated vehicles over cellular networks by orders of magnitude. As a result, remote automated vehicle operations centers could receive more accurate and detailed sensor feeds and real-time maps resulting in more immediate updates. Like V2X, 5G deployment will not necessarily determine when we might see large scale commercial automated passenger taxi/bus or parcel/freight delivery launches, but they could improve service and reliability levels. Such “tele-operation” could also reduce costs or autonomous systems. Similarly, 5G might evolve to support improved control and navigation of aerial drones.

The cloud also allows for transportation organizations and companies to seamlessly share data and develop more robust traffic modeling, traffic planning, and emergency response modeling. This can optimize traffic patterns, both within cities and among regions, resulting in less congestion, reduced travel time, and most importantly, fewer fatal crashes. In addition to the public benefits, private industry can use this data to personalize mapping based on behavior and need. For example, a commuter can find the quickest and safest route to work while picking up a cup of coffee and collecting dry cleaning. Although this may seem trivial, these types of applications lead to quicker user adoption.

A Better Future Transformed by Intelligent Mobility: Conclusion

I would be remiss if I did not strongly urge Congress and the Administration to identify long-term and sustainable funding for the Highway Trust Fund before the FAST Act expires in 2020 to ensure the law is reauthorized on time. Maintaining our infrastructure is vital. Funding for research examining the transition to a con-
nected and automated vehicle environment and a "connected infrastructure" is also important. This kind of research requires funding.

To keep pace with these advances in technology that are transforming transportation, ITS America supports a FAST Act reauthorization that prioritizes Federal policy and programs that make intelligent transportation deployment the rule rather than the exception and provides Federal funding, financing, and grants that encourage the rapid deployment of intelligent transportation technologies on a large scale.

To increase investments in intelligent transportation technologies, we urge Congress to leverage existing FAST Act programs and create new emerging technology grants in an infrastructure package. Intelligent transportation technologies, including vehicle-to-infrastructure communications, are eligible uses of most FAST Act highway program funds. Specifically, we support increased funding for the Intelligent Transportation Systems Program, Advanced Transportation and Congestion Management Technologies Deployment Program, Technology and Innovation Deployment Program, and for the Surface Transportation Block Grant program, and Congestion Mitigation and Air Quality program—flexible programs that often fund intelligent transportation deployment activities.

An infrastructure bill provides a unique opportunity to create formula and grant funding programs for emerging technologies that support congestion relief in metropolitan and urban cores as well as heavily traveled regions and freight corridors. Eligible projects would include capital and operational investments that improve system safety and performance such as priced-managed lanes; transportation demand management programs; strategic transit investments; advanced parking, freight delivery, and incident management systems; and programs to support the deployment of connected and autonomous vehicles, including V2V and V2I infrastructure communications technologies.

Transportation is now the largest source of carbon emissions in the United States, and carbon emissions from cars and light trucks account for almost one-sixth of the Nation’s total emissions. ITS America supports policies in the transportation infrastructure sector that will help reduce transportation emissions. Given that auto-makers are committing to alternative fuel vehicles that will reduce greenhouse gas emissions, ITS America supports standalone legislation and language in the reauthorization of the FAST Act and an infrastructure package that would provide increased Federal funding, financing, and grants to rapidly build out alternative fuel vehicle infrastructure and new technologies such as inductive charging to speed the deployment of electric vehicles.

Last year, I spoke at the Beijing Auto Forum. An official from the Chinese Ministry of Industry and Information Technology made clear that China’s goal was to dominate the information technology sectors and automotive manufacturing in the next five years. In the 20th century, people came here to marvel at our infrastructure and technology. If we want that to continue in the 21st century, we must be leaders in the 5G and artificial intelligence space. We must maintain our leadership in this space.

In conclusion, the future of mobility is happening today with ITS America members. From Mobility on Demand to connected and automated vehicles and infrastructure to delivery drones to the Internet-of-Things to When-I-Want-It/Where-I-Want-It-Logistics, our members are researching, developing, testing, and deploying technology that will create a better future.

Changes are happening today that will fundamentally affect how people interact with transportation in the months and years ahead. ITS America is helping states, cities, the private sector, and researchers as we work toward our vision of a better future transformed by intelligent mobility—one that is safer, greener, and smarter.

Thank you again for the opportunity to testify today, and I am happy to answer any questions you may have.

The CHAIRMAN. Thank you, Mr. Bhatt.

And I appreciate all members sticking with the time, and thank you for pointing out, all three of you so far, that we need to be the leader in 5G globally.

Mr. Wessel, welcome.
STATEMENT OF MICHAEL WESSEL, COMMISSIONER, U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Mr. WESSEL. Thank you, Chairman Wicker. Thank you, Ranking Member Cantwell, members of the Committee. Thank you for the opportunity to appear here today.

My name is Michael Wessel, and I am a Commissioner on the U.S.-China Economic & Security Review Commission, but as the normal Washington disclaimer, I am speaking for myself, although my comments are informed by my service on the Commission and our work on this issue.

China’s innovation efforts are broad and deep. China wants to be a global innovation leader and is doing all that it can legally and illegally to achieve its goals. 5G will be the backbone of tomorrow’s economy and infrastructure. Technologies as diverse as IoT, autonomous vehicles, cellular communications, and battlefield communications will be built on 5G foundations.

The National Intelligence Council released a report on the expected impact of 5G, and this is global figures, finding it will enable $12.3 trillion in global economic output and support 22 million jobs by 2035.

China wants to dominate 5G. They are poised to invest at least $400 billion at this point into its development. China is actively promoting its own, rather than global, technological interests through involvement in international standards-setting organizations, such as the International Telecommunications Union, where they chair more committees than any other country.

China’s government has said its principal domestic suppliers, Huawei and ZTE, will each be allocated one-third of the market, leaving foreign competitors to scramble for the remaining third. China is integrating its 5G plans with its Belt and Road Initiative strategy to create a digital Silk Road. We have no comparable plans here in the U.S.

During questions I’d be happy to discuss Huawei and China’s leading firms, but the leaders of our six major law enforcement and intelligence agencies have testified as to their concerns, which are now being embraced by many other countries. As the director of the National Counterintelligence and Security Center said, it’s important to remember that Chinese company relationships with the Chinese government, aren’t like private sector company relationships with governments in the West. China’s 2018 national intelligence law requires Chinese companies to support, provide assistance, and cooperate in China’s national intelligence work wherever they operate.

I worry about China’s approach and its implications for us for a number of reasons.

First, I approach this, as I know everyone here does, as someone who has always taken pride in America’s technological leadership and do not want to cede it to any other country, especially when that leadership results from state-directed policies and support.

Second, I care about the production and jobs that will be created during the development, deployment, and servicing of 5G networks. The competition is not being waged on a level playing field.

Third, and most fundamental, I worry about our Nation’s security: economic, critical infrastructure, and traditional security in-
terests. Chinese theft of our intellectual property, some facilitated and allegedly directed by the state, has cost us hundreds of billions of dollars while advancing China’s economic development and strength.

Financial networks, smart cities, power plants, dams, chemical production facilities, air traffic, and so many other sectors are supported by the Internet and will be increasingly dependent on 5G with the dispersion of IoT devices. If Chinese companies provide the equipment, control over the source code, the updates, and servicing, it creates extreme vulnerabilities.

Equally important, our warfighters and our defense sector are increasingly dependent on the electronic spectrum for command and control, logistics, and other needs. China’s military doctrine relies on “asymmetric warfare,” where they have identified the electronic and space domains as critical to their countering any U.S. capabilities in a potential conflict. Access to or control over significant parts of the telecommunications systems and the connectivity it can create, substantial and potentially unacceptable vulnerabilities.

Again, thank you for the opportunity to be here, and I look forward to your questions.

[The prepared statement of Mr. Wessel follows:]

PREPARED STATEMENT OF MICHAEL WESSEL, COMMISSIONER, U.S.-CHINA ECONOMIC AND SECURITY REVIEW COMMISSION

Chairman Wicker, Ranking Member Cantwell, Members of the Committee. I want to thank you for the invitation to appear before you today to discuss the development and deployment of fifth generation—5G—cellular mobile communications. This is a critical issue for U.S. economic and national security interests.

My name is Michael Wessel and I am appearing before you today as a Commissioner on the U.S.-China Economic and Security Review Commission (Commission), where I have served since its creation in 2001. But, as a disclaimer, I am speaking for myself, although my comments are informed by my service on the Commission and our work on this issue.

The Commission was created by Congress in 2001 in conjunction with the debate about the grant of Permanent Normal Trade Relations (PNTR) to China, paving the way for its accession to the World Trade Organization. The Commission was tasked with monitoring, investigating and submitting to Congress an annual report on the national security implications of the bilateral trade and economic relationship between the United States and the People’s Republic of China, and to provide recommendations, where appropriate, to Congress for legislative and administrative action.

The grant of PNTR ended the annual debate about whether to extend most favored nation status to China. But as it passed PNTR, Congress created the Commission because it did not want to forego the annual review of our relationship with China. Since the creation of the Commission, our mandate has been extended and altered as the U.S.-China relationship evolved.

The Commission is a somewhat unique body: We report to and support Congress. Each of the four Congressional leaders appoint 3 members to the Commission for 2-year terms. In 8 of the last 11 years, we have issued unanimous reports. In the 3 years where it was not unanimous, there was only one dissenting vote. In many ways, the evolving challenges and opportunities posed by the relationship with China have united us in our analysis.

Last year the Commission held a hearing on Next Generation Connectivity looking at both 5th generation (5G) connectivity and the Internet of Things (IoT) and included a chapter in our annual report on these issues. The prepared testimony and transcript of our hearing, as well as our Annual Report, are available online at the Commission’s website www.uscc.gov.

The Commission has been tracking and analyzing China’s high-tech development—and its impacts on the United States—for many years and found remarkable continuity and coordination in Chinese government policy. Indeed, in the Commission’s 2004 report, the key findings with regard to high technology were:
The Chinese government has a coordinated, sustainable vision for science and technology development. Many Chinese high-technology developments have been spurred by policies the Chinese government has instituted to accelerate the growth of industries in this sector, which the government believes can help lift the whole economy.

• The Chinese government uses foreign investment, tax policies, subsidies, technology standards, and industry regulation to accelerate the Nation’s technological growth. It uses government procurement and proprietary technology standards to advance its technology growth policies. These policies make it difficult, if not impossible, to achieve a level playing field in this area of U.S.-China trade.

• Global production networks dominate China’s high-tech export environment. Foreign investment into China has provided capital, management, and technology to Chinese production in various technology sectors. Taiwan firms are key investors and intermediaries in China’s high-tech production networks.

• U.S. trade and investment with China has played, and continues to play, a key role in China’s technological advancement. U.S. advanced technology and technological expertise is transferred to China, through both legal and illegal means, via U.S. invested firms and research centers in China. Chinese investments in the United States, bilateral science and technology (S&T) cooperative programs, and the tens of thousands of Chinese students and researchers at U.S. universities and research institutes who return to China after completing these programs.

• Large-scale piracy—at levels of over ninety percent—continues to characterize intellectual property rights (IPR) protection in China and is a major concern for U.S. exporters of high-tech goods and services. While the government has instituted laws to strengthen IPR protection, the enforcement of those laws has suffered from a lack of government coordination and from local protectionism and corruption.

In our report the following year, the Commission noted 3G—a precursor to the technology which is the subject of today’s hearing—was identified by China’s government as a key interest:

• China has its own globally approved 3G standard, TD–SCDMA for use in mobile telecommunications. It was developed by the Chinese Academy of Technology and Siemens and is supported by the Chinese companies Huawei and Lenovo. China is developing 4G mobile technology.

China’s government pursues an aggressive development path to become a high technology leader but its approach emphasizes Chinese technologies, and the companies that develop them, as the core of any future standards. China’s approach is the result of long-term planning, policy implementation and funding. In other words, government direction—supported by policy, politics, and generous subsidies—is driving China’s tech development.

We should not assume that China will adopt “Western ideals” or business practices and take China’s government at their word when they promise “reform” or a version of that. We need to determine what our interests are and assess them against what China has actually done over the years and what it says it wants to do.

I will leave it to my industry colleagues to discuss the technical issues relating to 5G and some of the implications. But, China has a well-defined and advanced approach to becoming a world-class player in this technology. China is poised to have a significant share of the global market in this and many other technologies.

China is now a leading technology power. In 2017, the U.S. ran a trade deficit in Advanced Technology Products (ATP) of $135.4 billion, and our deficit for 2018 is expected to beat that when the full year trade statistics are released. For the narrower category of information and communications products, for October 2018 year-to-date figures (the latest available), the U.S. exported $3.365 billion and imported $130.303 billion. China has produced the faster supercomputer on earth. It is advancing quantum computing with rapid gains in cryptography and communications. It is excelling in artificial intelligence (AI) and a variety of other sectors.

Our failure to sell more in China is a direct result of their protectionist and predatory practices, including a goal, as identified in numerous policy documents, to de-
velop indigenous capabilities to the exclusion of foreign players. As the Commission’s 2018 Report indicated (summarized):

- **Chinese IP requirements:** Since 2007, China’s Multi-Level Protection Scheme, which covers around 140,000 information systems, requires Chinese IP in core IT technology and components and annual testing, certification, and authentication for the top three of the five tiers of IT users, effectively excluding foreign competitors unless there is no domestic equivalent. 4 Article 34 of the draft guidelines would expand this scheme to cloud computing platforms, big data systems, industrial control systems and mobile networks, AI, and IoT devices. 5
- **High restrictions on foreign ownership and investment:** Under China’s 2016 Telecommunications Regulations, foreign firms can own up to 50 percent of Chinese telecommunications and cloud computing providers. 6 China’s 2016 Telecom Services Catalogue requires foreign telecommunications and cloud computing firms wishing to sell in the Chinese market to form joint ventures with Chinese firms. 7
- **China-specific technical standards:** The Mercator Institute for China Studies (MERICS) found “China sometimes formulates national standards in strategic industries that deliberately differ from international standards in order to impede market access for foreign technology and to favor Chinese technology on the domestic market.” 8
- **Restrictions on data storage and transfer:** Under China’s Cybersecurity Law, U.S. firms face significant restrictions on data storage and cross-border transfers—essential services for IoT devices. U.S. firms such as IBM, Apple, and Microsoft are required to form joint ventures in order to operate. 9 In addition, foreign firms must rely on domestic partners and government-approved encryption technology, potentially placing foreign IP and data at risk. 10

---

4 The ranking is based on technology innovation, brand influence, ecosystem openness, and input from industry experts and end users. IoT One, “2018 Top 500 Industrial IoT Companies.” https://www.iotone.com/iotone500. For more information on China’s efforts to develop its semiconductor industry, see U.S.-China Economic and Security Review Commission, Chapter 1, Section 3, “China’s 15th Five-Year Plan,” in 2016 Annual Report to Congress, November 2016, 155–161.

5 The Multi-Level Protection Scheme separates information systems into five levels based on impact. Damage to a Level 1 (the lowest) information system could result in harm to legal rights of citizens, legal persons, or other organizations without harming national security, social order, or public interest. Damage to a Level 5 (the highest) information system results in very serious harm to national security. Level 3 and above encompasses finance, banking, tax, customs, commerce, communications, health, education, and social services. Nick Marro, “The 5 Levels of Information Security in China,” China Business Review, December 6, 2016; Adam Segal, “China, Encryption Policy, and International Influence,” Hoover Institution, No. 1610, November 28, 2016.


Huawei and ZTE, deemed “national champions” by the Chinese government, are global players in the communications field—from handsets to routers to switching to full network deployment and operations. And, as is well known, much of the production of telecom and IT products for leading firms is produced in China, or has components produced there.

Of course, not everything is a zero-sum game. Should we be concerned about where the products and services supporting and utilized in our 5G networks are produced and from which companies do they come? Should we have similar concerns about what other countries around the globe do in this regard?

Does that matter to us? I believe it does, in many ways.

The lead front-page article in the New York Times Sunday edition two weeks ago was entitled “U.S. Scrambles to Outrun China in New Arms Race: Seeking to Restrict Beijing’s Control Over ‘Central Nervous System for Internet’.” The stakes are, indeed, enormous.

5G will be the backbone of tomorrow’s economy and infrastructure, including critical infrastructure; our telecommunications, e-commerce, and manufacturing sectors, along with military and intelligence assets, will all depend on it. Technologies as diverse as the IoT, autonomous vehicles, cellular communications, and battlefield communications will be built on 5G foundations.

The National Intelligence Council (NIC) released a report on the expected impact of 5G, finding it “will change the technological, social, and economic processes for a wide variety of industries by 2020.” By 2035, the NIC report predicted, $12.3 trillion in global economic output will be enabled by 5G tech, and its value chain will create $3.5 trillion in output and support 22 million jobs by 2035.

China’s government clearly sees the future economic and security potential of 5G and is poised to invest at least $400 billion into its development. But that’s only the tip of the iceberg. The communications and IT sectors are identified for preference and promotion as part of the Made in China 2025 industrial policy program, which means every province, local, and municipal government is marshalling its resources in response to the central government’s directives.

China is also actively promoting its technological interests through its involvement in international standards-setting organizations, which will write the rules for interoperability and operations. It’s part of their official government and Chinese Communist Party plans. China’s government has already announced that its principal domestic suppliers—Huawei and ZTE—with each being allocated one-third of the market, leaving foreign competitors to scramble for the remaining third.

China has aggressively participated in standards-setting bodies such as the International Telecommunications Union (ITU) where they play a significant role, as well as chair several committees. For several years, they have sent large delegations to these meetings hoping to drive standards that will advantage their own indigenous firms. This is contrary to the approach taken by many countries and industry delegations at the ITU and other international standard bodies who are seeking, first, to develop the standard that will create the most robust technologies and then seek to identify the best suppliers to meet those standards.

China is integrating its 5G plans with its Belt and Road Initiative (BRI) strategy. The 2015 Belt and Road Initiative White Paper, which was jointly issued by China’s National Development and Reform Commission, Ministry of Foreign Affairs, and Ministry of Commerce, calls for cross-border optical cables and communications trunk line networks, planning transcontinental submarine optical cable projects, and improving spatial and satellite information passageways to expand information exchanges and cooperation. The Chinese government is also actively seeking to loop its BRI partners into its “super-fast broadband network infrastructure” built in line with the Internet Plus plan.


\**\*[13\] Eric Auchard and Sijia Jiang, China’s Huawei Set to Lead Global Charge to 5G Networks, Reuters, February 23, 2018.


There is no comparable approach from our Federal government. While a document leaked from the National Security Council identified the idea for the development and deployment of a Federal 5G Internet, that approach appears to have been quickly abandoned based on industry opposition. Our country’s current approach is market-led and market driven. The Administration and Congress have adopted a number of security-related limitations to advance our interests. Just this past summer, Congress, as part of the National Defense Authorization Act for Fiscal Year 2019 adopted strict limitations on the procurement or renewal of contracts that include Huawei and ZTE equipment in government networks. In the past, a variety of other measures have been put in place to limit the exposure of critical information and networks to Chinese cyberespionage. For example, the FY 2013 Appropriations bill prohibited Commerce, Justice, NASA and the National Science Foundation from acquiring information technology systems that were produced, manufactured or assembled by entities owned, directed or subsidized by the Chinese government. Huawei, as one of China’s leading firms in this area, has received substantial attention. Today’s hearing, of course, is about 5G, but it would be impossible to discuss that technology, and concerns vis-a-vis China, without commenting on Huawei. But Huawei must not be the only focus of the discussion of China’s impact on 5G here in the U.S. and around the globe as there are many other vulnerabilities that must be addressed. Documented problems, such as China Telecom’s redirection of Internet traffic through China, have been identified. Huawei Technologies is the most well-known Chinese telecommunications equipment company with operations and activities in the U.S. and has been cited as an advanced persistent threat to U.S. interests. In 2012, the House Permanent Select Committee on Intelligence identified strong concerns about Huawei and ZTE. The report concluded that “the risks associated with Huawei and ZTE’s provision of equipment to U.S. critical infrastructure could undermine core U.S. national-security interests.” In early 2015, the FBI circulated a Counterintelligence Strategic Partnership Intelligence Note focused on national security risks associated with Huawei. That memo has been made public and included the following risk overview:

With the expanded use of Huawei Technologies Inc. equipment and services in U.S. telecommunications service provider networks, the Chinese Government’s potential access to U.S. business communications is dramatically increasing. Chinese Government-supported telecommunications equipment on U.S. networks may be exploited through Chinese cyber activity, with China’s intelligence services operating as an advanced persistent threat to U.S. networks. Huawei has been identified publicly for selling or attempting to sell U.S. intellectual property to export restricted countries (Iran/Cuba), making it a clear threat through its targeting of U.S. economic and proprietary information. China makes no secret that its cyber warfare strategy is predicated on controlling global communications network infrastructure.

According to press accounts U.S. Tier 1 telecom providers were counseled by officials of the U.S. government that utilization of Huawei equipment could create significant cybersecurity concerns and might jeopardize contracts with the U.S. government. Subsequently, each company reportedly decided not to procure equipment from the company for utilization on their networks.

In 2018, the heads of the CIA, FBI, NSA, DIA, NGA and the Director of National Intelligence publicly testified as to their concerns about utilizing products or services from Huawei. FBI Director Wray stated,

We’re deeply concerned about the risks of allowing any company or entity that is beholden to foreign governments that don’t share our values to gain positions of power inside our telecommunications networks . . . it provides the capacity to exert pressure or control over our telecommunications infrastructure. It pro-

---

17 Public Law 115–232, Sec. 889—Prohibition on Certain Telecommunications and Video Surveillance Services or Equipment.
18 2013 Consolidated and Further Appropriations Act (P.L. 113–6) (Sec. 516).
21 Counterintelligence Strategic Partnership Intelligence Note (SPIN), Huawei, Federal Bureau of Investigation, February, 2015. (SPIN—15–002)
vides the capacity to maliciously modify or steal information. And it provides the capacity to conduct undetected espionage.\textsuperscript{23}

China’s Huawei has been aggressive in trying to counter claims that it is a security risk. It claims that it is a private, employee-owned company and that we shouldn’t worry. But, in recent months, a number of other countries—those who are part of the Five-Eyes relationship and others—have joined in questioning the security of Chinese-company produced equipment and whether it should be utilized in existing or future networks.

As William R. Evanina, the director of the National Counterintelligence and Security Center was quoted in the \textit{New York Times},

\textit{It’s important to remember that Chinese company relationships with the Chinese government aren’t like private sector company relationships with governments in the West. China’s 2018 National Intelligence Law requires Chinese companies to support, provide assistance and cooperate in China’s national intelligence work, wherever they operate.}\textsuperscript{24}

No Chinese commercial entity can refuse to cooperate with China’s security services. In 2017, China’s government implemented a draconian Cybersecurity Law—despite the outcry from foreign governments and industry that it would raise serious concerns about the impact on the business activities of Chinese companies. The accompanying set of laws—National Intelligence Law of 2017, Counter-Terrorism Law of 2016, National Security Law of 2015 all raise concerns about Chinese entities freedom to act without government interference, coercion and direction.

Other countries have come to similar conclusions, based on their own assessments. For example, last July the United Kingdom’s Huawei Oversight Board raised its concerns in a report to that country’s national security advisor—despite 4 years of work with Huawei:

\textit{“Due to areas of concern exposed through the proper functioning of the mitigation strategy and associated oversight mechanisms, the Oversight Board can provide only limited assurance that all risks to UK national security from Huawei’s involvement in the UK’s critical networks have been sufficiently mitigated. We are advising the National Security Adviser on this basis.”}\textsuperscript{25}

I worry about China’s approach, and its implications for us, for several reasons. First, I approach this as someone who has always taken pride in America’s technological leadership and do not want to cede it to any other country, especially when that leadership results from state-directed policies and support.

Second, I care about the production and jobs that will be created during the development, deployment and servicing of 5G networks. As the National Intelligence Council report indicated, $12.3 trillion in economic value will be created along with 22 million jobs. I want the bulk of that value and the jobs to advantage our economy and our people or at least know that the competition is being waged on a level-playing field.

Third, and most fundamental, I worry about our Nation’s security—economic, critical infrastructure and “traditional” security interests. On the economic side, we have read too many stories about Chinese cyberespionage, some facilitated and allegedly directed by the state, to steal our intellectual property. The fruits of that cyberespionage is estimated to have cost us hundreds of billions of dollars while advancing China’s economic development and strength.

Financial networks, smart cities, power plants, dams, chemical production facilities, air traffic and so many other sectors are supported by the Internet and will be increasingly dependent on 5G with the dispersion of IoT devices. If Chinese companies provide the equipment, with control over the source code, the updates, and servicing, it creates extreme vulnerabilities.

Equally important, our warfighters and our defense sector are increasingly dependent on the electronic spectrum for command and control, logistics and other needs. China’s military doctrine relies on “asymmetric warfare” where they have identified the electronic and space domains as critical to their countering any U.S. capabilities in a potential conflict. Access to or control over significant parts of our telecommunications systems and the connectivity that will be an increasingly impor-

\textsuperscript{23} Testimony before the Senate Select Committee on Intelligence, February 13, 2018.
\textsuperscript{25} Huawei Cyber Security Evaluation Centre (HCSEC) Oversight Board Annual Report 2018, A report to the National Security Advisor of the United Kingdom, July 2018.
tant component for our defense systems can create substantial and, potentially, un-
acceptable vulnerabilities.

In its 2018 Annual Report, the Commission identified the following key findings,
regarding this critical area:

- The Chinese government has strengthened its strategic support for the IoT
  (physical devices embedded with sensors that can collect data and connect to
each other and the broader internet) and fifth-generation wireless technology
(5G) networks. The government has laid out comprehensive industrial plans to
create globally competitive firms and reduce China’s dependence on foreign
technology through; significant state funding for domestic firms and 5G deploy-
ment, limited market access for foreign competitors, China-specific technical
standards, increased participation in global standards bodies, localization tar-
gets, and alleged cyber espionage and intellectual property theft. This state-di-
rected approach limits market opportunities for foreign firms in China and
raises concerns about the ability of U.S. and other foreign firms to compete fair-
ly both in China’s domestic market and abroad.

- 5G networks are expected to quicken data speeds by 100 times, support up to
100 times more IoT devices, and provide near-instant universal coverage and
availability. U.S. and Chinese companies are engaged in a fierce competition to
secure first mover advantage and benefit from the trillions in economic benefits
5G and subsequent technologies are expected to create.

- IoT devices collect enormous amounts of user information; when aggregated and
combined with greater computing power and massive amounts of publicly avail-
able information, these data can reveal information the user did not intend to
share. U.S. data could be exposed through unsecure IoT devices, or when Chi-
inese IoT products and services transfer U.S. customer data back to China,
where the government retains expansive powers to access personal and cor-
porate data.

- The Chinese government is leveraging its comparative advantage in manufac-
turing and state-led industrial policies to secure an edge in the IoT’s wide-rang-
ing commercial and military applications. U.S. firms and the U.S. government
rely on global supply chains that in many cases are dominated by China. While
not all products designed, manufactured, or assembled in China are inherently
 risky, the U.S. government lacks essential tools to conduct rigorous supply
chain risk assessments. Federal procurement laws and regulations are often
contradictory and are inconsistently applied.

- International 5G standards will be set by 2019, facilitating large-scale commer-
cial deployment expected by 2020. The Chinese government is encouraging its
companies to play a greater role in international 5G standards organizations to
ensure they set global standards; such leadership may result in higher revenues
and exports from internationally accepted intellectual property and technology
and more global influence over future wireless technology and standards devel-
opment.

- China’s central role in manufacturing global information technology, IoT de-
vices, and network equipment may allow the Chinese government—which ex-
erts strong influence over its firms—opportunities to force Chinese suppliers or
manufacturers to modify products to perform below expectations or fail, facili-
tate state or corporate espionage, or otherwise compromise the confidentiality,
integrity, or availability of IoT devices or 5G network equipment.

- The lax security protections and universal connectivity of IoT devices create nu-
merous points of vulnerability that hackers or malicious state actors can exploit
to hold U.S. critical infrastructure, businesses, and individuals at risk. These
types of risks will grow as IoT devices become more complex, more numerous,
and embedded within existing physical structures. The size, speed, and impact
of malicious cyber attacks against and using IoT devices will intensify with the
deployment of 5G.

The Commission made two recommendations for Congress to consider:

- Congress require the Office of Management and Budget’s Federal Chief Infor-
mation Security Officer Council to prepare an annual report to Congress to
ensure supply chain vulnerabilities from China are adequately addressed.
This report should collect and assess:

- Each agency’s plans for supply chain risk management and assessments;
- Existing departmental procurement and security policies and guidance on
cybersecurity, operations security, physical security, information security, and
data security that may affect information and communications technology, 5G networks, and IoT devices; and

Areas where new policies and guidance may be needed—including for specific information and communications technology, 5G networks, and IoT devices, applications, or procedures—and where existing security policies and guidance can be updated to address supply chain, cyber, operations, physical, information, and data security vulnerabilities.

• Congress direct the National Telecommunications and Information Administration and Federal Communications Commission to identify (1) steps to ensure the rapid and secure deployment of a 5G network, with a particular focus on the threat posed by equipment and services designed or manufactured in China; and (2) whether any new statutory authorities are required to ensure the security of domestic 5G networks.

The impending rollout of 5G here in the U.S. and across the globe requires that we address these vulnerabilities quickly and aggressively. In my view it is better to err on the side of safety, as 5G will be the backbone of communications in the future. We cannot afford to ignore the actions and activities that China has engaged in with regard to predatory and protectionist policies, what their public pronouncements have identified are their plans and what actions they have engaged in in the cyber realm.

We also have to be realistic about the global nature of production and what the limits are on our policies and actions. But, the price of inaction is unacceptable. We must protect our interests where we can and manage and mitigate the risks where we must.

The CHAIRMAN. Thank you very much, Mr. Wessel.

Ms. Zentz, welcome.

STATEMENT OF KIM ZENTZ, CHIEF EXECUTIVE OFFICER, URBANOVA

Ms. ZENTZ. Thank you very much. Thank you, Chairman Wicker and Ranking Member Cantwell. I am deeply grateful for this invitation to address the Committee and members of the Committee. And I’m even more enthusiastic to add the perspective of the mid-size city or the mid-market city to this important conversation.

What is Urbanova? We say that we are—some call us a radical collaboration. I’ll get into who our partners are in a minute. But we harness data to gain insights, empower people, and solve urban challenges in new ways. So what we are doing is leveraging the vibrant urban advantages of Spokane, Washington, to find new ways to make communities better for people.

Spokane’s University District is where we have our proving ground. It’s about 770 acres, which is about the same size as Central Park in New York City. It is our living laboratory for scalable and replicable solutions that can be applied in mid-size cities anywhere, but our outcomes are focused on safer neighborhoods, healthier citizens, smarter infrastructure, a more sustainable environment, and ultimately a stronger economy because we believe and we have a stake in the ability of mid-size cities to lead on issues like this.

So I’ve mentioned our partners. It’s really important to have partners—it has been mentioned here today that it’s a team sport, and we couldn’t agree more. You really need to take the time to have everyone at the table, and Urbanova is especially fortunate to have a vast multidisciplinary, multisector set of partners. Those partners are led by Avista Corporation, by Itron, the City of Spokane, Washington State University, McKinstry, The University
District, which is our public development authority for that district, Gallup, and Verizon Smart Communities.

The human capital and resource situation in mid-size cities is different than it is for the larger metro areas. It is the place of infinite demands and highly, highly restricted resources. So I would assert to you that mid-size cities, or maybe even all cities, but the mid-size cities are the ones I'm familiar with, have always been smart. This isn't a new concept that they're smart. They're able to capitalize on years of decisionmaking in low resources and in high citizen engagement and hands-on, ground-level intelligence that make their cities run day in and day out.

With the introduction of new tools, like 5G enables, and like other smart city applications that don't require 5G, mid-size cities are able to work in a way that the larger metros can't. They can be more nimble. They can be more ambitious. And because of that, they have more power to try things before it's time to scale them up across the city, and that's what our providing ground brings to the table.

There are needs, though, and I would encourage the Congress to continue to focus on ways to bring innovative financing, a coordinated and cooperative policy environment, support for workforce training and development programs, and development of coherent standards and interoperability frameworks across jurisdictions because it's not just the cities that need to be working in a team fashion, it's really all of the jurisdictions that all intersect to make cities more livable.

In the accelerated run to 5G and other connected city deployments, it must not be overlooked that the city's primary asset is its locally owned and controlled rights of way. Collaborative right-of-way management that include city's oversight to ensure public safety, equitable and inclusive space allocation, and spectrum management is essential. The only way to ensure that we have a secure network when we're all done is to make sure that we begin at the beginning of the supply chain. It has to begin there and it has to translate all the way down to where people live in the cities, and that smart cities and these technologies—the technology part is the easy part, the harder part is the behavior part, and what must be kept in mind is that cities are first and foremost about people and that the applications must be simple and easy to explain.

So I encourage you to consider, to continue to consider, the advantages that mid-size cities can bring as we move in this rapid pace of acceleration that will change the face of America forever.

[The prepared statement of Ms. Zentz follows:]

**Prepared Statement of Kim Zentz, Chief Executive Officer, Urbanova**

Good morning Chairman Wicker, Ranking Member Cantwell, and honorable members of the committee. I am Kim Zentz, Chief Executive Officer of Urbanova, a non-profit based in Spokane, Washington dedicated to harnessing data to gain insights, empower people and solve urban challenges in new ways.

I am both grateful for the invitation to address your committee and enthusiastic to lend the perspective of mid-market metro areas to the discussion of the country's next era of technology innovation in smart and connected communities.
Key Points

• 5G and other smart and connected community enablers offer the promise to improve social, economic and environmental equity and resilience in communities of all sizes.
• Collaboration across all sectors and jurisdictions is required for success.
• Mid-sized cities are the perfect laboratory to demonstrate improved outcomes and health for residents, businesses and visitors.
• Impeccable end to end security and privacy practices are our collective responsibility to each other.

About Us

Urbanova leverages the vibrant urban advantages of Spokane, Washington to find new ways to make communities better for people. Spokane’s 770-acre downtown University District (about the size of Central Park in New York) is the living laboratory for scalable, replicable solutions that aim for outcomes measured by enabling healthier citizens, safer neighborhoods, smarter infrastructure, a more sustainable environment and a stronger economy.

While I certainly do not speak for any one of Urbanova’s partners, we are especially fortunate to count Avista Corporation,1 Itron,2 the City of Spokane,3 Washington State University,4 McKinstry,5 The University District,6 Gallup7 and Verizon Smart Communities8 among our invested partners.

Continued
Rise of the Mid-sized City

It’s been said that the 21st century is the century of the city as the shift to urban areas continues to gain steam. Already, half of the world’s population resides in cities of 500,000 or fewer residents. No matter how you count it, there are more than 3,000 communities in the United States with population greater than 10,000 and less than a million.

Cities of this type tend to be big enough for ambitious ideas to gain traction and small enough to form the necessary coalitions to embrace change and act fast. With the ever-increasing access to broadband services, already technology and talent are flocking to areas of the country with fewer headaches and challenges to daily life than those hindering quality of life in the very large metros. Furthermore mid-sized cities are actively willing to share lessons learned and insights with each other. Urbanova and Spokane hope to be a destination for cities on learning tours as we gain additional insights from on-the-ground project experiences.

However, the human and capital resource situation in mid-sized cities is substantially more challenging. In order to realize the vast benefits of smart infrastructure, thoughtful city leaders are in need of innovative financing mechanisms, a coordinated and cooperative policy environment, support for workforce training and development programs and development of coherent standards and interoperability frameworks across jurisdictions.

In the accelerated run to 5G and other connected city deployments, it must not be overlooked that the city’s primary asset is its locally controlled rights of way (ROW). Collaborative right of way management that includes cities’ oversight to ensure public safety, equitable and inclusive space allocation and local spectrum management is vitally important to keep in perspective.

Smart City Enablers

With the adoption of breakthrough enablers like 5G infrastructure and devices, cities like Spokane have the opportunity to capitalize on years of intelligent operations, creative problem solving, integrated planning/asset management and responsive citizen engagement to systematically adopt durable solutions to the pain points identified by the citizens—the ones with the lived experience in neighborhoods. City leaders are and will always be focused on ensuring that public benefits remain at the forefront of government operations. Approaching challenges holistically—employing tools like crowdsourcing prior to designing solutions and using decision criteria that ensure the outcomes are measured in terms of improving economic, social and environmental equity and resilience will be the expectation. There is a tangible opportunity to move public engagement from an episodic to a continuous experience.

As consumers and citizens we are living in a time of unprecedented acceleration of change—socially, economically and environmentally. Additionally we are experiencing the increasing availability of choices to meet every subset of our needs. As solutions informed by massive amounts of data become the norm, we have adjusted our expectations that everything become more personalized, more participatory, more predictive, and more preventive. Communities will increasingly have more comprehensive inputs to fully understand complex, personalized and localized systems. At Urbanova we think of this opportunity akin to “mapping the city genome” so that communities are no longer faced with one-size fits most prospects when charting the course of the future for residents, businesses and visitors.

5G promises to accelerate the smart city applications that rely on high-speed, high bandwidth and low latency. This includes a spectrum from widespread self-driving mobility to AI-powered image recognition shifting city services and industries into the realm of real-time, authentically data-driven operations. The efficiency and effective use of edge computing and edge intelligence opens the door to use cases that dramatically improve operational metrics.

In addition, even smart city applications that do not depend upon the high speeds delivered with 5G will benefit from the experience gained as cities, businesses and people adjust to doing things with a greater degree of inputs from a greater number of devices. The behavioral changes will take longer than the adoption rate and infrastructure modifications needed to realize the full benefits of 5G.

Economic Benefits

The promise of smarter and more connected communities is fundamentally a leveling of the playing field. In their 2018 Book: The New Localism—How Cities Can Thrive in the Age of Populism, Bruce Katz and Jeremy Nowak assert: “This new locus of power—this new localism—is emerging by necessity to solve the grand challenges their basic wants and needs. We partner with each city to design infrastructure, systems and processes that elevate the way they provide services in new and cost-effective ways.
lenges characteristic of modern societies: economic competitiveness, social inclusion and opportunity; a renewed public life; the challenge of diversity; and the imperative of environmental sustainability.” And “Power now belongs to the problem solvers.” Those problem solvers, equipped with high-speed, secure broadband services will live where the quality of life suits their needs.

In Urbanova’s Spokane University District proving ground, we’re fortunate to have a confluence of six higher education institutions (including two medical schools) co-located in an area adjacent to our thriving downtown and a medical district which serves as the medical hub for the multi-state region of the Intermountain Northwest. This 770 acre area is poised for intelligent, connected commercial and residential development. For example, Washington State University’s Elson S. Floyd College of Medicine was founded in 2015 and is a community-based medical school dedicated to rural and underserved populations. Students are immersed in team-based delivery techniques which prepare clinicians to improve health and wellness for individuals and populations.

Mid-sized cities have the greatest potential to lead an economic future that bridges the urban-rural divide. Communities which are presently less densely populated will benefit from the lessons learned and intelligence gathered by nearby cities experiencing growth. In fact, a 2017 report published by the National League of Cities noted that more than half of the people who live in rural areas also live in counties that are part of a metropolitan area.

Security and Privacy

Virtually every service provided by a city, utility or other service provider is done so only with and at the consent of the people served. In the case of technology-enabled services the potential is and always will be dependent upon the faith people have in the service to improve some aspect of collective or individual well-being.

Apple CEO Tim Cook, speaking in Brussels late last year said: “. . . At its core technology promises to learn from people individually to benefit us all . . . For artificial intelligence to be truly smart it must respect human values—including privacy. If we get this wrong, the dangers are profound. We can achieve both great artificial intelligence and great privacy standards. It is not only a possibility—it is a responsibility.”

Essential security and privacy practices are not significantly different from one communication transport infrastructure to another—be it Wi-Fi, 4G LTE, DSL, etc. The security of telecommunications networks begins at the origin of the supply chain for each piece of equipment. The key area of support for secure and successful realization of the potential of 5G deployments is ensuring that suppliers are motivated to make verifiably secure products. Procurement language must support evaluation before purchase and sufficient time must be built into schedules for trust-but-verify functionality prior to commissioning.

Conclusion

Communities empowered by the insights provided by quantitative and qualitative data can capitalize on their unique strengths to continuously improve the health and well-being of residents while businesses grow and thrive and visitors return. Thoughtfully deployed 5G networks help make this tangible future a reality for all.

The CHAIRMAN. Well, thank you very much. And let me thank all five members of our panel. Very, very informative and thought-provoking testimony.

We’ll begin with a 5-minute round.

Mr. Gillen, last year Meredith Baker testified before this Committee and said we were in danger of falling behind other countries in the race for 5G saying that the United States at that time was behind both China and South Korea, and that we were ranked sixth in availability of critical mid-band spectrum. We now have information that we still rank sixth in availability of mid-band spectrum. Are we behind other countries in the overall race to 5G? Where are we? And is there still time? And what do you recommend to this Committee in terms of statutory policy?

Mr. GILLEN. Thank you, Mr. Chairman. Thank you for the question, and it’s the exact right focus. Where are we globally on this important technology? Others see what 4G leadership has meant to
the United States and want to take that for the industries of tomorrow with 5G. As you alluded to, a report we did last year had us neck and neck with South Korea and China in the race to 5G.

I think to the credit of both industry and government, there has been a great response in the United States to update how we’re going site and actually place new 5G networks. And we’ve seen investment from all four national carriers and throughout the supply chain of responding to the threat from China. We actually have a study out commissioned now, so hopefully in a few months I can give you the latest rankings, but we feel a lot better that we’re in a position to compete globally and to lead the world as we all want to be.

In terms of policy, as you alluded to, the key one for us right now is we’ve done a great job in high band spectrum. We went from zero auctions to three auctions planned. We need to do the same thing on mid-band. The other countries have approximately 300 megahertz that are going to be available. We’re only going to have about 70 megahertz, and fixing that delta is key. We think the AIRWAVES Act is a great vehicle to do that.

The CHAIRMAN. OK, help us with this. This is not the Olympics where you cross the finish line and there’s all the evidence there. How do we know when we’ve won? And when will we know who has won the race to 5G?

Mr. GILLEN. I think we’ll know in a few years. I think the one thing you will—reason you won’t see is where——

The CHAIRMAN. A few years and not a few months.

Mr. GILLEN. Correct. Yes. This is a long generational buildout we’re going to have and a long generational of investment. I think we’ll know when we see where investment is going. When you look at where new AI and robotics investments are going, whose 5G platform are they building on? Why do companies build their R&D facilities here? Because we led the world in 4G, and you had to be here to have the most advanced networks.

So when we see where that investment is going—Is that Chinese based? Is that U.S. based? Where is that?—we’ll have a sense of where we stand in that race.

The CHAIRMAN. Thank you very much.

Mr. Berry, specifically what do you advocate in terms of changes in Universal Service Fund policies?

Mr. BERRY. Thank you, Mr. Chairman. Universal Service was based on 24 years ago, a concept that you should have similar reasonable services in rural America, and it was based on interstate voice calls. We would call that—sort of—equivalent to a 2G type of technology, although it was wireline. So we’ve come a long way from that period in time to where we are now. And as Brad just said, there is going to be an enormous amount of new innovative services and uses of spectrum, and we’re going to have to update our view of what is a contribution to the USF fund.

I think you have to also look at the other key critical elements. Spectrum, you have to have spectrum. You have to have that available in rural areas so that smaller geographic areas can bid, and win, and utilize, and integrate that spectrum. And I think you have to have infrastructure policies that allow you to excel on siting in rural America. All of those things are going to be important if
you're going to have a Universal Service Fund that keeps America, rural America, in the race.

The CHAIRMAN. Thank you.

Mr. Bhatt, how would the school bus accident have been prevented with the implementation of 5G?

Mr. BHATT. Thank you, Mr. Chairman. And so if you look at the number of school bus near misses every year in America, it's an astounding number. And so with vehicle-to-vehicle technology, you could have a signal coming from the school bus alerting all vehicles that are equipped with the technology, and as we drive forward, we'll get more and more of these vehicles equipped, so that instead of relying on a driver response to seeing those flashing lights and obeying those flashing lights, the vehicle itself knows that it can't go by there, it can't pass a school bus. And so there are all sorts of applications, but particularly with school bus safety, I think that's one we'd love to see more deployment.

The CHAIRMAN. So there is going to be a device in the school bus, and you anticipate that every—every vehicle manufactured after a certain date will have the capability of actually sensing that and stopping regardless of how inattentive the driver might be.

Mr. BHATT. Yes, Mr. Chairman. So what you're starting to see now is more and more connectivity within the vehicles. So you have vehicles talking to vehicles. You have in Colorado now they are working on a connected vehicle pilot on I–70. So you have roadside units that are talking to the vehicles, so if a vehicle deploys its airbag——

The CHAIRMAN. So we can do that now under 4G.

Mr. BHATT. You can do that under 4G, but what 5G allows is even faster connectivity. The latency, as the latency comes down, you get direct vehicle-to-vehicle connectivity. You also get greater penetration. And this is also involving broadband. So there are multiple layers of connectivity here.

The CHAIRMAN. Thank you very much.

Senator Cantwell.

Senator CANTWELL. Thank you, Mr. Chairman.

And again thank you to the witnesses. I want to try to hit on two issues if I could, and I know they sound, you know, at two ends of the spectrum, but I think that's what we need to address.

Mr. Wessel, you mentioned a couple of things. One, I think your written testimony is far more extensive than your remarks, so thank you for that. But I noticed in your testimony you say in 2018, the heads of the CIA, FBI, NSA, DIA, NGA, and the Director of National Intelligence publicly testified to their concerns about utilizing products or services from Huawei.

So I don't know where you are on this question of what we do to build out the network on security. You can give me your thoughts on that. But I'm also interested in your ITU comments because you are talking about an international standards body setting, and they're already over there dominating the standards body. Why aren't we leading the way in saying no one should be able to have backdoor networking, you know, as part of the system and leading a larger vocal concern about anybody who has used these tactics, you know, as state actors to participate in the standards-setting forum at all? Your comments on that.
Mr. WESSEL. Well, it's a great question, and thank you, and one that I've thought a lot about. And after our hearing last year at the Commission on 5G, IoT, and similar issues, we met with some of our governmental participants: NIST, FCC, and others. The U.S. goes to many of these standards-setting bodies, as it does on world health and many others, looking at, How do we define the best approach that's going to help the global commons? We don't look at it as how are we going to advance the interests of individual interests within our own country or government?

China, for many years, has taken a very different approach and has accelerated its work at the ITU and in other bodies and has been able to direct the approaches to try and advance the technologies that they are producing: Huawei, ZTE, and others. So it is a clear industrial policy that you can relate back to the five-year plans, China 2025, and others.

Senator CANTWELL. But we should be—we should be clear that we think violations of this kind of, you know, state actor activity shouldn't—that the ITU standards-setting body, we should come up with a framework that helps people understand that we can't have people who are participating in these activities sitting on standards boards and trying to influence this outcome.

Mr. WESSEL. I agree with you 1,000 percent.

Senator CANTWELL. Thank you.

Ms. Zentz, I know Mr. Bhatt mentioned transportation, which is a great aspect, but one thing that struck me about the entire smart cities effort and interest, and you mentioned some of your partners, Avista and others, is this issue of real-time savings on water. You know, irrigation is such a big aspect of the Washington economy, and our farmers and resources are being challenged by the changes in climate. What do you think that application could do for helping us in real-time information about water usage?

Ms. ZENTZ. Thank you for that question. Yes, indeed, water is, in fact, our most precious resource. And it’s interesting to note that it’s not priced as our most precious resource at the consumer level, and it’s not managed as our most precious resource by leveraging data in real time.

So there are applications where you—with the proper information, people can understand how you manage water like inventory. And so with the data, with the data-informed information for those who are operating our water resources, be they for irrigation or for potable water for citizens, then applications that are related to 5G and other methods of getting data to the operators help us substantially reduce the water that is wasted and is not used properly.

Senator CANTWELL. Is anybody else doing this right now better than we are, or are we pioneering this aspect?

Ms. ZENTZ. You mean globally?

Senator CANTWELL. Yes. I look—I mean, I know Israel is very efficient on water usage, but I don’t know if it’s because they’re using data or using other things——

Ms. ZENTZ. Right.

Senator CANTWELL.—that they’ve advanced. But——

Ms. ZENTZ. I don’t know that there is any one country that substantially leads the way, but the United States has a way to—a ways to go to catch up because of those economic signals that I
mentioned earlier. We've got to put those economic signals in real terms in front of the end user because that's where you have the opportunity to conserve and make more use of the resources.

Senator CANTWELL. I agree. Thank you so much.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Wessel, on Senator Cantwell’s question, is the horse already out of the barn in some areas of the United States with regard to these Huawei-ZTE IoT devices, and in some areas globally?

Mr. WESSEL. There is certainly some deployment, and Huawei, as I understand it, has about 9 percent of the essential patents. But this—the horse is not fully out of the barn. We also have some deployment management issues that are going to be coming over the next several years, and there are a lot of risk mitigation strategies we can engage in. And, again, as the administration is doing with many of our global partners, Five Eyes plus, trying to ensure the security of those systems. That will help drive a market-based approach that hopefully western suppliers will have greater opportunity to participate in the rollout.

The CHAIRMAN. Do you think the proper authorities are on this issue now?

Mr. WESSEL. I think that as you're hearing us doing, is we are, you know, focusing on these issues. This administration has—has given attention to it, but it is such a broad and deep problem, something I learn about new every day on new threat vectors, et cetera, that much more needs to be done.

The CHAIRMAN. I hope so.

Now we have Senator Fischer followed by Senator Schatz.

STATEMENT OF HON. DEB FISCHER, U.S. SENATOR FROM NEBRASKA

Senator FISCHER. Thank you, Mr. Chairman.

To the extent, Mr. Bhatt, that 5G becomes the vehicle-to-infrastructure solution, I've heard concerns that a slow 5G buildout in rural Nebraska and other rural areas of this Nation could put them at a disadvantage compared to urban areas. I think we all recognize that. If connected passenger and freight vehicles ultimately depend on 5G, a slow buildout will mean that rural communities will face significant economic losses. During the buildout of 3G and 4G, rural areas were a lower priority for carriers due to their population density. And we saw a lower return on investment for those carriers, which played into that as well.

It's my understanding that a 5G buildout will focus on network densification, requiring a much greater use of antenna locations, and that's going to further slow development in those rural areas. How do you think rural states can work together with carriers in order to address this?

Mr. BHATT. Thank you, Senator. And as I mentioned, I was the Secretary of Transportation at Delaware, I was the Director in Colorado, and I was the Deputy in Kentucky, and—

Senator FISCHER. You move around a lot.

Mr. BHATT. I can't hold a job. Somebody else will be here testifying for ITS America in a week.

[Laughter.]
Mr. BHATT. But those urban-rural issues are incredibly important. And how do you make sure that people can remain in the communities that they’ve grown up in and make sure, in particular, that they can engage in this global marketplace? And I think that what you’re seeing is the transportation network that was originally built first connected those communities, and now you’re starting to see broadband.

So in Wyoming, I-80 has a connected vehicle pilot, because freight is an important component, and is using broadband lines that are deployed to connect vehicles and the system and provide more safe information. And I think that it’s going to be critical that all of our partner states, cities, municipalities, work with private sector companies to make sure that we don’t have a digital divide, and there are infrastructure opportunities in the next infrastructure bill or the reauthorization where we can continue some of these partnerships.

Senator FISCHER. Do you look at those public-private partnerships as a solution? Do you think that this technology, as we see it with pilot projects now, but in the future, do you think it’s going to be able to make it just with states or cities being able to get the infrastructure in to do this? I mean, it’s hard enough maintaining highways that we have now without adding more technology to them. So do you think a public-private partnership is an answer to that? And how is that going to work? They’re used in some states now with infrastructure construction, but I think it’s going to be needed in the future when we look at the deployment here of 5G.

Now that I’ve led you into your answer, how do you view that?

Mr. BHATT. Yes.

[Laughter.]

Senator FISCHER. I didn’t mean to do that. But——

Mr. BHATT. So——

Senator FISCHER. How is that going to work when certain states are leery of a public-private partnership when you look at infrastructure?

Mr. BHATT. Senator Fischer, I think you’re exactly right. If you look around the country, the vast majority of P3s that are deployed are in areas where there is a lot of traffic or there is a bridge, and it’s a certain point. But I think that you can also look at areas where an innovative P3 is using availability payments. So as an example, in Delaware, we had challenges with rural paratransit, where it would cost the state $50 to provide a ride because it was just an expensive ride, and not everybody needed that level of service, but you could make an availability payment available to say, hey, for $20, if a private sector partner wanted to come in and deliver that ride, it created more opportunities.

So I think that between public sector infrastructure investment, and there’s a FAST Act reauthorization that will be a good opportunity to spur that private sector innovation, and then a firm, I think, steadfastness from Federal, State, and local partners that says the rural component here is important, I think we’ll be able to achieve those outcomes.

Senator FISCHER. Thank you.

Mr. Berry, when we look at the potential that’s out there for precision agriculture and the Internet of Things and being able to
have that growth, especially looking at agriculture, manufacturing, how can policymakers help with that to achieve those benefits in rural areas, those 5G benefits in rural areas, so we can overcome the density challenges and we don’t deepen the digital divide?

Mr. BERRY. Thank you, Senator. One of the things I should have mentioned with Senator Wicker, and obviously you are very well aware of the fact that we don’t have the data. Ms. Zentz was talking about data and transfer of data. We don’t have the information on where broadband exists in rural America. How can you build on a solution if you don’t know, you know, where you’re starting? So that’s one thing I think policymakers can do, is say we want actionable information on where these services exist, so then you know how you can build a system that will give you real time, 4G, 4G LTE, VoLTE, 4G Advance is going to be the precursor and NB-IoT is going to be the precursor to 5G. You can’t get there unless you have coverage.

So that’s the first thing we should do, and for the life of me, I don’t understand why we can’t figure it out, everyone here knows that they are lacking in coverage areas throughout their states. And yet the FCC indicated they were going to stop and look at the USF program, and then 5 days after they announced that, they issued a report saying there was 100 percent coverage in the United States. We have to do better, and that’s where I think we start because I think we’ve got a great lineup of good ideas here for the private sector to engage in, in the 5G world.

Senator FISCHER. Right. I think all of us here on this Committee, if we just had different gadgets in our car, we could drive around our states as we visit community and constituents, and we could tell you where it works and where it doesn’t.

Thank you.

The CHAIRMAN. Thank you, Senator Fischer.

Senator Schatz, and to be followed by Senator Blackburn.

STATEMENT OF HON. BRIAN SCHATZ,
U.S. SENATOR FROM HAWAII

Senator SCHATZ. Thank you, Mr. Chairman. Thank you to all of the testifiers.

I want to follow up on the line of questioning from Senator Fischer. And it seems to me, Mr. Berry, that we continue to not talk about the reason that we’re not expanding broadband coverage, and that is that the FCC is chicken to do contribution reform. That’s the problem. And every time we have a problem with coverage in rural America, whether it’s my state or the Chairman’s state or anybody’s community, we wave a wand called USF and we say this should be a new eligible use, but it’s a shrinking pie. And it’s a shrinking pie of the individuals who, as we all know, use landline telephones, and then they subsidize broadband and other connectivity for the rest of the country.

And so I worry that as we race to get 5G in as many places as we can, we don’t have 4G in many places, we don’t have broadband connectivity in many places. And we want to win every race, but we don’t want to admit that this takes resources. And so 10 percent of this, you know, of an auction, none if it’s enough, none of it’s enough. It is just enough for all of us to claim that we’re doing
something about it, but if we really want to think about it in the scale that is necessary, the way we think about, say, rural electrification or the railroads or the highways connecting our country, then we need more money for that purpose, and the idea that we’re going to keep charging people with landlines to subsidize an ever-growing list of stuff that we all love seems to be that we’re—we’re whistling past the graveyard here.

Mr. Berry, can you comment on that?

Mr. BERRY. Senator, I couldn’t agree more, that the investment opportunity or the economic opportunity that comes from a small investment is—I mean, Brad’s study and CTIA’s study show the economic growth that’s potentially available in the United States. We were going to have to address that issue, but you’ve got to start with the data. If you get the data right and you know where to target the money—we’re getting ready to make a $4.53 billion mistake if we deploy our resources in a way without knowing where they should go.

And then you have to look at the second phase of it, which I think you most appropriately pointed out, and that is those that are making a lot of money off of filling up the data—filling up the pipelines and providing data and information across these networks, and everyone agrees that not only rural America, but urban-suburban America, deserve the same type of service, it costs money, it costs resources. And we need to figure out who also should contribute in a contribution reform mechanism. I said to a friend the other day that for the last 24 years U.S. consumers, you and I, have made almost $150 billion of investments in the USF fund. Corporate America hasn’t done so, and many of those are earning trillion dollar benefits without the economic contributions. I think we have to address it.

Senator SCHATZ. Thank you.

Let me just change the topic back to the Huawei conversation.

Mr. Wessel, in your testimony, you describe this problem as both a sort of cybersecurity challenge as well as a competitive issue for the United States, and in your exchange with Senator Cantwell, you focused, it seemed to me, primarily on the sort of competitive aspects, race to 5G, how what we’re doing relates to our global competitiveness. Can you flesh out, however, the cybersecurity concerns related to the supply chain, and whether it’s Huawei or any other company, where we don’t know for sure that we’re cyber secure?

Mr. WESSEL. I’d be happy to. And my prepared testimony, as you said, dealt with that more, and after our six intelligence and law enforcement experts or leaders talked about this last week, they have more expertise than I do, although I’m certainly informed by the work with them and their people.

The supply chain risks, the cyber risks, are paramount there. As I indicated in the national intelligence law discussion, Chinese companies are required to comply with government decisions wherever they operate. So Huawei and others saying that they’re going to protect data in a foreign market, as they just have talked about with Germany, or Merkel has described that as a condition, they cannot do that based on their own country’s law, and we all know how China is aggressive in the use of detention, et cetera. And I
think they’re more likely to comply with what the politburo tells them to do than they are concerned about being brought before a court of law in Germany.

Senator SCHATZ. And so let me just finish up because I’m over time.

Mr. WESSEL. Yes.

Senator SCHATZ. As the Committee considers this particular issue, I think we do want to divide this question. The competitiveness issue is, listen, if somebody has got 7 percent of our market in a free market, in a global market, we can live with that, but if somebody that poses a cybersecurity risk to us has 7 percent of the IoT market, that has to be brought down to zero, or the cybersecurity risk has to be brought down to zero with some good safeguards.

So I just want to make sure we don’t think we’re in just some generic race like automobiles. This has to do with our personal privacy, our business secrets, our intellectual property, our global competitiveness. It’s a little bigger than whether some company can deploy, say, telehealth, you know, 7 months before us. Both are important, but they’re not the same.

Mr. WESSEL. This goes to traditional national security issues that the military intelligence personal security when you look at some of the applications you can have.

Let me quickly, if I can, though, also just——

Senator SCHATZ. With the Chairman’s permission.

The CHAIRMAN. Quickly.

Mr. WESSEL. Quickly, the rural issue you’re raising also has to be looked at here because the cost pressures, as everyone has identified, has driven a number of rural areas to utilize Huawei and ZTE Chinese equipment because of the cost benefits, and the result of that has put us potentially into have a two-tiered security issue that jeopardizes even more of the rural areas that has to be addressed.

Senator SCHATZ. OK. Thank you.

The CHAIRMAN. There’s a reason China has given that technology away at a cut-rate price.

We now have Senator Blackburn, and she will be followed by Senator Udall.

STATEMENT OF HON. MARSHA BLACKBURN,
U.S. SENATOR FROM TENNESSEE

Senator BLACKBURN. Thank you, Mr. Chairman.

And thank you to you all. And you’re exactly right, there is a reason they’re giving it all away, and it’s they want their data, our data, and they want the data mining, they want the access. Huawei and ZTE, as we well know, are well known for embedding that spyware and malware into their equipment, and it’s why several years ago at Energy and Commerce over in the House, Mike Rogers and I had the amendment to block them from selling to our U.S. Government and our military.

Mr. Berry, before I get going, thank you for raising the coverage issue. The 477 maps, we’ve talked about it many times, are a problem. NTIA needs to take over this mapping responsibility and clean it up before we get going on this. And we have to close the digital
divide; it’s imperative. And we’re not going to do that unless we know where we need to go, so important to do that.

I want to come a different way at some of this with China. And the Chairman and I both serve on Armed Services, and one of the things that I have done as we’ve looked at some of these telecom issues and technology issues, the integration of that, is being concerned about fostering the right type environment in our country for the commercial sector and the Department of Defense to be able to share information. And I think it’s vitally important as we look at what is going on with 5G and the applications that are there and as we consider spectrum availability and as we look at supply chain.

And, Mr. Gillen, I want to come to you. If you will just couch this a little bit and then Mr. Wessel quickly to follow him, on how we can benefit and how we best have that information shared between our commercial sector and Department of Defense. And the reason I’m asking this is because when you look at China, you never know where their commercial industrial complex ends and their military complex begins, and we’ve all seen it. And we know that they are reverse engineering, we know that they are stealing our intellectual property. So let’s approach this issue with standards, concerns with the ITU, and look at the supply chain, the spectrum availability for 5G and how we have encouraged that information share.

Mr. Gillen. Thank you, Senator. I completely agree the need to be strong partners with the national security community and the Department of Homeland Security to know where the risks are. I would say from when this Committee started talking about this issue in 2012, just to give some context, the Chinese vendor market share was roughly 4 percent in 2014. It’s now .2 percent—2.2 of 1 percent. Globally, it’s now 38 percent. And so I think it is one of those that the more information we have as to how it would help keep consumers safe, the more we can act on it in terms of our own supply chain.

Senator Blackburn. OK. Mr. Wessel.

Mr. Wessel. Just quickly, your service on the Committee, you understand all of the new drone technologies, situational awareness, the use of AI, big data, et cetera. You point to the key issues. How do we not only protect our networks but the data that has the value in those networks? And that is, you know, increasingly not just a Boeing or Northrop, it goes to a much broader cross-section of issues. China is involved in electronic reconnaissance of our critical infrastructure, has been for years, and all that data empowers them should there be any kind of a challenge or conflict that we have to deal with.

Senator Blackburn. What can the role of Congress be in fostering greater information sharing? Is there antitrust liability exemptions, for example, that we should consider? Because we know we’re in a race on this, and we also appreciate setting the standards are important. Any thoughts there? No. No one has an additional thought.

Mr. Wessel. I’d be happy to get back to you after giving it some more thought.
Senator Blackburn. Please do. I think that it is something that we need to be thoughtful about, but we also need to realize that greater competitive challenge that is in front of us.

And, Mr. Gillen, I appreciated your comments about the mid-band spectrum. “Goldilocks” might be a pretty good term for that utilization. And I appreciate that the FCC just completed its first millimeter-wave auction, and they’re looking at the beginning of the second, and I know that we are lagging behind in this mid-band spectrum. If we start with pulling more of that mid-band and putting it into auction, making it available, we are going to see the benefits of that via the economies of scale that are going to be out there and are associated with some of that global harmonization. We appreciate that. And I know that there are interference and public interest concerns. But at some point we are going to need to acknowledge that if we just sit on it and maintain status quo, we are going to lose the 5G race. Just a thought or two about what happens in the near term, in the mid-term, if we fail to move forward with making spectrum available and getting it out to auction quickly, specifically in the mid bands?

Mr. Gillen. Thank you, Senator, and thank you for your leadership on this issue for quite some time. I think the consequence of not getting spectrum, particularly in mid-band, is all the great things we were talking about on this dais can come to fruition or can’t come to fruition in the time-frame that we all want them to be. So for us, it really is a matter of mid-band is that missing piece to provide the connectivity we need, and as you said, it’s time for decisions.

Senator Blackburn. OK. Mr. Berry, anything to add?

Mr. Berry. Yes. I absolutely agree with your recognition that mid-band is critical to deployment in the 5G world. 3.5, the C-band, as we call it, the 3.7, the 4.2, and the L-band. The L-band issue has been languishing for 7 years, no decision. We have to do better on that.

It’s going to also send signals to the OEMs, to the manufacturers, that the devices and the capabilities and the dingles and, you know, all the unique technology that comes along with riding on spectrum is a signal that, hey, get ready because we’re going to need it. If we don’t have the spectrum identified and have it ready to go to market, it will be literally years before the devices are available off the shelf.

Senator Blackburn. Yes.

Mr. Berry. So we have to think ahead, and you’re absolutely in the right place.

Senator Blackburn. Well, spectrum is the sweet sauce, so thank you all very much. I yield back.

The Chairman. Thank you. Thank you, Senator Blackburn.

Senator Udall and then Senator Moran.

STATEMENT OF HON. TOM UDALL, U.S. SENATOR FROM NEW MEXICO

Senator Udall. Thank you, Chairman Wicker, and thank you to the panelists today, and I look forward to our work together in this Congress on this issue. Today’s hearing on making sure the U.S. leads on 5G and technological advances is critical to the future of
our mobile network and even more importantly, to both national security and privacy interests. We have known about the potential surveillance threats that Huawei and ZTE pose for networks for nearly a decade, but, frankly, we have not done enough to prevent their equipment from being used or to encourage other manufacturers to work with all network providers. If we ban this equipment on our networks, like we are encouraging other countries to do, such as the European Union, there is a significant cost, at least in the short term.

Mr. Berry, national security concerns about Huawei and ZTE have been well documented over the past decade, including a 2012 report from the House of Representatives Intelligence Committee that identified the risk, and I’m quoting here from that report, Huawei’s and ZTE’s provision of equipment to U.S. critical infrastructure could undermine core U.S. national security interests, end quote. Now, given this alarming report and other reports around the same time warning providers from using this equipment, why did your members continue to do business with these manufacturers?

Mr. Berry. Thank you, Senator. Good question, tough issue, serious issue. Many of—very few of our members have that equipment in their networks, and some of them have had it for several years. Our members want to do the right thing, they want to do the right thing by their consumers, they want to do the right thing for the community, and obviously they want to do the right thing for national security. I think by recognizing the fact that most of them are in small rural areas tax to find a way to build out a network on a shoestring, they, you know, have a small revenue stream, a few customers to attract to, and the attractiveness of getting into a service for their consumers has been very appealing.

You should also note that our support programs under the USF drives the cost down to the lowest common denominator. You don’t win and you don’t get any credit for using equipment that may actually cost more because it may or may not be on a government’s blacklist. So, yes, we want to work with the government, we want to work with the entities and the authorities that can identify and actually provide some guidance.

The good thing is we’re moving from a 4G LTE VoLTE to a 5G network. We have an opportunity to secure a 5G network, and I think we should have a national effort to do so, and I think we have an opportunity to cycle some of those small carriers into a more acceptable position from a national security point.

Senator Udall. Yes. Mr. Berry, last year your organization responded to the Federal Communications Commission’s supply chain notice of proposed rulemaking and submitted a number of declarations outlining problems that smaller carriers, including those serving hard-to-serve expensive areas, have attempting to procure equipment. These include that small regional carriers lack the economies of scale to incentivize other equipment manufacturers to work with them.

Two quick questions. Is this still accurate?

Mr. Berry. Many of my members, the same members that signed the declaration——

Senator Udall. Right.
Mr. BERRY.—are saying that it’s—it’s changing, that they have—they’ve been—they’ve had—overtures from some of the other vendors that, you know, recognize the dilemma they’re in, and I think slowly but surely we are recognizing that when you don’t have scope and scale, it’s a different—it’s a different service that you’re providing. And also, these carriers have 3G technology, which, in many cases, no one is making it anymore. So that is another challenge to get to the next generation of technology and also provide your customers service. In many areas, that’s the only connectivity.

Senator Udall. And to stay within my time here, just a yes or no on this one. Are those obstacles going to be even more pronounced in a 5G buildout?

Mr. BERRY. They could very well be. For those carriers that have the technology and the network, yes. For those carriers, the rest of the carriers, in the United States—as Mr. Gillen said, Huawei is probably the leader, world leader, in 5G technology, and taking out that, eliminating that, will in fact put more pressure on us as a nation and us, on the carriers.

Senator Udall. Yes. And, obviously, Mr. Chairman, we need to take a really hard look at these national security and privacy issues.

Thank you, Mr. Chairman.

The CHAIRMAN. No question about it. Thank you, Senator Udall.

Senator Moran followed by Senator Scott.

STATEMENT OF HON. JERRY MORAN, U.S. SENATOR FROM KANSAS

Senator Moran. Chairman Wicker, thank you for this hearing, your debut hearing as Chairman. It’s a great topic, an important one, for us, both from a national security point of view, but for our ability to remain a competitive country and for rural America to have access to technology.

Mr. Gillen, I’m going to start with you first. The President has called for a national spectrum strategy for managing our resources, and he recently issued a Presidential memorandum advancing that strategy. I chair the Commerce Justice and Science Subcommittee, that has appropriations over NTIA. This development caught my attention, what the administration is saying. How can the administration’s development of that national strategy speed up 5G deployment in the United States?

Mr. Gillen. Thank you, Senator. And we also think it’s a great opportunity to chart the course for where we’re going to be in spectrum for the next 5, 10, to 15 years. The key for us is an actionable plan. There is so much spectrum out there that’s been identified, from low-, mid-, and high-band spectrum, and the key is a schedule. When are we going to see that? When are innovators going to be able to invest in it? And when are we going to be able to plan to build these networks? So I think the most important thing coming out of that strategy is an actionable plan with particular focus, as we’ve talked about a lot this morning, on mid-band. That’s the place from our U.S. perspective that we need the administration’s lead on.
Senator Moran. Do you detect that that plan is forthcoming in the works and a schedule is part of that?

Mr. Gillen. We certainly hope so. That is our advocacy, and we're working closely with the Commerce Department and all interested stakeholders to do that over the summer.

Senator Moran. Ms. Baker's testimony before 2008 in the—excuse me, to the FCC, her testimony mentioned the FCC's September 2018 Communications Security, Reliability and Interoperability Council's report that highlighted the security advances associated with 5G networks. What are those improvements and what do they mean for your member companies?

Mr. Gillen. Thank you. It's a great question. We focused a lot this morning on national security, and part of it is, How do we secure our networks ourselves to protect our consumers? And the—one of the things the wireless industry is most proud is that every generation of wireless, the security gets stronger. Previous generation's vulnerabilities are addressed. I think the one that in 5G calls the most to me is the end-to-end authentication that will happen in a 5G environment so that when you're talking about Internet of Things devices, when you're on a Wi-Fi connection, that your network protections will go with you. And so, again, this is the most advanced wireless technology for security we've had, and we're excited for consumers to be able to benefit from it soon.

Senator Moran. Mr. Berry, your testimony caught my attention, and I think we've had questions about this topic, so I'm just going to say this in passing. I share your demand and insistence on accurate mapping, and it's dissatisfying, it's discouraging, to have us delayed in Mobility Phase II being able to proceed because the inaccuracy of the maps. And I'm saying this more for, again, the recognition by the FCC. I want them to hear one more time from me and others about the importance of getting those maps right. I would say once again that the solution should not be that we know we have a bad map and expect the consumer, the American citizen, to fix the map. We need accurate maps from the FCC, and we will continue our efforts to encourage that, to insist on that, but in the meantime, we're delayed.

Mr. Berry. And if I must say, the FCC should be congratulated for actually identifying, after looking over 20 million data points on those maps, that they're severely inaccurate, and they should be congratulated in stopping the process and trying to decide, what, in fact, should they do? I think this Committee has given a lot of guidance over the last year.

Senator Moran. So you're taking away from my insistence, my complaints, to the FCC, by giving them a compliment. So I'll do the same thing. I appreciate the direction that the Chairman and others are now headed on this topic, but it is critical that we get it right before we spend the money because it's sad, but we need the money to be spent now to advance the cause.

Mr. Berry, what examples of innovation from your membership can you point to in the United States in our aim to win the competitive global race on 5G?

Mr. Berry. Well, especially in rural areas, I think innovation is the mother of invention for all these small carriers. For example, C Spire in Mississippi has already put together a consortium to
identify new innovative ways to deploy a network, and to get to gigabit speeds in a rural area? They're using fixed wireless. They're using different types of unlicensed spectrum. What's going to happen is precision agriculture, health, education, distance learning, all those things are going to immediately respond to new availability and new connectivity. So you can look at Shentel out here in Virginia just kicked off what they call their—I think they call it the PowerHouse choice, and getting up to gigabit speeds in rural areas that before they were, you know, hitting, you know, lower speeds. So we're going to see the convergence of technology bringing every, you know potential solution to bear, and I'm hoping that rural America will, in fact, be recognized as an innovator in that area.

Senator Moran. Mr. Wessel, I've run out of time, but your testimony is very interesting to me, and I look forward to perhaps a second round or an opportunity to have a conversation with you. Thank you, Mr. Chairman.

The Chairman. Senator Markey.

STATEMENT OF HON. EDWARD MARKEY, U.S. SENATOR FROM MASSACHUSETTS

Senator Markey. Thank you, Mr. Chairman, very much.

Senator Lee and I introduced the Government Spectrum Valuation Act last Congress. That's legislation that will finally ensure that the public knows the value of spectrum held by the Federal Government so that we can know if it is being put to its best use because you cannot effectively manage what you have not measured.

Mr. Gillen, why is it so important that we evaluate whether Federal spectrum is suitable for commercial or unlicensed use, and then estimate the value of that spectrum to society?

Mr. Gillen. Thank you, Senator. We greatly appreciate your leadership on this issue and more broadly creating more efficiency in how government manages the spectrum it has. And the key for us here is to provide a dollar figure and an understanding on the gold mine that many agencies are sitting on that they may not be aware of, and that as we look at what the next opportunities for spectrum are, we need to provide more transparency and awareness both within the government and outside the government as to where those resources lie. So the more transparency and sunshine we can bring to this process, the more we'll get a modern spectrum policy.

Senator Markey. Do you agree that we should incentivize agencies to vacate or share spectrum that they don't need perhaps through incentive auctions where the Federal agency relinquishing or sharing their spectrum gets to keep some of the auction proceeds?

Mr. Gillen. It's a very interesting idea to create win-win opportunities, yes, Senator.

Senator Markey. OK. And what do you think about the legislation Senator Lee and I have introduced?

Mr. Gillen. We fully support it.

Senator Markey. Thank you. That's—that's very important to us.
On cyber shield, I've long said there's a Dickensian quality to the Internet. It's the best of wires and the worst of wires simultaneously. It's the best of spectrum and the worst of spectrum simultaneously. It can enable. It can ennoble. It can degrade. It can debase. And right now Americans are reeling from the dark side of the digital revolution, and that's why I was proud to join with Congressman Lieu in introducing the Cyber Shield Act. And what that bill does is it establishes an advisory committee of cybersecurity experts from academia, industry, consumer advocacy communities, and the public to create cybersecurity benchmarks for IoT devices, such as baby monitors, cameras, toasters, refrigerators, and IoT manufacturers can then voluntarily certify that their product meets those industry-leading cybersecurity standards and data security benchmarks, and display this certification to the public. Recently, CTIA released their own cybersecurity certification regime for IoT devices requiring all devices carried on their network to receive a certification, but this certification isn't consumer facing, it's between the wireless carriers and the IoT device manufacturers.

Mr. Gillen, could you help to merge what you're doing with the idea that the public should know what those cybersecurity certification standards are and to provide consumers with that information so that they can, like an Energy Star product, understand what the rating for that product is?

Mr. Gillen. We would welcome the opportunity to sit down with you and work on what that looks like for us. Eighteen months ago, we identified that there was a concern around IoT cybersecurity and that so any device that touches the wireless network meets these basic requirements. The question then for us is, What does a consumer mark look like? What information are you conveying? And that, as you alluded to, Energy Star is something that consumers can get their heads around, and cybersecurity is a really challenging one, but we look forward to working with you on what that looks like.

Senator Markey. Yes, but do you think the consumers ultimately should have that information as well?

Mr. Gillen. Absolutely, yes.

Senator Markey. Absolutely. Great. And I think that's important just so they can make up their own mind. And whoever controls 5G networks controls that valuable data it transmits, potentially granting companies—governments the ability to change, reroute, or copy data without detection, a prospect with alarming privacy and national security implications that cannot be ignored. And that's why we can't let firms like Huawei and ZTE, two massive Chinese telecommunications companies that national security officials fear, may use their telecom and computing networks to intercept military, government, civilian, and corporate communications and win the race to 5G. And we also can't let those companies like Super Micro Computer, Incorporated, which allegedly produces microchips, designed and manufactured by China's People's Liberation Army, to sell their technology to U.S. national security agencies, and that's why I'm joined by—with Senator Cortez Masto and Senator Brown in sending this letter calling on the administration
to investigate reports of Chinese government efforts to secretly manipulate U.S. technology.

We thank all of you for what you’re doing here.

Mr. Wessel especially, I’m going to ask you if you could respond in writing. I can see that my time has expired.

The CHAIRMAN. Why don’t we insert that letter in the record at this point, Senator Markey?

Senator MARKEY. I would—I would appreciate it if that would be included in the record.

The CHAIRMAN. Without objection, that will be done.

[The information referred to follows:]

United States Senate
WASHINGTON, DC 20510

October 11, 2018

President Donald J. Trump
The White House
1600 Pennsylvania Avenue, N.W.
Washington, D.C. 20500

Dear President Trump:

We write to express our serious concern regarding recent reports of Chinese government efforts to physically manipulate computer servers used in the United States to allow illicit access. Given the seriousness of the alleged activities, it is the responsibility of the administration to ensure that hardware in use throughout the U.S. government does not contain devices capable of infiltrating networks containing sensitive information. If the problems raised in this report are true, this raises important questions about what steps the government should take to protect commercial servers used by American companies. When reviewed in light of the full range of Chinese government activities to compromise U.S. national security, these reports demand a strong response by the administration.

According to Bloomberg Businessweek, the People’s Liberation Army (PLA) “designed and manufactured” microchips to be surreptitiously planted within the motherboards of servers assembled by Super Micro Computer Inc. (also known as Supremico).1 Elemental technologies, which has contracts to sell technology to U.S. national security agencies, installed these motherboards in servers eventually used by the Central Intelligence Agency and the Department of Defense. This Chinese government effort also is alleged to have affected at least 30 companies.

We are concerned that the PLA tampering could have effects more extensive than has been reported. According to the media report, a former U.S. intelligence official familiar with the Supremico case said that “attacking Supremico motherboards is like attacking Windows. It’s

1 https://www.bloomberg.com/news/features/2018-10-04/the-big-hack-how-china-used-a-tiny-chip-to-infiltrate-america-s-top-companies?utm海绵=ft&fbclid=IwAR2M3CzTvz-ORZ6R30nG3d0e7w17u67D1LipEJ7ZwYQ7BR2k3F6H_3QwZJ9
President Donald J. Trump  
October 11, 2018  
Page 2

like attacking the whole world.1 If true, the U.S. government servers, networks, and the sensitive information they contain could be compromised by a country that poses a significant strategic challenge to the United States. Additionally, any malicious P.L.A. effort could have severe implications for the privacy of data for American consumers purchasing products from American technology firms.

To better understand this ongoing issue, we respectfully request your response to the following questions by November 2, 2018.

1. Does the U.S. government own and operate any computers, servers, or other information technology hardware or systems that contain Supermicro motherboards?
   a. As the Bloomberg report named the Central Intelligence Agency and the Department of Defense as government agencies that conducted business with Supermicro and Elemental, do those organizations continue to operate equipment from these companies? If so, what steps have been taken or are being taken to identify risk posed by hardware implants, and ultimately mitigating risk, including by removing affected equipment?
   b. Are there other agencies that have purchased, or are planning to purchase, equipment that contain servers with Supermicro motherboards? If so, do they agencies continue to either use this equipment or proceed with the purchase?

2. If equipment from those companies are operating within U.S. agencies and private technology firms, what efforts has the U.S. government taken to ensure that they do not contain illicit microchips capable of compromising sensitive information about either the government, companies, or citizens?
   a. When did the government become aware of the illicit microchips, and what steps did the government take to alert U.S. agencies and private technology firms?
   b. Has the U.S. government conducted thorough investigations of motherboards and hardware from other companies that could also contain illicit microchips or other technologies designed to penetrate networks?
   c. If not, what steps is the government taking to ensure that such devices do not make it into U.S. agencies, offices, or other official locations?
   d. Recognizing the difficulty of detecting “hardware hacks,” what is the U.S. government’s long-term strategy to protect hardware from being penetrated by illicit microchips or similar technologies?

3. Do you know of other similar instances of the Chinese government infiltrating technology manufactured for end users in the United States?
   a. If so, and given the implications this might have on hundreds of millions of Americans, what steps is the U.S. government taking regarding the findings of

---

President Donald J. Trump  
October 11, 2018  

previous investigations – or plans for investigations responding to this report – and what effect this would have on private citizens’ data?

Thank you in advance for your attention to this matter.

Sincerely,

Edward J. Markey  
United States Senator

Sherrod Brown  
United States Senator

Catherine Cortez Masto  
United States Senator
Senator MARKEY. And I would ask Mr. Wessel if you could provide in writing how you believe we should be able to——

The CHAIRMAN. I’m sure Mr. Wessel will do that.

Senator Sullivan.

STATEMENT OF HON. DAN SULLIVAN,
U.S. SENATOR FROM ALASKA

Senator SULLIVAN. Thank you, Mr. Chairman. And I appreciate the panel’s testimony here today.

I want to ask Mr. Gillen and Mr. Berry a little bit more on the issue of C-band. And I think a number of folks have seen that as a favorable band of spectrum for 5G deployment, but I do have some concerns about what that could mean for states like mine that have issues of connectivity already.

So let me—let me just ask a couple questions that relates to that. I certainly want to ensure that the race to repurpose spectrum in the rollout of 5G does not have negative consequences. Let me just mention this as it relates to Alaska where incumbents are already providing critical broadband and public safety services through the C-band spectrum, how can we insurance—how can we ensure a balanced approach that helps us win the 5G race while also responsibly managing those that are using the C-band spectrum? And, quite frankly, will that go very well? It seems to be a bit of a difficult balancing act.

Mr. GILLEN. We—we certainly share your concerns, Senator Sullivan. We know that Alaska has unique uses of the C-band today. For us, we think there is a win-win opportunity, that there is vacant capacity available. The satellite industry has said that 200 of the 500 megahertz can be made available without impacting the current uses of those that are relying on those services, and we think that’s an important factor as we consider it. I think from our standpoint, 200 is a good start, but we need more. And I think, as you said, we have to find the balance of protecting users, but also the political reality of China has 500 megahertz of mid-band, Germany has 400, we’re at 70. This 500 megahertz is the next best and only opportunity to do that. So we need to get creative. We need to protect who’s there now. But we also have to keep our futures in mind.

Senator SULLIVAN. Let me ask, and Mr. Berry, you can respond to this as well, but I understand there’s a proposal floating around regarding the reallocation of C-band, and to be sold by foreign satellite companies. I’m told that this proposal would—these companies would conduct a private sale and keep all the profits. Why wouldn’t we auction the spectrum that is licensed by the taxpayers and use the estimated $40 billion in proceeds to expand rural broadband in places like Alaska that need it, and, of course, other states represented on this panel?

Mr. BERRY. Good question, Senator. GCI is also a member of CCA, and so we are very focused on the fact that we don’t want to impair those individuals and those companies that are currently using C-band. Some interesting work has been done by the C-band group itself, i.e., the satellite companies that have identified additional excess capacity, and they would like to sell it. Now, whether it’s through an auction or a private auction or it’s sort of an innova-
tive concept they came up with, I'm sort of with Mr. Gillen, that I'd love to see more spectrum available while we continue to service existing users.

The work that's been done shows that you can, in fact, make that spectrum available without eliminating existing capabilities, and I think, you know, additional satellites and so forth and so on. The issue of whether or not it should be auctioned through an FCC public auction or a private auction is novel. Many of our carriers have not seen on record the type of assurances that they would like to see in a private type of auction that normally you would see in a public auction. So——

Senator SULLIVAN. Do you see my point about, though, with a public auction and the ability to use the proceeds on areas? And if you look at the makeup of this Committee, we have a lot of states that are similarly situated than mine. I think mine is the most dramatic example of challenges with regard to connectivity and to be able to use that to help.

Mr. BERRY. Well, you know, the AIRWAVES Act is a good example of being able to get that rural element, rural reward, of access to the revenue created by an auction. So it's going to be a very difficult time.

The other issue is, How fast do we get it? I mean, you know, we're behind on the mid-band spectrum.

Senator SULLIVAN. Yes.

Mr. BERRY. I think there's a way to do both, i.e., get access to the spectrum and more—and maybe more spectrum in an efficient way.

Senator SULLIVAN. OK. Let me ask one final question. Mr. Wessel, we have set up a new subcommittee here, Senator Markey and I will be the two chair and ranking, and that's focused on economic security issues. It does have 5G as part of our jurisdictional approach. There's a lot of focus on China. Can you help us with just from your perspective, not just China, but principles in which we need to think about these issues that I know have already been discussed fairly significant as we look at 5G in the—in the mindset of national security?

Mr. WESSEL. Let me get back to you, if I can, with putting greater thought into that. The new effort you are going to—about to undertake is vital, and clearly was identified with the creation of that jurisdiction. The connection between national and economic security is, you know—is deepening. In China, those two are synonymous, and we need to have a broad agenda to develop. So I'd be happy to get back to you on that, sir.

Senator SULLIVAN. Great. Thank you.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you, Mr. Wessel, for taking that question on the record.

Senator Sinema.

STATEMENT OF HON. KYRSTEN SINEMA,
U.S. SENATOR FROM ARIZONA

Senator Sinema. Well, thank you, Chairman Wicker and Ranking Member Cantwell, for holding this important hearing today.
I share the views expressed by many of my colleagues regarding the need for the U.S. to lead in emerging technologies like 5G, and I'm really proud to represent the State of Arizona. We're at—we're at the forefront of testing new technologies, like self-driving cars, and we're building out smart cities that leverage IoT technologies.

In 2017, our State legislature passed legislation to make it easier for 5G operators to install small cell equipment in Arizona, and Gilbert became the first community in Arizona to fully implement small wireless facilities in municipal rights of way.

We understand this time of the year between 850 and 1,000 residents are living in our communities, but I recently heard from a community from Sunscape, Sunscape RV Resort, which is just east of Casa Grande, Arizona, lives in—is in Pinal County. And Sunscape residents are all 55 years and older. Many of them live in—are in their seventies. And depending on the time of year, between 850 and 1,000 residents live at Sunscape RV center. But no matter what cell provider they choose, the area has lacked reliable cell phone service for 15 years. This is a huge problem for these older Arizonans, most of whom live on fixed incomes. And these Arizonans have all paid for cell phone service, often over $100 a month, but they can't even effectively use these cell phones in their own homes. It's wrong, and it needs to change, but, more importantly, it's unsafe because seniors have acute health care needs that sometimes require immediate medical attention. And so when requests for medical assistance and 9-1-1 calls get dropped due to bad cell service, it risks lives.

Yesterday, my staff visited Sunscape RV Center to hear from park residents and management directly about the challenges they face, and we learned that this challenge isn't unique to this park. The minute you get off the highway, that's just a few miles away, service starts to get spotty. And this problem is as real for the surrounding neighborhoods as it is for Sunscape. And yet this isn't an uninhabited or especially far-flung place. Arizonans call these places home, and they deserve the same basic services that are afforded to those who live in our populated cities.

For us, cell phone service means being able to stay in touch with friends and family even if they don't live close by, and many of us couldn't imagine life without it. So what these families need isn't anything groundbreaking, they just need a new tower or some other means of expanding and improving service in the area, but it would mean the world to these Arizonans who are just trying to enjoy their golden years. So these guys are not asking for a handout, they pay companies for services that aren't being delivered, and I'd like to fix that.

So I hope that Sunscape's story should serve as a reminder that as we discuss the benefits of moving to 4G to 5G in the cities, there are communities all across my state and in our country that still don't have reliable 3G. In the digital age, these disparities in service are fundamentally disparities of opportunity. Rural communities must be a bigger part of the connectivity conversation, and we can't consider the race to 5G won until we all cross the finish line.

Mr. Chairman, we know that customer density is one of the biggest challenges to delivering quality cost competitive 5G in rural
areas. So my question today is for Mr. Berry, who I thank him for being here.

Congress passed the RAY BAUM’S Act in 2018, which reformed the permitting process for broadband infrastructure on Federal lands. And the FCC has taken steps to break down State and local barriers to 5G deployment. So what progress, if any, has been made as a result of these changes? And what else can you suggest to be done to help communities like the Sunscape RV community?

Mr. Berry. Thank you, Senator. I appreciate it. I think you are seeing what many of your colleagues are seeing, and that is that we do not have coverage in 100 percent of the United States. And, again, I’d like to go back to the data. This is good information, that this is data points that we ought to include in the FCC’s review of the map. Those areas, we’d love to work with you. Number one, that’s—we’ll sit down with some of our members that may or may not be in the area. I’m sure that other carriers would also like to address that issue. So we can do that.

On the larger scale, it is—it’s a problem you see over and over. We’re talking about 5G and basic coverage is not available in most areas. So can we address it? There may be some unique innovative ideas that we can—technology that we could utilize to help address those areas, but one—one community alone is extremely difficult to build out the capital investments. So we’d like to work with you and find out if there are solutions that we can do, help that one community, but, again, it’s across not only your state, but almost all of the rural states, that we have these huge gaps in coverage, and we’re going to have to do a better job of identifying if we’re going to find either USF or other innovative ways to service those areas.

Senator Sinema. Thank you.

And thank you, Mr. Chairman.

Mr. Berry, this community can skip over 4G right to 5G, can’t they?

Mr. Berry. I don’t know if they could do that. You have to have connectivity, and many of the 5G services are going to be built on fundamental 4G type of LTE network. But there are certain types of 5G services that, as we’ve heard today, that are inherent in the 4G technology itself. So, you’re going to have to have higher bandwidth and probably fiber connectivity or some type of fixed wireless capability going back to fiber if you’re going to get the 5G in a remote area like that.

Senator Lee. Thank you, Mr. Chairman.

Thanks to each of you for being here. This is a really important topic. As we’ve talked a lot about today, more technology necessarily requires more spectrum, which happens to be a limited resource with large valuable bands under the control of the Federal Government. And this is going to require us to look at both the licensed and the unlicensed parts of the spectrum because both play
an important role and both form part of this cohesive whole that is so important for the development of technology in our country and throughout the world.

Federal agencies have very little incentive to share the spectrum that they have been allocated to them or to make it available for commercial use even if it’s being used in a way that might be terribly inefficient. This isn’t surprising, it is understandable, this is inherent in the nature of government in many respects, but it’s our job, as a Congress, to watch out for that fact and to do what we can to make sure that we manage this resource effectively.

There does seem to be an absence of market-based allocation of spectrum, which I think has led to greater inefficiencies and some misallocations, and that, in turn, has a tendency to stifle the development of other technologies upon which we could rely and from which we could benefit greatly.

It’s one of the reasons why at the end of the last Congress I was pleased to team up with Senator Markey to introduce the legislation that he referred to during his remarks, which is the Government Spectrum Valuation Act. This bill doesn’t transition any Federal spectrum allocations. In fact, it’s a data bill that requires the calculation of the value of the Federal spectrum allocations specifically so that Congress can better understand what might be described properly as the opportunity costs associated with the holdings of spectrum by and within the Federal Government among these Federal agencies, and to make more informed decisions in partnership with Federal agencies.

So, Mr. Gillen, it sounds like, from your interaction, your exchange with Senator Markey, that given that spectrum is a limited resource, you believe that it is important for Congress to have the best data and tools necessary to identify any inefficiencies that might exist within the Federal holdings of spectrum.

Mr. Gillen. Absolutely. And thank you for the legislation. It’s an important data point, and as you said, this is about data. This is about providing the transparency as to what agencies have, and as you started talking, the focus, these agencies have a mission to run. They’re not in charge of spectrum. They don’t necessarily even know what they have. And so a lot of this is, How do we provide the tools for the Commerce Department and the other agencies to better the roadmap of what spectrum could be in the future available and what the economic opportunities there are?

Senator Lee. So in that respect, this could be helpful to both Congress and to the agencies themselves who manage it and may or may not know what it is that they have or understand what value it has.

Mr. Gillen. 100 percent, and the consumers in the end that could benefit from new spectrum allocated through that process.

Senator Lee. You’ve noted that NTIA is studying the 3.45 gigahertz band, which is a very key piece of mid-band spectrum. I’m pleased that NTIA is studying that. Do you think that an estimation on the 3.5—the 3.45-gigahertz band and its commercial value might be helpful as we consider that band’s allocation?

Mr. Gillen. We do think it would be helpful. We think it would be helpful as we start to talk about what commercializing that
band looks like. Understanding the opportunity would be first and foremost.

Senator Lee. Overall, do you think that requiring the identification of these opportunity costs of Federal spectrum allocations that I’ve described could help better equip—equip Congress to work with Federal agencies and manage Federal spectrum efficiently?

Mr. Gillen. Yes. I think this is a great tool that we would have greatly benefited from in the past as we try to figure out what agencies are using spectrum for, and do they even understand the value of what they have? So I think this is the type of transparency we’re going to need as these spectrum fights only are going to get harder as there is less and less spectrum to go around.

Senator Lee. So what then is the risk if we don’t do it, if we don’t do something like this?

Mr. Gillen. We’re going to miss opportunities where we could more efficiently use spectrum both within the agencies and as a country.

Senator Lee. And that, in turn, could stifle innovation within the marketplace.

Mr. Gillen. Everything we’re talking about on this day is if we don’t continue to provide a pipeline of spectrum, we’re not going to get everything we want.

Senator Lee. Thank you very much. I see my time has expired. I appreciate each of you for being here.

The Chairman. Thank you very much, Senator Lee.

Senator Thune.

STATEMENT OF HON. JOHN THUNE, U.S. SENATOR FROM SOUTH DAKOTA

Senator Thune. Thank you, Mr. Chairman. Thank you for holding this hearing. This is an issue of enormous consequence, I believe, to our global competitiveness, our economy, and the country that embraces and gets ahead and wins the race on 5G I think is going to benefit enormously in terms of the economic dividends that will come with that.

Mr. Gillen, a number of cities and states across the country are modernizing their siting policies in order to reap the benefits of 5G, and much of the early investment in 5G is going to places that have acted first. That’s why I’m pleased that in my home state of South Dakota, the City of Sioux Falls, among others, has adopted a forward-looking approach to the opportunities that next-generation wireless services will bring.

I am also pleased that the FCC has updated its guidance to states and localities to reflect new wireless infrastructure such as small cells. All of this is consistent with the STREAMLINE Small Cell Deployment Act, bipartisan legislation that Senator Schatz and I introduced last Congress.

Let me just ask this question: How important is streamlining the siting process to deployment of 5G?

Mr. Gillen. Thank you, Senator, and thank you for your focus, and you’ve really driven this issue. To get 21 states to act, to get cities like Sioux Falls to engage on this, you’ve brought the leadership to make this happen, and it is critical. We are not going to get where we want on 5G if we continue to have rules that look
like everything is a 200-foot tower along the sideways—along the highway. And so fundamentally it’s, How do we modernize these—modernize these rules for tomorrow’s networks? And with your leadership, we’ve made great progress over the last 2 years.

Senator Thune. Thank you. And you’re losing your voice, so I’m sorry to make you answer these questions, but I’ve got one other one. As you know, a robust wireless network with the speed and capacity to handle thousands and eventually millions of autonomous vehicles is crucial to realizing what I think are going to be enormous safety benefits that a connected transportation system would offer. During this Congress, I expect to continue to work on defining a Federal framework for this emerging technology. Could you speak to the ways in which the deployment of 5G will benefit the emergence of autonomous vehicles?

Mr. Gillen. Absolutely, and the importance of the ability to test here. If we want innovation to happen here, if we want this leadership for the industries of tomorrow to happen in the United States, we have to be an incubator for it. We have to allow the testing of it. We have to allow that to be developed. And so your legislation is critical. When we start talking about the life-saving aspects that my colleagues have talked so eloquently about this morning, that to get to those things, we need to test these technologies and we need to understand what they are, and that we need your legislation.

Senator Thune. OK. Mr. Berry, last October, U.S. Cellular, a member of both CCA and CTIA, expressed support for the rural dividend included in Senator Gardner’s AIRWAVES Act, which would allocate 10 percent of auction proceeds to wireless deployment in unserved and underserved areas. Given that the FCC is moving ahead with auctions of much needed new spectrum licenses regardless of legislation, what are your thoughts about immediately creating a rural dividend mechanism to capture the benefit from auctions for targeted rural buildout support?

Mr. Berry. Senator, thank you. We’re totally in favor of that concept. We supported it last year. I would note that we did a study at CCA, the assessment of the economic impact of the AIRWAVES Act itself, and we just looked at the expected revenue from two auctions, 24 and 28. What would be the economic impact to rural America should that rural dividend be in place? $1.25 billion economic impact to agriculture, $3.35 billion to health care, and $850 million impact to transportation, and that’s just from one suggested auction, it’s actually two auctions, 101 and 102, but that was a good example to use. And by the way, the study came pretty close to what was actually the number auctioned in the recent 101 auction. So I think those numbers are really low-ball numbers. If we’re talking about three or four or five different types of auctions, we’re talking about a huge opportunity for rural America that I totally support, yes.

Senator Thune. One last quick question. Mr. Gillen, you testified before this Committee that midrange spectrum leverages both capacity and coverage opportunities, which is helpful in more rural settings. Tell us why this band is so important to America’s 5G leadership and what we can do to ensure that the wireless industry has enough mid-band spectrum to deploy 5G.
Mr. GILLEN. Thank you, Senator. The value of mid-band is that it provides both capacity and coverage, that right now we have high-band spectrum that is incredibly valuable, but it only can go a couple blocks. We have low-band spectrum that can go miles, but it doesn’t carry the amount of bandwidth that we’re going to need for a lot of 5G applications. We think in a lot of places mid-band will be what we’ll be using for 5G. It’s also, frankly, something that we just don’t have that much of right now available in the market, only 70 megahertz that will be auctioned hopefully by this time next year. So for us, it really is, How do we get our national resources focused on making sure we have all type of spectrum for all different types of applications and communities?

Senator THUNE. All right. Thank you, Mr. Chairman. My time is expired.

Thank you all very much.

The CHAIRMAN. Thank you very much, Senator Thune.

Senator Blumenthal.

STATEMENT OF HON. RICHARD BLUMENTHAL, U.S. SENATOR FROM CONNECTICUT

Senator BLUMENTHAL. Thanks, Mr. Chairman. Thank you for having this hearing.

We’ve heard from a lot of witnesses, from you today and others previously, about the very important potential of 5G technology. It promises to bring us a new era of connectivity with Internet speeds as much as five times faster than what we have today with much lower latency, and that’s all a good thing, but 5G, as you well know, also uses higher frequency waves that don’t travel as far and will rely on a network of hundreds of thousands, potentially millions, of small cell sites. And the question then is, Are there any health implications, any public safety implications, to those additional sites that are likely to be located close to homes, schools, workplaces, and closer and closer to the ground? Correct?

Mr. GILLEN. Correct, Senator, yes.

Senator BLUMENTHAL. So in December 2018, I sent a letter to FCC Commissioner Carr asking him to site for me recent scientific studies demonstrating the safety of this technology, what research has been done, where has it been published and compiled? He has essentially failed to do so, and just echoed the general statements of the FDA, which shares regulatory responsibility for cell phones with the FCC. If you go to the FDA website, pretty unsatisfactory. There basically is a cursory and superficial citation to existing scientific data saying, quote, The FDA has urged the cell phone industry to take a number of steps, including support additional research, on possible biological effects of radio frequency fields for the type of signal emitted by cell phones. I believe that Americans deserve to know what the health effects are, not to prejudge what scientific studies may show, and they deserve also a commitment to do the research on outstanding questions.

So my question for you, particularly Mr. Gillen and Mr. Berry, how much money has the industry committed to supporting additional independent research? I stress “independent research.” Is that independent research ongoing? Has any been completed?
Where can consumers look for it? And we’re talking about research on the biological effects of this new technology.

Mr. Gillen. Thank you, Senator. Thank you for your focus on the issue. Safety is paramount, and as you alluded to, we rely on the expert agencies, rely on the findings of the FDA, and others as to the requirements to keep all of us safe. There are no industry-backed studies to my knowledge right now. I’m happy to visit with you as to what opportunities you think there needs to be more studies. And we’re always for more science. We also rely on what the scientists tell us.

Senator Blumenthal. So essentially the answer to my question “How much money?”—zero.

Mr. Gillen. I can certainly follow up with you, Senator. To my knowledge, there are no active studies being backed by industry today.

Senator Blumenthal. Anybody else know of industry commitments to back research, fund it, support it, to ascertain scientifically the health effects?

Mr. Berry. Senator, I’m not aware either, but I do know that with small cells especially, you’re going to have lower power levels. And, of course, as from a carrier perspective, you want to be able to manage interference so that that interference is the lowest interference possible. So, I would think that some of those studies or some of that information could be utilized in looking at the health consequences, but, no, I’m not aware of any——

Senator Blumenthal. So there really is no research ongoing. We’re kind of flying blind here as far as health and safety is concerned.

Thank you, Mr. Chairman.

The CHAIRMAN. Thank you very much.

Senator Tester, after two hours of testimony, I’m sure you’ll agree there is not a single question you could think of to ask this panel. Is that correct?

Senator Tester. No, I’ve got a——

Senator Wicker. OK.

Senator Tester. I’ve got one that’s unique. To be honest with you, Mr. Chairman, it wouldn’t matter anyway.

The CHAIRMAN. Senator Tester, you are recognized. You are recognized.

STATEMENT OF HON. JON TESTER, U.S. SENATOR FROM MONTANA

Senator Tester. All right. Thank you.

So, Mr. Gillen, I’m from Montana. Can you give me a time-frame for when we’re going to get service in the great state of Montana, 5G?

Mr. Gillen. I cannot, Senator, I think in terms of since the last time we had the opportunity to talk. The nice thing is we’ve seen rural carriers figure out their path to 5G. We have C Spire in Mississippi, we have Cellcom in Green Bay has moved forward with how that looks like. When it will reach Billings, I don’t have an answer for you.

Senator Tester. Well, not even—I mean, Billings is certainly one of the more urban, in fact, the most urban area in Montana. We’d
love to have it in Billings next week. But in your testimony you spoke about how 5G can help with telemedicine and can help with smart farming. I don’t think I’m wrong on this, telemedicine has its greatest effect in rural areas. Farming doesn’t happen in downtown Cincinnati.

So how can we get those kind of effects if we don’t have that service out there? Is the question. I mean, we’re not talking about Billings now, now we’re talking about Scobey, and not a lot of folks live in Scobey anymore, but if you’re going to have smart farming, you’ve got to have the infrastructure, and if the infrastructure is focused on the more populated areas, which I get it, to pay the bills, you have to do that, what do we have out there to help drive it to rural areas in a realistic way that will do it in a timely manner? Because as I pointed out to this Committee before, when I go to my farm, you can get texts, but this damn thing doesn’t work.

Mr. GILLEN. And I think it comes back to a lot of the conversation this morning about, How do we get to unserved areas? It is the FCC’s Mobility Fund, and we have to get the maps right, and we have to get that money going. It’s the rural dividend in AIRWAVES that would be $70 million from this most recent auction if it had been in place.

Senator TESTER. So do you anticipate that the digital divide will get wider with—implementation of 5G?

Mr. GILLEN. We don’t think it will get wider. It’s also going to take time. We think that 5G has the opportunity in places that aren’t fixed broadband opportunities, there may be applications that will get broadband in places that it’s not today.

Senator TESTER. OK. I don’t need to reemphasize my concern here. My concern is I think there is some great opportunity here to do some marvelous things to really create some real economy, not only in the buildout, but after the buildout is done. My other concern is, is that most of the stuff that’s driven around here is driven on population, so the benefits that rural America could get to help repopulate those areas are a long ways off.

I want to talk about something that probably already has been talked about, Mr. Chairman, and that’s Chinese equipment.

Mr. Wessel, do you believe that we should rip this equipment out right now?

Mr. WESSEL. I think there are certain critical networks that it should be ripped out of, but I think—

Senator TESTER. So in my local telephone co-op, the one right next to my local telephone—

Mr. WESSEL. I believe that you need to do a security evaluation. As you know, there is I-25 corridor and many other critical sites that, you know, we need. We have assets that need to be protected.

Senator TESTER. Yes, yes. I agree. Is there—is there—is there access for those small telcos to be able to get security evaluation? Do they have access to folks who can do that? Or do they have access to any money that could help them do that?

Mr. WESSEL. I’m not aware of money in terms of access to information. We found it to be very spotty between State DHS, Federal DHS, and other authorities that the localities don’t know—necessarily know where to go for the kind of advice they need.
Senator Tester. So, yes. And so—or where to go to—I mean, because, look, I know many of the folks in Montana, if not all of them, and I know that they don’t want to put this country in any sort of security risk. And so Mr. Berry, how are these guys going to do it because I—they aren’t running on very big profit margins, and I don’t know any of them that have a big old bank account. And so how—it’s a problem. I will tell you I think it’s a big problem. How can we find out if actually this outfit actually is in our backyard to the point where this stuff needs to be fixed and needs to be fixed immediately? And how can the guys do it? I’m sure they’re members of yours.

Mr. Berry. We have several members that have the technology, and some of them in your state, as you referred to. It’s—it’s a difficult issue. I mean, as you said, they’re running on a shoestring compressed with enormous responsibility to service an area that no one else exists. I mean, one of the carriers in your area services an area larger than all of the country of Great Britain and it’s——

Senator Tester. You got it.

Mr. Berry. Islands, and no one knows who they are.

Senator Tester. Yes.

Mr. Berry. Can we address it? I think we can. I think we need a little better direction from the authorities that have identified this as a national security threat. And I think as we mature and move to a 5G world, you can cycle out some of this technology that they identify as the most troublesome technology. And you’re talking about some carriers that are in 3G trying to get to 4G——

Senator Tester. Yep.

Mr. Berry.—they’re caught betwixt and between because they—3G technology is not being made anymore, and rip and replace is a huge—and it’s probably more cost than the value of their revenue. So it’s a tough question. We want to work with the U.S. Government and do the right thing.

Senator Tester. So I know the Chairman wants this hearing extended as long as I possibly can, but I’m not going to do that. What I do need because I don’t—we’ve got a problem, mission control, we’ve got to figure out how to solve it. My guess is that Congress is going to have to be part of that solution. Man, if anybody at this table can get back with some ideas on what we need to be doing, I know the chairman will be open to listening, and the ranking member, and I certainly will be because I think—I think we’ve got a problem here that we need to deal with, and I don’t think it’s going to be dealing with by just saying, “Rip the equipment out, fellows, you’ve just got to get rid of it,” because it’s just not going to work that way. So we need some input. OK? Ideas, solutions.

Thank you all for being here. And, Mr. Chairman, thank you for your ability to let me go on a little bit over.

The Chairman. Thank you, Senator Tester. Actually, I think those are two good notes to end on. And I can assure you, you have a lot of teammates behind this dais on your first point, which is bridging the rural divide. So I think we all want to work with you. A majority of the constituencies represented at this table are directly affected by that. And then I think it was well worth you coming and making that point about exactly what do we do and exactly
what needs to be done from a security standpoint about this equipment that’s already there.

So thank you very much, and there being no further questioners, the testimony will end.

Let me say—let me say this, because there are a lot of interested parties that have participated in this, and I appreciate the attendance. As we wrap up today’s hearing, it is apparent that 5G will be a platform for significant economic opportunity and U.S.-based innovation. I would also note that as we are on the cusp of this new industrial revolution, we need to ensure trust across the ecosystem among companies, consumers, and communities. 5G’s power and pervasiveness only highlights the need for a Federal privacy framework that this technology knows no boundaries.

So as we continue our efforts to win the race to 5G, I view it as this Committee’s assignment and this Committee’s obligation to create meaningful privacy legislation that protects consumers and fosters continued investment and innovation in the United States. This is a great opportunity for bipartisan lawmaking in this Committee, and my goal is legislation that will reach the President’s desk. I look forward to continuing to work with members of this Committee in a bipartisan manner toward that goal, which will be critical for our Nation to remain globally competitive and lead the world on the cutting edge of new technologies.

Now, I want to add something to the record in light of what Senator Blumenthal raised just so we can have a complete record. I am told the National Cancer Institute has determined that, “although many studies have examined the potential health effects of nonionizing radiation from radar, microwave ovens, cell phones, and other sources, there is currently no consistent evidence that nonionizing radiation increases cancer risk.” And that is a quote from the National Cancer Institute. And I will—I would be happy to have other information submitted to members of the Committee. But I will cite in the record the exact web address for this information.

[The information referred to follows:]

**NATIONAL CANCER INSTITUTE**

**Question.** Why is there concern that cell phones may cause cancer or other health problems?

**Answer.** There are three main reasons why people are concerned that cell phones (also known as “mobile” or “wireless” telephones) might have the potential to cause certain types of cancer or other health problems:

Cell phones emit radiofrequency radiation (radio waves), a form of non-ionizing radiation, from their antennas. Parts of the body nearest to the antenna can absorb this energy.

The number of cell phone users has increased rapidly. There were over 400 million cell phone subscribers in the United States in 2017, according to the Cellular Telecommunications and Internet Association. Globally, there are more than 5 billion cell phone users.

Over time, the number of cell phone calls per day, the length of each call, and the amount of time people use cell phones have increased. Because of changes in cell phone technology and increases in the number of base stations for transmitting wireless signals, the exposure from cell phone use—power output—has changed, mostly lowered, in many regions of the United States.

The NCI fact sheet Electromagnetic Fields and Cancer includes information on wireless local area networks (commonly known as Wi-Fi), cell phone base stations, and cordless telephones.

**Question.** What is radiofrequency radiation and how does it affect the human body?
Answer. Radiofrequency radiation is a form of electromagnetic radiation. Electromagnetic radiation can be categorized into two types: ionizing (e.g., x-rays, radon, and cosmic rays) and non-ionizing (e.g., radiofrequency and extremely low frequency, or power frequency). Electromagnetic radiation is defined according to its wavelength and frequency, which is the number of cycles of a wave that pass a reference point per second. Electromagnetic frequencies are described in units called hertz (Hz).

The energy of electromagnetic radiation is determined by its frequency; ionizing radiation is high frequency, and therefore high energy, whereas non-ionizing radiation is low frequency, and therefore low energy. The NCI fact sheet Electromagnetic Fields and Cancer lists sources of radiofrequency radiation. More information about ionizing radiation can be found on the Radiation page.

The frequency of radiofrequency electromagnetic radiation ranges from 30 kilohertz (30 kHz, or 30,000 Hz) to 300 gigahertz (300 GHz, or 300 billion Hz). Electromagnetic fields in the radiofrequency range are used for telecommunications applications, including cell phones, televisions, and radio transmissions. The human body absorbs energy from devices that emit radiofrequency electromagnetic radiation. The dose of the absorbed energy is estimated using a measure called the specific absorption rate (SAR), which is expressed in watts per kilogram of body weight.

Exposure to ionizing radiation, such as from x-rays, is known to increase the risk of cancer. However, although many studies have examined the potential health effects of non-ionizing radiation from radar, microwave ovens, cell phones, and other sources, there is currently no consistent evidence that non-ionizing radiation increases cancer risk in humans (2).

The only consistently recognized biological effect of radiofrequency radiation in humans is heating. The ability of microwave ovens to heat food is one example of this effect of radiofrequency radiation. Radiofrequency exposure from cell phone use does cause heating to the area of the body where a cell phone or other device is held (e.g., the ear and head). However, it is not sufficient to measurably increase body temperature. There are no other clearly established effects on the human body from radiofrequency radiation.

Question. How is radiofrequency radiation exposure measured in epidemiologic studies?

Answer. Epidemiologic studies use information from several sources, including questionnaires and data from cell phone service providers, to estimate radiofrequency radiation exposure. Direct measurements are not yet possible outside of a laboratory setting. Estimates take into account the following:

How “regularly” study participants use cell phones (the number of calls per week or month)

The age and the year when study participants first used a cell phone and the age and the year of last use (allows calculation of the duration of use and time since the start of use)

The average number of cell phone calls per day, week, or month (frequency)

The average length of a typical cell phone call

The total hours of lifetime use, calculated from the length of typical call times, the frequency of use, and the duration of use

Question. What has epidemiologic research shown about the association between cell phone use and cancer risk?

Answer. Researchers have carried out several types of epidemiologic studies in humans to investigate the possibility of a relationship between cell phone use and the risk of malignant (cancerous) brain tumors, such as gliomas, as well as benign (non-cancerous) tumors, such as acoustic neuroma (tumors in the cells of the nerve responsible for hearing that are also known as vestibular schwannomas), meningiomas (usually benign tumors in the membranes that cover and protect the brain and spinal cord), and parotid gland tumors (tumors in the salivary glands) (3).

In one type of study, called a case–control study, cell phone use is compared between people with these types of tumors and people without them. In another type of study, called a cohort study, a large group of people who do not have cancer at study entry is followed over time and the rate of these tumors in people who did and didn't use cell phones is compared. Cancer incidence data can also be analyzed over time to see if the rates of brain tumors changed in large populations during the time that cell phone use increased dramatically. These studies have not shown clear evidence of a relationship between cell phone use and cancer. However, researchers have reported some statistically significant associations for certain subgroups of people.
Three large epidemiologic studies have examined the possible association between cell phone use and cancer: Interphone, a case–control study; the Danish Study, a cohort study; and the Million Women Study, another cohort study.

**Interphone**

How the study was done: This is the largest health-related case–control study of cell phone use and the risk of head and neck tumors. It was conducted by a consortium of researchers from 13 countries. The data came from questionnaires that were completed by study participants.

What the study showed: Most published analyses from this study have shown no statistically significant increases in brain or other central nervous system cancers related to higher amounts of cell phone use. One analysis showed a statistically significant, although modest, increase in the risk of glioma among the small proportion of study participants who spent the most total time on cell phone calls. However, the researchers considered this finding inconclusive because they felt that the amount of use reported by some respondents was unlikely and because the participants who reported lower levels of use appeared to have a slightly reduced risk of brain cancer compared with people who did not use cell phones regularly (4–6).

An analysis of data from all 13 countries participating in the Interphone study reported a statistically significant association between intracranial distribution of tumors within the brain and self-reported location of the phone (7). However, the authors of this study noted that it is not possible to draw firm conclusions about cause and effect based on their findings.

**Additional analyses of data from Interphone countries**

An analysis of data from five Northern European countries in the Interphone study showed an increased risk of acoustic neuroma only in those who had used a cell phone for 10 or more years (8).

In subsequent analyses of Interphone data, investigators addressed issues of risk according to specific location of the tumor and estimated exposures. One analysis of data from seven of the countries in the Interphone study found no relationship between brain tumor location and regions of the brain that were exposed to the highest level of radiofrequency radiation from cell phones (9). However, another study, using data from five of the countries, reported suggestions of an increased risk of glioma and, to a lesser extent, of meningioma developing in areas of the brain experiencing the highest exposure (10).

**Danish Study**

How the study was done: This cohort study, conducted in Denmark, linked billing information from more than 358,000 cell phone subscribers with brain tumor incidence data from the Danish Cancer Registry.

What the study showed: No association was observed between cell phone use and the incidence of glioma, meningioma, or acoustic neuroma, even among people who had been cell phone subscribers for 13 or more years (11–13).

**Million Women Study**

How the study was done: This prospective cohort study conducted in the United Kingdom used data obtained from questionnaires that were completed by study participants.

What the study showed: Self-reported cell phone use was not associated with an increased risk of glioma, meningioma, or non-central nervous system tumors. Although the original published findings reported an association with an increased risk of acoustic neuroma (14), this association disappeared after additional years of follow-up of the cohort (15).

In addition to these three large studies, other, smaller epidemiologic studies have looked for associations between cell phone use and cancer. These include:

Two NCI-sponsored case–control studies, each conducted in multiple U.S. academic medical centers or hospitals between 1994 and 1998 that used data from questionnaires (16) or computer-assisted personal interviews (17). Neither study showed a relationship between cell phone use and the risk of glioma, meningioma, or acoustic neuroma.

The CERENAT study, another case–control study conducted in multiple areas in France from 2004 to 2006 using data collected in face-to-face interviews using standardized questionnaires (18). This study found no association for either gliomas or meningiomas when comparing regular cell phone users with non-users. However, the heaviest users had significantly increased risks of both gliomas and meningiomas.
A pooled analysis of two case–control studies conducted in Sweden that reported statistically significant trends of increasing brain cancer risk for the total amount of cell phone use and the years of use among people who began using cell phones before age 20 (19).

Another case–control study in Sweden, part of the Interphone pooled studies, did not find an increased risk of brain cancer among long-term cell phone users between the ages of 20 and 69 (20).

The CEFALO study, an international case–control study of children diagnosed with brain cancer between ages 7 and 19, which found no relationship between their cell phone use and risk for brain cancer (21).

Investigators have also conducted analyses of incidence trends to determine whether the incidence of brain or other cancers has changed during the time that cell phone use increased dramatically. These include:

An analysis of data from NCI’s Surveillance, Epidemiology, and End Results (SEER) Program evaluated trends in cancer incidence in the United States. This analysis found no increase in the incidence of brain or other central nervous system cancers between 1992 and 2006, despite the dramatic increase in cell phone use in this country during that time (22).

An analysis of incidence data from Denmark, Finland, Norway, and Sweden for the period 1974–2008 similarly revealed no increase in age-adjusted incidence of brain tumors (23).

A series of studies testing different scenarios (called simulations by the study authors) were carried out using incidence data from the Nordic countries to determine the likelihood of detecting various levels of risk as reported in studies of cell phone use and brain tumors between 1979 and 2008. The results were compatible with no increased risks from cell phones, as reported by most epidemiologic studies. The findings did suggest that the increase reported among the subset of heaviest regular users in the Interphone study could not be ruled out but was unlikely. The highly increased risks reported in the Swedish pooled analysis were strongly inconsistent with the observed glioma rates in the Nordic countries (24).

An analysis of primary brain tumor incidence data (including some of the first benign brain and central nervous system tumor data that SEER began collecting in 2004) reported that the incidence of acoustic neuromas (also known as vestibular schwannomas) was stable (unchanged) from 2004 to 2010 (26).

A 2018 national study that examined trends in brain tumor incidence among adults aged 20–59 years in Australia found that incidence rates for brain tumors overall and for individual histologic types, including glioma, were stable over three time periods—1982–1992, 1993–2002, and 2003–2013—including one (2003–2013) during which cell phone use was substantial (27).

An analysis of U.S. cancer incidence during 1993–2013 found no change in the overall incidence rate of malignant CNS cancers among children ages 0 to 19 years in the United States (28).

Question. What are the findings from experimental studies?

Answer. In 2011, two small studies were published that examined brain glucose metabolism in people after they had used cell phones. The results were inconsistent; whereas one study showed increased glucose metabolism in the region of the brain close to the antenna compared with tissues on the opposite side of the brain (29), the other study (30) found reduced glucose metabolism on the side of the brain where the phone was used.

The authors of these studies noted that the results were preliminary and that possible health outcomes from changes in glucose metabolism in humans were unknown. Such inconsistent findings are not uncommon in experimental studies of the biological effects of radiofrequency electromagnetic radiation in people (4). Some factors that can contribute to inconsistencies across such studies include assumptions used to estimate doses, failure to consider temperature effects, and lack of blinding of investigators to exposure status.
Another study investigated the flow of blood in the brain of people exposed to the radiofrequency radiation from cell phones and found no evidence of an effect on blood flow in the brain (31).

Early studies involving laboratory animals showed no evidence that radiofrequency radiation increased cancer risk or enhanced the cancer-causing effects of known chemical carcinogens (32–35).

Because of inconsistent findings from epidemiologic studies in humans and the lack of clear data from previous experimental studies in animals, in 1999 the Food and Drug Administration nominated radiofrequency radiation exposure associated with cell phone exposures for study in animal models by the U.S. National Toxicology Program (NTP), an interagency program that coordinates toxicology research and testing across the U.S. Department of Health and Human Services and is headquartered at the National Institute of Environmental Health Sciences, part of NIH.

The NTP studied radiofrequency radiation (2G and 3G frequencies) in rats and mice (36, 37). This large project was conducted in highly specialized labs that specified and controlled sources of radiation and measured their effects. The rodents experienced whole-body exposures of 3, 6, or 9 watts per kilogram of body weight for 5 or 7 days per week for 18 hours per day in cycles of 10 minutes on, 10 minutes off. A research overview of the rodent studies, with links to the peer-review summary, is available on NTP website. The primary outcomes observed were a small number of cancers of Schwann cells in the heart and non-cancerous changes (hyperplasia) in the same tissues for male rats, but not female rats, nor in mice overall.

These experimental findings raise new questions as to the potential for radiofrequency radiation to result in cellular changes and offer potential avenues for further laboratory studies. Cancers in the heart are extremely rare in humans, where the primary outcomes of potential concern with respect to radiofrequency radiation exposure from cell phones are tumors in the brain and central nervous system. Schwann cells of the heart in rodents are similar to the kind of cells in humans that give rise to acoustic neuromas (also known as vestibular schwannomas), which some studies have suggested are increased in people who reported the heaviest use of cell phones. The NTP has stated that they will continue to study this exposure in animal models to further advance our understanding of the biological underpinnings of the effects reported above.

Another animal study, in which rats were exposed 7 days per week for 19 hours per day to radiofrequency radiation at 0.001, 0.03, and 0.1 watts per kilogram of body weight was reported by investigators at the Italian Ramazzini Institute (38). Among the rats with the highest exposure levels, the researchers noted an increase in heart schwannomas in male rats and non-malignant Schwann cell growth in the heart in male and female rats. However, key details necessary for interpretation of the results were missing: exposure methods, other standard operating procedures, and nutritional/feeding aspects. The gaps in the report from the study raise questions that have not been resolved.

**Question.** Why are the findings from different studies of cell phone use and cancer risk inconsistent?

**Answer.** A few studies have shown some evidence of statistical association of cell phone use and brain tumor risks in humans, but most studies have found no association. Reasons for these discrepancies include the following:

Recall bias, which can occur when data about prior habits and exposures are collected from study participants using questionnaires administered after diagnosis of a disease in some of the participants. It is possible that study participants who have brain tumors may remember their cell phone use differently from individuals without brain tumors. Many epidemiologic studies of cell phone use and brain cancer risk lack verifiable data about the total amount of cell phone use over time. In addition, people who develop a brain tumor may have a tendency to recall cell phone use mostly on the same side of the head where their tumor was found, regardless of whether they actually used their phone on that side of the head a lot or only a little.

Inaccurate reporting, which can happen when people say that something has happened more or less often than it actually did. People may not remember how much they used cell phones in a given time period.

Morbidity and mortality among study participants who have brain cancer. Gliomas are particularly difficult to study, for example, because of their high death rate and the short survival of people who develop these tumors. Patients who survive initial treatment are often impaired, which may affect their responses to questions. Furthermore, for people who have died, next-of-kin are often less familiar
with the cell phone use patterns of their deceased family member and may not accurately describe their patterns of use to an interviewer.

Participation bias, which can happen when people who are diagnosed with brain tumors are more likely than healthy people (known as controls) to enroll in a research study. Also, controls who did not or rarely used cell phones were less likely to participate in the Interphone study than controls who used cell phones regularly. For example, the Interphone study reported participation rates of 78 percent for meningioma patients (range among the individual studies 56–92 percent), 64 percent for glioma patients (range 36–92 percent), and 53 percent for control subjects (range 42–74 percent) (6).

Changing technology and methods of use. Older studies evaluated radiofrequency radiation exposure from analog cell phones. Today, cell phones use digital technology, which operates at a different frequency and a lower power level than analog phones. Digital cell phones have been in use for more than two decades in the United States, and cellular technology continues to change (3). Texting and other applications, for example, are common uses of cell phones that do not require bringing the phone close to the head. Furthermore, the use of hands-free technology, such as wired and wireless headsets, is increasing (39, 40).

Question. What are other possible health effects from cell phone use?

Answer. A broad range of health effects have been reported with cell phone use. Neurologic effects are of particular concern in young persons since the brain is the primary exposed organ. However, studies of memory, learning, and cognitive function have generally produced inconsistent results (41–44).

The most consistent health risk associated with cell phone use is distracted driving and vehicle accidents (45, 46).

Question. What have expert organizations said about the cancer risk from cell phone use?

Answer. In 2011, the International Agency for Research on Cancer (IARC), a component of the World Health Organization, appointed an expert Working Group to review all available evidence on the use of cell phones. The Working Group classified cell phone use as “possibly carcinogenic to humans,” based on limited evidence from human studies, limited evidence from studies of radiofrequency radiation and cancer in rodents, and inconsistent evidence from mechanistic studies (4).

The Working Group indicated that, although the human studies were susceptible to bias, the findings could not be dismissed as reflecting bias alone, and that a causal interpretation could not be excluded. The Working Group noted that any interpretation of the evidence should also consider that the observed associations could reflect chance, bias, or confounding rather than an underlying causal effect. In addition, the Working Group stated that the investigation of risk of cancer of the brain associated with cell phone use poses complex methodologic challenges in the conduct of the research and in the analysis and interpretation of findings.

In 2011, the American Cancer Society (ACS) stated that the IARC classification means that there could be some cancer risk associated with radiofrequency radiation, but the evidence is not strong enough to be considered causal and needs to be investigated further. Individuals who are concerned about radiofrequency radiation exposure can limit their exposure, including using an earpiece and limiting cell phone use, particularly among children.

In 2018, the ACS issued a statement on the draft NTP reports noting that the findings were still inconclusive, and that, so far, a higher cancer risk in people has not been seen, but that people who are concerned should wear an earpiece when using a cell phone.

The National Institute of Environmental Health Sciences (NIEHS) states that the weight of the current scientific evidence has not conclusively linked cell phone use with any adverse health problems, but more research is needed.

The U.S. Food and Drug Administration (FDA) notes that studies reporting biological changes associated with radiofrequency radiation have failed to be replicated and that the majority of human epidemiologic studies have failed to show a relationship between exposure to radiofrequency radiation from cell phones and health problems. The FDA, which originally nominated this exposure for review by the NTP in 1999, issued a statement on the draft NTP reports released in February 2018, saying “based on this current information, we believe the current safety limits for cell phones are acceptable for protecting the public health.” FDA and the Federal Communications Commission share responsibility for regulating cell phone technologies.

The U.S. Centers for Disease Control and Prevention (CDC) states that no scientific evidence definitively answers whether cell phone use causes cancer.
The Federal Communications Commission (FCC) concludes that currently no scientific evidence establishes a definite link between wireless device use and cancer or other illnesses.

In 2015, the European Commission Scientific Committee on Emerging and Newly Identified Health Risks concluded that, overall, the epidemiologic studies on cell phone radiofrequency electromagnetic radiation exposure do not show an increased risk of brain tumors or of other cancers of the head and neck region (2). The Committee also stated that epidemiologic studies do not indicate increased risk for other malignant diseases, including childhood cancer (2).

**Question.** What studies are under way that will help further our understanding of the possible health effects of cell phone use?

**Answer.** A large prospective cohort study of cell phone use and its possible long-term health effects was launched in Europe in March 2010. This study, known as COSMOS Exit Disclaimer, has enrolled approximately 290,000 cell phone users aged 18 years or older to date and will follow them for 20 to 30 years (47, 48).

Participants in COSMOS will complete a questionnaire about their health, lifestyle, and current and past cell phone use. This information will be supplemented with information from health records and cell phone records.

The challenge of this ambitious study is to continue following the participants for a range of health effects over many decades. Researchers will need to determine whether participants who leave the study are somehow different from those who remain throughout the follow-up period.

Although recall bias is minimized in studies such as COSMOS that link participants to their cell phone records, such studies face other problems. For example, it is impossible to know who is using the listed cell phone or whether that individual also places calls using other cell phones. To a lesser extent, it is not clear whether multiple users of a single phone, for example family members who may share a device, will be represented on a single phone company account. Additionally, for many long-term cohort studies, participation tends to decline over time.

**Question.** Has radiofrequency radiation from cell phone use been associated with cancer risk in children?

**Answer.** There are theoretical considerations as to why the possible risk should be investigated separately in children. Their nervous systems are still developing and, therefore, more vulnerable to factors that may cause cancer. Their heads are smaller than those of adults and consequently have a greater proportional exposure to the field of radiofrequency radiation that is emitted by cell phones. And, children have the potential of accumulating more years of cell phone exposure than adults do.

Thus far, the data from studies in children with cancer do not support this theory. The first published analysis came from a large case–control study called CEFALO, which was conducted in Denmark, Sweden, Norway, and Switzerland. The study included children who were diagnosed with brain tumors between 2004 and 2008, when their ages ranged from 7 to 19 years. Researchers did not find an association between cell phone use and brain tumor risk either by time since initiation of use, amount of use, or by the location of the tumor (21).

Several studies that will provide more information are under way. Researchers from the Centre for Research in Environmental Epidemiology in Spain are conducting another international case–control study—Mobi-Kids Exit Disclaimer—that will include 2000 young people (aged 10–24 years) with newly diagnosed brain tumors and 4000 healthy young people. The goal of the study is to learn more about risk factors for childhood brain tumors.

**Question.** What can cell phone users do to reduce their exposure to radiofrequency radiation?

**Answer.** The FDA has suggested some steps that concerned cell phone users can take to reduce their exposure to radiofrequency radiation (49):

- Reserve the use of cell phones for shorter conversations or for times when a landline phone is not available.
- Use a device with hands-free technology, such as wired headsets, which place more distance between the phone and the head of the user.
- Hands-free kits reduce the amount of radiofrequency radiation exposure to the head because the antenna, which is the source of energy, is not placed against the head (40). Exposures decline dramatically when cell phones are used hands-free.

**Question.** Where can I find more information about radiofrequency radiation from my cell phone?

**Answer.** The FCC provides information about the specific absorption rate (SAR) of cell phones produced and marketed within the last 1 to 2 years. The SAR cor-
responds with the relative amount of radiofrequency radiation absorbed by the head of a cell phone user (50). Consumers can access this information using the phone’s FCC ID number, which is usually located on the case of the phone, and the FCC’s ID search form.

Question. How common is brain cancer? Has the incidence of brain cancer changed over time?

Answer. In the United States, 23,820 new diagnoses and 17,760 deaths from brain and other central nervous system cancers are estimated for 2019 (51). Brain cancer incidence rates have declined slightly in recent years and mortality (death) rates have increased slightly (52).

There is great variability in survival by brain tumor subtype, and by age at diagnosis. Overall, the 5-year relative survival for brain cancers diagnosed from 2008 through 2014 was 33.2 percent (53). This is the percentage of people diagnosed with brain cancer who will still be alive 5 years after diagnosis compared with the survival of a person of the same age and sex who does not have cancer.

The risk of developing brain cancer increases with age. From 2011 through 2015, there were fewer than 4.5 brain cancer cases for every 100,000 people in the United States under age 65, compared with approximately 19.1 cases for every 100,000 people in the United States who were ages 65 or older (53).

Selected References


That being said, the hearing record will remain open for two weeks. During this time, Senators are asked to submit any questions for the record. Upon receipt, the witnesses are requested to submit their written answers to the Committee as soon as possible, but no later than Wednesday, February 20, 2019, by the close of business.
Now, if there is nothing further from my capable staff, we will conclude the hearing.
The witnesses have been absolutely terrific, and I want to thank each and every one of you for participating.
This hearing is now adjourned.
[Whereupon, at 12:20 p.m., the hearing was adjourned.]
Hon. ROGER WICKER,
Chairman,
Committee on Commerce, Science, and Transportation,
U.S. Senate,
Washington, DC.

Hon. MARIA CANTWELL,
Ranking Member,
Committee on Commerce, Science, and Transportation,
U.S. Senate,
Washington, DC.

Dear Chairman Wicker and Ranking Member Cantwell,

I applaud the Senate Committee on Commerce, Science, and Transportation for examining how the United States can best position itself to compete with overseas interests to establish a secure, reliable, and evolving set of 5G technologies. The hearing you held on February 6, “Winning the Race to 5G and the Next Era of Technology Innovation in the United States,” focused rightly on how Federal policies can positively impact our competitiveness on 5G and related technologies. To supplement the record on these issues, we are directing the Committee’s attention to the important role standard-essential patents (SEPs) and related standards-setting activities play in fostering a competitive landscape that maximizes our efforts in leading the race to 5G. ACT | The App Association’s small business member companies create products and services in the mobile app economy that rely on far-reaching and fast mobile Internet connections. They have a large stake in the ability of the United States to host and drive the development of 5G networks and the innovation that occurs on top of the 5G standard.

1. SEPs are central to 5G development, and abusive SEP licensing practices harm innovation. The standards-setting system in the United States is strong and supports a private-sector driven approach that is superior to the government-controlled tactic other countries have chosen. In the United States, companies convene in neutral settings called standards-setting organizations (SSOs). The SSOs provide a forum in which interested stakeholders can take part in the development of technical standards. The gathering of companies across an industry to decide on the technologies that comprise a standard raises inherent antitrust concerns. As such, companies that wish to offer intellectual property (IP) as part of a standard typically must sign an agreement to license those patents that are declared essential to a standard on terms that are fair, reasonable, and non-discriminatory (FRAND). By requiring FRAND licensing of SEPs, SSOs thereby avoid antitrust liability by preventing SEP holders from “holding up” implementers of a standard—which must necessarily take a license on SEPs—until they accept unreasonable royalty rates and/or other unfair licensing terms.

The litigation brought by the U.S. Federal Trade Commission (FTC) against Qualcomm is a prime example of the problems created by SEP abuse and the importance of allowing U.S. antitrust law to curb such problems. Qualcomm refuses to license chip makers who are competitors to its cellular SEPs, only licenses end device producers if they also agree to exorbitant royalties and has engaged in other coercive licensing practices such as offering royalty rebates to one customer to exclude a competitor. Despite Qualcomm’s FRAND commitments, it only licenses end device producers such as its customers because, as Qualcomm told the IRS, it is “humongously more lucrative” to do so.1 Astonishingly, as a result of its breach of

---

1 FTC v. Qualcomm, trial exhibit CX6786-R, at 71 (emphasis added).
FRAND commitments and other coercive licensing practices, Qualcomm collects more than 25 percent of all patent royalties in the entire world.²

Through different administrations, the FTC has been consistently supportive of using antitrust law to curb SEP abuse where there is evidence of anticompetitive conduct. Moreover, the United States Patent and Trademark Office (USPTO) and United States Department of Justice (DoJ) issued a joint Policy Statement in 2013 reinforcing the FRAND concepts and discouraging abusive licensing tactics like SEP owners using injunctions to pressure would-be innovators that must use standards to compete. Unfortunately, the current head of DoJ’s Antitrust Division recently outlined plans to withdraw from the 2013 Policy Statement. The 2013 Policy Statement reflects good policy, and accurately restates a robust and growing body of Federal legal precedent that underscores the importance of upholding FRAND licensing commitments. Proposed withdrawal from the Policy Statement comes at a difficult time, just as the United States is competing to develop 5G technology. It is now more important than ever to ensure that U.S. antitrust authorities stop SEP abuse. A refusal to enforce competition laws where SEP holders hold up SEP licensees in a way that has anticompetitive impact could have grave consequences for the development of technical standards and would devastate American efforts to win the “race to 5G.”

Moreover, allowing abusive licensing to occur harms not just the American innovators that must use the 5G standard to develop new products, but it also harms consumers in the form of higher prices and lower quality. We urge the Committee to recognize the importance of enforcing competition laws in the SEP context to further American leadership in 5G networks. A broad coalition of manufacturers, software and device companies, and retailers support these views, which are described in more detail in a January 2019 letter to the United States Department of Commerce.³

2. The United States should maintain robust competition in the market for premium baseband chipsets. An important component of 5G connectivity is the premium baseband chipset, a piece of hardware that connects smartphones and other devices to advanced wireless networks. There are only two competitors left in the commercial premium baseband chipset market and both are U.S. companies, Intel Corporation (Intel) and Qualcomm Incorporated. They have been developing baseband chipset technologies in 4G and are poised to compete for the 5G baseband chipset market.

Very shortly after the FTC filed its complaint in U.S. Federal court, Qualcomm filed two patent infringement cases in the United States International Trade Commission (USITC), seeking to ban the importation into the U.S. of all iPhones with Intel modem chips in them. These two ITC cases could chase Intel out of the market entirely, leaving the United States vulnerable to a lack of competition. At issue in the first case are 88 Qualcomm patent infringement claims pressed against Apple for their use in late model iPhones (but only the models with Intel premium baseband chipsets), 87 of which have been dismissed throughout the course of the proceeding. The primary remedy at the USITC’s disposal in these kinds of cases is a ban on the importation of the allegedly infringing item (in this case, most late model iPhones).³ This remedy is extraordinary and well out of proportion to the plain patent infringement issue it seeks to address when applying the public interest factors as required by the relevant statute. In fact, the proposed remedy at the USITC would cause significant collateral damage that is unjustified given other infringement remedies readily available in Federal court that Qualcomm also is diligently pursuing for the same alleged patent infringement.⁴ The Committee should be aware of the implications for 5G deployment in the U.S. that could result from an import ban on iPhones with Intel premium baseband chipsets.

The administrative law judge (ALJ) assigned to review the first ITC case declined to issue the import ban, even though he agreed that one of the 88 patent claims was infringed. First, he noted his concern that if iPhones with Intel chips are banned, Intel would exit the 4G and 5G markets and only one U.S. premium

²FTC v. Qualcomm, trial transcript of Jan. 29, 2019, at 2125. This is not 25 percent of cellular phone royalties or even all telecommunications royalties. This is 25 percent of all patent royalties in all fields—communications, computers, medical devices, pharmaceuticals, chemicals, materials, aeronautics, automotive, energy, and all other fields in which inventions are patented.


⁴19 U.S.C. Sec. 1337(d).

⁵Qualcomm Inc. v. Apple Inc., No. 17-cv-1375 DMS (MDD) (S.D. Cal.). The trial in Qualcomm’s district court companion case is scheduled to begin on March 4th.
baseband chipset maker would remain. Allowing only a single premium baseband chipset maker to remain in such an important market, the ALJ reasoned, would deprive consumers of the higher quality, more secure, lower priced technologies that are driven by competition.

Second, the ALJ determined that undermining the quality and strength of 5G technology would degrade our national security. In brief, ALJ Pender found that “competition is necessary for quality, innovation, competitive pricing, and, in this case, the preservation of a strong U.S. presence in the development of 5G and thus the national security of the United States.”

A lack of competition in the market for 5G hardware could cede leadership in the development of the standard to other countries. Some of these nations—if allowed to lead the development of necessary hardware and the associated standard—would likely require the inclusion of insecure technologies designed to maintain an open backdoor for their own intelligence gathering. This would inevitably compromise mission-critical communications connecting to a 5G network. The full USITC is poised to review the ALJ’s final initial determination, and we believe that determination—declining to impose the import ban—should be upheld to preserve competition and U.S. competitiveness in 5G. The App Association’s member companies depend on secure and evolving next-generation networks, undergirded by robust competition and strong standards. Ceding ground to foreign interests in the “race to 5G” would seriously undermine our member companies’ ability to reach consumers with innovative products and services delivered through a secure and reliable network.

Committee members and witnesses raised important points throughout the Committee’s 5G hearing. The role of robust competition, and honoring FRAND commitments as a means of ensuring such competition, should not be understated, and the Committee should at least be aware of the grave consequences of a failure to enforce competition laws against SEP abuse, and specifically, of degrading competition in the premium baseband chipset market. We urge the Committee to take these important factors into account as it considers policy options and levers that best position the United States to lead the development of and further innovation in and building on the 5G standard.

Sincerely,

MORGAN REED,
President,
ACT | The App Association.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER WICKER TO BRAD GILLEN

Question 1. Mr. Gillen, during our hearing you expressed the importance of making more mid-band spectrum available for 5G deployment. Could you please discuss why making C-Band spectrum available is important to 5G deployment in the United States?

Answer. To achieve our 5G goals, we are going to need different types of spectrum, but mid-band is key as it can offer both capacity and coverage. Mid-band spectrum will be critical to help fulfill 5G’s promise to drive transformational improvements in health care, education, transportation, and nearly every other industry.

Unfortunately, the U.S. ranks sixth globally in terms of mid-band spectrum availability. Other countries are making four times more mid-band spectrum available than the U.S. South Korea just auctioned a significant amount of mid-band spectrum earlier this year. Here in the U.S., we don’t have any mid-band auctions planned right now.

We need to move quickly to catch up on mid-band and C-band spectrum between 3.7–4.2 GHz offers the best path to making a large swatch of mid-band available to support robust 5G networks.

Question 2. Do you believe Congress needs to take action to make C-Band spectrum available for 5G deployment in a timely manner?

Answer. This Committee has provided meaningful leadership and legislative direction to the FCC on mid-band spectrum, including the C-band, and we urge that leadership to continue. In fact, a provision in the Mobile Now Act, which became law as part of the Ray Baum’s Act last year, directs the FCC to report by September

23, 2019, on "the feasibility of allowing commercial wireless services, licensed or unlicensed, to use or share use of the frequencies between 3700 megahertz and 4200 megahertz."

We need Congress's support to stress the urgency with which we need FCC action on the C-band. Continued direction and oversight of the FCC by this Committee is important to advance the reallocation of this key band.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JERRY MORAN TO BRAD GILLEN

Question 1. As your testimony noted, China announced that its three existing state-owned wireless providers will receive a total of 460 megahertz of mid-band spectrum for 5G. What can we do to make sure U.S. wireless providers have access to a similar amount of spectrum as quickly as possible?

Answer. A predictable pipeline of spectrum will do much to advance U.S. 5G interests, and help us match the aggressive efforts foreign governments are taking to allocate spectrum for 5G.

Encouragingly, the Administration and the FCC have identified all the right bands. Now it is about execution and speed to keep up with the rest of the world. The Administration’s forthcoming National Spectrum Strategy provides a unique opportunity to develop a five-year schedule of spectrum auctions, which is needed to accelerate the deployment of 5G networks and fully realize the connected life and Internet of Things breakthroughs of 5G-enabled services. Congress should ensure the Strategy supports our Nation’s 5G ambitions.

A long-term plan will allow wireless providers to plan and build their 5G networks to maximize efficiency and robustness. A schedule that provides access to the same or similar mid-band spectrum bands that are being made available throughout Asia and Europe is key.

By harmonizing U.S. mid-band spectrum with bands being made available for 5G around the globe, economies of scale would be achieved, reducing both the costs and time to deploy 5G. Analysis Group recently estimated the economic impact of U.S. policymakers freeing up mid-band spectrum and found that 400 MHz of mid-band spectrum will drive $274 billion in GDP and 1.33 million new jobs.

Congress should also encourage several specific ongoing mid-band spectrum activities at the FCC and NTIA:

- The FCC recently finalized rules for the 3.5 GHz band for mobile broadband, which will result in 70 MHz of licensed spectrum to be auctioned soon
- The FCC has an open proceeding to evaluate repurposing up to 500 MHz of C-band spectrum (3.7–4.2 GHz)
- The Commerce Department’s NTIA recently initiated a review of the 3.45 GHz band

Question 2. While I have supported legislation like the RAPID Act and the MOBILE NOW Act to streamline overly-cumbersome regulations, what else should Congress be doing to increase U.S. competitiveness in 5G deployment?

Answer. Congress should encourage and provide oversight of two important Administration activities. First, the October 2018 Presidential Memorandum directed the development of a National Spectrum Strategy. Congress should support a proactive, 5G-centric spectrum strategy that includes a clear long-term spectrum plan. Second, the U.S. Government will participate later this year in the 2019 World Radio Conference. Congress should encourage the Administration to take positions that reinforce America’s 5G leadership and to maintain access to critical spectrum bands that have already been identified for 5G use in the U.S.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DAN SULLIVAN TO BRAD GILLEN

Question 1. In the race to find and repurpose spectrum for 5G, it is critically important that we also responsibly consider incumbent uses. This is especially important in Alaska, where incumbents are providing critical broadband and public safety services via C-Band spectrum. In any band transition, how can the wireless industry, working with the FCC, ensure that distance learning and telemedicine capabilities, and even FAA safety communications in Alaska will not be disrupted? In particular, permitting private parties to manage any reallocation and transition process raises red flags. If there is not traditional FCC oversight, how would we ensure that
those incumbent uses would be protected and that nothing would go wrong during a privately managed transition process?

Answer. Mid-band spectrum, including the C-band, will be critical to fulfilling 5G’s promise to drive transformational improvements in health care, education, transportation, and nearly every other industry. We are seeing countries like China and South Korea move forward aggressively to make mid-band spectrum available to deploy 5G. Today, however, the U.S. has a mid-band spectrum deficit, ranking sixth globally in terms of mid-band spectrum availability and we need to catch up quickly. The large swath of spectrum in the C-band offers the best path to making mid-band spectrum available to secure America’s 5G leadership.

The C-band today can be utilized more efficiently to accommodate the interests of both wireless and satellite providers. We appreciate that the C-band is used in a different manner in Alaska than in the continental U.S., and we pledge to work with you to ensure continued access to key satellite-based services as well as important access to mid-band spectrum for Alaskan wireless operators.

Question 2. Satellite companies have proposed a private sale of C-Band spectrum in which no money would go back to U.S. taxpayers. By contrast, FCC spectrum auctions have raised billions of dollars in the past. Do you agree that funding U.S. priorities like expanded rural broadband should come before enriching foreign satellite companies? If not, why?

Answer. CTIA is focused on making C-band spectrum available for 5G as soon as possible. As noted above, the United States is behind globally in terms of mid-band availability and we are committed to working with all stakeholders to remedy that deficit expeditiously.

We share your interest in using auction proceeds to help support rural wireless broadband deployment through a rural dividend or similar program. Unfortunately, no such mechanism is in place today, and we would welcome the opportunity to work with you to better leverage spectrum auctions—however constructed—to benefit rural America.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. SHELLEY MOORE CAPITO TO BRAD GILLEN

Question 1. In your testimonies, many of you discuss the framework for 5G. While I understand the importance of innovation and support faster speeds, I have concerns that rural locations will not be adequately addressed: What ways exist to ensure 5G develops in combination with rural broadband connectivity?

Answer. The potential of 5G will continue to evolve as more capable networks get deployed and new services and use-cases develop on these platforms. As with any network, larger scale will ultimately mean more value, for both users and providers, and more opportunity for innovation. Therefore, it will be in the interest of all stakeholders to extend 5G connectivity broadly. One of the most promising aspects of deployment on new spectrum, particularly in the low-and mid-bands, is that fiber-like speeds will be achievable with wireless connectivity. This could be a particularly meaningful way to improve the economics of broadband deployment in rural areas. We continue to believe that the FCC’s Mobility Fund and a rural dividend for future spectrum auctions will be critical to reaching unserved areas with advanced wireless connectivity.

Question 2. What are some steps the FCC can make to continue to streamline the deployment of 5G while ensuring rural areas continue to receive broadband and Internet support?

Answer. The FCC’s action in 2018 to address both Federal and local siting reforms are the most important steps the agency can take to promote widespread deployment and all stakeholders should commit to implementing those reforms expeditiously.

Further, sufficient spectrum is key to winning the 5G race and unlocking the corresponding economic and societal benefits. Encouragingly, the Administration and the FCC have identified all the right bands. Now it is a matter of us finishing the job fast by getting that spectrum in the hands of innovators.

We want to build out to as many communities as quickly as possible, and forward-thinking policies such as those recently adopted in West Virginia and by the FCC will help us do just that while preserving local siting authority.

Question 3. How can 5G be rolled out quickly to avoid a gap where there are have and have nots?

Answer. The wireless industry is projected to invest $275 billion over the next decade to deploy 5G. This private capital investment will follow the $226 billion
made in our networks just since 2010. The competitive nature of the broadband market—including within just the mobile sector—and the promise that fully scaled 5G network deployments hold for new economic activity provide tremendous incentive for wireless providers to not only deploy 5G as quickly as possible, but also as broadly as possible. As noted above, we also support the FCC’s Mobility Fund and an auction rural dividend to help reach those communities uneconomic to serve today.

**Question 4.** How does the Mobility Fund play a role in 5G deployment?

**Answer.** The FCC’s Mobility Fund II will deliver mobile wireless services to rural areas without sufficient access to the critical services enabled by 4G LTE today, such as public safety, healthcare, education and economic opportunities. Providers can speed the deployment of 5G to rural areas by leveraging the capabilities and infrastructure deployed with Mobility Fund support. We encourage the FCC to move forward with funding.

**Question 5.** 5G wireless services will require the deployment of a vast network of small cells. However, these networks will also need fiber-based wireline networks for their backhaul network. Could you explain to me the importance of a fiber backhaul and the allocation of spectrum in deploying these small cells?

**Answer.** 5G will rely on both towers and small cells, and we should seek out solutions to promote the deployment of both. Backhaul is an essential component of wireless communications networks, and that includes both fiber and wireless backhaul solutions. This has been true since the earliest mobile voice calls were connected between 200-foot towers and will be true when real-time automobile data is sent back-and-forth over small cells on lampposts. The Committee should support widespread deployment of fiber to support both wired and wireless communications.

**Question 6.** Fortunately, every school and library in my state of West Virginia has a fiber connection, but this not the case when kids go home from school. Many of them cannot do their homework assignments. This digital divide cannot continue to be overlooked. How will 5G help our students at home? How long will it take for these students to see the benefits of 5G at their homes?

**Answer.** Mobile broadband has been an effective tool to enhance education outside the classroom. A survey by Grunwald Associates found that more than two-thirds of parents said that mobile devices have opened learning opportunities to kids that were not available before. By delivering data speeds up to 100 times faster than 4G networks, 5G will further enhance learning through applications such as virtual reality and augmented reality. The potential for 5G to improve outcomes for students and resources for educators is yet another incentive to build out next generation wireless network capabilities as quickly and broadly as possible.

**Question 7.** Despite significant investment, the vast majority of my state lacks competitive access to a fiber network. How can Internet providers ensure rural Internet access remains competitive as 5G gains more prevalence?

**Answer.** 5G promises to deliver fiber-like speeds with the added benefit of mobility. The two critical areas where we need congressional leadership is providing access to more spectrum and modernizing the siting rules for tomorrow’s networks.

**Question 8.** How can Congress ensure the regulatory conditions are in place in order to ensure states like mine can participate in the 5G economy?

**Answer.** Congress should continue to anticipate the tremendous bandwidth and connectivity needs of a 5G future and ensure a pipeline of spectrum is available to fully realize the connected life and Internet of Things possibilities. Congress should also use its oversight authority to identify and eliminate unnecessary barriers to the deployment of 5G infrastructure, including by streamlining deployment on Federal lands and modernizing the guardrails Congress placed on local regulatory authority decades ago to ensure availability of nationwide mobile services. Congress should explore the potential of new and improved services that 5G networks will facilitate, which will reach nearly every facet of the economy. For those areas unserved today, the key lies in support for the FCC’s Mobility Fund and a rural dividend mechanism to direct future auction revenues to unserved rural America.

**Question 9.** Each member of this Committee has today or previously mentioned the importance of having accurate data and noted the flawed information that our current maps provide. Last year, I visited Flying W Plastics, a local polyethylene pipe products manufacturer in Gilmer County, West Virginia. According to a recent FCC Broadband Progress report, Gilmer County, WV is 100 percent served with 25 Mbps/3 Mbps service. While visiting, I found this to be inaccurate. They do not have adequate broadband and unfortunately, this is not the only example like this in my state. So my question is: When there are communities in my state who are still
Answer. This Committee should be credited with identifying challenges with our broadband mapping. Timely and relevant data is critical to measuring broadband services that reflects consumer’s real-world experiences. The FCC’s Mobility Fund II challenge process provides a unique opportunity to determine how provider reported data and on-the-ground information can be harnessed to effectively determine the availability of mobile wireless broadband services.

Question 10. Last Congress, I introduced the Gigabit Opportunity (GO) Act and I plan to reintroduce it this Congress. This legislation would seek expedited deployment of broadband services in low-income rural and urban communities. The GO Act gives states flexibility, streamlines existing regulations, and eliminates barriers to investment so we can connect our low-income and rural communities. How can tax proposals like the GO Act make a measurable difference in promoting rural broadband deployment? Could similar proposals help in 5G deployment?

Answer. CTIA supported the GO Act last Congress and we applaud your leadership on this issue. The wireless industry is projected to invest nearly $300 billion over the next decade to deploy 5G. A tax-based incentive proposal such as the Gigabit Opportunity Act would ensure more of that private investment goes into better networks and services for consumers.

Question 11. Congress has made several steps towards improving the deployment and accessibility of broadband to rural and tribal communities. For example, the AIRWAVES Act introduced by my Senate colleagues—Senator Gardner and Senator Hassan—included a “rural dividend” that would have dedicated 10 percent of any future spectrum auction funds to support the deployment of wireless infrastructure in unserved and underserved communities. How will rural set asides like this be used differently than Federal support already being distributed through programs like USF and RUS?

Answer. The rural dividend would provide policymakers and communications providers an additional, and more targeted and flexible, tool to further close our Nation’s digital divide. We agree it is important that any new program complement and support existing rural funding mechanisms, and we welcome the opportunity to work with you to ensure funds directed at rural America have the most impact to expand connectivity.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. AMY KLOBUCHAR TO BRAD GILLEN

T-Mobile/Sprint Merger. In April 2018, CTIA issued a report, which states that 5G deployment by our national providers is “driven by the intense competition in the wireless market.” But the heads of T-Mobile and Sprint claim that their merger—which would reduce the number of competing national providers from four to three—is necessary for the United States to win the global race to 5G.

Question 1. In your opinion, is further consolidation of wireless carriers necessary for America to win the “Global Race to 5G”?

Answer. CTIA defers to the Committee, the Department of Justice, and the Federal Communications Commission to evaluate the benefits of proposed transactions. The most important issue from our perspective is that American companies are clearly focused on leading in 5G deployment. This focus drives significant investment and shows our commitment to global leadership.

Spectrum and Public Safety. As we discuss national security threats, we must also recognize the role that 5G will play in the U.S. public safety systems.

Question 2. How can 5G technologies be leveraged to advance public safety communications, including opportunities for obtaining more accurate locations of 9–1–1 callers?

Answer. The wireless industry is confident that the benefits of 5G will be leveraged to advance public safety communications, especially with regard to obtaining more accurate 9–1–1 call location information.

Specifically, the deployment of “small cells” required for 5G will result in denser, more granular networks across the country. This densification process means that 9–1–1 location information will be available with more specificity than today’s systems allow. Moreover, as this densification process is coupled with growing numbers of in-home products that connect to the 5G network, E911 location accuracy will improve.

Apart from 9–1–1 enhancements, 5G promises to offer additional benefits for first responders. Enhanced vehicle to vehicle communications for public safety vehicles...
has tremendous potential. The FirstNet dedicated public safety network will include the latest 5G network upgrades and enhancements for the benefit of its millions of public safety users. And the ability of 5G networks to process the ever-increasing amount of video utilized by law enforcement will be a critical component of public safety capabilities in the future.

Finally, CTIA members are focused on developing 5G products and capabilities for the benefit of public safety. For example, Verizon recently announced the first five participating companies for its 5G First Responder Lab, an innovation incubator that will give leading first responder technology companies from around the globe access to 5G technology to develop, test and refine 5G solutions for public safety. The five companies in this initial effort will focus on a range of technologies, including sensor data, visual data from drones, analytics, and augmented reality for firefighters in zero visibility situations.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JON TESTER TO BRAD GILLEN

**Question 1.** How can we help small carriers that have Huawei Equipment in their networks?

**Answer.** CTIA is focused on protecting the security interests of consumers and the U.S. wireless industry, including the security of the U.S. communications supply chain. Huawei has only a fraction of 1 percent of the U.S. wireless infrastructure equipment market. Although Huawei is not in the plans of any national U.S. operators, CTIA members are committed to working closely with national security officials to assess and evaluate potential national security threats presented by Chinese equipment.

**Question 2.** What kind of workforce is needed to implement infrastructure for 5G?

**Answer.** The demands for 5G infrastructure will require a wide variety of resources in the field. CTIA member companies as well as supporting vendors and contractors will require employees with experience in the following areas:

- Fiber cable laying and splicing
- Replacing and setting poles in the city and metro areas
- Aerial work platforms, operating bucket trucks and manlifts to deploy equipment on poles
- Electricians to install demarcation points in poles
- Welders to cut hand holes in existing infrastructure
- Field technicians to connect, test, and troubleshoot installations for turn up and longer term for maintenance, and;
- RF Engineers to design and optimize networks.

**Question 3.** How can we make sure the workforce have the skills and training to deploy 5G infrastructure?

**Answer.** A critical component of making sure we have the workforce with the skills and training necessary to deploy 5G is public awareness. Federal, state, and local officials, along with the wireless industry, should take steps to ensure that relevant colleges, trade schools, employee unions, and government training programs are aware of the skills necessary to construct modern communications networks as well as the need for such employees throughout the wireless industry.

Industry is taking concrete steps to prepare interested workers for the employment opportunities presented by 5G network deployment. For example, CTIA member Ericsson has established Centers of Excellence around the United States to develop a trained and educated wireless workforce. These Centers are enhanced training facilities that provide best-in-class field services, training, and support for Ericsson employees and partners. Trainees participate in operator-specific courses taught by industry experts, ranging from site installation to integration.

**Question 4.** If we need workers, can we put training programs in rural areas?

**Answer.** Yes, we welcome the opportunity to work with you. Many of the skills needed could be gained from basic electronics trade schools.

**Question 5.** How are you thinking about workforce training, do you see a role for community colleges, job corps, and trade schools?

**Answer.** Yes, the wireless industry is recruiting from all of these today. CTIA members predict that demand for good people with the basic skills described above will be high for the coming years. According to Accenture, 5G investments will lead to 3 million new jobs nationally. These do not include the construction jobs that will also be created during the buildout of 5G networks. Community colleges, job corps,
and trade schools will all be institutions carriers and equipment suppliers look to
in strengthening their workforces.

**Question 6.** What overlap do you see for our Nation’s veterans, who have come
home with a variety of skills that may be useful for implementing 5G? Things like
heavy equipment, large trucks, technical electronics, and engineers?

**Answer.** The wireless industry is actively engaged with military veterans entering
the civilian workforce after serving our country. CTIA members appreciate relevant
experience gained while in the military as well as the work ethic instilled in so
many servicemembers while in uniform.

CTIA member companies are leading the way in veteran hiring, with carriers
making commitments to hire tens of thousands of veterans in the coming years. Additionally, many of CTIA’s members have partnered with Warriors4Wireless (W4W).
W4W is a non-profit that trains experienced veterans for futures in the tele-
communications industry. Currently W4W is working with industry partners to pro-
vide tower climbing and fiber optic installation certification through a local commu-
nity college. Further, T-Mobile is also working closely with a leading non-profit
(FourBlock) to help military veterans transition into corporate careers.

---

**RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. ROGER WICKER TO
STEVE BERRY**

**Question 1.** As you know, last Congress I introduced the SPECTRUM NOW Act
to help relocate Federal users of spectrum that is to be made available for commer-
cial use. Do you agree that the reforms contained in SPECTRUM NOW would help
provide better support for Federal users while also making it easier to make spec-
trum available for 5G?

**Answer.** Increased demands for wireless service and the launch of next generation
and 5G technologies require additional spectrum for commercial use. The SPEC-
TRUM NOW Act would provide Federal users with the research and development
tools necessary to use spectrum more efficiently, upgrade technologies where appro-
priate, and reallocate spectrum for commercial use, benefitting Federal users and
consumers alike. CCA continues to support this effort.

**Question 2.** Mr. Berry, 5G can help expand the use of telemedicine, precision agri-
culture, and other technologies that will be particularly beneficial to rural Ameri-
cans. However, closing the broadband gap in rural areas with existing networks has
been and continues to be a priority for this Committee. What are the unique chal-
lenges you foresee in deploying 5G in rural areas and what can Congress and the
FCC do to address those issues?

Can you describe the infrastructure that will be needed to connect thousands of
small cells? And, what kind of fiber investments will be needed to deliver 5G serv-
ices to less densely populated areas of the country?

**Answer.** Modern wireless technologies are already powering revolutionary uses of
telemedicine, precision agriculture, and other technologies. These services will
be supercharged as 5G is deployed, while enabling technologies beyond our imagina-
tions today. Many of these technologies will have the greatest and most immediate
impact in rural areas, so it is vital that these areas are not left behind.

Practically speaking, 5G will be built upon 4G LTE technologies, and we need reli-
able data to understand where 4G coverage exists so policymakers can advance solu-
tions to close the digital divide. Additionally, all carriers need access to low-, mid-
-, and high-band spectrum frequencies to meet demands today and deploy 5G in the
years ahead. For rural areas in particular, carriers need additional access to low-
and mid-band frequencies. Completing the 600 MHz repack on or ahead of schedule
and advancing solutions to allocate additional mid-band spectrum for commercial
wireless use, including in the C band, will help carriers serve rural America.

Carriers also must have certainty regarding infrastructure deployment policies.
As noted in my testimony, 5G will rely on a “high fiber” diet, and a greater focus on
fiber deployment for backhaul services, in addition to microwave and satellite,
is necessary to prevent backhaul from becoming a choke point in 5G networks. This
is the case for small cells and larger towers, and significant investments are nec-
essary in both urban population centers and less dense rural areas.

**Question 3.** Mr. Berry, your organization filed comments with the FCC explaining
how a prohibition of suppliers like Huawei could cost rural telecommunications car-
riers hundreds of millions of dollars and disrupt service to their customers. Can you
provide any additional information regarding what would be required to eliminate
Huawei and ZTE equipment from the networks of your member companies?
CCA and its members fully support efforts to protect and harden networks from cybersecurity and other national security threats. Working collaboratively with Congress and other Federal authorities, carriers need clear information regarding what equipment and services are secure for future 5G builds, as well as clear information on potential current threats to make appropriate changes to their existing networks. Carriers must have access to equipment that is secure, particularly for carriers that lack economies of scale, and additional resources based on threat assessments to provide all Americans with wireless services they can use with confidence.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JERRY MORAN TO STEVE BERRY

Question 1. As you and your members are aware, the Mobility Fund Phase II auction was expected to allocate $4.53 billion to support the deployment of 4G LTE network service over the next ten years, but it has been delayed due to questions around the quality of the data submitted in formulating the initial eligibility map. Whether it is 4G or 5G mobile service, would you agree that accurate data and maps are critical to effectively closing the Digital Divide?

Answer. Reliable data is absolutely critical to effectively closing the digital divide. 5G services will be built upon 4G services, doubling down on the need for a reliable and accurate depiction of 4G coverage before disbursing $4.53 billion over the next decade. In the wireless industry, a “generation” of services often enters its peak in its tenth year. With 5G being deployed today, if the Mobility Fund Phase II (“MF II”) is built upon unreliable data, the digital divide will be significantly increased by the conclusion of MF II, failing rural America, leaving communities behind.

Question 2. While I have supported legislation like the RAPID Act and the MOBILE NOW Act to streamline overly-cumbersome regulations, what else should Congress be doing to increase U.S. competitiveness in 5G deployment?

Answer. CCA commends your leadership to increase certainty for carriers as they navigate the broadband infrastructure deployment processes and welcomes further efforts to deploy the network infrastructure that will support 5G. These services will depend on a mix of small cells and macro towers, with readily available access to fiber and other advanced backhaul technologies.

Additionally, 5G deployments are dependent on increased access to spectrum, the invisible infrastructure that powers wireless services. Carriers require a mix of low-, mid- and high-band spectrum to keep up with existing growing demands for wireless use and deploy advanced 5G services. Congress plays a key role in ensuring that these finite, taxpayer owned resources are used to benefit all Americans, and CCA supports continued work to identify spectrum bands that can be reallocated for commercial use to increase U.S. competitiveness in 5G deployment.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DAN SULLIVAN TO STEVE BERRY

Question 1. In the race to find and repurpose spectrum for 5G, it is critically important that we also responsibly consider incumbent uses. This is especially important in Alaska, where incumbents are providing critical broadband and public safety services via C-Band spectrum. In any band transition, how can the wireless industry, working with the FCC, ensure that distance learning and telemedicine capabilities, and even FAA safety communications in Alaska will not be disrupted? In particular, permitting private parties to manage any reallocation and transition process raises red flags. If there is not traditional FCC oversight, how would we ensure that those incumbent uses would be protected and that nothing would go wrong during a privately-managed transition process?

Answer. The C-Band is an important source of limited mid-band spectrum for 5G, and policymakers should focus on reallocating as much spectrum in the band as is possible to support modern wireless deployments. Fortunately, that is not mutually exclusive with protecting incumbent users, including several CCA members. CCA supports continued oversight from Congress and the FCC to ensure that this process is conducted in a way that protects existing users while serving the public demand for modern wireless services. Any reallocation of C-Band spectrum should be accomplished in a manner that promotes the public interest.

Question 2. Satellite companies have proposed a private sale of C-Band spectrum in which no money would go back to U.S. taxpayers. By contrast, FCC spectrum auctions have raised billions of dollars in the past. Do you agree that funding U.S.
priorities like expanded rural broadband should come before enriching foreign satellite companies? If not, why?

Answer. As FCC Chairman Pai has advocated in his Digital Empowerment Agenda and bipartisan, bicameral members of Congress have supported in legislation, any auction of spectrum should include a “rural dividend” with a portion of the funds reserved to support rural broadband deployment. Rural broadband expansion, and any other priorities as directed by Congress, should be prioritized before disbursing any compensation above transition costs to current license holders.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. SHELLEY MOORE CAPITO TO STEVE BERRY

Question 1. In your testimonies, many of you discuss the framework for 5G. While I understand the importance of innovation and support faster speeds, I have concerns that rural locations will not be adequately addressed: What ways exist to ensure 5G develops in combination with rural broadband connectivity?

Answer. 5G services will have the greatest and most immediate impact on rural areas. That is why it is critical that rural America is not left behind as 5G networks are deployed and new services are developed. To ensure that 5G develops in rural areas alongside deployment in urban areas, the FCC should adopt policies to support rural deployment and Congress should reconfirm the mandate to ensure reasonably comparable services in urban and rural areas.

Question 2. What are some steps the FCC can make to continue to streamline the deployment of 5G while ensuring rural areas continue to receive broadband and Internet support?

Answer. The FCC has taken significant steps to help streamline the deployment of wireless network infrastructure. However, the job is not done. Carriers must have certainty regarding the costs and time necessary to deploy, maintain, and upgrade broadband infrastructure. Steps taken now to streamline current infrastructure deployment will ease and accelerate the deployment of 5G technologies.

The Congressional mandate for reasonably comparable services in urban and rural areas was not a snapshot in time as the Telecommunications Act of 1996 was enacted but intended to continue to support an evolving level of telecommunications and information services. In 2019, that includes the deployment of 5G, and CCA strongly supports efforts to ensure that rural areas are included in 5G deployment plans.

Question 3. How can 5G be rolled out quickly to avoid a gap where there are have and have-nots?

Answer. 5G services are built upon today’s 4G LTE networks. Absent policies to close the digital divide today, 5G will exacerbate this problem and leave rural Americans behind in the connected future. To ensure a rapid deployment of 5G services in rural America in the future, policymakers should focus on expanding current 4G deployments, and eliminating barriers deterring investment in unserved and underserved areas.

Question 4. How does the Mobility Fund play a role in 5G deployment?

Answer. If based upon reliable coverage data to determine eligible areas, the Mobility Fund holds tremendous potential to provide the business case for carriers to deploy 4G LTE services that will support future 5G deployments in rural areas.

Question 5. 5G wireless services will require the deployment of a vast network of small cells. However, these networks will also need fiber-based wireline networks for their backhaul network. Could you explain to me the importance of a fiber backhaul and the allocation of spectrum in deploying these small cells?

Answer. Fiber is a critical foundation of wireless networks. Absent sufficient backhaul, including through fiber, small cells will face a choke point that slows the services available to consumers. Additionally, absent sufficient spectrum access, carriers are unable to provide the wireless capacity to meet consumer demands. For 5G services to meet their potential, carriers require both sufficient access to finite spectrum resources and readily available fiber backhaul services.

Question 6. Fortunately, every school and library in my state of West Virginia has a fiber connection, but this not the case when kids go home from school. Many of them cannot do their homework assignments. This digital divide cannot continue to be overlooked. How will 5G help our students at home? How long will it take for these students to see the benefits of 5G at their homes?

Answer. Closing the digital divide will help ensure that all students have the resources they need to succeed, regardless of where they live. Connectivity is key. 5G services will provide new services from increased access to lectures and homework...
assignments to augmented and virtual reality demonstrations to advance studies. These services will be available to students as 5G services are deployed in their communities, underscoring the importance of rapid deployments. CCA also supports legislation to allow E-Rate funds to be used to provide Wi-Fi on school buses, to allow drive time to be used as connected learning time.

**Question 7.** Despite significant investment, the vast majority of my state lacks competitive access to a fiber network. How can Internet providers ensure rural Internet access remains competitive as 5G gains more prevalence?

**Answer.** Backhaul is a critical component to 5G services. Increased business opportunities unlocked through 5G deployments as well as sufficient support to deploy fiber to deliver fixed and mobile services are required to provide rural areas with reasonably comparable services as more densely populated areas.

**Question 8.** How can Congress ensure the regulatory conditions are in place in order to ensure states like mine can participate in the 5G economy?

**Answer.** No state should be left behind in the 5G economy. Congress can take steps to ensure that all carriers have access to sufficient spectrum resources, certainty regarding the permitting and deployment process, and support to ensure that reasonably comparable services are deployed in urban and rural areas.

**Question 9.** Each member of this Committee has today or previously mentioned the importance of having accurate data and noted the flawed information that our current maps provide. Last year, I visited Flying W Plastics, a local polyethylene pipe products manufacturer in Gilmer County, West Virginia. According to a recent FCC Broadband Progress report, Gilmer County, WV is 100 percent served with 25 Mbps/3Mbps service. While visiting, I found this to be inaccurate. They do not have adequate broadband and unfortunately, this is not the only example like this in my state. So my question is: When there are communities in my state who are still struggling to achieve 3 or even 4G, how do you suggest we measure the accuracy of their broadband availability?

**Answer.** Reliable broadband coverage data is critical to adopting policies to close the digital divide. Broadband availability should be measured using standardized parameters that reflect the your constituents' experiences as they seek to connect.

**Question 10.** Last Congress, I introduced the Gigabit Opportunity (GO) Act and I plan to reintroduce it this Congress. This legislation would seek expedited deployment of broadband services in low-income rural and urban communities. The GO Act gives states flexibility, streamlines existing regulations, and eliminates barriers to investment so we can connect our low-income and rural communities. How can tax proposals like the GO Act make a measurable difference in promoting rural broadband deployment? Could similar proposals help in 5G deployment?

**Answer.** There is no single solution to connecting all Americans with advanced mobile broadband, it will require policies that embrace an all-of-the-above approach. CCA supports the GO Act as one tool available to advance broadband deployment. Tax incentives can help carriers make the business case for 5G deployments where, absent incentives, no current business case exists to provide service. Investments in broadband networks foster opportunities for economic development and job creation throughout the entire community.

**Question 11.** Congress has made several steps towards improving the deployment and accessibility of broadband to rural and tribal communities. For example, the AIRWAVES Act introduced by my Senate colleagues—Senator Gardner and Senator Hassan—included a “rural dividend” that would have dedicated 10 percent of any future spectrum auction funds to support the deployment of wireless infrastructure in unserved and underserved communities. How will rural set asides like this be used differently than Federal support already being distributed through programs like USF and RUS?

**Answer.** If enacted, the rural dividend is an important tool to ensure that funding is available to support rural broadband deployments. A 2018 study assessing the economic impact of the AIRWAVES Act estimated that had the rural dividend been in place for FCC Auctions 101 and 102, as much as $2 billion could have been generated to support rural broadband deployment.

As with today’s USF and RUS programs, policymakers must remain cognizant of the potential for overbuilds or biases towards any one technology. CCA supports using proceeds from the rural dividend to specifically ensuring that funding is available to wireless deployments in rural America.
RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. AMY KLOBUCHAR TO STEVE BERRY

Improving Broadband Mapping. In order to successfully deploy 5G nationwide, we need reliable data on where service exists and where it does not. The information currently collected does not provide an accurate picture of deployment in rural areas.

Question. In your testimony, you stated that reliable coverage maps are necessary for policies to spur 5G deployment. How could consumer-reported data improve the accuracy of the FCC’s coverage maps and benefit rural areas?

Answer. The FCC should consider all data sources available, including consumer-reported data, to improve the current coverage maps. No one is more familiar with what coverage is available than the consumers that rely on service where they live, work, and travel. With appropriate safeguards regarding compatibility of devices and throttling policies should be reflected, consumer-reported data can improve the integrity of coverage data.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JON TESTER TO STEVE BERRY

Question 1. How can we help small carriers that have Huawei Equipment in their networks?

Answer. Congress can help small carriers by providing specific information regarding approved equipment, and assistance to access and deploy equipment that addresses cybersecurity and national security concerns.

Question 2. What kind of workforce is needed to implement infrastructure for 5G?

Question 3. How can we make sure the workforce has the skills and training to deploy 5G infrastructure?

Question 4. If we need workers, can we put training programs in rural areas?

Question 5. How are you thinking about workforce training, do you see a role for community colleges, job crops, and trade schools?

Question 6. What overlap do you see for our Nation’s veterans, who have come home with a variety of skills that may be useful for implementing 5G? Things like heavy equipment, large trucks, technical electronics, and engineers?

Answer. As carriers work to deploy 5G services, they rely on an increased workforce while simultaneously working to repack the 600 MHz band, enhance public safety services, preserve and expand 4G services, and deploy 5G. This requires an all-of-the-above approach, including expanding access to workforce training for tower erectors and other skilled positions. Community colleges, job crops, and trade schools play a critical role in developing the workforce necessary to meet deployment demands, and should include training programs in rural areas.

Particularly regarding workforce training for our Nation’s veterans, CCA supports programs that arrange certified training using GI bill benefits and place qualified veterans in open positions and apprenticeships, including the Warriors 4 Wireless nonprofit program.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JOHN THUNE TO SHAILEN P. BHATT

Question. In your testimony you state that ITS America “strongly supports preserving the entire 5.9 gigahertz band for Vehicle-to-Everything.” I agree that safety is a paramount consideration, but I’ve said for years that it would be a positive public policy outcome if engineers could find a reliable way for both Wi-Fi and connected vehicle technology to co-exist in the 5.9 gigahertz band. Along those lines, the FCC has talked about a new Notice of Proposed Rulemaking to reexamine this band. Would ITS America support the Commission moving forward with this action to see what may be achievable?

Answer. Since the Federal Communications Commission (FCC) commenced its ET Docket 13–49 in 2013, Intelligent Transportation Society of America (“ITS America) has supported sharing of the 5.9 GHz band between ITS and unlicensed devices provided that such sharing does not cause harmful interference to life-saving ITS services. ITS America supported the consensus on a three-phase testing methodology to be overseen by the FCC’s Office of Engineering and Technology (OET) arrived at with the U.S. Senate Committee on Commerce, Science and Transportation’s support (See September 9, 2015 letter). OET accepted public comments on its Phase 1 Test Report in late 2018. ITS America continues its support of the consensus plan
for testing and the completion of testing by OET to determine whether sharing of
the 5.9 GHz band is viable. Initiation by the FCC of an ancillary and collateral rule-
making bypassing the completion of testing is not in the best interests of the public
as it will further complicate an already uncertain regulatory environment into
which many public and private parties are investing their scarce resources to de-
velop and deploy lifesaving services, unduly tax those resources and delay the intro-
duction of those services. We urge instead that OET be provided all support nec-
essary to promptly complete its testing of band sharing.

RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JERRY MORAN TO
SHAILEN P. BHATT

Question. The FCC completed testing that showed that it could segment the 5.9
gigahertz band and provide spectrum for both transportation and unlicensed tech-
nologies. But your testimony calls for the FCC and DOT to engage in years of addi-
tional testing that, in the opinion of Commissioner O’Rielly, is no longer needed.
Why would we need to spend more years testing a kind of sharing no one wants,
instead of moving ahead with a process of segmenting the band, so both automotive
companies and Wi-Fi consumers each have spectrum?

Answer. ITS America agrees with National Highway Traffic Safety Administra-
tion’s (NHTSA) assessment, that the three-phase testing must continue to ensure
that this lifesaving technology is deployed and that the driving public can have con-
fidence in the results. “The three phases of the test plan are interdependent and
ongoing, and the testing will show whether unlicensed devices can safely operate in
the 5.9 GHz band.” (U.S. Department of Transportation’s National Highway Traffic
Safety Administration issues statement on safety value of 5.9 GHz spectrum, Octo-
ber 24, 2018)

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. SHELLEY MOORE CAPITO TO
SHAILEN P. BHATT

Question 1. In your testimonies, many of you discuss the framework for 5G. While
I understand the importance of innovation and support faster speeds, I have con-
cerns that rural locations will not be adequately addressed: What ways exist to en-
sure 5G develops in combination with rural broadband connectivity?

Answer. ITS America represents state and city departments of transportation,
metropolitan planning organizations, automotive manufacturers, technology compa-

cies, engineering firms, automotive suppliers, insurance companies, and research
universities that are researching and deploying intelligent transportation tech-
nologies. While ITS America includes among our members wireless communications
companies, we are not a trade association representing the wireless communications
industry, and as such, we do not have a policy specific to how that industry is plan-
ing to deploy 5G in rural and urban areas. ITS America is an intelligent transpor-
tation association. Our mission is the research and deployment of advanced trans-
portation technologies. As such, ITS America does not have a specific policy on ways
to ensure 5G develops in combination with rural broadband connectivity.

Ubiquitous access to high-speed broadband is key to intelligent transportation
technologies that are saving lives; reducing crashes; extending the life of transpor-
tation infrastructure; improving capacity; reducing the rate and growth in conges-
tion; moving more people in fewer vehicles; improving travel times and reducing
greenhouse gas emissions.

Our members believe that it should be a Federal priority to close the digital divide
in rural areas (as well as economically disadvantaged urban areas). To do so, we
believe the goal should be broadband in any, all forms, to help address rural
broadband connectivity. For rural communities, ITS America supports increasing
grants that are currently eligible under the U.S. Department of Agriculture. We rec-
ommend including in an infrastructure bill funding to further expedite broadband
in rural areas. Also, we support expanding broadband grant programs to enable
grant recipients to use grants to deploy various types of infrastructure capable of
offering middle-mile, last-mile wired, and wireless broadband access.

Question 2. What are some steps the FCC can make to continue to streamline the
deployment of 5G while ensuring rural areas continue to receive broadband and
Internet support?

Answer. ITS America does not have a specific policy on steps the FCC can make
to continue to streamline the deployment of 5G while ensuring rural areas continue
to receive broadband and Internet support.
ITS America is considering dig once policy in the reauthorization of Fixing America’s Surface Transportation (FAST) Act that would establish a new Federal funding (non-Highway Trust Fund) to assist states and localities to (1) identify a broadband utility coordinator to facilitate the broadband infrastructure right-of-way efforts within the state; (2) register broadband infrastructure entities that seek to be included in those facilitation efforts; (3) establish a process to electronically notify such entities of the state transportation improvement program on an annual basis; (4) coordinate statewide telecommunication and broadband plans and state and local transportation and land use plans, including strategies to minimize repeated excavations that involve the installation of broadband infrastructure in a right-of-way; and (5) ensure that any existing broadband infrastructure entities are not disadvantaged.

Funding under this new FAST Act reauthorization program would assist states and localities with recovering costs associated with conduit installation, maintenance of conduit, and conduit inventory. We believe this program would benefit rural communities by combining broadband conduit installation with highway construction, including expansion, resulting in a decreased frequency of construction on highways, decrease broadband installation costs, increase access to and reliability of broadband networks, increased public and economic benefits, and decrease time needed to deploy fiber.

Please note that this policy does not establish a mandate or requirement that a state or locality install broadband infrastructure in a highway right-of-way.

**Question 3.** How can 5G be rolled out quickly to avoid a gap where there are have and have nots?

**Answer.** See answer to question 1 above.

**Question 4.** How does the Mobility Fund play a role in 5G deployment?

**Answer.** ITS America does not have a specific policy on how the Mobility Fund can play a role in 5G deployment. While ITS America does not have a specific policy on the Mobility Fund, we support Federal grants to expand mobile broadband networks to areas that are unserved and underserved.

**Question 5.** 5G wireless services will require the deployment of a vast network of small cells. However, these networks will also need fiber-based wireline networks for their backhaul network. Could you explain to me the importance of a fiber backhaul and the allocation of spectrum in deploying these small cells?

**Answer.** In Vehicle-to-Infrastructure (V2I) applications, backhaul is the fiber-optic or wireless connection between the roadside unit (RSU) and traffic management center or other operational centers that allows data to be exchanged and enables supervisory control of the system.

**Question 6.** Fortunately, every school and library in my state of West Virginia has a fiber connection, but this is not the case when kids go home from school. Many of them cannot do their homework assignments. This digital divide cannot continue to be overlooked. How will 5G help our students at home? How long will it take for these students to see the benefits of 5G at their homes?

**Answer.** See answer to question 1 above.

**Question 7.** Despite significant investment, the vast majority of my state lacks competitive access to a fiber network. How can Internet providers ensure rural Internet access remains competitive as 5G gains more prevalence?

**Answer.** ITS America does not have a specific policy on how Internet providers can ensure rural Internet access remains competitive as 5G gains more prevalence.

**Question 8.** How can Congress ensure the regulatory conditions are in place in order to ensure states like mine can participate in the 5G economy?

**Answer.** See answer to question 1 above.

**Question 9.** Each member of this Committee has today or previously mentioned the importance of having accurate data and noted the flawed information that our current maps provide. Last year, I visited Flying W Plastics, a local polyethylene pipe products manufacturer in Gilmer County, West Virginia. According to a recent FCC Broadband Progress report, Gilmer County, WV is 100 percent served with 25 Mbps/3Mbps service.

While visiting, I found this to be inaccurate. They do not have adequate broadband and unfortunately, this is not the only example like this in my state. So my question is: When there are communities in my state who are still struggling to achieve 3 or even 4G, how do you suggest we measure the accuracy of their broadband availability?

**Answer.** ITS America does not have a specific policy on how to best measure the accuracy of broadband availability.
**Question 10.** Last Congress, I introduced the Gigabit Opportunity (GO) Act and I plan to reintroduce it this Congress. This legislation would seek expedited deployment of broadband services in low-income rural and urban communities. The GO Act gives states flexibility, streamlines existing regulations, and eliminates barriers to investment so we can connect our low-income and rural communities. How can tax proposals like the GO Act make a measurable difference in promoting rural broadband deployment? Could similar proposals help in 5G deployment?

Answer. ITS America did not take a policy position on the Gigabit Opportunity (GO) Act.

**Question 11.** Congress has made several steps towards improving the deployment and accessibility of broadband to rural and tribal communities. For example, the AIRWAVES Act introduced by my Senate colleagues—Senator Gardner and Senator Hassan—included a “rural dividend” that would have dedicated 10 percent of any future spectrum auction funds to support the deployment of wireless infrastructure in unserved and underserved communities. How will rural set asides like this be used differently than Federal support already being distributed through programs like USF and RUS?

Answer. ITS America does not have a specific policy position on how rural set-asides can be used differently than Federal support already being distributed through programs like the Universal Service Fund and Rural Utilities Service.

---

**RESPONSE TO WRITTEN QUESTION SUBMITTED BY HON. JERRY MORAN TO MICHAEL WESSEL**

**Question.** Your testimony highlighted the concerns of China’s involvement in international standards-setting organizations and the potential impact on technological interoperability and operations. Would you please describe examples of their involvement and potential harms stemming from it?

Answer. China has had an aggressive strategy to influence the standards and rules that will drive the development and deployment of 5G equipment. Most importantly, China has put substantial energy and resources into participating and leading the design of standards at international standards setting bodies such as the International Telecommunications Union (ITU), where they chair more committees than any other delegation. China has participated—via government and “private sector” participants—to drive standards in ways that will promote the interests of their companies. This strategy has the potential to provide enormous advantages to Chinese firms and the government.

5G will be the communications technology that provides greater connectivity between devices than ever before. The Internet of Things (IoT) and IoT devices will significantly expand threat vectors and attack surfaces which bad actors, primarily nation-state actors, can exploit and the presence of potentially hostile foreign-produced, serviced and maintained equipment in those networks increases those risks. The first step in addressing these risks is a comprehensive and regularly-occurring supply chain examination of our Nation’s telecommunications networks. We have already endured years of Chinese cyberespionage targeting our Nation’s economic and national security systems, some of which were facilitated and directed by the Chinese government. Given that reality, allowing Chinese companies—many of which are under direct or coercive state control—to provide network equipment and services for our telecommunications infrastructure creates extreme and unacceptable vulnerabilities. It needlessly gives potential hostile actors control over the source code, updates, and servicing of key networks.

---

**RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. EDWARD MARKEY TO MICHAEL WESSEL**

**Question 1.** Mr. Wessel, how can we identify hostile foreign equipment in our telecommunications networks?

Answer. The deployment of 5G alongside the increasing expansion of the Internet of Things (IoT) and IoT devices will significantly expand threat vectors and attack surfaces which bad actors, primarily nation-state actors, can exploit and the presence of potentially hostile foreign-produced, serviced and maintained equipment in those networks increases those risks. The first step in addressing these risks is a comprehensive and regularly-occurring supply chain examination of our Nation’s telecommunications networks. We have already endured years of Chinese cyberespionage targeting our Nation’s economic and national security systems, some of which were facilitated and directed by the Chinese government. Given that reality, allowing Chinese companies—many of which are under direct or coercive state control—to provide network equipment and services for our telecommunications infrastructure creates extreme and unacceptable vulnerabilities. It needlessly gives potential hostile actors control over the source code, updates, and servicing of key networks.

The U.S.-China Economic and Security Review Commission’s (USCC) 2018 Report to Congress envisions the regular supply chain examination I suggested, recom-
mending that Congress mandate that the Office of Management and Budget’s Federal Chief Security Officer Council prepare an annual report to Congress to ensure supply chain vulnerabilities from China are adequately addressed. This must be supplemented with aggressive efforts to assess the vulnerabilities in the private sector and, for critical economic and national infrastructure, foreign equipment suppliers from unsecure and untrusted vendors should be excluded. Where necessary, networks should be segmented or isolated to maximize security.

**Question 2.** How do we address the threat they pose? Do we need to remove them from the networks altogether? Do we need to install patches?

**Answer.** Ideally, when potentially hostile foreign supplied equipment is identified in any of our networks it can and should be removed. In networks that transmit critical economic and security data or support critical infrastructure, the removal of potentially malevolent equipment is critical and imperative. If a situation were to arise in which the removal of the equipment is not possible, it is vital that U.S. authorities be given complete transparency with regard to the examination of hardware, data storage and security, source code, and updates in use and accessibility throughout the network, with no exceptions. Equipment, software and updates should not be deployed until full assessments have been completed.

The USCC’s 2018 Report to Congress also recommended that Congress direct the National Telecommunications and Information Administration and the Federal Communications Commission to identify steps to ensure a rapid and secure deployment of 5G networks, and whether new statutory authorities are required to protect the security of domestic 5G networks.

As we chart a path into the next-generation of connectivity, it is important that our policymakers are provided any and all relevant technical information that identifies and mitigates future threats. It is my hope that Congress will act quickly to initiate the necessary examinations of our domestic 5G needs and vulnerabilities that can provide the data and situational awareness needed to craft a comprehensive response to the dangers posed by potentially foreign-produced equipment from hostile actors being utilized in U.S. networks.

**Question 3.** The New York Times reported on the Trump Administration’s efforts to pressure other countries to reject China’s offer for a 5G network. Is this the right strategy, in your view? If not, what is a better approach to addressing China’s efforts for a 5G expansion in other countries?

**Answer.** The United States reaps enormous benefits from its information and intelligence sharing relationships with its allies, as to those partners. These relationships represent a critical component of our Nation’s intelligence collection, analysis, and operations apparatus and are a vital aspect of a secure long-term national security strategy. However, for those relationships to provide that security to the U.S. and our allies, high-level sensitive intelligence must only be shared via safe and secure networks. Huawei equipment is a long-identified security risk. The presence of Huawei equipment on a network represents a serious vulnerability today that will only grow with time. It is entirely appropriate for the U.S. to make clear to its allies that current intelligence-sharing regimes may require significant changes if Huawei equipment is going to be utilized on their networks. We must always protect U.S. intelligence findings, including sources and methods, and that may require limitations on intelligence-sharing over networks that we cannot confirm are secure.

If our friends abroad are unwilling to secure their networks from Huawei, we must adopt new systems to allow for sharing intelligence, while segregating key data from networks that include potentially malignant equipment. The costs of exposing our critical national security information is too high for inaction. As our partners around the world wrestle with their own challenges in deploying a secure 5G network, the U.S. must continue to make its case that the proven security threats from companies like Huawei are too dangerous to risk. These concerns should also be assessed vis-à-vis other critical communications systems. The operation of financial markets, our electric grids and countless other supported infrastructure should not be put at risk.

**Response to Written Question Submitted by Hon. Jon Tester to Michael Wessel**

**Question.** How can we help small carriers that have Huawei Equipment in their networks?

**Answer.** Small or regional telecommunications carriers have not been provided enough support in identifying and mitigating potential threats posed by the presence of Huawei, or other foreign suppliers’ potentially suspect equipment on their networks. Regional companies often face challenges in providing reliable services to
fewer users over larger geographic areas and have found, in some cases, that using cheaper (subsidized) foreign-supplied equipment, namely Huawei, is a more cost-effective option. It is imperative that Federal authorities work with those regional telecommunications firms to provide up-to-date information on the threats and security flaws that are associated with equipment provided by Huawei and other foreign firms.

It is imperative that Federal authorities provide more support to those smaller and regional carriers, especially with regard to the threats and security flaws associated with equipment from Huawei and other foreign companies.

The first step should include the deployment of formal information-sharing protocols between authorities at the federal, state, regional, and local levels. The more information we can provide smaller carriers about the developing and ongoing cybersecurity threats they face, the better they will be able to address and manage them. Next, new security standards may be needed to identify the potentially malevolent equipment and remove it from networks. And finally, if these standards require the replacement of suspicious hardware on the networks of smaller carriers which do not have the resources to undertake a costly project such as this, Federal support should be provided for firms to secure their systems by replacing suspicious and potentially malevolent equipment with secure systems.

In conjunction with these efforts, it is appropriate to assess whether Huawei and other equipment and services provided by suspect actors is supported by state-provided subsidies. These subsidies, while lowering the acquisition cost for consumers, also has the impact of unfairly skewing the market and limiting opportunities for market-based suppliers, many of which are trusted vendors. The initial cost may be lower by procuring these potentially subsidized products and services but the long-term security costs are unacceptable.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. SHELLEY MOORE CAPITO TO KIM ZENTZ

Question 1. In your testimonies, many of you discuss the framework for 5G. While I understand the importance of innovation and support faster speeds, I have concerns that rural locations will not be adequately addressed: What ways exist to ensure 5G develops in combination with rural broadband connectivity?

Answer. In order to fully realize the substantial benefits of 5G for all citizens, our work as a country on this deployment must be done in concert with all stakeholders. Central and local governments, the public sector and the private sector must join forces to ensure an equitable and resilient deployment. Failing this effort risks creating divided and socially exclusive communities across the country.

Question 2. What are some steps the FCC can make to continue to streamline the deployment of 5G while ensuring rural areas continue to receive broadband and Internet support?

Answer. Cities and communities of all sizes must be collaboratively included in the discussions that affect the oversight of their rights of way to ensure public safety, space, local spectrum management and aesthetics. The FCC must take steps to ensure that these local responsibilities are not reduced or over-ridden by actions taken to accelerate 5G deployment.

Question 3. How can 5G be rolled out quickly to avoid a gap where there are have and have nots?

Answer. Smaller and mid-sized communities can be pilot installations. Starting in the lower population areas allows the unique challenges of smaller communities to receive deserved attention and the pilot effort allows stakeholders with roles in the installation to learn lessons at a smaller scale than might be present in an attempt to accelerate deployment in densely populated urban areas.

Logical practice dictates that taking care to get smaller-scale pilot installations done right before attempting large scale deployment will best serve all stakeholders interests in time, budget and efficiency over-all. The deployment schedule will be slower and more careful in the pilot installation, lessons learned will be cataloged and evaluated, stakeholders can weigh in before the larger scale commitments to equipment and personnel are made. With the known variables under control, the balance of the deployment can move much more smoothly and effectively—on time and on budget.

Question 4. How does the Mobility Fund play a role in 5G deployment?

Answer. I cannot effectively speak to the applicability of the Mobility Fund and its governing principles. However, I do believe that mobility applications will be among the first and likely most compelling use-cases for high-speed, low latency 5G
equipment. Furthermore, mobility is at the very heart of every community (of all sizes) because of its fundamental enablement of economic, social and environmental equity and resiliency.

**Question 5.** 5G wireless services will require the deployment of a vast network of small cells. However, these networks will also need fiber-based wireline networks for their backhaul network. Could you explain to me the importance of a fiber backhaul and the allocation of spectrum in deploying these small cells?

**Answer.** Wireless communications networks are worthless without reliable backhaul networks. The allocation of spectrum must take into account all of the factors that comprise essential service to citizens as well as the effective use of spectrum—including mid-band. With the deployment of 5G, applications will distribute to the most effective segment of spectrum, thus there will be some lower and mid-band spectrum capacity that should not be ignored in the balancing of priorities for communities’ spectrum needs. In other words, not all applications will suddenly demand 5G to function effectively.

**Question 6.** Fortunately, every school and library in my state of West Virginia has a fiber connection, but this not the case when kids go home from school. Many of them cannot do their homework assignments. This digital divide cannot continue to be overlooked. How will 5G help our students at home? How long will it take for these students to see the benefits of 5G at their homes?

**Answer.** N/A

**Question 7.** Despite significant investment, the vast majority of my state lacks competitive access to a fiber network. How can Internet providers ensure rural Internet access remains competitive as 5G gains more prevalence?

**Answer.** N/A

**Question 8.** How can Congress ensure the regulatory conditions are in place in order to ensure states like mine can participate in the 5G economy?

**Answer.** Digital connectivity is essential infrastructure and is increasingly the lynchpin for safety, health and well-being of our citizens. Thus Congress should treat relevant policy decisions with the same thoroughness as water, electricity, roads, bridges, sewers, etc.

**Question 9.** Each member of this Committee has today or previously mentioned the importance of having accurate data and noted the flawed information that our current maps provide. Last year, I visited Flying W Plastics, a local polyethylene pipe products manufacturer in Gilmer County, West Virginia. According to a recent FCC Broadband Progress report, Gilmer County, WV is 100 percent served with 25 Mbps/3Mbps service. While visiting, I found this to be inaccurate. They do not have adequate broadband and unfortunately, this is not the only example like this in my state. So my question is: When there are communities in my state who are still struggling to achieve 3 or even 4G, how do you suggest we measure the accuracy of their broadband availability?

**Answer.** Clearly, the best decisions cannot be made absent the best information that is possible to cost-effectively obtain.

**Question 10.** Last Congress, I introduced the Gigabit Opportunity (GO) Act and I plan to reintroduce it this Congress. This legislation would seek expedited deployment of broadband services in low-income rural and urban communities. The GO Act gives states flexibility, streamlines existing regulations, and eliminates barriers to investment so we can connect our low-income and rural communities. How can tax proposals like the GO Act make a measurable difference in promoting rural broadband deployment? Could similar proposals help in 5G deployment?

**Answer.** N/A

**Question 11.** Congress has made several steps towards improving the deployment and accessibility of broadband to rural and tribal communities. For example, the AIRWAVES Act introduced by my Senate colleagues—Senator Gardner and Senator Hassan—included a “rural dividend” that would have dedicated 10 percent of any future spectrum auction funds to support the deployment of wireless infrastructure in unserved and underserved communities. How will rural set asides like this be used differently than Federal support already being distributed through programs like USF and RUS?

**Answer.** N/A