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FUELING THE 21ST CENTURY WIRELESS ECONOMY

WEDNESDAY, APRIL 5, 2017

House of Representatives,

Subcommittee on Communications and

Technology,

Committee on Energy and Commerce

Washington, D.C.

The subcommittee met, pursuant to call, at 10:00 a.m., in Room 2123 Rayburn House Office Building, Hon. Marsha Blackburn [chairman of the subcommittee] presiding.

Present: Representatives Blackburn, Lance, Shimkus, Latta, Guthrie, Olson, Kinzinger, Bilirakis, Johnson, Long, Flores, Brooks, Collins, Cramer, Walters, Costello, Walden (ex officio), Doyle, Welch, Clarke, Loeb sack, Ruiz, Eshoo, Engel, Butterfield, Matsui, McNerney, and Pallone (ex officio).

Staff present: Grace Appelbe, Legislative Clerk,

Energy/Environment; Ray Baum, Staff Director; Karen Christian, General Counsel; Zachary Dareshori, Staff Assistant; Chuck Flint, Policy Coordinator, Communications and Technology; Adam Fromm, Director of Outreach and Coalitions; Gene Fullano, Detailee, Communications and Technology; Giulia Giannangeli, Legislative Clerk, Digital Commerce and Consumer Protection/Communications and Technology; Kelsey Guyselman, Counsel, Communications and Technology; Lauren McCarty, Counsel, Communications and Technology; Alex Miller, Video Production Aide and Press Assistant; David Redl, Chief Counsel, Communications and Technology; Dan Schneider, Press Secretary; Jeff Carroll, Minority Staff Director; Alex Debianchi, Minority Telecom Fellow; David Goldman, Minority Chief Counsel, Communications and Technology; Jerry Leverich, Minority Counsel; Lori Maarbjerg, Minority FCC Detailee; Dan Miller, Minority Staff Assistant; and Matt Schumacher, Minority Deputy Press Secretary and Digital Director.

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Mrs. Blackburn. The subcommittee will now come to order.

I recognize myself for 5 minutes for an opening statement, and I do welcome all of you to this hearing, which is titled, very appropriately, Fueling the 21st Century Wireless Economy. Thank you to our witnesses for, first of all, submitting that testimony in a timely manner; and, secondly, for taking your time to be here with us today. We do appreciate having your expertise.

It is often said that spectrum is the lifeblood of wireless connectivity, and wireless demand continues to surge at an incredible rate. As a result, it is imperative that the subcommittee continue working to unleash spectrum for commercial purposes.

The subcommittee held multiple hearings on this issue during the 114th Congress and noted that while a subscriber's data will grow by 400 percent by 2019, the subcommittee must demand that the FCC and NTIA work quickly to identify bands which can be reallocated and cleared for commercial use as we push to develop 5G networks, which are expected to be commercialized by 2020.

A two-sided solution is necessary to address the spectrum crunch. First, we should push for continued deployment of spectrum. Second, the development of technologies which enhance spectral efficiency is vital. The NTIA will play an important role in this endeavor as it sets new clearing targets and evaluates how efficiently government agencies use their spectrum.

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Federal entities should not be permitted to squat on this valuable resource without providing sufficient information detailing how they plan to use it. The societal and financial value of spectrum is simply too great for it not to be maximized.

The FCC's National Broadband Plan of 2010 identified 547 megahertz of spectrum suitable for mobile broadband to be unleashed over a 10-year period, and we recently completed two successful spectrum auctions. The AWS-3 auction generated \$44 billion in revenue and cleared 65 megahertz of spectrum, while the broadcast incentive auction raised \$19.8 billion and cleared 70 megahertz of spectrum for exclusive licensed use. These auctions were successful. However, it is important that as a general rule we not impose restrictions on who can bid on spectrum.

Congressman Latta and I wrote to the FCC in June 2015 about that issue and expressed concern that -- and I am quoting -- "restricting free and open access to spectrum creates barriers to capital investment, innovation, deployment, and puts the government in the position of picking winners and losers."

The free market is the most effective vehicle for continued spectrum development. Well-intentioned auction rules can artificially depreciate the value of spectrum. We should advance bipartisan legislation, such as the Guthrie-Matsui Federal Spectrum Incentive Act, which provide incentives for the reallocation of government-held spectrum for commercial

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purposes.

Also, Congressman Kinzinger's H.R. 1814 encourages spectrum available -- spectrum licenses to make unused and underused spectrum available for use by rural and smaller carriers in order to expand wireless coverage and is certainly worthy of further examination.

The subcommittee will also discuss the Senate's MOBILE NOW legislation, which addresses deployment challenges related to spectrum and infrastructure. The 5G revolution is upon us, and America must not fall behind. Deploying and promoting efficient use of spectrum is the two-sided solution we must adopt as wireless communications networks expand, and the internet of things is growing into the internet of everything.

We look forward to hearing our witnesses today, and I will yield the balance of my time to any member who is seeking it. Mr. Lance, you are recognized for the remainder.

Mr. Lance. Thank you very much, Madam Chair, and welcome to our distinguished panelists. This subcommittee's longstanding tradition of bipartisan work on communications and technology issues is essential to facilitate the growth of 5G, which will revolutionize our nation's healthcare, education, agriculture, energy, and transportation sectors.

This topic is of particular interest to me. The district I represent is a hub of 5G innovation. The policies we are

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discussing today significantly affect businesses back home, such as Verizon, Qualcomm, AT&T, and Bell Labs, which are working diligently to innovate in this important field.

For instance, Verizon has vowed to be the first to market on 5G and has already launched technology field trials. Qualcomm, which pioneered 3G and 4G, is also busy testing 5G at its state-of-the-art laboratories in Bridgewater, New Jersey, which has a long history of innovation. These are just a few examples of the businesses in the district I serve and around the country who are on the forefront of innovating in 5G technology.

These companies have already invested billions of dollars in 4G LTE, and as they continue to invest significantly in 4G and 5G, it is important that we in Congress help facilitate innovation by fueling the spectrum pipeline and removing regulatory barriers to deployment.

Laying a foundation for the 21st century wireless economy is essential, and I thank our panelists for being with us today.

Thank you, Madam Chair.

Mrs. Blackburn. The gentleman yields back.

Mr. Doyle, you are recognized for 5 minutes.

Mr. Doyle. Thank you, Madam Chair, for holding this hearing, and thanks to the witnesses for coming before us today.

Before I discuss this hearing and the important issues surrounding spectrum policy, I want to talk about something that

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has been on the minds of many Americans as well as my own mind recently, and that is privacy. Last week Congress rolled back critical regulatory protections that prohibited ISPs from selling individuals' browsing histories without their consent.

Congress didn't act with much deliberation. We didn't hold hearings or mark up any bills. We ran through legislation under the Congressional Review Act -- a blunt, draconian instrument -- to smash these rules, the only real legal protections that prevented internet service providers from using and abusing our data.

Recent public polling has shown that 74 percent of all Americans oppose this legislation. Last weekend when I was back in my district I went to a number of public events, and I couldn't find a single person who supported this bill or eroding our privacy rights. Not one.

I encourage my colleagues on both sides of the aisle, when they go home over the next two weeks, ask their constituents if they want their internet service provider selling their browsing histories. I believe my colleagues on the other side of the aisle, and the telecomm industry, have made a grave mistake here.

I see we have a representative from one of the associations that led the charge for this bill. I am extremely disappointed that an organization representing the wireless industry, which this committee has worked hard to support and foster, would act

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in such a selfish and irresponsible way. I expect more for you and your members, and the American people expect more from you and your members.

It is not lost on me or members of this subcommittee that your association support for the CRA means that no federal agency can stop your members from selling people's information. Believe me when I say that my constituents, your customers, are not happy about this.

That being said, I do look forward to the testimony of our witnesses, particularly Ruckus Wireless. I understand that you have some equipment deployed in Pittsburgh City Hall. I appreciate the ingenuity that your company is bringing to these types of problems. As this committee works to free up more spectrum, we need to appreciate that not every band that can be made available will fall into the traditional labels and understanding of licensed and unlicensed.

We need entrepreneurs and innovators willing to take risks and experiment with new bands and new types of network. Your comments and your company's work in the Citizens Broadband Radio Service band is a great example of this attitude. We shouldn't forget that many of the unlicensed bands in use today by Wi-Fi and other services were once considered junk bands, and now these bands are responsible for moving 60 percent of all wireless data.

I believe it is incumbent upon Congress to support unlicensed

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spectrum and continue to create space for innovation. With that, I will yield the remainder of my time to Ms. Matsui.

Ms. Matsui. Thank you, Mr. Doyle, for yielding me time, and I would like to thank the witnesses for being with us today.

Today's hearing topic is critical to our nation's digital future. Spectrum is invisible infrastructure that fuels our 21st century economy, and it is a finite resource. And as demand continues to explode, we need to encourage efficiency to put this resource to its best and highest use.

That is why I joined my colleague, Congressman Guthrie, yesterday to reintroduce the Federal Spectrum Incentive Act. It would provide incentives to government agencies to free up some of their existing spectrum bands for commercial use.

I look forward to continuing to work with my colleagues on a bipartisan basis on all of the above strategy that provides new opportunities for licensed and unlicensed spectrum, sharing and clearing spectrum bands. We will need every tool at our disposal, so the United States leads the world as we look to 5G networks. We have always been a nation of innovators, and our spectrum policies should be no exception.

Thank you, Mr. Chairman. Is there anyone else you would like to yield to, Mr. Doyle?

Mr. Doyle. Would anyone else like time? If not, Madam Chair, I will yield back.

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Ms. Matsui. Thank you.

Mrs. Blackburn. The gentleman yields back.

The chairman of the full committee, Mr. Walden, you are recognized for 5 minutes.

The Chairman. Madam Chair, I appreciate the hearing today on these very important issues relating to the wireless economy. I want to thank our witnesses for being here.

And I also -- I hadn't planned to really talk on this, but I think it is time to set the record straight about the whole issue of privacy because in my book it has been horribly spun about ISP selling your privacy.

Let's talk about that for a minute. We wouldn't be in this position if the Obama administration hadn't forced the FCC to treat the internet as an old-style common carrier. That removed any protections people had from the FTC, Federal Trade Commission, and then the FCC, under Chairman Wheeler said, "Well, there is nothing to worry about here because we still have various sections of federal law that protect people. So don't worry, don't worry, don't worry." And then they decided, well, maybe we should write rules, which, by the way, were never implemented. That is a fact.

Second fact. The Administration -- this and others -- has gone around Europe when we were talking about the safe harbor provisions arguing there is no need for regulatory authority in this space, and so we have got it all covered.

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Third fact. The people who you search through on your search history are companies like -- oh, shall I say Google has an 85 percent market share of search, Facebook, Amazon. How do you think they make their money? By monetizing what you do online. They were never covered by this rule to begin with. Period. Period. That is where the searches are.

My friend from Pennsylvania, I am glad you are on the subcommittee, but, boy, we have got to have some education here because that is where the searches are. That is not covered by the rule that you embrace that you are upset that we repealed, right? There is no difference there. Are you telling me that the edge providers were covered by that rule? Yes or no.

Mr. Doyle. The edge providers are regulated by the FTC.

The Chairman. They are not covered by the rule that was -- when Verizon sued and you can no longer classify ISPs out of Title 1 and they were classified in Title 2, there was no jurisdiction over the ISPs.

Mr. Doyle. Well, reclaiming my time, the ISPs have made it very clear they have policies that aren't covered. You have the option to opt out. I am just telling you that this is not what it has been made out to be. The former FTC commissioner, the current FTC commissioner, the chairman of the FCC, have all made this clear.

It is really disappointing. I mean, there are all kinds of

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folks that have weighed in on this saying that is just not the case, that we are exposing people to this. By the way, these rules were never in effect. They were never in effect.

I would yield to my friend from Illinois for further comment.

Mr. Shimkus. I just will read part of a column by the chairman of the FCC. "But in 2015, the FCC decided to treat the internet like a public utility, taking away the FTC's ability to police the privacy practices of broadband providers. This shifted responsibility from the agency with the most expertise handling online privacy, the FTC, to an agency with no real experience in the field, the FCC."

"As we feared, this 2015 decision has not turned out well for the American people. During the Obama administration, the FTC concluded that 'any privacy framework should be technologically neutral' because 'ISPs are just one type of a large platform provider.' Any operating systems and browsers may be in a position to track all of the consumer's online activity to create highly detailed profiles."

But the FCC didn't follow this guideline. Instead, it adopted rules that would have created a fractured privacy framework under which ISPs would have been subject to one standard in content providers, which Mr. Walden was talking about, would have been subject to another. The Obama FTC in a unanimous bipartisan comment criticized this approach as "not optimal." In

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Washington speak, that is a major rebuke.

So, I mean, we can politicize this. The reality is we made a great decision last week. I will stand by that. And I yield back to the chairman.

The Chairman. I will just close with this from TechFreedom. Berin Szoka wrote, "The FCC's rules were unwise and unnecessary. The FCC will soon return broadband privacy policing to the Federal Trade Commission where it belongs like all online privacy. In the meantime, enacting this CRA will simply mean the FCC will police broadband privacy case by case just as it had done under Democratic leadership after the FCC's 2015 open internet order, deprive the FTC of its consumer protection power over broadband by reclassifying broadband as a common carrier service."

And with that, I yield back.

Mrs. Blackburn. The gentleman yields back.

Mr. Pallone, you are recognized for 5 minutes.

Mr. Pallone. Thank you, Madam Chairwoman. Let me say, no one believes this Republican mumbo jumbo about the FCC, about clean air, about the Affordable Care Act.

You go home -- we are going to have a break for the next two weeks, and I would like to see what happens when you go to the town meetings and you say that you are going to repeal the Affordable Care Act, and you are going to somehow put something in place that is going to be helpful to the American people, you

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are going to get rid of the Clean Air Act and environmental protections; but don't worry, because somehow we are going to protect the American people.

We are going to get rid of privacy under the FCC, and Space last Friday, when they asked him about the FCC privacy rule said, "Well, don't worry because the President is going to get rid of net neutrality next."

The bottom line is: everyone understands when you go home that the Republicans are trying to do harm to every health, safety, privacy, environmental protection, that exists in the Federal Government, and that that is what they are all about. There is no legislative agenda. There is no tax reform. There is no infrastructure bill.

All there is is an effort unilaterally through executive orders and CRAs to tear down everything that the American people care about and everything that Democrats, and even Republicans in the past, would try to do to help the American people.

You know, we could talk here all day about FCC versus FTC. You can talk about, you know, oh, we don't need the Paris agreement; we don't need the Clean Power Plan because we are going to do other things that protect the environment. Nobody believes it. The fact of the matter is that this President ran on a platform saying he was going to help the little guy and he was going to, you know, work against the corporate interests and Wall

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Street, and he does just the opposite; hurts the little guy every day unilaterally with unconstitutional executive orders that probably break the law. You have got to sue him, and then he says, "Well, sue me and we will see you in court."

And that is what we are seeing here. That is what we are seeing here, and it is very, very sad. It is very sad.

I have some time left. I would like to yield some time to the ranking member, Mr. Doyle, and then to Ms. Clarke.

Mr. Doyle. Thank you.

Let me say to the chairman, who is my friend -- and I am glad to be on this subcommittee here with you, Mr. Chairman -- let's take a little walk down memory lane. But let me say to you, first, that perhaps if we had some hearings on this before we jammed a CRA down everyone's throat, we might have been able to get more of these issues out in the open.

But when the FCC tried to classify internet service providers under Title 1, Verizon sued, and the courts ruled that they couldn't be classified under Title 1. So that is how they got reclassified under Title 2. And when that happened, the FTC no longer had authority to regulate the ISPs.

So what the FCC did was put forth a rule. It took 7 months for the rule to be adopted. It was adopted, by the way, in mid-afternoon in October, not at midnight before the expiration of the Obama presidency as has been said by many members of this

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committee, and the rule said three basic things. We talk about this heavy-handed rule of the government. It said three things.

It says if you are going to monetize and use someone's data, ask for permission. Ask if you -- and then if they -- if America says, "Yes, you can use my data," then you can use it. The second thing it said was -- is secure people's data. Take reasonable measures to secure people's data. They didn't even define what "reasonable" was. That was left up for the ISPs to do. And, third, if there was a breach in someone's data, that you notify them.

Those were the three basic things that this rule said. Now, somehow that become a very heavy-handed situation. This isn't about this rule. This is about --

The Chairman. Will the gentleman yield?

Mr. Doyle. -- whether the FCC has any jurisdiction over these ISPs. It is a fight over who has --

The Chairman. Will the gentleman yield?

Mr. Doyle. -- jurisdiction. But to somehow say these rules were heavy-handed or they were going to stifle --

The Chairman. Will the gentleman yield?

Mr. Doyle. -- innovation -- I will in a second when I am done -- is just not a true statement. And I will yield to my friend.

The Chairman. I appreciate that. I know this is a

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controversial subject. Let me just suggest, though, on one point. In the Brand X case, which you reference as the Verizon case, actually, the Supreme Court affirmed that Title 1 could be used for broadband classification.

Mr. Doyle. That is not how the case came out. That is not the case we are referring to.

The Chairman. I am sorry. You are right.

Mrs. Blackburn. The gentleman's time has expired.

The Chairman. They are two different ones. The Brand X case, though --

Mrs. Blackburn. The gentleman's time has expired.

The Chairman. -- was about --

Mr. Doyle. Yes. Well, that is not the one I was referencing.

Mrs. Blackburn. The gentleman's time has expired, and we will move forward with our hearing. Sounds like somebody needs a glass of water down there. Maybe too much mumbo jumbo for him going on, so we will get him some water.

So this concludes the member opening statements. I would remind everyone that, pursuant to committee rules, all members' opening statements will be made a permanent part of the record.

And I welcome our witnesses to be here today and talk about spectrum. That is going to be our focus, and we are so looking forward to your input. Our witnesses, Mr. Bergmann, Mr. Scott

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Bergmann, who is the vice president of Regulatory Affairs for CTIA; Mr. Dave Wright, who is the director of Regulatory Affairs and Network Standards for Ruckus Networks; Ms. Jennifer Manner, who is the senior VP of Regulatory Affairs for EchoStar Corporation and Hughes Network Systems. And I do have her book up here. I looked through it. I thank -- I was pleased to get the opportunity to look at it. Mr. Jared Carlson, who is the vice president of Government Affairs and Public Policy for Ericsson.

We appreciate that each of you are here today, and we will begin with 5 minutes for your opening statement. Mr. Bergmann, you are now recognized for 5 minutes.

STATEMENTS OF SCOTT BERGMANN, VICE PRESIDENT, REGULATORY AFFAIRS, CTIA; DAVID A. WRIGHT, DIRECTOR, REGULATORY AFFAIRS AND NETWORK STANDARDS, RUCKUS WIRELESS; JENNIFER A. MANNER, SENIOR VICE PRESIDENT, REGULATORY AFFAIRS, ECHOSTAR CORPORATION AND HUGHES NETWORK SYSTEMS; AND JARED CARLSON, VICE PRESIDENT, GOVERNMENT AFFAIRS AND PUBLIC POLICY, ERICSSON

STATEMENT OF SCOTT BERGMANN

Mr. Bergmann. Chairman Blackburn, Ranking Member Doyle, and members of the subcommittee, on behalf of CTIA, thank you for the opportunity to speak about how forward-looking spectrum and infrastructure policy can facilitate the 21st century wireless economy.

The U.S. wireless industry is a powerful driver of economic growth. Our members have invested over \$300 billion over the last 10 years deploying 4G and are responsible for providing over 4 million jobs. Consumer and business use of mobile broadband continues to soar, increasing 25 times since 2010 and expected to increase another 5-fold by 2021. And we are about to have a revolutionary breakthrough in the next generation of wireless, 5G.

5G networks will be up to 100 times faster and five times more responsive than today's networks. They will support 100 times more wireless devices from beacons to wearables. The U.S.

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has the ability to lead in 5G, but the global competition is fierce. China, Japan, South Korea, and the EU are all racing to be first making spectrum available and streamlining siting regulations.

Winning the 5G race means not only faster speeds, greater value, and increased choice for U.S. consumers, but empowering our businesses, our schools and hospitals, with the tools that they need to lead the world. With the right policies in place, the U.S. wireless industry will invest \$275 billion over the next 10 years, adding half a trillion dollars to our economy and creating 3 million new jobs, with more than 1,300 in Clarksville and more than 2,800 in Pittsburgh.

5G will enable a new generation of smart communities and unlock the internet of things. From mHealth to smart grids and self-driving cars, 5G will unleash innovation and growth for industries across our economy, unlock trillions of dollars of economic benefits, and help save thousands of lives.

Our 5G future depends on this subcommittee's continued focus on securing a steady new supply of spectrum and developing modernized approaches to infrastructure siting. Licensed spectrum, in particular, is the key input in mobile networks and generates significant growth in jobs. In the near term, we must ensure timely access to the spectrum made available through the successful incentive auction.

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This was the second-largest auction in FCC history, and we support a seamless repacking process to achieve the FCC's 39-month schedule so that 5G is not delayed. Planning for the spectrum pipeline now is more essential than ever. For the first time in years, there are no additional spectrum auctions scheduled. CTIA supports the Senate's MOBILE NOW legislation, which recognizes the key role that spectrum and infrastructure policy play in facilitating the next generation of wireless.

This subcommittee has the opportunity to build on MOBILE NOW and establish a robust spectrum pipeline and modernized framework for wireless siting. This will fuel investment, drive economic growth, and enable the U.S. to win the global race for 5G leadership.

It takes on average 13 years to reallocate spectrum for wireless use. This underscores the importance of starting today. We encourage the subcommittee to review federal uses of spectrum, consider ways to encourage agencies to use spectrum more efficiently, and provide a clear plan for additional licensed spectrum across a wide range of frequencies.

Finally, Congress needs to update federal, state, local, and travel wireless siting policies, which were designed for yesterday's wireless networks, not today's or tomorrow's. The small cells that will be essential for 5G are far less intrusive, the size of a pizza box or a lunch box, and will be deployed by

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the hundreds of thousands.

Today's outdated siting policies deter investment and threaten the benefits that new technologies can deliver. MOBILE NOW includes some important federal siting provisions that CTIA supports, and we believe that more can be done to address state and municipal siting reforms, including addressing burdensome local permitting with reasonable shot clocks and deemed granted remedies; ensuring access to municipal-owned rights-of-way and poles, with charges that are reasonable and cost-based; modernizing our historic preservation and environmental review processes, particularly with respect to small cells; and directing agencies to speed deployment on federal lands and buildings, with a continued focus on spectrum and infrastructure will enable wireless providers to invest, create jobs, and lead the world in 5G.

Thank you, and I look forward to your questions.

[The prepared statement of Scott Bergmann follows:]

*****INSERT 1*****

Mrs. Blackburn. Thank you, sir.

Mr. Wright, you are recognized for 5 minutes.

STATEMENT OF DAVID A. WRIGHT

Mr. Wright. Chairman Blackburn, Ranking Member Doyle, and members of the subcommittee, thank you for inviting me to provide Ruckus Wireless' perspectives on the central role that wireless technologies play in our 21st century economy.

The United States is a global leader in the development and commercial utilization of wireless technologies. Wireless innovation and investment has resulted in economic growth for a broad range of U.S. industries, produced amazing new opportunities for American workers and citizens, and made immense contributions to our gross domestic product.

Ruckus is a leading supplier of wireless infrastructure solutions, providing products and services to both enterprise and service provider customers. Our products support wireless growth in a wide variety of markets, with noted leadership in connected cities, hospitality, education, healthcare, and high density public venues.

You may have utilized our Wi-Fi networks at locations such as Hardin Hospital in Savannah, Tennessee, Pittsburgh City Hall, with the Link New York City kiosks in the Bronx, the San Jose airport, Charter Communications' deployments in great cities like Austin, Tampa Bay, and my home city of Durham, North Carolina.

In addition to our success with Wi-Fi, Ruckus is also

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developing LTE systems, which will utilize the 3.5 gigahertz CBRS band. Ruckus supports a balanced spectrum policy, which makes adequate licensed, unlicensed, and coordinated shared spectrum available for investors and consumers. I will focus on unlicensed and coordinated shared spectrum today.

Wi-Fi is the default wireless broadband network for Americans in their homes, at the office, staying in a hotel, and while flying on a commercial aircraft. To put this in perspective, Cisco reported that 8400 petabytes of traffic was transmitted over Wi-Fi per month in the U.S. during 2015. This is 16.8 times the amount of traffic that was transmitted over cellular.

The total annual U.S. economic activity associated with unlicensed spectrum was valued at \$222 billion in 2013 and is estimated to have increased to over \$547 billion today. To support a balanced spectrum policy that will support continued investment, Congress and regulators will need a broad range of spectrum designation and management options in their policy toolkits.

Ruckus offers the following recommendations with a focus on unlicensed and new dynamic models. First, Ruckus recommends that Congress and the FCC augment current unlicensed spectrum resources because, number 1, the current unlicensed designations were created with yesterday's Wi-Fi needs in mind. We need new

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designations with larger, contiguous portions of spectrum to meet the needs for today and tomorrow's Wi-Fi.

Number 2, LTE technologies are about to enter these already congested, unlicensed bands.

Number 3, our unlicensed bands will increasingly connect the vast majority of the billions of IoT devices that are coming into the market. All of this adds up to a looming challenge. A Quotient Associates report issued in February forecasts a gap of between 220 and 620 megahertz of unlicensed spectrum by 2020, growing into the future. And, unfortunately, the reality is that there have been no new designations of additional mid-band unlicensed spectrum since 2002.

Given the sharply increasing demands for unlicensed spectrum, we strongly recommend expeditious action to identify additional designations, especially in the mid band. We believe the 5925 to 7250 megahertz range is one of the best candidate bands. We also support the designation of additional spectrum above 10 gigahertz for unlicensed use.

Second, Ruckus recommends that Congress and the FCC make use of a powerful new spectrum management tool to produce more value for the economy; namely, coordinated shared spectrum or CSS. CSS is a general term used to describe dynamic spectrum management frameworks that move beyond the static designation paradigm to free more value.

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CSS frameworks differ from unlicensed frameworks in that there is a coordination requirement to access the spectrum. They differ from licensed frameworks in that the spectrum managed by CSS can be shared by a multitude of users with similar or different use cases and can accommodate both exclusive and permissive uses.

The leading example of CSS is the CBRS framework, as currently applied to the 3.5 gigahertz band in the U.S. Industry organizations such as the Wireless Innovation Forum and the CBRS Alliance have formed to commercialize the band. Both of these organizations have a diverse set of members representing the cellular, cable, enterprise, and other sectors of the economy.

Permissive use of LTE and CSS bands unlocks new deployment options and business models. We believe this will be key to meeting the challenges of both in-building and rural coverage by allowing private and public entities to deploy and operate their own LTE networks without having to acquire rights to exclusive licensed spectrum.

Another expected use case is CBRS permissive access for industrial IoT services. If the commission reconsiders the CBRS rules for 3.5 gigahertz, it is critical that any changes be done in a manner that does not negate industry-significant investments and efforts to date, nor delay the commercial availability of the band.

Finally, Ruckus recommends that the subcommittee support the

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MOBILE NOW bill. The bill includes the important commitment to add 255 megahertz of new spectrum below 6 gigahertz. We would welcome and make good use of any additional unlicensed spectrum. We do ask that Congress and the FCC consider a balanced approach to licensed and unlicensed spectrum in its implementation.

In the worst-case scenario, the bill would require the FCC to designate only 100 megahertz for unlicensed. This would vastly underresource Wi-Fi and not even meet half of the lowest estimated gap identified in the Quotient Report. Ruckus also supports MOBILE NOW's specifically unlicensed sections.

Thank you again for the opportunity to testify, and I look forward to your questions.

[The prepared statement of David A. Wright follows:]

*****INSERT 2*****

Mrs. Blackburn. The gentleman yields back.

Ms. Manner, you are recognized for 5 minutes.

STATEMENT OF JENNIFER A. MANNER

Ms. Manner. Thank you. Chairman Blackburn, Ranking Member Doyle, and members of the subcommittee, thank you for inviting me here today.

With the recent launch of our latest broadband satellite, EchoStar XIX in December, we are at an exciting time as we bring the latest in satellite broadband services to the American people, including in rural and remote areas.

I am here on behalf of EchoStar and its subsidiary, Hughes, the largest satellite broadband operator in the United States, where I am senior vice president of Regulatory Affairs.

As Congress prepares to consider legislation to encourage the deployment of broadband infrastructure, it is important to remember the critical role of satellites as a provider of services and a significant contributor to the U.S. economy.

EchoStar operates a satellite fleet of 26 satellites, many of which are constructed by U.S. manufacturers, some are launched by U.S. launch providers, and we employ almost 2,000 workers, including at our U.S. Fleet Operations Center and manufacturing facility for ground infrastructure. We also employ local installers, all adding important U.S. jobs.

In addition, our satellite network provides services across the country, no matter how rural or remote. Satellites are

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particularly adept at providing cost effective broadband services to consumers where it is too expensive to deploy terrestrial infrastructure.

Satellite capability continues to evolve to meet consumer needs, including ensuring consumers in the most remote regions of the United States have access to comparable broadband services to urban residents. Since 2007, our broadband services have met or exceeded FCC-defined broadband speeds.

With the launch of EchoStar XIX, we have broadband speeds of 25/3 megabits and more at prices that are comparable to terrestrial offerings. There is also increased demand for capacity in spectrum. To address this, we have launched additional satellites, utilized additional spectrum, and, of course, developed innovative technology. In 2008, our first broadband satellite had a capacity of 10 gigabits. EchoStar XIX has a capacity of 220 gigabits.

However, the only real way to achieve meaningful increases in capacity for satellite in all wireless services is to access more spectrum. In doing so, Congress and the FCC must adopt the principle of technology neutrality, ensuring different platforms can compete to meet the full range of consumer demands.

A little more than a decade ago, spectrum was largely allocated to different uses on an exclusive basis. While spectrum-sharing occurred, it was very limited. However, the

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demand for spectrum continues to proliferate including for satellite, requiring the adoption of new methods of spectrum allocation. And as we move towards 5G, creative means of spectrum allocation will be required to meet the demands of complementary services.

Congress and the FCC must enable competition among platforms by ensuring that no single platform is favored. If spectrum is cleared, it should not be made available for one technology but should be split in a manner that takes into account the role of each platform as well as consumer demand. The same principle must be followed for spectrum-sharing. Where there is an incumbent, sharing criteria should be reasonable and enable both services to grow.

Terrestrial deployment will be focused mostly in the urban portions of country. Accordingly, there is unlikely to be a significant demand for dense terrestrial wireless networks in lower population areas, which makes those areas appropriate for greater satellite deployment. This does not mean that portions of the country will not receive wireless services. It simply ensures that both platforms can grow and deploy to meet consumer needs across the country.

Finally, until advanced sharing technology are proven, sharing must be limited between widely deployed services. We need to retain some exclusive spectrum.

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The 21st century wireless economy is booming. With continued U.S. leadership, the future is very bright. Congress must ensure all technologies are provided the resources necessary to meet the needs of consumers throughout the country. By allocating spectrum to enable competition among platforms, we can ensure that consumers, not the government, are able to pick the best technology for their needs.

Further, we will ensure that all Americans, including those in rural and remote parts of the United States, benefit from the 21st century wireless economy.

Thank you, and I welcome any questions.

[The prepared statement of Jennifer A. Manner follows:]

*****INSERT 3*****

Mrs. Blackburn. Thank you.

Mr. Carlson for 5 minutes.

STATEMENT OF JARED CARLSON

Mr. Carlson. Thank you, Chairman Blackburn, Ranking Member Doyle, and good morning to all of the members of the committee.

My name is Jared Carlson, and I lead Ericsson's legislative, regulatory, and industry efforts for our \$6 billion North American business. On behalf of the thousands of Ericsson employees based here in the United States, it is an honor to be here.

At Ericsson, we all share the subcommittee's mission to make it easier for every American to communicate. Our vision is one of a network society where everyone and everything is connected. Our solutions, which range from mobile broadband to cloud services to network design and management, serve customers across the globe in 180 countries.

Fully 40 percent of the world's mobile traffic continues to be carried over Ericsson's networks, and at the heart of everything we do is innovation. We invest billions of dollars every year in research and development, which has led to over 42,000 patents and key discoveries. In one of our labs back in the 1990s, the peer-to-peer wireless technology known as Bluetooth was invented.

Today Ericsson continues to be an integral part of the broadband ecosystem, which is made possible by access to

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sufficient spectrum, something that remains in very short supply and an even higher demand.

To truly understand the extent of that demand, Ericsson performs in-depth data traffic measurements in mobile networks from the world's largest installed base of live networks. These measurements are then captured in the Ericsson mobility report, which we issue several times a year. Our most recent report yielded some very interesting trends I would like to share.

First, the total mobile data traffic is expected to rise at an annual growth rate of 45 percent, resulting in an 8-fold increase by 2022. Second, Smartphone traffic will grow around 10 times and will account for roughly 90 percent of mobile data traffic by the end of 2022. Third, globally, mobile data traffic grew 50 percent year over year in 2016. Fourth, mobile video traffic, led by YouTube, remains the largest contributor to traffic volumes and will grow 50 percent annually through 2022 when it will account for 75 percent of all mobile data traffic.

And, finally, over 90 percent of the world's population will be covered by mobile broadband networks by 2022. All of these metrics, and the others I included in my prepared testimony, reinforce the reality we all know too well that demand and need for mobile broadband continues to grow at exponential rates.

Our findings also continue to lead us to a central question: where can more spectrum be found? From our vantage as a global

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leader in building networks, we believe there are a few key points to keep in mind as we seek to answer that question.

One, technology cannot satiate demand for capacity alone. Two, clearing spectrum for licensed use remains the best option available today. Three, federal spectrum holdings continue to be an excellent potential source for spectrum. And, four, barriers to broadband infrastructure deployment remain and must be removed where possible.

The observations in the Ericsson Mobility Report also underscore an important idea about the future of our industry. There is no limit to the potential of emerging technologies with 5G leading the way. In that space, we are currently working with operators and industry partners to tap into the \$582 billion of global 5G opportunity that will come over the next 5 years. Interest in launching pre-standard 5G networks has increased so dramatically that many deployments have already been announced in several markets, including the U.S.

Or consider the internet of things. We believe there will be roughly 29 billion connected devices by 2022, 18 billion of which will be related to IoT. These include connected cars, machines, meters, wearables, and other consumer electronics. So we are working with our customers to avoid network congestion by managing, monitoring, and analyzing these devices in real time.

How we do that in a way that ensures efficiency and security

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will remain a key question as the wireless broadband ecosystem continues to evolve. And that is where important efforts taken by you and by this committee and by Congress come into play. The Spectrum Act of 2012 paved the way for the auction of critical spectrum in the broadcast, AWS-3, and H-Block bands.

And now Congress has another opportunity to act again with the MOBILE NOW Act. The MOBILE NOW Act is comprehensive legislation that anticipates and promotes the rise of 5G technology. It sets policy goals for spectrum access and eases the burdens we see in the field every day when we deploy network infrastructure, and it calls for the critical spectrum needed, 500 megahertz by 2020, for commercial use by easing the demands on our networks as consumers and IoT devices access more and more data-rich services.

Quite simply, the MOBILE NOW Act represents another big step Congress can take to greatly benefit our nation's spectrum pipeline and telecommunications infrastructure. For that reason, I urge the committee to support its consideration and its passage.

Looking ahead, the work that remains remains challenging but incredibly exciting, too, and I am privileged to work in an industry that is not only constantly adapting and evolving but also transforming -- transforming how people and things are connected, transforming the ways we tackle our most complex

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issues, transforming the efficiency of schools, cities, and businesses, but, most of all, transforming lives for the better.

Thank you again, Chairman Blackburn, for the invitation to be here today, and I look forward to answering any questions the subcommittee has.

[The prepared statement of Jared Carlson follows:]

*****INSERT 4*****

Mrs. Blackburn. I thank the gentleman for the testimony. This concludes our testimony, and we will begin with our questions and answers. And, Mr. Carlson, I am going to come right to you, since you were the last one to speak.

Let's talk about unlimited data plans because as we look at spectrum and the need for spectrum, we are always thinking in terms of how this affects consumers and how it affects the marketplace. And we have a lot of consumers that do enjoy these unlimited data plans. They utilize a lot of that service.

Now, you are talking about an 8-fold increase by the time we get to the end of 2022. So wireless providers, if we don't go ahead and make more spectrum available, what will we see happen to those unlimited data plans that people appreciate, enjoy, and utilize?

Mr. Carlson. Thank you for the question. I think it was implied in your question that we can't go on the way we are going without more spectrum made available. I would love to see -- I benefit myself from an unlimited data plan, and I love it and would love to see more such plans, and that just doesn't happen without the creation or without the unleashing of more spectrum for licensed use.

And in addition, you know, one can see that they will have to be more expensive. There is just no way that you maintain the current use and the current demand on networks at the present rate

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unless you start charging people more for the services that they enjoy today.

So, you know, one of the things that that the MOBILE Act does that we appreciate is unleash critically more spectrum in the mid-tier bands and in upper level bands that we think are going to be crucial going forward.

Mrs. Blackburn. Or either kept those plans, which of course affects our small businesses tremendously.

Ms. Manner, let me come to you. You mention in your testimony the satellite industry has seen 2,400 percent growth in download speeds over the past decade. So do you anticipate that this growth will continue, or are there limits to the speeds that can be achieved through the satellite technology?

Ms. Manner. Thank you so much, Madam Chair, for the question. And I just want to be specific, that was actually with regard to our system and not the satellite industry as a whole, so --

Mrs. Blackburn. Okay.

Ms. Manner. -- but I think the answer is you will continue to see growth, both through additional technology developments -- we have labs right outside D.C. in Maryland where we work very hard to develop new technologies, including with our satellite manufacturers here in the United States.

But, more importantly, we do need spectrum at some point.

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There is a limit to what technology alone can do, so we are going to need access to additional bands, especially in the upper millimeter wave bands. Thank you.

Mrs. Blackburn. Okay. Talk to me a little bit about how the speeds that you achieve through satellite compare to other technologies.

Ms. Manner. So, thank you, Madam Chairman. We are -- our company in particular primarily focuses on unserved and underserved markets, and in those markets where there is limited choice we are, you know, on par with DSL and other services that are available. Unfortunately, satellite, because of the way it is built, it is a single satellite in the sky.

In our case, we have a network of three. We don't have sufficient capacity to offer the sorts of speeds that you might see from fiber, but we are certainly comparable in the markets where we compete. Thank you.

Mrs. Blackburn. Thank you. Mr. Doyle, I will recognize -- yield back my time and recognize you for 5 minutes.

Mr. Doyle. Thank you, Madam Chair.

Mr. Bergmann, welcome. We are glad to have you here today. Let me ask you, the MOBILE NOW Act addresses the need for more spectrum, which is one of the two critical inputs into wireless communications. The other critical input is back call, the connection between a wireless carrier's tower, base station, or

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small cell and the underlying company in each market.

The FCC has found that up to a third of the cost of operation of a tower or base station is the cost to back call. Later this month the FCC is poised to vote on a BDS reform order that would prematurely deregulate business status service prices, potentially driving up the price of back call for a number of CTIA members.

I want to ask a question. Do you believe that higher back call prices for your members would delay 5G deployments?

Mr. Bergmann. So thank you, Ranking Member Doyle. So, obviously, infrastructure is one of the key elements in wireless networks, and it is very much a focus for us as we think about the next generation. And so back call is a key part of that, having enough fiber to make sure that we can deliver the capacity that we need in addition to spectrum.

We have been very focused on siting as one of the key issues in terms of making sure that we have sufficient back call out there, and so this committee's consideration of the infrastructure modernization provisions in MOBILE NOW is really important. The dig once concept is a very important concept, but there is more, frankly, that this committee can do in terms of trying to address burdensome, local permitting, and siting obligations that add cost, add delays, and make it more difficult to offer those next generation services.

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Mr. Doyle. But do you support higher back call prices on your members?

Mr. Bergmann. We are always trying to find ways to drive down costs. As you may know, CTIA has members with different views on how those services should be regulated, but we are very focused on trying to make sure that participants can deploy infrastructure, including back call out in the marketplace, and trying to find ways to remove barriers to that, wherever possible.

Mr. Doyle. Thank you. Let me ask you and Mr. Wright, there has been a lot of interest in low power, wide area networks, using both licensed and unlicensed spectrum. Major carriers and small companies are working to deploy these networks and technologies, and I have read that some of these networks would use as little as 1 to 2 megahertz.

What impact do you see these new types of networks having on the internet of things and smart cities, particularly considering their low bandwidth and their small spectrum footprints? And what are some of the ideal bands for these types of networks? Mr. Wright?

Mr. Wright. Ranking Member Doyle, as Mr. Carlson mentioned during this oral testimony, the Ericsson Mobility Report in 2016 has estimated that I believe 18.1 billion IoT devices will be connected in 2022. They further go on to say that, of those 18.1 billion devices, 88 percent of them will be connected over

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unlicensed spectrum.

So we certainly believe that unlicensed is going to play a critical role in meeting the demand for the surge in IoT devices that has been growing from essentially a 2016 level of 5.6 billion to the 18.1 billion number over the next 6 years.

In terms of what spectrum is most suitable for that, frankly, I think there is opportunities, certainly in the low and the mid band and potentially in the high bands as well. We obviously have the spectrum that was recently made available below 1 gigahertz through the incentive auction. I think that is suitable.

We have technologies today that are being used in the mid-band unlicensed, so certainly Wi-Fi, and the Ericsson number certainly would include Wi-Fi but also technology such as IGB and Bluetooth and LoRa and things like this.

So there is a range of unlicensed technologies in the mid band. That is where the vast majority of the deployments and utilization is happening today, and that is where we need additional allocations.

Mr. Doyle. Mr. Bergmann, how do you see these low power, wide area networks? What kind of impact do you think they can have?

Your microphone is off. Go for it. Thank you.

Mr. Bergmann. So the sorts of networks that you all were discussing rely on unlicensed spectrum, and we think that is an

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important component of an overall spectrum plan. Clearly, licensed spectrum is an essential part, but we would encourage this committee to look at a balance of both licensed and unlicensed spectrum.

Mr. Doyle. Thanks, Mr. Bergmann. I yield back.

Mrs. Blackburn. Mr. Lance, you are recognized for 5 minutes.

Mr. Lance. Thank you, Madam Chair.

Mr. Bergmann, while siting on federal lands is certainly important, equally important is the need to address siting issues in areas that are urban and suburban. Should we be considering reasonable shot clocks and deemed granted remedies to ensure that deployment can happen expeditiously, so consumers and businesses can get access to these new wireless services?

Mr. Bergmann. Thank you, Congressman. Absolutely. As I was discussing with Ranking Member Doyle, infrastructure is a critical component in 5G networks. And as we look to this new technology, we are looking at a different kind of infrastructure. We are looking at small cells, at the hundreds of thousands. Where typically we looked at 200-foot macro towers, now the technology is the size of a pizza box or lunch box.

We will need to have much denser infrastructure, and those kind of shot clocks and deemed granted remedies are really critical in terms of our network planning for 5G services and will

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help today with 4G networks. As we continue to increase capacity and build out to meet that consumer demand, the ability to have those kinds of shot clocks and deemed granted remedies will speed our ability to invest today and to create jobs today.

Mr. Lance. Thank you. Would anyone else on the panel like to comment? Mr. Carlson.

Mr. Carlson. If I may. I couldn't agree more that shot clocks certainly have a great role to play. You know, another issue that we face at Ericsson is laws that look at towers the same as they have been looked at for the last 20 years. And as we deploy more and more 5G type of services that are going to be very small, the size of pizza boxes --

Mr. Lance. Or a bread basket, as was said on What's My Line? The audience is looking vaguely into the distance, not remembering that.

Mr. Carlson. The policies that treat them the same as if they were a 200-foot tower just don't make any sense, and so one of the things that we would urge are policies that recognize that we are going to have towers that are on lightpoles or flagpoles even, and treating those the same as towers that are large. You know, that doesn't make much sense, and especially as we are going to be looking at deploying hundreds of thousands of 5G-based stations.

Mr. Lance. Thank you.

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Ms. Manner?

Ms. Manner. Thank you so much, Congressman. We face a different sort of regulatory hurdle that I would like to talk about for a second.

Mr. Lance. Certainly.

Ms. Manner. For Jupiter XIX -- I am sorry, for EchoStar XIX, our latest satellite, we utilize just around 20 gateway earth stations. That is our ground infrastructure. And we don't face the same siting issues as the wireless industry terrestrially, and very happy about that, and we are happy to see the legislation to help further broadband deployment.

But what we do, and what we are seeing -- are facing now is the FCC, in the upper millimeter wave bands where we operate our satellites today, have put in very conservative restrictions on our siting.

So, for instance, in the KA band, which is where our satellite operates today, we can only deploy in areas with a less of -- .1 percent population density or less, which means in population coverage areas where there is 99.9 percent of the people we can't deploy. Unfortunately, that does harm our access to back call something we depend on -- roads -- and, and most important, employees because of course we staff our local facilities as well.

Mr. Lance. And that, of course, would include New Jersey, the most densely populated state in the nation.

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Ms. Manner. Exactly.

Mr. Lance. Now, is that an FCC rule and regulation that could be amended by the newly comprised commission?

Ms. Manner. Yes, we have -- actually, we and a number of other people have petitions for reconsideration pending, so we are hoping that will be revised. Thank you.

Mr. Lance. Thank you.

Mr. Bergmann, now that the auctions from the 2012 legislation have run their course, is it your view that we need a new spectrum pipeline initiative to meet America's future spectrum needs?

Mr. Bergmann. Thank you, Congressman. It is absolutely critical that we are planning now for a 5G spectrum pipeline. The work that this committee did in the early 2000s set the stage for our global leadership in 4G, and now this committee has the opportunity to make sure that we have enough spectrum resources to do that.

A really critical piece to that are the high-band spectrums that my friend from EchoStar was talking about. In that order that was adopted last year, the FCC established a framework to make those high bands 5G first bands. We believe that is really critical. We want to make sure that the commission continues to press forward and that the wireless industry is able to build out those bands.

Those are really the launching pad for 5G services. We

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believe the FCC struck a very reasonable framework, and we want to make sure that those bands are available and able to be deployed, so that we can lead the world in 5G.

Mr. Lance. Thank you. My time has expired. Madam Chair, thank you very much.

Mrs. Blackburn. And I appreciate the gentleman mentioned the TV show What's My Line? as I --

Mr. Lance. How would you know, Madam Chair? You are much too young to recall that.

[Laughter.]

Mrs. Blackburn. I was once on that TV show, and that is all I am going to tell you.

[Laughter.]

Mr. Pallone, you are recognized for 5 minutes.

Mr. Lance. I want more time.

[Laughter.]

Mrs. Blackburn. Ain't happening, buddy.

Mr. Pallone. Thank you, Madam Chairwoman. Today I put forward a discussion draft, a bill called The Connected Government Act, which acknowledges the need to bring government services to people where they are. And, increasingly, struggling families are on mobile devices. People who make less than 30,000 a year are 13 times more likely to access the internet only on a mobile device than those who make more than 70,000 a year.

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So we need to make sure that the government services they need are easy to access on those devices, and this bill would do that by requiring consumer-facing government websites to be mobile-friendly. So I wanted to ask Mr. Bergmann, I can't -- I am sure you haven't had any time to even look or analyze this bill that just came out or this discussion draft. But do you think that CTIA could support a bill with those goals in mind?

Mr. Bergmann. So thank you, Ranking Member Pallone. Absolutely. Americans live mobile first lives. From your description of the legislation, it is encouraging government to recognize that. We know that over 45 percent of all households are wireless-only, and we love it when our government partners recognize that Americans are mobile first.

Mr. Pallone. Thank you.

I want to go to Mr. Wright. In your testimony, you note that annual U.S. economic activity associated with unlicensed uses is estimated to be well over \$500 billion today. I am concerned that when Congress starts to discuss spectrum policy, at some point the conversation inevitably turns to how much money we can raise for the treasury.

But as you point out, the value of spectrum goes beyond how much money the government can raise. So do you think it is important to make sure we address good spectrum policy before worrying about how much the spectrum is going to make for the

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government?

Mr. Wright. Thank you, Congressman Pallone. That is I think a very pertinent question and a fundamental question for the subcommittee and government at large to address. I do question the manner in which we value spectrum today, solely on the basis of the revenue that can be generated at auction.

I have noted that in some of the provisions within the Budget Act of 2015, I believe, the provisions regarding the relocation fund, we are incenting federal agencies to make spectrum available for commercial use either by clearing it fully or by making a shared federal/non-federal type use available.

However, the technical panel that is going to review payments to those federal agencies, it can only value the activity of those agencies based on, is there an incremental increase in the amount of revenue that is raised at an auction? So there is no incentive for an agency to make spectrum available, even on a shared basis with unlicensed use or permissive use with a coordinated shared spectrum framework. I do think we need to revisit how we are evaluating spectrum.

Mr. Pallone. All right. Thank you.

And then my last question, I am concerned, not for anybody in particular, I am concerned that just identifying new spectrum isn't enough. It takes far too long for entities to gain access to spectrum, and even longer for the public to benefit. So the

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question, really, is: where are the bottlenecks in the current processes? What should Congress do to resolve these issues?

I guess I could ask you, Mr. Bergmann, to start out.

Mr. Bergmann. So thank you, Ranking Member Pallone. So this committee held a hearing about a month-and-a-half or so ago on NTIA reauthorization, and I thought that was a really productive discussion about things that can happen to make government spectrum, which Federal Government users currently have primary access to over 60 percent of that spectra below 3.7 gigahertz. Those are key low-band and mid-band spectrum.

And I had a really good conversation about things that NTIA can do to have greater transparency, create greater incentives for Federal Government agencies to make spectrum available. We should certainly encourage this committee to look at incentives for federal agencies. I know that your colleagues Congressmen Matsui and Guthrie have proposed some legislation.

Creating those kinds of incentives to help make it win-win for government users is really important. I know that just yesterday the Center for Strategic Intelligence, just released a paper with -- you may remember General Wheeler, who was in charge of the communications systems for DoD, and he talked about how the last two spectrum auctions really improved DoD's capability.

So we believe that the spectrum reallocation process can be win-win, can create benefits for our global leadership, but can

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also create benefits for government users, and that makes it more likely to happen.

Mr. Pallone. I have 18 -- do you want to say something, Mr. Wright? Go ahead.

Mr. Wright. If I could, Congressman. I just wanted to agree with Mr. Bergmann. I believe that if we can encourage NTIA and the commission to work together to just identify which bands will be made available for new designations of licensed, unlicensed, or coordinated shared use, and really let industry know sooner -- we had a recent experience with the 5350 to 5470 band that we were hoping and that industry was expecting would be made available for unlicensed -- that had been in play for a number of years, and then we just learned at the end of last year that that wasn't going to happen. So I think more expeditious processing would be very helpful.

Mr. Pallone. All right. My time is up. Thank you.

Mrs. Blackburn. The gentleman yields back.

Mr. Shimkus for 5 minutes.

Mr. Shimkus. Thank you, Madam Chairman.

It is great to have you all here, and welcome. And I want to turn to Mr. Bergmann. I think you have done a good job articulating that there is a different world now between the big cell towers of the past and, really, the small cell applications.

Can you give us some -- what I want to focus on is I think

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some of the testimony, some of the comments that siting policies that are overly burdensome, discriminatory, and going beyond cost-based fees, can you give us -- I mean, what does that really mean? I think I know, but --

Mr. Bergmann. Sure. Thank you, Congressman Shimkus. I really think about it in sort of 3 buckets -- access, delays, and costs, the ABCs of infrastructure setting, and I think there are challenges on all those fronts.

We have encountered a number of localities throughout the country that have adopted moratoria on building out. So --

Mr. Shimkus. So even these small cells, they would say absolutely not, even though it is a lot different than the large tower.

Mr. Bergmann. That is exactly right.

Mr. Shimkus. And you are talking like a community, like a city, a village?

Mr. Bergmann. Communities across the country, 17 in Florida, in Tennessee, in Massachusetts, in New Jersey.

Mr. Shimkus. I mean, you go back to the old days of trying to hide the cell tower by making it a flagpole or a fake tree or something like that. So this is a different world.

Mr. Bergmann. It is a very different world. You know, when something is the size of a pizza box or shoe box -- and credit to a lot of my colleagues on the panel -- there are companies that

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are coming up with smaller and smaller cells all the time, and so we are looking to site, again, not on towers but on the sides of buildings. So it is important that we have access to those lightpoles and municipal-owned poles. And as well costs, as you mentioned, are key. We found --

Mr. Shimkus. Let me ask again, so you used a word -- I think there was a word used, "discriminatory." So give me an example of where they are discriminating.

Mr. Bergmann. In a municipality in Minnesota, one company got access to poles for \$600 a year, \$650 a year. The next company that came along 2 years later, the price was 7,500. That is a pretty big difference, and we don't think that reflects the actual costs.

We really believe that access to those rights-of-way should reflect the cost to manage it, and it shouldn't be a revenue stream. We shouldn't create a new fund diversion process.

Mr. Shimkus. And so that is the first -- the last part of my first question was this talk about beyond cost-based fees, right?

Mr. Bergmann. Sure. So --

Mr. Shimkus. Delays -- our members have routinely found that this process can take up to 2 years. When you add those delays, you add costs, you create uncertainty. It is harder to deploy your networks and plan your networks. Again, with the 5G

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services we are talking about, we are talking about those high capacity, low latency services. And we want self-driving cars? We want to make sure we have that dense infrastructure, so that we have that reliability, safety, and security.

Mr. Shimkus. Thanks.

Let me go to Mr. Carlson. Kind of along the same line, in your testimony you state that the proposed legislation reduces many of the costs of infrastructure deployment. What is not being addressed that you think should be addressed?

Mr. Carlson. Let me give that some thought. You know, I think that the idea of shot clocks isn't in this, and that could really help.

Mr. Shimkus. Pull that mike a little bit closer.

Mr. Carlson. I am sorry.

Mr. Shimkus. Mr. Lance can't hear very well.

Mr. Carlson. That the idea of increased use of shot clocks -- and Chairman Pai has raised this, too, and so I will channel him briefly, and that is the idea of using a tool called deemed granted.

So that if enough time goes by and you haven't gotten an answer one way or another, then an application to build a tower would be -- a certain amount of time you could say -- you could take it to the bank and say, "We are done." It has been however many months we are going to allow, and your inaction has meant

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that we will now put up the tower.

Mr. Shimkus. Okay. Madam Chair, I am done. I yield back.

Mrs. Blackburn. Mr. Shimkus yields back. And, let's see, Mr. Loeb sack for 5 minutes.

Mr. Loeb sack. Thank you, Madam Chair. I do want to thank the committee for holding this hearing today, the witness -- and the witnesses for testifying on this very important issue. It is a fascinating issue. It is hard to understand sometimes I think for most people, but it is so absolutely critical. There is no doubt that the advances in wireless technology have changed our life pretty dramatically, and our economy as well.

I think especially the past 10 years or so, and looking at all of the innovation happening in the industry, with all of the technology, I personally think it is -- and I know a lot of people on this -- maybe everybody on this committee believes the same thing -- we can't leave anybody behind, especially in rural areas.

I am, obviously, a huge advocate for rural America. I have 24 countries in southeast Iowa, and we have some towns of some size, but it is a largely rural place. And it is just very difficult for a lot of folks in those areas. You know the stories. I mean, you have heard about the homework gap. A lot of these kids who in school get assignments, and they have to be able to go home and get on the internet, so they can complete the assignments, their homework, but it is almost impossible in many

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instances for those kinds to do that. They have to find a hotspot somewhere, and there aren't McDonald's in small town Iowa. It is very, very difficult to do that.

Rural economic development is absolutely critical. We talk about telehealth. It is great for hospitals to have that capacity to reach out to folks in rural areas, but if someone in a rural area doesn't have sufficient bandwidth, then they can't take advantage of the other -- they can't access rural telehealth. So it is a great concept, but we need the infrastructure, we need the capacity, we need the access to spectrum, for them to be able to do that. So that is why this is so critical.

And we are mainly talking, I understand, about the MOBILE NOW Act. But, Madam Chair, I was very happy she mentioned the Rural Spectrum Accessibility Act. That is H.R. 1814 that Congressman Kinzinger introduced. I am the lead Democrat, and I want to thank him for working with me. We don't have a lot of bipartisanship at the moment in Washington, D.C., as you all know. But those of us in rural areas work together all the time on these issues, and it is really, really critical that we do it.

And, basically, this bill is very simple. It is not very long. But it would help to expand wireless coverage in those rural areas by establishing a program that would encourage spectrum licensees to lease unused spectrum to small rural carriers. That is all it would do, but that is something that

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hasn't happened in the past.

And so, basically, what it would do is, you know, allow some of those rural carriers to access spectrum that is unused. It may seem kind of far-fetched that there is unused spectrum, but there is in some places. There is no doubt about it.

I guess I want to ask, Mr. Bergmann, in your view, would this legislation help close the coverage gaps in rural parts of the country? And I am sure you may not have been able to look at the legislation yet -- we just reintroduced it -- but go ahead if you would.

Mr. Bergmann. Thank you, Congressman Loeb sack. We certainly commend you and your colleague, Mr. Kinzinger, for this legislation. I have had a chance to take a look at it, and I certainly think it offers the kind of creativity that you need to make sure that we have enough service in rural areas.

It is critically important. As you mentioned, folks in rural areas stand to benefit as much as anyone, whether it is remote surgery or whether it is education and bringing the benefits to rural kids. So we certainly applaud your creativity in terms of trying to create incentives and opportunities for flexibility in building out to rural areas.

Mr. Loeb sack. Thank you.

Yes, go ahead, Mr. Wright.

Mr. Wright. Thank you, Congressman Loeb sack. I wanted

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just to address that as well. I do understand that the cellular industry has made spectrum available to rural carriers, and that is certainly helping in this case. Ruckus has done a lot with connecting the unconnected, and I am very sympathetic to the examples you mentioned of kids having to, you know, sit in fast food restaurant parking lots to get their homework done. That is ridiculous.

I would mention the coordinated shared spectrum framework, such as CBRS, one of the things that we find very compelling is the ability to deploy LTE services in that spectrum by -- at the permissive tier, so at the general authorized tier of access without having to go through a license auction to acquire the spectrum.

So we believe that would enable municipalities and rural carriers and potentially new entrants into the market to provide coverage to rural communities at a much lower price point.

Mr. Loeb sack. You actually addressed my second question, which I don't have time for, but, Ms. Manner, go ahead. Thank you.

Ms. Manner. Thank you, Congressman. As a satellite -- nationwide satellite broadband operator, and with the launch of EchoStar XIX and going into service this March, I think you will see much-improved service with speeds upwards of 25/3 and even more for enterprise customers. So with the satellite industry

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moving in that direction, I think it is really good news for rural America, and we look forward to being a good partner with you and your constituents.

Mr. Lance. Thank you.

My time has expired. Thank you, Madam Chair. I yield back.
Thanks to all of you.

Mrs. Blackburn. Mr. Latta for 5 minutes.

Mr. Latta. Well, thank you, Madam Chair, and I am looking forward to finding out about What's My Line? now. I can't find it on the internet, but I will find out.

But thank you again for this hearing today, and I want to thank our witnesses because this is an area that -- where our country is going. As my friend from Iowa was just discussing, a lot of us that are on the rural caucus here in Congress are very concerned about areas of cost for our districts that don't have that service to help our businesses and our kids get ahead. We want to make sure it is out there.

And, Mr. Carlson, if I -- I think I am going to start my questions with you, because you have got some things in your testimony that are very interesting, because one of the great things about serving on this -- the Energy and Commerce Committee, but also serving on this subcommittee on telecomm, through the years, you know, we hear a lot of things come through here, but we are also looking at life maybe 5 to 10 years over the horizon,

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which we only have regulations out through -- we are looking in the rearview mirror.

And several years ago when -- I can still remember the hearing that we were told that probably worldwide by the end of this year we would have 1.6 devices per individual. And when I was co-chairing the internet of things working group this past Congress, and your testimony kind of brings this forward, is that you are looking at that we have between -- we are going to have between about 29 billion connected devices by 2022. And I would say the number that we were given could even -- by 2025, even have up to 50 billion by that time.

So, you know, things are moving very quickly. And I guess as we go forward with this, as we are looking for all of these devices being connected, especially through the internet of things, from our aircraft, trains, water systems -- you know, one of the greatest threats we have out there is on cybersecurity and the risks associated with that. And are we going to be prepared with our -- these internet of things devices to be reliable enough to protect against attack from cyber attacks into the future when we get to that point?

Mr. Carlson. So let me address this as Ericsson can. When we talk about 5G and IoT, they really go hand in hand. You know, from our point of view, the amount of data that you are going to see from IoT devices demands 5G technologies. And I will tell

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you this, that the standards groups that are working in 5G right now, and that Ericsson is an integral part of, are building in security at the beginning. It is not going to be an afterthought. This is something that is -- you know, will be a part of the standards from the moment that they are put out there.

You point out plains, trains, and water systems specifically, and I agree, those are crucial areas. You know, it is important to recognize that some areas that might connect by an unlicensed device maybe don't need that level of security. So it really requires, you know, sort of a holistic look at what you need for what application you are looking at.

And like I said, from Ericsson's point of view, 5G will have those levels of security that are needed to protect infrastructure, like you have pointed out, built in from the beginning.

Mr. Latta. Thank you.

Ms. Manner, if I could go back, there is something you had said -- because you were talking about with the FCC and on the regulations affecting you, and especially on the satellite site, and you thought that maybe -- that they are -- I think you used the word "conservative." Could you explain that?

Ms. Manner. Certainly. So when the FCC -- oh, thank you for the question. When the FCC adopted its regulations, it took an approach where they treated the country as a whole, and they

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said, "We are going to limit satellite deployment in all areas to this very small .1 percent population density coverage where you could put your ground facilities."

We actually do believe that is appropriate in urban areas, where we do think that 5G is going to be very widely deployed. But when you get to rural areas, I can give you an example. We have a gateway earth station in existence today that we would not have been able to deploy, and there is no people, absolutely no one within the coverage of our system.

So we are being denied access to areas to bring service, especially to rural and remote regions, but also satellite is a critical part of the 5G ecosystem. We are today; we will be tomorrow. For instance, we support pipeline customers. We support the banking system, finance, and without the ability to site our gateway infrastructures, our ground systems, we are not able to bring those services.

So while we understand some of the restrictions the FCC adopted -- and we do think those are even a little bit more conservative when we get to the more middle and lower population densities area of the country, we do think the FCC went a little too far and was aggressive in its ruling.

Mr. Latta. Well, thank you.

And, Madam Chair, my time is expired, and I yield back.

Mrs. Blackburn. The gentleman yields back.

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Ms. Eshoo, you are recognized for 5 minutes.

Ms. Eshoo. Thank you, Madam Chairwoman.

First, I just want to make a couple of comments about the legislation that is being considered MOBILE NOW, and then I have some other questions. I think on the positive side that the bill is, I think, good on unlicensed spectrum. And I think this committee knows very well, and others do, too, that I have worked hard on unlicensed for a long time because I think it really is the innovation platform. We can always do more, but I think the bill treats unlicensed well.

I think the bill is mediocre or maybe a few tabs down from mediocre on a dig once policy. It is not going to accomplish anything. It just isn't going to accomplish anything. It mentions the words, but it is -- there isn't any action plan to actually dig once and be able to expand connection for broadband, especially in rural parts of our country. So those are my two observations about the bill.

Mr. Bergmann, I want to go to you and the issue du jour that has just recently taken place, and that is the Congressional Review Act that wiped out privacy protections, and CTIA was part of the coalition that was for that. Since then, I have been busy reading what the companies have posted. I read the AT&T's blog post defending the use of the CRA to repeal the FCC's broadband privacy rules, not exactly a shock to me, but it is still

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interesting to read.

The post says that "No one is saying there shouldn't be any rules." It goes on to say that supporters of the CRA believe the FCC's rules should be replaced by the FTC's longstanding approach to privacy.

Just to be clear, does the FTC approach involve setting rules for ISPs? I mean, what do you think about that? And would ISPs be required to precisely follow the FTC's privacy framework?

Mr. Bergmann. So thank you for that question, Congresswoman.

Ms. Eshoo. Oh, you are most welcome.

Mr. Bergmann. So our companies are absolutely committed to earning the trust of their customers, and that is something that they practice every day. You are correct; we do believe that the FTC's approach, which is based on the principles of data sensitivity and consumer choice and transparency --

Ms. Eshoo. Let me just say this, Mr. Bergmann. The FTC lacks rulemaking authority. They set guidelines. So there isn't anything that is going to guarantee consumers of anything or what may constitute violations of the law. So I think it is important to set that down.

CTIA has previously testified that the patchwork of state laws covering data security and data breach notification is confusing for businesses and provides uneven protection for

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consumers. So, in your view, how is leaving consumer privacy to the same patchwork of state laws any different?

Mr. Bergmann. We do believe that having a consistent, uniform approach to all players in the internet ecosystem is --

Ms. Eshoo. How is that going to be accomplished under a patchwork of 50 states? How is that consistent?

Mr. Bergmann. So, again, we support the FTC's framework, and the FCC does have enforcement authority and does, over the vast swath of the internet ecosystem, enforce that privacy framework, and we do continue to believe that consumers should have the --

Ms. Eshoo. You know what I think has happened here? And I think the companies may not see this right now, but there is a hue and a cry from constituents on this issue. I think companies have damaged their brand with this. That is just my opinion, but it is the opinion of my constituents. I have been around for a while. I know how to measure things, and I think that they have really taken a hammer and banged away at their own brand. They have hurt themselves in this because -- for all the obvious reasons. I just want to set that down.

Now, the FCC's rules also would have required ISPs to disclose when data breaches occur. That is another protection that now won't take effect. It has been blown up. How do consumers trust that ISPs are going to keep their data secure?

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How are they going to know this?

Mr. Bergmann. So our member companies all have policies and follow the FTC's guidance on data breach notification. To your point, Congresswoman, our companies depend on the trust of their customers. And in a competitive market like --

Ms. Eshoo. Well, they depend on the trust of their customers. They have -- as I said, in my view, they have more than chipped away at that. And I think that, you know, there is something else to this, and that is that this bill was signed behind closed doors. It was not a source of pride. And I think that this is going to haunt the companies and it is going to hurt consumers. Thank you.

I yield back.

Mrs. Blackburn. The gentlelady yields back.

Mr. Guthrie, 5 minutes.

Mr. Guthrie. Thank you very much, and I was going to talk on a bipartisan bill, too, like my friend Mr. Loeb sack did. It seems like I am in a hearing about every other day. Almost -- not all hearings, we had a few here, but most somebody always starts out with, "Despite all the partisanship in town, this is a bipartisan bill."

So saying that, there is a lot of bipartisan stuff going on. Some of the big stuff that makes the news and you talk about, we just have differences of opinions on, and we express those. But

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just some of these things that are not ideological, it is just trying to move -- to fix things, we are working together.

And an example is Congresswoman Matsui and I have worked together on spectrum, a spectrum caucus, trying to free spectrum. I have said before is that I -- this is an issue I didn't campaign on, go around saying, "Send me to Washington, and I will deliver you spectrum" but people expect it and want it and want the products to work and more, more.

And so as we look at who -- the biggest holder of spectrum is the Federal Government, and so we are -- our bill has the intent of -- and it is a work in progress. It is supposed to have been filed last night. Quite honestly, I had it in my hand. This is how laws get made sometimes. I had it in my hand, and I sat it down because something happened.

I said to somebody in my office, "Remind me to take that to the floor when votes are called, and I am going to get a new designated reminder," because I knew I was going to forget, but it made its way over last night I think and got filed; if not, first thing this morning. But the important thing is that we are trying to -- how do you incentive the federal agencies to free up the spectrum?

On their behalf, one is that if you have something, you want to get rid of it, you don't want to lose it, and the second thing, is it expensive and time-consuming and difficult to clear and

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repack?

So I know like, Mr. Bergmann, and anybody on the panel, if you want to start first, you all have looked at the bill. The concept of federal incentives and, like I said, this is a work in progress. This is similar -- even though it wasn't filed until late last night, it is similar to -- it is the same as last year, and it is a work in progress to fix. So if you could comment on it, I would really appreciate it.

Mr. Bergmann. So, Congressman Guthrie, we thank you for your leadership as co-chair of the spectrum working group, and certainly your partnership with Congresswoman Matsui on that legislation -- I have seen prior congress' version -- we certainly look forward to that. We think your focus on federal incentives is critically important.

As you mentioned, the Federal Government, which has very important missions, nonetheless, has, you know, primary access to over 60 percent of that key spectrum in those key low and mid bands. And so trying to create incentives for that spectrum to be made available for commercial use is critically important.

The partnerships that we were able to develop through the AWS-3 spectrum, which freed up government spectrum and created the largest spectrum auction by revenue in FCC history, enabled us to lead in 4G, but also gave important funding to those federal agencies through the Spectrum Relocation Fund and has enabled them

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to upgrade their systems.

So we truly do believe that there are win-win opportunities, and we believe that the legislation that you are working on only underscores and makes those benefits stronger.

Mr. Guthrie. And I will open it to the panel, but I want to focus on something and everybody can comment on, too. Like I said, it is the same bill. Whether it was publicly available tonight or this morning, it is the same bill. So it does take a long time to get this through the system and to clear and repack.

So, in the meantime, and, for one, about the incentives anybody else on the panel wants to talk about, but also should the FCC be taking steps to modernize its rules and bands that could be repurposed for broadband and embrace secondary market transactions that could potentially make additional spectrum available for wireless broadband in the meantime?

Mr. Bergmann. Sure. There are absolutely things that the commission can do and we certainly applaud the FCC. At its open meeting last week, it provided more flexibility for companies to use spectrum for LTE services, took steps to eliminate some of the redundant licensing requirements and harmonize those across different spectrum bands. So we think the FCC can be busy trying to create more opportunities for flexible use.

We also think it is incredibly important that they move forward on that high-band spectrum that we have talked about

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earlier. Again, that really, we believe, is a launching pad for 5G services.

And as we talked a little bit about satellite's access to those bands, I just want to reaffirm for the committee that the satellite industry, we welcome their competition in 5G. They also have the opportunity to lease spectrum or to show up at auction and bid for spectrum the same way that the wireless industry does.

Mr. Guthrie. So you think the FCC has its own authority enough now to release high band into the marketplace, or does legislation need to be passed to do that?

Mr. Bergmann. We certainly -- we applaud them for the work that they are doing. We think that when Congress can provide clarity in timelines and guidance, that is always helpful. This committee has a long history of setting deadlines and making --

Mr. Guthrie. Ms. Manner wants to say something. I only have seconds, if you want to -- as long as the chairwoman allows it.

Ms. Manner. I really wanted to respond not directly to Mr. Bergmann, but to you, Congressman, and your statement about how to move things along faster. And we recognize -- my company certainly recognized there is a need for spectrum sharing. But I think that overall the process would work faster and better if there was also a recognition of the need for technology

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neutrality. And it doesn't mean splitting spectrum in half and, as I said, giving half or a third to a wireless, a third to unlicensed, and a third to satellite. That won't work.

But I think without those protections you are going to end up -- continue to end up with these long, protracted regulatory proceedings, and that certainly does hinder access to the market and, more importantly hinders certainty in the marketplace, which is critical for all of our companies to deploy.

Mr. Guthrie. Thanks. I thank the chair for her indulgence, and I yield back my time.

Mrs. Blackburn. The gentleman yields back.

Mr. Engel for 5 minutes.

Mr. Engel. Thank you, Chairwoman Blackburn. Before I start here, I wanted to reiterate on something that Mr. Doyle said earlier. My Democratic colleagues and I were all unanimous in our opposition to the privacy CRA, and I thought that this CRA was snuck up on us, and Mr. Doyle made an excellent point that there was plenty of time for this subcommittee to hold public hearings on this issue, argue about statutory authority, and educate ourselves and the public. And for whatever reason, we didn't do any of that.

Instead, this was rammed through, rammed the CRA through, and our constituents now, as far as I am concerned, are all stuck under this regime where they have no control over their browser

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history, their financial information, any of it. I think it is just percolating out into our country now about what really happened. People are outraged. I have heard from my constituents they can't believe that this would happen, and they feel violated. Their privacy has been violated.

So the next time an issue like this comes up, I hope we can actually follow regular order instead of doing a rush job with the CRA. I have a lot of respect for our committee and our subcommittee, and we have good people here on both sides of the aisle. And we could have had an open discussion, open hearing on it, but we had none of that. For some reason, the leadership decided to ram it through, and I just think it is an outrage.

I have been here for nearly 30 years. And, frankly, I think it is one of the biggest outrages I have seen in that time, that people should lose their privacy when they are not even aware of it and it should just happen quickly and the President quickly signs it in a closed signing. It is just not the way we should be doing business here.

I want to thank the witnesses. I am glad that there is bipartisan consensus here around the question of the need for more spectrum allocation. But in the written testimony I saw some disagreement about the question of what we should do with this spectrum once it becomes available for commercial use.

As everyone knows, Senator Thune's MOBILE NOW bill would make

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it official policy to set aside enough unlicensed spectrum to make sure that American consumers have the wireless services that they need. I think this is the right place to start this conversation. So that this is clear, I understand and appreciate how tight licensed spectrum is becoming. Carriers need to be able to clear the space they need, so that our phones, tablets, watches, televisions, and who knows what other devices in the future can maintain a secure, robust connection.

Companies absolutely need licensed spectrum to do business, and consumers rely on the services that licensed carriers provide, so they can manage their connected lives. But I am still struck by how important the unlicensed parts of the spectrum are for innovation and competitive. Wi-Fi runs in an unlicensed spectrum; Bluetooth mice and keyboards run on unlicensed spectrum. The companies are going to innovate, but the next big open source cutting edge, garage lab technology, is going to have to use the unlicensed parts of the spectrum.

Let me ask Mr. Wright a question. And, by the way, being a New York Mets fan, I love the name David Wright. I want you to know that.

You wrote a bit about this in your written testimony. You quoted FCC Chairman O'Reilly saying that the best part about unlicensed spectrum is, and the quote is, "You don't know what you are going to get out of it." I was wondering if you could

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expand a bit on what that means and why we need unlicensed spaces for people to innovate.

Mr. Wright. Thank you, Congressman. So in terms of the quote by Commissioner O'Reilly, I believe it just speaks to the flexibility that unlicensed spectrum opens up for innovators in the best minds of our country to come up with all sorts of new services. It goes back to 1985, again, when the 2.4 gigahertz band was initially opened up.

We now have Wi-Fi carrying the vast majority of wireless data traffic in the world. I won't bring up the Cisco stats, you know, for all wireless traffic. But even if we talk about just dual-mode mobile devices, so devices that have a cellular and a Wi-Fi radio in them, 60 percent of the traffic from those devices is going over Wi-Fi. It is expected to increase to 63 percent against those Cisco numbers.

So to my mind, as we look forward and we talk about virtual reality, augmented reality-type applications, unlicensed spectrum is going to play a key role in delivering those things. I was at Mobile World Congress. Certainly, the mobile industry is doing a lot in that space as well, and there will be, you know, licensed services to do that.

But in the home, in the classroom, we think unlicensed is the right technology there at the rate -- pardon me, spectrum framework there for lower cost technologies that can be deployed

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and that consumers can benefit from. So I think that is really the value of unlicensed spectrum.

Mr. Engel. So the unlicensed space that is currently available is filling up, right?

Mr. Wright. Yes, sir. Unlicensed, we have, you know, pressing needs for Wi-Fi, the Quotient Report that I cite in the testimony. We have LTE services that are coming into the mid band now, and we also have IoT taking off like a rocket ship as the Ericsson report attests to.

Mr. Engel. And, Madam Chair, if I might, I would like to ask Mr. Bergmann a quick question. It sounds from your testimony that you understand the value also of this unlimited space. You talked in your testimony about the need, and I quote you, "for a mix of licensed and unlicensed spectrum," that they are each valuable in their own way. Could you elaborate for a few seconds on it?

Mr. Bergmann. Sure. Thank you, Congressman Engel, for the question. And you are right, we do support a balance of licensed and unlicensed spectrum. I think my colleague from Ruckus has spoken about the benefits of unlicensed. Licensed plays a critical role as well, too, particularly as we look towards healthcare applications that are going to be available over 5G.

Having the ability to have the security and the performance assurances that licensed spectrum gives you is critically

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important. That is why we have really encouraged this subcommittee to build on MOBILE NOW, to make more licensed spectrum available. Again, when we are talking about investment, we are looking at the opportunity to have \$275 billion of investment and to create over 3 million new jobs in our communities, if we can make the right spectrum available for 5G.

Mr. Engel. Thank you.

Thank you, Madam Chair, for your indulgence.

Mrs. Blackburn. The gentleman yields back.

Mr. Olson for 5 minutes.

Mr. Olson. I thank the chair, and welcome to our four witnesses. I work for the people of Texas 22, which is southwest of downtown Houston. I would say it is about to overtake Chicago as the third largest city in America. My home has access to 4G, and we have -- about one-third is farming and ranching operations.

We talked in here about self-driving cars. I have seen a self-driving tractor in Fort Benton County. This man's tractor -- first of all, the cab was luxurious -- air conditioning, Sirius radio, nice big cup of cold iced tea. That tractor with a GPS would -- he predicted the field, put that in there. Every seed was planted perfectly, same distance, same depth. He just watched it happen.

Now, Texas has 254 counties. My district has 3. Those counties, most of them don't have that access. And so my

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questions are, Mr. Bergmann, a recent study by Deloitte observed that in order for us to realize the full potential of 4G networks and 5G networks, governments at all levels have to make "permitting and regulatory process more efficient."

My question is: as we work in Congress with the FCC to develop a rational regulatory process for the development of small cell technologies, what should be our key objectives?

Mr. Bergmann. Thank you, Congressman, for the question. I absolutely agree with you. Certainly think citizens in rural areas and businesses in rural areas are among the folks who can benefit the most from the next generation of wireless.

Focusing on infrastructure setting is critical. The delays that we see, particularly siting on federal lands, which you often have in the western part of the U.S., is absolutely critical. We routinely experience delays of 2 to 4 years, sometimes even longer, to site on federal lands. Even things like site renewals can take well over a year. And, again, that delay adds uncertainty, it adds costs, so reducing those delays, reducing those costs to site on federal lands, is absolutely critical.

Again, making the right spectrum available, we are about to have 600 megahertz spectrum available through the incentive auction. That is spectrum that travels long distances, so we want to make sure that that spectrum is able to be put to use as quickly as possible, so we are working very hard to make sure that we have

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a seamless and timely repacking process and get access to that spectrum are just a couple of the things that you can do to -- I am sure that that investment in that 5G is not only in rural areas but -- or it is not only in urban areas, but is also in those rural areas as well, too.

Mr. Olson. In your comments here, sir, you have mentioned the delays in the siting process. Do you think a shot clock or some deemed granted remedy, would that be helpful for federal and local siting to improve these delays and make sure we get these things going like that?

Mr. Bergmann. Shot clocks and deemed granted remedies are extremely effective tools, and we would certainly commend the committee to consider them for both federal siting and for municipal access as well, too.

Mr. Olson. Mr. Wright, comments about getting 4 and 5G to rural America. How do we make this thing happen? What should we do? What should be our key objective here, working with the FCC?

Mr. Wright. Thank you, Congressman. In terms of making LTE 4G services available to rural America, one of the things that we think is most important is the coordinated shared spectrum framework, so like CBRS and the 3.5 gigahertz band. We think that because of the flexible framework with CBRS where you have obviously the incumbent federal entities as well as commercial

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entities, you have the opportunity at the second tier for exclusive use of spectrum, and then you have the opportunity at the general authorized or third tier for essentially permissive use.

So we think that can be very critical for rural coverage, to provide 4G LTE services, where municipalities, rural service providers, or even new entrants to the market could access that spectrum, perhaps initially permissively when the spectrum is available, and at auction if necessary. We think that --

Mr. Olson. Ms. Manner, any comments, ma'am, please, quickly?

Ms. Manner. Thank you. So I would say one of the most important things, just building on my conversation with the Madam Chairman, was getting access to more spectrum for satellite services to be able to reach -- to be able to provide higher speeds and greater capacity to rural America. So thank you.

Mr. Olson. Okay. And, finally, Mr. Carlson, your comment, sir, please.

Mr. Carlson. Yes. And I will go back to something that Mr. Bergmann mentioned, and that is we have great spectrum that just was unleashed from the FCC and 600 megahertz. So anything that can be done to speed that to market, as you know, it -- the statute calls for 39 months. Anything that we can do to get that 600 megahertz spectrum out there, given its great propagation

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characteristics, should help bring broadband to your rural areas.

Mr. Olson. Thank you. My time has expired. I yield back.

Mrs. Blackburn. Mr. McNerney for 5 minutes.

Mr. McNerney. Well, I thank the chairwoman, and I thank the witnesses. I apologize for missing your testimony, but I am very excited about this issue. And I have got a staff member that is even more excited than me, so we have got some good questions prepared.

Mr. Wright, the CBRS sounds like a very interesting technology, and I think what it -- I am just going to try and explain what I understand of it, is that you have the technology that allows switching in and out of different users in the same band at the same time. Is that more or less what is happening?

Mr. Wright. Yes, Congressman. And that is exactly one of the things that we think is really novel about these coordinated shared spectrum approaches. They get us away from -- and, pardon me, I just want to say we do support a balanced designation of licensed to unlicensed and coordinated shared spectrum, but we think coordinated shared spectrum needs to be an increasing tool that, you know, regulators go to.

And it provides that flexible use between exclusive and permissive uses, as I mentioned to the Congressman from Texas, so, yes, there is the flexibility there. And the opportunity for people to actually go back and forth is also very key. You can

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start out perhaps at a permissive level, and if there then becomes some contention for the spectrum in an area, you can then go to an auction and purchase licensed spectrum. So we think that flexibility is very critical.

Mr. McNerney. And you promote expanding that beyond the 3.5 gigahertz into other parts of the spectrum, is that right, that technology?

Mr. Wright. Yes, Congressman. Obviously, every band that is looked at for possible designation, licensed, unlicensed, or coordinated shared, each band is going to have its own unique characteristics, and we think coordinated shared should be looked at. Especially when you have potentially federal protection issues, I think CBRS has shown the ability to protect federal entities, and then this very flexible partitioning between exclusive and permissive.

Mr. McNerney. Well, in your written testimony, you mention that the framework would help with rural communities have access to broadband. Could you expand on that a little bit?

Mr. Wright. Yes, Congressman. In our opinion, the opportunity for rural carriers, municipalities, or new service providers to access the CBRS spectrum, again, either at the permissive tier and/or at the priority access or licensed tier, would open opportunities to deploy LTE services, you know, at a new level, at a local level.

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Mr. McNerney. So it might help us expand broadband to the rural communities. It is one of the more economic ways to do that.

Mr. Wright. Absolutely. Because you do not have to acquire the rights to exclusive license spectrum. It is much more economical to deploy.

Mr. McNerney. Well, I am going to talk a little bit about security here. Yesterday, on an op-ed in The Washington Post, FCC Chairman Pai and Acting FCC Chairwoman Holzhausen stated that no one had to worry about their privacy because if an internet service provider were to sell their customer's personal information, it would violate ISP privacy promises.

I am concerned that these promises are all we have left to protect customer privacy. In other words, we don't have the rule of law. We just have promises. Now that the CRA has passed, is there any federal law or regulation that could stop an ISP from changing its privacy -- changing its privacy policies tomorrow? Mr. Bergmann?

Mr. Bergmann. So, Congressman, thank you for the question. I do want to assure you that nothing has changed with our privacy policies. They are the same today as they were yesterday, and the FCC still retains authority under Section 222 to set privacy rules. We are obviously working very closely with both the FCC and the FTC and certainly welcome the input of this committee on a path to make sure that the FTC, which is the expert agency, is

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able to have a consistent and clear framework across the entire internet ecosystem. But I do want to make sure that you all understand that nothing has changed with respect to our policies and that the FCC continues to have its authority under Section 222.

Mr. McNerney. But you could change your policies, theoretically.

Mr. Bergmann. So, again, our companies all have policies that comply with Section 222, the FCC's authority, different state laws, and those all govern consumer choice and transparency and data security, to your point as well.

Mr. McNerney. Okay. Mr. Wright, again, about the internet of things, how much unlicensed spectrum is currently available?

Mr. Wright. Today for internet of things we are making heavy use of the 2.4 and the 5 gigahertz mid bands for IoT devices, so that is technology such as Wi-Fi, ZigBee, Bluetooth, LoRa, Ingenu, a number of other ones. The demand for unlicensed usage of IoT devices is expected to increase significantly from approximately 5.6 billion connected devices today to 18.1 billion connected devices by 2022. This is from our friends at Ericsson, their mobility report.

So the demands for unlicensed spectrum to connect IoT is increasing rapidly, and that is one of the things that is creating a lot of pressure in the mid band for more unlicensed.

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Mr. McNerney. And with the chairwoman's indulgence, CBRS will help in that area?

Mr. Wright. Yes, Congressman, it will. One of the primary applications that we see for CBRS is also with industrial IoT, specifically where people like to use LTE technology for IoT applications but do it at a lower price point than with traditional license spectrum, and we think CBRS accomplishes that.

Mr. McNerney. Okay. Thank you. I yield back.

Mrs. Blackburn. Mr. Kinzinger for 5 minutes.

Mr. Kinzinger. Thank you, Madam Chair, and thank you all for being here with us today. I also want to thank Congressman Loeb sack for introducing with me the Rural Spectrum Accessibility Act. Once again, we introduced this because we believe it is imperative to expand wireless coverage in our rural communities, so that they are able to stay competitive in this increasingly interconnected economy.

The more we continue to talk and take action on this issue, I think the better off for all of our communities in the future. Madam Chair, I also have a letter of support from the Competitive Carriers Association, CCA, that I would like to insert into the record.

Mrs. Blackburn. Without objection.

[The information follows:]

*****COMMITTEE INSERT 5*****

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Mr. Kinzinger. Thank you.

Mr. Bergmann, first off, your organization sent out a statement of support, and I want to thank you for that. But let me ask you, what other actions should Congress take that the FCC can't in order to promote the deployment of 5G services and infrastructure?

Mr. Bergmann. So thank you, Congressman, and thank you for the legislation as well, too. So the two most important things that this committee can do is to focus on spectrum and infrastructure siting. And, again, particularly with respect to rural areas, infrastructure siting on federal lands and property, federal lands encompasses 28 percent of federal lands, literally tens of thousands of buildings, so particularly in rural areas being able to site more quickly, again, will reduce costs, will make it easier for providers to get out there, along with incentives such as the legislation that you and Mr. Loeb sack have introduced.

Certainly, your oversight of things like the development of the mobility fund is extremely important. That provides support, and we applaud the FCC for moving forward with a mobility fund to help make a better use case for -- business case for delivering services in those areas.

And then, finally, again, your oversight over the transition of that 600 megahertz spectrum is really important. We want a

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smooth transition that works for all consumers, but we really want to make sure that our companies who have just invested almost \$20 billion are able to build that spectrum out because we think that is really going to be key to serving rural areas and delivering 5G.

Mr. Kinzinger. Thank you. I am going to ask you this question as well and add Ms. Manner to this. With the closing of the incentive auction and revenues right about \$20 billion, how do you believe we should judge its outcome? We will start with you, yes.

Mr. Bergmann. So we certainly think it was a successful auction in terms of spectrum. In terms of revenue, it is the second largest auction, again, whether you measure how much spectrum is made available or how much revenue was produced. It is also just a helpful use case for the tool of an incentive.

Does it work to give folks a financial incentive to switch uses? We certainly believe that, you know, it has allowed spectrum to now be used to provide mobile broadband services that will be, again, critical for our 5G leadership. It will help our companies invest \$275 billion over the next 7 years, so we are certainly supportive. There will be lessons learned, I am sure, with the incentive auction, but we think it is a valuable tool.

Mr. Kinzinger. Thanks.

Ms. Manner?

Ms. Manner. Thank you so much. We were not a party to the incentive auction, so I don't have much of a view except to say that, of course, we are supportive of anything that gets spectrum out into the marketplace.

Mr. Kinzinger. Okay.

Ms. Manner. Thank you.

Mr. Kinzinger. And then given -- again, for both if you have comments -- given Commissioner O'Reilly's comments on the potential of another incentive auction, what are your thoughts on holding another one? And are there specific bands that we should be looking at in that process?

Mr. Bergmann. So I certainly think it is a very useful tool and agree with Commissioner O'Reilly there. And this committee has the opportunity with MOBILE NOW to show leadership as you have in the past and to create a pipeline of auctions that can fuel that 5G lead.

So certainly as we think about 5G, we think about the need for low-band spectrum, mid-band spectrum, and high-band spectrum. We would encourage this subcommittee to look at all three of those options. We think you ought to be looking at 100-plus megahertz of licensed spectrum in those low bands, hundreds of megahertz of licensed spectrum in the mid bands, and then we measure differently, we measure by gigahertz in those high bands, tens of gigahertz of spectrum for licensed use in those high bands.

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We would be delighted to work with the committee on that legislation.

Mr. Kinzinger. Okay. Do you have any opinion on it, Ms. Manner?

Ms. Manner. I would actually raise a slightly different point, if I can, Congressman, which is the need for technology neutrality and the need to ensure competition among platforms. So whether you are looking at MOBILE NOW or spectrum being made available that is available today for the FCC to make sure that there is sufficient resources for all the platforms to compete to meet all of the needs.

We certainly serve a very different need than mobile cellular industry, but to deny spectrum for that use would harm consumers, millions of consumers, across the country. So thank you.

Mr. Kinzinger. Yes, thank you.

Right on time, Madam Chair. I will yield back.

Mrs. Blackburn. Military precision. I expect no less.

Mr. Johnson, 5 minutes.

Mr. Johnson. Thank you, Madam Chair, and thank you to our panelists for being here with us today. I spent nearly 30 years in the information technology arena before I came to Congress, and, obviously cybersecurity, encryption, those are very, very important issues to me.

Mr. Carlson, the Commission on Enhancing National

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Cybersecurity identified risks associated with wireless communications as a priority in improving the nation's cyber resilience. What is your company doing to ensure our wireless connections are secure?

Mr. Carlson. So thanks for that question, Congressman Johnson. You know, I think the short answer is: everything we can. And the longer answer is one that I mentioned earlier, which is that when we roll out new networks -- and these new networks are going to be more than just connecting phones.

We are really talking about the internet of things, and by "things" that can mean connected cars, factories, healthcare, that when you look at the needs from those industries, cybersecurity is so crucial that we are really, as a company and as an industry, driving the standards bodies who make the standards that define what 5G will look like; consider cybersecurity up front to bake it in, so that we are not tacking it on afterwards, that this is something that is thought of at the very beginning when we design these networks.

Mr. Johnson. Yes, I agree with you. Security is something that has to be thought of -- thought about upfront, in the design of a system, not an afterthought. And for generations we kind of looked at it as an afterthought, and we are paying some of the prices now for that oversight.

Ms. Manner, it seems that the move to 5G is a more fundamental

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shift than even the evolutions from 2G to 3G to 4G, in terms of network architecture and spectral usage. As wireless evolves to 5G, though, how must policymakers here on the Hill, but also at the FCC, shift our thinking on spectrum policy?

Ms. Manner. Thank you, Congressman. It is actually something I have been thinking a lot about, and I wish I could tell you I have the right answer, but I can share some thoughts if that is okay. I think, first of all, you are looking at a number of technologies, wireless technologies, whether it is satellite, whether it is unlicensed, whether it is solar plains -- you know, choose your favorite -- that are all going to play complementary roles.

And it is whether -- you know, and being chosen, I think the most important thing here is giving consumers choice. And if you disallow the development of any one technology or favor one technology to the detriment of the other, it will impact what consumers can do and how the market functions.

So not that everyone should get equal -- I am certainly not advocating that, but there is a role, and that is why I think you have to move away. And I couldn't come up with a new name, so I used technology neutrality, but it is really ensuring there is competition among platforms and taking a different approach. And so I do think that is going to take a revisitation to some of the regulations and, going forward, a new mind-set.

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So thank you.

Mr. Johnson. Okay. Sticking with you, Ms. Manner, page 3 of your testimony references the resiliency of satellites. You know that because satellites are located 22,300 miles above the Earth's equator, they are immune to natural and manmade disasters taking place on the ground. The importance of such resiliency is especially obvious to emergency response communications, such as FirstNet.

How much should resiliency factor into the overall broadband equation? And, more specifically, does resiliency alone make satellites superior to fiber, wireline, or fixed wireless systems?

Ms. Manner. So thank you. It is a very good question. Resiliency -- and I used to be deputy chief of public safety and homeland security at the FCC, so I have a certain passion for these sorts of things. I wouldn't say it makes it superior, but it certainly makes it a critical part of the network and the ecosystem.

So, for instance, one of the things my company is doing right now in Arkansas, for instance, is working to deploy redundant -- basically, a back call line for satellite to the PSAP -- from the PSAP to the data center. Today a lot of times a PSAP will have two fiber links, but they will be using the same cable. So you don't really have resiliency.

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So I think what you will see -- and this ties into your last question when it comes to 5G -- you may not necessarily have satellite as the only link, but it is going to be a critical part of the network for things like IoT, whether it is security or otherwise.

I think the recent announcement -- and congratulations to the subcommittee and the committee on the announcement about FirstNet -- is that one of the big parts of the FirstNet network was the announcement of a satellite component, and I think that shows how important resiliency and having this added measure of security is to the country.

Mr. Johnson. Okay. Well, great.

Madam Chairman, I yield back. Or, Mr. Chairman. Sorry.

Mr. Lance. [Presiding.] Thank you. Thank you very much.

Mr. Johnson. Changed seats.

Mr. Lance. Thank you. It has gone downhill.

Mr. Long, you are recognized for 5 minutes.

Mr. Long. I think I resemble that remark. You say you are going downhill and then you introduce me?

[Laughter.]

Mr. Lance. It was a different paragraph, different chapter, different verse.

Mr. Long. I apologize because I left -- I got here right at the start of the gavel. You have got to be here at the drop

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of the gavel to get in order to ask your questions. And I got in here, and it seemed like this was all on privacy CRA, so I am like, you know, maybe I am in the wrong room. So I ran around the Capitol, but I think I am in the right spot.

Mr. Bergmann, you discuss in your testimony the need for a spectrum pipeline, but, unfortunately, we seem to find ourselves with no future auctions planned. And being an auctioneer for over 30 years, I have a little interest in that. How imperative is it that we schedule new auctions?

Mr. Bergmann. So thank you, Congressman. I certainly think it is one of the top priorities in terms of facilitating our 5G leadership. Having a 5G spectrum pipeline really should be a top priority. We encourage this committee to look again at a pipeline plan that has low-band spectrum, mid-band spectrum, and high-band spectrum for 5G services.

We believe that all three of those are going to be important, and we would certainly encourage you all to build on the successes in MOBILE NOW by making sure that we have enough spectrum -- again, a balance of licensed and unlicensed -- but enough licensed spectrum in each of those frequencies, in each of those different categories.

Mr. Long. If we do schedule auctions in 2017, how long will it take to authorize and conduct an auction and put that spectrum to use to serve your customer?

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Mr. Bergmann. We are always paying it forward in the spectrum world. We have reaped the benefits of decisions that this committee made in the 2000s with our 4G leadership. On average, it takes 13 years from when bands are first identified to when they are put to use, so it really is critically important that we start now in order to unlock that \$275 billion investment, those 3 million jobs that this industry, that the wireless industry can create, if this committee can move forward with additional spectrum.

Mr. Long. Okay. Just as you mentioned there, I understand that we have been a leader in 4G LTE mobile broadband with -- I had \$200 billion in investment since 2010, 4.6 million jobs, and a vibrant wireless device and application ecosystem of nearly \$120 billion, with 3 or 4 companies from the U.S. In the race towards the 5G networks, how can we ensure that we see the same kind of benefits to the U.S. economy?

Mr. Bergmann. So you are right, Congressman. It is \$200 billion from the wireless industry of investment just since 2010. That is building out those 4G LTE networks. We talked a little bit about spectrum, and creating that spectrum pipeline for 5G is critically important.

The second piece is modernizing our infrastructure siting policies. MOBILE NOW does a nice job addressing siting on federal lands, so we would encourage the committee to look at what you

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all can do in terms of shot clocks and deemed grants, so that those burdensome local permitting processes can move faster and we can invest and create those jobs. That is something that doesn't have to wait. That is something that can happen now.

Our industry is deploying small cells now. We expect to deploy hundreds of thousands of small cells over the next 3 years, and this committee's action can help unlock that and speed that investment and speed those jobs.

Mr. Long. Okay. Thank you. And Mr. Bergmann and Mr. Carlson, in the MOBILE NOW Act, when it comes to federal spectrum, the bill makes it clear that there must be a preference for licensed and auction spectrum, and you also state as much in your testimony. With the growing importance of unlicensed and sharing spectrum, why is that preference still important? I will go to Mr. Carlson.

Mr. Carlson. Thank you, Congressman Long. You know, the miracle, for lack of a better word, that we have seen with the explosion of 4G services in the U.S. was driven by licensed spectrum. That said, Ericsson fully appreciates and most of our -- I think probably most of our products have built-in Wi-Fi and unlicensed flavors of the -- of LTE, the standard that we use today.

And I want to point out that this is crucial for the U.S.'s technological leadership worldwide. When we look around the

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world as Ericsson, and we look to, you know, what is going on in the rest of the world. The bands that specifically are teed up in MOBILE NOW are exactly the bands that the rest of the world is looking to do 5G, and they are going to be doing it with primarily licensed spectrum. So when you look at 3.1 to 4.2 --

Mr. Long. It will be in low bands, mid bands, and the high bands.

Mr. Carlson. Yes. You know, the mid band that we are talking about in MOBILE NOW is really 3.1 to 4.2. This is just a terrific band worldwide and, you know, in our opinion, if the U.S. wants to maintain and grow its leadership in mobile broadband, this is the band to focus on.

Mr. Long. Okay. Thank you.

And, Mr. Chairman, I yield back.

Mr. Lance. Thank you very much, and the chair recognizes Mr. Flores.

Mr. Flores. Thank you, Mr. Chairman, and I want to thank the panel for this enlightening discussion. One of the things that was just briefly touched on early in the testimony today was the need to set standards for 5G. As I understand it, the 5G standards are not fully developed at this point.

I also understand that the Chinese are trying to pack the standard-setting committees with their representatives, so that they can be the lead in setting the 5G standards.

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I would like to know two things from you -- well, actually, three things from each of you. Number 1 is, how should we set those standards? Number 2 is, what is the -- what are the implications of the U.S. not having a lead role in setting the standards? And, number 3, what should or could the Federal Government do, if anything, to be involved?

So, Mr. Bergmann, let's start with you.

Mr. Bergmann. So thank you, Congressman. So, interestingly enough, U.S. companies play leadership roles in 5G standard-setting. I am not familiar with the issue that you mentioned, but I know that U.S. companies have pressed hard to accelerate the timeline for 5G standards. We want to be first.

And to sort of underscore your point, other countries around the globe recognize what we had with our 4G lead. They saw the benefits of that. We have the two leading operating systems in the world based here in the U.S. We have over 70 percent of the apps developed in the U.S., and that is in part because we were the 4G LTE leaders. The wireless networks here gave us that capacity.

So there really is a global race -- China, Japan, South Korea. They are making spectrum available. They are streamlining their siting processes right now. And so, you know, here at home we need to make sure that we are doing the same things, that we are making that mix of low-, mid-, and high-band spectrum available

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with an emphasis recognizing the value that licensed exclusive use spectrum plays in allowing that investment, again, certainly needing a balance of licensed and unlicensed, but recognizing that exclusive use is key for that investment that will get us that 5G lead.

Mr. Flores. Okay. What is the role, if any, that the Federal Government should play, or should it stay the heck out of the way? Other than spectrum, okay?

Mr. Bergmann. The other key piece is infrastructure siting.

Mr. Flores. Okay.

Mr. Bergmann. Making sure that we can invest and build out that spectrum is absolutely critical. We have invested, as I mentioned just a moment ago, \$200 billion over the last 7 years, and we are poised to invest 275 billion over the next 7. We need to be able to move quickly, and so shot clocks and deemed granted remedies are essential for that.

Mr. Flores. Okay. Mr. Wright? And if you can keep your answer short, that would be helpful.

Mr. Wright. Very good. Congressman, I just wanted to agree with what Ms. Manner said earlier, that in our opinion 5G will be a broad umbrella of technologies that will be needed to meet the needs of the American public. That will include satellite services, mobile services, unlicensed services such as Wi-Fi.

I think some of the areas where are showing leadership --

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certainly, Mr. Bergman can speak to the great things the cellular industry is doing, the advanced things, 3GPP, as an organization, other areas certainly on the unlicensed side. And specifically with the CBRS framework and coordinated shared spectrum, that is a spectrum management tool that the U.S. has really innovated about, and I think we should take that forward.

Mr. Flores. Okay. Ms. Manner, can you do it in about 45 seconds?

Ms. Manner. Yes, thank you. I wanted to -- thank you, Congressman. I wanted to bring up the fact that, actually, the satellite industry is actively participating in 3GPP and setting 5G standards as well for satellite. So we are very excited --

Mr. Flores. Do you have a robust seat at the table, in your opinion?

Ms. Manner. I am sorry?

Mr. Flores. Do you have a robust seat at the table, in your opinion?

Ms. Manner. You know, it is -- we are getting there. How is that?

Mr. Flores. Okay.

Ms. Manner. It is really -- I have to say, traditionally, the satellite industry has not been as active as perhaps they should be at the standard-setting bodies, and I think you are seeing, especially now with the promise of 5G, that we are

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participating more actively, so I am very excited about that.

But the other place which people don't often think about is at the ITU, but not the radio communications sector but the telecommunications sector. And the U.S. -- and you asked where the Federal Government -- and I think is doing a very good job led by the State Department -- at leading the way towards creating 5G as part of the ITU framework on the -- besides for just on the spectrum side, but on the telecommunications side and on the development side. And I think the Federal Government should continue that role.

Mr. Flores. Mr. Carlson, 26 seconds.

Mr. Carlson. You raise a good point, and that is that companies do use the standards by these groups as ways for a competitive advantage, and that is no surprise. Ericsson, if it makes you feel any better, is very active in 3GPP, and we chair a number of the committees there.

So we do take a lead in trying to make sure that the standards that come out of 3GPP are consistent with the 5G goals. And since we are so active in the U.S., you know, we are very cognizant of the need to keep, you know, the U.S. in the forefront and meeting innovation in 5G.

You also asked specifically what the Federal Government could do in relation to standard --

Mr. Flores. I am running short on time.

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Mr. Carlson. So very quickly, you know, one thing that we could do from the Federal Government's point of view is have more involvement in the coexistence studies that are used to look at different bands in these standards groups.

Mr. Flores. Okay. Thank you very much.

I yield back a negative 30 seconds of time.

Mr. Lance. Thank you for yielding back the negative time.

Mrs. Walters.

Mrs. Walters. Thank you, Mr. Chairman. I would like to thank the committee for holding this hearing and our witnesses for being here today. I particularly appreciate your expertise, since I am new to the committee and I am still learning spectrum policy.

As other members on the committee have mentioned, spectrum plays an increasing role in our lives, particularly as consumers use more and more data. Being new to the spectrum issue, I am interested in hearing your thoughts on a variety of topics.

Mr. Bergmann, this question is for you. The FCC recently issued a public notice on potential FCC actions to help expedite the deployment of next generation wireless infrastructure. Does the FCC have the authority it needs to take the steps you believe are necessary to support next-gen networks? And what, if any, steps does Congress need to take to address this?

Mr. Bergmann. Thank you, Congresswoman Walters.

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Infrastructure is an absolutely critical piece of the 5G equation. And you are right, the FCC has recently proposed some steps. At their April open meeting, they will consider some additional reforms as well, too.

We certainly applaud Chairman Pai and his colleagues at the FCC for the steps that they are taking. We think it is absolutely appropriate that the FCC update its framework. We would certainly encourage this committee to update your framework for infrastructure siting as well, too.

We think that there are things that both the FCC can do and that Congress can do. This subcommittee has, over the last 20 years, provided guidance on the appropriate policy for wireless infrastructure siting, trying to make sure that there are not delays, trying to make sure that there aren't barriers to entry.

Over a series of laws that were passed over the last 20 years, this committee has spoken to help recognize the importance of having a wireless infrastructure out there. We talked a little bit about the evolution of wireless away from macro cells towards small cells that are the size of a pizza box or a lunch box.

We really believe it is critically important that we have updated policies that reflect the need for much denser infrastructure, and the fact that that infrastructure will have less of an impact on the environment around it. So we think that there is a lot that this committee can do to speed that small cell

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deployment, and that will really help us invest and build out that spectrum that you are referring to.

Mrs. Walters. Great. Thank you. And then I have another question for you. I know many providers have faced significant challenges when attempting to deploy small cell technology. This is especially true in my home State of California where some cities have created barriers that hinder efforts to roll out new technologies.

You mentioned in your statement that CTIA supports streamlined policies for small cell deployment on federal properties and its support for shot clocks and deemed granted remedies. Can you provide an example of some of the bureaucratic roadblocks one of your member companies has faced when trying to deploy new technologies like 5G?

Mr. Bergmann. So thank you. Certainly, I would say they fall into three buckets -- denying access, so that we are not able to deploy those small cells through moratoria, which we have seen in countless localities across the country; or inability to get access to municipal-owned poles. Being able to put these small cells on tops of utility poles or lightpoles will be critically important towards the self-driving vehicles and the kinds of new services that we see out of 5G.

So access cost, we have seen fees that have no relation to the cost to actually manage the right-of-way. So we want to make

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sure that those right-of-way fees are cost-based. And the last is delays, and that is where shot clocks and deemed granted remedies can be really important.

Mrs. Walters. Okay. Perfect. One more question for you. In your testimony, you commented that there are benefits to congressionally mandated spectrum auctions for all parties involved. The wireless industry gets access to new bands to offer better services to consumers, while the government receives some proceeds to send to the treasury. In fact, wireless carriers have spent over \$100 billion on past spectrum auctions, \$36 billion of which was directed toward debt reduction.

Can that pace continue, or have we seen the height of spending for spectrum?

Mr. Bergmann. So thank you, Congresswoman. You are absolutely right. Spectrum auctions have been I think a tremendous win-win for the U.S. economy and for the treasury. That spectrum that has been made available, that \$100 billion that was spent, helped us get the 4G lead. That is what our companies built out, that \$200 billion over the last 7 years. So it is critically important.

At the same time, it has also allowed Congress to address priorities through that \$100 billion. If you look just at the last 2 years, the last 2 auctions, over \$60 billion, funds that were used to pay for the buildout of FirstNet, a public safety

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network, and also over \$36 billion to reduce the deficit.

Mrs. Walters. Okay. Thank you. And I am just about out of time.

Thank you. I yield back my time.

Mr. Lance. Thank you very much.

The chair recognizes Mr. Bilirakis.

Mr. Bilirakis. Thank you, Mr. Chairman. I appreciate it so much, and I thank the panel for their testimony today.

I want to take some time to highlight how spectrum and wireless technology is leading to innovation in my district in Florida. I represent the Tampa Bay area in Florida.

The Hillsborough Area Regional Transit, also known as HART, will soon be operating phase 1 of its autonomous public bus system, thanks to the wireless technology we are discussing today. HART will operate two vehicles along a one-mile exclusive use route operating a 10 to 15 miles per hour.

I have high hopes that Hillsborough -- again, a county in my district; Tampa is the biggest city in Hillsborough County. Again, I have high hopes that Hillsborough's first-of-its-kind system, based on spectrum technology, spurs further autonomy for the Tampa Bay area and also throughout Florida and the country.

Mr. Bergmann, beyond the rapidly advancing technology of autonomous vehicles, can you describe what other innovations to the transportation sector are expected to arise from 5G

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capabilities? Very exciting stuff.

Mr. Bergmann. Thank you, Congressman. It is exciting to see these next-generation wireless networks built into the transportation system. As you mentioned, public transport is an area where there is a lot of interest in terms of trying to make the public bus systems more efficient. The ability to manage these systems with wireless networks are predicted to reduce travel times by up to 40 percent, to reduce emissions by over 40 percent, so these are the kinds of things that can save cities money, but they can also make quality of life better, right?

If we could all reduce our commute times, we would be a little bit happier. If the quality of the environment is a little bit better, we would be a little happier as well, too.

There are also opportunities for things like smart parking, right? And we see some of that deployed today with 4G networks where we are having the ability to, again, reduce cities' costs by not having them go out and collect the money for meters as often or to route drivers to parking spots more quickly. These are small things that spread across the economy can make a big difference.

We are seeing that with 4G. I think we are going to see that exponentially greater with 5G. Part of the 5G standards are not just faster, more capacity, but the ability to connect many, many more devices, up to 100 times the number of devices. And the kinds

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of sensors that we are seeing today in fleet management, we are going to have much more capability with 5G. So there is a lot of opportunity.

Mr. Bilirakis. Very good. About 24 percent of my constituents are seniors; again, a number well above the national average. They are increasingly involved in the healthcare market and would greatly benefit from the telehealth technologies.

Mr. Bergmann, in your testimony, you briefly note that 5G networks will be more responsible than current abilities, more responsive than current abilities. Can you discuss how latency is improved in 5G and how it may advance the telehealth sector?

Mr. Bergmann. That kind of quality service and that responsiveness is critical for things like remote surgery, right? So to the extent that we are trying to put experts from urban areas and connect them with patients in rural areas, it is a really critical tool. For the elderly, the ability to have remote patient monitoring, right, to have cardiac sensors or sensors for diabetes will keep people in their homes longer.

And then maybe to tie your two questions together, any of us with an elderly relative, like the thought I think of self-driving cars, to give seniors the ability to have their freedom while keeping all of us safe on the roads as well.

Mr. Bilirakis. Very good. Thank you very much.

I yield back, Mr. Chairman. Appreciate it.

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Mr. Lance. Thank you very much.

The chair recognizes Mr. Costello.

Mr. Costello. Thank you.

Mr. Bergmann, increasing machine-to-machine communications, the rapidly growing IoT, it strikes me that battery life will be increasingly important in order to maintain the connectivity of these systems. Can you, or anyone else on the panel, explain further how 5G technology addresses or impacts battery life in IoT?

Mr. Bergmann. I may defer to my colleagues on some of the technical aspects. But certainly as we contemplate mobile first lives, this is an important area of innovation for us. We want to make sure that we have wireless wherever we want it and whenever we want it. So I know it is certainly a priority for the manufacturing industry.

Mr. Wright. Congressman, I will mention that in the context of 5G as an umbrella of technologies, including unlicensed technologies, if we look at Wi-Fi specifically -- the next generation of Wi-Fi is called the 80211AX specification -- it has new capabilities specifically around power-saving on the client. And that will be very helpful in the IoT space where we have, you know, battery-powered devices and low power consumption.

So, in the Wi-Fi space, we are certainly addressing it, and I am sure my colleagues in the cellular industry can address it

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as well.

Mr. Carlson. Yes. If I may, you know, one of the considerations that we look at when we look at standards is a recognition that we will have devices out there -- and people are building toward these standards today -- that will have to last for 10 years. So we really do see -- and to your point about the umbrella of 5G, that there will be devices that, in addition to requiring high speeds and very low latencies, some of them are going to have to last a long time, be out in the field, and so we are looking, as an industry, at extremely long battery lives and, like I said, in 10 years.

Mr. Costello. Mr. Carlson, on the MIMO antenna technology, can you explain further how the 5G new radio works to alleviate network congestion? And how does it address key needs of 5G?

Mr. Carlson. Well, I can try. When it comes to 5G, there are a number of technologies. MIMO is one that allows you to use the existing spectrum more efficiently. Other examples are beam-forming, and that is what it sounds like. So as you walk around, our towers follow you in a virtual sense and aim the signal right to you as you move around. So those are some examples of how 5G technologies really speed data to you as an end user.

Mr. Costello. On the siting issue, I struggle -- it strikes me that the next generation of siting issues is probably more like a pipeline approval process than it is your typical cellular tower

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approval process, because you need siting approval in all the locations for any one location to actually work when we are talking about the micro cells, if I got that term correctly.

What thought has been given to -- on the issue of preemption for the land use approval process or zoning process, or how is the industry going about trying to approach the fact that land use controls essentially vary municipality to municipality in most states?

Mr. Carlson. It is a difficult question. I mean, it is one that we face every day, and hope that through activities such as this and MOBILE NOW and other things that we can do here to, you know, help unify the process and bring some regularity to it.

Mr. Bergmann has talked at length about some of the problems that we see in our industry. I would also like to point out that the FCC, for its part, is going to launch a Broadband Deployment Advisory Committee, and we fully expect these issues to arise there. And hopefully some of the ideas there can percolate up to this committee.

Mr. Costello. Okay.

Mr. Bergmann. Congressman, I would say look how these absolutely play an important part in the siting process. And so we do a lot of work working with states and localities to educate them on the benefits of being the first to 5G. We really want to see smart communities, and so, you know, my colleagues in the

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industry have testified in over a dozen states since January alone. We are working hard to create incentives and interest in being the first.

At the same time, this committee has played a role historically over the last 20 years in setting out guardrails on the intersection of that local process and making sure that we are prioritizing and able to be first in wireless.

And as recently as 2012, this committee spoke as part of the 2012 Middle Class Tax Relief and Job Creation Act and recognized that wireless technology was changing, and actually said for collocations when we are adding a new antenna on, localities shall approve those and set shot clocks out there for those.

It has now been 5 years and the technology continues to evolve as we move towards small cells. We certainly think it would be appropriate for this committee to revisit that balance and, again, to provide that guidance to the localities so that we can make sure that they are able to take into account all of the appropriate considerations while making sure that we are able to invest and build out that next generation of wireless infrastructure.

Mr. Costello. Good. Thank you.

I yield back.

Mr. Lance. Thank you.

The chair recognizes Mrs. Brooks.

Mrs. Brooks. Thank you, Mr. Chairman.

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Building off my colleague from Pennsylvania's question, Mr. Bergmann, can you -- are there state and local laws on the books right now to facilitate this infrastructure deployment that you consider particularly forward-looking and that we might build a national model? Are there any that come to mind? And, if so, where are -- you know, where are they, and what are the best features of these laws?

Mr. Carlson. Sure. Thanks, Congresswoman, and I know your background as a former mayor; you have a particular interest in this issue.

Mrs. Brooks. I might add, I was deputy mayor.

[Laughter.]

Mrs. Brooks. Wasn't quite mayor, but -- and I am very, very pleased that the city of Indianapolis has been chosen to build out 5G, but --

Mr. Bergmann. And we do -- so we see some competition amongst the cities to try to be first, and recently Ohio and Arizona have passed laws. The kinds of things that I think are sort of key elements are shot clocks, deemed granted meaningful remedies, so that we don't get caught in protracted litigation, making sure that we have access to municipal poles, utility poles, and lightpoles, so that, again, we can make decisions, get access, and build that infrastructure quickly.

Mrs. Brooks. And the states that are moving forward, is this

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something that has happened at the state and the local level? Or is it primarily state legislation that has enabled it?

Mr. Bergmann. I think you see folks both at the state level and the local level recognizing that their communities want -- they want good wireless service, and they want fast wireless service. And so, you know, we have certainly seen leaders, both at the state and the local level, trying to take steps to facilitate that investment.

Mrs. Brooks. So while we certainly have heard a lot about the potential and the importance of 5G, how it will alleviate traffic congestion and, as you have brought up, enable more and more smart communities, can you talk a little bit -- that sounds very urban, and many of us I have -- while I represent Indianapolis, I also have very rural communities and counties that I represent. Can you talk about the benefits that 5G will offer in rural communities, and can we expect 5G to get to rural communities?

Mr. Bergmann. Sure. So thank you. So, you know, there is a ton of innovation and experimentation and thoughts around what 5G might mean, but let me just offer a couple of ideas. The one is as a replacement for fiber. 5G is providing the kinds of speeds and capacity that are fiber-like, and so it may provide a more cost-effective way of reaching consumers in rural areas.

Another way is through technologies like remote surgery, so,

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again, allowing an expert in urban area to serve a patient in a rural area brings those resources to the rural area. They also may then cut down on the cost to transport that patient or the time needed, right? When it is time-sensitive, you don't want to have to transport a patient from a rural area to an urban area, if you can bring someone in through remote surgery.

And another example that I think is particularly notable is the idea of virtual reality in education. So the ability to take students in a rural area, have them put on VR-wear and immediately be transported into the Roman Coliseum is a powerful way to teach those students and make sure that students in all areas of the country have opportunities.

Mrs. Brooks. Thank you. Those are terrific.

And, Mr. Carlson, and if you would both like to comment.

Mr. Carlson. Sure. And just briefly, I will add that, specifically to your question about how do we guarantee that your constituents in rural Indiana reap the benefits of 5G and new services, you know, the need for, as we have talked about, spectrum in the low band specifically for you, that is crucial.

And so, you know, the more low-band spectrum that is made available -- and the FCC just had an auction at 600 megahertz -- the characteristics of that spectrum are just perfect for serving -- for rural areas because of how far it can travel.

Mrs. Brooks. Okay. Thank you.

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Go ahead.

Ms. Manner. Thank you, Congressman. So satellite is going to play an important part of the 5G infrastructure, and especially in rural and remote areas where the cost is prohibitive for terrestrial buildout. And so we can talk about our services, but I wanted to focus for a second on next generation non-geostationary orbit satellites that are going up.

There is a number of applications pending at the FCC, and we are an investor in one company called OneWeb, and that is a low latency, high broadband speed service that is going to be available globally and be able to deliver, even in the most remote places as we do, very low latency services that are high speed without the need for the cost of the terrestrial infrastructure buildout.

So I do think that is one thing that is really important because that is part of the reason terrestrial hasn't built out to the rural areas today.

Mrs. Brooks. Thank you for that explanation. Thank you all for your testimony.

I yield back.

Mr. Lance. Thank you, Mrs. Brooks.

The chair thanks all members of the committee, including Ranking Member Doyle, for participation today.

Seeing there are no further members wishing to ask questions

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for the panel, I thank all of our witnesses for being here today.

Pursuant to committee rules, I remind members that they have 10 business days to submit additional questions for the record, and I ask that witnesses submit their responses within 10 business days upon receipt of the questions.

Seeing no further business before the subcommittee today, without objection, the subcommittee is adjourned.

[Whereupon, at 12:33 p.m., the subcommittee was adjourned.]

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