The National Press Club
NTIA Spectrum Policy Symposium
Tuesday, September 10, 2019
8:15 a.m. – 12:00 p.m. ET

Remote CART Captioning

*Communication Access Realtime Translation (CART) captioning is provided in order to facilitate communication accessibility and may not be a totally verbatim record of the proceedings. This transcript is being provided in rough-draft format.*



>> Please join me in welcoming Deputy Secretary Karen Dunn Kelley to the stage.

[Applause]

>> Karen Dunn Kelley: Good morning.

And thank you, Diane, for those kind comments and your introduction. On behalf of Secretary Ross, who is currently finishing an overseas trip to Greece and Turkey, I'm pleased to kick off the NTIA second annual spectrum conference. We created this forum for you, our stakeholders from both inside and outside the government. To provide a forum to discuss how our nation should manage radio frequency spectrum. Everyone gathered here today knows the strategic management of spectrum is critical for promoting economic growth safeguarding national security, advancing our scientific understanding, and preserving American leadership and innovation. We are witnessing ever-growing demands for limited spectrum resources as a result of technology, particularly in the fields of 5G and space commerce.

Effectively managing these new demands will require input from in close coordination with the executive branch partners, including the FCC and private sector stakeholders. I am happy to see so many interested groups gathered in one room today. My goal this morning is to share with you the administration's vision on the comprehensive long-term spectrum policy for the 21st century.

When Wilbur Ross spoke at the first spectrum conference last year, he highlighted the critical role that spectrum plays in our economy and job creation. It's been 15 months since that conference and his predictions on 5G and space commerce are already coming to fruition. Smartphone developers are delivering the first 5G capability phones to the consumer market, our nation's four national wireless carriers have each deployed 5G networks in selective cities and I learned watching football on Sunday, including NFL stadiums. And in the early stages of the network 5G smartphones are already achieving speeds of up to 10 to 40 times faster than 4G LTE speeds.

As the networks become more widely available, we expect innovators will create more powerful 5G consumer devices and establish new types of businesses and services. In space, the first non-geostationary satellite mega constellations are being readied and operators are preparing for space-based services and the first satellites have already been launched and are achieving initial milestones. If these constellations become fully operational, thousands of satellites will deliver high speed low latency and low cost broadband connectivity to every inch of this planet. Just think, once completed, nearly ½ of the world's population can have access to broadband Internet for the very first time. Last October President Trump issued a memorandum defining the administration long-term comprehensive approach to spectrum.

This began a body of work by the White House NTIA and other agencies which continues today.

One task for federal agencies has been to identify the current spectrum use but also define and anticipate future needs for the next 15 years.

Later this fall, the White House will release the national spectrum strategy called for by President Trump's memorandum. This strategy will clarify our long-term approach that incorporates planning, innovation, and collaboration. Our strategy will detail a path to realizing the president's vision on long-term spectrum infrastructure that sustains American technology and dominance. The president has made it very clear that we need a comprehensive spectrum management regime to achieve our national goals. First we need to dedicate enough spectrum to meet the growing demands of the 5G wireless services. The United States successfully led the world in the deployment of 4G LTE technology, which revolutionized the use of cell phones in everyday life. Just as we did in 4G, we need to lead the world in the 5G development. This will require that we deliver enough spectrum necessary for the innovation and that American telecom industry develop the necessary investment to get it over the finish line. Second, we must accelerate efforts to make the United States the preeminent leader in space commerce.

Morgan Stanley predicts that the annual revenue for the space industry will exceed $1.1 trillion by 2040. So it is no surprise that there are more than 80 countries vying to be the premier -- the industry's premier home. We must ensure that the U.S. is the flag of choice for space commerce. And this means a need for simplified regulatory and spectrum environment that encourages innovation.

A major goal at the Department of Commerce is set up a one-stop shopping bureau that space industry can turn to for regulatory needs. In addition, NTIA must work with federal partners to provide the satellite industry with sufficient access to radio frequency spectrum. We want to increase not just the number of satellites in space but the variety of functions that they will perform. This robust growth of satellites will improve our connectivities in the sky and ignite growth back at home.

Finally, we must protect the spectrum resources used by the government to keep us safe and improve our quality of life. The U.S. Government is the most sophisticated consumer of

spectrum in the world. Our Armed Forces, law enforcement agencies, scientists and engineer all rely on spectrum to successfully serve the public.

By protecting resources, we ensure our military remains strong and scientific understandings remain second to none. In our competitive world, our country does not have the luxury of only pursuing some of these priorities, we must pursue them all. We must pursue and achieve all of them, which will require ingenuity and close coordination between NTIA and our other federal partners.

There are many reasons to be optimistic. The United States allocated 5.9 gigahertz spectrum license exclusively for 5G. This is more than any other country on earth and we're not finished. There is an additional 7 gigahertz of spectrum under study right now and this in theory could mean 13 gigahertz allotted to 5G in the near future. To complement license spectrum, 14 unlicensed is available for use in the low, mid and high bands. Each with their on technical advantages. Just as WiFi was developed using unlicensed spectrum, we are confident that these unlicensed allocations, particularly in the high band range will unleash a wide range of new applications including virtual reality.

I also want to point out the progress we have been making in the 3.5 gigahertz band also known as the citizen' broadband radio service. Our scientists and engineers have made huge strides building a model that allows both commercial and federal users to share the 3.5 gigahertz band in realtime. Later on today, Charles Cooper from NTIA will discuss the development in greater detail, but I want to emphasize that this kind of innovation paves the way for new and exciting commercial investment. This means we are even closer to enabling technologies such as the Internet of Things, machine to machine communication as well as driverless cars. We also are working on speed to delivering satellite broadband solutions to global markets. The department's office of space commerce is actively working with the private sector and congressional stakeholders to streamline regulatory governing that satellite launch processes.

In March, NTIA submitted a report to the president with 13 specific rec long-term recommendations. These policy actions will open the door for that new generation of satellites that can provide high speed Internet access to remote locations. It also means new wireless path to realize the presence goal of affordable and reliable broadband for rural America.

The hallmark of the Trump administration's approach to the spectrum resource strategic is the resource is a strategic asset for economic and national security. This means we must make a comprehensive whole of government view on how to use spectrum, and on how best to unleash the power of spectrum based technologies to the private sector. To accomplish a whole of government approach we must follow three major tenets. The first is balance. We must balance the competing needs of all major equities to reach all of our major goals. This means not just 5G and space commerce but also critical national security and scientific exploration missions. The balance approach will produce a rising tide that lifts all boats. The

Department of Defense is already devoting resources to adopt 5G technologies for national security, and the private sector satellite technologies are interdependent.

The second principle is thing long term and comprehensive. We must develop an overarching framework that address new spectrum demands, not just for today but for centuries to come.

The third principle is innovation and pioneering. And this requires us to think beyond the traditional model of one allocation for one license for one use. You are already seeing this out of the box thinking when we think about, for example, the discussion I had before about the 3.5 gigahertz or the citizen broadband radio service. But you can also see it in what we're developing in first net. When completed, first net will allow national telecom providers and local public safety agencies to share a cutting-edge broadband technology network and particularly in spectrum allocation.

Our last principle is collaboration. The success of the spectrum policy and management structure will require collaboration and creativity from all stakeholders. The White House, Congress, federal departments and agencies, NTIA, the FCC and the private sector. With these principles as our guiding light, we will build a strong foundation for effective and efficient spectrum policies.

The United States has always been a leader in developing wireless technology, whether through the launch of commercial satellite industry or through our leadership in auctioning and licensing terrestrial mobile services, this administration is committed to maintaining this leadership particularly in the fronts of 5G and space commerce.

And the president's comprehensive and long-term approach to spectrum strategy will ensure that we are successful.

Again, I would like to thank you very much for being here today. I hope the rest of you the symposium is extremely successful and I look forward to being briefed on many of your discussions. Have a great morning.

[Applause]

>> Doug Kinkoph: Good morning. I'm Doug Kinkoph, acting deputy secretary and I would like to thank Secretary Kelley for joining and sharing her perspective of spectrum to the larger national priorities including innovation economic growth and technology leadership. We appreciate her leadership. Before we introduce the next keynote, Charles Cooper, there's probably a few housekeeping matters that could be helpful over the next couple hours. And I apologize for my voice. I'm trying to lose it here.

WiFi, the press club network is event router 6, password is events with capital E0919.

Anybody need me to repeat that?

Events router 6. Events, capital E, 0919 for the password. Refreshments, cafe on the second floor offering coffee, water and snacks. One thing about government conferences that you've been to, we provide nothing other than knowledge, hopefully, or some good dialogue.

The spectrum podium web page -- the spectrum symposium web page on NTIA.gov has a full agenda, and after the event we'll provide an archive of the webcast. Social media, use #SpectrumSymposium. Follow NTIA for followup information and keep up with NTIA related news.

With that said, it's my great pleasure to introduce our next speaker, Charles Cooper, NTIA's associate administrator for the office of spectrum management. Charles joined a little over two months ago and brings both experience and enthusiasm and has jumped in with both feet with a lot of issues on the table.

He's leading our agency's work on national and international spectrum policy issues.

He's in charge of overseeing the agency spectrum management and our federal agencies, including frequency assignments and certification. Charles manages staff of 75 here in D.C. and works closely with our lab in Boulder, Colorado. He also is responsible for developing innovative approaches to spectrum sharing and other challenging areas of spectrum management. Prior to joining NTIA, Charles was the -- was at the Federal Communications Commission serving as field director in the enforcement bureau. He also served as senior engineer as a partner with engineer and partner with Dutrell, Ludine and Rackly engineering firm specializing in radio frequency coordination and design. Charles is a member and two-term past president of the association of federal communications consulting engineers and he is also a former member of the Mississippi air National Guard and reservist, and he graduated with honors from Mississippi State. Please welcome -- please join me in welcoming Charles Cooper to the podium.

Thank you.

>> Charles Cooper: Thank you for joining us this morning. As Doug mentioned, I joined the NTIA a couple months ago as he headed the office of spectrum management. I'm grateful to speak about the progress we are making in implementing a comprehensive spectrum policy for the country.

My job this morning is to tell you how the NTIA has been working to turn the president spectrum vision into reality and what we're planning in the near future.

I also will introduce panel discussions which we're excited about. We have a great mix of government and industry experts here to share views on the challenges and opportunities that we face as we marshal our spectrum resources.

To start I would like to provide a bit of background on the NTIA's role in spectrum policy.

I'm an engineer at heart. As you can imagine, I'm excited about the opportunity to lead into a spectrum office because I know the work is rooted in the core functions of managing federal spectrum use. Every month NTIA engineers process on average 7,000 spectrum assignments and 25 equipment certification requests on behalf of our federal agencies. These are the people who make sure our service, men and women, our air traffic controllers and meteorologists have spectrum access they need to serve the country and meet their missions.

Increasingly our engineers are also helping to manage interactions among all spectrum users, federal and non-federal. As interactions have grown more complex we have been challenged to develop and implement groundbreaking approaches. Engineers both here in D.C. and in our lab in Boulderer, Colorado, the institute for telecommunication services has worked to further the goal of balancing all competing demands for spectrum. This has been a collaborate process involving not only our own engineers but those of the federal agencies, the FCC, and within private sector companies, trade associations and standard bodies.

You can certainly see the results of these four leaning approaches that have characterized the AWS1 and AWS3 transitions, ongoing efforts to show the millimeter wave bands and collective effort to implement dynamic sharing capabilities in 3.5 gigahertz citizens radio service broadband. It's a real honor for me to be part of this collaborative work. As the deputy noted, there was a far-reaching spectrum of policies last year with the presidential memorandum. We have responded to that call in close concert with both the White House, the FCC and federal agencies.

I would like to give a brief update on what we've done thus far. Last week we released the first annual update on the U.S. Government ongoing spectrum repurposing initiatives. Put together in consultation with the commission, this report provides a snapshot of the efforts to make spectrum available for broadband wireless networks, including 5G.

Through a concerted effort across government, more than 5,800 megahertz spectrum has been made available to be used for license terrestrial services including 5G. This includes under 1 gigahertz what we call the low band spectrum more than 200 megahertz available. In 1-6 gigahertz, mid-band spectrum, more than 700 megahertz. Above 24 gig, high band spectrum, nearly 5 gigahertz of spectrum. A further 7,250 megahertz potential licensed spectrum is under study or active consideration for repurposing.

There is a similar story for unlicensed spectrum. More than 14,000 megahertz of spectrum has been made available for unlicensed usage across all the bands, low, medium, high, with additional 1200 being considered. Our report shows we made significant accomplishments in that we are well-prepared to continue our efforts.

In addition to the repurposing report NTIA has embarked on a long-term effort to understand how federal agencies currently use and manage their federal spectrum assets. And to determine which spectrum requirements the federal agencies will have to use in the future years.

it's important to take a close look at the federal spectrum usage even though we know it will be a time and resource intensive project. We need accurate data to establish how spectrum vitally underpins federal operations. The better data we have, the better we'll be able to determine how to balance spectrum access for all critical users, including ongoing federal operations.

Earlier this year in response to a directive in the presidential memo the federal agency sent reports on future spectrum requirements. We're in the process of preparing a summary of those reports. For the current usage, we sent out a package of guidance documents instructing the federal agencies to begin reviewing current spectrum usage.

We asked the agencies to provide more detail than they ever have before, beginning with 3100 to 3550 megahertz and second band is 7125 to 8400 megahertz bands. We'll add additional bands on rolling basis as capacity for these reviews increases and accelerates. finally NTIA worked to create a document outlining national strategy. This will provide an outline of the elements that drive spectrum policy further into the future.

There are, of course, other ongoing efforts that predate the directives in the presidential memo. I'd like to touch briefly on the 3 and 5 gigahertz mid band citizen radio service. NTIA carried out vital engineer and software development across the spectrum access system SAS. This was a collaborative effort. Department of Defense and forum and various industry participants including the laboratory in Boulder was key to this effort. Both capabilities are integral to establishment what we call dynamic protection areas. Rather than creating static exclusion zones that would have kept CBRS out of many coastal cities we have defined geographic areas where sensing and database technologies can be leveraged to dynamically determine how the CBR systems can operate while protecting federal radar systems.

I think it is important to underscore two things with the sharing framework that is poised to kick off with the CBRS. First, when you look at the long-term goal of introducing realtime dynamic mechanisms like this, we are still on the frontier. With much further effort and refinement that will no doubt be needed as we go forward. Second, the dynamic protection areas have been tailored for operations in the 3.5 gigahertz band. Similar approaches may be useful in other bands but we can't assume a one size fits all approach will work everywhere. Still as we stand on the cusp of the initial deployments we shall reflect on audacity of the ecosystem the industry is creating in this band. We must remember the decision to replace static exclusion zones with dynamic protection areas is what got us to this point where nationwide wireless broadband service could even be viable in the mid band 3.5 gigahertz. This is a kind of bold and innovative thinking that spectrum community needs.

Looking forward, we will continue to put the president's spectrum policy approach into action. We are gearing up to implement the national spectrum strategy once it is released. We already have begun generating discussions with the leaders of the newly reconstituted Commerce Spectrum Management Advisory Committee otherwise known as CSMAC. They will be meeting soon.

Other aspects of the strategy in broader implementation of the presidential memorandum will be taken up by the policy and plan steering group, PPSG, and the interdepartment radio advisory committee IRAC, primary venues for consultation and governance in the interagency spectrum community.

We also are planning to issue requests for comments, RFCs on two important policy matters. Federal spectrum initiatives and the potential for leasing federal spectrum for non-federal uses. The incentives under the report are reallocating for spectrum. That report is due next March. Spectrum leasing concept is one that NTIA has included in past budget proposals and we continue to believe it is worthy of exploration.

We also are in the final push to prepare for the world radio conference 19 which begins at the end of October and will run through most of November. Many staff are participating members of the U.S. delegation of the conference and as always we have a vital stake in the outcome of the global allocation and regulatory decisions that will be made there.

We will provide support for head of delegation, ambassador Grace Co and her entire delegation.

Now it is time to turn things over to our distinguished panelists. I would like to thank the speakers for joining us here today and providing expertise and unique perspectives.

The first panel discussion this morning feature representatives from government, including agencies that are key federal spectrum users. These officials are familiar with all aspects of federal spectrum policy and management. They oversee some of the most sophisticated spectrum dependent systems in the world. The range of the systems from micro cell extended in the solar system is breathtaking.

These folks are all the major players in international spectrum policy work and we look forward to hearing their views.

The second panel brings together private sector experts to tell us how they see their role in spectrum and policy impacting their futures. I look forward to open discussion and also invite audience questions for both panels.

So now let's take a few minutes and I would like to have the participants of the first panel come forward and make seats at the table and I'll turn the microphone over to Peter Tenhula to moderate the discussion. Thank you.

>> Peter Tenhula: Good morning, everybody, as we're gathering for our first panel. I would like to make a few opening jokes -- I mean remarks.

Email... email... no, that's not it.

So as Charles mentioned, my name is Peter Tenhula, I am deputy associate administrator office of spectrum management. I chair a group called the interdepartment radio advisory committee.

Compute secretary Kelley talked about the importance of collaboration, and that's what we're all about. Since 1922, the interagency collaboration has been strong and keeps getting stronger and the folks to my left are a subset of that. Many other groups that go on within the government and behind the scenes that really make spectrum management happen on behalf of the federal government, I mentioned IRAC, there's also what is called policy plan steering group, PPSG, and a spectrum working group after that, SWG created under the George W. Bush administration, and that's still going strong as kind of a higher policy level.

There's other groups. Karen is involved with the interagency groups such as the position navigation timing executive committees, and its subgroups. Charles mentioned the commerce spectrum management advisory committee where we bring the industry and academic and other stakeholders in to advise us on the international side with intergovernmental and advisory groups as well. So the core, we're looking at that one leg of the stool being collaboration. That's kind of what we do. And these folks here are key parts of that.

Before we kick off basically a Q&A format for the panel, we'll let you know that we'll have some time at the end, hopefully. I can't see a clock anywhere, but I'll keep time. And some people yell at me when it's time for that. We'll have a few Phil Donahues running around with microphones so you don't have to get up. And just raise your hand, you know, if you've got a 10 or $20 bill it might get a mic faster. Maybe hold up spectrum if you've got that, we'll get your question. And we'll focus on that time cues questions and brief questions. So we have time to gather them. Because we've got some fine experts here and we've got folks here that, you know, in spectrum management community with boots on the ground, not necessarily heads in the clouds, so they know what is going on. They really know what is going on.

So we'll take advantage of that and get some of their knowledge.

I think that's it, that's all I wanted to touch upon. One rule, we're going to try to follow, just folks that aren't familiar with a lot of the stuff we do, we'll impose an R. You know what the R is? The No Acronym Rule.

Michael Calabrese taught me that joke. Blame him.

We also have a no acronym and abbreviation rule. Without a doubt, if you have an acronym or abbreviation, please try to speak it out.

So we'll start with the Q&A. I mean, the questions and answers. Right away.

Let me introduce the panel. Ian Atkins is director of spectrum strategy at FA... I'm sorry, FAA, Federal Aviation Administration. RJ Balanga. Renee. What does J stand for. Joseph.

Renee Joseph, Balanga, senior regulatory policy adviser at NASA, which stands national aeronautics.

Karen Van Dyke is PMT in spectrum. PMT is position navigation timing, spectrum management at DOT. Department of Transportation.

Last but not least, we're going in alphabetical order here. Colonel Frederick Williams, who is director of spectrum policy programs at the Do D.

We'll go in order down the row, if you don't mind.

To the extent you're involved in managing spectrum for your department or agency, you know, what are the greatest challenges and concerns? And on the other hand, what are the most promising aspects of federal spectrum management for your agency? And you do not have to kiss the IRAC ring right now. Just talk about what is going on in your agencies. You know, challenges, concerns, and also what are the silver linings? Ian?

>> Ian Atkins: I think the biggest challenge we face is that naturally we have, as our mention, just safety, everybody here, should never know how we do things. You worry about your luggage. You shouldn't worry what spectrum is used to get your aircraft from A to B. So the biggest challenge is the natural way of managing that is everything stays away from the safety mission. Nothing comes near it. So it leads us to be naturally protective and not a collaborative type of agency when it comes to spectrum. So sharing spectrum with other people, how is that going to work. Is that going to affect safety? Before I came here, they said you can't talk about that spectrum, that's especially for DMEs, we can't do that. So after some explanation, the challenge is how you change that paradigm. You're not affecting safety, that's the key thing. We were positioned to be exclusive of other use. That's how we would protect safety. But if you make two key assumptions, number one, everybody flies, and number two, that nobody wants safety to. So with those in mind, you can have an inclusive way by including partners and collaborating, and once the missions are shared, then the missions collaborate to become safe. So the rewards, as soon as you go down that, everybody wants to be involved, everybody understands your mission, and it's no longer very, very separatist and exclusive. It's now very inclusive and very rewarding.

So just the paradigm change is difficult to make for an agency focused on safety.

>> Peter Tenhula: RJ.

>> RJ Balanga: From a NASA perspective, going to outer space is not easy. It takes a long time for us to get from the ground up to space. So in turn, the timing from con ops to R&D and deployment and operation and sustainment take a long time. So as we are developing our missions to go out to outer space, the next program we're ensue right now is the Artemis, going to the moon, Mars and beyond.

We're trying to get the first woman and next man on the moon, boots on the moon by 2024. So that takes quite a while to achieve. This is a compressed time frame. However, my point being that spectrum is always changing, the spectrum management process. We have developed our processes and developed the systems, you know, from the get-go, maybe five or ten years ago, and then trying to get -- meet the demand of this ever-increasing spectrum environment. There's always changes, but how do you effect those changes into today in a process already in play for the last five or ten years.

Change is fun.

>> Peter Tenhula: Karen, challenges, concerns, promises?

>> Karen Van Dyke: Safety is Department of Transportation's top priority, so we have a four strategic goals, safety, innovation, infrastructure and accountability, but safety is always number-one for us, and so we really see this as an opportunity given that safety is our top priority, looking to the future. It's really important to ensure the radio frequency spectrum is protective from harmful interference and ensure spectrum meets current and emerging needs for the Department of Transportation. So in 2017 there were 37,133 deaths on our nation's highways and nearly 2 million injuries, not to mention significant property damage. And so critical to DOT safety improvements and efforts to reduce the number of vehicle crashes is the ability for vehicles to communicate with one another and everything around them, the infrastructure, pedestrian and other applications. And it's connectivity that creates a level of situational awareness such that properly equipped vehicles can warn drivers of impending crashes, pre-arm airbags and other safety features when a crash is imminent. And as the use grows throughout the fleet, research has shown that active vehicle control will reduce crashes even further. And so critical to this is low latency short range and immediate spectrum access offered by the 5.9 gigahertz beyond and so a lot of our efforts are focused on that.

Some of our challenges and concerns are number one, a regulatory certainty or uncertainty is a challenge, and transportation users really need to have the confidence in the system and businesses to make long -term investments in innovative technologies and innovations and ensure the spectrum is going to be available for those purposes. And we recognize technologies change and evolve more rapidly than has been so in the past.

And, again, foot stomping safety, protection of radio frequency bands from harmful interference, so we can't have safety critical applications that are subject to disruption.

>> Peter Tenhula: Thank you. Colonel Williams, we only have an hour for this panel, so the greatest challenges and concerns and promises at DoD.

>> Fred Williams: Thank you very much and thank you for the invite today, honored to be here, a privilege to be here and be able to work with what I call the whole of the nation on these matters. I think Mr. Tenhula rephrased the question overnight. He asked what keeps us up at night, and I think to maybe plagiarize former Secretary of Defense for the DoD position, we sleep pretty good. We keep other people up at night, right?

We are very good in DoD at turning challenges into opportunities. For us DoD is a mission-based with missions that are designed to create effects on an adversary. Those missions go across our domains that we operate in, air space, cyber, sea, sub-sea, and land. So we occupy a great number of spectrum bands, because those capabilities that we design are spectrum dependent systems. You can imagine we are highly mobile. And so that allows us to exploit the spectrum. We have things called air superiority, land superiority, sea superiority, space superiority. We also like to have spectrum superiority when the balloon goes up and we get called to duty. So we occupy those bands and our greatest challenges or opportunity is making sure spectrum doesn't create a readiness issue for the United States Department of Defense. We have to get the operators repetitions, in other words, practice their craft in the United States and provinces. We have to train. We have to test. We have to exercise. And we do so a lot. Spectrum has become congested. And so we're learning new ways to play through that or operate through that. But that's what the big impact is. Spectrum is a huge enabler for the Department of Defense.

>> Peter Tenhula: Thank you for that. I'm going to throw direct questions at each of the panelists specifically what they're working for and hit kind of the follow-on to the point that Colonel Williams was making about the mission. If there's any particular spectrum management policies that the department would consider essential, you know, to meet that 21st century global mission, colonel do you want to take that on?

>> Fred Williams: Thank you. To know where you're going, you kind of have to know where you have been, and I think it's very enlightening if you look back at broadband coming into the fold, if you will, it's got quite a story. And it's a good one. It's a positive story for this nation and we need to be in lead in that. DoD in particular needs strong companies. We have economies of scale that we benefit from. And we fully support the president's vision on 5G. But you've got to go back and look at the story and what has served that. Our spectrum management processes, systems, they have served us greatly up to this point. But what we're seeing now is technology vectors that are pointing us to where we have to start thinking and lead turning policy ramifications to accept some of these technology innovations. We are very excited about that. I think any future policy must strike a strategic balance. Today the appetite for broadband is there and we need to go after that. We need to be a world leader in that. And we greatly support that. However, it doesn't cause us to deny the other capabilities that also provide services, economies of scale, such as satellite WiFi. We are big users of satellite, and so I think while we may put a primacy on one capability at some point in time, we have to be mindful and be balanced that those other things also contribute holistically to the entire apparatus. I think one of the most exciting things for DoD is what we're seeing in the way of cognitive cohabitation. We have, up to this point, had pretty much a static chart that we manually separated capabilities either in geography time or frequency. Now we're seeing where we can actually operate in the same time, same frequency and same geographic space.

The CBRS effort is an initiative that I think is indicative of a whole of nation approach, what we can do if industry, federal government, non-federal, FCC, NTIA, all get together and put our heads together. And if you look at the history of that band and how it was set up, we actually set it up with protection zones on the cost to protect DoD from broadband. Industry brings in a solution and allows them to sense us and avoid us. That is brilliant. And we've been working

very hard to pull that off and we're excited about that. We also think that lends itself to applications well beyond that band.

And in the reverse. DoD also produces similar systems to sense and avoid, and if we can use these things to cognitively cohabitate, then we really build efficiencies in the U.S. enterprise. Our policy has to adjust to account for those. We've taken steps before. I think the current policy allows for dynamic spectrum access of systems but we have to start really putting the rules together for that and start to figure that out. We are designing some frameworks that we're going to share with NTIA for consideration. They're not a specific answer, but a starting point. Thank you.

>> Peter Tenhula: And Karen, you mentioned intelligent transportation as a core focus on the transportation department. Other areas you might want to mention in the spectrum policy work that the transportation stakeholders kind of need to resolve. What might be driving the demand in these areas, any technological advancements, commercial band regulation, with regard to either the -- the smart vehicle side or other areas?

>> Karen Van Dyke: So spectrum is important for all modes of transportation, navigation systems, communication systems, surveillance systems, so while we've been focusing a lot on surface transportation, that's not to minimize the other applications as well. And so really foot-stomp again the regulatory certainty that is needed to allow those innovations to blossom and much focus on automated vehicles really to reduce the number of deaths and injuries that we're seeing. And on the navigation side, Department of Transportation serves as a civil lead for GPS, great partnership with the Department of Defense. But as we look to the future, GPS is critical to every mode of transportation, again, with safety as our top priority. We really want to ensure that GPS is protected from harmful interference.

>> Peter Tenhula: A hush falls over the room.

Good hush. You guys are paying very good attention.

NASA, RJ... you're aggressively pursuing manned and unmanned space programs over there. Have you got your ticket yet for the moon or Mars?

>> RJ Balanga: Not yet. Where do I get it?

>> Peter Tenhula: What are NASA priors for retaining or gaining new spectrum access going forward?

>> RJ Balanga: Based on the spectrum space directive number one, NASA is returning to the moon, as you mentioned, followed by robotics manned missions to Mars and beyond. We have increased focus on human space flight and robotic endeavors to the moon and Mars and those endeavors will require higher data rate transmissions. That results in increased spectrum usage by NASA for radio services such as space research, space operations, earth explorations and satellite and aeronautical required to support robotic and space operations.

NASA will continue to rely heavily on spectrum frequency allocations that we currently are ascertain to support existing NASA missions. S band and X band and KA band frequencies will increase. Enhancing interoperability between NASA missions and supporting NASA and the commercial networks is one of NASA's main objectives going forward to enable flexible and agile spectrum access for NASA missions. NASA will need to work closely with the commercial service -- the commercial space industry and our international partners. Where the communications act amended provides great regulatory framework for terrestrial and sub orbital systems, much of the spectrum regulations for space are at the international or global level. NASA would like to assist NTIA and FCC in defining regulations suitable for space operations and therefore we are planning to operate a symposium next year for all space users. This will be what is called the space spectrum symposium and will be held sponsored by NASA and held at our NASA headquarters in Washington. You can visit our website for more information.
>> You can't call it a symposium. That's our word!

[chuckles]

>> RJ Balanga: We'll figure out another word for it.

>> Peter Tenhula: All right.

>> RJ Balanga: During this event we intend to bring together thought leaders in the private industry, academia and federal government to address the strategic policy, technology and mission objectives for U.S. policy regarding spectrum in space. This symposium, if you may, will serve as a venue to foster inclusive partnerships across private and public organizations in order to facilitate innovations in space and spectrum access.

Thank you.

>> Peter Tenhula: All right. Thank you. Ian, what is going on at the FAA when it comes to the safety mission you talked about and the specific spectrum dependent technologies that are kind of emerging that might require new or different allocations that you're working on?

>> Ian Atkins: Interesting enough, we actually are not planning on increasing our spectrum need. Our spectrum need will actually go down. And we're able to do that because a lot of our systems are somewhat older. For example, we can take a single analog channel and get so much more utility out of it. So what we're really looking at is focusing on increasing the utility of the spectrum we have and looking at combining systems, reducing basically the whole infrastructure footprint. That actually makes us safer. It actually makes it more reliable. And one of the other things that has happened, working with new entrance, particularly in the unmanned aircraft industry has really been quite exciting and quiet enlightening. Because one of the key questions people kept asking is have we got to use aviation spectrum. And if you look at the explosion of unmanned aircraft, there would never be enough aviation spectrum to use. And so the question it comes down to is we can use the spectrum that has the same characteristics, same availability, same reliability we require for an aircraft, that's what we need

to specify. We don't need to specify you have to have your own spectrum. When we went down that road we started working with the cellular companies and saying, could you provide this service to this level? And the answer was yes. And so now what you have is by far most of the unmanned aircraft, big pilot programs, are working with the main cellular companies for their command and control and all their data links.

So that's taken a huge load off what would have been aviation spectrum.

The other thing we have done with working with these guys is, you know, we're not boots on the ground. We're actually heads in the cloud people. We actually have to manage our spectrum unlike the cellular companies. We have to manage it in 3D. We don't do service areas. We do service volumes. Now, the way we plan our spectrum, we're required to plan our frequencies so that two aircraft at 40,000 feet can see a long way. So we have to space our frequencies out considerably.

So what we have been looking at if we are providing a service up here, the room low down where we can do things? Is there a 3D white space that we could find and provide?

So, when the reauthorization came out we were looked at a couple bands, L band and C band. Initial in C band was, that's sensitive, navigation equipment, you can't touch that. Second reaction is, well, hang on, if we at altitude, is there a way to fit in unmanned aircraft mission low down by managing that? And we started looking through the spectrum to see that and we are finding there is a great opportunity to support that at low altitudes where it doesn't interfere with the operation up here. That is actually -- we approached that in two ways. If we didn't approach it, then we could see we would get interference and have problems, because people would try it out anyway. If we did approach it, we would be able to approach it from the point of view of we could collaborate with the people wanting to use the service down there, so that we could tell them, here is a 3D geomap of what you can use and where you can use it, and basically by us providing that map, we end up protecting ourselves. If we ever get interference we can take a single channel out of that map so it doesn't cause interference. So now we have a very much -- we're not in the cohabitate. We're into cohabitation. It could even be the same system. We could share systems now.

So it's a whole change from we have to stay separate to everybody supports the mission, nobody wants to break the mission. Once you have that realization, you end up with a much, much more involved much more exciting area.

>> Peter Tenhula: Right. Interesting. So I'm going to raise it up to 10,000 feet, back up in the clouds a little bit, or 10 gigahertz, as they say.

Deputy secretary Kelley mentioned national spectrum strategy expected to come out this fall from the White House.

At the risk of previewing that, what would your industry like to see resulting from the strategy and its implementation, which we're going to be a big part of in collaboration with the agencies, and what would you like to see coming out of that strategy to support your agency's spectrum management activities and duties? I'll just throw that out to whoever wants to be brave enough to tackle that one.

>> Fred Williams: Thank you, sir. This is another exciting project that DoD is immersed in. With this administration, we saw a new national security strategy. We then design a national defense strategy, international military strategy and in that we're after lethality reform and partnerships. The Department of Defense chief information officer designed what we are calling a digital modernization strategy that is going to involve command and control communications, C3, cyber, and then enterprise cloud and AI.

Spectrum is a big, big part of this. And so what we've been doing in help the whole of nation build this national spectrum strategy, align DoD position with that so that when it comes to implementation it's a natural fit, and NTIA and DoD have been working very, very hard over about a year to get at least DoD positioned such that we can contribute to and benefit from what we see as these technology vectors in particular 5G.

What we would like to see out of it, we are already conducting future spectrum requirements drills and current usage drills, which we think hopefully will help us improve data, help us to see and maybe go after some efficiencies. We love the research and development projects that could come out of this, that find efficiencies and more spectrally efficient capabilities. And then, of course, I'll go back to you have to know where you've been to know where you're going.

Our automation, our spectrum management systems processes, and people for that matter, we've got to modernize. We are taking way too long to get to the speed of decision. And we are excited about those lines of effort that could potentially come out of a national spectrum strategy where we feel like an enterprise architecture that DoD is developing right now for spectrum operators, we are trying to build that from target to takeoff, where we focus on what our missions are supposed to do, and we build that back to where we can use the same systems and tools in an automated fashion to do our daily spectrum management functions of assignment, certifications and things like that.

We also would like to see a set of tools that allows the entire community on a shared basis to get to "yes" quicker on certain decisions for this nation, specifically our electromagnetic spectrum analysis tools. The modeling and simulation, to ray models, anomalous propagation models, atmosphere models, all those need to be modernized and we feel like the national spectrum strategy is going to be a big catalyst of getting those things done.

>> Peter Tenhula: Anybody else on the strategy?

>> Karen Van Dyke: I'll just echo Colonel Williams' remarks and within the Department of Transportation, with the exception of FAA, we don't actually manage most of the radio frequency bands, so we utilize them, so we want to really ensure that those tools are available to conduct sound engineering analysis, so we're making informed decisions on the utilization of spectrum and what the innovations can bring for all of our missions, and so it really requires that close cooperation with industry, and I think it's an opportunity looking to the future just in terms of best utilizing a spectrum that is available and really having that sharing analysis and the tools for interference assessment. And while we don't want to -- we don't want interference to occur in the first place. If it does, the ability to rapidly detect it and have the notification so it can be addressed.

>> Peter Tenhula: Good point. RJ.

>> RJ Balanga: We know that the national spectrum strategy, as soon as it comes out, it will be made available, but the premise for the national spectrum strategy was a presidential memorandum of October 2018. And in that presidential memorandum the president referenced advancing space missions and sharing, and NASA is looking forward to seeing those types of elements in the strategy to help advance those objectives and help us and open the doors to partner with our commercial space industry folks as well as our international space partners.

One of the things I mentioned earlier is Artemis, that program. NASA's campaign is we are going. One of the things when we are going to the moon and to Mars and beyond, we are going to quickly -- we're going there quickly and sustainably with reusable architecture. Going with commercial international partners to explore faster and more together. We're going to bring new knowledge and opportunities for everybody and use the moon's resources to enable further exploration, proving out those technologies will take us to Mars and beyond. And we're hoping that some of the initiatives that will be outlined in the strategy will help open those doors for us to do so.

>> Peter Tenhula: I'm sure they will. Ian, any words of wisdom on that?

>> Ian Atkins: We've gone down the road of automating significantly. Most spectrum tools are available online. We've trained other agencies. We're trained commercial industry and members of the public on how to use it. So anybody can apply for a spectrum allocation from that.

One of the key things we get -- the other things we've done is we've done a lot of modeling of our radars. To the extent that we built our own propagation models, that we actually discovered interference, the technicians have struggled with and haven't told us about, we're finding it in the models and confirm that it actually exists. We've done a lot of background work already. A key thing is a lot of the new entrance to this that some of the unmanned aircraft keep bringing to us, why are there so many layers of spectrum management in government?

Why do I have to go through three FCC layers, a couple NTIA layers, several FAA layers. Why can't I have -- what is the process? And for somebody to ask such a simple question "what is the process," it's very difficult to answer that. So that is the one thing we would love to see come out of this, is a rationalization of process, not just an automation of it. I think the day-to-day stuff is easily automated, but the rationalization for new entrance, that's one of the big difficulties they have. The other thing we would like to see come out is we have gone completely through all of our spectrum looking at what could we do, what if, what if... all the way through. And we have a bunch of programs lined up that we could execute, you know, almost straight away. No technical challenges. And the challenge really -- the pipeline funding has helped a lot in getting some of this off the ground. But the biggest question is what I call gap funding, having determined the solution, I'm expected to take out of budget, changing that whole thing out to get the money back later on.

There's some sort of a gap investment needed to make that happen.

We're committed to utilizing the minimum spectrum and the minimum footprint. That's not the issue. The issue really is how we push that program forward.

And we're not just asking for extra money, because it does actually come back. We're just asking for the investment to repay back.

One congressional meeting, I was asked, can you guarantee this will pay us back 100%?

Well, nobody can ever guarantee that, but what I can guarantee is that this will work and put spectrum out into the commercial market. It's not just the value of the spectrum today, the value of the spectrum tomorrow. It's the utility of the spectrum, what you do with it later on.

So the solution on how government looks at its spectrum, how it invests to increase utility and move it out into the promotional area, that is something we would like to see.

>> Peter Tenhula: All right. Well, I notice there's a few folks that are still awake, so while on the topic of automation, we can deal with them.

Since the presidential memorandum did call for a secure automated capability to facilitate spectrum use, expedite coordination, shared access among federal, non-federal stakeholders, any more details on how your agency wants to leverage that capability and what feature -- what specific features you might be seeking as this kind of capability -- automated capability is built out? We touched upon a little bit. If there's more details on that, to put the rest of our folks to sleep. Go ahead.

>> Ian Atkins: So, for the FAA, it's had a wonderful opportunity with a suddenly emerging market, unmanned aircraft. It's allowed us to examine a whole lot of things we wouldn't have looked at for manned aircraft. There's a speed of business in aviation, the right speed, nothing changes in a hurry. Unmanned aircraft changes very, very quickly. So what we're looking at is you'll see things -- we're actually contracting out to low altitude authorizations, to private

companies. And I think skyward is owned by a cellular company now. So they can do the authorizations in the air space. So what we're looking at spectrum management, if we create a bank of channels, a geospatial map -- I don't mean 2D, a 3D man of what can be used where, then the concept is that one of these commercial suppliers, when somebody wants to fly a drone over Washington, they plug the drone into the network and apply where they want to apply, the channels are downloaded to the drone automatically, it flies, it completes its mission and when it completes the mission, the channels go back in the bank for somebody else to use. Now, the FAA's take on that is we don't manage that system whatsoever. We manage and commit to providing the maximum number of channels into the bank. If we need to apply one of the systems, we alter the bank and alter what is in there. Yet people are saying, are there going to be places where there isn't enough capacity? Absolutely. What we're talking about is capacity that wouldn't exist if we didn't try this. Our initial looks are very conservative from protecting our own assets. Don't get me wrong. Our real motivation is protect the aviation. If we take this route, we still retain control. We do protection, but that is what I said right at the start, sudden realization is we can enable a whole new thing and keep ourselves protected.

So we're very excited about this. Fully automated. We don't spend anything on it. It's not something we need to operate. It's something we control through specification and requirement.

>> Peter Tenhula: Right, and I notice remote ID rulemaking may be a component of that and it's been delayed a little bit, but I would imagine those innovations are associated with that kind of -- in the UAS space could maybe you think translate into other areas of spectrum management, not just air space management?

>> Ian Atkins: I think that's true. When you look at some of the companies -- I won't mention anybody by name, but one company in particular would say we don't want any spectrum for our unmanned aircraft. We want complete automation. So that's at one end of the spectrum. The other end of the spectrum is guy that wants to fly up down left right, like pilots on the ground doing what pilots in the air do. We see technologies cross both ways. I think the big mistake that happened with UAS is they tried to mimic what the big aircraft do. Our key is designed specifically for the U.S. And ideas are coming out there, wouldn't it be good if we applied that to our manned aviation?

So the ability to upload digital messages over a single analog channel to an aircraft, now, the pilot is still sitting there saying, yes, yes, yes, I agree with that, and selecting what he wants. Rather than the controller telling him turn left, turn right, he's getting the complete script.

So that's a huge change, when you are looking at that. And, of course, the impact on spectrum, the single channel is doing far, far more than what it would have done previously.

>> Peter Tenhula: Right. Any more details from you, Colonel Williams on, like, the automation or on the UAS context?

>> Fred Williams: First of all, we all have similar interests but we do have dissimilar missions. And one of the areas that we are really focused on in DoD is congestion. We go into environments, small space, lots and lots of capabilities in a variety of weapons systems, communications systems, platforms, capabilities, to get these missions done and create effects, and we put that in a box and it's very difficult to deconflict it among ourselves. If you think about harmonizing five military domains and then you throw in cyber, it can get pretty congested. And then put adversarial elements in there, it can get quite contested.

We think there is great promise in identifying some of the aspects of spectrum management functions to automate. In other words, get it to the machine and take the human out of the loop. One of the things we're trying to do specifically is get the data right. That's one of the areas we feel like the system today asked for data to do some very specific things. But now we're being asked to do very different things and we have to go back to that data and reframe it. Data in, then decision quality information out.

One of the designs we want to see come from that is spectrum on the common operating picture for the war fighter. We don't have that. We need to be able to show the C2 elements, commanders in the field, what that spectrum on the COP looks like so that they can make decisions. Also, as I said before, some of the fundamental spectrum management analysis tools, the things that allow the apparatus to work efficiently is becoming inefficient. And there's avenues, I think, in the national spectrum strategy that is going to allow us to get after that, and it has to be in a holistic fashion. DoD cannot go build something and then have nothing to plug into at the national level. We need our regulators working in parallel, both FCC and NTIA to harmonize this and bring this shared database in and bring the tool sets in common to exploit that.

The R&D efforts, we have really taken off in this arena. And when you think about the 5G aspects, you look at DoD and you immediately can make analogies to what we call the industrial Internet of Things, IoT.

So we are identifying through our national spectrum consortium, avenues of approach that we want. We received technical concepts in from industry. We're partnering with industry. We're partnering with NTIA in national test centers. We are going to create test beds and allow industry to come in and partner with DoD to exploit our infrastructure. I think out of the gate you probably will see things such as smart base, smart port, smart ship, smart test range, smart depot. We're very interested in supply chain, logistics and what 5G opportunities can bring to those aspects in the Department of Defense.

>> Peter Tenhula: I'm going to open up the floor for questions. So our volunteer Phil Donahue is going to grab the mics in a minute and we'll go around and recognize folks.

If you want to delve deep into the automation, as folks start to wake up to ask their questions, and then we'll move to the floor. Go ahead.

>> RJ Balanga: As Ian mentioned earlier, aviation, two aircraft at 40,000 feet seem a long way -- they see a long way, so the frequencies have to be separated to do spectral re-use and

sharing of spectrum resources. More so, when we have satellites operating at 300 kilometers and 37,000 kilometers up in space, and we hope that the automation will help streamline the frequency authorization processes. You know, one of the things, as the Colonel mentioned earlier, as well as Ian, on a previous question, we need to find ways to use automation to help deconflict frequency process in the spectrum management world.

You know, as more and more... as we leverage more and more in commercial services, again, to meet our federal objectives, there is commercial partners out there that are in it for their own bottom dollar and bottom line.

There's going to be huge number of networks going up, you know, number of NDS OWN network to provide connectivity and broadband in the rural areas in the United States all over the world.

So trying to do a deconfliction process where it was only NASA and a few other operators, now we're going to have more than, you know, 16,000 systems up there all sharing the same spectrum.

So I think this whole automation process can facilitate in that.

>> Peter Tenhula: Great. Colonel Williams, while we get a mic, is there somebody that wants to raise their hand and offer some spectrum? Go ahead, Colonel.

>> Fred Williams: I just wanted to reattack that. Also of great interest to us and one thing we're very excited about is the -- what we would called dynamic sharing or cognitive cohabitation, cognitive collaboration. We're seeing more and more of that. I mentioned the CBRS band. We're very proud of that accomplishment. We just signed off, I think, on the technical pieces of that and we're going to ribbon cut next week and we are pushing the envelope over in DoD under our defense advance research project agency. We are really pushing the envelope on having software defined radios deconflict themselves in contested space or in congested space.

We see those lines of effort continuing, which are going to, we hope, bring big promise to spectrum efficient uses. And also make us all think about the policy ramifications to harness that.

>> Peter Tenhula: Right. Thank you for mentioning the dark as well in the spectrum challenge, which is going to be announced in LA I think in a few weeks. So that's going to be an interesting announcement.

If you have a mic and for the benefit of the folks watching on the Internet --
>> Excuse me, folks if you could state your name for the folks listening in, state your name and your organization, that would be great.

>> Peter Tenhula: Thank you, mystery voice.

>> AUDIENCE MEMBER: Hi, Tyler with CTFN. So we heard a lot about safety and balance today, which I assume to mean weighing current operations with freeing up spectrum for 5G. So with that in mind, what spectrum repurposing efforts are you the guys most concerned with?

>> Peter Tenhula: What are you not concerned with?

>> Ian Atkins: It's interest that you bring up 5G, because part of our education -- this would be two-way education with the cellular industry. They didn't see unmanned aircraft. We were thinking aviation, aviation, aviation. They saw another part of the Internet of Things.

So the safety piece is easy. There's no concern on the reallocation of spectrum. It's very easy to define. if I need to do this, it has to be done with this availability and this reliability, and you have the risk model there.

So it's not ha concern providing that you know what your mission is and you absolutely know what the performance is. So for unmanned aircraft using cellular networks, you go through a whole analysis of, I need to move from A to B through this piece of air space, what is availability of signal, what is my loss link procedure.? Once that is in place, you don't have any concern as such because you need to deal with those things upfront. And once you've dealt with them, it gets a lot easier. I think a lot of angst on safety was it's new, we don't know how to deal with it. But it's been very exciting working with the cellular industry on this, particularly on 5G. Because it absolutely defines performance.

I think one of the questions we asked early on -- and I was from one of the major cellular companies -- can you provide a service with so many lines of availability? The answer is, well, yes, we already do for this large car manufacturing plant, and it's a function of how much you want to pay for it.

So we don't have any concerns in a future -- I don't know how distance it would be. Could everything be run commercially? Absolutely. I can remember the last administrator, Mike Werter said we don't as an agency need to operate equipment. We need to make sure the service provided meets requirements and is safe. So does that mean the equipment could be operated commercially? Absolutely. Could that mean all of spectrum could be allocated commercially? Absolutely. But it would come with the caveat the service of aviation would be provided to these pre-set metrics.

>> Peter Tenhula: Are there repurposing concerns? Karen?

>> Karen Van Dyke: So I had mentioned connected and automated vehicles previously as a mechanism to reduce the number of fatalities and industries and we've been conducting extensive research over several decades using the 5.9 gigahertz band, 75 megahertz of

spectrum from 1850 to 1925, and concerned about that spectrum potentially being repurposed, because we invest a considerable research to get to the point that we feel OEMs original equipment manufacturers -- sorry, I don't know how many dolls I need to put in the art jar, but we feel the industry is ready to equip and move forward with that, which, again, from a safety standpoint is extremely exciting and beneficial, and within the Department of Transportation we now have started referring to the 5.9 gigahertz band as the safety band. And so we really want that preserved for connected and automated vehicles.

>> Fred Williams: Thank you. I think we've had a perspective change. If you go back two decades and look at the AWS1 repurposing, you may have felt federal agencies that felt very defensive. That's changed. I think today we find this almost necessary to progress this nation. We are learning a lot. And because this administration, Congress, FCC, NTIA has fought to do the right things on behalf of the federal side of things, we get resources to look at the problem a little differently.

Our job in repurposing is not to say no but to do due diligence and say, hey, what can be done?

There's going to be bands that have near dear things, and it's probably going to be tough pulls to get around them. There are other bands where we can find room. You look at where we've been, we've compressed up into space, we've relocated the bands where it's tough to work with incumbents. We're locked in with range rings or distance rings around us for enduring relationships with industry. We're now bringing environmental sensing capabilities and spectrum access systems in and doing that kind of work.

We're learning a lot. We've been resourced with Road projects where we're trying to -- with R&D projects where we're trying to find efficiencies in making the AWS3 relocation work.

That is very healthy. You look at the sensor spectrum efficient national surveillance radar, again, that's three federal agencies in a collaborate fashion trying to develop a solution that is spectrally efficient but also frees up 30 to 50 megahertz of spectrum. That's a win-win. I think we're trying to turn them into a win-win.

We don't look at any one particular band as any more serious than the other. It's really defined by the capabilities that are in it.

>> Peter Tenhula: All right, who is next?

Right over there with John, microphone.

Then there's one over here.

>> Audience Member: Thank you. My name is Danielle with NCTA and I would like to direct my question to Karen. You mentioned that the regulatory uncertainty associated with the

ongoing stasis and the gigahertz band is undermining innovation and it certainly seems it's blocking access for new innovations like cellular V to X and undermining broadband innovations like WiFi 6. And I think we can agree the current situation is not great for the country. What do you think the DOT and FCC can do to work together to find a win-win solution?

>> Karen Van Dyke: So great question. The Department of Transportation, again, we have been conducting a sense of research on utilization of the band for connected and automated vehicles, and, you know, the benefit really being, if you -- we heard long distances from FAA and we're concerned about short distances, so vehicle three to four cars in front of you, hard braking, and your vehicle being able to receive that information and act appropriately in terms of assisted driver applications and just the safety benefits are incredible for that. And so we're very focused on V to X vehicle to everything, technology, and really working certainly with NTIA and the FCC on evaluation of technologies from the Department of Transportation, we're technology neutral in terms of utilization of the 5.9 gigahertz band for traffic safety but we're not performance neutral, and so whatever technology is utilizing that band for vehicle safety has to be reliable and accurate and we have test programs underway again working very closely with NTIA and FCC to evaluate technologies, utilizing that 75 megahertz of spectrum.

>> Peter Tenhula: Over here is a question.

>> Audience Member: Kelsey with law 360. I wanted to ask you, Karen, about the 5.9 gigahertz band, what is going on with the DoD and FCC. It sounds like the FCC is at least open to sharing this band with WiFi and some unlicensed devices. Does that set up a conflict with DOT and if so how are you working to mitigate that?

>> Karen Van Dyke: Again, thank you very much for that question. So Department of Transportation has been working very closely with NTIA and FCC, so in particular looking to share with unlicensed devices, and so there was a three phase test program put together. FCC published the phase 1 report last year and we're embarking on the phase 2 effort. But also in conjunction and also looking at V to X technologies, operating in the band. So there's really two types of testing looking at which technologies could utilize the 5.9 gigahertz band for vehicle safety but also within the band the ability to share with unlicensed devices and not cause harmful interference to those vehicle safety applications.

>> Peter Tenhula: Any over here, John?

Go ahead. Not for Karen. Sorry...

[chuckles]

>> Audience Member: Good morning, Paula Trimble with Lewis and associates. This for RJ. I know you talked a little about space exploration and impacts of spectrum management on that. Can you talk about how you're viewing scientific spectrum that used for space science or scientific exploration of space that is not necessarily commercially desired but potential for encroachment from other systems like 5G.

>> RJ Balanga: That's a great question. One of the challenges that we are having, especially in this world radio communication cycle right now is the encroachment of 5G being adjacent operators to some of our active and passive frequency bands.

So we believe that there is sharing opportunities there between the two. We just have to get it right. Because once we don't come up with the correct protection levels today, then satellites have been operating for 10-15 years cannot be affected by changing out a filter, putting a new filter on there. We can't change those satellites, those remote sensing satellites to a different frequency band, because what we're looking at from a scientific perspective is certain resident frequencies, the molecules, water vapor or oxygen and hydrogen resonate at.

So we can't just shift that spectrum to another location and say, hey, we're just going to -- we're going to mitigate the potential interference by going to another band. That is not a feasible at this time. So we have to work together with the industry folks, the 5G community, we've got to make sure that we understand their deployment scenarios, we understand what their system characteristics are, and make sure that when we are doing our modeling and simulations that all the assumptions that go into those models and simulations are agreed upon by both entities.

>> Peter Tenhula: Great. We have time for one really quick question. One quick answer.

Does anybody have a mic right now?

Right there, okay.

Then we're going to wrap up and take a 15-minute break to get ready for the next panel.

Go ahead.

>> Audience Member: Brandon Allen with International Association of fire chiefs. My question is for Colonel Williams. What is DoD's perspective? Is it changing at all towards the shared use of federal spectrum with non-federal users?

>> Fred Williams: Absolutely.

>> Peter Tenhula: The answer is yes, all right.

>> Fred Williams: We're huge advocates of sharing spectrum. Again, if you look at the vector of one, two, three, four, 5G, we're talking about standards of speed. That is very important to DoD. It cuts across all our domains.

But if you look how we're allowing the broadband companies to come in, it's unsustainable. So we have to figure out how to share spectrum. And we mean all of it.

We in DoD occupy a great deal of the federal space as it's designed today.

We also use a great deal of non-federal spectrum. We just don't do that in this country, right?

But we can, if we can take these technologies and learn to share in those spaces with the non-federal players. And that's actually -- you would almost think, I paid this young lady for an advertisement. We called it bidirectional just because of the non-federal nature of how we designed the management structure. But it's really about what capabilities can co-exist to really use that spectrum efficiently.

You know, on our side we're looking at white space. We're looking at future requirements, everything we can do to squeeze more and more out. But really you're opening the door, if you blend those non-federal and federal lines and get after this machine-to-machine. Thank you.

>> Peter Tenhula: That's all we have time for. I hope everybody has enjoyed this little glimpse behind the curtain of federal spectrum management. And if you want more, come back to next year's symposium. We'll do it again.

And we'll go to NASA's symposium too and dig a little deeper into that. Join me in thanking our panelists.

[Applause]

And the next panel starts promptly at 11:25, is that correct, John? 10 or 15 minutes. Stretch your legs. Get a drink. Not coffee. Not dessert.

¶
>> The panel is getting ready to come up. If the panelists could come up and be seated.

Panelists, let's come on up.

>> Derek Khlopin: We're going to give folks from the hallway a few moments to come on in.

So I hope everyone is enjoying the symposium this morning. I think the last panel was fantastic and I know as we move to the next one here with our private sector panel, our industry panel, I know there will be -- I'm sure they will thread in their remarks reactions on the federal side. A lot of focus at NTIA is collaboration, so government panel and private sector panel as well. I'm going to introduce my panelists here.

Working right down the line here, first is Dean Brenner, a senior vice president spectrum strategy and technology policy for Qualcomm.

Next we have David Goldman, director of satellite policy for space X.

After David is Hank Hultquist, federal regulatory for AT&T.

And then we have Chris Szymanski, director of product and marketing and government affairs, wireless connectivity combo division tore Broadcom, and Dave Wright is director of regulatory affairs and network standards for calm scope. And also president of the CBRS alliance. And we've had conversation about CBRS. I thought we would start different than the last panel, having each panelist spend a few minutes, maybe five minutes or so give a high level overview on the organization and some of the top priorities or issues we're looking at in spectrum and I think we'll build on that, follow up with Q&A after that. So we'll go right down the line and, Dean, you can lead us off.

>> Dean Brenner: Thanks, Derek and thanks for having me on this panel today. For those that don't know Qualcomm, the largest manufacturer of chips for smartphones, tablets, other wireless devices, as well as one of the leading developers of 2G, 3G, 4G and now 5G. I think as a company we're really focused like a laser beam on really the just rapid proliferation of 5G. For those that don't know, 5G is rolling out much, much, much faster than even 4G did. So 5G just as a status report, 5G is launched on four continents. When we launched 4G, there was -- in the United States, there was one 4G device for quite some time. With 5G we have already launched numerous 5G devices all over the world, and probably for spectrum folks of most interest, all of our chips for 5G support both 6 gigahertz frequencies and millimeter wave. In the rest of the world 5G is launched in either one but not both. In United States launched with both millimeter wave and sub 6 and a huge runway to the 5G ramp. We're working on second generation 5G chipset, including the antenna modules, which is really a technological breakthrough. When we invented 5G no one thought 5G would be able to be used for phones because you were going to need so many antennas in the phone and then we went back to the drawing board and working on 5G for years and developed antenna modules that are really half the size of a penny that have many antenna elements in there.

So I'll just -- I'll talk about a few game changers for 5G. One is something called DSS or dynamic spectrum sharing. Dynamic spectrum sharing is going to accelerate the 5G rollout dramatically. What it does is enables 5G to be launched in the same frequency band, in the same location where 4G is already deployed. So the whole refarming process, which typically has taken a decade or even more, before we can launch a new G in a band, we have to empty that band of the prior G users, just the way we refarm a field. We won't have to do that with 5G and you'll see DSS, this technology, launch in the United States in the first half of next year and unless you're a real spectrum geek you won't know that you have DSS, but if you have a phone, you will have the 5G icon on like all the time because all the sub 6 gigahertz frequencies used today for 4G will be used for 5G. Second game changer with 5G is something we announced last week, which we call extended range millimeter wave. So the traditional orthodoxy about millimeter wave is that you have a large amount of spectrum, which is how you get these super-fast data rates but the trade-off is that these ultra-high frequencies, the signal can only travel, let's say, 500 meters from one base station until you need another base station. So in the standards process, there's support for using 5G for fixed wireless access, not mobile, and that involves some higher transmit power, but in addition, again, working on advanced antenna technology, we have -- we launched last week antenna modules optimized for fixed wireless, and these antenna modules when they go in a device mean that instead of that 500-meter coverage, let's say, a rural area, you have a mile coverage in a rural area. So all of a sudden the last mile which has been such a huge problem for rural broadband is something that is very achievable with 5G.

And then last thing I'll talk about quickly is the industrial Internet. It's a gigantic area. Some parts around the world call it industrial IoT and other call it vertical use cases, and still others have other names for it, but the use of 5G to enable factories, warehouses, ports, to do all the things without wires that today require a wire is a major area of emphasis for Qualcomm and other companies around the world in 5G and in the next version of 5G we'll be launching a technology that we call 5G NRU. I know that's a great buzzword.

5G new radio for unlicensed, which is optimized for these industrial settings and will enable a level of connectivity that is not possible today. So there are lots of other things we're doing and I'm happy to talk about them through the course of the panel, but that's kind of a quick summary.

>> Derek Khlopin: Thank you, Dean.

>> David Goldman: Thank you for having us. I work at space X. I love listening to Dean talk about stuff. You're doing what now!?

So I work for Space X. We launch rocket ships into space. So we actually -- for a spectrum panel, for me, it's interesting, because I'll talk about it a little bit, but we're going to do satellite broadband, but we also use spectrum in a lot of interesting ways for launching rockets. We have to -- I mean, I'm not sure how many people realize this, but we have to go to the FCC for permission to get authority for every one of our launches. We have to get separate authority to launch. And we land rockets too. We have to get authority for that too. We run into a lot of

new spectrum questions on how do you do this? How do you -- what frequencies are allocated for landing rockets?

So there's a lot of interesting questions that come up there, so that's one piece of it. The piece I work on primarily is we're licensed for 4,000, 400 or so satellites in low earth orbit using KU and Ka spectrum bands. We have another license for 7500 in the VU band, which is lower than what you're used to with satellite broadband. Which leads to -- which changes things in a number of ways. One of them is the latency is going to be a lot different. One of the things I didn't realize initially, but latency on satellite broadband has a lot to do with what altitude you're flying at. You just have the speed of light. Your signal has to go up and come right back down. And so the lower you can go, the more it lowers your latency, and we'll have latency at like sub 30 milliseconds and it allows a lot more features that are latency sensitive, including voice.

So we're looking at that. We're constantly looking to see, as we're looking ahead -- obviously everything we're doing is new. And so there's new issues. We're always looking at different spectrum bands, what can we do with them, how can they be useful, how do we get out of everyone's way and do what we need to. I'm looking forward to the conversation.

>> Derek Khlopin: Thank you. Hank.

>> Hank Hultquist: Thank you to NTIA for inviting me to speak. It's lucky David is sitting next to me after Dean, because basically I would have said the same things Dean said. Our focus is all about 5G. AT&T launched 5G service in 21 cities by the end of next year, by the end of 2020 we'll have service nationwide.

We are, you know, focused to maybe -- maybe I should say like a rocket ship, but a laser beam on the policies that are needed to really help this 5G service grow, including both spectrum and infrastructure policies at the federal level, in the states, internationally. It's a big field that is involved in bringing 5G service to market, but, you know, it really is a great mission for us.

I think you've got a sense on the first panel of how 5G is really in some ways opening a door to lots of new things. I thought the remarks from Mr. Atkins from FAA were really interesting, about how they're working with commercial operators with respect to unmanned aircraft. I think, you know, whether it's Internet of Things, smart this, smart that, 5G is really going to be, you know, this enabler of all kinds of applications that have never -- that we've never seen before. So it's really exciting. We are focused on it every day. It is our mission.

>> Derek Khlopin: Thank you. Chris.

>> Chris Szymanski: Thanks, Derek, and thanks to NTIA for inviting me to speak here today. I'm going to give a quick sound.

We're a wired and wireless communication semiconductors and recently gone into the software field. We're U.S. headquartered. 19,000 employees worldwide and a little over half in the United States living in 38 different states. An industry leader in R&D and have over 20,000 patents.

So when we think about things from a telecommunications perspective, we're looking at it from an ecosystem. We have switches that have far more transistors than people living on the planet that can switch hundreds gigabits a second. We support back haul like DOCSIS fiber, G fast, and most components in your home, your set-top box and smartphones. We love LTE and 5G. We have the filters that power the hero class phones and very excited about WiFi 6. So the result is that over 99% of all Internet traffic crosses at least one Broadcom chip. We realize it's going to take more than a single technology. We know oftentimes the public debate focuses on a single technology, but it's much more than that, it's an ecosystem.

So deliver the 5G services you need to have not only the wired and backhaul in place but also the wireless. So first let me talk about the backhaul.

Through the leadership of NTIA, Congress, the FCC, and the U.S. industry, there's a real commitment in increasing broadband speeds. And it's really throughout the nation. And this has led to extraordinary levels of work and investment. And what we are seeing now with the deployment of DOCSIS 3.1 you went from maybe 20 million homes and enterprises that had Internet capable speeds to well over 50 million. So, you know, at least 2X increase. Really almost overnight. But for the nation to realize the significant investment in backhaul, we need to make sure the wireless spectrum keeps space. You know, and from a Broadcom spectrum, WiFi is how Americans experience broadband. It is the single most important wireless technology for broadband access today and it's the way that most Americans use and take advantage of their wired line networks. People aren't just plugging away in the corner of the room these days experiencing the Internet. It's all done wireless. According to Cisco, the lion's share of wireless enter in effect traffic, over 70% goes over WiFi, and they project the demand for unlicensed spectrum is only going to increase as 5G networks are deployed and more cellular traffic is offloaded. As Dean mentioned, there's a 5 gnu radio and license standard as well. We don't have enough spectrum to keep up with the demand. And the spectrum that we have doesn't support the wide channels that are really going to help take advantage of the latest standard WiFi 6.

WiFi 6 is capable of operating in 160 megahertz channel. It will deliver 10 gigabits per second for a single access point, and up to 2 gigabits a second for a single user.

This is critical for supporting 5G services but the U.S. lacks a sufficient number of 160 megahertz channels to keep pace

And really 160 is just the beginning. Soon you're going to see DOCSIS, the next generation, 4, which will be capable of burning through roughly 10 gigabits per second. So the IEEE is standardizing the next iteration of WiFi, which will require 300 megahertz channels.

So the industry is moving maybe a bit faster than the spectrum allocations. Fortunate FCC Chairman Pi has recognized the need for more spectrum and considering the growing spectrum needs. These bands will be up to 10 160 megahertz channels and three 320 megahertz channels. It will be a game changer for broadband deployment and America's residences and enterprises. One of the things we look at as a chip maker is scale. Is the U.S. the only country looking at this? What are the opportunities worldwide? And we're happy to report that Europe is also actively engaged in the 6 gigahertz, making it available for low power indoor operations and very low power portable.

I currently expect a harmonized European standard for 48 of the European countries that participate in their super regulatory regime as early as July 2020, and that's just the first tranche. I expect they'll open up the rest two or three years hence.

The U.S. has always led on spectrum policy.

The 5.9 and 6 gigahertz bands are exactly the right frequencies to focus on. But time is of the essence. So let's make it happen.

>> Derek Khlopin: Thank you, Chris. Dave.

>> Dave Wright: Thank you, Derek. And thanks to NTIA for the invitation to participate. I apologize for my voice. I've been dealing with a summer cold. Hopefully on the tail end and hopefully won't be a problem.

In any event, I am with Com scope in office of chief technology officer overseeing regulatory and standards. And for those who aren't familiar with Com scope we are a leader provider of connectivity solutions. That's a little nebulous because we do just about a little of everything. So we do structured cabling, both copper and fiber. We make a lot of active electronics for the wire line industry. So Chris was talking about a lot of the DOCSIS solutions for broadband services. We supply a lot of that equipment both in their core networkers and infrastructure networks as well in the residences of subscribers, so the actual customer premises equipment. And I'll try to remember to define acronyms as I go.

We do a lot of fiber to the home products and solutions as well globally.

And then probably more germane to this discussion, we are a leading provider of wireless solutions as well. And wireless including unlicensed products, so we are the owner of Ruckus networks, one of the leading providers of carrier and enterprise grade WiFi solutions. Again, globally.

We also provide antenna systems to mostly mobile operators for everything from really 2G, 3G, 4G and now 5G.

So as Dean and Chris talked about a lot of the technologies in the wings coming to market, you know, even now 5G, WiFi 6, some of these other things, we play against all the products

and I think we can count Broadcom and Qualcomm as important suppliers for equipment needs. Appreciate that.

So our interests go from licensed to unlicensed and what I'm going to refer to as dynamic shared spectrum.

And I am glad Dean mentioned DSS upfront, because it's worth kind of highlighting that, you know, 3G PP is using dynamic spectrum sharing to talk about the band refarming capability developed, which as he said is hugely important allowing to deploy 5G bands where you still have 4G operating. When I talk about dynamic sharing I'm talking about introducing a new service in a band where there's incumbent and sharing that band.

So my poster child is the citizens broadband radio service, henceforth to be called CBRS to save breath and I'm the president of the alliance as Derek mentioned and CommScope has been active in the development really since the beginning, dating all the way back to the president's Council of Advisors on Science and Technology report back in the 2010-11 time frame to meet the nation's spectrum demands, we're going to need to find ways to share spectrum and specifically share federally held bands. And that has led to where we are today, as Colonel Williams pointed out, being on the verge of commercial service. So those who aren't aware, we have a big ribbon cutting and launch event scheduled next Wednesday here at the Mandarin. If you're not invited, let me know I'll get you an invite. Hank is going to be there and a bunch of people are going to be there and we're going to be celebrating the culmination of all the effort that has gone on between government to include NTIA, DoD, the Commission, of course, ITS, who was mentioned earlier, and industry. And it really is somewhat unprecedented in terms of the amount of work that has gone on, the collaborative effort that has gone on. I'm sure I'll touch more on this as I go, and I think as I look at what was laid out in the presidential memorandum in NTIA's request for comments on the spectrum strategy and what I'm hoping, gleaning a little bit of indicators, what we'll see in the actual strategy when it's released.

You know, there's a real focus on -- of course, on the sharing between federal and non-federal, but also on automation, making more intensive and efficient use of spectrum going forward, automation tools and the like, and, again, Colonel Williams mentioned that when he was up here. So we're very keen to see how we can take what we have done with CBRS and extend that into the future and figure out how we're going to make more intensive and efficient use of spectrum resources as a country. In addition to CBRS, CommScope has extensive experience with TB white spaces. We were a TV white space database provider. We're one of the third-party databases in the 70, 80 and 90 gigahertz band where we can take requests from licensees and feed that into the NTIA system and kind of -- that's an automated process, which I think is another sort of positive example of how we can move things a little bit faster going forward.

And then finally for the 6 gigahertz band, you know, we're certainly advocating for opening that up for unlicensed operation, both in the lower power mode but also a higher power, standard

power utilizing the automated frequency coordination capability. That's, again, another sort of dynamic spectrum sharing capability. So we have activity across all of those things.

>> Derek Khlopin: Thank you. Appreciate the comments. I'm going to ask a few questions for the group and maybe some individually and we'll leave time to open it up to audience for Q&A. Clearly you all have demonstrated I think what we've been talking about all day, that spectrum demand is growing from all corners. I think we heard on the last panel as well from federal. I guess my question to consider, you talked about how the various technologies will meet this demand, but how as a nation do we balance you know, these diverse priority that is we've heard and going back to Deputy Secretary Kelley's comments this morning that we have these national priorities of leadership in 5G, advancing next generation WiFi, which really is an American success story, space commerce, you know, national defense and other government missions, you know, how can -- what are thoughts on how we can move forward as nation in balancing these requests? I open it to anybody who would like to chime in.

>> Dean Brenner: I guess I'll jump in since no one else has. Spectrum questions are interesting because to a great extent you can rely on market forces to figure out how to allocate resource bus you can't do it completely. So it has to be a combination of policy, market, driving greater efficiencies. I mean, just thinking about the mobile industry, the extent to which the mobile industry has achieved greater efficiencies of spectral use over the last decade is incredible, if you think about it, if you think about refarming spectrum, densifying networks. There are ways to get more efficient use of spectrum, but ultimately there are parts of it that depend on good public policy, and coming out of the first panel this morning, I actually think this is an area where the United States has always been a leader, has been an innovator, whether you look at going back to the first auctions and incentive auction, the example of CBRS. We have always led in finding innovative ways to use public policy to make sure that -- to try to make sure that spectral resources are used efficiently. And so I think we will continue to do that based on the discussion I heard earlier and the discussion I'm sure we will have, I am confident that, you know, we will balance these priorities. One good thing I think about spectrum debates is they are conducted in good faith. There are a lot of discussions in Washington that are, you know, 75, 80, 90% posturing and 10% substance. Spectrum, we're blessed. They are really discussions that are conducted in good faith. So I am hopeful we will figure out a way through this problem.

>> I would just like to add on, I thought Ian Atkins from the FAA made a pretty compelling point earlier, and that was that, you know, our capabilities increase in tech and spectrum efficiency. Sometimes it's orders of magnitude over a 10 or 20-year period. So I think that policies that are built on old and legacy equipment should be revisited sometimes. I think it's useful to restart a conversation and look at whether or not more intensive use of spectrum could be had given, you know, upgraded capabilities as, you know, equipment and network architecture and, you know, governmental systems are upgraded year over year.

>> Dean Brenner: I'll just chime in. I agree with both of you, but I think what is striking to me is so on the private sector technology side, we're never stopping. We're just always going to continue to innovative, continue to invent new ways of doing things that are more efficient, you know, 5G, one of the reasons that we're excited about it, because, yes, it's faster and the quality of service is better, but you know, Hank's company understands that it's going to be dramatically less expensive to deliver each bit. So it's, you know, dramatically more efficient.

So I think with CV2X in 5.9 gigahertz band, if it wasn't a lot better, we wouldn't have invented it. There's a legacy technology, unfortunately the FCC rules dictate that's the only technology that can be deployed in the band called DSRC, and if DSRC was the best there was there would be no reason for anyone to invent anything new. In fact, it's not. And so we invented this other technology using 4G and ultimately 5G called cellular V to X, and the reason we need FCC action is because, unfortunately, this is one of the few areas where the rules dictated a technology and that technology just isn't the most efficient. And that's why there isn't a car maker who has -- who currently is deploying it. Instead the only car maker that wants to deploy a new technology, any technology in the 5.9 band is Ford, and they want to deploy CVX and we need FCC action to fix it. But I think it's just that the pace of innovation from the private sector is going to constantly accelerate, and it brings to -- it gives rise to these naughty tricky spectrum policy issues. But we're not stopping just because it's a naughty issue, no one is stopping.

>> David Goldman: Everyone is saying efficiency and I think that's right, but you have to say, what does efficiency really mean? And I think what I heard Hank and Dean talk about, to them efficiency is within their license serving as many people as they possibly can. But what you're asking about is we have all these new technologies trying to compete for this. We have new entrants trying to come in all over the place. How do we jam in all this new stuff into this?

Which isn't just serving as many customers as you possibly can within your license. It's how do you coexist? So I think there's a question that is sitting there of, do our policies actually drive people toward developing systems that can coexist well? We look at 3.5, I think you're seeing stuff there, but are the incentives within the policies actually to develop a system that does allow new entrants in and does allow new technologies in, or are the incentives actually I want to cordon off everything I can for myself and serve the customers I can, but I actually don't want to let anyone else in. The policies change the economics there for anybody. So I think that's a hard question.

But I also -- just a little bit of a counter intuitive point, as we look at some of the numb spectrum bands, especially as we look higher and higher in millimeter waves, I know we're talking a lot about lower ones, but as we look higher and higher, it may be worth holding off on allocating spectrum as technologies develop. We may get ahead of ourselves a little bit on some of this. To Dean's point on DSRC, I think when FCC allocated for it 20 years ago, they thought they were doing something brilliant. This was a new technology. They were allowing this to flourish, a new idea. but technology passed it. And now we have this legacy rule that now is preventing new technology from coming in, new more efficient technology coming in. And I think as we look higher and higher, that was high at the time, now we're looking way higher than that, it's worth it to ask the same question, of are we actually allocating something and are

we setting rules that are going to be with us for decades that maybe we don't actually know how this is developing out yet and maybe we want to allow the spectrum to develop first.

>> Hank Hultquist: There is a big difference between allocating spectrum to a specific technology and allocating spectrum for flexible use. An entity holds flexible use rights does have incentives to drive that spectrum to its highest value use. That is different from a situation where spectrum is allocated to a specific technology.

>> David Goldman: Yeah, I guess it's how flexible are you talking about. Some of the licenses that you think are flexible use I think are unusable. For new -- for things that we're working on. So I get your point. I think that's right, but I think there is just a bigger question of are we really -- should we be always assigning and deciding way in advance we want these to be this kind of technologies, these to be this kind of technologies, and you guys should really stay out of each other's way or should we think about incentives to let things coexist? As we look at higher millimeter waves is it physics that satellite and terrestrial can't be in the same place or is it we haven't looked at the technology or invested in technology to allow that to happen?

>> Dave Wright: Yes, I'll jump in. Sorry, I was distracted. I was going to say I think in terms of public policy to facilitate federal and non-federal sharing going forward, I certainly agree with David that the proper incentives are important here. So, I mean, I have long held that we need to look closely at the authorized uses of reimbursements from the spectral reallocation fund. And right now that's tied to auction revenues, which, sure, auction revenues is a huge value to the country, but there's other valuations of spectrum that is not sold at auction, the rights are not sold at auction unlicensed or the GA here in the U.S., and the activity in those bands is huge to the country. So we shouldn't discount that value when we're incenting federal agencies to find ways to share or relocate for that matter. I was encouraged to hear there is going to be RFC looking into leasing the federal spectrum by known federal entities. I think that would be a positive step as well.

But Chris starred off his comments saying -- referencing something that Ian mentioned, and I thought he was just going to start I think with one of Ian's summary points being we're moving from the mindset of exclusive use to, you know, shared use under the right parameters. And I really am seeing that progress happening, you know, within the federal spectrum holders and I watched this event last year, I wasn't here but I watched the stream of it and I remember Colonel Williams a good amount of time last year talking about the attitudes in DoD really have evolved. They understand the industry pressures that are growing from the new technologies, from the need for wider bandwidth, as Chris was talking about. Our world is increasingly wireless, no doubt about that. And if we are going to remain competitive and be the global leader in innovation and reap all the economic benefits, then we've got to stay at the front of that and making spectrum available is key to that, and I do believe that, you know, now the attitude is shifting more towards how do I share, or here are my parameters, safety. Don't do anything that is going to impact the safety of my airplanes and let's have a conversation about that.

So I think once we have those parameters established and we begin having real collaborative conversations about what sharing can look like, you know, I think we're in a good place. But I do like the idea of proper incentives for federal spectrum hold percent.

>> Derek Khlopin: I think that's a great segue. We talked about the presidential memorandum on a national spectrum policy, which we're truly trying to make a holistic policy for the country, and going back to the PM, there were tenets that the strategy is going to expand on. I'm going to mention a few of those and maybe we can react a little bit to those as well as maybe if you have any thoughts on how, you know, government might tap into industry and work collaboratively to move some of this forward. The obvious one of increasing spectrum access for all users, and this includes sharing, but also by putting more transparent how spectrum is used both on the federal/non-federal side, creating flexible spectrum management. And this is not just in a license but, again, standards and, incentives, enforcement, how do we bring flexibility. You know, R&D and beyond R&D, researchers have testing and evaluation as well to advance these technologies. I know, again, Colonel Williams was really excited about R&D efforts.

Building a secure automated capability to facilitate assessments, and that will require collaborative work in the federal government, both with federal agencies and FCC collaboration. And overall with a mission to improve the global competitiveness of the U.S. terrestrial and space industries. So if anyone has thoughts, I know we're waiting to see the full text of the strategy, of course, but, you know, building on those tenets a little bit.

>> Dean Brenner: I'll just say this. What actually struck me during the deputy secretary's comments was that if you closed your eyes, those comments could be given by basically every regulator in the world, that it's actually remarkable what a global -- now, I'm going to say this, I know at the WRC there are a myriad of issues, but if you just go -- you know, I was at mobile world Congress China in June and I heard comments from Chinese and other Asian spectrum regulators and I don't think you could substitute her text for their text, and I find that a really heartening discovery.

>> Derek Khlopin: Any other comments?

Okay, I'm going to open it up to some questions from the audience. I have some more, but let's -- sorry, do we have a comment?

>> Dave Wright: I didn't want to...

One of the questions that was in the memorandum was about expediting coordination of shared use among federal and non-federal stakeholders. And I think that is something that is very interesting to us, you know, and Colonel Williams, I think said -- in talking from a DoD perspective, you know, we need to modernize -- I took it as automate, you know, our systems

and our personnel. And he said it's taking way too long on some of these issues. And I would agree with that assessment. You know, I'm really excited that we are having, you know, a launch event next Wednesday and we're on the cusp of launching commercial service in the CBRS band but I would be disingenuous if I said I wish this hadn't happen a year or more ago. It is unprecedented what we have done here. It's been a little bit of a -- I think everybody has been working well together in good faith, industry, government, but it's the first time we've done some of these things. It's the first time we've had to go through the process of certifying these ESC systems, the environmental sensing capability sensors that sit there and look for the signatures of military radar systems. So, you know, understandably the military is very concerned about making sure that that doesn't compromise operational security in any way, and that has taken a good amount of time to work through that and make sure everybody was, you know, comfortable signed off on the approach. And I look at the certification of the SAS systems by STS and, again, we haven't done this before. The commission hadn't been in a position of having to certify a solution where you combined a database and radio and you get an output and you have to make sure that that output is protecting the incumbents properly. So a lot of this was really groundbreaking and I can't say enough about Rebecca Dortch and the folks in Boulder that led the effort and the long hours they put in and we appreciate everything they've done there. I think we've broken the seal on some of this for the first time, I do hope we'll be able to move faster going forward. I think it ties back into the conversation about automation tools. A lot of it comes back to sort of early disclosure of federal incumbent operations. As much information as can be made available to industry, and obviously, with the DoD in particular there's security and classified information issues at times, but, you know, if we can get early disclosure of incumbent systems locations, parameters, so that industry can work those problems early in the process, I think that will definitely help expedite things.

>> David Goldman: I wanted to double down on both comments. What Dean was saying, I don't think I was necessarily clear on it. The system we're building is a global system. When we start launching, we're non-geosynchronous satellites. We're everywhere at once. From our perspective this has to be global. This has to be decided internationally. What Dean is saying is very heartening that he's hearing countries around the world all kind of thinking the same thing. That has to be. These systems are going to be more global as we push forward, so everyone has to work together. We also support bidirectional sharing, and I think that we have -- the spectrum that we have has federal users in it. And absolutely, to your point exactly, of we need to be able to coordinate quickly. We need to be able to know their capabilities. We share our capabilities. I think both points were 100% right.

>> Derek Khlopin: Do we have --

>> Audience Member: I would just like to --
>> Hold on a second.

>> Derek Khlopin: Make sure you identify yourself as well.

>> Audience Member: Peter with NXP semiconductors. There is a fallacy in terms of connected vehicles, DSRC is the extant technology out there, it's tested and vetted, and more importantly it has been deployed. In fact, deployed by a major U.S. OEM, albeit on a relatively limited basis. What we need is certainty coming from the FCC. Certainty as to certainty of 5.9 for automotive safety applications. Nothing wrong with CV2X as a future technology. We embrace it and look forward to a degree of interoperability and coexistence, but barring the introduction of 5G tomorrow you're still looking at somewhere in the high 30,000 to 40,000 fatalities a year on America's roadways. The technology exists to deal with that problem now.

>> Derek Khlopin: Do you have a question for the panel?

>> Audience Member: That's the question. When do we get it?

>> Dean Brenner: The only thing I will say I think there's regulatory certainty. If I look in my rule book for 5.9 gigahertz there's a set of rules for the deployment of DSRC, so there is certainty in the sense that DSRC is the only technology allowed to use the spectrum and CV2X or anything else in that matter isn't allowed. That's the situation.

>> Derek Khlopin: Other questions? We have one over here.

>> Audience Member: I'm Scott Patrick of Baker Hostetler. Dean, you might be the lead as the conversation goes. I heard David talk about coexistence and new technologies and intense use. At the millimeter band -- or the millimeter waves, adjacent users, adjacent channel users have the -- are the traditional techniques working for the higher bands or will new technologies be needed for these kinds of intense operations to work?

>> Dean Brenner: Thanks for that question. One of the marvels for millimeter wave for 5G is it's highly directional. We have techniques called beamforming and using the spectrum in these very narrow beams. The beams encompass a large amount of spectrum but in a highly directional manner. So that actually means that in terms of ADA band emissions and that sort of thing, it's actually much -- there aren't the kinds of problem that you have when you're going in a more omnidirectional manner.

>> Chris Szymanski: One of the things I think about in disruptive technologies and frequency bands, I agree with David. I think we should not rush to allocate things for a specific purpose. If I just think about ultra wide band technology in the beginning, it was really meant to cut the cord. We were going to connect everything, set-top box, our TV with ultra wide band technology and it was going to be goodness. Never really materialized, right?

And then it was, you know, -- you start looking at the 60 gigahertz and start looking at, well, we can cut the cord with 60 gigahertz, with wide gig we're going to do these disruptive things with 60 gigahertz. Never materialized. But what we're seeing now with 60 gigahertz is fixed point to point with massive memo beamforming similar to what Dean is saying, and you're going to see fantastic ways to move massive amounts of data short hops.

I think you're going to start to see this in field motion disturbance sensors, so we have a more Tom Cruise like -- I'm waving my hands in front of the phone and able to do a whole lot more without actually touching the handset. So you're going to see advances in the technologies. When I think about DSRC and allocating it 20 years ago, we didn't have cameras and sensors and all these things in our cars. So the use cases that DSRC is trying to solve is a subset of what they originally intended to solve. Now it might be there are new use cases for DSRC or CV2X but it's important to understand you don't have just one tool in your toolbox. You have more than a hammer. We have multiple things we're trying to accomplish in these bands and I think we shouldn't take a narrow focus with respect to how we're allocating a spectrum, especially long term given how quickly technology evolves.

>> David Goldman: It's an interesting question. We have phase array antennas for satellites and user terminals which operate similar. We have beamforming and beam steering. So I think we can get the closer in with each other. I think we can do that. If everybody is investing in technology and using that technology. But kind of getting back to, like, maybe we're getting a little bit ahead of ourselves, we're still deploying in the 28 gigahertz band and figuring out how those rules work and how to accommodate all of this. Those rules have already been imported up into the 37 to 51 gigahertz bands. Before we really have tested them to see how they work and see if there can be refinements on it. Now we're looking up -- we call it the V band. In the V band we're looking exactly the same rules without having developed the technology to see how they work together. Getting back to my earlier point, maybe you put the brakes on it a little bit as the technology is developing. I'm not saying that we put the brakes on developing the technology at all. I think we want to get this out as fast as we possibly can, but I think there is an amount we should understand how the technology works before we start limiting uses.

>> Derek Khlopin: Do we have any other questions out there at moment?

We've got one over here.

>> Audience Member: My name is Toby and I'm a policy checker. I'm wondering if you can share hopes and fears from the WRC radio communication conference or if it's more or less relevant from the context of the U.S. national spectrum strategy.

>> Derek Khlopin: I think the question is around priorities for the WRC.

>> Dean Brenner: I'll go. The one that obviously has gotten a lot of attention would be because of the machinations between the FCC, the commerce department, NTIA, NOAH, state department, I'm not sure if I left anyone out, over this 24 gigahertz issue and also the hills been involved, and I think were very, very hopeful that perhaps -- I know a U.S. position which was finally formed and I think adopted at a recent meeting and I think the 24 gigahertz issue,

which is a global issue because that band goes from 24 up to 24.7 and 27.5 so it's a key band in Europe and Asia as well as in the United States. We obviously hope that issues comes to a soft landing.

>> Hank Hultquist: I would like to reiterate leaving aside how we got here, we have a U.S. position and our hope for WRC would be that that position be supported and ultimately some version prevail.

>> Derek Khlopin: Thank you. Looking out here for more. Again, while folks think to have a question... we've got one over here.

>> Audience Member: Hi, Rob with utilities technology council. I wanted to ask about the 6 gigahertz band. Folks know there's been opposition to that band from a number of critical infrastructure entities including utilities, public safety railroads and the Department of Energy sent a letter to FCC and NTIA about the AFC in particular about offering natural labs to test that. I was wondering if you had a reaction to the letter and request to test that.

>> Chris Szymanski: I'll take the first shot at this one. So, yeah, there's a lot of really important safety critical incumbent users in the 6 gigahertz band that need to be protected.

Thankfully the FCC has an office of engineering and technology that engages in these types of proceedings with a high degree of technical rigor and ask entities to bring before them technical parameters required for their systems to meet their design targets, such as the availability. Maybe those critical links that are used to pass control signals for these utilities. It could be public safety or it could be operator backhaul.

But the FCC is, you know, very rigorous in investigating sharing, and I think that there's a very robust record right now demonstrating that WiFi style devices, which we're calling RLANS because it could encompass devices such as 5G, new radio unlicensed. Absolutely can share the band without fear of harmful interference.

Now, any time you talk about upsetting the status quo, especially in a band where there's a high density of use, certainly understand that that could be a cause for concern for incumbents. I think my recommendation would be, rather than talking past each other, it would be a great opportunity for the utilities and utility industry to engage directly with equipment manufacturers and parties that are seeking to deploy the band. We've become convinced after four years of research that it's absolutely possible to share this band in a way where we could bring, you know, terabits a second in a given community with an incredibly low probability event of a very slight degradation of maybe a few kilobits or megabits a second. We've been convinced of that, those engaged deeply in research and would welcome one to one conversations and discussions to make sure all parties really understand the core objectives and, you know, how these technologies can coexist.

>> Hank Hultquist: I do want to reiterate one point Chris made that I agree with. I think the FCC process will be, you know, a process that will figure this out. I don't think AT&T is at the point yet where we're comfortable across the board that this use can occur and critically I would say two components would have to be in place, we avoid interference, and if interference occurs, there's a way of identifying the source and mitigating it.

So, you know, we're eager to participate in the process and figure out, you know, what is the right answer for sharing the use of this band without harming the existing operations.

>> Dean Brenner: The only thing I'll add is, at Qualcomm, we talk to everyone. So we have had direct interaction with both the UTC and done extensive analysis of one utilities system and how it could -- it would or wouldn't be impacted by 6 gigahertz. And the bottom line is, as Hank is saying, there's no allocating new spectrum in the middle of the night when no one notices, so obviously these issues are, you know, vetted through the exhaustive FCC process and, you know, the proper technical solution will be reached. And we're continuing to work with everyone who has a stake in the band to make sure obviously the spectrum can't be allocated unless and until everyone is confident that it's going to work well. Just the way we have done with CBRS.

>> Derek Khlopin: Thank you. Other questions?

>> Audience Member: This morning I heard both on the previous panel and right now, a lot of support for sharing and collaboration, and the question is for the whole panel. In your opinion, what is the best way, the best approach for that collaboration to happen? And what are -- your best experience, the things that have worked and haven't worked in that collaboration?

>> Chris Szymanski: The first shot, from my experience, the best solution is direct engagement privately before you start firing salvos publicly that are very hard to reclaim. But I think the more you can talk to one another rather than pastor at one another and really try to understand the core objectives of both the parties that are in the band and have important operations, critical to their operations, need to be protected but also understanding the perspective of the parties that are seeking to deploy new services and trying to understand all of the technological rigor that went into the analysis prior to deciding to seek to deploy these new technologies. So it's really having these deep meaningful conversations where you learn a little bit more about the current systems and requirements, not only where people are today but where they want to go.

>> Dave Wright: I'm going to go back to something I said earlier, early engagement, specifically in a federal and non-federal sharing type of scenario, but, you know, I think early engagement is critical and, to Chris' point, if you can sort of have that and study groups that can be Frank and honest about, you know, what the incumbent situation sand whether or not sharing is possible for not to begin with, that's a good starting point. And then you look at the actual prediction issues, and then, you know, you work collaboratively over time to address this.

So I think one of the probably not so great examples would be what happened with the 5.35 to 5.47 band where industry's expectation was that would be allocated for unlicensed operation and then kind of proceeded along that path for a few years and then you know, found out that that wasn't going to be possible due to some of the federal operations there.

I think CBRS is the opposite example. It's a positive example how collaboration can take place, I think both Charles and Colonel Williams, if I remember correctly, talked about, we first looked at the ship borne radar systems that have to be protected there. Okay, well, there goes the coast of the U.S. and about 65-70% of the population. So commercial interest would have been probably suspect if that was the way this would have rolled out.

And so we looked at that. We spent a lot of times thinking about how can we provide operations and do it in such a way, again, that the military is comfortable that we're not compromising operational security in any way, and we came up with this novel approach combined with dynamic protection areas, huge swaths of ocean. And so there's no way to really pinpoint the location of any aspect based on that.

So I think early engagement, direct engagement, that was something that CommScope through our Ruckus and units, we need to fully exercise groups like CSMAC and the joint working group to look at those as early as possible and have open conversations about those things.

>> Hank Hultquist: I would be remiss not to mention, sharing is a big part of the way wave spectrum is being thought about. But back to my opening remarks an 5G, it's important to recognize in the U.S., 5G, the deployments, a lot of this will take place on frequencies that are licensed for flexible use, more traditional sense, whether talking about the millimeter wave bands, mid-band spectrum, the FCC will be holding a series of auctions that will be critical to the success of 5G.

>> Derek Khlopin: Thank you.

>> Audience Member: Hi, Bertrand Lee with public knowledge. This is more of a question for Hank and Christopher. I think you talked about expanding the range of spectrum to give 5G more rural broadband access but how do we make sure the expanse of 5G doesn't already benefit kind of communities who are already seeing 4G access and 3G access and make sure

that the expansive 5G benefits all Americans, rural, and those who are in the broadband kind of digital divide at the moment.

>> Hank Hultquist: Sure, so the Telecommunications Act specifically directs the FCC to ensure that these services, advanced communications services are available generally speaking both in high cost areas and in communities where they might not be. This is a -- this is a public policy issue, I think, that the FCC, it's really their job, they have been told by Congress to undertake policies to ensure that these services are available.

And I guess I would say I think it took the FCC a long time really to start to refocus universal service program away from traditional voice services, and, you know, that process probably started in 2009 when they did the national broadband plan, and it's moved forward. I think it's taken a long time. Government -- I think going back to a point Dean made earlier, the private sector moves really fast here and the government has moved more slowly. But I ultimately -- ultimately this is something that the FCC needs to figure out what are the priorities, how does it define the level of connectivity that it wants to pursue, and then how does it fund it? And I think those are public policy problems for the FCC.

>> Chris Szymanski: I would go back to the underlying premise of the previous panel that you have all of these divergent, sometimes seemingly divergent interests, because different parties, when a provision of service using different technologies, satellite, cellular, WiFi, wired, you know, you have a variety of communications capabilities, and I think at the end of the day consumers, urban or rural areas are looking at key capabilities. I would go back to thinking about 5G as the services that will be enabled, all of the economic output that will be enabled, and having fantastic cellular networks with 5G and understanding how it's blanketed across America is going to incentivize application providers to provide these new disruptive applications that so far we only have seen in movies, right?

And you'll begin to see some of those technologies deployed. As you begin to see these application providers deploying these new technologies, I think it's going to be agnostic to the radio access that is being deployed, whether it's WiFi. It could be Bluetooth. It could be a brand-new proprietary technology. It could be 5G. But at the end of the day, the consumer is really looking at, you know, what is this capability and how do I get it?

So if we think about rural connectivity, I think the WISPs have been doing a fantastic job in spreading broadband. I've heard a lot of satellite provisioning brand-new coverage. So I think it's probably going to be an all of the above approach. And so I think that we need to be -- to continue to drive towards looking for the most economic means to provision these capabilities to these rural areas, and, you know, it is important that we close this 5G divide. I think it could be starker than the current digital divide because of the capabilities one will have with these new 5G services.

>> David Goldman: I don't know how to not answer that. I think the answer is it has to be more than one technology. For us, but not just us, satellite and a number of technologies, the

economics are different. Just using us as the example, it doesn't cost us any more to be in a rural area than an urban area. In fact, we might be able to provision hire throughput and more bandwidth in the rural areas early on. So it's a complement. It has to work together. We have to think about spectrum policy cohesively across all the different technologies and enable as many technologies as you can because they're going to have different strengths and reach different people. And it's -- you can do it two different ways. There's the other technologies that serve directly, but there's also -- we're going to have a low latency because of our lower altitude. That means some of these new satellite systems that are just coming online are great for backhaul for 5G. So potentially moves what could have been stuck kind of in the very urban areas and pushing out to rural can leapfrog them out into rural areas much quicker by not having to wait for fiber be deployed, really expensive fiber to get out to remote areas that could jump in faster by using different technology for backhaul. So I think that's -- you have to look at the different technologies that are available. Again, that's why we have to look at all the spectrum bands and make sure we're enabling as many technologies as we can.

>> Dave Wright: I was going to mention, in my opinion, one of the use cases for CBRS that will probably see immediate traction will be fixed wireless, actually. There's a lot of reasons for that pent-up demand, propagation characteristics of 3.5 at the powers with we operate at, the availability of CPE ecosystem. It's relatively easy for people to adapt existing part 90CPE which operates in 3650 to 3700 range to cover the full 3550 to 3700, and then as David was mentioning, context of satellite, the same with CBRS. We expect more contention or demand for the spectrum in the metropolitan areas or urban/suburban. That's where I expect cable operators, enterprises, industrial users will be trying to access the spectrum, whether the protected access tier or general authorized tier. But you go out to rural areas of the country and I don't think you're going to have that same demand for the spectrum resources, so it becomes very attractive for operators such as AT&T and Charter, they both talked about using CBRS to extend the reach of their fixed broadband networks. And then the WISP community, which Chris mentioned, you know, they're very eager to have access to the full megahertz, not just the upper 50 and then the economics that will come along with this ecosystem formed around the opportunity. So fully agree with all the comments here, but it's going to take a range of technologies and types of spectrum to tackle the rural connectivity issue but I do think CBRS is going to help.

>> Dean Brenner: I'll go out on a limb here. I predict in the next three to four years rural broadband, rural connectivity will improve dramatically. You know, every presidential candidate basically is talking about it. It's a major focus at the FCC. We finally do have all these different technologies that we have talked about, extended range millimeter wave, satellite, CBRS, there will be more fiber built out, as expensive as it is. I actually think in the next three or four years it will have to be solved.

>> Derek Khlopin: Thank you. Great responses to the questions. I was actually going to be my -- sort of took over the next question I had and really struck, too, you have a lot of diverse interests up here from the technology companies but they actually agree on quite a bit. So

that's great. I've got one more, unless there's a question out there, I was going to wrap up and try to maybe tie the two panels together a little bit. I thought from FAA, DoD and others on the panel that really expressed a real openness to innovation, to private sector collaboration, to private sector tools. I just wonder if you guys could comment a little bit on some thoughts and moving forward there. I know you certainly work with them now, but in terms of collaboration with the federal spectrum users to share spectrum but also potentially as a customer of a new service, and, Hank, of course, on the local government side you have First Net and maybe parallels on the federal side. But any thoughts on -- I'm sure there were reactions to FAA and DoD and other comments on maybe some ideas moving forward.

>> Hank Hultquist: I think in a sense commercial services are a way of using the market to share the use of spectrum among a multitude of different users and different kinds of use cases, and I thought the comments from the gentleman from the FAA were very interesting and, you know, in a sense I had the impression that it was an eye opening experience for them to see they could go to the commercial sector and specify needs in terms of requirements and then get the level of service that they needed.

I think from the mobile perspective, 5G will extend that because the capabilities of it are broader than the capabilities of the previous generations, and so those opportunities will only grow over time.

First Net obviously is another great example of a kind of collaboration and sharing that produces great benefits for different kinds of users. And so I guess I would strike a very hopeful cord about the future of these kinds of approaches.

>> Derek Khlopin: Other comments?

>> Dave Wright: Yeah, sort of how we can benefit from increased automation and awareness that we're getting of the spectrum environment, you know, in concert with our federal partners. So I think, as you said, at one point, Derek, Colonel Williams is interested in collaborative research efforts between industry and DoD in particular, and we've got some DARPA-led efforts looking into that as well. I think we're really getting new capabilities fielded with things like SAS and like CSC, and even the tool 70-90 for fixed links up there, where third-party industry hosted databases can communicate directly with the NTIA database and get green light or yellow light readout pretty quickly on whether federal services would be interfered with by a new entrant.

Automation around leasing, one of the things, again, you'll be getting comments from us on your RFC, I can assure you. One of the things that the Commission did that I think is really progressive is they put in what is called a light touch leasing framework within the CBRS rules and that allows a priority access shrines holding to enter into a leasing agreement with a lessee, and it's all automated, so the lessee essentially gets preapproved or precertified by the Commission and that's a one-time process, and they can enter into an agreement with a holder at any time and inform the Commission via one of the SAS providers, it's activated by the SAS and the commission reviews retroactively. Which is huge. We've never had that sort of

capability. Those automated processes that can really expedite spectrum availability while making sure we're protecting things following all of the policies I think are going to be huge.

And then to your point, Derek, about, you know, how can federal agencies also benefit from, you know, what we're doing commercially. We talk a lot about the federal holders, and particularly DoD, as an incumbent, protected incumbent. We fully expect federal agencies at-large, including DoD to be users of CBRS services. Colonel Williams talked about smart base initiatives and smart depot initiatives. I've talked to a lot of federal agencies about how they can utilize the spectrum and the equipment that goes in there.

>> Derek Khlopin: Great. Appreciate it. I'll open up if anyone wants to make a final comment on that. It doesn't have to be a question.

>> David Goldman: I was going off the other spectrum. We work with the government all the time. I was actually really excited to hear about the NASA spectrum symposium next year, but it's not just broadband. The spectrum is getting used for all kinds of different stuff. NASA is doing all kinds of really cool stuff. They're going to the moon, talking about going to Mars. We're hoping to work with them on all of those projects. That all takes spectrum too. These are other uses that we need to make sure we're accommodating.

In order to launch, like I said before, you need to have spectrum. Right now we use federal spectrum. The system is a little cumbersome, but -- probably going to be streamlined a little bit, but we have good federal partners there. But we're also looking at how do you communicate if you're going to go and put people on the moon, what frequencies are you using? If you have commercial partners, how do you do that? How do you communicate with Mars? One of the things we're talk about is point to point suborbital rockets. What spectrum is allocated for that?

So I think these are all things that I think we all have to work together. These are new different kinds of uses. The government, federal users have been great partners for us on all of these things. So I fully anticipate that to go forward.

>> Derek Khlopin: Thank you. Anybody else?

I want to take the opportunity to thank the panel. I ask you guys to stay here for a moment and we're going to have a real short wrap-up, but if we can have a round of applause for the panelists.

[Applause]

>> Derek Khlopin: I know we look forward to continued collaboration with private sector and the government as well, as was mentioned, we have CSMAC starting back the October 1 meeting. I'm going to invite acting deputy assistant secretary Doug Kinkoph to provide closing remarks.

>> Doug Kinkoph: Thank you and thank you to the panelists. As we close the second symposium I would like to thank you all for coming and sharing this event with us. I hope you found it both the speakers and panels as informative as I did. You have heard from acting deputy -- or I should say assistant secretary Diane Rinaldo. You heard from deputy secretary Karen Kelley and associate administrator Charles Cooper on the efforts of NTIA and the administration are taking to ensure U.S. leadership in spectrum for both government and commercial needs.

And our panelists delved into how spectrum impacts the use -- how spectrum policy impacts the use of spectrum, federal operations and non-federal operations. I found that very informative. NTIA looks for continuing the dialogue and ensure we gain perspectives from all the stakeholders as we advance spectrum policy work.

Please look at NTIA.gov for important upcoming news and releases. Follow on Twitter@NTIA.gov. And I would like to thank the office for pulling this all together.

Thank you for coming.

[Applause]