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>> Welcome to the -- is this penultimate CSMAC meeting or the ultimate CSMAC meeting?

[Laughter]

>> All right. So, well, it's the one before the end. So welcome to the ultimate or penultimate C spanning meeting. Today, we're going to do readouts and vote on the representations. And so there's been some good work done on the recommendations, so thanks, everybody, for that. And I think what I'll do is I'll give Dave Redl has opening remarks, and so without further ado, I'll pass it to Mr. Redl who just flew in from Cheyenne.

[Laughter]

>> Special --

>> Yeah, exactly.

>> Thanks, and good morning. It is good to be in Colorado, given that, yes, I was on the tarmac in Cheyenne for about an hour yesterday trying to get in around the storms. So I welcome all of you who traveled here today from Washington and around the country and those of you that are joining on the web. I'm very much looking forward to today's meeting and to this year's ISART, the international symposium on advanced radio technology which is cosponsored by NTAI's Institute for Child Communication Scientists and NIST. This year's symposium will challenge propagation challenges related to ultra dense networks. We all recognize the simple fact that our airwaves are about to get a lot more crowded. As 5G becomes a reality, new satellite systems are about to come online and connected devices are even more widely adopted, we'll be asking a lot more of our spectrum resources.

Today's meeting marks the end of another two-year cycle of the CSMAC, and I want to congratulate and thank you all for the work you have done. I'm looking forward to hearings the reports on key band characteristics, 5G enforcement, and spectrum efficiency. These topics will continue to be relevant,

and your work makes a significant contribution to increasing our understanding of these issues.

I'm looking forward to my first full cycle with the CSMAC coming up shortly. I'll be available and engaged with the reconstituted committee as it puts together the slate of questions for the upcoming term. As most of you know, I have focussed on spectrum policy throughout my career. I speak your language, at least as much as any lawyer does, and I plan to speak a great deal with you.

At NTIA's spectrum policy symposium last month, we talked about the administration's view that we're at a watershed moment in spectrum policy. What remains our first preference to make spectrum available for commercial services, the old paradigm of clearing out spectrum to make way for new commercial services is not alone going to get us where we need to be to meet our future spectrum needs. Our challenge going forward is to ensure U.S. spectrum leadership in implementing new technologies as 5G and the commercialization of space continue to make sure we benefit from the important missions of our government agencies as well, including those that support public safety and our national defense.

At the symposium, I felt energy and enthusiasm about the future of spectrum policy in the United States. As Secretary Ross noted in his remarks, the U.S. is in the forefront of global development of telecommunications and space technologies. We must seize the initiative as leaders, and CSMAC has an important role to play.

We need you to identify the policy tools that we may not have explored or even fully envisioned yet, we need you to challenge our assumptions, and we need you to share some of the expertise and experience that you've accumulated as you've formulated business plans and base cases for new networks, satellite systems, and services.

For those who are moving on from the CSMAC after this term, I extend my full appreciation for what you have done, what you've brought this group, and to our policy process. I know that I speak for all of my NTIA colleagues when I say that we'll miss your insights and your hard work.

I'd especially like to thank Janice Obuchowski. Janice isn't here with us in Colorado today, but she's been a member of the CSMAC since its inception. Tirelessly serving in an advisory role for an agency she used to once lead, Janice's contributions to

spectrum policy are simply too numerous to recount, and her wisdom and insight will be sorely missed by me and I'm sure by the rest of this group.

On a happier note, although we have not yet announced the membership for our next term, a good number of you are likely to be continuing on. Let me thank you in advance for all the work that we're going to do ahead. It will be hard. And I mean thank you. We plan to push you to be very active over the next two years in helping us to address some of the complex spectrum challenges we have and to help maintain U.S. leadership in wireless.

Although the final study topics will be finalized down the road, I'd like to offer a preview of where I think we're headed. First, Congress has given us our marching orders through enactment of the Mobile Now Act to work with the FCC on repurposing 255 megahertz of spectrum to study spectrum incentives and by directional sharing and policy opportunities. As we move down a path to viable shared spectrum access, we'll have to find ways to provide the regulatory certainty that commercial spectrum users and federal entities need to make longer term investment decisions. We've also made significant progress towards finalizing

the technical aspects of spectrum sharing arrangements that are key to rolling out CBRS in the 3.5 band.

In particular, I want to highlight DPAs, the dynamic protections area. Replacing static exclusion zones with DPAs will maximize the commercial potential of a band while not losing the assurance that incumbent military radar systems will be protected. This is truly a win-win, and while it may be too early for definitive pronouncements, DPAs could serve as a model for additional spectrum sharing opportunities down the road.

We're also very interested in digging into the request of whether there may be a upside to exploring in greater detail if and how NTIA may be able to lease federal spectrum for commercial uses where it makes sense. This proposal was included in the president's fiscal year '19 budget request, and we continue to think it has enough potential to warrant its pursuit. To a large extent, what Congress has asked us to do will dovetail with the approach the administration is taking to kick the tires or potential policy and regulatory mechanisms that can help us optimize spectrum access over the long-term.

I also believe that NTIA can tap into this committee's diverse expertise as we get closer to a 5G

world and we push the envelopes in terms of what America can do in space. Questions we need to weigh, what are the technical challenges in deploying communication systems and ensuring they can all coexist in an increasingly crowded and noisy spectral environment? How do emerging technology fit into the equation of ensuring that all Americans have sufficient broadband access so they can participate in this incredibly connected future? There's no shortage of interesting questions for the next CSMAC to tackle, and I'm really looking forward to it.

Finally, I'd like to take a moment to recognize the leadership and dedication of Paige Atkins who is retiring at the end of this month.

[Laughter]

Paige's illustrious career has been defined in particular by devoted public service, both with NTIA and at the Department of Defense, in addition to her time in the private sector and in academia. Her absence will be deeply felt at NTIA. She has exhibited true excellence, professionalism, and perhaps, most of all, a spirit of collaboration and cooperation in identifying and pursuing solutions to the problems we face.

When we talk about moving beyond a zero sub mentality towards win-win situations, in many ways, we're describing her legacy in this community. Both in my years on Capitol Hill and in the months I've worked with Paige directly at NTIA, I've come to rely a great deal on her wisdom and guidance, and I know that we will all miss her, even as we wish her the best in a well deserved retirement in sunny Florida. Thanks, Paige.

[Laughter]

[Applause]

>> With that, I'll turn it over to the cochairs.

>> Okay. Thanks, Dave. It sounds like based on what you're thinking about for CSMAC, we'll probably have 25 subcommittees, so we're looking forward to that.

I'd like to just add my voice to those that are wishing Paige the best. I've really much enjoyed working with you. It has been very collaborative, and it's kind of nice to share this with somebody that knows a direction, not that, you know, your predecessors didn't, but it has been very collaborative and I've very much enjoyed it.

Janice Obuchowski is also leaving, and I look at her as the grandam of CSMAC, and so I -- we've really

enjoyed her input and guidance and wisdom, and I hope she can carry that into her future.

Larry is also going to be leaving, so thank you, Larry, for your work, and give a little --

[Applause]

>> But I put my application in so.

[Laughter]

>> See how that turns out.

[Laughter]

>> A little too early.

>> Yeah.

>> It's only an application.

[Laughter]

>> So with that, Larry, do you have any comments?

>> No.

[Laughter]

>> I'll have some at the end.

>> Okay. Let's do the roll call.

>> I just wanted to say thank you to David and to you. It has been a joy.

>> Thanks, Janice. It is good to hear your voice.

>> Yep. Yep.

>> Okay. So let's do the roll call. Let's just go around. Start with Karl and go around.

>> Karl [Inaudible], AT&T.

>> Tom Bren, [Inaudible].

>> [Inaudible], Verizon.

>> Rick Weezer, Raytheon.

>> Bryan Barker [Inaudible].

>> Mary Brand, Cisco

>> Bob [Inaudible], National Association of Broadcasters.

>> [Inaudible], FCC

>> David Redl, NTIA.

>> Larry Alder with One Life.

>> Mark Gibson, Comscape.

>> Paige Atkins, NTIA.

>> Mariam [Inaudible], Network.

>> Chris Wheeler, Facebook.

>> Michael Celbrese, New America.

>> Andrew Roy, Aviation Spectrum Resources.

>> Mark McHenry with [Inaudible].

>> Caroline [Inaudible].

>> Dennis [Inaudible].

>> Paul [Inaudible].

>> Okay. And CSMAC folks that are on the phone, could you all try to weigh in, not at once?

>> Janice.

>> Thanks, Janice.

>> Paul [Inaudible].

>> Mark [Inaudible].

>> Paul [Inaudible].

>> All right, Paul, we got you twice. Good. Is Dale on? Okay. Is Donna on? Donna Buthaya? I'm just going to call names. Mark Crosby, are you on?

>> Should be. He said he was going to come on.

>> He's not on. All right.

>> Mark is on.

>> Hi, Mark.

[Laughter]

>> Thanks, Mark.

>> I had to hit my mute button.

>> That's okay. Use to learn the mute button. Kurt, are you on? Kurt Showbak? No Jurt? And then, Jen Terr? Jen, are you on? You got a question.

>> She wasn't sure.

>> She wasn't sure. Okay. All right. Okay. Now, let's go quickly around the room, if we may, starting with you.

>> George [Inaudible].

>> [Inaudible], CIO.

>> [Inaudible].

>> [Inaudible] Pierce.

>> Taylor [Inaudible].

>> [Inaudible] McHenry, NTIA.

>> Excuse me. Rebecca George, NTIA.

>> [Inaudible]

>> Tom Kidd, [Inaudible] the CIO.

>> Dan [Inaudible].

>> [Inaudible].

>> Ryan [Inaudible].

>> Jake [Inaudible].

>> [Inaudible] Facebook.

>> [Inaudible]

>> Karl [Inaudible] Department of Energy.

>> [Inaudible]

>> [Inaudible].

>> [Inaudible] Network.

>> [Inaudible] NTIA.

>> [Inaudible], NTIA.

>> [Inaudible] NTIA.

>> Bruce Jacob, NTIA.

>> [Inaudible] Jay, Green Technologies.

>> [Inaudible] Kelly [Inaudible]

>> Kevin Roe, [Inaudible].

>> NTIA [Inaudible]

>> Barb Martin, Alliance Science, contractor.

>> [Inaudible] NTIA.

>> Okay. That's it. Wow. There's more people that are guests here when we're not in D.C. That's interesting.

>> I think it's about the location.

>> Yeah, it is okay. So a few things on logistics. So we're going to be voting on recommendations today so, those CSMAC members that are on the phone, just make sure you, when we do the votes, you pay attention.

The other thing for those that are following at home --

[Laughter]

>> Raise your hand.

>> For those that are following on the video, all the documentation is available in the NTIA's website under Spectrum Management CSMAC. Dave put it all up there, everything is there, so you can follow along at home, if that's where you are.

The other thing, finally, is to thank everybody for being here. We're going to be gathering tonight, I think it's at 5:30, right?

>> It is.

>> So for a, thanks to Bryan, by the way, for a ho down for Janice.

[Laughter]

>> So.

>> A ho down?

>> Well, not a ho down, a gathering.

>> For Paige. What did I say?

>> Janice.

>> Well, we'll celebrate Janice in absentia.

>> We can toast Janice.

>> Or roast.

>> We can toast Janice.

>> In absentia.

>> Or roast Janice.

>> At Emerson's on Pearl.

>> On Pearl. Emerson's, Pearl, yeah. And I think that's it. Oh, and recognize Julie. Welcome Julie. That's all I have. So without further ado, let's go to the spectrum update with Paige.

>> Thank you. Thank you to everyone for the kind comments, and thank you, Janice, for your time in supporting our agency. Thanks to Mark and Larry for kicking this off and setting the stage for a good discussion today. And Larry, thank for your times a cochair as well. I want to also thank David for his opening remarks in really charting the course for this group, so it will continue CSMAC's relevance and importance not only in the next cycle but for years to come.

And you have to believe me, and I know you do, that I'm leaving you in great hands with David at the helm of NTIA as well as the ongoing leadership with Peter Hila and Steve Molina at the Office of Spectrum Management.

So as traditional, and for the final time for me, I will take this opportunity to provide a short spectrum update to cover some of the activities and accomplishments since our last meeting, not just for the agency but for the community at large. And then I'll turn it over to Jew lie who will continue that update from an FCC perspective and then we'll wrap it up and turn it pack to the cochairs to get to the meat of the discussion today in terms of the subcommittee and the committee's recommendations.

So many of you were present or perhaps watched the webcast of NTIA's spectrum policy symposium which we held June 12th at the National Press Club in D.C. that David mentioned earlier, and this really was an opportunity for our leadership to emphasize how important spectrum policy to the administration, to NTIA, and to all of us with this community.

We also heard from a panel of experts that represented a real cross-section of the community, including the White House, the Commission, the agencies

and industry. It was a great discussion, from my perspective, although I did moderate the panel. So and we were very pleased by the level of participation in this first symposium that we held, not just in terms of the panel but the attendees. It really exceeded our expectations. And I think the event showed that there is a keen interest in how spectrum policy is evolving to meet the demands and opportunities of the rapidly changing technological landscape as well as the market growth that we're seeing.

And there was consensus that though we've made tremendous progress over the last few years, and I can't emphasize that enough, we've made tremendous progress, that we need to chart a course toward a new comprehensive and sustainable national spectrum strategy to ensure that we continue to meet the growing needs of for spectrum access not just for users but also critical government services, and the development of this strategy will no doubt be informed by all of the great work that CSMAC has done over the last few years. But your job is not yet done. CSMAC will continue to play a role in shaping how future national spectrum strategy might unfold.

And as we and NTIA work with our partners, including the commission, the agencies, and industry,

we will continue to look to CSMAC in particular to provide an expert voice from industry that will inform what we do moving forward. So we are still finalizing our approach, and this is collectively finalizing our approach to developing this strategy, but we expect, again, CSMAC to have much to contribute on its development and implementation, so I thank you in advance.

Meanwhile, Congress has given us a full plate of activities, including Mobile Now that David mentioned earlier and the discussion that we discussed at the last meeting in terms of the elements of Mobile Now. Much of this work involves close collaboration between NTIA and the commission. And we are actively working not just for the commission but the agencies to develop and implement a work plan to ensure that we can respond to the requirements and the provisions of Mobile Now. Fortunately, we have a strong foundation of this collaboration and working together on these kinds of issues. And the Mobile Now work will actually dovetail very nicely with ongoing efforts in such areas as spectrum repurposing and incentives. So we've got a head start, so to speak, but we need -- there's a lot of work left to do, and we'll rely on CSMAC on a ongoing capacity.

In terms of ongoing work, we continue to support the preparations of the groundbreaking citizens broadband radio service, CBRS, which David also mentioned earlier. And I won't go in to the DPAs. However, I can't stress enough what this could mean to us and the community, just demonstrating a tremendous tool in our tool kit for sharing in the future and particularly dynamic sharing.

For the spectrum access system equipment, or the SaaS equipment, we and I'll say ITS in particular are now working through software verification and validation process ahead of certification testing. And once that verification process is complete and we've worked through the remaining bugs and glitches, ITS will collect that data and hand it over to the commission for equipment certification.

The FCC, meanwhile, plans to carry out additional work and initial commercial deployment and field testing, and I'll let Julie talk to that when he fills in the voids from the commission perspective.

With regard to the environmental sensing capability, we are preparing, and, again, ITS preparing a precertification process for equipment providers which will allow them to work with us to ensure their systems will meet the requirements and the standards,

and after the actual testing occurs, again, ITS will collect that data and transition it to the commission for certification. And as they've done throughout the CRS implementation process, the commission will continue to work closely with NTIA as well as DOD in the process to review that test information, the certification information.

And our goal is not to play gotcha. It really is to ensure we have clear certification standards and testing processes and transparency, so we're all in this together and we all want it to work. So that's really the intent. And we want to smooth out any bumps that occur along the way, because they will occur, and I know Julie will echo that comment.

Now, with regard to 3450, the 3550, as you recall, we identified that band for further study, and we're going to begin and NTIA will begin a feasibility assessment on that band over the next few weeks, so we're getting ready to start that. We've seen some preliminary work in preparation. We plan to leverage the successful approach that we collectively employed in 3.5-gigahertz, which involved the joint interagency working group, and in this case, again, it will predominantly the commission, NTIA, and DOD. In particular, on the government side we also expect DOD

to submit a pipeline plan to gain resources from the spectrum relocation fund to help study the band in more detail and to help feed the process along the way. So, again, that will be kicking off over the next few weeks.

But we have to be careful to note that though some characters -- or that some of the characteristics in the 3450 to 3550 band are significantly different from 3550 to 3650, so there's no predetermined outcome or quick fix, so to speak. We need to study the band and see what methods can be used for sharing, for instance. But we do hope, again, that we can leverage the collaboration and the problem solving processes that were established for 3.5 to apply to this band as well. And I'll let Julie address in more detail the FCC's recent work looking at other bands related to mid band spectrum like 3/7 to 4/2. It's safe to say, however, mid band is -- has had increasing attention lately, and we're supporting the commission and the commission is supporting us as we look at mid frequency or mid spectrum going forward.

Similarly, I'm sure Julie will talk about spectrum frontiers and horizons. We continue to work with the commission in preparation for upcoming options and continued progress on the proceedings. There's also

some overlap between the domestic frontier's band and some of the bands being studied in the millimeter wave for broadband wireless services at the International Telecommunications Union, or the ITU, as part of our preparation for the World Radio Conference in 2019.

Some of the federal agencies have been conducting studies as part of the ITU process. While the study parameters may not carry over 1 for 1 domestically, we are working with the agencies to determine how we can distill the technical work that's already been done and inform the proceedings that the commission has underway.

And speaking of the ITU, preparations for the 2019 work are poised to enter a new phase. And this is very important as we ramp up for preparations the conferences November of 2019, so it's a mere 15 months away. The various ITUR study groups and working parties are winding up their technical studies of systems potentially implemented by the work 19 agenda items, and this includes task group 51 which is the group studying the potential for introducing terrestrial broadband wireless services into the bands between 24 and 86-gigahertz and ITU specific agenda item 1.13, and it's a very important agenda item for all of us in this room and for the United States.

So from here on, the United States and other countries will begin finalizing positions and proposals for agenda items going into the conference preparatory meeting early next year and the work. And as part of that process, CTEL, which is our Americas regional group, held a meeting in its work preparation group last week in Mexico to consider several regional proposals for the conference. And the United States is working hard to reach consensus with our regional partners on as many of the agenda items as we can, and that's a critical step to our success going in to the conference in 2019.

Now, taking a slightly different twist, as many of you are aware, the administration and the Department of Commerce has a new --

>> Rebecca.

>> -- they're --

>> It's a nice touch.

[Laughter]

>> They've taken a keen interest in space, satellite systems. NTIA is supporting the Department of Commerce as it works to implement the provisions of the president's space policy directive number two which calls for creating regulatory conditions to promote U.S. space commerce. A key component is a report on

how U.S. spectrum policies can help to improve global competitiveness of the U.S. space sector. This is certainly something we feel is integral to our mission, and we'll be working in partnership with the commission as well, and we welcome the chance to contribute to the administrative agencies focus on space industry. And, again, just a collaborative effort in this area.

I want to emphasize that in this area and other aspects of spectrum management, NTIA welcomes collaboration with many different partners across many different sets of issues. As all of you know, most of what we do involves balance, balancing the viewpoints of all stakeholders, and I talk about that probably incessantly, not only between federal and nonfederal users but also between and among different types of radio services, space and terrestrial, active and passive, unlicensed and licensed.

And as I have said many times in many forms is cooperation and balancing of views and interests is the best way to make progress and sometimes the only way to make progress. It is not an easy balance but one that CSMAC can continue to help us maintain because it is an absolutely critical to get to where we need to go.

So as I conclude my last spectrum update, I want to thank each of you for your wisdom, hard work, and

recommendations over the last months and years. Your wisdom has been impressive and your support has been truly valuable to NTIA, Department of Commerce, the nation, and to me personally. CSMAC becomes the embodiment of the values of hard work, collaboration, and compromise that have led to so much technical and policy innovation over the years. And that work ethic and spirit of cooperation will be very much needed in the future to continue to address America's spectrum access needs.

I will truly miss working with all of you. I am humbled and honored to be part of this process and to be part of this group. But as I said upfront, I'm very comfortable that I'm leaving you behind great leaders and in good hands with, again, David, as well as the OSM leadership. So thank you very much. I'm happy to take questions before I turn it over to Julie if anybody has any questions.

>> I'd like to just make a statement while we're here in Boulder, that you mentioned the SaaS and ESC testing, to just acknowledge the work of Rebecca's team, Keith, it's going well, and we're learning a lot and we're going to get it done, and largely to the collaborative effort that Rebecca has led. So thank

you, guys, for your work. I know it has been rough, but it is happening, and it is working, so thank you.
>> Okay. Without any questions, I'll turn it over to Julie.
>> Can I make a real brief statement first? First, I apologize for the tightness of the room, but we have -- we are webcasting the CSMAC over in a larger room if anybody needs to spread out so.
[Laughter]
>> We've already shuffled many people over there so.
>> Thanks, David. It has brought us all closer together.
[Laughter]
>> Tough crowd. So thank you, Assistant Secretary Redl and Paige. I was going to tell David, lock the door and we can unlock it when we get Paige to agree to stay.
[Laughter]
>> I don't know if we have that kind of power.
>> Okay. So it's a pleasure to be here, and it seems like I make more of the meetings here in Boulder than I make back in D.C. So many of the things that we do at the commission are the result of work in collaboration with NTIA and the federal agencies, and I want to second or third the remarks about the wonderful

progress we've made. In fact, I think next year we're going to be down to tackling the last remaining megahertz of spectrum and then we can all rest.
[Laughter]
>> Now, that's a joke. We're never going to get to rest. So I'm just going to go through a few of the things that we worked on with NTIA and, you know, in the last several months. This past February the commission initiated a proceeding to expand access to the spectrum above 95-gigahertz which, for -- you know, the fact for many of us who have been at this for awhile are talking about use of spectrum in the millimeter waves, no less above 95-gigahertz, just reflects the remarkable change in technology and the demand for access to spectrum.

So in that item, we allocated 102 or we proposed to allocate 102.2-gigahertz for licensed point-to-point services and 15.2-gigahertz for unlicensed use and we sought comment on creating a new category of experimental licenses that would be available in the spectrum between 95-gigahertz and three terahertz. And as most of you know, as you get higher up in the allocation chart, I like to think of it's above 40-gigahertz, almost all of the spectrum is allocated on a coprimary basis, so we are -- it is really

critical as we are tackling these issues to be working together with the federal side.

In June, the commission took another major step in the spectrum frontier's proceeding by addressing a number of the outstanding matters for the bands that had been previously been allocated at 24-gigahertz, 28, 37, and 39-gigahertz. Sometimes it sounds like a call in a football game.

[Laughter]

>> And sought comment on making 2.75-gigahertz of additional spectrum available in the 26-gigahertz and 42-gigaghertz bands for next generation wireless services and we also solicited feedback on potential rules for the fixed satellite use of the 50-gigahertz band for a limited number of earth stations.

Then in July the commission proposed to add a mobile allocation in the 3.7 to 4.2-gigahertz band, that's better known as the C-band satellite data link spectrum, potentially clearing part of the spectrum for mobile service and sharing part of the spectrum with new fixed point to multipoint broadband service. And later this year the commission's planning to initiate a proceeding and process to make spectrum available for unlicensed use or licensed lite in the 6-gigahertz region. So there's work going on in that as well.

And as they say in the commercials, but wait, there's more. Perhaps less in the noticeable is all the work that goes on behind the scenes between the FCC and the NTIA on other major projects, such as collaboration to approve the spectrum access systems and the rollout of the CBRS, the system broadband radio service at 3.5-gigahertz, there's lots of pieces to it, including work that's going on to be able to start to roll out initial commercial deployments, hopefully before the end of this year.

We've been working together on the tasks in the Mobile Now Act, the Ray Baum Act, particularly relative to the recommendations on bidirectional -- to develop recommendations for bidirectional sharing and a national strategy for unlicensed. We've also been working on together, obviously, on the preparations for WRC19, the national space directive, and quite a few other things, as Paige mentioned.

So please forgive me if I neglected to mention your favorite spectrum proceeding, but they only gave me, Paige, what was it, an hour? There's clearly so many other things going on 4.9-gigahertz, 900 megahertz, you name it. And we've working quite a bit on satellite, making spectrum available for new wireless satellite

broadband systems as well. So there's a lot going on across the spectrum allocation table.

I'd like to say a few words about coordination between the CSMAC and the FCC's technological advisory council or TAC. The FCC and NTIA have liaisons for each group, and I think it is particularly important that the two groups collaborate on certain topics. Both the CSMAC and TAC have been doing work on 5G, and there's bounds to be information that gathered on each side that would be valuable to the other so that we're all pulling together in the same direction.

And both groups had made recommendations relative to enforcement. The NTIA working with the FCC had held a workshop with the federal agencies focussed on what we termed as interference avoidance and mitigation or resolution, and we're having discussions on followups to that. So that work is not forgotten. There's actually things going on behind the scenes there as well.

And there are certain topics where there's shared interest for both the federal and nonfederal side, such as spectrum for unmanned aerial systems and the spectrum implications of advances in antenna technology, and, in those cases, even though we may not have identical overlapping work groups, the information

is probably useful to pass across the work between the federal and nonfederal side.

And I want to thank Dennis Robberson for the leadership on the TAC, and we've had other members who are either formally part of the CSMAC process that are on the TAC kind in a bridge that work between the two.

And lastly, I'd like to thank Assistant Secretary Redl and Paige Adkins for their support in working through all of the above. If it wasn't for their terrific work and the ability to work through some very difficult issues, we couldn't have accomplished nearly what we did. So thank you. And I'd be happy to take questions, too, and pass them on to Paige.

[Laughter]

>> So any questions for our distinguished guest, Julie? Wow, you're -- this is what is what being in Colorado does, take advantage of the Colorado air or something.

>> Could I make a comment?

>> Yes.

>> So thank you, Julie, for your partnership and the Commission's partnership. It has been invaluable. But I also wanted to mention that as we think about the next cycle and as David thinks through the priorities from an NTIA standpoint, let's look at opportunities for or you look at opportunities for potential

collaboration and synergy with the TAC and if it makes sense, maybe have a collaborative topic or area to address collectively. So just think about that as we move forward.
>> If I could add to what both Paige and Julie have said on that note, and David and I have been talking about this, this is a percent time to do that because often the cycles don't match up very well.
>> Yeah.
>> So we're right in the middle of a cycle for CSMAC when TAC is negotiating its next round of activities. But this time we're pretty close because we're finishing up here and we'll start a new cycle in January, so this is an ideal time for CSMAC and the TAC to, in fact, come up with collaborative activities where you sing and I'll dance and as we get that kind of synergistic activity. So just add to pile on what you've both said already.
>> And I would just like to say thanks to the commission for your work in 3.5 gig. We're learning a lot. And it has been fun.
[Laughter]
>> Knowledge is good. Take that for what it's worth. Okay. I pass the mic to Larry. We've got four

subcommittee briefs. We're going to vote on all four. Let's get to it.

>> As Mark said, the objective today is to vote and approve, hopefully, the subcommittee reports. We will note if there's modifications or anything. Before we get into it, we do -- we have a decent amount of time for discussion on each of these matters, so feel free to weigh in, that's the purpose of having the whole committee.

I want to say before we get in that it has been incredible to see the rally by these four committees in a very short period of time. I was fully impressed by all the committees, but I will say especially the spectral efficiency committee, that was quite a report done. So great work by everyone.

And with that, we'll kick it off with we'll just go in the order here with the 5Gs, who is going to speak to 5G? Mariam?

>> Thank you. So on the 5G subcommittee, I first wanted to thank Ranum for all of his assistance which we could have not come up with these recommendations without his assistance. I also want to acknowledge Amy Sanders and Bob Denny who have supported Ranum, thanks a lot. Also, the subcommittee members, thanks for the participation and the input.

So basically what we started out is we got a NTIA draft for a proposed sort of interaction with the standards development organizations, or the acronym of SDOs that I will be using, and originally when we received this, we started to put some comments in and we also came up with a short-term plan because the NTIA actually, you know, has their 3G PP membership so that would have been an avenue that they could have started immediately.

So not to hold up anything, we came up with a very short-term recommendation, and that was the participation obviously at the SDOs for monitoring purposes and also informal engagements with not only the industry but other interested parties, as Dale has pointed out, we just cannot focus on industry alone, there's other actually groups that would be interested probably to participate in this engagement.

So it was, you know, the short-term plan kind of said reach out to consortiums and existing sort of bodies to be able to gather input, but we knew that that is not a good long-term plan. A good long-term plan needed a little bit of a more formal and transparent process. So our final recommendation came through talking to various entities to be able to establish this formal recommendation. We reached out

to the FCC, so the FCC is obviously interested in what was going on with what was mentioned right now to collaborate on this formal engagement.

And let me just, sorry, before I get this, backtrack to say the reason why the formal engagement and the transparency is needed is for several reasons: one, for the FTIA to be able to collect input from various groups. Two, to actually submit questions or ask, you know, what is needed for spectrum sharing, so it has a multi-purpose sort of engagement. So we actually try to see what's out there that could be utilized and did not go into creating new concepts. Like, for example, if you look at public safety, NPSTC was created, requirements came there, and then IPSTC was created, requirements came there, then ITS implemented it at the 3G PP standards. We really truly believe that it could just be kicked off as the final recommendation points out without having to create a new group or a formal portal for this engagement.

So, sorry, now going back to the FCC, the FCC is obviously interested to participate but they do want to see a more formal process or maybe, you know, sort of a concrete framework, and they're ready to engage and understand how the NTIA and FCC collaboration could be

done through this process on getting SCO changes or implementations.

We had several discussions with the ITS, the ITS group, specifically Andrew Thiessen is their resident expert group on standards. They've done a lot of work but primarily their public safety requirements that they implemented in 3G PP was really an excellent job. They have resources and knowledge and know how not only on the technical side but also on the process and the framework because their bodies, organization bodies, each one of them have their unique characteristics which make things very hard to implement, to just kind of show up and say, I have this cool idea. Doesn't work that way. So that knowledge and know how is pretty valuable. So through this several engagements with ITS, understanding how the FirstNet requirements were done, we got a very good idea of how the -- this could be done in sort of the 5G recommendations.

Then we also talked to the state department. We engaged them because, you know, just sort of advice seeking of frameworks or portals. Interestingly enough, the state department came back and said, well, there's ITS, you know, and they already have portals for engagement. So then, finally, we talked to ATIS, which is an industry forum, and the reason why ATIS was

significant is because ITS has, through ATIS, created a place where they could actually have an industry collaboration or framework. So there's an existing working group over there that this could be done through. It is called the WTSC-RAN group, and ITS is very familiar with that, so that could be actually a liaison initially, and other liaisons could obviously be created after discussions with the FCC and other entities.

So based on these discussions and also, you know, we reached out to the various standards groups to understand, you know, basically their frameworks, but after all, we recommended that ITS should lead the SDO work and utilized it as a means to collaborate with the industry and other stakeholders, academia, civil societies, public interest groups, and we believe that that would be a pretty good process to actually implement what's needed to enable sharing with 5G.

And finally, I think on future work, because we started out with a draft plan by the NTIA, we did not want to leave that hanging. Once NTIA decides to move forward the CSMAC representations, then obviously we can come back and help the NTIA with a drafting of that document, going into much more levels of details of what is obviously presented at this very high level

presentation and come up with a document that could be shared with the FCC or other interested parties to move forward. So we recommend that as a future work for the CSMAC subcommittee of 5G. Thank you very much. That's it.

>> Questions for Mariam and the 5G committee?

No questions? I have a question.

>> Sure.

>> So this is not a area I was deep on, but did you actually list out the standards of development organizations? Because I know there's many. Was there a recommended list of ones to participate in?

>> Well, if you look at the 5G subcommittee history, we had two, one white paper, then we had another document, so as part of the initial work, there's a lot of work that went out to listing out all the standards organizations. So I think I would refer everyone back to that white paper. So we didn't want to, you know, re-bring up that once more. But there are -- there are numerous, I mean, you could get lost in the SDOs. So it is also a matter of maybe picking --

[Laughter]

>> -- and choosing what is the most effective, you know, and what is needed. You know, 3G PP and R triple E are leading, but there's also all the other

organizations listed in the white paper, so there's an opportunity from all of them. But they're sort of the two leading bodies that are defining the industry standards on a global scale.

>> Thanks. There are only 200.

>> Yes, there you go.

>> All right. If there's no more questions, I think I would be looking for a motion to approve these recommendations. Paul, motion. I need a second.

>> Second.

>> Second. All right in favor of the recommendations as submitted, say aye.

>> Aye.

>> Any opposed? Any abstentions? The motion is passed. Congratulations.

>> Good job.

>> Thank you, Mariam.

[Applause]

>> Again, I want to thank Mariam who has led this committee for two consecutive terms and has really done a great job.

>> Yeah, are you going to update the paper?

[Laughter]

>> On 6G.

>> Yeah. Cool. Great. Next year.

By the way, the folks on the phone, please remember to mute unless you're voting. Because we hear dogs barking.

[Laughter]

>> Okay.

>> And I know it's not in the room.

>> So next we're going to go to the key characteristics with Charla and Tom. I'll turn it over to you.

>> I'm going to present and Charla will chime in as she likes to do but doesn't want to present so.

[Laughter]

>> So she's been presenting multiple times so now my turn.

[Laughter]

>> Yes.

>> I have to pull my own weight here a little bit.

>> Actually what he meant to say is that I have been presenting so therefore --

>> Correct.

>> It's his turn.

>> It's my turn.

>> It didn't quite come out that way.

>> I'm a engineer, I'm not good with words.

>> So our committee has a somewhat more detailed report that also went with this as well, really building upon

what we did with the last go round on the key characteristics of determining which spectrum bands make the most sense for commercial use.

We had a very active committee this time and tried to get everybody engaged and frankly, I think Charla would agree with me, we had a lot more engagement this time, a lot more help from the rest of the committee, so very much appreciated to the other subcommittee members.

But we're just going to focus on the sort of seven slide deck presentation that sort of gives the high level overview of what we came to work on, and as you see on slide 2, we have the list of subcommittee members as well as the NTIA liaisons, a very large group of subcommittee members, but if we go to the overview slide, which is labeled slide 2, we were asked to develop a methodology to help NTIA assess federal bands for sharing, so we already come up with sort of the key characteristics which, if we go to the next slide labeled slide 3, which was the question in the last go round.

So we had sort of five key characteristics: Number one, pulpation and coverage; two, capacity; three, contiguity; four, international harmonization slash scale and then incumbency issues.

And what NTIA had asked us is can you take those five things and sort of help game plan how we use those to look at different bands when we're actually analyzing them for commercial use. So the committee took that under advisement and worked through and came up with three different recommendations.

If we go to slide labeled four which is recommendation one, we've decided that we could take those key characteristics that we had defined and then apply them to each sort of four band segments out there, the low band, the medium low band, the medium band, and the medium high or high band, if you will, chunks of spectrum, and then assign sort of priorities of those five key characteristics to each of those sort of chunks of spectrum, recognizing that this will change over time. This is a snapshot view of what it looks like today from the industry perspective.

And then if we go to sort of slide 5, taking those sort of prioritizations for those four spectrum chunks, thanks to Caroline Kahn who sort of pulled this together for us, we created a decision tree, and in the report itself there's some more text that goes to that chart that's listed there in slide No. 5, but, in general, looking at the low band and seeing, you know, what are the high priority items for the low band, what

are the high priority bands for the medium low, what are the high priority issues for medium and high band, etc., and we think this will help, as you're looking at different portions of the spectrum, to sort of say, okay, when I'm first getting a chunk of spectrum, what thing am I looking for most perform as a starting point before I move on? And if it fails there, maybe I shouldn't even look at this band for that particular use at all. If it passes that, then I can work my way down through the decision tree, if you will.

So the recommendation generally is to take this sort of mapping and apply it to bands as sort of looking at different bands that are potential for sharing or use by commercial interest. So that's the first recommendation.

The second recommendation came from I believe Mary Brown which is a technology radar approach of trying to help NTIA to sort of keep abreast of what's happening out there in the technology field in the commercial wireless technologies, so on a periodic basis conducting a technology assessment with the vendors that were involved in the technology development, and really the goal is to inform with respect to what's happening in the silicone area. So, for example, one of the things we mentioned in the more detailed report

is, you know, we would have given a little heads up on millimeter wave becoming something well before the fact it actually became something because there was a lot of work in the commercial industry before it became federal government issue, if you will, in terms of looking at different spectrum bands, So trying to give a sort of way of seeing what's coming down the road before it actually is hitting the government for requests and surprising anybody. So it's something that industry uses relatively well.

And I think the danger that the committee -- subcommittee would note is that we don't think to go down every single rabbit hole but having the industry direct sort of three or four promising developments on a regular basis, maybe biannually or something of that nature, to sort of give an idea of things that are far long in development that may have a lot of commercial applications.

And then the final recommendation is looking to really engage with the private sector as you go down these paths. We know -- we would note that at 3.4, there has already been a little bit of engagement with the city, but still thinking that through each step of this process, as you're looking at these bands, engaging with the commercial industry upfront, during,

and prior to final decisions in some fashions, sort of really engage on different bands or on the band before you actually make some decisions and to sort of understand what it is they're desiring to looking to get out of it, as well as what criteria may be beneficial for sharing or reallocation, whichever approach that goes down that path.

And I think the last part of that recommendation is recommending looking at the 3450 to 3550 as a possible first band to sort of engage in that that approach. And we've done this in other spectrum bands so this isn't new ground we're going down, but just another sort of formalized recommendation from that.

And I think in the last point that didn't actually make it in the report because we got it very last minute from the subcommittee members is also noting that the 3.5 process should be informative of this as well and that there was good engagement all throughout the process, it would be good to repeat that in other places.

And also one of the lessons learned at 3.5 is at some level, and I think you're already looking to correct this at 3.4, is getting funding for DOD an the federal agencies up-front to really look at these issues prior to getting into the soup which is where

we've been at 3.5 for a bit now because there wasn't a lot of that sort of spade work done ahead of time prior to actually getting to the point where there actually is sharing among the federal and commercial users. So I think that closes what my formal comments. I don't know if Charla had other points she wanted to add as well.

>> Yeah, just a couple of things that I would say is one is just thanking the committee generally because the first recommendation we really came out of the back and forth that we had in April and trying to create something that looked a little bit, you know, more like a formal process, the decision tree we talked about it then, and then, as Tom said, you know, Carolyn actually is the one who developed the table that we put there.

The second thing is I wanted to make sure that it was clear on the second recommendation, and I think Mary might even want to say a little bit more about this, this is not a complicated white paper we're talking about. This is -- this should be a very, you know, I don't know how often it would be, but it would be very quick, sort of quick and dirty look at what's going on and a very simple response to just kind of make it available and make sure that people are aware what's going on in technology. It isn't supposed to

be, you know, add a incredible burden, and, in fact, it's probably to take things that, you know, everyone within NTIA does already but just put a little bit of a more formal structure on it so that there's actually a result.

And then the third thing, which is sort of the opposite of what I wanted to say on the second recommendation, is, again, I think this already goes on, that type of coordination and discussion with industry, but I feel like sometimes it's actually industry driven. We know you're working on something so we're going to come in and talk to you. I, you know, I think the view of the subcommittee was that it would be helpful if it were a little bit more formalized, the process were, you know, understanding where NTIA is in, you know, in its process and actually, you know, not -- not necessarily -- and I think it's something to discuss with the full committee, not necessarily, you know, very formal process like you would do through at the FCC but at least a little bit more formal than it is now. So I don't know if you have any additional comments on top of mine.

>> That's it.

>> I just would like to -- yeah, this is Mary Brown. I'd just like to say just a word on the technology radar. So these are literally one-page concentric circles where technology that is about to be commercialized near the center and the stuff that's a little out there is at the edge, and the input to develop it can be as simple as interviewing some of the vendors in the space, it could be more elaborate if NTIA chooses, you could collect comments from people, but the intent is to base it on publically available information that is ongoing in standards work or as a result of papers that the vendor community is putting out in the technology space, just to get a sense of where people think technology is going. So it can be as simple or as elaborate as you want.

And it's also intended to be a living document. So things that you might put at the outer edge of the circle might ultimately drop off because something has been deemed not important. But many organizations maintain them. And if you Google technology radar, you'll find examples all over the web about what a technology radar looks like. You would design your own for your own purpose.

>> All right. Thank you. There's a question from Paige.

>> Yep. So a comment, first, and then a question. So the technology radar I think is a great idea. I think it's applicable not just to technologies that need access to federal spectrum but spectrum in general, so I would broaden the perspective, obviously for us, we're looking at federal spectrum, but I think it could be a collective tool.

For recommendation No. 1, I'm trying to understand how we might use this and in terms of going back to the matrix that's identified, you know, obviously there -- you use one band over another because of certain characteristics, and I'm trying to understand, if you could walk me through this matrix and help me understand how we might apply it in terms of weighing the pros and cons, other than the fundamental technical characteristics of particular bands that are assumed to be there. Did that make sense?

>> Yeah, I mean, yeah, to some extent we did, in the sort of longer document, sort of walk through an example and, in general, the thought is you would look at these priorities and sort of formulate questions. So if we're looking at the low band, let's start with that since it's on the left side, it's a little bit easier to look at, you would look at the high priority things of propagation and coverage and contiguity, so

the first question would be, is the band that we're looking at have large contiguity, is there a contiguous spectrum here or is there 5 megahertz here and 5 megahertz here and 7 megahertz here, or is all of that together? So that would be sort of the first question as you're going down the decision tree. And if it is, great, that's the high priority item to have that contiguity, so good, this is a good low band option for potential for commercial use because, really, trying to prioritize having contiguity in the lower band.

Similarly, the propagation and coverage, it's sort of inherent to the low band, so I mean, at some level it's a little obvious, I'm not sure that's helpful as a question, if you will, if you think about it, but it's really more in terms of prioritizing the other different things against it. So if the commercial application itself was looking for something with propagation slash coverage characteristics as a key thing that they needed, they'd be looking in the low band in general for that application.

>> All right. So I'll repeat I think what you said. So if we were to look at this chart knowing that propagation and coverage is an inherent characteristic, the area of emphasis and priority for industry would be contiguity versus the other --

>> Correct
>> -- characteristics?
>> Correct.
>> And likewise, for above 6-gigahertz, the driver would be international harmonization as I read this, the prominent driver? Is that -- am I reading --
>> Yes.
>> Okay.
>> And actually, the note there is if you go back and look at the paper, we put satellite in there because originally we were thinking that maybe, you know, the international harmonization really is almost band specific, but there's some -- there's some sense that in the high bands for satellite it becomes, you know, important. So we kind of went back and forth on that, the -- as a criteria, global harmonization is probably one of the more difficult things to work with because it is so contingent.
>> The other question I have is putting the high bucket above 6-gigahertz seems very broad.
[Laughter]
>> That's from the last paper.
>> Talking about 6 terabytes.
>> And there's some distinct, you know, if you look above 6 or above 24, above 95, you know, they are very

distinct characteristics. So I just, the granularity we may need to look at some additional granularity above 6.

>> Oh, hey, Paul.

>> Paul had a question.

>> Yeah, Paul Kolodzy. So I'm just, I'm going back to the matrix as well because it's -- I'm trying to understand if the matrix is telling me this is the desire by industry to have certain bands or this is the applicability of that characteristic to associated for sharing and should be look looked at for sharing?

Let me tell you the reason why. Generally when I look at tables like this, it tends to remind me a little bit of about 10 years ago, 15 years ago where we were looking for a lot of coverage capabilities and a lot of issues associated with cellular. Now the commercial broadband wireless technologies are not just into, hate to say this, but it's not just mobile telephony but it's a lot of other, it's wireless access and overlays and underways and ground to air and the like. Sometimes high bands actually become very useful even for their propagation because you get great gain on both sides and actually it allows that out.

So I'm just wondering, am I misinterpreting this or is it just something we hadn't looked at in the sense

of the applications that really look at more toward the terrestrial normal mobile telephony or was this more broader than that and I'm just missing it?
>> No, I don't think it's necessarily focussed just on terrestrial because we certainly have the satellite folks participating as well. But I will say it was not probably as broad as it could be because we don't have representation from every sort of different industry necessarily in each area. But I think the way we looked at the matrix is I actually think it's sort of both of the things that you suggesting which is, number one, is from a commercial industry, which bands would be the most desirable for these particular characteristics and how would you apply them, if you're the commercial industry looking at the band, and then secondly, on the sharing point, and if you look at the more detailed discussion, not just the pretty color chart, we actually talked a little bit more about how you would sort of divide and conquer, if you will, in terms of, you know, if you're looking at sharing, you may want to go a little bit different direction than if you're looking at exclusive use of the spectrum as well.
>> Right. Okay.
>> I got a --

>> I --

>> You got a --

>> The takeaway I got from reading this, this is more of a comment than a question, and this is kind of, I think, from the very beginning, this was a really tough ask and to come up with a methodology given the very diverse interests, you know, as you mentioned, all of the different things, and so my takeaway is given a tough ask, this is kind of what you were able to kind of come to. So that --

>> Yeah, I think Tom just didn't want to say that for the about the fifth time.

>> But it was clear. It was clear.

>> I -- so in the context of -- I guess I have two questions. In the context of propagation and coverage, did you consider propagation and interference? For example, you know, higher bands and their ability for frequency reuse because of propagation implementation? Did that figure in your considerations at all?

>> Yes. Yes.

>> Where?

>> Yeah, I mean, that's part of the sort of discussion --

>> Okay.

>> -- and thought process was, okay, so when you're at the low band, obviously you're going to have --
>> Right.
>> -- self-interference issues, so you're really looking at it more from a coverage standpoint, but from the high bands propagation, again, sort of to Paul's question, it actually works out have fairly well because you're not in self-interference and therefore capacity becomes a bigger gain, if you will, from that particular spectrum.
>> Okay.
>> From the commercial industry standpoint.
>> And my other question was, going back to the, when you did your briefing, you mentioned another recommendation that wasn't in the briefing which was to get money upfront to do all of this. Is that going to be in your final report?
>> We'll have to raise it with the whole subcommittee.
>> Okay.
>> Because we got it at the very last minute from one member.
>> Okay.
>> So we'll have to discuss wherever we could put it in there. But I don't see any reason not to put it in there.

>> Okay. So we probably don't want to vote on that one then?
>> No, we'll just be doing the ones as presented.
>> Okay. And speaking of the final reports, are you -- you're going to have a final report?
>> The presentation is the final report.
>> That's your report, okay.

And then other two, when you guys do your briefing, just let us know the status of the reports.
>> If they're --
>> Yeah, that's what I was going to say, so how does that work?
>> I think we can vote on the recommendations, but I think what we need to do is to make sure that the full report gets presented to NTIA as the work of the subcommittee.
>> Just --
>> We can leave already --
>> The full committee vote on the report via e-mail then, I assume, before we close out this?
>> Yeah, that was my question.
>> That was a question.
>> That would be the way.
>> Okay.

>> Yeah, we can't submit anything to NTIA without the full vote, that's the --
>> Well, yeah, the question is, are -- does anybody have final reports left to make? I mean, I know you guys probably do, but do --
>> I guess it depends on the conversations today.
>> I thought the --
>> I thought the final reports were there.
>> Okay.
>> Three of the four subcommittees we have final reports, unless they're modified due to discussion today.
>> Okay. So what's the one subcommittee that's missing the final report?
>> 5G.
>> They're not doing a report. They're just doing a presentation.
>> We've got everything.
>> We've got everything.
>> All right. So --
>> Sorry to open that can of worms.
>> To your question, and because we had it at the last minute, I guess the question is how do we move forward on that incorporating that into any final written report and/or if it is a technical, I would argue this

is probably a fourth recommendation coming out of our group because it's very different than anything else we had here.
>> So what -- I'll wing it here, but what I would say is that if you guys feel there's a recommendation to be brought forward and voted on today, then we'll do it. If not, I think it's an addendum to the report as today as for something for future consideration but it's not a formal recommendation.
>> I think that would be where I would want to apply it, that way it's captured but then we don't have to keep things open.
>> Yeah, okay.
>> Bryan, do you have a comment?
>> No, I'm fine.
>> Okay.
>> You looked --
>> I did.
>> And maybe more of an observation and not to make it tougher, but often I think we lose sight of what the neighbors are, and I'm not thinking of any one particular, and but more, you know, you get into it and say we can clear this band but I'm going to be next to a gigawatt something that makes the band unusable or I have to have a band submit a suppression so low that I

can't design anything that's going to work, so somewhere in the mix there has to be something that's thought about.
>> Yeah, that's actually in the lengthier report, we talked about the neighbors and what the ramifications indications are in terms of the neighbors as well as part of the consideration when you're looking at that.
>> That's the old adage, location, location, location.
>> Other questions or comments?
>> On the --
>> On your scoring or how you're doing your coloring there, I think what would help us is a lot of those are attributes that would help us on judging the overall value for that band, what potential value, because one of the key items that we have to worry about is when we pick a band, we're trying to pick a band that are most likely become successful to our feasibility study to egg forward and when we keep things that didn't need meet that 110% rule, you know, for the cost if we were going to relocate that spectrum, what kind of revenue would be generated from it to cover the cost of the equipment. So one of the things is trying to -- and we've had Julie help us a lot on this side, but with those factors, if they were, you know, going from green to yellow, what would be the percentage of decrease in

the value of that band based on that? You know, so -- and I know that's a --

>> You just made the question harder, I didn't think that was possible, but you actually made it even harder because that, to me, is going to vary and it's going to depend on the band, it's going to depend on when the band actually becomes available, what the state of the technology is at that time, so it really needs to be addressed sort of, from my perspective, not with a color coded key but looking at that specific situation in time.

>> Yeah. And I'm going to be channeling my satellite brethren here because this, we did talk about this in April as potentially one of the questions, and there was sort of an immediate response of, well, you know, and you can think about it, you know, that then puts the spectrum in a very particular, you know, use right away on CSEA, and I know there would be people here who would argue that might not always be it. It could be a function of it. But we actually, we sort of looked at it and as a result of the discussions last April I think, you know, and when we put in the first decision tree, we just left that out.

>> Rick, did you have a comment?

>> I have one comment on recommendation 3. This is Rick Reese from Raytheon. The phrase in accordance with the law at CSMAC recommendation just sounds kind of off to me. I was wondering if we, if the CSMAC needs to be telling NTIA to do things in accordance with the law. I don't know.
>> It is better --
>> You don't want to tell them not to.
>> Telling them to --
>> But, tell them not in accordance with the law --
[Laughter]
>> Though in total abrogation of U.S. statute that might be worth saying, but I wonder whether that phrase is actually required, if that could just be hand in a footnote. Maybe ask the cochairs what they think about that.
>> I mean, I'm not -- as a nonlawyer, I'm never really worried about the law too much so.
[Laughter]
>> At least he didn't say he's an engineer.
>> Can that be noted?
>> Absolutely. Put it on the record.
>> He does work for a law firm, though, it's worth saying.
>> Charla, do you have any comments?

>> Well, y'all know I'm not a lawyer either. But, you know, I think in a way, what that was about is you make sure you do what's lawful, it was make sure you're sort of going back and looking at the law and looking at the components of the law that you would need to investigate as part of that. I -- I really don't think that --

>> It was more directed towards like the, you know, the Mobile Now Act or other things like that, that sort of direct what needs to be done type of thing rather than saying follow the law, if you will.

>> So could we say something like instead of in accordance, like consistent with, would that be an appropriate amendment to the text?

>> I turn to the cochairs.

>> Just a side comment, so when I read that, I read just a reminder not to break FACA.

>> That's the way I read it as well.

>> That's what I thought too.

>> So I don't think it does any harm. I'm not a lawyer, but I don't think it does any harm. And for simplicity, I would recommend just leaving it.

All right. So I think we're going to leave it.

Final questions before we look for a motion to approve?

>> Questions from the galley or no?
>> I don't know. I have to -- I don't think I'm allowed to. David, is --
>> No.
>> I'm not allowed to.
>> We can make comments at the end, yeah.
>> Okay. Sorry about that. But following the FACA rules and staying in accordance with the law.
[Laughter]
>> Check the box, he's done it.
>> This is a committee vote.
>> So I think we're looking for a motion to approve the recommendations as presented, along with the reported as, you know, a supporting document.

Do I have a motion? Okay. A motion. I need a second. Karl. All those in favor, say aye.
>> Aye.
>> Any opposition? Any abstention? With that, that has been accepted. Congratulations. And good work by the committee. Thank you very much. I know this was a tough question, as I mentioned earlier, and good job soldiering through.
>> Just real quick, is anybody on the phone that either votes in favor, not, or abstains?
>> I'm assuming that the phone --

>> Broadband --

>> Okay. Unless there's an abstention or an objection, we'll assume the phone is good. Good to hear that you're on the phone, Mark.

So now the next topic will be enforcement and we got Mark on the phone but we've got Paul in the room, so I assume you're presenting, Paul?

>> Yes. But we're going to start with my esteemed cochair, Mark.

>> Okay.

>> I'll keep it brief. By the way, I feel like I'm there, I'm watching this on webcast, the live webcast. You all look really good.

>> Thanks.

>> Sorry about your eyes.

>> But I can't follow the slides, but I think slide 3 is subcommittee members that I want to thank everybody, you know, Paul and I want to thank everybody for their participation and, you know, at the risk of -- it's always risky, but Mary Brown, Mark Gibson, Dale, Bill, Rick, Dennis Robberson, Andrew Roy, and Bob Miller, were significant contributors and their guidance and input was very important, so thank you to all the subcommittee members.

Our objective was, you know, was not that many words but it was difficult, and I think the final work we did, we're on version 11 when David Reed said hey, you guys are done, put a fork in it.

[Laughter]

>> We could kept on going but we stopped. And just to give you a clue that -- of the depth of our discussions, our objective is on slide 4 and there was some discussion that the automated interference prevention detection and resolution was not encompassing enough and there was some discussion that literally could to change that to detecting, classifying, identifying, locating, reporting, mitigating and remediating.

[Laughter]

>> I couldn't come up with a good acronym for that, so we left IPDR. A couple of things, I think very prominent early on in our discussions suggested we organize our responses to the technical capabilities, legal issues, and policy issues which guided our discussions throughout the past several months. I also want to know that we, you know, to get where we need to go, we're going to need a lot of feedback and input on what's possible and what's possible in the future from the current SaaSs, so I want to thank Mark Gibson who

at the proficient moment weighed in I think version and that input was going to be helpful for us to present our document.

So I'll just cover the major conclusions and then turn it over to Paul to conclude. I don't want to necessarily read --

>> No, recommend.

>> But the ECS capabilities being deployed at 3.5 and there's monitoring systems under development at AWS3 are, you know, presently perhaps limited in scope but certainly seem to provide a foundation to create more sophisticated monitoring capabilities for interference detection as well as interference detection.

Major conclusion 2 is commercial systems and identification of the interferer or source of interference had developed, yeah, not directly but the radio frequency monitoring system for AWS3 is a good first attempt at an automated system being developed for identification purposes, and our subcommittee thought this was an area that would certainly he did deserve in the future for research.

And finally, major conclusion 3, before we get to the recommendations that Paul will cover, the mechanism is needed to confirm that the indirect resolution action taken by an SaaS was undertaken and successful,

the mapping mechanism would be needed to value indication and to make sure that the units may have been modified from a power standpoint or turned off for certain areas were returned to the previous operational states as soon as possible. So those were our major conclusions. And then I'll turn it over to Paul now for our recommendations. Thank you.

>> Okay. So we had about five recommendation that is we put together. Most of them are in the legal, in fact, all them are in the legal and policy area, as you can see for you restarted off with the conclusions, there's a lot of work going on in technology, but we thought that there's a lot of questions that have to be addressed and we recommended some work to be done in to resolving some of those.

Recommendation No. 1 was that one of the legal issues is essentially associated with the liability as to when something goes wrong and the idea was that we recommended NTIA, probably with FCC involvement, try to, first of all, define what the liabilities might be, for one, if the -- if you have harm that is caused by an interference event that the SaaS or whatever automated system you had worked perfectly, it did exactly what you asked it to do as designed but still an event occurred, so now, who is liable for that? Is

it the system? Is it the person who had a interference event? Is it no one? Is it no foul? You know, what is the liability issues?

But the other one is now the converse of that which is now what if the SaaS didn't work well? Didn't work correctly, not well, didn't work correctly, who is liable in that case? Is it the SaaS provider, is it the people who approved the SaaS, you know.

The third is that if that -- if you came to the conclusion that operations that were suspended prevent interference, where interference probably did not occur. So you modify and basically took away capacity from somebody but that, you know, assuming there's going to be an interference event but there was no really chance of a interference event. So this is essentially your premise of how you actually develop the system was faulty in that area.

And finally, the wildcard in all of this, that Dale threw in which is -- because Dale is big into the rogue and malicious devices, what happens, you know, who is liable when a rogue device is not using the system comes in and starts creating interference? Who is liable for that? So that was the first recommendation.

The second one was actually looking at the extent of automated systems or capable of resolve in the

actual interference, then the regulator is going to wish to access an act upon that. The fact of the resolved interference event, you have some legal questions you have to address, like, for instance, is recommended that NTIA and FCC develop specifics as to which data needs to be obtained, how it should be obtained and how it might be used that will allow you to actually do something about this interference event. So what do you need to collect, you know, what kind of -- and how does it need to be collected, and you're going to see a little bit more of this later on which is that trail of evidence -- we have another recommendation of the trail of evidence, in a sense, is that when you start moving from just monitoring to actually doing something or actually creating a legal or a -- a regulatory action, what information is necessary to actually do that action to provide that?

Which actually pushes us to recommendation No. 3 which is how do you validate and accredit a device for interference detection? So if you're using all of these devices out there, including even handhelds by the consumer, okay, that the monitor it, how are you going to actually figure out how to accredit those devices? So it's recommended that NTIA investigate two potential mechanisms. One is a means to accredit the

signal to just basically the R app or the technical characteristics, how did we accredit that, and we all know as people who are our doing it for a living, getting the calibration right and getting all of that information correct is a very big issue. So now if you start looking at automated systems, how are you pulling that in, what is the mechanism that you're going to be at, requiring to actually have that? And the second one is that now have you an interference event, okay, but it's now saying I have a interference event, I now detected, again, what is the way you are going to accredit these device, you know, to in the sense that you could use that interference event information as evidence. And so we think that threads starting points looked at that. So that's recommendation No. 3.

Recommendation No. 4 is that is really going down to the policy objectives, okay, so basically what are the policy objectives to try to develop a automated system? Should users of the band be required to forgo certain, and this is an argument or discussion that we had consistently throughout for actually not only this year but last year and I think probably even before that, and the sense is that here's a trade space here, I get to know more information about your device, I get to know information that you're basically collecting

about other people's devices and the like, and there's -- and that actually allows you to use the band more effectively, more efficiently, it opens up more capacity, but at the same time, you're foregoing some privacy.

And so what is the policy balancing act between the privacy and the ability to have a safer spectrum environment or more access to the band? That's a policy question that maybe you might have asked specifically some day to some folks to take a look at, but it is something we believe recommended that needs to be studied and actually some thoughts be put to it.

And the final recommendation is sort of the last few recommendations kind of pool together is that this should be a forward-looking type of study needs to be done by NTIA to look at the relationships between increasing capabilities, monitoring equipment, the processes, and the speed and accuracy of detecting, classifying, identifying, locating, and reporting interference events, meaning the better I do the classification and identification, how does that translate to more capacity or more sharing? So what is that quantification? Because if the quantification indicates that if I do all of this work, I'm going to get one megahertz more of spectrum over a gigahertz

letters, then the answer might be, well, we're not going -- we all believe that there is going to be a big benefit but we need to start quantifying that benefit, and that's what we thought a recommendation is a great study action that a couple of your folks could actually look at.

The next one which actually follows directly from the previous recommendation, what are privacy and other issues that implicated by these increasing capabilities? What are those?

Okay. And, finally, the optimal trade-offs between that privacy and technology capabilities. Where -- at what point do we think we want to go to at the present time? And where do we want to kind of draw a line? And that's the recommendations.

Any questions? Or comments? Actually any comment from the group that were -- our colleagues?

>> Why don't we jump to Bryan first.

>> Okay.

>> I guess maybe two things. On major conclusion three where you talk with a mechanism as needing to confirm that the indirect resolution was undertaken as successful, what's indirect about it?

>> Well, it's indirect, are you not -- when a SaaS says to a device, lower your power by 3DB, it is not -- it's

not lowering its power, it is telling it, that's an incorrect action. The SaaS is not having a knob that it knows that that action has taken place. If I actually hack the software and said, yep, did so, no problem, okay, you have no direct --
>> Direct means I'm not physically doing it.
>> You're not physically doing it. You have no direct evidence that it is actually taken place.
>> That it is done.
>> That the action, so it's not that you did it but you have to have direct evidence that actually the event has taken place.
>> That's not necessarily true. The way it works in 3.5 gig is the SaaS tells the device do something and the device says I done it.
>> Right.
>> So all the -- so the SaaS will know, the device has an option to say I'm not going to do it, in which case the SaaS says, okay, if you're not going to do it, you're not complying and, you know, here's a shutdown. So there is a handshake back. So just want to -- there is a confirmation medication message but there's not a direct --
>> The SaaS, if your point is the SaaS is actually not controlling the device.

>> That's correct.

>> That's the point.

>> Okay. I see. Yeah, I think I was -- okay. I was thinking the role of government vis-a-vie enforcement so I thought that was the indirect part here.

>> No, no.

>> So you're not saying it's that, it's the actual physical act.

>> It's a technical issue.

>> Yeah. Okay. And then on --

>> But good question.

>> On the overall capability, do we have any, and this is my ignorance, do we -- have are interest any examples of a federal government system or a commercial system or an international -- a system internationally that has the capability that you described or that you're discussing in your recommendations?

>> Which recommendation, all of them?

>> Just the capacity, I mean, the enforcement regime that you've sketched out.

>> Right.

>> Or that people should study, is there someone who has done it, either in a private commons context or a DOD band or I'm just trying to think of a --

>> I'm going to open it up to the committee. I personally do not know of any, that's why we personally believe -- or that I believe it is a very good area to get into and should be actually started to put pen to paper and some analysis, but I'll open it up to the committee if anybody else knows of something I do not know of.

>> This is Bob Weller. As Paul says, enforcement has been a continuing area of direction from CSMAC, and last year in the 2017 enforcement report we looked into the commercial capabilities and were, frankly, surprised at how relatively primitive they were and that they were typically very technology specific. We tried to get information on federal capabilities but were told that that's not really something appropriate for the CSMAC to be getting information on.

So but I would emphasize one point from last year's report so it doesn't get forgotten, and that is an information sharing program or database needs to be established to help enable automated identification of enforcement and/or identification of interference sources and enforcement. If automated enforcement is going to happen, we need to get in front of it by understanding what's already been detected, classified,

and identified, and this database should include contributions in both commercial and federal agencies.
>> I'll follow-up with what Rob just said is one of the things that happened last year in that report is they're saying a lot of the lessons learned to people who are interference hunters, remember, that was last year's request, and we were trying to say this database was why don't we capture some of the ways they do it so that way we can actually build a better foundation to do so some of these things.
>> I want to --
>> In the --
>> I want to clarify your question. You know, I -- there is -- as far as the committee knows, there's nothing like this yet that does everything the way the recommendations are, so there's really no, you know, prior art we can look at. In the context of CBRS5 gig SaaS, there is a open collaboration or dialogue going on with the commission about interference reporting and mitigation. There is a rule that requires the SaaS to play a role in that. We're still working with the commission, both the bureau and OET, on exactly how we do that. And so there could be a point at least at which that effort, interference and mitigation reporting, is dealt with, probably not to this level,

but at least at some high level. And, in fact, we should have some clarity on that by the time we get into or at least out of cert. So there will be some thing there we could probably hang our hat on at some point.

>> So the reason behind my question is if it is indeed going to be the first of its kind in the world, I think there's value in at least asserting that it would be because it makes shoot at if they have something that's close to or they don't think it's the first in the world, it helps draw attention to it and it also helps appreciate the challenges we face in trying to execute to this. So that's I guess the spirit of the question was to try and own that if that is indeed the case that we think this is the first system of its kind that would be developed.

>> So I have, to my knowledge, there's nothing in the spectrum world but there's lots of examples in the nonspectrum world.

>> Oh, yeah.

>> So really what really comes to mind is automated enforcement, there's just a lot of parallels I think can be drawn on. So I'm going to turn to Michael who had his hand and then we'll come back.

>> Yeah. Michael Calbrese. Recommendations 4 and 5 both focus quite a bit on a privacy tradeoff. Can you explain what is the privacy concern? Because at least in the context of CBRS, each transmitter needs permission before it transmits for a very discrete short amount of time. So I'm just wondering what it is that we need to know that would implicate any privacy concern at all, you know, in the sense that it's just about, isn't it just about transmission, where you are, what power? I mean, do you need to look at the content of what they're sending?

>> Well, if you want to do the more sophisticated techniques to find out location, identification, and the like, usually look at more detail structures of the wave forms and so therefore, some people look at that as you're looking at the interior of the wave form and then there's a privacy issue associated with that.

It's also asking that if people are going to using -- if you're asking people to use their phones as being detection devices, then you're actually asking to get access to information that they have collected on their personal device and so there may be a privacy issue there. So we weren't trying to assert that we know of all of the privacy issues but as soon as you start collecting more details and depending on how far

they go. You got to remember, engineers love to get all I can locate that within a meter if you just let me take a look at all of the bandwidth and all of the content in there and I can actually correlate a lot of things. So the idea was at what point do you start drawing a line and saying, you know, I don't need to know within a block, if I know within ten square blocks but I don't use the internals of the wave form, okay, I do a better -- unless -- I -- I'm not as good on enforcement, okay, but I have, maybe I'm using -- not as much of a privacy issue because I'm not extracting any of the internals. Okay? And the converse. I'm just making this up as an example. And then but or do we want to get to the point where we can pinpoint people to that area, like, for instance, I send a message to the carrier and such, could you ping that device so I can listen to it, now, is that a privacy issue there? I'm not a lawyer so I'm not about to sit there and say I know about privacy law, but I think the group was worried about as you get more and more sophisticated in your techniques for automated enforcement you have to ask the question, have you gone too far at some point?

>> Yeah. You could go too far.

>> But the --

>> Go ahead, Mark.
>> If I may. Michael, I don't think we were taking any issues of privacy issues now, but it was the committee, the subcommittee said, as automated enforcement further develops, we must keep in mind always privacy issues as this develops. You know, it almost needs to be a integral part of the discussions. I think that's why it was an issue for the subcommittee.
>> Okay.
>> All right. Tom.
>> All right, so I have the -- I thought recommendations are great, but it looks like a whole lot of work and a whole lot of effort, and the question I had is, you guys talk about funding for any of this in any shape or form? So I mean, I can see there's commercial interest, I think there's a government interest, but so and I'll just throw out some examples since I've now thrown a little bomb out there, but, you know, was there any discussion that maybe SRF could be used given that 3.5 is an option band, given the account if a that this could lead to other sharing that could then lead to other options, this groundwork, for having enforcement so people have certainty before they participate in option s, therefore you should be able to use SRF funds to help stand up some of these

studies, some of these databases and, frankly, the commercial industry also benefits from this too, so maybe there's a commercial funding piece that can be worked here? I just didn't know if you guys had any discussion about that.

>> There's --

>> I thought it was clearly law firms that are working in this area.

>> Yeah.

[Laughter]

>> Out of their personal funds.

>> That makes sense. That makes sense.

[Laughter]

>> No, we didn't actually look into the funding areas, but that personally I believe that you're going to have a little bit of a spiraling effect that you have to get started somehow, so does the government get started initially to say this is actually worthwhile because we're seeing the benefit in a little way which will actually begat trying to get funding, using some of the funds to get the more details, which would begat, you know, using more band, which would begat more investigations into technology for automation? So the idea is I think one of the first steps that has to happen is if I have this, does it make a difference? I

think can be done without a large amount of effort in a sense of getting at least pen to paper to do so some, you know, it will be crude -- not, coarse, coarse resolution, but you might be able to get some ideas and then try to do a spiral development. Or, you know, but we did not really look in to the funding.

>> Okay.

>> Mark Crosby again. Tom, good question. That wasn't one of our questions, but it would be a good one on a go forward basis because I'm -- I always ask who is paying for this. You know Gibson is not going to pay for it, he's not going to pay for it.

>> Wait a second, he just raised his hand. He said he's going to do it. I saw the hand raised.

>> I raise my hand in support of Mark's point, thank you very much.

>> I think is it is a great question for if the subcommittee continues of how are we going to pay for all of this. And, again, but, no Tom, we didn't have the time to get to that particular point.

>> That will be in rev 53.

>> Mariam, any other questions?

>> Go ahead. Go ahead.

>> No, go ahead.

>> All right. So thank you, Paul, Mark, good recommendations. I am curious, I guess more concerned about looking at the objective in your recommendations, the relevance of the RFIMS on ASWS3? Because this just doesn't seem to fit in in any context of what the objective or recommendations are. That the RFIMS was meant as a monitoring service for licensees, so it's licensed operations, it's not like a SaaS or a CSE, it's also, you know, it also obviously -- there's no interference protection or avoidance or detection or enforcement. I mean, the framework of that is the very different than what you're doing here. So I was wondering if you may want to remove it as an example.
>> The reason we put it in as an example was because of the technology that you're trying -- or the monitoring system is to understand interference levels and trying to understand the when you actually might have an issue and then potentially pinpointing where that issue is coming from, that feedback. That was the only reason. It was not trying to say that it should take over, you know, and do the same thing as the SaaS. What is it was trying to show is where is the technology trying to head and the thought that the RFIMS was an example, trying to do that kind of monitoring and trying to do that in a broad scale, and then I'm asking the

question, you know, could some of that -- could lessons learned from that system over the next few years, so it hasn't been deployed yet so we don't know any lessons learned just yet, but what once it does get deployed and start being used, is there something that will be learned and can be used to put in to automated enforcement? That was the level of it.

>> Okay. So but I guess the point is that, you know, I mean, the learning from there, I'm not sure how it would relate to, like, a SaaS or a ESC concept which is the objective of the question, because that's monitoring a single licensee and a band and basically, you know, there's coordination, there's no endorsement concept there.

>> Oh, no, there's not.

>> So I just feel it is out of context a little bit.

>> Well, if we only -- yeah, and I guess the answer is, if you want to take the explicit question which was to say only for SaaS, ESC technology and systems, then, yes, it's out of context. But I was looking at it, I'm trying to look at it as a overall technology and ask the question.

>> I think the actual question was automated enforcement. It didn't call out ESC, as I recall.

>> Actually I think this year it did.

>> It did.

>> It did.

>> You guys made it very specific this year.

>> It did specifically say.

>> Go to slide 4.

>> As I recall, okay. I stand corrected then.

>> And the reason was because last year was a little bit more open and then we were going down some paths and you were saying no, I'd really like to understand a little bit more about how we can learn off of those and move. So she's actually, Mariam is correct in the --

>> So are you proposing an edit to the recommendations is the question here? Or that's just one of their conclusions, it's not part of their representation.

>> Take a look at the report because I think it has a little more context. Basically in the report, you know, it says, an automated system developed for interference identification purposes, an area of research which the space defines the number of signal identification tags that would be necessary to enable the identification of an admiter that is causing in interference. It assumes, however, that a single emitter is the cause of the interference.

So what the paper tends to -- tries to do is say, well, here's something that has been developed or at

least being discussed that does a little bit of both, I don't think what we're talking about it as an example of what we should do it this way, but it is saying the RFIMS has a goal of identifying when there could be interference eminent and telling the system to react accordingly. So it is an interference monitoring and reporting system. At least that's how I read this. Is that --

>> Yeah.

>> Okay. We're not trying to say that that's what's going to be the application. We were just trying to look at the, where the -- three aspects, technology, that was in the technology side.

>> Right.

>> Okay. So I guess I apologize, I have not read the report. So what do you -- should I read that because, I think the recommendations are perfectly fine. I support the recommendations.

>> Okay.

>> But I -- the conclusions are my concern, so I would propose an edit to the conclusions and just --

>> Okay.

>> -- leave the recommendations.

>> Well --

>> I don't think -- this is Mark again. I don't think the conclusions are in the report.
>> Well, not per se.
>> Yes, they are.
>> Yes, they are.
>> Mark, yes, they are.
>> So if I may, Mariam, one of the challenges with this committee action and we had so many iterations of this is we were trying to take a look at what is today, what is the state of technology today versus what are the gaps going forward that would have to be filled to get to a more fulsome enforcement tool. So I think what our reference here to RFIMS is, is sort of this is where -- this is a pretty primitive monitoring system in terms of what the future would have to be, but we wanted to sort of make reference to this and to today's SaaS's as sort of these are -- these are early attempts in the direction of where things need to go but that's all they are. We're not -- we're not trying to make any statement about this technology developing into an enforcement mechanism. It just is just what is the state of technology today.
>> Yeah, and as I read, it the conclusion is that actually that the system has not -- there's not a system developed yet. And this is more of a reference.

>> Correct.
>> That's exactly right. It's the first, if you read the first and third sentence, that's really the conclusion and the second is a mechanism to help get you into the space that the first and third sentence are talking about. Because it really --
>> It's an example.
>> It's an example. So that you mentally get into that space but it isn't really the conclusion at all.
>> So Mariam, I'm going to put you on hold, think about it, if you want to propose an edit, we'll come back to it, but, you know, Julie, you had a comment.
>> Yeah, I just, again, a couple of observations. So we're hoping to get the I know a lot of this is focussed on 3.5, so we're hoping to get these systems up and running fairly soon, probably before any work will be done on the recommendations. And there's a debate I think even among, inside the FCC between the engineers and the policymakers and the attorneys, I think we're kind of feeling our way on some of this. I say, you don't know how hard this is.
>> Oh, I know.
>> Because when folks say, well, it just we'll manage interference and I say well, yeah, but we've got flexibility, can be any kind of device, we haven't

specified, you know, some of the points you raised, what are the receiver bandwidths, and the role links play, and when I'm looking at a signal strength that gets reported back, is it -- is everybody measuring it the same way, do I have faith? And what constitutes interference, is it, well, my neighbor turned on and now before I was getting 100 megabits per second and now I'm getting 80, is that interference? The end points are easy. In other words, somebody is operating a device that they've hacked, you know, or I don't expect this could ever happen, but the SaaS has deliberately tilted things one way or another to create more interference to one and let another to get a better service, for example. So -- and I don't want to lose sight of some of the broader issues, you know, about the recordkeeping and that we've wrestled with too because there are legal issues there too with pending enforcement indications and what gets reported when.

And I think we also kind of touch on, you know, beyond this, what are the tools for monitoring interference and identifying the sources and so forth, can we create better detection systems? So I think it's really critical, my main point out of all of this,

we probably will learn more, nothing ever happens that is done once and it never gets modified.
>> Right.
>> Yeah.
>> All right.
>> Andrew Roy, just to follow on Julie's comment and not to try to steal Bryan's thunder in the efficiency report, but one of the agencies we interviewed in there actually commented they do the enforcement assessment and then at the end of it they hand it over to FCC because it's not under their jurisdiction. So I think it's an element that has to be considered in the automated process about this multiagency process to say how is the information carried forward, to what extent do the agencies apply it, the information, maybe there's a different criteria for assessment as well. As we've seen with the subject, there are many arms and legs and they keep on growing and grabbing different things and moving forward.
>> Other questions or comments? We'll go back to Mariam then, see if you want to propose a change or are comfortable with this as is?
>> I mean, I just think that these are really good recommendations, taking out this what was now contexted as an example, not even a conclusion, is not going to

change your recommendations. It's an example that is not even relevant to the question. So I mean, would it be just as simple a strikethrough for not confusing things? Would that be possible?
>> Mark?
>> The recommendations are probably more critical than the conclusions. I'll defer to the full CSMAC. If you want to delete it, that's fine.
>> So there's three possibilities, leave it, delete it, or put it as a footnote in that statement.
>> My concern about deleting it is Bryan made a comment earlier about, you know, is this being done anywhere, and I think if we don't mention something like this, maybe we need to caveat better, something like the RFIMS which is something like it, maybe not to the level we're saying in the paper, it looks like it is an incomplete work so
>> Is there a modification --
>> I think the concern is exactly that that it's not something like it, right, it's not a -- the RFIMS is not a ESC or a SaaS. That's the concern.
>> Mariam, could we just put a introductory clause that said although not a SaaS, ESC, comma, the radio frequency measurement system may be a first attempt.
>> Sure. I think maybe that would --

>> Would that be okay for you, Paul?
>> That's fine by me. Mark.
>> Works for me. Although not a -- okay. Got it. Yep.
>> Although not ESC, or whatever all the acronyms are, comma.
>> Okay. All right. With that, I think I'm -- unless there's any other questions of one last call for questions? Folks on the phone, questions, because I know sometimes it's hard to get them in when you're on the phone?

Hearing no questions, looking for a motion to approve the report as modified?

>> We had just gotten a motion to approve the recommendations as amended. There was one minor modification on a conclusion. So with that, I think we're ready to vote. All those in favor, say aye.
>> Aye.
>> Any oppositions? Any abstentions?
>> I'm going to abstain. Comscape is a SaaS provider and I just don't think we should vote on the recommendations so Comscape abstains.
>> So we'll note for the record that --

>> Mark --

>> Mark Gibson is abstaining. Any other abstentions on the phone?

>> Paying for the research.

>> Comscape is not paying for the research.

>> Thank you to the enforcement committee and to future work for enforcement, it never seems to go away.

So the final report we have to go over is the spectrum efficiency report and who is going to be --

>> That is me to start, and Caroline will. So, thanks, everybody, for all of your contributions to the spectrum efficiency committee. As you can see, we did not win awards for brevity in our report. We have 11 pages of text in a total of 29 pages when you include appendices of the interviews, so we appreciate your indulgence in reviewing the more detailed report.

We did have two questions to answer, one was the outreach and finalized recommendation -- well, this is coming out of our last meeting, to complete the outreach and finalized recommendations on the action toss improve efficiency without harming effectiveness, Caroline had the lead on that, and then I led on the mechanisms to increase efficiency and what the barriers are. So I'm going to turn it over to Caroline to

discuss the interview process from our last meeting and then I'll take over after that.

>> Sure. Thanks, Bryan. So we interviewed eight federal agencies, OTB, ITS, DHS, DOD, FAA, Noah, DOJ and NASA for the purpose of getting agency input so that we had that information to consider in our recommendations and our report, and we really appreciate the participation from these agencies. We found it very valuable, having them share their perspectives and their insight, and it helped us provide better, more useful recommendations. So this information was incorporated into our report, and a highlight of the interviews from the agency are included in the appendix, as Bryan noted. So as the group, we scheduled these different interviews, met with them, had questions that we had sent and so we followed a similar pattern with each agency to make them consistent and found it very useful.

>> Okay.

>> Okay. Can I ask a question? So I just wanted to verify that whatever was included in the report frat agencies explicitly were reviewed and cleared by those agencies?

>> So all of the notes were sent to the agencies and they were approved or in one case one agency

didn't -- said that there were no issues or we asked if there were any issues so almost all of the interview notes.

>> And explicitly for public release?

>> Correct.

>> Okay. Thank you.

>> We also are noted that in our interviews that it was for public information.

>> Thank you.

>> All right. I do commend those notes in the back of the report. They make for interesting reading. So we divided the rest of the report into barriers to implementing structural efficiency mechanisms and then we discussed what mechanisms were most promising, promising, and other, very controversial about how we characterized them. I don't know if we had 11 drafts but we had virtually that many.

>> That's a small --

>> Exactly. So on the legal barriers, you would not be surprised to learn on slide 6 that the this act and efficiency was the terms of the spectrum fund and the preparations process were all flagged as explicitly as legal barriers. It is no coincidence that they largely run along the line of resources to the agencies to help explore sharing options in particular and ultimately

implement technologies that would improve sharing efficiency gains -- or and allow for efficiency gains.

Structurally, additional NTIA authority and resources and general staffing and resources within the agencies, and finally, whether the bang is worth the buck, as they say, in terms of additional administrative burdens that would be caused by implementing these types of sharing or efficiency regimes and whether or not the benefits to the public would warrant those resources. And also, incentivizing sort of in a principle agent problem incentivizing the relevant actors to take those steps.

On information barriers, lack of updated comprehensive data regarding federal spectrum use. This has been a challenge at various times during the spectrum management process, including in our efforts on AWS3, and sort of trying to develop a more robust set of data that would allow for more robust assessment across bands of where sharing and efficiency gains are most likely to be achieved. And then the complexities of quantifying a monetary or economic value for spectrum, that assets of spectrum, sorry, for federal spectrum assets, so this is not a unfamiliar conversation to the one we had earlier about the value to the commercial side, just as that is hard to measure

and hard to prioritize so, it is difficult to assess what the value is of spectrum in the hands of federal users because it is often against the context of commercial use.

And then, finally, on barriers, high transaction costs trends through all of this and then, timely, a lack of trust and technology and regulatory interference resolution process which is also not far removed from the last set of presentations because as the sharing regimes become increasingly complex, it is increasingly important that, well, all parties, including federal agencies, can trust the enforcement mechanism in place. As Dale often says, no spectrum management make any sense unless there's a enforcement component to it, and I think similarly here that if you don't have trust that there's an enforcement mechanism, well, neither commercial, commercial providers, nor federal spectrum users are likely to participate or embrace a sharing regime.

So on mechanisms, as I mentioned, we divided them in to three categories. Those most promising, promising, and others. And these are kind of represent a blended set of possible paths, drawing on the literature and in some things that were generated by the committee itself. So you'll see that, and I'm not

going to read the details of each of the four, and as I mentioned, our report is longer in discussing these issues, but funding, something closer to property rights for federal spectrum users, creating flexibility, which is sort of a outgrowth of two, for bidirectional spectrum changes or swaps so that being the federal government user has a swath of spectrum, sharing is possible with another federal spectrum user, they could swap with commercial provider and get adjacencies and allow for consolidation and allows for increased efficiencies or sharing, and the tools are not always -- transaction costs associated with those tools are very high, to the extent it happens at all.

And then, finally, an expansion of NTIA authority and resources because David told us to put that in there. No, just kidding. Making sure you're paying attention.

>> Get me in trouble.

>> No, because we do think the stronger the spectrum management hand of NTIA, the more likely some of these regimes would come in to use because they have a -- they're the sole government entity that has a view across all federal spectrum users, so they're uniquely well positioned to identify opportunities across the

bands and to execute the kinds of tools we talked about in the most promising.

In addition, some promising mechanisms are listed on 11, overlay rights, spectrum scoring reform, dynamic federal spectrum, second markets, and then an increased component of option revenue going to federal government users, and we talked about some of the -- well, they there have been improvements in the CSCA process, etc., at least there's a view in some of these interviews and conversations with commercial entities that there's still some work to be done on that. You know, the I -- I will assert that the differences among the three categories was not always uniformly held by the committee. The list on which is on the list three lists is the result of extensive conversation and compromise and it is fought -- we don't have a colored chart that dictates why certain things ended up on certain pages.

>> Why not?

>> We did have a voting mechanism -- we failed. We did have a voting mechanism, the result of the initial prioritization and some follow-up changes. But in the other mechanisms, these are mechanisms that have significant barriers to implementation and may not be worth pursuing. That's as far as we got. The spectrum

auditor, spectrum use, but they're still on the list, shared spectrum super highs, spectrum currency, etc., a lot of things that came out of some of the work of the, help me.

>> PCAST.

>> PCAST report, and then, finally, the always popular but never implemented BRAC model in the last one. So those were the four that ended up in the other mechanisms column.

So across on slide 13 and 14, we go through the six recommendations, explore the most promising ones first, work with Congress to explore ways to reduce barriers from our federal -- more efficient federal use in a way that it does not impact commission effectiveness.

In terms of the national spectrum strategy, develop a set of guiding principals to focus on spectrum efficiency. One the guidelines and the strategy in place, consider working with OMB to figure out if there's ways to reform the federal acquisition process, which has always been raised and especially in interviews, and Caroline can add color to that if you want to. Continue to work with agencies to increase spectrum efficiency collaboratively and strategically while meeting mission objectives. And finally, should consider the findings in this report to develop a

report to Congress with recommendations that could incentivize efficiency. That is our list. I don't know if Caroline and I don't know if Jennifer, who has joined since we started the meeting, but if Jennifer wants to add anything or Caroline wants to add anything or any other members of the committee.
>> I'll just add, so one of the insights that came from the agency interviews is the importance of mission and mission effectiveness and they want to use spectrum more efficiently but they are driven by meeting their mission and it's often a matter of safety and vitally important, so I think the -- the insights they brought is, which helped with us our recommendations, is finding an incentive or process that addresses -- enables them to meet their mission while using spectrum as efficiently as possible.
>> Yeah, just a follow-up from that, firstly, I think we need a whole new slide for Brian's caveats on the other.
>> You have to vote on the caveats and that would not go well.
[Laughter]
>> And to emphasize that point, some of the comments were they're mission focussed, they'll do a set of requirements, look for vendors and get the option

itself and if they're two alike but one has a more spectral efficient system they may not have authorization to spend the extra money on efficiency, because there's non-priority, the mission is the priority. So it is sometimes they're withheld back from doing that priority because of an approval process to get the efficiency in there.

>> And just to react to that, we spent a lot of time on A-11 and whether or not there was some way to modify A-11 or the acquisition guidelines to make sure that the spectrum efficiency gets taken into context. There had been legislative and other methods to do that. Based on our interviews, those have not been terribly successful. And so it remains a challenge, if someone has ideas about well, how better to have that what seems like a very clear public interest objective met by the acquisition process.

>> That's good. Other -- Tom?

>> Just a quick question, and mainly because Bryan read it so fast, I don't think anybody actually heard what he actually said.

>> Sorry. Sorry.

>> On slide --

>> Trying to be efficient.

>> You're --

>> You can do less slides.
>> Well, that's fewer pages in the report.
>> There could be like a slightly --
>> Yeah, on slide 10, the second bullet where we say grand agencies spectrum ownership.
>> Yeah.
>> I'm wondering if that was really intended or are we really talking about giving someone ownership over spectrum or is it really you just want to grant agencies flexible use rights?
>> That's fair and that's yes, that is a --
>> Since I don't --
>> From a legal --
>> I don't think anybody owns spectrum really.
>> The nonlawyer tells the lawyer.
>> I know.
>> Even me, I'm --
>> It got beaten into me when I was within the government. So
>> That's fair.
>> So we're striking spectrum ownership?
>> No, just ownership. Ownership and would be the two words deleted on slide 10.
>> Ownership and.
>> Flexibility.

>> To reach grand agencies flexible viewers.
>> All right.
>> Similarly, it grabs, more importantly, in the actual report.
>> I think in general you're indirectly still saying that if you're talking about giving the agencies the ability to do whatever they want to with the spectrum, whether it be sublease or what have you, and my -- I was going to just question, since you're advising us to pursue the most promising mechanisms and that was identified as one of the most promising, it, to me, personally, I'm not sure it would be one of the most promising because of the complexity of the use by multiple agencies at almost every bond that we manage, so that's just a comment.
>> Can I --
>> So, again, just so I can keep the cycle, I want to get Tom accurately into the report, so on page 6, it would be grant agencies, instead of spectrum ownership, it would be flexible use rights for encumbered bands, including the rights to --
>> And then you've got property rights down at the bottom.
>> Yeah. So --
>> Cross --

>> Okay. How about this. We'll do editorial privileges to make edits, how about that, for the always catch-all solution, okay?
>> But I think we need to come back to Paige's point too, because it --
>> I --
>> As many of you know that this has been real difficult area, and having been part of PCAST, I mean, we really struggled with this in PCAST way back when, and it continues to be, the government is not like commercial side, I mean, it just is not, and --
>> Right.
>> And we try to apply commercial principles into government regimes like this, it's -- it just is really, really difficult, and I think --
>> I think that's noted in the report pretty --
>> I know -- I know it's in there, I know it's in there, but it's --
>> This will contradict it then.
>> It goes beyond the fact that it's noted in the report. I think it's in some cases, for me, it's prohibitively difficult. Actually it's part of why I didn't join this group.
[Laughter]
>> Now the truth is revealed.

>> I also should, I was remising on one thing, one of the things that we talked about in terms of the most promising, promising and other is that test beds would be really important as part of this, so, for instance, just to take this one, so there may be a band where you would experiment with something that looks like this and give super, once again, with the caveat that NTIA would have more power to manage it, why you would try a band where you gave them flexible use rights, yeah, flexible use rights and saw what the -- what that would entail, what would the outcome would be. And maybe some bands would not be good candidates for that, and I hear you, but there may be bands that you could identify as a test bed would work. Because to the best of my knowledge, we've never tried anything like that, nor have other governments around the world.
>> But who becomes the CE/O in this case? I mean --
>> So it's --
>> Thanks, guys.
[Laughter]
>> Yeah, that's what I --
>> In that case --
>> Congratulations, David.
>> That's not what this says.

>> Okay. I've got a long list of people with comments. We've got Paul, we've got Charla, we've got Mark, and Michael, so let's start with Paul. And I see you too. Okay

>> Okay. And this might be a misunderstanding of me, okay, mine. Are you trying to grant, I'm just going to go back to that same statement because it is intriguing to me, is it the allocation and everybody who is in the governmental location of that, because you used the word band versus an assignment that is given to an organization to do a particular application, so I was kind of confused by that, because those have very different ramifications within the government sphere and maybe I'm just not knowledgeable enough to understand that there's no issue there. So if you give flexible rights to the band or you give flexible rights to an organization who has an assignment in that band --

>> Yeah, I should -- my understanding is the latter.

>> So you're going to give, because -- so that gets to some very interesting complications, like, for instance, it is an F15 radar band, okay, can they have flexible rights to use it for something else? Okay. Can they let somebody else use that band? And so the question is, is that, so now you've got a subdivision

as to the F15 radar may want to use that, they have a location in that but so does some other place that has a allocation for radar in that band. So not what I'm trying -- allocation of assignment, excuse me, let's get differentiations here. So I'm just trying to figure out if you thought about that carefully as differences between how it is being allocated, how it's being signed, and what kind of flexibility you are actually asking for?

>> So and I should -- this one in particular was drawn from other -- from the literature, and I should check my sites here, but it -- there it is. Looking at, that making waves, Harry Felden, Gregory Rose, breaking the logjam. My understanding of how this would be characterized or done is that you would have your assignment would be translated into a property like right for that -- and within the scope of that assignment. It would not be a -- so, for example, if your F15 radar was sharing with a mobile, land mobile system -- what's that?

>> Sorry.

>> It would be each of those would get those, that bundle of rights, not a full -- it wouldn't get the full -- a bundle of rights beyond what their current assignment is.

>> Okay.

>> Now, that is not to say that you longer term you wouldn't have something that would be more flexible, but what I would assume would be the case is that you would have, let's say, in that band where those two services share is that then they would be able to, just, for example, that land mobile system might then swap out with someone else to give more efficient use to the M15 band because maybe there's a reason that the PLR was limiting the use of that or some other system could be put in there and the agencies would have more flexibility with NGI's approval to make those sort of swaps. So they become more like pieces of a puzzle and then you could -- you could inter move them around more flexibly than at least the perception of the folks who brought this idea thought there was today. Charla, did you have something?

>> No, no, no.

>> But Charla, you're next. Paul, are you finished?

>> Okay.

>> Caroline is going to help us.

>> Okay. So we also noted in the report that these right would need to be defined and so there is more work to do so that would be --

>> Yeah, I just wanted to, I have to read the full report then to actually get that but. I think there's a huge complication there and I just want to --
>> Not to keep making more excuses for the report, but we did go through some 20-odd some possibilities, so the notion that there's a lot more intellectual work to be done on at all 20 would not be at all surprising to me. The theory is that we were trying to find categories of things that were worth spending time on and so some of the things that would be more ambitious theoretically would have a greater impact which is why they're in the front, and not everyone agreed on where things are, obviously Paige would like to move this one down, but I think it's a combination of how hard would it be to do and how impact would it have and that was the sort of general framework into which the categories were put, original edit from you, actually.
>> Did you did literally do a two-by-two matrix?
>> Not in color.
>> There was a discussion of the matrix among the group and then there were votes, which is an unusual CSMAC tool, but we were trying to find a way to get to consensus other than just fighting the whole time without going where. So that's how we it, we scored it on what categories.

>> I'm going to go to Paige real quick.
>> Just a quick follow-up. So in the description of that this can occur but it has to be coordinated and approved by that those thoughts are somewhat in conflict because it's rights that they can do something else with would imply that there wouldn't -- it wouldn't be going through the normal process, so just, you might want to clarify what that --
>> Putting aside the earlier caveat that it shouldn't look like commercial, I think we were conceding of it that it is -- like the commercial in the sense that the NTIA would serve as a traffic cop of those swaps, just as the FCC serves as the traffic cop for the swaps in the commercial setting. So I think that's the way it was conceived of.
>> And just to remind folks that the assignments on the federal side are for specific systems purposes, geographic, so any --
>> Yep.
>> -- other than use than that would then require a process to --
>> Right.
>> So I just want to make sure it's characterized the right way, which, to me, doesn't imply any kind of property rights or flexible use in the way that you are

articulating it. So just to, I ask you just to clarify what the context really is.
>> Just Charla.
>> Sure. Charla. This is just follow-up really to, more to Dennis's point. I think, in fact, the reason that this is in this report is for precisely the reason that Dennis said which is that it continues to come up over and over and over again, and we talk about it, we think there might be some value to it, but what we really need to do, I feel, is work through it in more detail. It does, when you look at the literature, it does, you look at when people talk about it, people -- it is something that continues to come up and, I just think that the part of what we were trying to do is not necessarily saying, you know, this is the most promising, we should just move to this system, this is going to work but it is the most promising to move to the next step and really investigate it.
>> Okay.
>> Thanks, Charla. The next person I had was Mark McHenry.
>> You mentioned here the lack of data from the federal spectrum use is really critical. We try to convince DOD and federal users to use advanced spectrum sharing and we could never make the case they could get more

channels, you could do your mission together better, but there was no recommendation to fix your finding that you still don't leave a way for the user to say, well, if I had sharing, I could do my mission better, and the reason they can't make the calculation, there's no data, they can't go through the assignments and the sharing rules to figure out that there's value. It's like you're missing a recommendation to make the data available so people can prove that they could do their mission better if they had fancy technology.
>> I'm not completely sure I track what you're saying.
>> Page 8, you say.
>> But I think --
>> The barrier is lack of knowledge of federal spectrum use.
>> Yes.
>> But I don't see any recommendation that would address that.
>> Well, I think we were trying to get that it was 7, about expanding authority and resources was the theory.
>> Which one is that?
>> It's in most promising.
>> And also continued dialogue.
>> Yes. And also the recommendations -- oh, I'm sorry, so I'm sorry, it's in -- it's in two places, and Mary

points out it is in the recommendations on the second one on page -- on slide 14. I was pointing to expanding NTIA resources and authority as most promising, it's one of the most promising recommendations.
>> I don't see it. How is it making the data available?
>> Well, the point is it's not clear that the data exists, right?
>> Well, they have assignments data, and you could ask the users how often they use the assignments, they could put together scenarios.
>> Who is the they? We were making it them. We were making it NTIA.
>> Federal users could calculate among themselves what their usage is and if they had a new technology, the new technology would have that many more channels available. I thought that's what your slide 8 was trying to -- your first bullet on 8 was -- since they can't make that calculation because they don't have the data.
>> Right. I guess I'm -- I think we're arguing about where the -- where the data should sit, and I guess we're defaulting to having it sit with NTIA and have federal users access it that way. It sounds like you

want -- you're more envisioning a situation where the individual federal spectrum users have access?
>> I don't think DOD even knows how much spectrum they really need or use so I think it's a -- there's a -- I don't see your recommendation addresses the issue.
>> Okay.
>> It -- I don't know if this addresses your issue, but on slide 14, the second recommendation is NTIA dialogue with agencies to address, plan, and implement increased spectrum efficiency collaboratively and strategically. Maybe it doesn't say the word data, but that's what NTIA would be doing, right?
>> They would make scenarios available so users could say if I had the better or efficient technology, I'd get more channels, I could do my mission better.
>> The limits of PowerPoint, yes. I think that's what it was intended. That's what was intended.
>> All right.
>> All right. Did you have something?
>> Yeah. I just want to make clear what you're, so are you saying that NTIA should be in the business of analyzing each of the spectrum systems that are being used by the federal agencies and proposing efficient alternatives?

>> You say here's some datasets that if you want to calculate, if you had the better technology, you could get some more channels and be more mission effectiveness, here's the data you could make the calculation with, there's no way they can get access to data. We go to DOD program of record after record say use better technology, you'd get more channels and they just can't make the calculation, there's no datasets available, they can't make the calculation.
>> They can't make the calculation because?
>> They don't know how many users are out there, they don't know who they are competing with, resources, they don't know how often the other people use it, since there's 50 other people they're competing with, they have no way to make a calculation.
>> I see what you're saying. You want us to surface the data to other federal users of who else is sharing the band with them?
>> So they can determine is the technology useful to me or not. Right now it's a black hole.
>> I see what you're saying.
>> I think it's -- I think we may be conflating different issues. So there are -- there's a need to better understand how we define efficiency, how we assess trades among alternatives for same capability as

well as trades among how well we share, whether among federal and federal or federal and nonfederal, and so the data element, there is a lot of data today, whether it's as granular that we need it to be to do some of those things is another issue. And who has visibility into that data, federal on federal may have more viability than non-federal to federal. So I -- I just think we're starting to conflate a couple of issues, in my head, but that's just my personal opinion.

>> Does anybody want to respond to any of those comments or?

>> Well, I just, to go back to the recommendation that Mary was reading from, but it does suggest more research to more resources to explore spectrum use and systemically and strategically to identify more spectrum efficient cross agency solutions, address cross agency challenges and risk and set timelines for activity, etc. So the theory is that that does capture it, so if you have a -- if you have a recommendation or want to alter the recommendation five on page 11 of the draft report, then we're all in, if we're not capturing what you just described. Because it is, I think, it is an interesting component of this that you've raised.

>> Want to think about that, Mark, and then, Michael, you had the next.

>> Yeah. Yeah, Michael Calbrese. Just want to come back to what Paige raised before about most promising mechanisms. The number two and number three spectrum property rights and exchanges or barter swaps, you know, I think the main problem is that it seems like the way it is worded to exclude NTIA as the coordinating mechanism. And Paige I think particularly mentioned, you know, first of all, both of those are impractical because of without that coordination by NTIA because these bands are multiuse by many federal agencies for very divergent purposes and so no single -- no agency by itself, you know, can be side to make these deals. They're not necessarily aware of what all of the other agencies are doing, are able to coordinate or avoid problems and so on.

But there's a bigger problem than that, and that that's the practical problem. The policy problem is it creates brand fragmentation. I mean, imagine if the Navy, when CBRS, 3530 to 3700, if the Army had done the some sort of sale, lease, swap, barter, exchange of just a bit of the spectrum, some of the spectrum in one state, you know, at one time, it really would ruin the ability of the FCC, well, both NTIA and FCC, to coordinate anything band wide. So you'd have this tremendous fragmentation of federal spectrum, when, in

fact, with coordination, you could get far greater use out of it by looking at it holistically.

So I think, though, at the same time, they could be worth looking at as mechanisms, but it would have to be, I think, substituted NTIA for where it says agencies. So if you said grant NTIA spectrum flexible use rights to facilitate lease, subdivision, etc., permit NTIA and commercial users to negotiate barters in or exchanges, that would preserve a NTIA statutory coordination mechanism and make sure that this was going to be done in a coordinating fashion, including with the FCC which NTIA actively collaborates with, whereas a myriad of individual federal agencies do not. So I just want to -- I just think the way it is written, it seems to exclude NTIA where it actually it should really emphasize that these capabilities are given to NTIA.

>> So I think that, to Mary's point, the text more actually elucidates the role of NTIA and specifically talks about it in the actual report so that the weaknesses of PowerPoint come back into play on how they're characterized on slide 10. But I do, because I -- the theme running through the entire thing is sort of a empowered NTIA, not a weakened NTIA, so I don't want to -- that is the intent.

>> Do we want to make any -- is there any propose to change any of the text here, or do we feel like the report covers it?
>> I leave that to Michael, but it is specifically referenced in the property rights and it is implicit in the bidirectional steering section as well and then the ultimate recommendation talks about NTIA.
>> Can you hold on a second?
>> The -- yep.
>> We'll come back to it but --
>> Yeah, I mean, I think the recommendations, it reports the recommendations themselves aren't that individual agencies should have these authorities, but, you know, I just find it troublesome that we don't include some language about, you know, with NTIA's --
>> Take a minute, look at it, see if you want to propose a change.
>> All right.
>> I think the committee is saying they feel comfortable that the intent is reflected. And so with that, just I'm going to hold you, Michael, and then Mary, you had a -- I have a question, actually, for Caroline about the recommendation on procurement which I thought was really interesting. Of course, an agency at the point of procurement is procuring things that

the vendors have shown up with, right, so we're pretty late in the game in terms of the technology that's been developed. Was there any indication in the interviews that agencies thought there were gaps in basic research that need to be addressed in terms of developing more spectrally efficient federal systems? And I'm aware of federal systems are highly specialized, right, it's not like the commercial sector at all, but were there areas where you could back up from the procurement process and try to address efficiency that way?

>> Sure. So yes, more research for more spectrally efficient technologies would be helpful, but more than that, also making sure they're reliable because agencies don't want to take on additional risk with technologies that aren't proven and then when you have technologies that are specific to federal systems, those can be more expensive because you don't get the economies of sale so there's some issues like that, but yes, more research.

>> Thank you.

>> Dennis, did you have a question or a comment?

>> No, I was just going to pile on, on Mike's, this --

>> Before we come back to that, is there any other folks with comments, questions about the subcommittee report? Go ahead, Rick.

>> Just to follow-up a little bit about what -- about this question. I think that the other thing that was kind of interesting from talking to agencies was that they would be hard-pressed to justify spending money on this stuff unless it was -- for research unless there is a requirement to do that. In fact, they don't -- they never reviewed spectral efficiency as like a prima requirement in the first place even when they buy stuff. They certainly do contract for services and research and service so forth, but it -- I got the feeling, unless there was like a strong incentive, like a mandate to go do that, they probably wouldn't do that because they're going to pick the cheapest thing, they said several times, they're going to pick the cheapest thing that meets our minimum requirements, and spectral efficiency is usually not part of that equation. It's -- that was kind of the whole discussion about the O&B about do you use that at all, and the answer was pretty much no, not really. So I just think they want to do research but they're not going to be incentivized to do that but they're not going to that unless there's a really a strong incentive or a mandate to go do that and make that a primary. I've said this in our piece that we get from our government customers, why don't you incentivize

spectrum efficiency as one of the evaluation factors for award, you know, when you actually give out contracts, and I kind of get this look like what the heck is all of that about, you know? We're just trying to get the link closed, you know. And so that's kind of my expert experience.

>> Thanks, Rick. All right. So we'll come back to Michael. Do you want to make any proposal or are you comfortable?

>> Well, yeah, I think we could clarify around I hope it's not just the case of clarifying the PowerPoint, but, you know, we'll have to carry it obviously to the report, is for that's the most promising No. 2 and 3 spectrum property rights and exchanges or barter swaps is we could just put at the end of each one, comma, based on the coordination and approval of NTIA. Because ultimately NTIA would have to be involved in coordinating and ultimately approving because they have to, in essence, it's going to be their fiduciary duty to certify this isn't mucking up anything else.

>> Since my understanding of the PowerPoint is that's not the binding thing to the document, I would like to do that to the document instead, if we can, and just add with in coordination with NTIA either at the -- we'll make conforming edits both to spectrum

property rights and bidirectional spectrum exchanges and make clear the prominent or the central NTIA role. Does that make sense?
>> Yeah.
>> And I don't mind changing it on the PowerPoint, but I sense this is the big --
>> I realize that, and I can't find quickly enough how to do it in the report.
>> We can do that.
>> Just based on the coordination and approval of NTIA.
>> Sounds like we have a path there.
>> Okay. Thank you.
>> And then with that. Wait, we have one more question.
>> I haven't given up yet.
>> Okay. Mark.
>> Section 5 is --
>> Section 4.
>> Where are you?
>> Recommendation 5, in [Inaudible]
>> Yes, 5.
>> The next to last sentence, could we put something in there that would make data available to federal users so they can timely prove capacity, just so that -- one of the things they would do, you give examples here,

one of them to be provide datasets to allow users to then calculate how their mission would be better performed on a more efficient basis?
>> I have no idea what the implications of that are for NTIA, so I don't have any problem with that.
>> I'm not sure I actually track what it means.
>> So program access, we're interested in this technology, but we don't really who we're competing with on the band, we don't know how many more channels we can get if we had the efficiency, can you help us make the calculation. That's what is lacking. They can't calculate how many more channels they would get if they had more technology.
>> Right.
>> Because there's no information on the 50 other users and anything about it so.
>> Well, they actually do have access to a lot of that information, but we'd be happy to work with to see if there are additional mechanisms and information. But they do have access to a lot of other government information as well.
>> So you're generally okay with --
>> Yeah, I mean, it's your recommendation to us that we can --

>> Well, I am just a little nervous making it without knowing more about what the --
>> I agree that there's the nervousness to the last minute, it does feel like the spirit is captured, and maybe that's something for the future to look specifically at data. But it does feel like it's pretty broad in its recommendation, as I read it.
>> Well, last sentence says NTIA should continue to collaborate with the FCC to evolve a spectrum efficiency policy. You could just say FCC and agencies. Would that --
>> You want the data --
>> The --
>> With, maybe it's the first sentence, with agencies to address, with agencies to address, plan, implement spectrum efficiency collaborative and strategically and, I mean, we could put in and including through data sharing or including through -- including data management, the guy that share management.
>> I give up.
>> You're -- what do you think?
>> Enhanced data sharing or information.
>> I don't think they can make these calculations. I sit with these guys all of the time and they have no idea how what they get out of these technologies.

>> Okay.
>> Including through enhanced data sharing, how the potentially gives us a way out but it still gets in here.
>> But it's on the record then.
>> Okay.
>> Can you read it one more time, Bryan, just so --
>> I'll do my best to, I always feel like I get the reports that have all of this at the end, I don't know why. Okay. NTIA should continue a constructive two-way dialogue with agencies to address, plan, and implement increased spectrum efficiency collaboratively and strategically, open paren, including potentially through enhanced data sharing, close parens, while meeting mission objectives.
>> Okay.
>> That's fine.
>> Okay. With that, I'm hoping to get a motion to accept the report presentation. Oh, that's the motion?
>> Yes.
>> Okay. The report and --
>> As --
>> As edited, so we are have a motion from Miriam, any second? All those in favor, say aye.
>> Aye.

>> Aye.
>> Any nays? Any abstentions? With that, it is passed, and I also want to thank this committee. It's a very impressive report. A lot of work went into, I'm impressed by all the work that went into the agencies. I found it to be a very valuable read, and I think it is great that it's going to be a public document, so thank you very much. Thanks, everyone. Let's give everyone a round of applause.
[Applause]
>> I guess we're at the opportunity for public comment. And the person that wanted to comment is no longer in the --
>> Is there any other public comment in the room? Seeing none, is there any public comment from the phone? All right. Hearing none, we'll close the opportunity for public comment.

So then, the final thing is a closing remarks. I'll make a couple of remarks. So this is my last CSMAC. I've been with the CSMAC I think four terms, starting -- so about eight years, plus or minus things. It has been a -- it has been a really good experience for me. I don't consider myself really a spectrum wonk so I've kind of learned a lot about spectrum. I've mostly learned from all of you. And the one thing I've

learned is if you're ever in the role of being the chairman, there's really only one important job and that's to have great subcommittee cochairs and selecting those, and I think we've had really, really great cochairs, and this has made my job, in fact, trivial. And the other good thing is to have a cochair you're working with who does all the work, and that's Mark.

[Laughter]

>> So for me, it's just time for a new voice on the committee, I'll create a space for a new voice, and I look forward to the future things, but it has been great working with all of you. Rick.

>> And I want to thank you personally. You've been a great mentor for me during this process, I'm like you, always -- when I figured out your what your number, which was wash hard, but the person we could talk to when we were having our own little issues inside of the committee and you always had great insights into that, so I'll certainly miss you as a person, and I'm sure the rest of you will as well.

>> Thank you, I appreciate that. Mark, do you have any other --

>> I second what Rick said. I've really enjoyed the collaboration. We go back to TB white space and that fun thing.
[Laughter]
>> Was that on the record? But, I mean, it's, I think you're right, it's having, you know, the right people in the right spots. And I think this whole committee has been really overachieving, and, I mean, it's a committee of overachievers, so managing that has been fun. So but, you know, new leadership across the board, I think we're looking to the 25 subcommittees we're going to have when David gets his stuff together. But I think I've enjoyed it. And thanks for all the hard work, everyone.
>> And the committee, you truly try to do the right thing. You don't see a lot of agendas. Everyone seems like they're just trying to get the best answer for the country, and that's really great to see. So I really enjoyed that. And thanks, Paige.
>> Thank you.
>> And everyone should come to Paige's celebration tonight at 5:30.
>> Real quick, a couple of things. I noticed you made a few modifications to the recommendations on the

reports, so I'll be looking for your updates, subcommittee cochairs.

>> You don't have a microphone so they can hear you. Over the next couple of weeks, please. Thanks. So I can have the most up to date and reliable information because from that we do draw the recommendations that we then consider internally at NTIA and have them best addressed and I appreciate that. And I believe Rebecca has something she wants to say too.

>> Yeah, I just wanted to let everybody folks here know that ITS has some of our equipment out in the parking lot where the vans are out there. They have been doing demonstrations for the last two hours, and several folks here said, oh, darn, I'm going to miss the demonstrations, so the ITS staff are staying out there through the lunch hour, they'll be there until 1 o'clock, so feel free to go out and enjoy their demonstrations and ask them questions. And Frank Sanders is out there and he's talking about radar detection also.

>> That's all he talks about anymore.

>> That's the radar.

>> And just for tonight, everyone is welcome, including attendees, whomever, so don't -- feel free to bring along a friend or whatever.

>> Thank you.

>> It's a big tent.

>> A tent?

>> No, we're not a tent. Sorry.

>> Big tent.

>> And [Inaudible] so we're good for government people to attend.

>> Paige.

>> Just last comments, again, thank you. I can't express enough how much I've appreciated your input, your sage wisdom, and you've benefitted all of us in the community at large. So thank you very much. I will miss all of you. But I'm sure you will have good things to do in the --

>> You're not inviting us to Florida?

>> The year -- any time you want to come by Sarasota, give me a call.

[Laughter]