

CSMAC NTIA

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Okay. I guess welcome everyone to the final CSMAC meeting of 2017. It's been a good year. Just to kick things off, I'm going to turn it over to Glenn.

It is surprise that everybody in the room that [inaudible].

Including you?

Including me. We are [inaudible] board. There's always that last bit of paperwork that takes longer to get done than needs to get done. Frankly, the paperwork is awaiting the signature of the President who was out of the country for a good chunk of the last week. So, literally, he could be on board, but as of this morning, he has not had his paperwork signed and been sworn in, and we are hoping that will change soon. So all I'm going to say is thank you for being here. Thank you again, as always, for all your hard work. I desperately hope I'm not here in this seat next time, and we look forward to hearing from your reports.

Thanks, Glenn. I'm going to make a few opening remarks, then we'll do the roll call. Before I get to that, Sharla, as our host, did you have anything you wanted to say?

Sorry. We have a new microphone system that even I haven't used yet, so. But thank you and welcome to our TPC again. I know we did this about nine months ago. In case you don't remember, coffee and, you know, some food is out there, and restrooms, just go back down past where you came in, and that's all I have to say, so thanks.

I love this facility, like, the lighting here is really great. Sharla mentioned the mic. So we have -- I have no experience with the mics, but I'm told they are very simple. Just press the little button. It will turn green. You will be live. You don't need to pick it up and hold it in your face or anything, and then you hit the button again and you will be red. So we'll try and use these new mics.

So I'm going to say a few words. One of the main things we're trying to accomplish today is all the subcommittees have done some fantastic work over the years. We've put a lot of pressure in this one-year cycle. We got a little bit of a late start. I remember sitting back with Paige debating, should we wait for the secretary. Well it's probably a good thing that we didn't. We were able to complete one year. Now it puts us in a good spot to do another turn next year with the secretary so he can have his input. I think we're in a good place. I appreciate that it wasn't easy. It was very short-term. But all the subcommittees have produced some recommendations and reports, and that's what we're going to review today.

The objective will be to approve, through a vote, the recommendations. The reports will obviously be attached, but the recommendations will be approved so we can forward them officially through the NTIA for their review and comments. So that's kind of our objective today. At the end of the meeting, we'll talk about what we're going to do for future work. But today generally, we will collect ideas, you know, just in the discussion. We'll take notes, but we're really not going to spend a lot of time planning future work. That's something that will happen after this meeting, and probably before the next meeting. This will be the last meeting of this year. We're not sure exactly when the first meeting of next year will be, but probably late January, early February, David will fill us in to know that.

So, with that, I think we'll -- any questions on generally where we are and what we're going to try and accomplish today? Great. Let's do a quick roll call.

Janice, why don't you start us off. [Inaudible].

Bring your lunch money.

[Inaudible].

I guess, yeah, people need to turn the mic on as you go around. That would be a good practice.

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You want to do it together. Dennis Roberson here.

Robert Weller.

Tom Dombrowsky.

Sharla Rants.

Bryan Tramont.

Jennifer Warren.

Mark Lewellen.

Mark McHenry.

Carolyn Kahn.

Mary Brown.

Rick Reaser.

Chris Weasler.

Kurt Schaubach.

Audrey Allison.

Andrew Roy.

Paul Anuszkiewicz.

Mark Crosby.

Mariam Sorond.

Mark Racek.

Donna Bethea Murphy.

Steve Sharkey.

Dale Hatfield.

Carl Povelites.

Matthew Hussey, FCC.

Paige Atkins, NCIF.

Mark Gibson, CommScope.

Larry Alder.

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That was great. We all didn't say our affiliations this time, so it was new and different.

Glenn Reynolds.

How about our guests? Well, yeah, I realized I forgot to. Okay, so on the phone, do we have any CSMAC members? Allen McKinsey, Virginia Tech. And any other guests on the phone that want to introduce themselves. So this is a great attendance, physical attendance today. That's fantastic. So, with that, generally agenda, we'll give our spectrum update. Matthew Hussey will give an FCC update, then we'll walk through the subcommittees.

We have about 25 minutes per subcommittee. We're hoping for a rich discussion. We're hoping to not have to cut people off, but we're hoping to also hear from a wide variety, so keep the comments focused. We want to hear them. Mark's going to lead us through that exercise when we get to it. So, for now, though, I'll turn it over to Paige for comment.

Good morning, everyone. It's fantastic to see such a full house for this last meeting of the year in coming to closure on recommendations. I'll repeat a little bit of what Glenn said. So, in Boulder, we were very hopeful we would have an assistance secretary in place for this meeting, and that we don't, we are very, very close, so that's a good thing. And we really look forward to leveraging [Mr. Reynolds] vast experience in spectrum policy as we move forward, and looking forward to his leadership and his engagement from a CSMAC perspective as well.

So, CSMAC really embarked on a very aggressive schedule this year, trying to perform an entire cycle within a one-year scope, which I know was very challenging for all the members, and I appreciate what each of you have done. And we're here at the last meeting, and even with the aggressive schedule, I know we're going to come out of this with very productive recommendations or ideas for further study, so it be a good discussion today.

And though we will hear some of those recommendations from the subcommittees, as Larry was saying, the real emphasis today is coming to closure as a committee, full committee on those recommendations for NTIA's consideration, and I congratulate you all in advance for a job well done, so thank you.

So, before we get into the heart, I'll do my normal spectrum update, and talk a little bit about what's been going on since the last meeting in August in Boulder. And I know Matthew Hussey will be talking briefly about multiple items, including 3.5 and Spectrum Frontiers, including an order that was adopted yesterday from Millimeter Wave. But I would like to touch on 3.5 a little bit, from my perspective.

So, we continue to make great progress on the technical aspects of sharing or rolling out the citizen's broadband radio service or CBRS and protecting the federal and non-federal incumbents in the band. NTIA continues to work very closely with the DOD, the commission, and industry to make this a success. It's very important to us. And this has been an incredible collaboration. I can't overemphasize that point. It wasn't always perfect, but we were able to identify the road bumps, address them, and continue to make progress and move down the road, and that's what it's all about.

NTIA and DOD and the commission are meeting regularly with WinForm as well to complete the standards and certification process for the Spectrum Access System, the SAS, as well as the Environmental Sensing Capability or ESC, which enable the CDRS devices. And the WinForm standards will help define the protection of federal radar systems, military radar systems. So, again, it's very important to us and the agencies, particularly the Department of Defense.

WinForm has committed to completing their standards and software by the end of 2017, just a little later than originally planned, and NTIA, in particular the Institute for telecommunication Science or ITS, our lab in Boulder, will then have two months to review the WinForm software prior to starting the SAS

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certification process. And if all things go as planned, the SAS certification casting can start as early as March of 2018, so an exciting time.

And the ESC compliance testing will be performed and, hopefully, completed the same time as the SAS testing, so we would have both implements coming through fruition at the same time. NTIA also is in the process of publishing two technical memoranda related to the ESC compliance testing, and those will be incorporated in the WinForm standards, and, actually, the content of these memorandum have already been coordinated with and agreed to by DOD, as well as the Win participants industry. And we've talked about that this is really a complicated sharing proposal with the SAS and the ESC, but also this movement toward dynamic protection areas, replacing the static exclusion zones and that's, to me, one of the most exciting pieces as well. The DPAs, the dynamic protection areas, will only be activated when they sense the radar in the area. And this is really what I would call a great pivot point toward more dynamic sharing, particularly between federal and non-federal systems.

And NTIA is working closely with the ESC applicants and finalizing these DPAs based on their sensor locations, and NTIA will send a letter, similar to the memoranda we talked about earlier, to the FCC, that document the technical implementation for the DPAs. Again, that have already been coordinated and agreed to with the DOD, as well as industry specifically.

So, if you take a step back at where we were a few years ago, I mean, it really is amazing. I assume everybody remembers those very large exclusion zones around the coast inhibiting any real commercial deployment or value of this band. And now we've moved toward these dynamic protection areas enabled by SAS and ESC technologies to maximize commercial potential while still protecting the implements, and particularly from our perspective, the military radar systems. So, this is a huge step forward, and right now it's up to all of us to just bring this to reality, so it's great activity.

And the 3.5 model also demonstrates how you can start moving toward dynamic sharing without exposing sensitive information. So it's about the sensing component triggering the SAS and ensuring that there is not sensitive or classified information through that process. That's a great example of what we can do in that regards. But we also continue to expand our Spectrum compendium reports on federal government use of Spectrum in selected bands, and this is spectrum.gov, or you can also go to our website directly and gain access to these reports. And, originally, these reports covered 225 megahertz to five gigahertz. And this past August, we added reports to the six to seven gigahertz range, specifically 5925 to 7125 megahertz, and we are planning to add a report early in 2018 on 37 gigahertz, so we're starting to look at the millimeter wave bands as well. And we will follow that with new reports on the bands in the seven to ten gigahertz range, hopefully the first half of the year, and, again we're trying to continue to extend this information. And this is important so we can be more transparent and can enable discussions and assessments in terms of sharing techniques and sharing opportunities collectively as we move forward.

We also see -- continue to see the federal agencies seeking funds pursuant to the Spectrum Pipeline Act in 2015, which we've talked about in prior meetings, and this is to assess potential opportunities for making additional spectrum available for commercial uses, and there are some statutory requirements around that. The Spectrum Efficient National Surveillance Radar or as most of you probably would recognize SENS-R, S-E-N-S-R, the SENS-R program, involving FAA, DOD, DHS, and NOAA, has become relatively well known. That was the first pipeline plan approved, and that program is well underway and on track. And those agencies are exploring the potential to free up at least a portion of 1300 to 1350 megahertz by consolidating various radar capabilities and relocating those to alternate spectrum.

Now, in addition to SENS-R, NOAA has obtained funding for a pipeline plan engineering study of potential sharing with their operations in 1675 to 1680 megahertz, so that is just now underway, and additional pipeline act proposals are either under review or are being developed by the agencies, so stay tuned, because there's more to come. And as I said before, we strongly believe the most effective incentives are the ones that can provide resources to the agencies so they can look at alternatives, they can look at more efficient technologies to accomplish their missions into the future. And I expect we'll see great benefits resulting from the Pipeline Act and the related agency activities.

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Now, the Pipeline Act has become a key component of a more comprehensive strategy and process that NCIA leads in collaboration with the federal agencies to assess, prioritize, and explore bands that may be suitable for sharing, or even relocation. We continue to leverage and improve our inner agency processes. This is the policy and plan steering group, the Interdepartmental Radio Advisory Committee, EPSG in Iraq respectively, that have proved successful in the past, and we are confident in these processes, complemented by the Pipeline Act flexibilities that we have with the Spectrum Relocation Fund that these will continue to bear fruit and, in particular, in the area of promising sharing technologies, as well as opportunities.

Along those lines, we are continuing to plan a couple of workshops, and we talked about these at the last meeting. One of them will be an interagency workshop to start peeling back enforcement, and then the second one is to talk about sharing, and some folks would use the term bidirectional sharing, in particular focused on how federal users could benefit from and gain access to non-federal spectrum from a sharing perspective. And we hope to hold these sessions in early calendar year 2018, so they're on the horizon, and it is related to a past CSMAC recommendation as well.

Meanwhile, NTIA has continued to study ways to increase the efficiency of federal spectrum use. ITS or Lavin Boulder has been working to better understand the technical aspects of Spectrum efficiency, including how to best define it in the context of very diverse federal use and how to develop tools that can be used by the agencies and others to make better decisions or more effective decisions regarding efficiency, and that work will continue into 2018.

We're also gaining a better understanding of how the agency's reach decisions about spectrum-based equipment acquisition and spectrum usage, and this helps inform us as we continue to look at options and potential effective incentives to increase spectrum efficiency, as well as maintain or enhance effectiveness over time, so these are very important elements to our future work in this area. I want to mention another initiative that we began this fall, which will be a significant undertaking for us over the next year or so. And that's performing a major review and transformation of the NTIA manual, also known affectionately as the Red Book. And we are planning to make it more accessible and usable through digital publishing and overhaul the content to make sure that it is relevant, accurate, and up to date. Though, the manual has been continually updated over many, many years, it still contains much of the original content from its inception in 1965. And through the IRAC, we've established an inner agency ad hoc working group that has begun to take a strategic look at the manual, in trying to revision it and remake it in the process. And for those that may be interested that ad hoc is titled "Ad Hoc 1965. And if you know Peter [Templeit] I think that was probably his idea.

So, we are looking at major changes to ensure that the manual best serves the community, including NTIA's need, but in terms of accessibility, as well as content, so we're excited about this. This is actually long overdue, and we hope to have a lot of the revisions in place by the end of calendar year 2018.

Now, finally, I want to shine a spotlight on the efforts of the many men and women across the country who responded to the extraordinary cluster of disasters that we faced this summer and fall, particularly the hurricanes. For its part, NTIA sent members of the Office of Spectrum Management's Emergency Response Team or ERT, in Texas and Puerto Rico in response to hurricanes Harvey and Irma to help coordinate spectrum use among federal, state, and local responders.

Our ERT members spent many weeks in the field, supporting FEMA's emergency support function for telecommunications recovery, helping federal agencies work to restore their communications, identifying federal first responders with communications equipment deployed in the disaster areas and assisting in frequently deconfliction among all of the players, and particularly between federal and local public safety.

And I also want to credit and thank the commission, the FCC, as well as industry. I think wireless carriers and others, along with all of the experts, other experts and technicians across the government and

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industry rose to meet the challenges in these hard times, and much activity is still going on, but it was a tremendous effort, everybody pulling together, as we normally do in times of disaster.

So, before I turn this over to Matthew, I want to thank you all again for your hard work. I know it's been much more intensive and much more work than perhaps was anticipated this year, and I just want you to know that your recommendations, your insight, your collective wisdom is very important to us and we take your recommendations seriously, as you have seen us adopt and move forward with at least some of the recommendations to help us achieve our goals. We will continue to need your advice and expertise, and I'm sure that when David Redl gets on board, he will be engaging SIRI and help guide the future actions of the CSMAC well.

So, thank you for your continued dedication and excellent work. It's been a real productive session and I'm looking forward to the discussion later this morning from the subcommittees, and then the robust deliberation across the company, so thank you.

We'll have Pat Matthew continue the update and add some.

Question.

Okay.

[Inaudible] the questions.

This isn't a question.

Before we move forward, could we have a moment of silence to recognize the loss of our new beau. Those of you who worked with [Bonu] or followed his career, he made Spectrum not just a business or a job, it was a calling, and most recently in connection with his calling, his company was in Puerto Rico at, you know, no commercial compensation, trying to bring service to the people there. So, if we could just take 30 seconds in his memory. Thank you.

I was meant to be a none but I just [inaudible].

Other questions for Paige and her remarks? What kind of authority -- did you have the biggest badge down there, I mean, when you needed to get things straightened out.

The national response framework is an established framework. The emergency support function for telecommunications is in support of FEMA. It's an interagency group. And, again, we typically are down there with the commission and the other agencies that are supporting that framework. So it's a very collaborative environment, and FEMA for that ESF function, they lead that for the national response. So it's not really a biggest batch kind of thing, if that make sense.

Yes. That sounds like a difficult task, depending on how many people show up and how many agencies, state, local, and government, federal.

And that's why it's so important to have, one, the framework in place and some semblance of structure.

Right.

But, also, that free flow of communication, particularly for us, we partner very closely with the commission, and that allows us to get a lot of things done, along with the agencies, of course.

Thank you.

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Thank you, and thank you for the report. Great news about the transformation of the Red Book. I know it's primarily your internal tool, but it impacts a lot of us who do, work for you. So, will there be any mechanism for feedback or suggestions from the private sector who also uses the Red Book. I think there's a great idea. I have not actually read the plan, the more detailed plan of how it will go forward, and John -- is John Aldon here? Do you have an answer to that, by any chance? John is intimately involved in this as well.

Well, at the point [inaudible] suggest another round of that and maybe include that in the plan. But we'll take that back.

I think that's an excellent idea, and we should follow up with that.

Rick.

So, my experience is that typically in Red Book changes, they actually go out in the federal register and they do ask for public comment. I've seen that in the past.

Yeah, but I think the idea will be more proactively working with industry to get input to shape before it gets there.

Well, we have a whole list of comments we'd love to give you.

I'm sure you will.

It's Ed [inaudible], Bob [inaudible]. In fact, we'd love to help with that.

Great. Thank you.

On the same topic, I hope I will get hit with tomatoes from my colleagues, but you could even consider whether that's a task, you know, for this body. If you had a question, how can we improve the Red Book and make it more responsive to your needs and ours? You know, it may be something that there's a, you know, subgroup here.

The only problem I would have with that is timeline, because we're moving forward now, and I'm not sure the timeline of getting response from the CSMAC as a committee would fit, but we will definitely look at how we can best engage in district and get the feedback we need, because it really is -- we want to make this relevant and appropriate and useful for everybody who uses it, not internal NTIA or the agencies.

My informal view of the response, Michael, is your response would get voted down by the group.

But Michael personally will be happy to join and help in any way.

Yeah, you really need to be a Spectrum nerd to wade through that thing, but some of us are.

A real quick comment, I just wanted to pick on what you said about CBRS and sort of wave the flag. The engagement with the federal folks on this has been amazing, and think we can put some of that down for the work we did with AWS for CSMAC and how we worked through some of those things. Your team and OSM, you know, Edgar [Sela] and Bob [Sola] and all those guys, the guys at the navy and all those guys across DISA and DSO, it's really been amazing their level of engagement. I think whatever success we have, the successes we have will be largely based on this ability to engage. So I think that really is the beginning of a new era, if you will with Spectrum Management sharing with federal, is the ability to have these assets engaged and work together, so thank you.

Yeah, I would emphasize that it did start with the CSMAC engagement, with AWS-3, and this takes it to just another level.

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All right, well let's move to Matthew here for an update.

Well, thank you. First off, you know, as the FCC lays on and Rangam NTIA liaison for both the TAC and CSMAC, and we're not only -- I just want to remind that we're not just here to kind of inform of various activities, both groups are doing, but also to be a resource for all of you to help facilitate, hopefully, greater collaboration between the two groups and really work through some of the interesting issues today. So if there are ever any questions, items that you have that you want to bring to the attention of myself or Rangam, that we then bring to the respective bodies, please feel free to do that. So, you know, my door is always open for e-mails, always open, so please feel free to utilize us as a resource moving forward.

The next TAC meeting will be held on Wednesday, December 6th. I think the topics are still kind of being fleshed out and finalized. But just to give kind of a brief recap of the September 19th, meeting, some the key recommendations that the FCC has kind of taken up from the TAC that are pertinent to the CSMAC that the FCC will, in the near future, issue a public notice on the TAC Spectrum Management recommendations, as well as a whitepaper on interference resolution. Again, that's supposed to be sometime in the near future, but that is plan today be issued.

Also, the FCC -- one of the problems that the TAC has been concerned with is the rising voice floor, and so the FCC has taken, you know, the effort to test lighting and switching power supplies, determine, you know, the contribution of those to the rising noise floor, and then hopefully figuring out resolutions to address that. And then also, the TAC has also recommended kind of providing a balanced spectrum approach in the pursuit of freeing up, making more spectrum available. And one thing I'll touch on is that the FCC recently released an NOI on mid-band spectrum to try to do that to that extent.

And, in addition, you may have been aware, one of the recommendations that, actually -- well, one of the items that the TAC did was released a public inquiry, inviting comments about technical regulations and the process for adopting and updating them in an effort to try to remove obsolete or outdated regulations that currently are on the FCC books. The FCC actually released that on August 30th, and comments were due by October 30th. The FCC received about 32 filings in regards to that public notice, public inquiry, and the FC staff and TAC members are currently reviewing them, so that will probably be a topic of conversation at next month's meeting.

And now moving to the FCC activities, yesterday was kind of a marathon meeting compared to other ones, and one of the most prominent items that was adopted was the ATSC-3 Next-Gen Broadcast Television. I know a few people are here, very excited about that. But the commission adopted important work that authorized ATSC-3 on a voluntary market-driven basis. It also required broadcasters to continue delivering current D-TV service, as well as uphold public interest obligations.

And, also, last month was pretty busy as well, with Spectrum Frontiers. The commission adopted a second order and further notice of proposed rule-making to take further action to facilitate the development of advanced wireless service and greater more flexible access in spectrum bands above 24 gigahertz. And then as Paige was talking about 3.5, gigahertz, there was an NPRM adopted in October that seeks comments and proposes changes to the priority access licensees, basically makes adjustments to the licensing terms, expands the geographical areas, and also revises the auction rules regarding the [PALS].

And then in September, the FCC adopted a report order to update and streamline rules regarding NGSO operations to facilitate deployment, relax milestone rules and coverage requirements for non-geostationary satellite orbit fixed satellite service, so in order to give greater flexibility and to allow more innovation to occur in regards to the new systems being designed.

And then a little bit more detail on the mid-band NOI. In August that was adopted. The FCC seeks comment on potential opportunities for additional flexible access for wireless broadband services, in

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particular, for spectrum bands between 3.7 and 24 gigahertz. This evaluation will assist in establishing a comprehensive sound and flexible spectrum policies that enable innovation and investment to keep pace with the technology advancements that are occurring in the space, and, really, to main the U.S. leadership in deployment of next generation services. And, to date, we have received actually, over 170 filings for that NOI, which is great.

And then lastly, the 900-megahertz NOI was released in August as well, and it was basically to examine whether any rule changes may be necessary to appropriate -- may be appropriate to increase access to spectrum, improve spectrum efficiency and expand flexibility in the 900-megahertz band. So, one of the reasons is because that band was designated back in 1986, and it's just kind of a way to kind of see what new opportunities, what new technologies might be able to be utilized in the band, and so that's basically the update I have. Happy to try to answer any questions that any of you have.

The FCC issued notice of inquiry in the 900 megahertz. It's all good, man.

[Inaudible].

I still love you, Brian.

Got one eye on him.

Thank you very much. Really appreciate your [inaudible].

Oh, I had one more thing, because I know one of the issues is enforcement -- oh, there we go, sorry -- is enforcement also in September. I almost forgot to mention that the FCC adopted NPRM, basically in an effort to try to streamline, consolidate procedural rules in regards to enforcement, so there is continued tension and effort in the enforcement area with the FCC. And just to emphasize the workshops that I talked about on enforcement and what I hope on sharing those with the government collaboration commission as well.

Last call for questions for Matthew. Again, thanks, Matthew. We really appreciate having you here and hearing that update. So, with that, I'm going to turn it over to Mark here, who is going to walk us through the subcommittee enforcement.

Okay. Are there any special guests or visitors that we should acknowledge? Okay. Okay. Here we go.

We've got Carl.

Carl, yeah. [Applause].

Thank you. [Inaudible].

That's a good point. Thank you.

[Inaudible].

Okay. So we'll start with 5G. So, we actually have, now, about two hours for discussion. So it's about half an hour each for subcommittee report, which is good. But that doesn't mean we need to be loquacious. So let's keep our comments focused and move ahead toward resolution, and we'll try to do -- if we have to do any edits to the recommendations in real time, we'll try to effect that up here. Right now we have this set up, but I don't know if you guys can see this behind our heads. If you can, we can do this, and it will be, like, you know, CNN. If not, we can just move ahead. So let's try to move ahead. If we need to do this in real time, we'll go there. So, having said all that, 5G is up first. Mark, Mariam, go for it. That's it.

Wow.

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Wow is right.

[Inaudible].

I think that's it. We're going to put it here.

[Inaudible].

It's like Star Trek here.

[Inaudible].

Send an e-mail to help.

In the interest of time, we can go ahead and continue.

If we get this up, fine.

Yeah.

We haven't used something like this before.

Right.

So let's not let technology move away.

Yeah, the ease of technology.

Everyone should have this report out there.

Oh, there you go. Whoa, there we go. Wrong one, though.

It's the wrong one, though.

[Inaudible].

We have some views, but.

Why you start.

Yeah, go ahead, Mark.

Okay.

Yeah.

So we're only going to go ahead and talk about sort of the changes that we saw, at least in the beginning here, of our presentation in comparison to sort of the midterm type of thing. With respect to the subcommittee members, we did add some subcommittee members. So, you know, Robert Denny, NTIA liaison, joined us as well, and also Donna Bethea Murphy joined us as well. Apologize for all of the confusion about e-mail addresses.

We met eight times through conferencing. We had a significant amount of e-mail, especially towards the end. There was a lot of review of the document, so thanks everybody for their comments. We much

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appreciated it. You'll see where, down on probably the next slide maybe, this is, you know, the study question that is everybody has that we went over last time. The way we're going to talk about this is that we have three recommendations. I'll turn it over to Mariam to discuss two of them. I'll take one on, but I want to draw your attention to the fact that in the report, we also have some recommended future items that we would like NTIA to take a look at as well. So we're not going to discuss those now, but if you can please go ahead and draw your attention to the report where they're documented. So, Mariam, I'm going to turn it over to you.

All right. So, first of all, I want to thank all the subcommittee member. I think there's a lot of good work put into this. I also want to thank Mark. It was a joy working with him on this subcommittee, so.

It's on.

Yeah, it's green. Is that good?

Yeah.

All right. So, with that said, we, as Mark highlighted, if you look at the questions, there's really technically five, counting the three subgroups. Some of these were in the form of basically asking questions, which the report tried to address, and some of them actually had recommendations as an output. So we categorized them into three recommendation buckets. One of the recommendation buckets would apply to two of those questions.

So, on the first one, if you go to the next slide, we talk about interference mitigation techniques to facilitate sharing. I think we just wanted to first highlight that this was a general question. It had a general response. And primarily because mitigation technologies need to be evaluated on a spectrum band basis, so they could be specific, so we need to include all the other factors and the use cases before going down a layer deeper on things.

And also, both receiver and transmitter characteristics are considered over here, and we've highlighted that need to be considered in order to get to that level specificity. With that said, going to the recommendations, on the first one, which is really the key one and the primary one, recommending that the NTIA really opens up a series of NOIs basically, to collect information on potential spectrum bands. Therefore, we could go the layer deeper on applying some of these and finding suitable ways of doing it. And this -- you know, the list could encompass multiple spectrum bands and it could be information about, also, their legacy wave forms and operations, and potential future operations, which would, therefore, you know, be able to address questions such as one, when it's asking what weight forms or technologies are addressed.

The second recommendation, we're also asking -- recommending that the NTIA request that the FCC consider a counterpart process on the NOI, with the commercial bands identified and consider these for, you know, bidirectional sharing. And also, then, going on to recommendation three, and these are really just -- we're trying to follow one after the other. These new technologies that are being developed in 3GGP, that can address sharing between federal and non-federal systems like -- there's a series of acronyms over here. I'm not going to go through every one of those, but the report has considered that. So, in conjunction with recommendation four, these approaches can be considered as a subsequent step, and these technologies can be considered in a subsequent step to enhance the release 14 progress that the 3GPP has already made. So the next releases of 3GGP would have room for such considerations.

We also are seeing the NTIA should evaluate the technologies that are outlined above, based on spectrum application and functional requirement, so, again, it needs to be one layer down specific. Recommendation six, we are highlights that in the past, we also recommended that a workshop on bidirectional sharing -- and Paige noted that that's in progress, so we're happy to hear that, and it's being emphasized over here. There also could be a workshop held on recommendation seven, with an

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objective to establish a platform for an industry-led consensus on solutions to fundamental questions on sharing interference mitigation.

And finally, recommendation eight, we're highlighting that there are no regulations currently for receiver performance. Basically, the way the wireless systems work, they have very stringent receiver performance standards, so we propose that the NTIA examine receiver technology and existing and future systems that could allow federal and non-federal systems to coexist with minimal performance degradation. And that pretty much sums it up, I think, for the first recommendation.

Second recommendation, Mark will do, then I'll do the third one again, and then we'll open to questions for everyone. Thank you.

Okay. Thank you. Okay. So the next one is on Spectrum Management automation. This is also in response to question number one, which is talking about, so what technologies might be included in 5G standards to facilitate sharing between federal and nonfederal systems? And 5G standards, also one of the considerations was the 3GPP, not the only standards that is considered but 3GPP definitely is in the development of 5G standards, and so we recognize that those CMRS and those technologies prefer a licensed dedicated regulatory regime; however, that's not always possible. The spectrum may be that the incumbent is very difficult or would take a very long time to be able to -- or impossible even to go ahead and relocate to another band, or there may not be technologies in place that would allow them to go ahead and move to another band or another technology. So spectrum sharing is definitely necessary.

And as we've heard, you know, Paige was talking about sort of the dynamic nature which this -- you know, for instance SAS very much has the capability to be able to provide this dynamic nature, dynamic protection. When the spectrum will be available, what spectrum will be available, where the spectrum will be available are all things that, I think, really go towards spectrum automation. The static form, obviously, this is not something that we necessarily need to have an SAS for. So it's very important that when we identify spectrum-sharing opportunity, that we actually look at sort of what are the technologies, what are the services, what are the use cases, what are the frequency bands even. Those are very important to identify what is the sharing solution.

And so, going now to the recommendation, which has sort of several parts. First is to monitor the activities, which is already happening. There is a lot to learn, but there is a lot of new as well in this process, and I think that to be able to see where this application or this opportunity can exist in other bands, we need to go ahead and monitor what is happening within the SAS and learn from those lessons, you know, make necessary modifications as we sort of learn some lessons there and incorporate that into this framework.

Also, there are opportunities as well, especially in those standards organizations that are discussing sharing to actually -- for NTIA to participate. Right now, sort of the main focus is maybe more of an intersystem-type of sharing within standards organizations. But I think that there's still an opportunity for NTIA to be able -- especially when there's certain bands that are being discussed, to be able to come in and to be able to recommend or participate in the activity to make sure that any sharing framework that is being discussed includes their interest as well, or even the opportunity to actually propose some sharing opportunities, or sharing frameworks, I think, is also an opportunity.

The third one is to, as we've seen before, is to, you know, open up one or more series of notice of inquiries, you know, to collect more potential information on opportunities, and possibly in other frequency bands. You know, I think this is probably something that, Paige, you were talking about that is, is that this could open up -- you know, SAS could open the opportunity to look at how this framework could be used in other bands. So, this notice of inquiry, we're following along with that, recommending that, yes, this is an action that we think that NTIA should take as well.

Also, there may be an opportunity to actually maybe work with the FCC. It sounds like that effort is already underway. We're not sure maybe what is the right mechanism to do that. We understand that

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there's already an MOU that's in place. Maybe that sort of has the right sort of framework to be used for this establishment of sort of a formal working group to actually look at opportunities, because opportunities especially maybe when you talk about bidirectional type of thing, you know, the opportunities are going to be, you know, on the FCC side, but they also are going to be on the NTIA side. And to be able to go and head and get the best solution, I think, requires sort of both of the regulators to be there talking about, you know, talking about how they could go ahead and work together on this.

In doing so, I think also develop a list of legacy information, we saw that in what Mariam was saying in her recommendation as well, because as I was saying at the beginning, that, you know, every sharing situation is going to be and has to be looked at to identify what sort of sharing opportunities could present itself. But to do so, you need to actually identify sort of some information about the incumbent and the "sharee" to be able to determine what is the right framework that could go ahead and facilitate, you know, the best access to the spectrum, the most spectrum efficient solution as well. So we would say that, you know, that is something that we could go ahead and do, is start to go ahead and identify some information.

And the last part is, you know, this is more about sort of modeling. I think in many of the case, I this is sort of happening to some degree, and that is, is when we do our modeling, you know, we're not just looking at sort of when interference can occur, but we're looking at sort of the probability of interference. In other words, that, yes, there may be the possibility that interference could happen, but it may be in such a remote way, and that should be taken into account whenever we do sort of an assessment of spectrum or an assessment of interference, and not only just sort of look at the probabilistic sort of risk assessment aspect of it but also looking at it from the service perspective, because one type of service may actually need to be treated differently than another type of service. For instance, if we're dealing with public safety, then we need to sort of account for that in our model, and in our sharing solutions as well. So those are, you know, the parts of the recommendation. Now I'll turn it back over to Mariam.

On the file recommendation, first, I want to take this opportunity to highlight that we had this recommendation involved, thanks to Rangam and Amy and Bob, who have been great NTIA liaisons, helping us get to something that is more tangible. Basically, this is a question of the standards and how do we do standardization changes, and 3GPP IEEE or any other open source technology, probably the same challenge at high level needs to be identified first, so the standardization efforts are long term. So for the NTIA to be able to effectively basically lead or guide the industry on getting results, there needs to be a long-term commitment. I think that's the first thing, because not only technologies evolve but also consistent and active participation are needed to drive things. So that's the first thing, before getting to the actual recommendations, we want to highlight.

So, now with that said, on how that's done and what are the resources and could groups like ITS be considered so that such roles can be fulfilled, or if the NITA increases their resources, here's, actually, some recommendations that maybe could be held immediately until that consideration is given on how to address a long-term solution.

The first one is to hold workshops to gather contributions from a wider group. So that includes the industry, manufacturers network operators, academic institutions, industry verticals, and research firms. These workshops could use also not only to gather information but perhaps promote industry-led activities, so it's a good step to get to the ultimate goal.

The second recommendation is also saying that maybe some liaisons with industry trade organizations that could be active participants could be established and that could be also another mechanism to get to the goal and GMN, 5G Americas or ADIS, and the final recommendation is, also talking on a different level of liaisons, with more through administration collaboration, so maybe the ITU CTEL or other such bodies. Now, some of the standardization bodies have direct liaisons with these groups already, but depending on the standard body, this could be done in two ways. So that's the recommendation. Thank you.

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So that's quite a set of recommendations in a year or less than a year. I mean you guys were -- and I saw the traffic, so I mean an 8000-word report, 25 pages, probably two dozen recommendations, what do you guys do in your spare time? Anyhow.

You had spare time?

So we have about ten minutes for comments, questions, so any comments, questions? Really? Okay. Andy.

Thank you for the presentation and the information. I'm curious, in the discussion of wave form characteristics and the transform function, adjacent band issues, particularly with high-sensitive receivers, like radars, is always a whole landmine environment to get into. Curious about what considerations there were and discussions on the wave form to try to minimize adjacent band power from 5G? Because obviously trying to prevent that, that interaction with the high sensitivity receivers is quite key and can limit some of the preliminary systems quite heavily sometimes.

That's a good question, and I think that's what we were trying to say. I think the key in that question, is you mentioned "such as radar," which is where we were saying you need to pick a specific band and an adjacent operation and then find out what the interference mitigation technique is. That's what our challenge was, is that we couldn't exactly go into such specifics without knowing the use case. It makes a difference if it's radar, if it's satellite, if it's something else and your adjacent band dictates what interference mitigation technique is. So we kind of -- if you look, we've done a lot of general categories if such things could be used. But we're definitely recommending that it be taken to the next level to be able to address a specific question like that.

Okay. Thank. We'll do Jennifer, then Michael.

So, Jennifer Warren. In light of that response to. [Anjo], can you help me understand, then, the recommendation of Page 5 about sharing [inaudible] can be considered for standardization. I mean, you didn't mean standardization applicable in lots of different areas. Can you just talk about that. Because, to me, as the non-engineer, when I hear that, to me, that means it can be applied in lots of different places because you will standardize it, as opposed to a standards organization being involved. Which way did you mean that, or did you guys mean that, Page 5 recommendation two, the second line. Page 5, Jennifer Page 5 recommendation to -- I think we measured in --

That's what happens when you have that many pages and recommendation.

It's standards. I think we meant standards, but not standards --

[Inaudible].

Uh-huh. Oh, this one?

Yeah.

Yeah.

So, what was envisioned is that the -- you can, like in 3GPP you can introduce study items and work items within 3GPP. And NTIA already participates within 3GPP, so the idea is that they can participate in and have the opportunity to raise a sharing situation and have it addressed by 3GPP.

May I do a follow up?

Go.

And then I won't ask anymore more questions of this group.

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[Inaudible].

So I'm just -- I'm paying attention, so I'm trying to, then, understand. So we standardize the sharing scenarios, and then I look at Page 6, number three, and it talks about, you know, developing a unified view on spectrum sharing through ITU or CTETL. And I know that many of us that do international work have not always been able to have the U.S. Government, particularly the FCC, support having sharing scenarios actually embedded within ITU work, saying, no how sharing scenarios is a national decision, not an international decision. So, can you help me understand how those would work together. Because I think if you're going to standardize it, then you would want those sharing scenarios to actually be reflected in the spectrum allocations that 5G pursues, yet I don't understand that we have widespread wireless industry support, let alone USG support. So help me understand how that recommendation all works, thanks, and I'm done.

Yeah, I think ITU could handle that one.

I think just to highlight, the first question you had on standardization is more like I think Mark was trying to highlight groups like Win Forum or things like sharing is being considered, so just to give a context of what that is, versus when you turn into the other one that you went to, that's more highlighting groups like 3GPP. So there's kind of a difference over there, where Win Forum is solving a specific use case for a sharing scenario, versus 3GPP is not doing anything unless someone tells it to do something; right? Because it's such a wider group, and it's such a -- you know, it's 100 percent consensus.

In order to have an active work item to be able to go into sharing, there needs to be somebody proposing it, and others actually agreeing to it. So where the ITU comes into place is that perhaps -- I completely recognize your point or how is the administration led, is that perhaps, from the ITU side, there could be sort of a liaison asking 3GPP to do some work. That's what we were suggesting. Not the other way around, where, you know, you go to 3GPP to ITU and say, consider this sharing, because ITU is already doing whatever it's doing on sharing. But the whole answer over here is that if you want to get 3GPP-like industry organizations, maybe you could go through ADIS and go through IT. They need a liaison and sort of a proponent of this work to start sharing things.

So does that mean a little work and recommendation to make it clear?

Yeah.

Okay. Can you guys think about that?

Okay.

No matter how you entered it.

Sure.

Okay. So, we've got Michael and then Rick and then Dale. Michael you're up.

Okay. So I may give you a bit more work along the same lines, to extend Jennifer's question. It's unclear to me -- I mean just so that it's clear about the scope of the standardization, are you talking about standardization across federal uses? So, for example, that the military should standardize all of its radar, or that -- you know, is this across federal uses or is this just for the slice of federal activity that has a commercial counterpart, and then you want the federal government to standardize to the industry? Because it's not clear if we're talking, to me anyway, the scope of the standardization isn't clear in terms of whether we're -- because it seems like the biggest opportunities, in terms of spectrum sharing, typically, as we saw in CBRS, are these bands where you have noncoms, such as radar, but if we're going to, you know, be asking the government to standardize across, you know, radars for example, and,

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you know, that has been a problem this 5 gigahertz, as you know. There's short pulse, long pulse, all this. That seems like a bigger -- a much bigger deal or a different beast than saying to the extent that the federal users have come coms that are similar to commercial, they should standardize between federal and commercial, so just looking for clarification.

Okay. So I think it depends. So, I mean, so, really, if you look throughout the report, the question you're asking is general, and it depends on which aspect you're talking about. As far as standardization changes, the questions and answers were geared for commercial standardization changes, because the question is under 5G. I'm not -- you know, at least I'm not aware of a federal initiative on developing 5G-type sort of systems on federal, so it can't apply, in that sense, to federal radar or anything like that, because to my knowledge, if they do have standardization bodies and they're doing 5G, we personally don't have any knowledge of that. So I think it's definitely -- we're trying to be clear that it's answering the 5G question that's being developed by the commercial industry.

Okay. Briefly, just briefly, federal 5G systems.

No, commercial 5G systems. So strictly commercial 5G systems when we're talking about industry bodies such as 3GPP, not standardized federal systems; right?

Okay. You good? Okay. Rick, and then Dale.

So, I was kind of curious about the receiver standards recommendations, which, I think, is a very good idea. The Question I have is, have you thought about how that might come about and then how you develop those things and how you enforce them or somehow encourage people to use receiver standards? Would that be part of an equipment authorization process, or what's the thinking on that? But I think it's a very good idea. The question is how do you come about developing those things and how do you get people to actually do it?

So it is one of those things I think that you're pointing out very correctly. It's good idea. A lot of folks, a lot of industry, a lot have been talking about it. It's being done in other parts of the world; right? The Europeans specifically have a lot of receivers. I know Dale has been talking about receiver approval for as long as I've known him, so it's one of those things that -- I apologize, we keep highlighting, but you're asking a really good question. How does it happen? I think it needs to be a very, you know, joint collaboration between NTIA, FCC. It involves the different regulatory bodies to be able to get this moving. And there are some good efforts, I believe, on the TAC and the NTIA maybe could consider, you know its own efforts. But I'm not sure how to answer that that would actually help.

Dale.

[Inaudible]. I'm not anxious to see the government get involved in the details of actual receiver designs. That's the reason that my colleague, Pierre De Vries and I have pushed this idea, you know, of the harm/claim threshold idea, the same in Europe, in the UK the Spectrum user writing. There is, on Page 25 of our full report, mention of going in that direction to keep government from getting into detail and design. I mean, I think this industry's changing too fast. You send a receiver -- set a receiver saying today, and tomorrow it's going to be different. I think that's a tremendous challenge. And I think the harms/claim threshold approach should be given serious consideration.

Thank you. I had that same thought, too. Any other comments or questions? Great. Right into time. All right. Thank you. That was a very comprehensive report. Little tweaks, but I think otherwise it's in pretty good shape. Yes, ma'am.

[Inaudible].

That's it. Yeah, that's all I saw.

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[Inaudible].

We're not voting today, or are we?

We are.

Oh. Okay. Sorry. You know, I lost track of the meeting going around in this memo.

[Inaudible].

Could I just -- it's been so long, I've forgotten, does it have to be unanimous?

I've forgotten. Can it be minority? I've just forgotten. Well, we'd like it to be unanimous. It's actually consensus, I think, by virtue of the bylaws.

Is it consensus?

But, yeah, let's see what happens.

We have options to deal with.

Yeah. So, okay, all who are in favor -- well, actually I need a motion, so.

I say we adopt and recommend.

Is there a second?

I would second.

Any other discussion? Okay. So, the movement is to adopt the report as written with the tweaks we're going to see. All in favor say aye.

[Group] Aye.

Any opposed? Any abstentions? Okay. So we have two abstentions until the tweaks are done; okay? Good. Thank you. Now I know what we're doing. Okay. Key characteristics, which is -- is it Tom and Charlotte?

Yes. We're going to tag team. I'll do the first part, and I think the way we put this presentation together was to sort of walk through what we did, including the questions up and running.

Okay. One second.

All right. I'll wait. I'll wait. But while we doing that, I can give you a little background, which is, so in the report though, the sort of PowerPoint report, that really summarizes the lengthier report, so if you're not seeing everything you want to see in the PowerPoint, go look at the lengthy report, because what we did try to do is answer each of the five questions that was presented to the group in more detail. The PowerPoint just tries to get the sort of one-paragraph summary for folks to see.

Yeah. And the report -- if you remember from August, the report was nearly finished in August, so it supported -- we just felt like it wasn't ready for prime time, and we did do some additional work on it after August.

Yes. So here's the slide. So there's our members that participated. I just wanted to express, at least for me, and I'm sure Charlotte agrees with me, the appreciation for our group, because we had five

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questions, and what we did is we delegated to members of the group to draft answers to the questions. So, if folks have more detailed questions about some of the responses, we may point you to the people that actually drafted the answers to those questions. So, if you can go to the next slide then.

Like I said, we had the five questions. We did answers for each of the questions, and that's in a more detailed report that's also included in your materials here, and we have four recommendations that came out of those responses to those questions. The way we're going to handle this is I'm going to try and sort of quickly walk through the questions and the high-level summary of the responses, and then I'll kick it to Charlotte, and she'll go through the recommendations, the goals to have more discussion about the recommendations, and then the questions and responses if we can. And, frankly, I think wait to the end for herb's questions as well for the whole thing, and it will go quickly.

So, really, question number one was what the subcommittees charter was all about, which is what are the key characteristics. And we really found out that propagation and coverage, capacity, continuity, international harmonization/scale, and incumbency issues are sort of the big five issues, if you will, and I think we had general agreement across industry groups that those were the five issues. What we could not give an absolute answer to were some of the things Paige asked for, which is how do you prioritize those, and, frankly even among same industries, it's hard to do that, depending on the use case. So, really, what we wanted to provide back is it is very highly dependent on the use case and on the industry and what you're trying to do in terms of how you prioritize those five things. But there was agreement that these are the five things to look at when you're trying to look at the key characteristics.

Second one is a little bit more of an eye chart up there, but really about talking about contiguous versus noncontiguous spectrum, and rather than going through all that answer there, I'll just say this, that there's a strong desire to have contiguous spectrum. There are technologies that allow you to use noncontiguous spectrum. But, in reality, if you can have contiguous spectrum, that would be a much better, greater use for folks to actually get better use and efficiency out of the spectrum, and that particular response has an appendix, and there's a lot of sort of back-and-forth discussion of beta 211-type technologies, satellite technologies, and LTE-type technologies.

So, on to question three, which is really when we're talking ability low, medium, and high, what do we mean, and frequencies, and that's everybody who is a spectrum geek, like some of us on this committee, knows that that depends on what they were talking about low, medium, and high. And our friends at the FCC have set a new bar for what mid band is. I'm not sure everybody on our side of the table agrees what mid band is or isn't. So, really, the response to this question is that it depends on the eyes of the beholder, and it's subject to change and its dynamic, and it also depends on the industry to some extent. So, that's sort of the quick answer to question three.

And on to question four, which is, you know, channel bandwidth as a function of that sort of low, medium, and high, and, really, our response to that is channel bandwidth is not going to depend on what frequency band is. Channel bandwidth is actually a physics problem. So whatever bandwidth you have really dictates what your capability is going to be on the application side.

Onto the last one, Larry. And then the last one was really about maximizing the potential for sharing between federal and nonfederal and how to get more common technologies to help that sharing. And, really, we kind of listed, again, an eye chart. Apologize for sort of the five key different things that we had in response to that, in terms of how you develop trust, how do you get information sharing, how do you support deconfliction if you're both trying to use the same asset and that sort of thing. So, again, if folks want to see more details, that part of the response is very detailed, and there's a lot of information in terms of issues you have to think about when you're looking at spectrum sharing. And with that, I think I'm going to kick it to Charlotte, because I believe we're now up to the actual recommendations that came out of the Q&A.

So I feel like we -- I'm not sure how well we did our job. We had far fewer recommendations than we did in our five-team committee.

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We didn't try really hard. I'm sorry.

We only have four, and, in fact, three of these are exactly what we presented in August. But happy to go back through them. The fourth is the only new recommendation that we had. And the first is fairly obvious. What we recommended is that NTIA actually look at the five key characteristics when it is evaluating bands and look at the five characteristics that we identified in our report. And, you know, again, just noting that the relative priority really does differ from industry to industry. I mean it becomes quite obvious when you're -- you know, Jennifer and Audrey and others were talking about the satellite industry, you know, how important international harmonization is versus it's important in the wireless industry but perhaps a little less so. It's also important in the license industry. I'm looking over to Mary, because the three of us actually worked on the second part of the question, and those issues all permeate. But it was really impossible for us to give anything other than a recommendation that you look at all these five.

And then, to the extent that it does come up, when you're looking at key characteristics and you know, you know, which industry or where, you know, what you're actually trying to accomplish in terms of making available spectrum, you know, then you might be able to look at those. And that actually leads into recommendation four, which I'll get to in a minute. But we did make a recommendation based on that particular issue.

The second recommendation really talks about contiguity of spectrum and the -- you know, in this age where we're all talking about aggregating different bands and being able to do carrier aggregation in ways that allow us to create larger bandwidths out of multiple different bands. What we did -- and, again, this is was the group that I was alluding to earlier, that Jennifer, Mary, and I actually looked at through, you know, going back to our different industries and looked at the issue of continuity. And we were relatively -- it was interesting, because a lot of the answers were very similar, and, you know, Tom went through those a minute ago.

But our end result and recommendation from the subcommittee is that it is very important, and it would actually be good even to be looking at, if you're looking at key characteristics for commercial spectrum, that you investigate where it may even be contiguous to existing commercial spectrum. So that was the second recommendation. As I said, you know, it was one we gave to you in August.

And then the third recommendation is that you not rigidly define bands. Although what we did provide in the report is just, you know, a framework of sorts, we where we kind of looked at, you know, where you might actually consider what's low, medium, and high in this day and age. But that will change as those of us who have been around for a few years know that that, you know, as I've said before, you know, I think high band, we've all talked about millimeter wave as being a hide band, but, you know, mid band went from being around, you know, two gigahertz, to now it, you know, depends. It could be -- yeah, it could be all the way up to 24 gigahertz.

And we talked about this last time, just to remind people; is that when you that I can a mid-band that goes from -- you know, in the commission's case from 3.7, we actually put it a little bit higher at 6 gig hertz, which is something what consistent with ITU as well. You know, 6 gigahertz to 24 gigahertz, a huge difference in what you not only see in terms of incumbency there, but obviously in all the propagation characteristics and other things. So it's, you know, useful, probably, for you to have it as you're thinking about it, but also, be prepared to have a change. So that's our recommendation, is don't be rigid, so.

And, again, now on to the fourth recommendation, which is really a recommendation to direct us to do additional work, which is to develop a methodology or rubric framework to identify federal bands for potential commercial federal sharing, and it would involve, you know, primarily probably the first recommendation, just in terms of the characteristics that we identified here, but to kind of help go further into that. And I know that a couple of folks on the committee, we had sort of talked about it a little bit offline might -- on the subcommittee itself might actually have some thoughts on that last one, but just sort of further conversation, but basically that's it.

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As I said, the only new one is recommendation four. You've seen the other three before, and just leave it open to the full committee and maybe I don't know whether any members of the subcommittee -- Carolyn, I know you had some comments. I don't know if you wanted to mention them now.

You want to go ahead, Carolyn.

So just one comment, kind of a broader picture with regard to the scope of the question, and also recommendation number four, is just to keep in mind, this is just one part of the problem. There's also -- you know, consider partnering and leveraging federal user inputs to get their insight into how the bands are used by the federal user to be able to assess compatibility for federal/nonfederal sharing. So just to keep in mind that part of the picture.

Yeah. And we agree with that. I think, actually, this fourth recommendation sort of dovetails nicely with what the 5G group was talking about as well. And, frankly, to Paige's earlier comments, talking about AWS-3, in our mind, recommendation four is sort of building on the AWS-3 type of collaboration. The idea would not be to have just the folks from CSMAC thinking about this but to have actual interested stakeholders from the federal side engaged to talk about what we'd have to do on particular bands in terms to actually encourage and have sharing habit.

Okay. Thank you. Any other -- Anna was up first.

I guess I'd make two observations. [Inaudible].

Hang on. Can you turn on your mic.

So, recommendation one, you know, with all the good work that went into it and I appreciate it, it's largely common sense. We've always known this; right? It's nice to wider band rather than narrow band. It's nice to have contiguous. I think that kind of brings us to the second question. We live in the real world where spectrum is congested and contested, so that's great. We should always go back to those rubrics. But I think it somehow -- if there's any implication that people haven't always been considering this, and working hard to try to make it happen, but the reality hits, I think that implication is incorrect, which kind of gets me to jump to recommendation four.

As someone who's lived in both worlds, commercial and federal, it's, again, a little bit naïve to suggest one studies these federal bands and comes up with clear-cut answers, because those of us who've been dealing with this see the domino effect. It's everywhere. You know, you move a federal user somewhere else, and that implies that, you know, some need to adjust in that band, which then take it to the next band. And there are serious attempts to develop very sophisticated, you know, computer-based technology that enables you to address some of that domino effect, but in real-time, you know, it's always changing. So I just kind of put those two observations out there, because if there's any implication here that, you know, this isn't already happening, it's misguided.

And the other observation I would make is to repeat what I said out in Boulder. We live in a very, very dangerous world, and our adversaries, unconventional, as well as conventional, are very, very clever at using commercial bands as attack modalities. We see that, and using very sophisticated possible new satellite constellations, et cetera, et cetera. So, again, I think these are good recommendations. It's not really necessarily easy to translate them into the real world, where we have to, on behalf of the security apparatus of the country, realize a lot of our systems probably ought to be hiding in plain sight. So just kind of a bit of a reality check. There's nothing wrong with these recommendations, but that's just kind of a step one.

Do you guys want to comment on the comment?

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I mean, we certainly didn't have any implication about people not doing this already. It was just trying to be responsive to the question.

Right.

Which is, what are we looking at for key characteristics? And certainly not saying this isn't exactly what everybody's doing. However, that's just sort of where the group came out on a consensus of what the issues were and how we should look at it. And in terms of sort of the recommendation four, again, I don't think the goal was to try and create something that was rigid, just to steal from recommendation three. I think the idea is we need to start at least talking about it. I mean, we're having great conversations at 3.5. We had a great success at 3WS-3. We should continue to try and work through that in other bands and other places, and it's not going to be a one-size-fit all, so I do agree with that. And if you have some recommendations that we have to change that to make it clear that it's not a one-size-fit all, but that it's very going to be very deterministic and, frankly, the 5G folks talked about it a lot, and I agree with that, which is it's going to be very specific to whatever is happening in either adjacent band on the same band to actually create these rubrics. You can't just sort of have a black and white, this is how we do sharing for everybody and everywhere.

I think those are --

Go ahead, Janice.

Those are very fair points, and I didn't mean to suggest there was anything misguided about these recommendations. But when you look at four, "recommends that NIT consider directing CSMAC to develop a methodology to identify federal bands for potential sharing." That's a very high-level recommendation. When you get one step down and into the domino effect, at least it needs to be somewhat intimated. I mean, AWS-3, there's a classic example. You know, you recommend moving something. Well, you know, now AWS-3 is being very actively pursuing, you know, going a little bit higher up in the band that was supposed to be a no-fly zone, you know, five years ago. So the domino effect is real, and at least sort of hitting that is a reality check, I think should be done.

Okay. Thanks, Janice. The order I saw of these were Bob, Paul, and then Jennifer.

Can I actually -- yeah, as co-chair, the one thing that I wanted to say is, while I, you know, hear everything you're saying Janice, and think there is nobody in this room who doesn't deal, on a daily basis, with the reality of these things, I do think that even though we all know all these things, it's actually good to have, as a group, come to a conclusion that several different industries look at the same things, and, you know, I'm not suggesting that we couldn't have all figured that out some other ways, but it's, in my view, this is actually not a bad thing to have, you know, before NTIA, you know, completely acknowledging that this is not an easy thing to do; that this will, you know, this will require all the types of things that you talked about. But, you know, again, as Tom said, we were answering the question, and I actually think, to me, it was instructive. You know, working with several of my colleagues, and then, you know, hearing what I actually thought I already knew, but that we all look at this in very similar ways. We just sort of balance it slightly differently. And to me that was an interesting outcome of this.

Okay. Thanks. Bob.

I'd like to commend the work of the subcommittee. And following on to Janice's initial remark, recommendations one and two, they may be common sense, but I think writing them down gives great clarity to that common sense, and I think those two recommendations probably do have, and will continue to have, some good shelf life.

Recommendation four, I guess I could say a lot, but I could just summarize by saying the devil's in the details there. I wanted to talk a little bit about the response to question five. Information sharing among users has -- federal and non-federal users has proven to be a critical and potentially substantial obstacle

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to sharing. I could give some examples, but I'm sure everybody in the room has some. I think Mark mentioned in his subcommittee report that each sharing situation is unique and needs to be studied with specificity. So I guess I would have appreciated an additional sub-bullet in the response section that information sharing is a key component to facilitate trust between operators and users. That's all I had. Thank you.

You guys want to comment?

No.

Can you make the bullet he suggested?

I mean, that would just be a change to the report. It wouldn't be a change to recommendation. You're not suggesting a change to the recommendation.

No.

Yeah, I think we could do that. I don't think it affects anything.

All right. Paul. Nice to see you here, Paul.

Hey, I made it. Traffic's good. I made it. First of all, thanks for the presentation. And I know you've already stated, Charlotte, when you were presenting for the recommendations, that, yes, you guys didn't get to trying to rate the different areas of characteristics that you should look for for a new band, and how you all worked together across the different groups. But I want to challenge you in a little different way and see what your committee might think; okay?

There's been technological changes, and so you make -- sometimes the statement is made a little bit broadly. It's always more efficient if I'm broader band; okay? And so there's always a trade space that goes on, and we all know that, so it's not like it's anything new. But it would have been interesting to state like we're seeing roughly this much of an overhead, so this is the kind of gain you might get because of the experience of the organization of the committee member, if they could have actually brought a little bit, because that actually would allow and help other people to say, well if I give you 20 percent more spectrum, but it's not contiguous, is that better than giving you 20 percent less and making it bigger. Not making the decision from the group but maybe giving us a little bit of a hint.

Well, and, also, if you give spectrum that is close -- not contiguous but closer in proximity --

Right. So the frequency, the filters would --

You know, multiple bands versus a couple of bands.

Right.

I mean, I think there are a lot of things that would go into that, which I think is somewhat reflected in the appendix. But we didn't put percentages on it. We didn't say, you know, this will give you a 20 percent gain, because I'm not sure, you know, in conversations I've had at least internally.

Because the only reason I bring it up, and we've all lived this. I mean, this is like preaching to the choir by the way. But it's 20 years ago -- 10 years ago, we said, oh, band aggregation, what's that. And so you have to have a contiguous because there's no way you can get instantaneous, you know, capabilities up to a certain point. But now we do band aggregation. And then what's the trade space between instantaneous capacity, okay, versus overall capacity? Those kind of things, I think, are really important for when the government is trying to figure out what bands to try to shift around and alike. And I just think

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that with the experience level between, you know, the different groups in your committee, I don't know if -- if it's in appendix, then I apologize. I haven't read it; okay? And I'll now go take a look at it.

Yeah, we did make -- we did go into our engineering teams, on behalf of LTE 802.11 and satellite, and asked them to make a series of declarative statements about the benefits of larger channels, and also the reduction in engineering complexity associated with contiguous versus noncontiguous. And in the appendix, you see those declarative statements that we pulled out of our engineering teams. The statements that you are seeking may not be there. These are not considered to be, by me or, I think, any of my authors, to be the complete universe of statements you can make about these problems from an engineering perspective, but they were intended to be representative. So, we did make a stab, within the timeframe that we had, to try to get to very specific statements from the three different technology groups about those two issues, benefits of larger channels, production, and engineering complexity.

So, would you think, as a committee, would it be a good -- do you think it would be a good recommendation to actually ask to go back at a CSMAC just to look at those categories sometime in the future and ask a question, how do you quantify some of those pieces, parts, so that you can actually build on that for, I guess, some of your recommendation number four in a sense? If you can't do that, when you get to recommendation four, it gets kind of difficult.

Yeah, Paul, there's probably more work that could be done in this area.

Okay. Good.

And I think, in particular, you bring up an interesting point, is, you know, I am sure that internally when we look at these things, we do exactly the kind of analysis you're talking about, because that is -- you know, it's a cost benefit analysis. So, but I would actually not want to add it to, you know, this particular recommendation and have it be, as you suggested, future work. I think we'd all like to be able to close this one down today, so.

[Inaudible].

Yeah.

But you should look at attending sites of qualitative.

Okay. [Inaudible]. I'm very quantum.

[Inaudible] then Larry.

Thank you. A little late on her offer for comment. But I think in recommendation four, and even throughout, one of the things that's lost, that's clearer and was in what Charlotte said was that this reflects multiple technologies. This is not as in, like, the prior question response just about wireless technology. So I think that that's lost in, actually, how it's up there, because we're so used to everybody, quite honestly, being about 5G and wireless, that we're not reading wireless, satellite, et cetera -- broadcast, sorry, unlicensed, you know, being incorporated there. And I don't know if that, for purposes of everybody here, needs to be reflected there, or just understanding that the report itself embodies that, so I just wanted to emphasize that. And then I do, of course, agree with a point that Janice made, which is there's always go to need to be that national security lens and implications. And, you know, the hiding in plain sight bit, you know, I agree completely with what Janice said on that. So, thank you.

Okay. Larry.

Yeah, first of all, I thought very good recommendations. Kind of responding to Janice's point, the five characteristics, what's interesting, we got the best minds together. We couldn't come up with a sixth;

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right? That's interesting; right. I think that's an interesting thing. So, my comment actually doesn't really apply to the recommendation. I am very support of [inaudible].

I did have a question about number four. I did read the report and I apologize if I probably should have probably brought this up earlier, is you say the channel band with this kind of independent of the high, medium, and low. I think technically there are some issues around that. It's very hard. There's something called your fractional bandwidth. It's very hard to build a 1 gigahertz receiver at 1 gigahertz of bandwidth, where you can build a 1 gigahertz receiver at 90 gigahertz. So I just want to make sure we're saying something that's incorrect.

No.

No.

No.

Absolutely not. And Dennis and Paul worked on this, and there's some good detail in terms of talking about the differences in each of the bands, and sort of breaking it down by band, even though we have a blanket statement that says channel bandwidth and channel bandwidth, channel steering, and all that. But, at the end of the day, when you look at what Dennis and Paul put together, it's more much more detailed and nuanced.

It's just a summary.

Exactly. Exactly. A choice of summaries.

And we're not voting on the summary.

Yes. We have two more. Is that Audrey or Kurt? Audrey? Okay.

Thank you very much. My point only goes to something that's in response to question four in the report. It doesn't impact the recommendations. So, would you like me to hold my question?

Yeah. Actually, in the interest of time, can you go wait and just communicate directly to the chair.

Okay. I know we're already tweaking the report for another issue, so this is another tweak.

Okay.

Okay. Thank you.

Dale, turn your -- there you go.

Just another hot button of mine, of course, is the jamming issue, and it's not clear to me. And we just saw what Amazon, the door unlocking thing for your house, where they can deliver and unlock your door. And it turns out there is a jamming issue apparently. And what scares me is some of these things, where you're saying let's put all things close together may make it easier for the jammer. Now this is an area where I don't have any expertise in term of what the military is doing and so forth. But I didn't see resilience in here mentioned as much as I would like to see. In other words, how do these recommendations impact? Is there a tradeoff here -- certain tradeoffs that would impact resilience or robustness?

Any thoughts on that or --

You know, I have to admit, Dale, that I don't think folks raised resilience in terms of looking at key characteristics because I think folks were more focused on what are the sort of characteristics for use, not characteristics for people to stop my use, to put it sort of bluntly. And I think that's not a bad thing to sort of add in, in terms of discussion, but it's not something that we talked about in the subcommittee.

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Okay, I'll make one comment and pass it to Paige and you. The thing I think is good about the report is, while Janice might say, you know, duh, and I agree --

Encapsulated [inaudible].

She did it in a very kind way. I think it's a really good description of why those are key characteristics. And it's good to see written down in recommendations. I mean, to the extent that we can use this as a touchpoint for rule-making or anything else going forward, it's really good to have because it explains why these are what they are. So, you know.

Just a very quick comment. So, going back to the genesis of this question, it was wrapped around -- you know, I've mentioned our interagency process; part of that is we have our own group work that we're using to assess and prioritize bands, largely also addressing the national security issues, the [inaudible]. And so the intent of this particular topic was really to help feed that process so we could refine it over time. So, I just wanted to make sure folks didn't think that we were void and you should come up with something new, because really, to give us pieces so we could enhance and refine our rubric as we move forward.

Thanks, Paige. Okay, could I get a motion? Can I get an amen? No. Can I get a motion? Mariam and -- Miriam can make the motion. Paul can make the second. And the motion is to approve the report as presented. Any further comment? With some tweaks, yes. The recommendations with some tweaks. Thanks. This is [inaudible]. Okay, all in favor of approving the recommendations as presented, say aye.

Aye.

Any opposed? And any abstentions? Okay, we're batting a thousand. Thank you. Okay, next one is enforcement, and I think that is Mark and Paul.

Thank you.

Mark Crosby and Paul.

I'll start, then I'm going to turn it over to my wingman. Thank you for showing up today.

I was going to come a little later, but I did catch up.

I was getting a little nervous, where the hell are you; right? And he responded, he said he's in an Uber at 395 -- on 395, "I'm on my way." I go, "Good."

Good ahead and get started Mark.

All right. Listen, we were told obviously to put on the slide all the recommendations. And I looked at this and said if I did that, we'll have 45 slides and you won't be able to read it. So, we condensed it and kept the recommendations in the slide at a high level. There's a lot of detail obviously in the report. And so -- and actually this report is an absolute group effort. Everybody contributed. The names are on that one slide, of the participants, but I'd like to highlight Bob Weller did a lot with addendum one and taught me how to do contents on Word. That was really good. And Rick Reaser, who did the enforcement cycle, was great, and helped with the questions for the SAS; that was very significant. Of course, Dale, who always sort of keeps you straight going, these are the questions we need to answer for us to keep going. So, those are pretty much in recommendation five. So, it was all good.

We didn't really start with looking at the questions and go, okay, this group, you take this question, you take this question, because I think we sort of looked at it and go, "What do we know today and what don't we know," because I think we had to look at that before we could provide meaningful recommendations

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back to CSMAC and NTIA. There was some discussion about a kill switch. I'm sorry, Mark, it didn't make it in there, but there was great discussions on a kill switch, who can use it and, you know, when and under what circumstances. And I think maybe we'll talk about that at a -- in the future. But this is -- since it is a very collaborative effort, when there's questions, I would absolutely welcome obviously the subcommittee members of the thing to weigh in and help us, you know, respond to those questions. So, and thank you for the NTIA advisors who always, at the very propitious moment, I would get an email, "Have you thought about?" And I'd go, "No, but I guess I better." And so it was always excellent. So, thank you very much. And now I'll turn it over to Paul for --

Oh, okay, I get the content part.

You get the content part, yeah. Yeah.

[Inaudible].

Excuse me?

[Inaudible].

Yeah, finding slide.

Finding slide.

And the question -- well, I probably should have said why we didn't answer some of those questions.

Yeah, we didn't answer -- yeah, what we did there in that first slide was actually indicate, of all the different things, some of the things that we didn't actually get to with the shortened schedule, but we tried to highlight what we actually accomplished. This is a brief version of the findings slide. I'll kind of walk through a little bit of these findings. The findings, I actually tried to bring you a backdrop of why we had the recommendations that we had.

The first one, in a brief way of saying, is that most companies, you know, hire consultants to go out there and try to find and identify interference, and the reason that's made a comment like that is because it's a complicated process, and so it's just not a very simple thing that you can go and determine these things. A lot of groups do not have the resources to be able to do this, and so they have to go out and hire individuals who are experts in the area to do interference hunting and actually try to do some localization and the like. So, that kind of leaves you a backdrop that we'll get a little later as to this whole process of doing enforcement and understanding and characterizing the environment actually has gotten a couple of us, like Mark and I, employed for a long time, but it's a hard problem. It's not something that you just simply just go off and do in a moment's notice. And so the idea is that -- is at least to understand that [inaudible] I think the entire group was very much on board on that.

The second one is that when you're looking at interference, or at least looking at types of interference for doing automated enforcement, what you actually see, it breaks down into three basic categories, and those basic categories actually impact you and how you can actually automate any kind of -- an enforcement mechanism. One of those is an intra system, where the system itself is interfering with itself. And so, therefore, it's sort of like an ecosystem contained to itself, and the question is who's actually responsible for that, how is that actually being developed, and alike.

The second aspect is proximate, which is a very, very short range, and maybe only a single device interfering with something else. That's actually -- interference hunters have to worry about that a lot when somebody complains that they're having interference here and they have to find out, like, is it everywhere or is it just there, how do we get access to that location, where it is, you know, and how do I actually determine all -- basically more of that is access as to one of the limitations associated with proximate. And, therefore, one of the things we say is, for example, the exquisite sensitivity, like tower top antennas

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with low noise amplifiers, often means that interference, a lot of times, is not visible to external users, and so, therefore, even though that person is being interfered with, you may not be able to hear it yourself because you don't know the system.

And then the last one, which is actually one of the easier ones to try to do, because it's usually strong, is widespread interference. You have a lot of cases that are going on, a lot of issues. You can actually have a lot of evidence associated with that and actually try to work with it. So, that's actually one of the areas actually saying that it breaks down. It's not just simply one type of problem, it's actually multiple problems that you have to deal with.

The third finding was that everything that's automated at the present time for making measurements and trying to do characterization and trying to figure out actions have been very primitive up to date. I mean, you're seeing things that actually are in a variety of industries. The Wi-Fi industry actually has a variety of techniques that they use. The cellular industry also has some techniques, but it's generally limited to the waveforms that they're working with. And they're hoping that they're actually going to see some characteristics associated with those waveforms. Well, if somebody's using another waveform to do the interference, it gets very difficult. Now you don't have that match filter that's built into your detection system to go off and try to find the source of interference. And so, therefore, the automated systems would have to be much more complex, they have to be able to handle all types of interference, not just signal energy but actually the waveforms themselves and trying to actually get that kind of sensitivity.

The third is that 5G is both -- in two ways, is providing an opportunity, meaning there's lots of bandwidth, theoretically, around to try to pass information around, but it's also creating a huge number of complexities that would have to be addressed in any automated system. So, if you want to use it just for saying, "Hey, 5G's around, I want to be able to pass information around about interference cases and be able to collect together," yes, there's advantage there. But a big disadvantage is it's going to be very much localized, there's going to be a lot of directionality associated with it, there are multi-antenna systems that are out there that are going to make it very difficult to determine where it's coming from or even to be able to pick up some sources of interference. I could be interfered with and Mariam right next to me would not be interfered with just because of the way the multi-antennas system is actually operating, and so then how is she going to actually help me to determine who's doing the interference to me. And so that actually creates a lot more complexities.

And -- but another finding, which was kind of interesting and comes a little back to where we didn't get to the kill switch, but it actually says that modern spectrum systems use multiple bands in general; okay? There are still places that are single band, but for a lot of systems there are multi-band systems, which gives you the opportunity to think about a little bit more -- look at different mechanisms to actually go after stopping the interference. When you only have one band and you want to say that band is interfering with me, then if you actually do something to tell them to stop their services or whatever, that has an impact to their entire service. If that's only a fraction of their entire service, then you may have other opportunities than what you do automated enforcement. And so, therefore, it's sort of like a risk-benefit, how risky or how much information do you need to know to be able to do something should actually depend upon what the impact of you being wrong in that enforcement mechanism. So, that's actually what those findings mean. So, now I'll move on to the recommendations. And there's a lot more detail in the report.

The recommendation, the first one is that, as we all probably know here quite well, it's not a panacea. Right now, automated enforcement is not here right now. It's going to be manual for a long time just because the technology to be able to keep pace with all the changes and the characteristics of the waveforms or in the environments is such that we may be able to automate some pieces but to get the whole picture is going to be very difficult for all bands; okay?

And so the idea is we encourage NTIA to basically to establish capabilities and processes of piece parts, okay, that may be able to be pulled together for an automated system. Don't think you're going to pull together an automated system from the get-go. Maybe what you want to do is if you look at how to detect or how to characterize interference sources or how to localize those interference sources, or how to

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actually look at the impact of actions. That would be a good starting point to actually build upon to build an entire system in the future. So, what I'm trying to say is even though it's not a panacea doesn't mean you should sit and do nothing. You should be starting some pieces parts, and then we can build on those later, because it's going to take a while.

We actually included three recommendations for NTIA in the details.

Yeah. The second recommendation is that -- go to that -- is obviously, if you want to do automated enforcement, you're going to have to come up with some kind of -- not using a standards group but a "standard," in quotes in a sense, for interference detection, classification, logging, report generation, because that's how it's only to get out there and be able to be used is when people actually have the same kind of mechanisms. It could be done with XML in the sense that you have a little bit of flexibility. It doesn't have to be this is how the report should be done or this is how everything should be done. It should have -- I can have some flexibility but you're going to have to come up with some kind of standardization, especially in a sense of what do you mean by interference detection. It somebody detects something that's considered interference, what information are they going to provide, how much information are they going to provide, you know, what kind of calibration are they going to use in a sense to provide that stuff.

And so -- and a subcategory to that is to do that you should base -- one of our strong recommendations right off the bat was you should develop a machine-readable report for interference detection, because once we can start -- this is those baby steps that we're talking about. If you can start at least having a machine-readable report, then you can start bringing more people involved and they can start looking at those reports and looking at techniques and whatever to use that. That's, like, the first step. If you can't even say what it is and report on it, you'll have a tough time to actually enforce it afterwards. So, that's our -- a very, very strong recommendation that we had, which is to look for that machine-readable report.

The third is there's been a -- as we said in our findings, there's a lot of interference hunters and people that are high on the outside to look for interferers and trying to locate them and characterize them alike. They have a lot of lessons learned. There's a huge group out there that should be, in some sense, leveraged so that you're not building your capabilities and your understanding on how to -- some of the tricks of the trade, okay, or engineering best practices in the sense of doing interference, hunting and interference, localization and alike. And so the FCC has looked at some of this before in certain cases, I'm going to give you a couple examples of those. We're looking at NTIA is that what you want to probably do is find a mechanism in which you can somehow codify those reports that have been out there and saying here's how some people have done this before, and that will actually help others who do not have the resources to be able to look at, okay, number one, what are the best practices that have been done out there, how did these people find these things before, and they can leverage that knowledge base, and even that knowledge base then could be leveraged eventually in an automated enforcement mechanism.

And the last -- I mean, the last -- and the second half of this recommendation is, if you were going to do this enforcement, who is going to pay for the enforcement activity? And so we made a suggestion -- a recommendation that, hey, should investigate -- you know, if you have an automated enforcement, is that going to be the users who are going to be -- the license-holders are going to be the ones, or is it going to be the agencies who are sharing going to be doing, is it going to be both of them, is it going to be the government who's providing this, is it going to be a third party.

Carriers. Carriers.

Carriers? So, who are the groups that should be paying for this? And that was -- we just kind of kicked that around, like, you know, we're not going to even try to figure out that problem. That's --

No, but it's a very critical question, and not going to happen unless there's funds devoted to it.

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Yeah. Recommendation four is we came up with, in a sense, and this should be no surprise, and Rick was actually very helpful in pulling this together. In some sense, it's almost like the old -- if you go on the DOD folks and the old military folks, it's the OODA loop, which is equivalent to a detection categorization, how to act and how to report. So, those kind of actions, okay, are the enforcement processing stages. And what we should do is analyze those and look at what the best cost-benefit is and which stages to try to go after first, meaning if everybody knows what they need to do and it's the act is the biggest bang for their buck, or is it better to try to build a detection system up there first as you're automated. So, we talked about the having to do it in pieces parts. Now this is actually asking the question look at the cost-benefit ratio and ask the question where can you get the best benefit for the system.

And of those different categories that we talked about, localized interference, global interference, you know, or intra-system interference, that's something we should be taking a look at. And doing that will actually bring up an ability to actually understand what kind of architecture should be looked at for shared spectrum bands, and that should be something that needs to be investigated, in a sense of an architecture. We were talking about trying to put an architecture together, and it's like, well, there's too many moving parts. Until you've actually figured out what the cost-benefit ratio is, that actually will tell you what architecture you want. This is too difficult to say you're going to build a generic one from the group up, from the first step.

Finally, recommendation five is there's some -- every time you do enforcement, every single time that any group, at the FCC, NTIA, carriers, users alike, they come up with almost exactly the same questions that we're going to have to address if you're going to do any kind of enforcement mechanisms in the automated enforcement. How are you defining interference; okay? What are you going to do once you've detected it? How are you handling it; okay? How do you deal with externally-generated interference that differ from unintentional interference; okay? Are you going to handle those two things differently? Are you going to handle them always the same way?

And then what is the chain of custody issues, in a sense, of interference, who is handing off to whom, what information, how is that going to be protected in case there's, you know, a [indiscernible] operational capabilities and the like? How do you actually have that chain of custody of the information? It's almost like -- I mean, remember, enforcement is just like a police action; right? It's a chain of custody. And how are you actually going to encapsulate that and maintain it? And so that's what we kind of came as a group. I think I leave it up to the rest of the group. If anybody else have some comments along on the subcommittee.

Go for it, Rick. You're first. And then Mark.

I just have one little -- I should have made this editorial during -- when we were in the process, but I wanted to clarify that that's really the Mark E. Crosby Memorial Kill Switch, so.

Moving right along, Mark.

Mike, Mark.

So, the value of the kill switch is mostly is a pause switch to detect who is causing what, and to detect and localize it. In the footnotes on page six, it doesn't make that distinction. So, I propose we add some more value for the kill switch or the pause switch to detect localized --

That's the Mark A. Mc --

I'll take over.

Yeah, Memorial Pause Switch.

Just a question, you know, the term "kill" is pretty intense.

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Yeah, I think it's the wrong name for it. "Pause."

"Stop buzzer," does that mean the same to you all?

[Indiscernible].

Okay.

[Inaudible].

It does. It does. It does. I mean, it goes into robotics as well, but okay. Mike.

We'll share.

Okay. I have one.

[Inaudible].

Just, yeah, a question. I thought the addendum two with questions for SAS administrators regarding automated enforcement is extremely helpful. This seems like a very valuable part of your report, but a question is if all of these questions that you highlight were taken into account by NTIA with FCC, for example, would that take care -- would that then turn the SAS into a complete system for automated enforcement, or is the value of the SAS primarily preemptive and then you would still need, you know, additional measures?

So, part of that is to think about whether, when we have database management, does that double as a complete enforcement system potentially?

I don't know if we can answer it with a high degree of specificity. However, it's a good start. I -- Rick and a couple others in the committee came up with these questions, and they were, like, really key, I thought, to taking our subcommittee to the next level, because SAS is going to have, I think, a huge role in automated enforcement in the future, but I -- you know, we discovered -- I had some great conversations with several, three actually, and they're very eager to get to these answers, but they're -- it's not the time yet; right? So, that's why I said they're so critical, let's make sure we have them as an addendum because I think that's, like, another level we have to get to some -- maybe not all of them, but there's very critical questions, and I think then I think it helps answer your question.

I want to add one other thing. In AWS-3, there's also the RFIMS, Interference Monitoring System, that they're trying to develop also there, and that's another possibility of a feedback mechanism, you know, that could be used for a -- it's both a feedback mechanism but it could be considered an enforcement tool.

I'll make a comment as a [inaudible]. I see Kurt's tent up there. There needs to be a bright line, I think, between what SASs do and what constitutes actual FCC enforcement. And we talked a little bit about this, because I think I helped with these questions, and I'll just leave that at that. And I think, you know, this may be subject of future work. I'd be interested in seeing how that comes together, but, I mean, SASs obviously don't have the wherewithal and we're not collecting data sufficient for evidentiary proceedings, and you guys made that mention. So, nor do we really want to get into that realm, I think, and maybe I don't want to steal Kurt's thunder, so enough said. But, anyway, Jennifer and then Kurt, and then Larry. Any of you.

First of all, I think it's a really good report, and I thought you guys did a great job. I have one observation in this -- perhaps here, no, it's just an observation, is that implicit perhaps in all these questions, which are really good questions, are there are also going to be scenarios where interference to particular federal agency systems will not be reported for a variety of reasons, and that can't be discounted as they're not

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being interference, and that's beyond, you know, sensitivity for public information. There's other reasons for that; right? So, I think somehow implicit in all this, there needs to be that layer understood, and that's all I wanted to say.

That's great feedback.

It's great -- and it's also -- but they have that problem even today, even without any sharing or anything.

Absolutely, it's just enhanced.

Kurt.

Yeah, thanks, Mark, and thanks to the subcommittee for its contribution. I would just like to underscore the point that Mark made with regard to enforcement and the need for a very bright line between what, you know, a SpectraMax system or similar database technologies could do or provide versus, you know, making sure that, you know, authority to conduct enforcement isn't somehow subjugated to those entities. I think one of the things I'd be curious if the subcommittee discussed was, you know, with regard to a SpectraMax system or database technologies, the fact that a closed loop operation, in fact, maybe obviates the need for or reduces the requirements around enforcement, that, you know, having knowledge of uses and the fact that systems actually have to, you know, check in and coordinate with these databases would be potentially an aid to, you know, reduce the potential for, you know, as I said, some of these enforcement incidents.

Thanks, guys. You just nod your head until you agree. Okay.

Yes.

Agree.

Thanks. Larry and then Dale.

Given that you said it's not quite the time for these SAS questions to be responded to, but may be in the future, I was wondering if it's appropriate to actually add that officially as a future recommendation, because I don't see it in your recommendations? That way we don't -- it will appear on the list of -- checklist that the NTIA will --

What do you mean, like a recommendation six would be --

No, just five, add a bullet recommending a -- because you say you have recommendation for future work, calling that out specifically would be merited.

Okay. Thanks, Larry. Dale. Push your -- can you --

As usual, I'm a little slow. I don't understand what you say there's a bright line. I don't quite understand what is meant by a -- I kind of think you want a fuzzy line actually, because you want information coming out of the SAS system that you could combine with information from other sources. So, maybe, just so I understand --

That was my comment, and I'll elaborate. I think, you know, as we get into this realm of automated spectrum management via SAS or something that looks like SAS, there is a necessarily the -- as we talk here about the need for enforcement, I think that -- and, again, this is as a SAS provider, we -- maybe it is a fuzzy line, but I think we need to have some rules engagement with respect to the information the SASs collect and how that can be used for the type of enforcement actions the commission goes up -- goes after that end up in notices of apparent liability. I think it is -- if I'm collecting data from a SAS that's going

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to be used in some sort of a proceeding, there will be a higher standard that's going to be put on the collection of that data, and that's going to incur costs and issues with its uptake.

And so I think -- and we're talking with the commission right now -- well, not right now, obviously, but we're going back and forth with them on how this gets rolled out as to what their thoughts with enforcement are. And so we'll see. You know, stay tuned, I'm sure you'll see it in the press, but that's why I say at least until we understand better that engagement, we need to at least understand what commissions are going to do with the data that the SAS provides and what they can't do with it, and what, you know, what that means. So, that's what I meant by bright line. Does that make sense?

Could I -- could I just add one --

Sure. Sure.

The -- I'm still concerned about this external interference issue, especially when the external interference maybe intermixes through Intermod or something like that with what's happening in the system. The other thing, I think there's a tie here also to the rising noise floor, at least in the lower bands here, that the interference that you're getting may be from a whole aggregate system of sources, and that may be causing your system failure, and that's sort of a different problem, I think, than looking for sort of coherent signals out there. Yeah.

Kurt.

I was just going to add, Dale, to your point. I think the spectrum access systems or database technologies can help improve the accuracy or efficiency by which the information can be, you know, collected, but I don't think it -- you know, I think that's the point about the bright line as well, at least from my perspective, that it doesn't change really the rules and responsibilities of the parties, you know, with regard to the use of that information and, you know, ultimately what the commission or others might do with regard to enforcement.

Go ahead, Nancy.

Well, I wanted to compliment the report. It, I think, advances the ball. We had -- and also comment that we had a prior round on enforcement where we talked about the difference between setting up steps in advance of an event, and then the post-hoc I guess is the term you'd use technically for after-the-event enforcement. So, at risk of seeming overly rigorous, you know, you see cases such as Singapore, where the rules of the game are really clear before anything ever happens. And it then limits the need for enforcement. Now, we don't want to be Singapore, but I do think the idea of retaining -- obtaining data and potentially using it if there's an offense afterwards is a good thing. We're at a very complex environment and the -- there are a limited number of bad actors, but there are some, and you don't want to leave it out there that it's going to be very hard for the FCC or NTIA to make a case, because then you'll never really accomplish what we all want to accomplish, which is a very straight forward and optimally useful system.

Just a very quick comment, again, going back to the genesis of the topic and some of the framework that I hoped to set going in. When I say "enforcement," and maybe that -- part of the problem was using the word "enforcement," I do not -- I was not defining it as strictly the traditional enforcement function. So, it was, going back to the bright line discussion, it's -- there's no bright line. It's mitigating it before it happens as well as resolving it after it happens. So, just a side note in terms of what I had hoped to set as the framework going in.

Okay. Thanks, Paige. One more Dale. Mic.

To come back to the jamming and spoofing issue, too, because that's a major concern in this band and who's responsible for detecting things which are deliberate jamming and spoofing, because certainly you

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need the resources from the system at the same time you're doing other techniques to try to find out where that jamming signal's coming from, for example.

Okay. Dennis.

I'm just going to reinforce the point that is in there because we continue to talk about these things as though they were the same as they were historically, but Paul talked about it and we have a significant section about this, but the technology is changing so radically now that a lot of the methods that we've had historically just don't work, and that's where this really is an important topic for us to address as we go forward because the world is shifting so dramatically with MIMO and moving into millimeter wave and all of the things that are going on, bi-directional and so on, that we -- we really have to look at this in a completely different context than where we historically have been. So, that's just -- it's a reinforcement of the points in the document but it's -- it really is key.

I was -- I was only going to say, I was just looking at a ham receiver that went to six gigahertz now and gives you I and Q output. I mean, that goes -- I mean, that is mindboggling, mindboggling to me to think that you could get the -- today, you and I can get right out of the receiver at those kind of -- which goes to your point, Dennis, that the techniques for enforcement or tools we have are much different as well.

Okay.

That's the point, we don't [inaudible].

Okay, would someone please make a motion to approve the recommendations? Jennifer -- Jennifer. Bob seconds or Bob --

I think there was a recommendation to add to the recommendations, to consider the application of SAS resources to enforcement activities and interference mitigation, as suggested in addendum two.

Recommendation. Okay, so we'll add a recommendation.

[Inaudible].

Okay.

Okay. Thank you. That's the discussion we had. Is there a second? False seconds? Okay, so that's the discussion. We will add a recommendation for future work. All in favor of the report as presented with additional recommendations, say "Aye."

Aye.

Any opposed? Any abstentions? Excellent. Thank you. Okay, good job, guys. Last but not least, Spectrum Efficiency, I see Brian and Jennifer there.

Yes, and we are ready to make up time even.

Wow. That's a promise all right.

Which has now invited all flags to go up.

Exactly.

So, but Brian and I were very lucky to co-chair the subcommittee. We had great NTIA support and very active members. I know there's a lot of movement in the room as we're starting here. Our work was broken into two questions, questions one and two. In the interest of time, I'm not going to read them.

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They're up there. But question one working group was led by Carolyn Kahn, and I want to thank her -- Brian and I both want to thank her. She did a tremendous job. And as punishment for the tremendous job that she did, she'll lead the discussion on this question. And then Brian will lead the discussion on question two. I think you'll see that the only source of recommendations to be adopted here are in the context of question two, and they were reviewed at the last meeting. So, folks should already be quite familiar with them. So, with that, let me turn it over to Carolyn.

Thank you, Jennifer. Okay, so a recap. Much of this was presented with the schedule in Boulder, but what we did for the first question is we broke it into two parts. So, we had our own internal subcommittee discussions, and you -- we met multiple times to bring in all of our knowledge and discuss, but then also on the right-hand column, the outreach. So, we have been doing external -- having external discussions and doing a lot of outreach, and I think both of those components, the internal and the external discussions, have been very productive.

So, on the outreach side, we first interviewed agencies with management and regulatory focus, used the survey of questions that Rick developed, but have evolved that, it's been very much a two-way discussion. And then the responses and information we got from the management and regulatory agencies, we used that to inform our discussions with the agencies who have an implementation focus, who would implement different policy regulatory actions for spectrum efficiency. So, we have interviewed on the implementation side DHS. We've had outreach and are working to schedule discussions with other agencies, including DOD, FAA, NASA, and NOA. Next slide, please.

Based on our discussions, we've made some observations that have been helpful. One is that measurement of spectrum efficiency differs by usage, as we discussed in some of the earlier subcommittee reports is very much case-specific and differs according to how it's used. So, spectrum efficiency, it's multifaceted, you can't really narrow it down with one measure or metric, and all of these complexities need to be recognized and reflected into any kind of policy reform in order to be effective. For instance, going back to a CSMAC recommendation in 2008, looking at definitions of efficiency and spectrum use, CSMAC then identified that it's not possible to establish a uniform metric for spectrum use efficiency because the use of spectrum encompasses such a wide range of services. And so we feel that that recommendation still holds, and so any effective incentive shouldn't be premised on a singular measure.

Then also we looked at technology advancements and how those are contributing to spectrum efficiency, things like environmental sensor networks, decision aids, automation, software-defined radios, advanced signal processing and policy-based spectrum access control features. So, embracing this technology has and will continue to improve the efficiency of spectrum use. Also, for an example, for radars, radars for particular missions have increased, and with requirements, in some cases, to avoid intentional jamming and improved mission effectiveness. So, that's still -- that's an example of an important consideration that needs to be factored in.

Also, the whole spectrum management regime is constrained with how it was originally designed and developed over 100 years ago where agencies and certain assignments had been made previously, and so these are inherent constraints that need to be taken into account. And a lot of these previous -- this design does impact systems and different -- it's very expensive and takes a lot of time to make these changes. So, that needs to be considered as well. So, it's a macra federal and non-federal problem. It needs to be addressed collaboratively and constructively with both federal and non-federal agencies as well as regulators, policymakers, and academia. And all of the dimensions of the problem space should be leveraged, frequency band, also geographic location, directionality, and time. So, lots of different components.

Since it's the considerations that our group is -- has been talking about is looking up this macra federal/non-federal options, and so a one-government concept where all the agencies are brought together collectively to overall use spectrum more efficiently in terms of their systems and their dollars, and also partnering with industry to address this issue. We're considering recommending a roadmap, so

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technology standards, metrics, other implemented cost and schedule to drive towards greater spectrum efficiency relative to individual mission needs, so, again, providing a focus for this movement. And then any kind of policy change should have sufficient resources and staffing so that agencies can properly address it.

We've been considering further expansion to the Spectrum Relocation Fund, the SRF, in particular to cover costs for operations and maintenance that's not currently included in the SRF, and could encourage more cooperation and smarter spectrum efficiency. The SRF is tied to cases where spectrum could be auctioned. So, in other cases where sharing or secondary markets model might be appropriate, so mechanisms for the federal government to share spectrum without giving [inaudible].

So, our recommendations on the next slide is we have, you know, still a lot of calls out where we're in the process of scheduling some additional agency interviews because we want to have a round picture, all of this input before making formal recommendations to CSMAC and NTIA. So, to ensure this well-rounded discussion, we're recommending continuation of our subcommittee's work to gain this additional interview and to gain the additional input from the agencies, including DOD, which we're expecting written input, and the other agencies such as FAA, NOAA, and NASA, and potentially putting together a compendium summary of the inputs that we've been receiving. And then consider focusing another CSMAC working group on economic mechanisms that could be employed to increase spectrum efficiency via sharing options, such as the secondary markets model, to help monetize assets on a non-permanent basis. I'll turn it back over to Brian.

Sure. So, I led task group two, Industry Practices Supporting Government Network Optimization. Here, too, was sort of a compendium approach. We drafted, as a group, 14 questions that we shared with all members of the CSMAC and sent those around. We got six responses from a variety of stakeholders. Those were provided at the August meeting, anonymized as we had agreed before we solicited them. Pulling from those six, we developed the recommendations on slide ten of our deck, investigate -- I think you're two more -- investigate if there are ways to make federal procurement processes more responsive to market-based incentives, to invest in new technologies. This is probably the most substantive and perhaps most surprising one.

[Inaudible].

One more.

Keep going. There you go.

There you go. This is probably the -- I don't want to fall into Janice's trap of everything else being obvious in our slide, but the -- I thought the first one was the most interesting in terms of the role of procurement and figuring out if there was a sense in -- at least from the commercial stakeholder's perspective, that the procurement process really inhibited the ability of federal users to get to more efficient results, and were there ways in which we could -- that could be modified. It's probably beyond the scope of what we know about. It would probably require us to look outside the CSMAC -- okay, way outside the scope of what we know about, but I think it's -- was an important interesting issue, I thought, at least in terms of stakeholder education, because I think there's a real lack of awareness, at least -- or there was going into this, about how the procurement process can be improved. And it's got -- had some overlap with some of the issues that Carolyn talked about, too.

Okay, make extensive use of commercial off-the-shelf equipment where feasible; sunset old technology; consensus-based industry standards wherever possible to get the economies of scale and scope; determine whether compatible missions can be consolidated under one platform; and then closely monitor, which I think has been a theme for us this morning, 3.5, to see what lessons can be learned for that and how that can be expanded to other bands to increase sufficiency. In terms of -- so those are our recommendations on slide ten.

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And then on slide 11, we wondered whether or not there should be a working group that could match up on the federal procurement side, which, once again, may be something that comes out of the work that we are doing on the other task, and then whether or not any of the -- and Paige and other folks have used, whether or not there's anything under our recommendations that would benefit from NTIA learning more about how the commercial side does any of those processes so that they might enhance how they do it, but I think that's got to come from the NTIA side as opposed to our side. With that, did you want to comment?

No, I think -- no, I don't.

You left Jennifer spellbound. That is --

[Inaudible].

I wasn't planning on that hand-back.

Can I ask a question for clarification? So, the recommendations that Carolyn made out of the first task group, are they supposed to be the four recommendations, because I don't get that in the report?

So, the -- if I may, Carolyn, the recommendations that were in question one really are of the same nature as the CSMAC future work for question two. So, ideally, in hindsight, we would have folded them all into CSMAC future work flowing from question one and question two. We didn't structure it that logically. Sorry.

Okay. So, just for clarification when we vote, do you want future work to be a recommendation?

Well, that's a good question. Is that -- we've done that for all the other working groups, correct? Or are we just --

Two of them, yeah.

Yeah. So, I think we should just be pulled in.

So, yes, let us relabel that "recommended CSMAC future work" or "recommendations for CSMAC future work."

Okay. Sounds good. Thank you. Mariam was up first. And I see Rick. So, Mariam, then Rick.

Thank you. Good work. So, well, don't worry, it's a straight-forward comment. I have two, though. So, I'll start with the last one and then if I can come back to the first one. And these recommendations on slide ten, five out of the six make perfect sense and they're great recommendations.

Or, as we call them, "the Janice school," yes.

There you go. Number two looks not only totally out of place to me but also a contradiction to the other five. I mean, if we're "sunsetting" old technology, if we're looking for new ways, how could we recommend making use of commercial off-the-shelf equipment that is primarily used because it's cheap, it's available sooner, or whatever, and there's nothing new, innovative, changing about it?

So, I guess two responses. One is I think it was -- does number two -- well, two responses. One is that the recommendations were derived from things that other people told us. So, it's a bit odd to try to modify them because it wasn't per se an input. But two is I believe what this is designed to get at is, where possible, to use off-the-shelf as opposed to having it be designed for specific government uses, so it's a cost issue and a time-to-market issue. So, I don't think it's designed to suggest that it's always better to

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have commercial off-the-shelf, it's just, where possible, and you can get the same mission-critical use, you should try to do it. So, I --

I think this came in the context of when people still think about LMR.

Yes. Well, it is always the most common use case that they're quick to point out.

Right. I know. It's not very applicable beyond, I think -- not very beyond wireless systems as opposed to some of the other --

Certainly as opposed to radar --

Spectrum-based --

Yes, that's right.

Spectrum-based systems that governments procure, that the government procured. But I think your point's a very good one, but I usually think that that always comes up in the context when people are thinking dated LMR or self-designed wireless networks, why not use commercial off-the-shelf, but I'll leave others of the committee that put them forward -- subcommittee that put them forward to speak to them, if anybody else wants to.

Of course, they're submitted anonymously, so there's that trick, too.

Oh, right.

But if we do modify it to make it more clear about when it's consistent with the mission, Miriam, would that get you there?

You have a point, Steve?

Yeah, I just -- I mean, I don't think that it's necessarily true that commercial off-the-shelf is old and dated; right? I mean, you can buy systems that are new, that are developed by industry and more widely available. So, you know, and I think even with LTE equipment that is more efficient than systems that government uses currently, you know, may be part of that, or as we develop new systems. You know, I don't know that they're mutually exclusive or that it necessarily goes back to just LMR.

Let me ask a clarifying question. I think one of the things that Miriam was asking, and I think you guys said this, is "where possible"?

Yeah, or consistent with the mission I said, yeah.

Where feasible.

Okay. So, if you crafted that a little bit more, because either states sense of use without that qualification, would that make more sense?

Yeah, I mean, first of all, I didn't say old, I said commercial equipment is used because it's cheaper and it's available earlier, primarily. Primarily now. I think, though, if there's some clarification to be made to this, it would be good. Otherwise, if we're just going to generalize and say any commercial off-the-shelf equipment, that -- both for the federal and non-federal side, I'm actually talking about both sides, not necessarily just the commercial side. On the federal side, I mean, I think part of our issue has been that, you know, some of these systems need upgrading and whatever, and commercial off-the-shelf really has been, you know, a challenge to spectrum efficiency use. So, I think if it's caveated on which specific use

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case that you guys found where this makes sense that helps spectrum efficiency, because that's, I thought, the question, that would be good.

Can you guys propose a change to that recommendation in light of her comment?

Sure. "When consistent with the mission and feasible, make extensive use of commercial off-the-shelf" -- excuse me -- "terrestrial wireless equipment," is that what you want me to say?

Well, I was wondering if what we're really talking about is when we have substitutable -- you know, substitutable services. So, when we're talking about a terrestrial wireless use, that's when there's more likely to be some form of advanced or less advanced COTS available. And so when you're looking at substitutable mission -- or substitutable uses, make the most extensive use of COTS equipment. Does that make --

I don't think we should take satellite out.

I'd say -- yeah, I'd say if you definitely specifically say for "terrestrial" or the specific use case, then I think --

It does say "where feasible."

It does.

I take a lot of comfort in that word "feasible."

Feasible is --

Or practicable?

Do you want to add something?

Yeah, I view this as to avoid the \$3,000, you know, specialized handsets when you can buy something off the shelf that will cost you a couple hundred bucks.

That was its intent.

And I think that's its intent. It's not to say, you know, that you -- but I think we all know -- we all know those stories where there's been, you know, specialized equipment, and I don't know how common it is anymore, but, you know, I grew up with those stories where people, you know, bought equipment, had specialized equipment made that you could buy off the shelf for a tenth of what they were purchasing it for. So, that's -- I read that and that's how -- I went, "Yeah," just because that's what I was thinking. I don't know how to make that necessarily more clear.

Well, how does it tie into spectrum efficiency?

Yeah, I see a couple of other nodding heads, too, so.

I think it would be clearer if you tie it into spectrum efficiency. I think that -- the question is how does using commercial -- isn't that the question you guys are trying to answer? Maybe I got this all wrong.

That's economic efficiency, if you're --

Yeah, I mean --

Spending ten times what you need to.

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That's economic -- I mean --

Why don't you try?

I thought that's the question; right?

Yeah, so --

One more time, we'll try it.

I'm going back to looking exactly at the question because she's got a really good point.

Why don't we get on some of the other tents here?

No, it says "optimize efficiency," it doesn't say -- go ahead. I'm sorry, Mark.

Yeah, let me get Rick and Janice and the other guys in here, and then we can have a little turnaround and they can think about it, we'll come back to it in a minute. So, Rick, then Janice, and then I'll take you guys down the line. Rick.

Rick Reaser. So, on the recommendations for future work, it was -- I wanted to sort of fine-tune that a little bit. I really think that I want to finish the interviews and document those, that's what I -- that's my major thing. I want to -- because I kind of hung these guys out, and these ones I'm working on, we do want to do them and finish them off, and then maybe summarize that. So, that would be a useful thing to do. That was sort of my comment. So, in the future work product, is that -- is that anticipated as being included?

I think that we anticipate to include -- we will include the future work as a recommendation.

Right.

Is that what we're hearing?

Yes.

Yes. Okay.

I just want to make sure that it includes -- that it includes wrapping up the interviews that we kind of have been trying to get scheduled.

Carolyn's nodding her head, so yes.

Okay, that's all.

All right, thanks, Rick. Janice.

[Inaudible].

Mic. Mic.

On the commercial off-the-shelf, I think it's time to deep six what we learned about, about, you know, radically inefficient LAN mobile systems. I mean, the federal government has accepted that, and the debate has now moved towards you don't want to modify the chips either, so will it be okay with the commercial players for those systems to be operating in commercial bands with federal utilization? And that has been, you know, one of the big issues with bidirectional sharing and we're just beginning to study

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it, and it's not because of resistance on the federal side. That's where commercial resistance might come into play. So, you know, I think that particular issue probably ought to be taken off the table. At least as to commercial mobile.

I would say much the same as the satellites, I don't think the government has -- there are piece parts of the government that need and have, you know, proprietary systems, but, increasingly, there is a trend towards federal use of commercial systems and NTIA is working very hard towards it. And I've raised this repeatedly because I can't help but see that when legislation is advanced, you know, it's always government efficiency. And I think, at least in fairness to work that's already been accomplished by the government, much of those objectives are very much being considered. So, that doesn't really disagree with the general recommendations here. Everybody wants to be more efficient. You know, we should interview folks, but some of these issues were discussed and sort of put to rest five or six years ago by the CSMAC, they're still on the table, and we can take a closer look, but the intimation in some of this that some of this hasn't already been embraced by the government, to me, is a little bit unfair.

Okay. Thanks, Janice. Let me just go down the line there. Andrew. And then is that Kurt or is it Audrey? Kurt and then Chris. Go ahead, Andrew.

Thanks for the report. Very interesting. I was, in my mind, trying to figure out measurement of spectrum efficiency. There's an interesting example in there about someone's idea of spectrum efficiency was actually increasing bandwidth. So, I was curious -- although trying to define it in isolation is very difficult from the examples and other industry feedback you had from existing examples in spectrum efficiency, was there any other surprising aspects of what industry thought was spectrum efficiency or underlying themes or trends that came through as, hey, yeah, this seems to be a majority opinion or is it all over the place from existing examples?

So, for instance, what we found, it differs, for example, from what's in OMB A-11, which looks at the LAN mobile radio example, you know, might be applicable for that and some other specific cases, but how it looks at valuing spectrum and the economics of spectrum, and it's based on population density, and there's been some improvement as to how that's calculate but still based on population density. So, not applicable to all the use cases.

Okay. Kurt.

Yeah, thank you. Just on the discussion earlier about COTS equipment, I think one way to tie it back to efficiency is to think about a spectrum sharing scenario where, when there's some commonality between systems, it's much easier to bring about effective sharing versus having to deal with disparate technologies trying to share a common band. That's actually, you know, one of the points that was made in one of the other subcommittee reports. So, I think, you know, potentially, you know, commercial and federal use of, you know, common off-the-shelf technology could certainly help facilitate greater sharing and more efficient sharing, and bring about more efficiency.

Just to go back to that for a second, because I think we can wrap this up in a pretty easy way. The question that was asked of our group was what practices has industry adopted to optimize its efficiency across disparate networks, and one of the answers we got was making extensive use of commercial off-the-shelf equipment more feasible. So, it is a statement of what the commercial guys are doing that might be a useful lesson for the feds. I don't think -- in other words, I think maybe we got twisted around how we were answering it.

Okay. Go ahead.

Yeah, so I'll --

Do you want to state it that way? I mean, that would really be helpful if you kind of state it that way. I think it would address the point.

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[Inaudible] statement that these are the industry practices that were put forward, that -- you know, that answers that question that NTIA may wish to look at, something like that, and then it's not we're telling them they have to do these things but this is answering the question actually. So, thank you for doing that, Miriam.

Sure.

I also had a second point that I wanted to come back to, if I may.

Chris had his hand -- Chris, did you want to add to this discussion?

Sure. Yeah, I'll just throw in my two cents on this one, too. So, when I read this one, I thought that that second bullet was suggesting an approach that, you know, included commercial off-the-shelf equipment but, you know, sort of was doing these other things, too, related to segregating hardware from software, coming up with more flexible technology and architectures that ultimately would let you probably save money, depending on how it's deployed.

Okay. Are you -- are you good with it now or -- are we good with this recommendation? I kind of forgot -- lost track of where it is. So, can -- you talked about chapeau --

[Inaudible].

Brian is drafting the chapeau statement based on what we talked about.

[Inaudible].

I guess I'm the worrier today, but one of the things when I hear talk about using standards and -- to get economies of scale and so forth, and drive prices down, you got to really be careful, I think about, you know, genetic diversity. The more we get using a single thing, if everybody uses LTE, if LTE gets sick, you take down, I could argue, like in Boulder, if I have a telemetry system coming out of the mountains, I might be better off with a one -- you know, a custom-designed system that's not LTE, because if it's LTE and LTE gets sick like I say, in general, there's a bug in it, it takes down a lot of things. So, I just think we need to be a little cautious here. And this doesn't apply just to this conversation here, but in more broadly, there are some benefits than people doing things differently. And I'm not just talking about economies of - well, I'll leave it at that.

I think your point is taken. Chris, are you still -- okay, thanks. And Miriam. All right. So, you guys have a chapeau statement?

I --

Oh, you're still --

I have a second -- I did have a second point. Sorry. At the beginning, I said that. It's a different one. So, it's on -- and this is just -- I would just kind of state it as an observation because it's not part of the recommendations. So, I think this past one was really good, but just in one of the observations, you know, we're talking about spectrum efficiency, and on the second sub-bullet there's talk about how increasing bandwidth requirements. You know, I just don't -- you know, that, again, to me, is a total contradiction. When we're talking about spectrum efficiency and being -- using spectrum efficiently, then a solution of increasing a bandwidth to address a problem is exactly the opposite, unless I [inaudible].

It's not meant as a solution, but it was truly an observation. There are moving targets and things are -- just a lot of complexity. So, in order to meet different mission requirements, all of these factors need to be taken into consideration.

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And, also, there is, as we've said in other, I think, meetings of the CSMAC, et cetera, there's not a definition that decreasing spectrum usage by an application automatically means it's more efficient. In the beginning, we talked about spectrum efficiency taking into account the mission needs, can you meet your mission in a way that perhaps enhances sharing but you might need more spectrum to do that. So, that is not something that's -- I think that we have all agreed on that, spectrum efficiency means automatically a reduction in the use of spectrum by an application.

Yeah, I think -- and this is an important point, because you're exactly right, we haven't agreed on it. And I think it should be highlighted that because we don't -- you don't want also a situation where we say, okay, in order for radar to be able to share with commercial networks, radar's going to come back and say, "I want, like, you know, twice as much spectrum than I" -- I mean, there's a question of which way should it go; right? I mean, and you're right, it's not been decided and it could be that giving more spectrum to federal users would enable more efficient use. I'm having a hard time putting my hands around it, but I just want to highlight that that is a key point that maybe as future work we can look at.

You guys have your chapeau?

We do. So, the first bullet and the last bullet will not be under the chapeau or whatever. Anyway, it will say "A number of industry practices to improve efficiency have been adopted that may hold useful lessons for NTIA:" and then you'll have the four middle bullets.

You put that in the top of the recommendation then? Okay. That's the chapeau.

But "investigate" and "closely monitor" are then standalone. They are not under that, just to be clear for everybody else in the group.

So they would go -- [inaudible] up here and these are these.

Except for one.

Except for one, the first and the last.

Oh, up here.

Yeah.

Okay.

Yeah.

Okay.

Correct.

Does that work?

I think that works. I think we all have [inaudible] this at this point.

I think we have tweaks and revisions, but let's see if we can get a vote on at least the concept, and also the recommendations will include a recommendation for the future work that Carolyn suggested. So, it's -- okay, we have a motion to adopt it. Is there a second? Kurt seconds. Any additional discussion? Okay. All in favor of approving the recommendations as we've discussed, vote by saying "Aye."

Aye.

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Any nays? Any abstentions? Thank you. Right on time.

Perfect.

All right. Thanks.

Perfect.

So, that concludes that. I think that was really good. Thank you very much for the back and forth and for the alacrity. [Inaudible]. With that, we'll go to a public comment. Is there any public that wants to comment? Yes.

[Inaudible].

Could you identify yourself again, please?

[Inaudible].

And actually, give him a thing. A mic.

Complicated, huh?

Yeah.

Armando Montelongo from LGS. A couple observations. We talk about the spectrum efficiency and [inaudible] enforcement on spectrum sharing, other actions [indiscernible]. One thing that this committee I don't know if have considered or not considered so far, is what is the data, right, that needs to be collected, either for enforcement? And as you go back to, you know, sharing -- spectrum efficiency being engineering, if you say in the [indiscernible] equation, there is a lot about [indiscernible] but the thing that is most applicable to all of this, to enhance [inaudible] is how are we going to do the bandwidth portion, how many shares, all right, sharing of bandwidth and so forth and so on associated with the question of using COTS equipment; all right? So, the question -- the observation put forward is anybody consider what [indiscernible] data that needs to be considered and what do you do with that data, all right, in order to guarantee that you can force it. I mean, the processing through the data to make decisions and to make correlation decisions about whether or not you violate an agreement or not.

Okay. Thank you. Any other comments from public? Okay. All I'd like to say is thank you, again, for your work. NTIA is going to go back and cogitate over this. We will -- when is our next meeting?

We haven't set it yet.

We don't know when our next meeting is yet. So, what I will do is [inaudible].

[Inaudible].

As I mentioned earlier, what the plan is, we took notice that last time we started a little slowly, it took us a couple minutes to get off and running. So, we've taken that into advisement. So, expect to hear -- it's not going to be just quiet between now and the next meeting. Hopefully we'll get some organization so we can hit the ground running into the next meeting, but there will be the selection in topics, et cetera, and then, as Mark said, the NTIA will respond to the recommendations that we've adopted and forwarded here today. But I just wanted to make the point that we are considering that we want to try and hit the ground running because we will have, again, just one year do our next round.

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Larry, could I ask just how will the changes that we've talked about here today, when will we get, as a group, the final version?

From my understanding, and Paige can respond, is the NTIA will, the next meeting, give us a response to the --

No.

He's talking about the changes --

No, just the -- the -- what we would call editorials, I think, if we were at the --

I don't have the answer. I was thinking that the editorials would get changed by the groups and submitted to David, and he would post. I don't have a date for that, though.

Soon.

How about a two-week deadline on that?

Yeah, this would place it at two weeks, so, you know, remember, we're -- Thanksgiving is next week.

Yeah, you don't get it done then.

So, we've got --

How about end of -- yeah, end of November?

Yeah. Thank you, because I'd like to see them all.

Yeah, yeah.

Make sure I've got the right version.

Yeah, okay. All right. The only thing I'd like to add is thanks, again. Hope everybody has a safe and happy holiday. I'm giving it now to Paige.

Yeah, I just wanted to say thank you. It's obvious that everybody's put a lot of work into these recommendations, and just great work. So, I really appreciate what you've done. And, again, have a great holiday.

I guess the final thing is if you have input, like, about the mechanics we're using, we have too many subcommittees, too few subcommittees that should do something differently next time, now's a good time to catch Mark or myself or David and let us know.

Okay. With that, we're adjourned with minutes left. Thank you very much.