UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION

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COMMERCE SPECTRUM MANAGEMENT ADVISORY COMMITTEE (CSMAC)

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MEETING

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TUESDAY

AUGUST 15, 2017

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The Advisory Committee met at the Renaissance Boulder Flatiron Hotel located at 500 Flatiron Boulevard, Broomfield, Colorado, at 8:00 a.m., Larry Alder and H. Mark Gibson, Co-Chairs, presiding.

PRESENT

LARRY ALDER, OneWeb, Co-Chair
H. MARK GIBSON, Comsearch, Co-Chair
AUDREY ALLISON, The Boeing Company
PAUL ANUSZKIEWICZ, CTIA
MARY BROWN, Cisco Systems, Inc.
MICHAEL CALABRESE, The New America Foundation
DALE N. HATFIELD, University of Colorado at Boulder
CAROLYN KAHN, The MITRE Corporation
PAUL KOLODZY, Kolodzy Consulting, LLC
MARK LEWELLEN, John Deere Intelligent Solutions Group*
ALLEN MacKENZIE, Virginia Polytechnic Institute and State University
DONNA BETHEA MURPHY, Inmarsat
JANICE OBUCHOWSKI, Freedom Technologies, Inc.
CARL POVELITES, AT&T Services, Inc.
MARK RACEK, Ericsson, Inc.
CHARLA RATH, Verizon Communications*
RICHARD L. REASER, JR., Raytheon Company
DENNIS A. ROBERSON, Illinois Institute of Technology
ANDREW ROY, Aviation Spectrum Resources, Inc.*
STEVE SHARKEY, T-Mobile US, Inc.
MARIAM SOROND, Dish Network, LLC*
BRYAN TRAMONT, Wilkinson Barker Knauer, LLP
JENNIFER WARREN, Lockheed Martin Corporation*
ROBERT WELLER, National Association of Broadcasters

ALSO PRESENT

PAIGE R. ATKINS, NTIA
MICHAEL COTTON, NTIA
JULIE KNAPP, FCC
GLENN REYNOLDS, NTIA

***participating via telephone**

AGENDA

P-R-O-C-E-E-D-I-N-G-S

(8:00 a.m.)

MR. GIBSON: Okay, welcome. We're only up here because that's where they put us. We have done nothing to deserve this, I'm speaking for myself. The rest of this, all this bunch may belong here, but I'm just here because this is where they put me.

MR. ROBERSON: So, when we approach the bench, we have to say, Your Honor?

MR. GIBSON: You do. Everybody else --

PARTICIPANT: Objection overruled.

MR. GIBSON: Okay. And I see Julie is in here, great. So we'll start off, welcome to Boulder, actually almost Boulder.

Thanks to everybody for coming. It's good to look out and see non-CSMAC people here as well, as well as CSMAC people.

That's basically all the opening remarks I have. Anything else for anybody else on the stage here? I take that as a no.

So let me start just with my comments. First of all, thanks to everybody for showing up. We're tagging this at the beginning of our ISART conference, which I always look forward to. This one is about millimeter wave, so there's a lot of good panel discussions and presentations about that, so I hope everybody can stick around for that.

And thank ITS for keeping this going for us, here in Boulder. Thanks also to the Co-Chairs for getting your materials in on the deadline, that always makes it helpful.

I'm sure Dave and the folks within NTIA really appreciates that, as does the public that reads this. There's a fair amount of work that's been done so far and so thank you all for doing that.

And today's meeting is really to kind of check in where we are. Some people have submitted recommendations, others are in the midst of discernment, let's say, doing surveys and what not.

So we'll hopefully check in, provide any guidance. You guys are facing each so you can help each other out. And we on the dais will listen and enjoy.

So having said that, the other thing I will just remind you of, because I like to do this every now and then, tomorrow is the anniversary of Elvis Presley's death. Forty years, so Don't be Blue.

(Laughter)

MR. GIBSON: So having said that, let's go ahead and, any other comments? You have any comments? Okay. How can you follow that up, right?

(Laughter)

MR. GIBSON: Yes, and Glenn will be doing remarks for ITS. And Glenn is, where is Glenn, I mean NTIA. Should I give Glenn now? Glenn.

MR. REYNOLDS: Thank you. And I'm really going to keep this short, and not sort of get into the usual high-level opening comments.

I do appreciate NTIA. Greatly appreciate you all being, willing to come out here and willing to get out of D.C. in August. But it is important.

It's helpful or us, we hope that there are synergies between the work that CSMAC is doing and the efforts and the focus of ISART this year. As I'm sure you all are aware, ISART is going to be very much focused this week on millimeter wave bands.

The discussion, the talk, all of the policy engagement in D.C., on 5G, has moved forward, I think, faster than certainly any of us, in the Government side, have expected. And I think we are all trying to figure out how we, if not stay ahead of the curve, try to keep up with what you all are doing in the industry so that the policy and spectrum needs, for all you, are not being dragged down by slow processes going on in the policy on the Government side.

Relatedly I guess I would sort of address the elephant in the room briefly. Just

to emphasize that despite the fact that we, at NTIA, continue to be without a political appointee, I can assure you that the work that you all are engaged in remains critically important.

And it will be used and emphasized and studied by both the folks, by the career staff and by the political leadership that we fully expect will get onboard in the near future. Things are continuing to move, as you can imagine.

There are decisions that need to be made, there are policies that need to be thought about. And we are continuing to engage, both within the department and with the folks over at the White House.

As you all know, Grace Koh is over there. And Kelsey Guyselman is now over at OSTP. And we're working with them to keep the trains moving until we have our new political leadership onboard.

So with that, I just want to say thank

you again for coming out here and we look forward to hearing your thoughts today.

MR. GIBSON: Thanks, Glenn. One bit of housekeeping, actually two bits of housekeeping, one, for all the CSMAC people, please remember to say who you are when you speak. And if you don't, one of us will remember. That's for the transcript.

And for those on the phone, please be sure to mute, unless you're speaking. That always causes some weird feedback. It's kind of cool to listen to, but it really screws up the meeting. So if you would just please adhere to the protocols when you're not in the room that would be great.

Now we're on the point where we'll do the roll call, so let's start with Brian and go clockwise.

MR. TRAMONT: Bryan Tramont, Wilkinson and Barker.

MR. RACEK: Mark Racek, Ericsson.

MR. SHARKEY: Steve Sharkey, T-Mobile.

MR. POVELITES: Carl Povelites, AT&T.

MR. KOLODZY: Paul Kolodzy, Kolodzy Consulting.

MR. HATFIELD: Dale Hatfield, University of Colorado.

MR. MACKENZIE: Allen MacKenzie, Virginia Tech.

MR. ROBERSON: Dennis Roberson, Illinois Institute of Technology and Roberson and Associates.

MR. WELLER: Robert Weller, National Association of Broadcasters.

(Laughter)

MR. KNAPP: Julie Knapp, FCC.

MS. BETHEA MURPHY: Donna Bethea Murphy, Inmarsat.

MR. CALABRESE: Michael Calabrese, Technology Institute.

MS. KAHN: Carolyn Kahn, MITRE.

MR. REASER: Rick Reaser, Raytheon.

MS. BROWN: Mary Brown, Cisco.

MS. ALLISON: Audrey Allison, Boeing.

I also have a billboard.

MR. ANUSZKIEWICZ: Paul Anuszkiewicz, CTIA.

MS. OBUCHOWSKI: Janice Obuchowski, Freedom Technologies.

MR. GIBSON: Okay. And then for those CSMAC members on the phone.

MS. RATH: Charla Rath, Verizon.

MS. SOROND: Mariam Sorond, Dish Network.

MR. ROY: Andrew Roy, ASRI.

MS. WARREN: Jennifer Warren, Lockheed Martin.

MR. GIBSON: That was Jennifer. Okay. Anybody else --

MR. LEWELLEN: Mark Lewellen, John Deere.

MR. GIBSON: Okay. Any other CSMAC people on the phone? Okay. Good, so that's the roll call.

We'd like to acknowledge our very special guest, Julie Knapp, the head of the OET.

Julie, welcome, thanks for being here.

Any other special guests? That's it?

MS. ATKINS: That's it.

MR. GIBSON: I think so, okay. If you're special and you're here and you want to be a guest, just let us know.

(Laughter)

MS. ATKINS: If you are here you're special.

MR. GIBSON: If you're here you're special, yes. Special people. Okay, now we're ready for the spectrum update. Paige.

MS. ATKINS: Good morning. I'd like to echo Glenn and Mark's welcome today. This is the third CSMAC meeting of the year as well as the current term, and we're lucky to have this alongside with the ISART conference. So I hope that everybody can participate.

And I asked this last year, does anybody actually know what ISART stands for? And ITS can't answer. Okay. International Symposium on Advanced Radio Technologies.

Last year it was the students that I think answered. It was Dale's students.

So the ISART topic is very relevant. We've mentioned millimeter wave, but it really is a conference about information exchange, brainstorming, collaboration.

And that's really appurtenant to what we are discussing today. It's not just a topic, but then that deliberation, collaboration that gains us the biggest bang.

So I appreciate everybody being here and I hope many of you can stay for the actual conference, it will be an excited one. Lots of good panels and keynote speakers. Including one that's in the audience.

So I recognize that the current CSMAC schedule has been aggressive for the meaty topics that we've teed up for your deliberation. And I expect today we'll have a pretty robust discussion around some of the preliminary results and findings to date.

And it's really important that we have

that robust discussion as we move toward, hopefully final recommendations toward the end of the year. So I encourage you to vet and discuss during that, this morning.

And before we dive into the primary focus for today, which is the Subcommittee updates and discussion, we're going to have a slightly expanded spectrum update. Not only my normal spectrum update, but we will ask Julie to provide an update on the FCCs Technological Advisory Council, if I got that right, the TAC activities, as well as ITS.

Mr. Mike Cotton will give us an update on some of the ITS relevant activities to the topics that we're deliberating here.

So on to our update. So we collectively continue to make steady progress across all fronts, from AWS-3 transitions to making 3.5 gigahertz in frontiers bands a reality, as well as looking at new options. And I'll mention the mid-band in a while, a little bit later.

And by the way, when I give you my update, I want to emphasize, this is a collective update. It's not just an NTIA update. And all of the hard questions go to Julie.

(Off microphone comment)

MS. ATKINS: I just want to keep the momentum going.

So NTIA recently published their 10th Annual Report to Congress, as required by the Commercial Spectrum Enhancement Act or CSEA, describing the progress of the federal agencies and transitioning out of, not just AWS-3 band, but also the AWS-1 band, which we're still reporting.

We also recently published, or posted on our website, an AWS-3 transition status report providing the completion status for the federal AWS-3 assignments transitioning relative to their original schedule in the transition plans.

And the intent here is to create better transparency into our progress, to relocate systems or to share bands. So I would

encourage you, if you haven't see those reports, take a look at them. But it's a good source of information on the progress, for our transitioning activities.

A lot of work on 3.5 continues. The 3.5 gigahertz band. And it's really been a great collaborative effort with government and industry stakeholders making steady progress on implementing this innovative sharing and licensing approach embodied in the citizens broadband radio service.

And equipment providers are pioneering hardware for the band. And we continue to hear plans from service providers and carriers, big and small, for a host of applications. So it's really an exciting area.

And NTIA working in collaboration with the Commission, the DoD and the wireless industry, particularly the Wireless Innovation Forum, or WinnForum, are finalizing a certification system and process to test compliance of both the spectrum access systems,

the SAS, as well as the environmental sensing capability, the ECS.

And we are working with the ESC applicants to define Dynamic Coastal Protection Areas, DPAs. And that's to replace the static exclusion zones as we have traditionally defined.

And these DPAs will only be activated when the sensing capability senses that there is a Military radar in the area, and it's detected. So it's a different way of approaching the problem and hopefully moving us closer to dynamic sharing in the future.

So the majority of the effort over the last few months has been focused on completing the WinnForum standards that will be used as the bases for the SAS and ESC, FCC certification.

And the initial SAS certification is expected by the end of this calendar year, and the initial ESC certifications are expected the first quarter of 2018, on the current schedule.

Meanwhile it's been a little over a year since the FCC released a Spectrum Frontiers

Report and Order and Further Notice. The use of these millimeter wave bands for 5G sparked a great deal of interests, as all of you are aware.

And this ISART conference is very well timed to continue that dialogue in this, I'll call it "new spectrum." Which just a few years ago was thought infeasible relief for some of these emerging mobile applications.

And as you know, the interests in millimeter wave bands, for 5G, doesn't stop at the border. Delegates to the International Telecommunications Union, or ITU technical meetings, also are examining the compatibility of terrestrial broadband services with incumbent services. Both in the frontiers bands as well as other bands above 24 gigahertz.

We just had a successful CTEL meeting. And for those of you unfamiliar with CTEL, it is Region 2 in ITU speak. And think of it as the Americans.

And Region 2 is pushing forward with the sharing and compatibility studies needed to

accommodate wireless broadband technology, in the millimeter wave bands. And again, ITU speak for the conference, it's Agenda Item 1.13, if somebody mentions that.

And as you know, NTIA is intimately involved in developing the federal and U.S. positions for these meetings in close collaboration, again, with the Commission, Department of State, the Agencies and Industry. And we look forward to working with many of you, to prepare for the next role of radio communications conference. Which is now just over two years away.

And now our national proprieties for the conference continue to evolve. Agenda Item 1.13, this item in particular, which covers broadband and bands above 24 gigahertz, remains a top priority for the U.S. And that's not going to change.

So both domestically and internationally there remains much work to do in pioneering sharing in millimeter wave bands. For

example, NTIA is working with the Commission, and soon with the agencies, to explore workable sharing approaches in the 37 to 37.6 band.

And we will also be working with the Commission and others to evaluate the additional bands and the further notice. And they actually raise some interesting challenges from a coexistence or a sharing perspective.

And I think that really highlights the need for a strong technical foundation to feed the policy decisions that we make, in this band, as well as others.

And we will continue to work with the Commission to make sure rules are in place for the spectrum to be available. Especially for those bands that will be shared with federal users.

And though there has been a great deal of focus on millimeter wave, the Federal Communications Commission recently launched a new inquiry seeking comments on ways to expand opportunities for next generation services, in

mid-band spectrum between 3.7 and 24 gigahertz.

And this new notice of inquiry seeks comment on three specific non-federal bands and asked commenters to identify other mid-band frequencies that may be suitable for expanded flexible use.

In parallel, NTIA continues to leverage our own interagency processes. The Policy and Plan Steering Group, the PPSG, as well as the Interdepartment Radio Advisory Committee, the IRAC, to assess other opportunities for increased commercial access in bands used by the federal agencies. And that's especially if we're looking at sharing scenarios.

As we collectively continue to build the pipeline of spectrum to meet increasing commercial, as well Government requirements, spectrum efficiency and sharing will continue to be key elements to our success. Reinforcing the continued important and urgency of the work that this Committee is doing for NTIA. So we are very appreciative.

We also continue to work with the federal agencies to explore the strengths and weaknesses of various incentive mechanisms intended to result in efficient and effective federal government use.

We have engaged ITS to conduct initial research on how to technically define spectrum efficiency in the federal agency contacts. And for those of you that have been involved in this discussion over the last 15 or 20 years, will know that's not an easy problem to tackle.

We are also assessing how the agencies make decisions regarding spectrum use from the very earliest stages of defining mission and system requirements through operational deployment.

And these results will help us identify the gaps in our knowledge, processes and tools, so we can start closing that gap, or those gaps, and provide the necessary tools that help the agencies make better spectrum efficient decisions.

And we also are very much looking forward to the CSMAC recommendations coming out of your effort. Looking at perhaps other policy recommendations that we should consider, to promote efficiency over time, and move the ball forward.

As I've mentioned before, we strongly believe one of the most effective incentives are ones that give the agencies the necessary research to look at alternatives. In terms of other ways, other spectrum or other technics, as well as upgrading to more efficient spectrum technologies.

The Spectrum Pipeline Act of 2015, which we've talked about in prior meetings, broaden the scope of eligible expenses covered under the Spectrum Relocation Fund, or the SRF. And we continue to see agencies seeking pipeline funds to create opportunities for increase spectrum access for commercial users.

And for example, and we talked about this at the last meeting, FAA, DoD, DHS and NOAA,

are jointly assessing the opportunity, or possibility, of consolidating and relocating long range, short range and weather radar systems, to potentially free up a portion of 1,300 to 1,350 megahertz, for commercial access. And it's called the Spectrum Efficient National Surveillance Radar, or SENSR.

That program is the first pipeline plan approved by the technical panel notified to Congress. And that occurred in the January time frame. And the program is well underway.

The SENSR joint program office is currently reviewing responses to requests for information. And they plan to wrap-up their assessment on the RFI responses by the end of this month. And at that time, they will be able to better understand the technical risk of the program and whether any adjustments to their program are necessary.

But again, that's well underway. So that's the first program that was born out of the Pipeline Act.

Also since our last meeting, a second pipeline plan has been approved and notified to Congress. And that will study the potential for sharing in the 1,675 to 1,680 megahertz band currently used by the National Oceanic and Atmospheric Administration, NOAA, for meteorological satellite and radiosonde operations. Radiosondes being the weather balloons.

And they anticipate the transmittal of additional agency pipeline plans, transmittal through the technical panel, and OMB to Congress over the next few months.

As we continue to make progress, Congress has also been working on several related bills. As you're aware, such as MOBILE NOW and the recently introduced Airways Act.

That if an Act it could influence our efforts fairly significantly. However, we're confident that our activities will yield good results, our current activities, and build a solid pipeline of spectrum over time.

So before I wrap-up I want to mention a couple of other items. Following up on a recommendation from the previous CSMAC cycle we are continuing to plan a workshop, ideally by the end of this calendar year, that will look at bidirectional sharing.

And that means different things to different people, but particularly we're interested in the potential for federal users to access non-federal spectrum. And this, again, was a topic for discussion during the last CSMAC cycle.

And our goal is to have a substantive discussion with industry around specific use cases of interests to federal users. That's been the challenge.

How would the federal users anticipate using non-federal spectrum, what are these cases, to help us figure out the viability and the methods by which you would do that. So standby for more information, and again, hopefully we'll have that by the end of this calendar year.

In collaboration with the Commission, we are planning a series of workshops that will focus on spectrum enforcement. And by that, I mean not necessarily the traditional definition of enforcement, but the whole scope of prevention, detection and resolution.

And as we move to more intensive use of spectrum and more spectrum sharing between federal and non-federal users, all parties really need to have confidence in the enforcement regime that reduces the risk of interference to acceptable levels.

Our initial workshop is going to be for the federal agencies, only, to share best practices, exchange information, understand current concerns. But we look forward to extending this outreach to industry, in particular, in the near future.

And again, our initial workshop will be sometime within the, hopefully within the last quarter of this calendar year. Again, for the federal agencies. So, two areas that we're

following up with, largely based on the CSMAC recommendations.

So before I turn the microphone over to Julie, let me congratulate the Subcommittees. There's been a great deal of engagement within the Subcommittees.

And again, these are meaty issues and I know we've been on a compressed schedule, so I really appreciate everyone's contributions and work, I know it's not easy. And can't emphasize enough, we appreciate that you all are volunteering your time to do this, to help us.

And it is important for us to get your feedback and your recommendations so we can make better policy decisions over time. And it really does result in a world leading spectrum policy, in promoting the U.S. economic and technological leadership while ensuring the U.S. Government can also fulfill its missions for our citizens.

So I encourage all of us to take advantage of this meeting and the clean mountain air, to engage deliberate and collaborate and

hash out as much as we can. Again, as we look at moving toward the end of the year for final recommendations.

I know in some cases that may be challenging, so think about final recommendations as well as potentially topics to tee up for the next year following. And with that I'm happy to take questions or we can turn it over to Julie and do questions toward the end, after both the TAC update and the ITS update.

MR. GIBSON: No questions for, Paige? Really?

MS. ATKINS: They're saving them.

MR. GIBSON: I have a comment. I'd just like to comment on the work that's being done for 3.5 gig CBRS, SAS and ESC certification. Just to say that, I won't speak for industry but I reckon industry shares the sentiment that the collaboration has been amazing.

There are a lot of surprises, and I think we expected them. But I think just the level of commitment, across the government, DoD,

Navy, NTIA, ITS, has just been really awesome. So thank you. And let's hope it sets up the framework for moving in shared band situations. Janice.

MS. OBUCHOWSKI: This was a, kind of a shout out to NTIA. We finally caught up with the research that NTIA was doing back in 1989, '90, when I was assistant secretary and I came out to ITS, and they were doing millimeter wave research. Basic first and only in the world at that point.

I thought I might have to investigate because I kept keeping these travel vouchers for trips to Hawaii. I said, what's this dude from ITS doing in Hawaii. And it said, ideal circumstance for studying rain attenuation.

So, glad, you have to be grateful that I bought off on those vouchers. But no --

(Laughter)

MS. OBUCHOWSKI: -- he did do the breakthrough research. And when I hear about the breakthroughs that are currently, finally coming

to market, I do want to extent that complement.

MR. GIBSON: Cool.

MS. OBUCHOWSKI: I don't know that it's really appreciated sufficiently. Thank you.

MR. GIBSON: No other questions? Okay, Julie needs to be at a mic. Take Dennis' mic, that's always good.

MR. WELLER: Mark was going to order that anyway.

MR. GIBSON: Nobody heard that.

MR. KNAPP: So I'm not going to be on camera? That's a good thing.

(Laughter)

(Off record comments)

MR. GIBSON: Is that on? Is his mic on?

MR. KNAPP: I think so.

MR. GIBSON: Okay.

MR. KNAPP: Yes. So thanks. And we may be sitting at opposite ends here but actually, on all these issues that Paige discussed, we sit side-by-side in working through

some very tough problems to come up with good solutions, I think, for the country.

So, there were a couple of things I did want to add. So dido to everything that Paige said.

It perhaps has been a no busier time on spectrum. I started to think about all the different things that we're doing. If I went into all of them, we'd be here a long time.

I'm just going to touch on a few others. So Paige mentioned the NOI on the mid-band spectrum. And also, the next day the commission issued an NOI on 900 megahertz, and how we can make more efficient use of that band as well.

So, the work is continuing on the spectrums frontiers proceeding. And both the bands where we had petitions for reconsideration and the bands that we had in the further notice.

And there's been interest above 95 megahertz, and we're trying to do some work to flesh out exactly what kinds of rules we might

propose there.

The incentive auction team, is led by Jean Kiddo, they're hard at work implementing the TV incentive auction yielded at 84 megahertz of spectrum for wireless broadband services. And at the same time, we've got a proceeding, as Bob well knows, to consider providing for ATSC 3.0 on a voluntary basis. So there's a lot of work going on there.

We've completed the Phase 1 testing on license sharing on 5.9 gigahertz with the DSRC. We're busy analyzing the results and preparing a report.

We also have a proceeding that was considering additional allocations and licensing provisions for NGSO satellites, so we're doing work on that as well.

There is quite a few others, I'm sure I'll leave out your favorite one. TV white space reconsiderations and the reserve channel proceeding, the Ligado proceeding of course, the 4.9 proceeding, the higher ground

reconsideration, et cetera. So, lots of things going on, on the spectrum front.

So let me just say a few words about the TAC. So, to start with, I want to recognize Dennis Roberson's leadership with the TAC. We wouldn't be where we are without all of his fine work.

Dale also participates on the TAC. We've had liaisons between the TAC and the CSMAC, so that the work is complementary.

The TAC, it's a little bit larger than this group I think. We've got 45 active TAC members and there's about 120 additional work group members that span roughly 70 entities. Many of your organizations have other representatives who have either been members of the TAC or have been working with the TAC.

And the thing that we always charge the TAC with is coming up with actionable recommendations. We may not be able to do everything that the TAC recommends, but it really has played a key role in so many of the things

that we're doing.

Everything from the work on spectrum frontiers really had its root on our side in the TAC. The work on 3.5 was sparked there and so forth. So, a lot of terrific ideas have come out of there and we actually implemented them.

So I'm not going to go into all of the work that the TAC has done, I'm just going to highlight a few things that I think may be relevant here.

One group that we called, this is from last year, future game changing technology, had recommended that the FCC should institutionalize a process for anticipating keeping up with major shifts in technology, usage in patterns. I am not going to tell you the response because we have a meeting coming up on September 19th, and so this is just a teaser for the things that you'll probably be hearing about.

It also called for balance spectrum allocations that we should work closely with the administration, NTIA and Congress, to ensure a

flow of spectrum that's balanced across high, middle and low spectrum bands for commercial use and promote flexible use policies that support experimentation.

Many of you may know that just earlier in the year we made available program licenses with much greater flexible now in conducting experiments.

Out of the spectrum and receiver performance group, one of their recommendations was that the FCC direct our lab to measure advance lighting and switching power supplies on the market to ascertain if they met regulatory noise limits and initiate enforcement if not, and to also issue a notice of inquiry/notice of proposed rulemaking to gain more information about the advisability of rule changes to deal with advance lighting and switching power supplies and to reduce noise in the spectrum.

The emitters are both government and non-government and so we're all in this together. So the question is, by most accounts the nice

floor is rising and when I've talked to the group I've said, well, don't just tell me the noise floor is rising, what do you think are the leading contributors and what should be done about it.

There's a lot of work that went on in that group as well in developing a policy statement on spectrum. And it recommended that the FCC consider it, and I'm just going to go through, quickly, some of the points in there.

Formalizing and implementing the TACs receiver recommendations and spectrum allocation principle and policies to adopt risked informed interference assessment and statistical service rules. So many of our standards right now are based on worst case as opposed to truly evaluating, well, how big is the risk and what would happen if there were an adverse consequence.

To implement the steps outlined by the TAC for improving enforcement. I know that there's been work going on here as well, and as

Paige mentioned, trying to work jointly on that. Particularly as we do things, like at 3.5, where we've got sharing across systems.

And that's to include a next generation enforcement architecture to create a public database of past enforcement activities and incorporate interference hunters. They haven't made the TV show about them yet, but --

(Laughter)

MR. KNAPP: -- we all think it's pretty exciting.

In some of the topics that we're working on right now we've continued to do a lot of work on mobile device theft prevention. And we've got a group that's working on identifying technical rules that perhaps should be eliminated or no longer necessary and outdated. So they've got some ideas of what to do there.

We've also got a group working on broadband deployment technology challenges, more from the technical side then the policy and infrastructure deployment side.

Another group working on the implications of next generation TV broadcasting satellite, not satellite, TV broadcasting technology, and we've also got a, that's continued to work on satellite systems and so forth.

So, I will stop there and any hard questions I'm going to turn back over to Paige.

(Laughter)

MR. GIBSON: Okay. Any questions for Julie? Bob.

MR. WELLER: Julie, can you elaborate a little bit on the status of the laboratory testing of advance lighting systems and a list of whys that you actually got devices, are they being tested?

MR. KNAPP: So, it's like wine. No wine before it's time.

(Laughter)

MR. KNAPP: There's work going on. Stay tuned, we'll have more to say as the sun falls.

MR. WELLER: Okay.

MR. GIBSON: Any other questions for Julie? Boy, this thin mountain air has really made you all mellow. Cool. Okay, cool.

I think Paige said, let's be liberated, was that the word?

(Laughter)

MR. GIBSON: So here comes Mike Cotton speaking for Keith Gremban.

(Laughter)

MR. COTTON: Hi everybody. I just wanted to say thanks for the opportunity to speak with CSMAC.

I wanted to note that I was the last, I made the last trip to Hawaii in the rain attenuation measurements, so it was really fun to hear about that research into that.

So the need for additional spectrum to support consumer applications is growing. And last year ITS presented at CSMAC and the research projects that we work on towards spectrum sharing.

The research topics were in three major areas. One is in spectrum monitoring, one is in radio wave propagation modeling and measurement and one is in electromagnetic compatibility studies.

So, I'm here to basically provide a delta on that and talk a little bit about what we've accomplished in the last year.

So, for spectrum monitoring. Our spectrum monitoring project continues to develop tools and best practices and technologies to enable wide area continuous monitoring of spectrum use.

Our goal is to demonstrate cost effective sensing and sensors, software to integrate across multiple sensors, and also user interface technologies for exploring the data that's acquired.

Last year at ISART we spoke about spectrum forensics and I stood up and said, in collaboration with Ms. Gaithersburg, we are releasing a capability, a monitoring capability

called MSOD. Which stood for Measured Spectrum Occupancy Database.

Only two months after that public release we determined that really the approach taken there and the assumptions in the development of that was, it made it too big to scale. Basically, the application was too big, too integrated, crossed over too many disciplines.

For any organization to really host it, they would require an ITT team, an RF engineering team, a software architect team and so forth.

So, we went back to the design board this year and we've broken it up. We've re-architected it. And the focus of this year's work, in spectrum monitoring, has been at the sensor manager/sensor network level.

And what we're trying to do there is basically, you know, not provide a full solution, but provide sensing as a service. So that RF engineers can develop and install this type of

network, and basically make a profit off of the data.

And then, on the data client side, the data clients would come to this sensor manager and basically say, okay, go to the website, what is your sensor network capabilities, get those capabilities, how are the sensors that out there deployed scheduled for measurements, what kind of data, and hey, I'd like to have some of that.

And basically that enables a data distribution model where data clients can work on the data visualization and the data mining part of that.

So, on the sensor development side of that, we have deployed a number of sensors along the coast to measure the 3.5 gigahertz space. We're going to start reporting to OSM on a monthly basis on those to kind of get our connection with OSM going with monitoring.

I should also say we've prototyped a cheap sensor that costs about $5,000. We're building about 20 of those guys. And we're going

to be deploying that in and around Boulder this year.

So the goal for the Boulder deployment is to prototype an automated spectrum enforcement system in Boulder. And so I'm very excited to hear about the initiative here at CSMAC. I really hope to participate in the workshop and basically share in the discussion.

But our approach is to start with a baseline understanding of the RF environment in Boulder and then understand where there are changes from that baseline. Manmade noise certainly is something that's changing.

So we can identify the trends and changes like that, and also changes from the baseline and have that trigger work flows. And that's kind of what we're doing towards automated enforcement.

We're hoping that this is really the foundation, or a foundation, for testing experimental licenses and testing out new technologies in a real-world environment. So

we're hoping to have that baseline understanding environment for that.

Okay, so propagation measurement and modeling. We've been working in the space for a long time, and we continue to advance state of the art through a number of internally and externally funded projects.

DSO and OSM has us focusing on characterizing propagation and cluttered environments. Environments where radio wave propagations are moving through manmade structures and foliage and so forth.

So we've been going into a number of different environments, Arizona, L.A., Los Angeles, Denver and we're moving to North Carolina next month I think. Some of those measurements have been published in IEEE Military communications conference, last week, at the IEEE EMC conference.

In addition, the measurements. We're really attacking these things from first principles too.

ITM was released in 1965, IF-77 was in the '70's. Those code bases are old. And the authors are not on staff. So we --

(Laughter)

MR. GIBSON: That's a good way to put it.

MR. COTTON: -- we have maintained the expertise. But we're doing on an approach for modernizing these tools, is we have formed an ITS propagation focus group. And our focus there is to develop these models from first principles.

This year our focus is on air to ground propagation, where we're focusing on the IF-77 model, which needs to be re-architected. DSO is interested in that as well as OSM.

So literally, 40 lectures to get from Maxwell's equations to all of the work, all of the models that go into the algorithm that is IF-77.

I suspect there is a lot of work to publish this, still to be done. The material has grown. And next year I suspect we will produce

an algorithm paper on IF-77, similar to the algorithm paper that is associated with ITM.

We are also not just driving our measurement bands into these most complicative environments, we're also doing simple propagation measurements out at Table Mountain where we're measuring canonical geometries, knife, single knife edge diffractions, measurements through single walls, a wall with a window.

We're trying to kind of validate those core pieces of our propagation models. See if we can do things numerically to generalize those things and make our models more general.

And then finally, on propagation, I wanted to say that we are working to improve the usability of those tools via software best practices. So this year we published an official version of the (indiscernible) model, which WinnForum has been using for 3.5 gigahertz SAS developments.

We are establishing a modern software infrastructure and framework for the development

and testing of our propagation models. And we're involving OSM with that.

So it's not just our experts throwing together engineering code and getting that done, we now are establishing a muscular storage behind this so that we're data driving in our predictions. We have an API on top of the data to gear the interface with it, so we can query that data in a uniformed way.

And we have a QA environment which we're going to have both ITS testers, OSM testers on, before it gets to public release. We're hoping that that will actually grow to the ITU community, and even broader.

Because, similar to the way GNU Radio is to software defined radio and all that, where we really feel like ITS is in a position to establish a community around propagation modeling and measurements. And so we're trying to do that with software best practices.

Electromagnetic compatibility, this is a difficult problem that we continue to work on.

You know, there's a, it's a matrix problem with all kinds of parameter, input parameters to these problems.

Also, there is the Black Box problem where we don't really know what's going on inside, the device is under test.

Over the last few years we've developed, we focused more on simulation capabilities rather than testing the boxes and that's beginning to bear fruit. We have been focusing on characterizing the IPC of radar systems, specifically for SPN-43 (phonetic), which is for 3.5 gigahertz incumbent.

And then also we're looking into solid state radars and interference in and out of LTE systems. Which are kind of the most important systems these, I shouldn't say that, which are important systems these days to consider.

The other thing that I just wanted to mention on the EMC side is the aggregate problem. We've started working the aggregate problem in 2016 in the AWS-3 scenario where we were modeling

the Monte Carlo simulations, emissions, aggregate emissions from smart phones. And an uplink scenario with where the incumbent is the NOAA MET-SET Station.

So we've moved that this year, and advanced that in a number of ways. We have advanced the layout of transmitters such that assumptions like uniform spacial distribution is not the assumption put down there. We found out, via measurement, that that's not a good assumption to make.

We are looking at TDD systems, which is relevant to 3.5, where up and down link both operate in the same band. We are also executing on evaluating heterogeneous transmitters which, again, is we're moving our aggregate modeling towards 3.5 and we're trying to advance that to make sure that we can be smart about certification and so forth in that space.

And most importantly, in the aggregate thing, we're working to validate. I mean, we've been modeling and running these simulations to

try to make it go faster.

We haven't gotten to making some measurements to make sure that it's right. And so we are getting to work on that. And making progress there.

And we're also working to do a sensitivity analyses so that we're investigating, what are the strongest contributors in the aggregate emission modeling model and do we need to do this extensive Monte Carlo simulation or can we just cut to the chase and work towards modeling those strongest contributors.

So just one more minute, I'm not sure how much time I have.

MR. GIBSON: You're good.

MR. COTTON: So, in addition to the work supporting spectrum sharing, we have a number of other projects that are working to advance radio science in developing tools that will be needed in the future. We continue work on quality of experience.

In the past, we have set the bar for

doing subjective evaluation of audio and video when subjected to background noise and interference.

We continue, I mentioned about the software, I was talking to Dennis earlier about this. Software is becoming an important part of our output.

It's not just publications, we are working to, we are using GitHub software repositories as another publication mechanism for us. So we have developed an ITS policy that we're hoping to be an NTIA policy, in terms of software release, so that spectrum monitoring can make available sensor software that people can pull from. These propagation models can be available to the public.

IoT, we're working on getting a test bed going in there to evaluate what it means when these huge numbers of devices are on and we're looking to model that and measure what type of noise floor increase would happen there.

We are working for DoD, DOT, DHS,

Coast Guard, NOAA and even DARPA these days. Kind of on a sharp end of things.

So, I just wanted to, again, I'll take any questions, but, you know, one thing too I wanted to say with Julie, is I've been in contact with Bob Pavlak in talking about a lot of your work on TAC. I think Bob and I are trying to work out a deep dive you guys in late September, because I think that a lot of the spectrum monitoring infrastructure that we're building, I think you guys, we should compare notes on a little bit.

MR. KNAPP: He's coming.

MR. COTTON: Yes, I hope so.

MR. GIBSON: Glenn wanted to make a comment.

MR. REYNOLDS: Sort of an advertising message for a second. First of all, for those of you who don't know Mike, Mike is the head of our theory division in ITS. He's been in that role for about two years and has been doing a great job.

I think last year ITS, we had to go back to Congress, for the first time ever, and ask Congress to raise the ceiling on the amount of reimbursable work that we can do, in which we did, which is just showing the kind of aggressive work that Mike and Keith and Rebecca and all the ITS folks have been doing.

In particularly, in frankly what I guess would understatedly say an extremely challenging budget environment. I think if any of you all have any interest in the capabilities of ITS, what we can, what type of work we can do, a lot of our work on the creative basis, Mike is a great guy to talk to. Keith will be around this afternoon, Rebecca is here, other folks are here.

But I also sort of, I think we would like to hear from you all, just informally, just as part of conversations, what type of work is the most important for the industry going forward, what should we be focusing, what I can say are very limited resources right now,

particularly in our budgetary, our budget funding as opposed to our reimbursable funding.

Because as we are evaluating our options right now, we're actually going to have to make some difficult decisions on where to focus our efforts. And so understanding from you all, what is the most important types of work that we can be focusing our resources in over the next couple years would be extremely helpful.

MR. GIBSON: All right, thanks Glenn. A couple questions. Rick.

MR. REASER: Rick Reaser from Raytheon. I want to think, you talked a lot about sort of looking at interference for IPCs and stuff like that, have you guys kind of come up with some ideas about what is interference and what categorizes it?

Like, what is the definition of interference to these things and when do you, how do you determine whether that's interference or it's a nuisance or whatever?

I think that, all these things are

really, really important that you're doing, but the fundamental issues, and it goes back, we probably don't want to define what harmful interference, so I'm not going to go down that path, but at some point you have kind of a metric, okay, this is kind of a reasonable man about, okay, if this is happening, yes, you're being interfered with, now we need to decide what we want to do about it. Or if anything.

So that's the other thing. And by the way, each radio service kind of has its own kind of sets of things that you worry about that are different between a radar and a broadcasting versus other kind of things.

You know, I have speckles on my TV and I realize it's not wireless, it's probably wireless up to some point it is, but out of all the ones that go off my modem and through my other parts of my house too. But, you know, I'm not necessarily bothered if I miss a few pixels or use a few words. Have you thought about that? What's the definition there?

MR. COTTON: Yes, I think that, you know, the one thing about IPC simulation is that you're in kind of the error rate space, right? And there's really, and that's good to quantify that, you can do things because it's a big matrix problem that you can get to that way.

But yes, if you don't get the human element into the measure, then it's really difficult to get to that final assessment.

And what happens in there, for us, is when it becomes a priority to test that, this service or that service or the other, then we will bring it to the lab. We'll put a, whatever the human interface is for that system and we'll look at it.

We have, there's the QoE, Quality of Experience Group that we have that will help us assess what type of quality that is in a subjective way. And we can even do it objectively by bringing in testers as well.

So, it's a big question, but you're right, I think that that's the bottom line. If

you don't get to that bottom line answer, then you can always just argue about those error rates and things like that forever.

MR. REASER: And a follow-up to that. Rick Reaser.

MR. GIBSON: Rick, make it brief if you would because we got three people on the line, so thanks.

MR. REASER: Okay. The other thing is --

MR. GIBSON: Four.

MR. REASER: -- have you started looking at statistical ways of looking at that as well?

I've been involved in some of these things where it happens once in a billion years and if it happens once in a billion years it's harmful interference, which is kind of ridiculous. And sometimes the scenarios of these core cases just rarely happen.

I'm talking about the L band or GPS thing I was involved with for like literally 20

years. But some of these have, so statistical, are you looking at statistical things in terms of, terms with this interference?

MR. COTTON: Yes. I mean, we don't usually go -- there is an economics sort of element to this whole thing. There's also, systems these days are more adaptable.

LTE networks, if they have interference in a space they can adapt and go at it in a different way and things like that.

So yes, I mean, we recognize that there are these statistical means. There is risk assessments that should be done in a probabilistic way.

I think that that's something that kind of needs to be addressed as a community in engaging with us to some degree.

MS. ATKINS: Just to add, so as we have progressed with 3.5 and other scenarios, we have moved toward a statistical approach in terms of looking at potential for interference, the protection zones, et cetera. So we are moving in

that direction, there is still a lot of work to go.

MR. GIBSON: Okay, so we got Dennis, Dale, Bob, Michael, you in or you're out Paul? And then Paul. So, and we've got like ten minutes, so I'd ask you just to implore to keep it brief and succinct, I'd appreciate that, thank you. Dennis.

MR. ROBERSON: I'm going to tie several things together here. But this interference one, just following up on Rick's point, and really, it's Glenn's point of, what can ITS do for you.

I think this really is an extraordinarily important issue. We keep dancing around it as a community, and we have danced around it for years.

We've got Pierre de Vries with his harmed claimed threshold and so on, but we never quite nail this one down. And it is a logical extension off the propagation work. Okay, so you propagate, then what.

MR. COTTON: And propagation is probabilistic too. I mean, it's --

MR. ROBERSON: Yes, indeed. Indeed. But getting much further along that path would be enormously helpful, because we get into all of these issues, and with our sharing, these things amplified tremendously.

The boundary issues, in the TAC we've been at this for a decade, maybe more, two decades. So, we really could use some significant leadership, I think out of ITS, to help us in that space.

It's just an enormous issue that spends all kinds of time, spends all kinds of time with the commission trying to sort these things out and, well, enough, you said to keep it short but it's a huge one for your consideration.

The other one that also ties into the funding, there is this funding for ITS itself but there is Naston (phonetic). And you are part of Naston, but you're not, and could you, or maybe Glenn, speak to how you are seeing Naston these

days with its testing because it's certainly come along and has become a major thrust and done some significant studies at this point, but how is that going and how do you see the relationship and how do we think about that in terms of your funding, because Naston seems to have a model for funding that's independent of the ITS model and where do we go for this and where do we go for that, is there some definition you can provide?

MR. REYNOLDS: I'll give a quick answer and I will defer to Keith. Yes, the Naston is something that we've been working as part of.

There are, actually, there are costs associated with actually participating in Naston. And the types of work that Naston is going after are not always the same types of work that we're in a position to engage in, so we're trying to figure out the, frankly, how Naston fits within the ITS model. And we can have a further discussion about that offline, but it's a challenging situation.

Again, partly because of the budget situation and the fact that we --

MR. ROBERSON: Yes, that's why I addressed here because it fits right in what you're talking about.

MR. REYNOLDS: Yes. So, with the amount, you know, it takes resources, it takes money to make money. It takes resources to invest in order to be in a position to do a certain amount of work.

And we're trying to figure out, again Dennis, kind of going to the ultimate question that we're literally working on, as we speak, is where do we put those limited investment dollars, both as far as budget money and in personnel, and do we direct them in that direction or in other directions. And that's something we're literally in the process of trying to figure out how best to utilize those resources.

MR. ROBERSON: Thanks.

MR. GIBSON: All right, thanks, Dennis. Dale.

MR. HATFIELD: Oh, I was just going to say that I really support --

MR. GIBSON: Can you pull the mic down there? Thank you.

MR. HATFIELD: Yes, I'm Dale Hatfield. I just want to say I support what Rick said and add just a little bit.

And I'll read from something I wrote here very recently. Like many localities in Boulder, we have an automated speed limit enforcement system, but how can you automatically decide to issue someone a speeding ticket if you don't establish the applicable speed limit itself. So it's really, really is fundamental to what we're doing.

And then associated with that, it seems to me there's two sides to this. One is, when you're looking at interference to a government radar and we need to do something kind of immediately and get it fixed.

And then there is the issue, I want to go back and issue a notice of apparent liability,

where I want to see somebody's equipment, because that gets you in to an enforcement area that's sort of different than what you do right when you're fist sensing it. And I don't think those distinctions maybe have been explored as much as they could.

I could go on, but I, you know, this is an area that I feel very, very strongly about but I'll let it stand in to those two points.

MR. GIBSON: Thanks, Dale. Bob.

MR. WELLER: I probably don't need a microphone. Michael, thank you for the excellent presentation. I would echo the comments of others concerning the importance of your work relating to interference.

I'm kind of a propagation geek. And the ESSA databanks that data were collected in the 1960's and '70's, formed a databank that I and many others have used for validation of propagation models.

Is your current work something of similar scale? You know, month long projects all

around the country.

The previous work was, as I understand it, CW fixed frequency operation over a fairly wide range, but are you now looking at wideband propagation models with extended, the related extended parameters?

We're talking about the spectrum frontier, so measurements above 10 gigahertz, say clutter. Can you expand just a little bit more on what it is that you're doing?

MR. COTTON: Sure, I appreciate that. So, let's see. So, right now we have been marching up these propagation measurements. They are primarily CW type measurements.

This year with OSM we've brought back our pseudo-noise random code impulse response measurement, which is a more wideband type of measurement. And we're doing comparisons alongside. So there's some subtleties in comparing those two data sets and we're doing that.

Yes, I mean, one thing where that's

been great, let's see, in terms of scope, I mean, we don't, I talked about opening up the software into a test environment. You know, we really haven't made any of the data accessible, so we are basically driving to, internally, to advance the ITS models. So we haven't gone there yet.

Did I touch everything there?

MR. WELLER: That's helpful. I don't want to take any more time, but I want to emphasize there's interest and it's important and thank you for doing it.

MR. COTTON: Okay.

MR. GIBSON: Okay, thanks. We have four minutes and two people, so it's two questions per. And I really want to make sure we have plenty of time, the allotted amount of time for the Subcommittee reports. So Michael and then Paul.

MR. CALABRESE: Okay. Yes, it should be two quick questions here.

MR. GIBSON: That's my job, keep us on time.

MR. CALABRESE: Pardon?

MR. GIBSON: Nothing, keep going.

MR. CALABRESE: Your propagation measurement in modeling, is it, it sounds like that can be incredible valuable, but I'm wondering, are you focusing in any particular place? In other words, is this focused on millimeter wave or are there particular bands that you're focused on?

MR. COTTON: Yes.

MR. CALABRESE: Did you focus on, and the other, as you mentioned, the aggregate emissions problem. You're focusing on the 3.5 band, is that in relation more to fixed satellites or the Navy?

MR. COTTON: Yes. So, yes, I missed that. So we are focusing our clutter measurements on shared bands, so 1.7 and 3.5 is where we're measuring those.

Really, we have collaboration with the University of Colorado where we have a link to measure. It's way up at like 280 gigahertz.

Measure propagation up at those higher frequencies, it's more driven for Military applications at this point.

But there is this link that we're looking to put more channels in that are more related to the 5G type of scenarios. That has not been installed yet but we're hoping to get that off the ground this year.

Really, it's funny, because I was a part of the millimeter wave lab. I started at ITS as a student working underneath Hans Lebee (phonetic). You know, it's amazing that this space is coming back. I'm amazed at that.

But ITS retired that program, probably in 1996. And so we have expertise in that space. I was basically a physicist when I joined ITS and we still have that here, but we're really excited to bring back the measurement side of it. It's going to take some investment and work.

MR. GIBSON: All right, Paul, you got two minutes. And put your tents down if you're not speaking.

MR. KOLODZY: Okay. Mike, as you're looking at some of these interference analyses and things, I think it's great. A couple questions for you to think about.

One is, have you broken this up into actually, what I look at as a three components of interference in a sense of application impact of interference versus the transport layer impact of interference versus the PHY layer impact of interference where we finally can tease apart these things to basically look at technology, neutral ways of reviewing this and trying to get ahead of it so you're not continually revisiting this like, oh, (indiscernible) is here now I got to do this, oh, now a distributor of (indiscernible) is here now I got to do that.

Have you started to break that down to those pieces or are you still looking at it as a grouping as to interference impact at some level?

MR. COTTON: We are starting to. We really do, you know, we're the PHY layer lab. We kind of look at energy detection. That's our

first thing, right, is to get into that.

We've also, just this last year, we've expanded it, our staff, to a couple of PhDs and comp theory and that focus on the different layers of this, are helping us move towards assessing these other layers.

MR. KOLODZY: Yes, I really recommend you think about the, that's the space that's moving so rapidly in what's going on in the application space. And we tend to forget that.

We're all geeky scientists, we always love to work on the stuff that we can do in physics versus doing something that's a little bit squishier, which is the application side. But there's actually where the rubber hits the road. You may really want to --

MR. COTTON: Yes, we got to our QoE guys in with our comp theory guys.

MR. GIBSON: Okay, speaking of rubber hitting the road, thanks, Mike.

(Laughter)

MR. COTTON: Thank you very much

everybody, I really appreciate it.

MR. GIBSON: And I would just note, that's his addition as a game show host with his microphone that way, so he looks like Gene Rayburn.

So with that, we move into the committee out briefs. We'll start with the 5G Subcommittee, Mariam is on the horn. Are you going to be doing the brief, Mark?

MR. RACEK: Well, I'm going to start off with the status --

MR. GIBSON: Okay.

MR. RACEK: -- Mariam is going to go ahead.

MR. GIBSON: Okay.

MR. RACEK: She's the co-chair, Mariam Sorond. She's the Co-Chair of 5G Subcommittee and she's going to be giving the presentation. But just to go ahead and the give the Membership a little idea of what the status is.

As somebody said before, I guess with respect to the TAC, we're very focused on sort of

actionable recommendations. So we're very focused on that.

We, so far we've had five meetings. And thank you to all of the Membership of the Subcommittee, it's been very productive. Mariam is going to go into sort of the details, but we fairly have been able to go ahead and provide a lot of detail with respect to our responses when it comes to the recommendations, or the questions.

And we've been able to have a draft final report. That draft final report has been made available to the Membership.

And okay, I guess that's it. I'll turn it over to Mariam.

MS. SOROND: Okay. Hi everyone. So, this is Mariam Sorond from Dish.

As Mark said, I think we were, so the draft report right now is, it actually, it does need quite a bit of work we just wanted to share an interim version with everyone. There are comments back and forth from different

Subcommittee Members that we still are talking about it, and we'll actually go through them at our next meeting. So please consider this as a draft, it will probably change.

But we thought to help the discussion over here, we put a few slides together that we've shared with everyone. So I was going to go through the slides and not so much focus on the report, at this point.

So, basically in the slide, the first one is just a repasting of the NTIA question. On Slide Number 3 we're trying to say that we're looking at interference management and sharing in multiple standards bodies. And at this stage the standards bodies are not necessary focused on sharing.

So there's an exercise that says, okay, what's there so we can leverage it that would help sharing. But I think ultimately, you know, also the past Subcommittees we've been pointing out that we need to make this a little bit more focused on sharing and try to see if the

standards bodies would entertain specific work that allows for sharing between federal and non-federal users.

Because the technics that are there are really just enabling the sharing that is, that is within technology, intra-cell and intra-user and things like that. And they're leveraging, they're helpful really for the network efficiency and network interference matters, rather than being sort of parameters that you would use to enable sharing between different networks per say.

MS. ATKINS: Mariam?

MS. SOROND: Yes.

MS. ATKINS: This is Paige. One thing I wanted to note in this, I'm keying off the words on your slide as well, that I don't want to focus on sharing between federal and non-federal explicitly, as it relates to standards, it is more of a generalized sharing technics or technologies. Understand that your comment, I believe, was focused on looking at optimization,

I'll say, and interference within someone's network versus with external or inter-network or inter-systems.

But I just wanted to make sure that we aren't focused on federal versus non-federal as much as general sharing across the board.

MS. SOROND: Okay. Okay, that's helpful. I appreciate that clarification.

But yes, you're right, it is really about, within a network and basically other users. Let's say associated with a different type of network.

So basically like, you know, there is mechanisms for resource scheduling, and things like that, within the 3GPP and IEEE standards. But these are not necessarily geared towards different users as much as the same users.

Now, they go through like adjacent channel users, but it's still within the same technology level. So basically, when you have and LT carrier, they do look at what happens with the adjacent LT carrier, but not necessarily a

different technology. That's what I was trying to point out.

So, basically that's what we wanted to bring out and see if we can get any feedback or thoughts on that, at this point. But that's the situation we're dealing with.

So we can pull out, or we're trying to attempt to pull out, things that are there already to help, but really the solid approach would be to actually incorporate things that are meant for different technologies and different networks to share.

So that pretty much covers the thoughts on Slide 3 and 4, at a high level. And there is, Slide 5 is really about deployment. So this is another layer of things.

So basically, one layer of things is, what's there in the technology, what are the specifications and mechanisms within the interface or the network that enabled sharing.

But, the last one is also the deployment, which is distinct. It's, how do you

deploy these networks in more of an implementation of those technologies aspect that also could potentially be looked at for trying to see how we can efficiently look at the multiple deployment scenarios that, for example, small cells versus macro cells or basically satellite versus terrestrial or things like that that could also be looked at.

So this is a lot of sort of different layers that we're investigating in a Subcommittee.

So, we're going to land at, probably right now, ultimately towards a recommendation to try to account for these scenarios. But as far as actionable recommendations, I think we're going to probably land where we did last time where there will be a lot of information there and now we need to probably figure out, how did this information CSMAC and the TAC and the FDC and the NTIA efforts, the standards bodies, how is this brought together.

It's probably going to be the same

challenge that we're going to face. Because right now there is not necessarily a path that says, okay, I'll take this, I'll go to this place and this is where you can get these implemented. It gets a little bit more complicated than that.

So, going over to the very last slide, this is an example of --

MR. RACEK: Okay. So we did have some discussion about this as a proposed NTIA action. The thought was, is that to actually study sharing, one of the things that could be done is to actually introduce a study item within 3GPP.

And sort of the discussion that we had within our subcommittee is actually who should actually do that, whether it should be NTIA itself, or should it be sort of sponsored by NTIA but performed by maybe one of the companies within CSMAC.

The feeling was is maybe that this may be something that NTIA would actually want to perform. Apparently, NTIA is allowed to submit --

MS. SOROND: I'm really sorry. The bridge kicked me out.

MR. RACEK: Okay. I was just covering this.

MS. SOROND: Okay, great, go ahead.

MR. RACEK: You can add anything. I'm at the point now that NTIA, it looks as if they do have the authority to be able to submit to 3GPP.

And it may make sense that NTIA actually would take ownership over the study item itself and that here, what we have is sort of -- there are some sort of conditioning.

And that is you do have to get four co-sponsors from member companies, which I don't think would be a problem, and that, you know, it probably could be useful to actually find, within the CSMAC group, maybe co-sponsors or something that also are interested in a particular type of sharing as well.

And we have here sort of what the next meeting is. If NTIA wants to take this action,

then in September there is a 3GPP meeting. So it gives a little bit of time, maybe not a sufficient amount of time, to identify what an appropriate study item might actually look like. But, you know, that would be sort of the first opportunity to be able to do that.

So, you know, as we have indicated throughout the slides, these are just sort of thoughts that we have. We haven't actually come to a recommendation standpoint, but we did want to conclude on something that sort of, you know, kind of summarizes the efforts that we've had within the subcommittee.

CO-CHAIR ALDER: Mariam, did you have anything to add?

MS. SOROND: Yes. I would just say, on this last slide we did get feedback from Amy, you know, from our NTIA member of the subcommittee, about potentially, you know, issues or challenges with NTIA proposing work at 3GPP.

So I just wanted to mention that that's been brought up. So we really need to

kind of go to the next meeting and figure this out. That's why we pegged it as an example. But, you know, it's been done in the past for the first net contributions in 3GPP.

The NTIA will need supporting members, so we need to also figure out what the industry members that support this work item is. But we think it's a really good way to move forward capturing what we've been trying to highlight in this presentation.

CO-CHAIR ALDER: All right, great. I think we have time for questions and discussion on this topic. So I see two questions. Janice?

MS. OBUCHOWSKI: Well, it's part question, part observation. Compliments to the Co-chair and the active people, phenomenal sort of description of the 5G process and the kinds of sharing that it fundamentally addresses. And it's pretty straightforward in saying this is kind of an intra-system, intra-technology form of sharing. Got that.

It, however, does lead me to the

observation, when you look across study items you also, in another item, have, you know, very encouraging statements about how 5G is most efficient across broad swaths of spectrum. Fair enough.

I also heard the observation, "the most important technology." Having said that, as someone who thinks there are very substantial requirements going forward for federal technologies and other commercial technologies, it is striking that, well, it's interesting that the study, because it was very straightforward and very honest, said there's a radical difference when you look at LTE or any other robust standard between designing in sharing for non-completely related technologies or bolting them on. And that does concern me.

And I think, to my mind, it needs to amount to some kind of recommendation that it is crucial to decide how sharing will happen with 5G, particularly because 5G is so ambitious in terms of not just its standards ability but its

desire to acquire a vast array of spectrum which hitherto has been shared.

And if you decide not to design it in, you know, you're in this bolt-on scenario, or you're in a scenario of what we currently do, which is geographic sharing.

And since many of these other technologies also have ambitions not to be stagnant but to develop, and that's in the national interest, I'm not sure where we, as a committee, will address that concern which has to be a fundamental concern of NTIA's along with promoting commercial spectrum.

It's more of an observation. And this is a very -- you know, as somebody who wants to learn and contribute, I sit in on all these committees. And when you listen to the discussion, what is presented is a phenomenally ambitious growth path for 5G commercial across myriad bands.

But there are a lot of other technologies that, if they are not somehow

designed into that picture, will either have to be bolted on or will be in a national debate, band across band, for geography.

And I don't know where we're heading with our recommendations, but that's an observation that concerns me. Because we're here talking about commercial technologies.

But we're doing that in the context of an agency that also has very substantial responsibilities to ensure that in a, you know, a world where, number one, there are a lot of other sophisticated technologies that want access to those same bands and, two, we live in a very dangerous world with very sophisticated players. And on the federal side, people need to understand how we are going to use radio waves going forward.

CO-CHAIR ALDER: Thanks, Janice. And after the direct response, we'll move to Mark.

MALE PARTICIPANT: All right. Well, I have two questions. One, I'll just talk to you offline about. It has to do with the

accompanying paper. And I just want to ask a question about that.

But I wanted just a more foundational question. With respect to recommendations, do you have recommendations kind of that you're working on that you think you'll be able to bring into the meeting in November? How do you feel about that?

MALE PARTICIPANT: Well, the paper does have some draft ---

CO-CHAIR ALDER: Yes.

MALE PARTICIPANT: -- recommendations. I mean, we had a couple before this point that sort of talked about sort of database and how databases could be utilized as well. So we will have sort of some recommendations, I guess, in November. Is that the timeframe?

CO-CHAIR ALDER: Yes, yes.

MALE PARTICIPANT: Yes. Then we will have some recommendations. But in some of these cases, going back to what Janice has said, is that, you know, the questions were fairly

generic.

I think Paige has sort of re-emphasized that we're looking at general sharing, versus federal, versus non-federal type of sharing. So the answers are going to be, you know, fairly general.

And as we said in the slide presentation that, you know, these type of technologies are going to operate across different frequency bands, and they support different use cases. And therefore, we'll have different requirements like latency, reliability, those sort of things.

So all we can bring forward, I think, is sort of, you know, to sort of formulate the question that sort of needs to be answered in the hopes that we can come to some sort of definition, maybe through activities within 3GPP where you can bring a study item and actually start to get some clarity, and bring some of the requirements into 3GPP, and let them work in that vein.

Of course, that doesn't address all of the other standards organizations. But as we heard, you know LTE is very important. So that could be a start.

CO-CHAIR ALDER: Okay, thanks.

MALE PARTICIPANT: Mark, a couple of things. In getting back to what Paige said in the beginning, one of the degrees of freedom you have here, there's a lot of questions. You don't have to answer everything this, you know, this year. So pick the things that you guys feel you have the most information. And you can push some of the other stuff out and say, hey, we just didn't get to that this time. So you can choose to focus on what you think.

I do agree with Janice. This is a great report. It lists a lot of the technologies. And I think you had the really important statement that, hey, it's really not designed for sharing between technologies, just kind of designed within.

And so it kind of begs the question,

you know, which is actually what should be added. That, to me, begs the question. We have a couple of more questions though. I think, Dale, you had your tile up, or is that leftover?

MR. HATFIELD: I'm sorry. Just very, very quickly, I'm still a little bit concerned that it's really focused on the 3GPP ITU thing. And there's a lot of other activities, I think, that are relevant, of course, the internet IETF/W3C and so forth.

But also, I see so much going now on the open source area. And I think some of the open source things, here again, if you're trying to build capabilities in for sharing, some of those open source projects may have features and functions that could aid it.

So I think just focusing on 3GPP and the ITU, as admirable as that is, I think we risk perhaps missing something. And I'm not plugging anything here at all. But Facebook has what they call OpenCellular now.

MALE PARTICIPANT: Yes.

MR. HATFIELD: Yes. I mean, and they're trying to go to a more open architecture. Will that succeed? Actually, I'm not advocating or anything. But it seems we need to think about some of those open source things which are increasingly important, I think, in this area.

CO-CHAIR ALDER: Paul?

MALE PARTICIPANT: Mark, and Mariam, and your group, what I saw looking at this, wondering if you're trying to tease apart -- there seems to be some confusion between the mobile, and non-mobile, or fixed aspects with respect to 5G.

Do you plan, I have not read your report, so I apologize if this is actually teased out in there, but have you started looking at the aspects of --- are you focusing more on the mobile aspects of sharing, and what might be the issues, or the fixed?

Because I think those tend to get confused, and everybody kind of lumps it all together. And I think sharing opportunities in

one might be more readily available than on the other. Have you guys thought about that?

MS. SOROND: Yes. I can take that. So this is Mariam. And that's a really good point by Paul and also a good point previous to that by Dale.

But it boils down to a couple of things for us. These are all really interesting to look at. And there's no disagreement there. One is we could leave them as the next steps if we don't get around to it this time. But our challenge right now is actionable recommendations.

So there's a lot of information there, there's a lot of different angles of things that we could look at. How do we turn that into an actionable recommendation, and not just necessarily another white paper, is what I would really like to get feedback on at this meeting.

Because we're going to end up with this last slide, actionable recommendation, like last time. It is to take one these standards

bodies, and it doesn't have to be 3GPP, that is absolutely correct, but assuming that 5G right now is sort of -- there's a lot of activity in 3GPP, it might be a good one.

But it's what we do with all of this information that is a challenge. Mobile and fixed is a really good point, but how do we address that? How do we turn it into an actionable recommendation is the challenge.

CO-CHAIR ALDER: Anyone want to help Mariam?

MS. SOROND: Do I want to what?

CO-CHAIR ALDER: No, I said anyone want to provide some help for Mariam there. She asked a request.

MS. SOROND: Yes, please. Please, I would really appreciate feedback. Because we went through this the last time. And I feel sort of a deja vu again. And I really want the subcommittee, with a lot of the good work, and focus, and emphasis --- and by the way, we do have

a fifth member from Facebook on there. So that's really being looked at as well. But, you know, what we could do to move forward and what we could set in action I would appreciate feedback on.

MALE PARTICIPANT: Well, I was just going to reiterate what Larry said, what Paige said which is, you know, if no recommendation is to be had, don't make the recommendation. Maybe you can just define further study that might lead to the recommendation.

And I know we're not trying to make more work for ourselves, but this is probably one of the more complicated topics that we deal with which is 5G, because it means different things to different people, at least in the context of spectrum sharing. So if all you do is parse it and come up with a better way to address it, that's success. I think it is.

MS. ATKINS: This is Paige. So just to add, I think that we need to be reasonable. And I think there may be some actionable

recommendations that would come out of this discussion. And I think the members perhaps can provide additional feedback in that regard.

I do agree that if we need to tee up a potential topic for this next year, that is okay. Though I would like to emphasize that 5G is aggressively moving forward to include the standards activities. And I'd hate to loose a window of opportunity if there are things that we should be addressing now.

So do what's reasonable, and what makes sense, and that is useful to us in this cycle, and understand that we want to take advantage of the window of opportunity if possible.

I would also say, just a quick comment in general, though the reports are helpful, I wouldn't focus too much time just on writing a report. It's really are there recommendations that we can wrap context around versus generating, I'll say, a large report, though the information in the reports are always helpful. I

just want to ensure we aren't diverting too much resource and time just in writing and editing a report.

CO-CHAIR ALDER: I think we're going to move on to the next subcommittee. Was there someone on the phone that had a comment there?

MS. WARREN: Yes, this is Jennifer. Can you hear me?

CO-CHAIR ALDER: Yes, go ahead, Jennifer.

MS. WARREN: Hi. I just wanted to add, because I was listening this discussion, and it sounded like there were time constraints ---

(Telephonic interference)

MS. WARREN: -- with different possible recommendations. Would that be relevant to note, where any recommendations that come out of the group have any time constraints on them being meaningful to do?

MALE PARTICIPANT: Yes. To move on.

MS. WARREN: So that would be my request then.

(Laughter)

CO-CHAIR ALDER: Thanks, Jennifer. You know, before we move on, just something that comes to mind personally. I don't know if this is helpful to the subcommittee. It just feels like 5G is going to try and use all these different bands. And these different bands have different things in them, radar, fixed, satellite.

I don't know if there's expertise on the subcommittee to address any particular of those use cases, if you say, well, how should 5G share with, you know, fixed terrestrial, or satellite, or radar. That just comes to mind for me when I read this stuff.

MALE PARTICIPANT: And just a reminder for those on the phone, you guys, if you're not speaking, please mute. I think that's why Jennifer sounded somewhat duckish.

CO-CHAIR ALDER: Okay, with that, we're going to move on.

MS. WARREN: I didn't need to know

that. Thank you.

(Laughter)

MALE PARTICIPANT: We just wanted to defend you from sounding duckish.

CO-CHAIR ALDER: We're going to move on to the next agenda item which is the key characteristics. But we have neither Charla nor Tom is --

MALE PARTICIPANT: I think Charla's going to do this one.

MS. RATH: I'm on the phone --

CO-CHAIR ALDER: Charla's on the phone?

MS. RATH: -- Larry.

CO-CHAIR ALDER: Okay, great. Charla, take it away.

MS. RATH: Yes, thanks. And sorry that I can't be there in person. I had some family commitments that I couldn't get out of. So I had to stay here in DC. And my co-chair, Tom Dombrowsky, couldn't be here at all. So it's just me here as the co-chair. But there

obviously are several, I think almost all of our subcommittee members are on the phone or there in person.

So what I'm going to do is run through where we stand, and what our thinking is, and then, you know, to please ask fellow subcommittee members to speak up and add anything that they'd like to do -- that they would like to.

As you may have noticed, our report is very short. I realize now that we probably could have made it a little bit longer by actually including the questions which we didn't. I'll review them very briefly for folks, in case you don't have them with you.

But what we decided last week, in fact, we were actually writing a report and, you know, to Paige's point, we were writing a report, but we were writing it in large part so that we could use it to generate discussion on how we might answer the questions and what kinds of recommendations we might make.

And what we decided is while it, you

know, we do, as most of these reports are, it's in draft shape. As we were going through, sort of back and forth on it, it became clear that, you know, several of us felt as though the answers to the questions didn't really address all the different possible industry players.

And by that, I mean, we can't be comprehensive, obviously. But there was, you know, there was clearly some would have advanced more toward terrestrial services, particularly mobile. And the idea is that we want to get more in each of these areas and be thinking about them before we actually share it with the full committee.

And it's not to say, you know, some of the questions actually did deal with it probably better than others, but as I said, we just felt that the timing wasn't good in terms of sharing, if it's where we actually had a chance to go through and really deal with those issues a little bit more closely.

We intend to do that very quickly and

are not waiting until the next meeting. And we're hoping to be able to get something out to the committee before, you know, well before November.

When Tom is back from vacation, what he and I will do is call a meeting and then also try and do this. We've actually accomplished a fair amount through email as well.

So the -- welcome to my notes here. So basically what we did do is we actually put before the committee three recommendations. And we would really like to talk them through.

I think even among some of us, there might not have been full, you know, agreement on the nature of the recommendations. They more or less follow the first three questions. So we have recommendations on the first three questions but not the last two.

So what I'll do is let me --- I'll read the question, and then we can talk through the first draft recommendation. And I'll do the same for the second two.

So the first question was, from an industry perspective, what are the key characteristics to consider in evaluating the desirability of a particular frequency band as a candidate for license inclusive for shared and unlicensed spectrum?

And then we also got feedback through Amy from Paige that she was interested in having us look at the relative priorities of characteristics, not just the characteristics themselves.

So our --- you know, you can read this, but basically what we, as a group, looked at as being, you know, critical to commercial industry for propagation, coverage, capacity, contiguity, international harmonization, and encompass the issues.

And we did actually take up Paige's question, but there was just a lot of back and forth on that. And, you know, I think we'll take it up again just to see whether we can hone in.

But what we came out with was that, in

fact, the relative priority for the characteristics is likely to vary based on industry, and actually even within industry, on each case.

So that, you know, again, Paige, to address your issue, you know, I'm not sure that we're going to have a better take than this. Although quite frankly, this is actually --- I believe that it, you know, if we kick the tires on this, both here in this meeting as well as when we go back to our subcommittee, I think this could actually be a useful part of the recommendation.

I don't know how you want to handle this. I can stop now and let my subcommittee members chime in. Or I could go through all three.

CO-CHAIR ALDER: Charla, why in the interest of time, why don't you cover the brief, and then we'll do discussion and comments.

MS. RATH: Okay, great. So second recommendation, you know, is fairly

straightforward. We recommend that, for either re-purposing or sharing, that the government actually look at contiguous spectrum.

And, you know, this is harder to show without the, you know, without the background. But what a few of us did from satellites, unlicensed as well as licensed point of view, is we went and looked at various technologies and looked at, you know, the key components of both, you know, what you gain from having contiguous spectrum.

And again, there was a question that Paige raised, and it may have lost something, Paige, in translation, and I would like to actually, you know, have you walk through it. It had to do with, you know, putting this in context.

And we looked at that and were, you know, somewhat -- we were a little bit --- we were having to make an interpretation of what that actually meant. So what we were interpreting it is whether, for example, the need

for contiguity changes depending on band width or frequency.

So, you know, when I'm finished here, that would be helpful, Paige, to have you sort of talk about that and again, you know, my colleagues.

The third recommendation is --- and this is one I just wanted to be clear that, you know, the language is pretty, you know, NTIA should not attempt to rigidly define, blah, blah, blah, blah, low, mid, high band spectrum. And sorry, I forgot I was going to read each of these.

Question 2 was what are the technical and operational impacts of contiguous versus non-contiguous spectrum to satisfy commercial requirement.

Question 3, the one that I'm on now, is when industry describes its need for low, medium, and high band spectrum, what should we understand to be the definitions of those broad frequency ranges and the rationale for selecting

the boundaries between each.

I think, you know, one of the comments that clearly, you know, we'll think of a better way to say this in the final recommendation, but certainly if we were looking at this, and everybody around the table knows this, is that, you know, several years ago if you had talked about low, mid, and high frequencies, it would not be the ranges that we're talking about now and certainly not, you know, mid-band spectrum would not be what the Commission just adopted in NOI 37 out of it, you know, frequent seven gigahertz to 24 gigahertz.

So, you know, and one of the issues we were looking at is saying when you talk about a band like that as a bit-band, you know, clearly the propagation characteristics, and just the way that it can reduce even availability that can be encompassed can change dramatically when you have a large range.

So one of the things that we're looking at, you know, is again, that we're not

100 percent sure how helpful it is. You know, in some ways those definitions are, you know, they're being used by us, they're being used by government, they're being used across the board.

But, you know, we're struggling with just how useful they are definitionally, whether we should actually be, for purposes of answering the questions, you know, which is the rationale for selecting boundaries, we might even --- we were even looking at potentially, you know, making them more than --- having more than just grade, you know, low, mid, and high, maybe even looking at ranges where there's a little more commonality in propagation characteristics.

So we don't have recommendations on the final two questions. Question 4, to what extent does the channel bandwidth need for any given deployment barrier, depending on whether deployment is low, medium, or high band spectrum. Obviously, that is somewhat contingent on what we recommend for spreading (phonetic)***1:42:34.

And Question 5, what commonalities and

compatibilities between federal and commercial application could be exploited to maximize the potential for sharing between federal and non-federal users. These might include, for example, applications that coexist technically and/or operationally for common technology.

And the lack of recommendations there is not, you know, it is not an evidence that, you know, there hasn't been work done in those areas. I think we just haven't really been (inaudible) yet.

And again, as I said, our plan is to, you know, take the feedback we get here and then move forward fairly quickly in trying, you know, to finish up the report and potentially come up with recommendations for, you know, to hone these recommendations and come up with new recommendations or, to the extent that Larry had said earlier, you know, perhaps recommend that some of those things could be used for the (inaudible).

I'm not saying we think any of them do

at this point. But, you know, I heard that. And, you know, if we think that makes sense, we'll probably recommend that.

So that's my description. And turning it over to some of my cohorts if anybody has any comments, if I left anything out, if I misrepresented what we're thinking, please comment.

CO-CHAIR ALDER: All right, Charla. I think Paige wants to make a comment first.

MS. ATKINS: Yes, Charla, I want to address, I think, a couple of items. The question on context, and this was particularly relevant to the key characteristics for commercial deployment, you know, obviously, the key characteristics as defined have tradeoffs, particularly propagation and coverage versus capacity, as an example.

So the context was related to how we consider these key characteristics associated with perhaps, I'll say, use cases, or unlicensed versus licensed, or other applications, different

kinds of technologies, just to help us as we try to apply these key characteristics in our own processes of looking at bands for consideration.

Also the part of the intent of the question of low, mid, and high is to help us prioritize where we focus our resources in this resource constrained environment.

So as we look at the needs across all of those bands, what does that look like in terms of projected requirements? And how do we define those bands so, as we look at options that we may want to focus resources, how we prioritize those smartly. So that just gives you some additional background, I think, in terms of the intent of --

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MS. RATH: Actually that, yes, that's helpful, and particularly the latter which I think fits in with some of the description I gave as well. Because if we narrow, you know, that probably is helpful to you as well, is if we narrow, say, you know, big bandwidth, one, two and three kind of thing, as opposed to, you know,

3.72 as well, you know, 24 gigahertz.

CO-CHAIR ALDER: All right, are there other questions and comments? I see one from Dennis.

MR. ROBERSON: Dennis Roberson. On this third point, the recommendations and the comments you just made about low, medium, or mid, and high bands, I'm just going to really hit this point an additional time.

These have been so fluid over the years that, even though we've just put out an NOI in the mid-band and redefined it once again, it's really becoming less and less helpful, in my mind, to make these distinctions.

I think we're better served just to put out numbers and characteristics of bands, in the way you described it, for applications rather than try to artificially create low, mid, and high.

Because the terms don't have any meaning anymore from, at least from my perspective, just because they're so fluid and

they're so different in different timeframes, and different based on the way the technology has evolved.

So things that we only thought we could do with low band, where low band was kilohertz, if you go back far enough, and Dale is laughing, because, yes, you know, it has really, really, really changed. And I think it's very, very artificial to use that terminology.

MALE PARTICIPANT: Yes. I think what we're hearing is, you know, focus on what bands should they focus on instead of naming ---

(Simultaneous speaking)

MALE PARTICIPANT: And there are numbers that are ---

MS. RATH: But not specific individual bands. But ---

MALE PARTICIPANT: -- frequency ranges.

MS. RATH: -- I'm looking at kind of ranges. And because we understand that there are evolving requirements across everything.

MALE PARTICIPANT: Right.

MS. RATH: But we can't focus on everything, so helping us prioritize our resources. And I fully agree that the assumptions we made, you know, five years ago on bands, and applications, et cetera, have changed in some cases very dramatically. So we don't want to get locked in. It's just a matter of how do we help prioritize ---

MALE PARTICIPANT: Yes. And that's the point, just to recognize that. I mean, if you go to the physics, since I do have a physics degree along the way, there are things like water absorption, where water absorption hits, and oxygen absorption bands, and things like that, that are fixed. But beyond those kinds of things, much of the rest of it is really, really very fluid.

CO-CHAIR ALDER: All right.

MALE PARTICIPANT: Well, in terms of what will ---

MS. WARREN: And this is Jennifer.

MALE PARTICIPANT: -- help you versus what will help Charla, I mean, that's where we need to make the connection.

MALE PARTICIPANT: Right.

MALE PARTICIPANT: Charla and the committee. So, I mean, we can talk all that we want to about what this means. I mean, 100 years ago, high band was kilohertz. So, you know, it changes with the times.

MS. RATH: But I do think it's helpful just, you know, Paige's comment in particular about the resource constraints and sort of focus, and then Dennis' on top of that suggesting, you know, that it really is about --- again, I kind of had to, when we started talking about mid-band, again, I was like, well, what do we mean by mid-band? Okay, great, we'll call that mid-band now.

But it was not even -- like I just said, a year or two ago it wouldn't have been that high.

MS. WARREN: This is Jennifer. Could

I get in here?

CO-CHAIR ALDER: Go ahead, Jennifer, you're up.

MS. WARREN: Great. I also think that focusing on band ranges is important because of the fact that this approach varies significantly by sub-sector of the industry. So high range and mid range haven't varied as much for the satellite industry as, you know, the shift within the wireless industry.

But more importantly, internationally, none of this translates, whereas band ranges do. And if we're going to be talking about harmonization and scale, I think that's a better opportunity for alignment. So I would support this change. Thank you.

CO-CHAIR ALDER: Thanks, Jennifer. Donna?

MS. BETHEA MURPHY: Yes. Donna Bethea Murphy from Inmarsat. I agree with the previous speakers, that is that each band has a different propagation characteristic. So maybe we talk in

specificity associated with propagation characteristics or bands, and assuming everyone knows what the propagation characteristics are that are associated with those.

But I think that when we're looking at sort of, you know, writing a bigger document, we have to consider the --- and I know we're trying to bring this to a higher level, but I think when you look at the service, the applications, the coverage, and even if you're talking about, let's take for example satellite service, well, you could have a mobile satellite service. You could have someone providing broadcast within the mobile satellite service, or broadcasting within the fixed satellite service.

And I think each time you look at the characteristics, the dynamics with sharing or, you know, how you can fit other services in, changes.

And I do think it's interesting as we look to sort of make everything the same, even if we're looking at --- not looking at worst cases

like Julie was talking about before. If you have a frequency band where you have lots of different applications in there, what you may be doing is rewarding the one system that was built, instead of being built to sort of maximize the use, the one system that is built sort of, you know, at the mid-level.

So I think that this group has an interesting task. And I think that there are a lot of things that we need to look at to put out something that is usable, that someone can make a decision about. And I think that we will have to get a little bit into specificity as opposed to sort of generic things.

CO-CHAIR ALDER: All right. Any other comments on the phone?

(No audible response)

CO-CHAIR ALDER: All right. Thank you, Charla. That was great. And, I guess, Charla, anything else, or we'll move on?

MS. RATH: No, that's it. Thanks.

CO-CHAIR ALDER: All right. With

that, we will move onto the Enforcement Subcommittee. And I think Paul's going to present. Am I correct?

MR. KOLODZY: Well, again, my cohort, I think, is also on the phone right now, Mark Crosby.

MR. CROSBY: Yes, I am. But you have the conn, Paul. Go ahead.

MR. KOLODZY: Okay. Which means I can blame him, good.

(Laughter)

MR. KOLODZY: Okay. This group has been struggling a little bit and trying to get some momentum going. We've been --- there's been some meetings going on. We're trying to be different than the previous --- actually some of the questions we were asked were different than the previous Enforcement Committee questions.

And so we were trying to address, you know, how to, you know, some of the technologies, some of the possibilities that are out there for doing enforcement. What are some of the

technology pieces, and what are some of the things that are going on in the 5G world that are unique for enforcement that should be brought on?

Those are essentially the questions that you asked and sort of asking what do we recommend to try to do to move forward in the automated enforcement area. And you can see here all the members. We've had -- everybody has been involved one time or another in some of the meetings.

If we go to the next slide, how we kind of broke it up as a group, and I'm just going to go quickly through this, was simply to bring up , in a sense, four different groups, one of them to look at the background area and ask the question, you know, hey, what has been going on in enforcement? How is enforcement being done? How is automated enforcement being done at the present time and, in trying to link back into other studies that are going on, so it's not simply we're trying to recreate and repeat other work.

The other aspect was then, okay, what is currently out there today that we can take advantage of with respect to enforcement and automate the system. So what's, like, right now available, what's on the mark, what's out there, and what are the ramifications legally and policy-wise? Because that would be sort of like the near-term or the low hanging fruit in the sense of trying to look at for enforcement.

Group 3 was trying to look at, hey, what's really technically possible, and what is out there that, if we actually started bringing into the system, that would sort of try to build up new automated enforcement mechanisms which, at the end, I think what you're looking for is trying to understand how you can use automate enforcements to push sharing to a new level.

And that's really what your goal is, it's not really just to enforce the mechanisms. But right now, we tend to build enforcements or rules for sharing based upon that there is no enforcement mechanism.

So you have to actually be very conservative and try to back off, versus if you have some automated ways, so all those corner cases that we tend to look at, if you can automate those out, now you can actually be much more aggressive, I believe, in the enforcement process. And so that's what this Group 3 is trying to ask, you know, "What can you do there?"

And then Group 4 was trying to look at, hey, what is the 5G specific? And you're going to hear a little bit about some of those aspects.

We've met a few times, as I said. Look at everything you have here as a work in progress. This is an interim report. This is when we talk about recommendations or findings, they have not been thoroughly vetted by the group. We are just getting to that point. So take these with, as I said, a grain of salt as we move forward here. So (inaudible) what, you're thinking of this?

But feedback as to areas where you may

not have been looking at that we should be looking at, I think, it would be very valuable right now.

And I think the rest of the committee, you know, as we get done with this, feel free to jump in and kind of expound on a little bit of some of the ideas we were putting out here. The status, as I said, we're doing these preliminary findings, and these are raw materials.

The next slide, the next slide. So the activities, we've had multiple meetings, we've actually developed a bibliography of prior work thanks to the Group 1 activities. We have a list of references and contacts where they've been looking, and you'll see a little bit later on, trying to talk to interference hunters and the like, and trying to understand a little bit about how they're doing it to see how you can automate some of those processes. And we're talking to equipment manufacturers about what is possible.

If you go to the next slide, so the

preliminary findings on this, again, preliminary should be double, triple underlined, okay. First of all, which is kind of interesting to note, is that most companies hire consultants, at least the smaller companies, to find their interference. When they have a problem, they actually hire out.

Some larger companies, like I would presume the big wireless carriers, will have internal teams. But in general, all the other players are all looking at some individuals, like your interference hunter people, or whatever, to go out and find that.

And they break up the interference into really the three types. One of them which is, believe it or not, one of the biggest cases is intra-system or self-interference. We find that a lot.

The other one is that somebody, one group, one item, one person, one emitter, causing problems. So you're just trying to find that emitter.

And the other one, as we talked about before, and Julie was looking at it, is the rise in the noise floor, is that all of a sudden, we're having a problem in general here, it's no longer very specific, find that.

So when you talk about automated enforcement, and you look at somewhat in the AWS-3 band that I've been involved with, it's almost, like, widespread when you're seeing the whole noise floor rising up because of many, many users integrating together. You have to look at that differently than you can look at, hey, there's just a hot spot there, and I need to be addressing it. So we find that.

We also find out that, really, there are limits. And I invite some of the committee members to comment on this later, there's a limit to what consultants can actually do. You know, there's only so far they can go in the sense of locating people and tracking them in, like, due to legal or policy issues, and especially in the privacy area, and the ability to access

particular locations so they can determine what's really going on.

So in overall, just even using these kind of mechanisms, if you don't find some way of automating it, you still are going to have to bring in outside teams from the regulatory agencies to actually have the ability to break through these privacy and access issues. Or you're going to need policy changes to allow that to occur. And that's a sticky wicket.

Automated systems tend to be also applying just to current waveforms. So basically, people build systems that do WiFi hunters, that do, you know, looking for cellular bands and all this stuff. They don't build systems that actually cross the board and actually can use waveforms that aren't standardized.

And so therefore, if you're actually trying to locate somebody who's using a waveform that is not using one of the standard waveforms, you have a tough time at this. And so therefore,

there's a whole technology built up there.

Instead of using energy detectors or using something actually much more sophisticated, you're going to need much more sophisticated technology to be able to hide, I mean, to find some of these people who are using waveforms that are not standardized waveforms.

The next slide, some of the evolving challenges that happen, giving that as a backdrop, essentially you're getting to smaller and smaller cells. So now it's no longer just a big stick looking for who's interfering associated with them. It can be in so many different characteristics. You have to somehow understand how to break those up.

As I was saying, even though there is more cells, they're getting closer together, and that the capacity and latency constraints now, interference now could be on latency not just on pure dropping something out and the like. And this actually goes to some of the questions I was asking the ITS folks, which is how are you

looking at interference.

And some of the new challenges that are going on in the 5G world, the whole area of device to device communications is now coming up. And so now interference, which is associated with the device to device, is something that probably many of us are not thinking about.

We also have to deal with what is interference when you have adaptable rise (phonetic)***1:59:40. And considering that is now being employed not only in the high frequency bands, but it's actually in distributed and non-distributed MIMO systems. It's actually becoming more prevalent.

And you also have --- the systems are already doing dynamic framing which means that, when you're trying to actually understand what interference is, you have to put it in the context of how it's changing its frame sizes which actually indicates what kind of interference you actually are getting. And so those are kind of the new challenges when you're

trying to go into automated systems.

But the good news is there's new capabilities in the sense that, as we go to 5G and these higher band spectrums, there's a lot of bandwidth to be had that maybe you might be able to glean off a percent here, a percent there, which gives you a better capability of actually distributing the information around to be able to do enforcement.

Next slide. So again, now that was three underlying of preliminary. This is the four underlying part of the preliminary.

(Laughter)

MR. KOLODZY: And that is one of them --- and pretty much the group has been talking about this, which is how you get best practices or databases of what people have found out before to be used by future users, future interference hunters, and the like.

People have built up techniques. In fact, a lot of them are willing to share those techniques, okay. But the question is, is how do

you get a database together so that people can say, hey, this is how I found, you know, how you can locate this kind of interference source and the like.

And that's actually a pretty straightforward type of process. The question is, how do you actually host something like that?

The next one is how do you actually look at transient interference cases and the impact of transient interference, okay. And the idea is to somehow find a way to study that. Because everybody tends to look at, if it's in one microsecond, one nanosecond, is that interference? Is it one second interference, is it one second every second for half a second, for ten mintes, is that interference? What are all these duty cycle issues?

And this goes back to the application and in the transport phase, not actually in the five layer anymore. And that actually gets a lot more complicated. So recommending maybe a study in that area.

Trying to also require a machine-readable report for interference detection systems. So basically, how do you standardize the methodology to actually provide the information about interference?

One possibility is that when you start to do sharing, do you actually put in the policy or in the technical rules to enable kill switches or pause transmission switches. Or, we've talked about in previous times, beacon IDing and ID capability.

So the idea is that you do that in the 5G to aid in this machine and machine interference diagnostics, also to look at analyzing the different enforcement stages of automation, all the way from --- it's not that you have to go all the way to the step of, "Listen, this is the person who's interfering with you, and this is how they're interfering me," but actually looking at, first of all, I want to find if I have interference.

How do I report that process? How do

I report what the impact of that is, how to report, you know, the characteristics of it, how to report maybe the spacial characteristics of it? So how do you go up the levels instead of just saying enforcement is everything, you know, from beginning detection stages all the way up into the shutting down of the interferer?

And finally, and these kind of all tie together, how do you build an automated enforcement architecture? Because that actually is how you're going to be able to fit all these pieces in.

And with that, Mark, would you like to add any additional comments?

MR. CROSBY: You did a great job, sir. I think my only comment, I think, we covered in the last two bullets. I think one of the issues that we have or challenges that we have is I think it's easier to, you know, work with interference mitigation.

You know, you can identify it, and you can figure out where it is, you know, but it's

not malicious, right. So interference mitigation is, in my opinion, not enforcement. It's maybe a lower piece to it, but it's not an enforcement activity.

And sometimes we also get discussions into, well, we're doing enforcement when we have automated means to maintain the integrity of systems. Yes, that's important. But again, I don't think that's enforcement.

Enforcement is when somebody, or a group of people, or one person, or even vendors get -- you know, equipment can come in that's not type-accepted, or there's malicious, or maybe not malicious, but rules are broken. And then you've got to fix it. That's enforcement to me.

And so I really want the subcommittee to, maybe with Paige's comment, I know interference mitigation is important, but I don't view that personally as an enforcement.

Enforcement is when somebody breaks a rule, you know, on purpose or by mistake. But you go after them, and you fix it. That's

enforcement. And, you know, I sort of also have been spending a lot of time reading Dale's emails and I ---

(Laughter)

MR. CROSBY: -- and, you know, Dale's right, you know, in a lot of respects. You know, what are we enforcing? I mean, is this --- do we leave it alone and the parties will take care of it? Because, you know, the speed limit's 55, and they were doing 50? Or enforcement's when somebody's doing 90, and the speed limit's 55.

I mean, I think the committee, the subcommittee's doing great work. I think we have a lot more to go and further clarification and guidance from Paige, I think, at this time, and the other members of CSMAC, would be helpful.

MS. ATKINS: Okay, Mark, I'll chime in. This is Paige. And I've said this in past sessions. I'm going to repeat it here. When I use the term enforcement, I use it fairly loosely and broadly.

It's not just the traditional

enforcement definition or mechanisms, as you describe, but looking more wholistically at how you even prevent interference. You know something's about to occur, and you can prevent it, or you identify and then resolve it.

So I've always talked to that term of enforcement, and in context of this subcommittee as a broader context, particularly as you look at automated capabilities that you might want to inject into the, I'll call it the infrastructure, more broadly.

I also wanted to just ask a question in terms of --- and this is probably a step too far. But as you look at this problem set, as you look toward the future and things like dynamic spectrum access, software defined radius, software defined networks, then how does that change the dynamic for, no pun intended, or, you know, the framework of what you might be looking at as well?

MALE PARTICIPANT: Correct.

MR. CROSBY: That's a great question.

One would think that, and listen, I'm no technologist in this, but one would think you'd be able to embed those type of devices or the very sophisticated hopping and, you know, interference mitigation type of software inside those systems and those devices, one would think. But again, maybe I'm a dreamer.

My only other comment is, with Paige, I love talking about things like kill switches and the things which is, you know, really hard core enforcement.

(Laughter)

MALE PARTICIPANT: I appreciate it.

MALE PARTICIPANT: It's hard core anytime you say kill anything.

MR. CROSBY: No, I mean, again, I like that, Mark, though, you know. And sometimes I understand.

MALE PARTICIPANT: Sometimes they call that stop buzzer. But if you want to go full, you know, metal jacket, call it ---

CO-CHAIR ALDER: All right, Mark, if

you don't have any more, we have a lot tents --

MR. CROSBY: I'm done.

CO-CHAIR ALDER: -- up here in the room.

MR. CROSBY: I'm done.

CO-CHAIR ALDER: Let's move that. I think, Mark, you were actually the first tent.

MR. MCHENRY: Yes. So I wanted to make a comment. I said this before. I think you've got some SAS people. I know I'm on this committee, although I have missed the call, so mea culpa. I think Paul's on the committee, and I think Curt's on this committee.

You're going to have an excellent example of how this is going to work in the context of SAS, CBRS, and ESC. Because right now, in fact, probably in the next couple of weeks, we're going to be meeting with the Commission to talk about enforcement in the context of SAS. And we're talking about interference reporting and enforcement in the context of ESC. So stay tuned.

I'm not sure if we'll be able to feed anything back in terms of recommendations by November. But that's playing out exactly in CBRS along the lines of what, you know, what you're asking about.

You know, and Mark mentioned it's not enforcement until you break the rules. So that's an interesting concept. We're trying to put the anti-enforcement on some of what we're doing so that breaking the rules means we don't interfere with ships coming onto air craft --- or air craft coming onto to aircraft carriers. I'll leave that as it is. So we'll try to feed that back to you in the context of calls. But there will be a lot coming out of that.

MALE PARTICIPANT: Well, that said, I presume then you're going to be very actively participating in Group 2. Because that's actually the group that you said. This is the technology today.

MR. MCHENRY: Yes.

MALE PARTICIPANT: This is how we're

employing it, and this is its challenges associated with that.

MR. MCHENRY: Yes.

MALE PARTICIPANT: So I'll count for your input.

MR. MCHENRY: I'll be there.

CO-CHAIR ALDER: Bryan.

MR. TRAMONT: So this is Bryan Tramont. I have two quick things. One is when we did one of the prior Enforcement Committee activities, we drew a distinction between ensuring compliance versus taking enforcement action. And it might be a useful distinction to continue to draw from a taxonomy perspective, about the compliance versus enforcement. So that's one.

Two is whenever there's a bullet that starts with mandate about technologies, I break out into hives. And one thing I would just, as a comment ---

MR. KOLODZY: Number 4 underlined.

MR. TRAMONT: Understood. There's a

lot of salt here. I know, very small grains, but for everybody to think about where the incentives align here.

And Dale talks a lot about incentives, and are we really talking about a mandate? Or are we talking about a situation where compliant companies will do these things because their incentives align to do so?

And then relatedly, companies who want to break the rules won't comply anyway. So it won't matter. So there's a bit of a cross-connect about how you think about mandates and incentives aligning.

You don't need one if you have the incentives aligning. And indeed, the people who will break the rules will break the rules. So just try and think about that. And I always am nervous about any mandates that have any specific technological capabilities associated with them. So I just wanted to add that cautionary note.

CO-CHAIR ALDER: Thanks, Bryan. Dale?

MR. HATFIELD: A real minor thing, but

it seems to me, talking about waveforms and shifting waveforms, we've had emission designators in the past which have been useful in enforcement. If you see an FM, this is a silly example, you receive an FM signal on an AM band, it kind of tells you, hey, there's something going on.

So we've used emission designators. I'm not sure what they mean anymore. I think there might be an interesting recommendation coming out of this that would be look at the role of emission designators. In a situation now with software defined radios, you can be changing those waveforms on the fly.

Finally, and I apologize for being a broken record here, but I still am extremely concerned about the spoofing and jamming issue.

We've had this recent, the issue, GPS that --- and again, these systems went -- radio systems are inherently open. You put them in a Farady cage, they don't work for their intended purpose.

And we've got, I think, in talking about the enforcement thing, is to look at people who are using the evolving technology can both spoof and jam. And I don't think the reactions, it seems to me, the architecture of the design of the enforcement system, I think, has to change a little bit when you think about that threat vector.

CO-CHAIR ALDER: Thank's Dale. Michael?

MR. CALABRESE: Yes, Michael Calabrese. On recommendation, preliminary Recommendation Number 3 ---

MR. KOLODZY: Four lines preliminary ---

MR. CALABRESE: Right, exactly, four lines. It talks about develop a machine readable report standard for interference detection results.

And I'm wondering if -- does this suggest development of standardized metrics or collecting interference detection results? And

if so -- I mean, which I think would be probably very useful -- but if so, does that then go beyond, for example, the mechanism of a database to work in bands where monitoring is the mechanism, and perhaps even monitoring by incumbent. But if it's a standardized way, then it can be shipped over to the FCC, and they actually know what they're looking at?

MR. KOLODZY: Right. This specific recommendation was not on how do you standardize the measurements but more how do you standardize the presentation of that information, okay.

So the two are intertwined. But I just want to make sure we're not telling people this is how you make measurements. It's more if you can tell us what the noise floor is, if you can tell us what you're measuring and how you measuring it, then at least it can be brought in together versus telling people, you know, mandating, not mandate, sorry, bad term, suggesting standards with respect to how you make the measurements or how you do it.

So this is the idea of --- it's almost like building a messaging format that we do for a lot of things, you know, to make sure that the messages can be read by everybody and can be understood by everybody.

MR. CALABRESE: So the goal would be a degree of standardization?

MR. KOLODZY: Yes, on the reporting, not on how you, you know, how you report it, not what you report.

MR. CALABRESE: And then in terms of mechanisms, are you focusing on monitoring, spectrum monitoring as a mechanism as well as databases?

MALE PARTICIPANT: Well, yes, definitely spectrum monitoring, but we haven't gotten to that point. We have to figure out what any kind of recommendations are for spectrum monitoring. So good idea, good point, we just haven't gotten to that point yet in the discussions.

MR. CALABRESE: Yes, I was thinking

that maybe the combination of those standardized metrics and monitoring could ---

MALE PARTICIPANT: Oh, yes, that's ---

MR. CALABRESE: -- you know, perhaps work in more places than the database mechanism where you can get the kilohertz.

CO-CHAIR ALDER: Hi, Rick. You had one?

MR. REASER: I just wanted to amplify. Some of these things are related, and so we have some things about cleanup. And not to hammer on the mandate thing, but one of the ideas is to actually, you know, as a part of the authorization and licensing system, to have requirements for --- there are certain features that would be implemented in devices that we get authorized in the future.

So one of the things could be you have to provide a report. One of the things you do if you're going to have a certain class of service, or certain rights, in order to have those, you would be, you know, told you'd have to provide

that as a part of your device and be able to report in.

And we've talked about this in terms of, like, tethered and non-tethered systems. And there are systems like that today. If you take a look at the way the TV White Space works, and this whole business we're doing with the three and half gigahertz, those are very similar kind of things.

Now I guess you kind of lock down this method or this thing about whether to mandate or not, but if you pile those things together it's very, very powerful.

CO-CHAIR ALDER: All right, thank you. I had a few things to just --- what strikes me is it seems like the general problem is super hard in enforcement.

(Laughter)

CO-CHAIR ALDER: So it just seems like is there kind of an easy --- is there some low hanging fruits, some easy wins? Or is there, like, an if/then statement? If we did this, then

we'd unlock a whole nother level of sharing between systems or something.

I just fear that the general problem is super hard. So I'd look for the low handing fruit or what can enable -- maybe 3.5 gigahertz is a good if/then, if we do this, then we can do that. So that was some of mine.

Anything else from the phone? I want to make sure we give the phone people an opportunity to comment before we move on.

(No audible response)

CO-CHAIR ALDER: Okay, not hearing anything, either the phone's disconnected or there's no comments.

(Off the record comments)

CO-CHAIR ALDER: We'll move on to the last of the subcommittees to give a briefing today, which is the spectral efficiency group. And I assume, Bryan, you're going to be presenting?

MR. TRAMONT: That's right, and Jennifer will correct me as appropriate as we go

through this.

So we are the Spectrum Efficiency Subcommittee. Our list of members is on the second slide. We were given two questions. And Carolyn has the lead on the first one. And I have the lead on the second.

So what additional regulatory procedural, legislative, or policy actions could be implemented to improve spectrum efficiency without harming effectiveness, including enhanced funding options for federal agencies, one, and then two, what practices, technical and otherwise, has industry adopted to optimize its efficiency across disparate networks that might have useful lessons for NTIA and federal agencies?

So Carolyn's going to talk us through the work done so far in Question 1, and then I will take it over on Question 2.

MS. KAHN: Okay, so for Question 1, we had an overall subcommittee kickoff. Then we focused on outreach. And we had some

discussions, planning on how we're going to do the outreach. Our subcommittee developed some survey questions both for OMB as well as for the federal agencies.

So we first conducted targeted outreach focused on the management regulatory side to date. And so the point was to use these responses to inform our questions. And the dialogue then was a federal agency.

So to date, we've received some input from NTIA, specifically ITS on their metrics effort, and also conducted an interview with OMB. We then had some -- the subcommittee provided some input. We had some brainstorming discussions about preliminary recommendations and then decided that we did need to have some more interviews to better understand the implementation side. This rounder discussion would help inform all elements of this topic.

So we then reached out to federal agencies with focusing on implementation of regulatory, procedural, legislative, and policy

actions. We reached out to DoD, FAA, NASA, NOAH, and DHS, as well as to conduct some follow-on discussions with ITS and OMB, specifically their Office of Federal Procurement Policy. So that is ongoing. Then that will be followed up with our report and recommendations.

So we're keeping an open mind, considering many options. This slide lists some of the considerations that we're discussing and thinking about. This includes further expansion of the spectrum relocation fund.

This would be applicable in limited situations when there's a case for auctions, because that's how the SRF is replenished. In other cases, we're considering devising mechanisms for federal government to share spectrum without giving up their assignments.

Some preliminary considerations that we've talked about is considering recommending a focus of another CSMAC working group on federal mechanisms to monetize assets on a non-permanent basis. This could be a follow-on effort.

So we're also talking about spectrum efficiency metrics leveraging the work that ITS is doing. We're talking about agency accountability to current and additional guidance, and policy, and regulatory requirements, but recognize that there are some resources that need to go along with it.

So considering making a recommendation about any policy, or recommendation, or change should be accompanied with sufficient resources and staffing to properly address it by the agency.

So if there's a requirement, the agencies have the resources and staffing available to address that properly, also considering the various federal incentives and proposals that are out there, considering a macro level kind of systemic look at both federal and non-federal options, such as sharing and property rights, as well as combinations of all of these different proposals.

MALE PARTICIPANT: Can I ask a

question before you go on? Are those considerations based on the survey and the interviews, more or less?

MS. KAHN: Based on that as well as our subcommittee discussions.

MALE PARTICIPANT: Okay, good. Thanks.

MS. KAHN: And I'll turn it back over to Bryan.

MR. TRAMONT: Great. So as you can see by the framing of the questions, the first question was really focused on federal users. The second is focused on industry practices. And so we've been working since, I guess that's April, on a variety of responses here.

We began by developing a series of 14 questions that we developed as a group and shared with all the CSMAC, so you all got that. Those questions were finalized. We solicited inputs on any changes to the questions. Then we sent out the questions to every member of the CSMAC as well as any non-members of CSMAC that people

thought would be useful to get feedback from.

And we now are presenting --- the sort of state of play right now is we have, and we're going to go through briefly, the responses from those questions so far. We would like to plead with other members of the CSMAC to respond if you haven't already.

We've heard from six so far. And we appreciate that very much, our responsive friends. But others have been less responsive. So we would love to hear from more of you. Because the report will be stronger the more people are in it.

The results are anonymous. We concluded that that was the best way to ensure the best feedback. And so we'll now proceed through the 14 questions. I am not going to detail the answers. Instead, we just sort of gave taglines.

The real reason we decided it would be useful to have these listed with you all this morning is so that it might --- because it might

trigger some of you to respond and say, oh, no, that dynamic load balancing is ridiculous. We should never have government do that, or what have you. So it's supposed to prompt some thought on various members of CSMAC to respond.

So what practices, technical and otherwise, has industry adopted to optimize its efficiency across disparate networks that might provide useful lessons for NTIA and federal agencies? And so here you see, and once again, anonymized across the six responses.

And then we did have, and I didn't touch on this, but it was on the slide, we had manufacturers, service providers, broadcasters, all participate. So we do have a good diversity so far.

Did somebody have something on the phone?

(No audible response)

MR. TRAMONT: Okay. Two is what future practices has industry planned or considered to enhance efficiency. And here's

another, once again, robust set of responses from our members.

Then we went to --- and now we walked into the mess of what is low, mid, and high band. But nonetheless, industry has emphasized the need for access to all that stuff. In order to be able to meet customer expectations, how does spectrum efficiency play into the needs for this access to spectrum across the range of frequencies, and what bands are users provided with services? So sort of tailoring it down more narrowly from the prior question. And what should these types of frequency requirements apply to government --- how should these types of frequency requirements apply to government users?

So how has spectrum efficiency improved as we move across different generations of service as sort of an analogy to what federal government users could do? What other methods have you used to increase network efficiency? That's basically a catchall. What difficulties have you encountered when such transitions

occurred?

Commercial users have gone through a series of transitions to more efficient technologies which have included substantial investments. And they've been doing it while continuing to meet the needs of their customers.

That would be the same type of transition that the federal government would need to use in order to maintain its mission critical function. And so the hope was that there would be some lessons learned from the commercial side that maybe the federal government users, because of the lack of resources, have not had the opportunity to learn those lessons yet.

How do you go about phasing out less efficient technologies? This is particularly interesting, I think, from the commercial side where command and control of your customers is not always available. Steve can't go to all the customers at T-Mobile and make them give back their phones that are inefficient. And so the challenges on the federal government side are

different here.

MR. SHARKEY: Eventually we can.

MR. TRAMONT: Well, perhaps. Yes, we have had that --- well, anyway, that's a whole different story.

(Off the record comments)

MR. TRAMONT: Exactly, encouraged, strongly encouraged. But they can use marketplace incentives to do that, yes. Only that one time.

But anyway, at any rate, so the challenges are different here, and we recognize that. But I thought that --- we thought that it would be useful to get some of this from the commercial guys.

Number 8, as a manufacturer or a commercial service provider, what incentives did you typically need to offer customers to incent them to switch? As we just talked about, here's a free phone. And do you think such incentives can translate from commercial to government?

Are there differences in efficiency

advantages that can be gained based on the size and frequency of the blocks of the spectrum? So one of the things that we didn't, well, we wanted to be cognizant of is that some of the experiences, for example, of LMR, et cetera, in lower band and narrower frequencies is much different than you might have in a fixed microwave band or in a CMRS band.

So we didn't want to overgeneralize on the differences in this frequency advantage or efficiency advantage across those systems. And we're trying to capture those distinctions with this question.

Some recent allocations in the spectrum decisions are based on the use of database, which we've talked about. How is industry anticipating those type of controls to spectrum access to impact overall spectrum efficiencies in all these technologies? Something the government should be developing.

So I think there's, in exclusive bands as well, I think we recognize this question is

capturing some shared learning between commercial and federal. But to the extent that commercial entities have knowledge or experience, it may not be completely transparent to the federal side. We wanted to try and capture that here.

How important will unlicensed offloading continue to be for meeting future spectrum use requirements? Here to, recognize it doesn't map exactly to federal users, although it does have a certain QOS analogy, if you will, in the sense that when commercial systems traditionally turned unlicensed, they recognized that they may be getting lower QOS in some cases, and they may be getting less security.

And so are there ways in which that same set of considerations may translate into federal users and therefore maybe have some lessons that might be useful to them?

What's been the biggest obstacles? This is an open-ended question. And how is industry overcoming them? And you see a few of them, the tradeoffs between cost and power,

regulatory restrictions, and reforming. The loss of efficiency during spectrum reforming sprang up. But this is one where we would like to get some more feedback if we can before we get to the final report.

Are there other lessons learned, once again, a catchall, that have application for federal government users? And finally, is there anything that you, you commercial user, as you sit here, efficiency gains that government's readily achieved that you're aware of? Sort of the low hanging fruit question.

So those are our 14. More is better. We would love to get more inputs or feedback on these inputs. Our goal is to take the next four to six weeks to get more responses in, including non CSMAC members, if you have suggestions on other people we should go to.

And then we will push all this into a report that looks more like, I think, like a catalogue of things that people have given us as opposed to some of our other reports which tend

to be more narrative, with more editorial control, is our plan.

So I don't know. Carolyn, if you want to --- is there anything else on your work plan? I think we've kind of detailed that already.

MS. KAHN: Right.

MR. TRAMONT: Jennifer, anything I messed up?

MS. WARREN: No, not at all.

MR. TRAMONT: Whoa.

(Laughter)

MR. TRAMONT: Mark your calendars. All right.

MS. WARREN: Exactly, only today.

MR. TRAMONT: Well, I know how you feel about the schedule.

(Off the record comments)

CO-CHAIR ALDER: Other questions, comments for this group?

MALE PARTICIPANT: I have a quick question. And maybe you said this at the end. Do you see recommendations coming out of this or

more and more work coming out of this? I mean --
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MR. TRAMONT: I see a catalogue of answers to those questions coming out of this. And I feel like the challenge -- and Paige, maybe you can shed light on this now -- is we're, especially on my question, it may be less true for Carolyn's, we are trying to come up with a list, sort of a catalogue of things.

You can only access how useful they are in terms of lessons for the federal government side. And so I feel like the way the work flow would probably be most logical is for us to finish, NTIA to come back with places where they think the suggestions actually have some merit, and then maybe there's more interchange of information across that, if that makes sense.

MS. ATKINS: Yes, I think that makes sense. I would also add that if there is some sort of a, I'll call it prioritization, but things that have made the biggest difference on the industry side, that we may want to focus on

initially as part of that discussion.

MR. TRAMONT: And the trick for us, that we just --- because they're coming in as inputs from across multiple CSMAC members, getting that comparative is going to be tricky. But I hear you. And we'll see if we can prioritize.

CO-CHAIR ALDER: Dennis?

MR. ROBERSON: Dennis Roberson here. How are you trying to address the challenge that spectrum efficiency is in the eye of the beholder?

I mean, there's the classical, being an academic, there is the classical bits, per hertz, per square meter or cubic meter, depending on your perspective. There's that kind of metric for spectrum efficiency. But that doesn't apply when you're in a specific case. Spectrum efficiency for public safety is very different from spectrum efficiency for cellular, commercial cellular. And it's very different for satellites than it is. So how are you trying to deal with

that?

Since I've fought with this now for a long time and still don't really have an answer that I'm very comfortable with other than going back to the academic side. And I can hide behind that one.

MR. TRAMONT: Well, and your channeling our initial call. So we began our initial call by saying that we are not going to re-litigate what the definition is of spectrum efficiency, that we were going to take the definition that had previously been adopted by CSMAC in one of our earlier working groups and just use it. Because we worried that it was infinite regression for all the reasons you just outlined.

MR. ROBERSON: Yes, okay.

MS. KAHN: And if I could, I think what we're also going to do, as we're talking to the federal agencies that are the operators, is let them define for us how they want, you know, and we'll incorporate that so that it's more

mission specific or agency specific. We've run into this discussion already with one of the agencies.

MALE PARTICIPANT: Yes. Let me make one comment about that. Because I'm setting up some of these agency interviews. And so you have this OMB definition. There is a definition, you know, in the OMB thing. And they say what the heck is that?

This is how we --- we're going to hear about what they think spectrum efficiency is. And it's interesting, I think, that all of these people we've been talking to have a different idea of what it is. And they're all doing it to some level. But it's not on some kind of uniform mass thing that the OMB circular says.

CO-CHAIR ALDER: Steve?

MR. SHARKEY: Right. I'm, you know, I think to Paige's point on what's the most effective, and one of the things that, I guess, I don't see in here is there's a lot of kind of focus on technical implementation of what drives

efficiency and techniques that are used.

But one of the things that, at least from the commercial perspective, I would say, has really driven efficiency or economic incentives, and, you know, that may be something that should be worked into here. How do we do that?

I mean, it's difficult to force somebody to implement a specific technology or technical approach to it. And I think that's the whole basis of an overall economic incentive approach. And I know we're looking at that in other areas for federal users to promote sharing, or to do other activities. But it may be something that we should work into this report as an effective mechanism to help drive efficiency.

MALE PARTICIPANT: He needs to respond to the survey, right?

MR. KOLODZY: I can't confirm or deny whether he has. I mean, I think we were trying to capture a little bit with Question 8 about what incentives commercial uses to offer customers. But it's a fair --- yes, maybe we

just need to --- or also as well is expanding and maybe under --- you were looking at Number 13 or 12, I think, at 12.

But eight talks about what you do as a commercial provider to incentivize customers to switch to more efficient technologies and how they translate. So maybe we can put some more stuff in there.

MALE PARTICIPANT: Yes, because I think it's different of what we incentivize customers to do versus how we, you know, what we do as far as densifying cells, or transitioning to the new technology because it's more ---

MALE PARTICIPANT: Well, you're in ---

MALE PARTICIPANT: Right, because it's more efficient. Yes.

CO-CHAIR ALDER: Jennifer, do you have a comment?

MS. WARREN: Yes. I was just waiting for an opportunity. I think this discussion that Steve is raising is part of what will be discussed in Carolyn's subgroup. Because it's a

question of what is the transapplicability, if you like, of that concept? And I have a feeling that that's where we would have that discussion.

CO-CHAIR ALDER: Well, I personally think this first task is very interesting, because we had it in the past with the adoption of the spectrum relocation fund, and it was really powerful. And I think finding other powerful means like that is a real opportunity but obviously difficult. So I think it's interesting.

Any other comments from the phone on this topic?

(No audible response)

CO-CHAIR ALDER: Paige, did you have any?

MS. ATKINS: No.

CO-CHAIR ALDER: So thank you very much. Thanks to all the subcommittee members as well as co-chairs. We have definitely gotten feedback. And we're definitely aware that it's been a tough go. We kind of started late. We

didn't really get all these things launched until mid-April. And we asked for interim recommendations here in August which is really over the summer. So we realize all that. It's a very compressed timeline.

So again, we're going to ask now for November to consolidate into a final set of recommendations that the NTIA can react to formally.

I said it earlier but will say it again, because we've talked about this as a group, that there's certainly freedom to say, hey, this is something we don't have a final recommendation on. We recommend, you know, continued work.

Please have something for, you know, each of your subgroups. But there's definitely no --- it's not necessary to cover all the questions that have been put in front of you if you feel that some of them you just don't have good answers for and you want to focus on. So it's definitely a degree of freedom that's

available to everyone.

But with that said, we are going to still shoot for this one -- it's kind of been this one-year experiment where we're going to try and get a wrap-up by November. And then what we'll do is embark on next year with a refreshed set of topics, perhaps some carryovers.

Again, with that, thanks also again for everyone getting me everything on time. It made it very easy to go around this time. All right, with that, I think we're at the section where we have opportunity for public comments. Ah, we have a commenter. I don't know if we have a mic available or the ---

MALE PARTICIPANT: Come to the front, Mike, and get a mic.

(Laughter)

MALE PARTICIPANT: Or two mics.

(Off the record comments)

MALE PARTICIPANT: And please introduce yourself.

MR. MARCUS: All right, I'm Mike

Marcus, a retired FCC employee and occasional professor at Virginia Tech. I've also been very interested in the specific issue related to those comments of spectrum above 95 gigahertz which I assume qualifies as millimeter wave discussion. And I hope some people can stay around for my paper tomorrow afternoon on this issue.

But let me make one point, for example, on propagation. A key issue in above 95 gigahertz is protection of passive satellites in NGSO orbits. The key propagation model for that is IGRP676. And there was no publicly available software to do that.

NASA has an internal implementation they won't let other people use. May I suggest that ITS either make a copy themselves or get NASA to make their's public available but in order to engineer that.

But more importantly, above 95 gigahertz, all the spectrum is NG shared. And there has been a lot of friction in how to move above that. Chairman Pai has publicly said he

wants to move about 95 gigahertz.

I would urge this community to consider, in the iteration, to look at the special problems above 95 gigahertz where sharing is very, very different than at lower frequencies because the physics is very, very different.

I do not begrudge the cellular industry more spectrum. There are mobile allocations there. The mobile allocations should stay there. But there are no service rules for anyone above 95 gigahertz. And while the discussion in this group about commercial has seemed to be only for cellular, there are other commercial NG users, other than cellular, and they should be given access to a spectrum above 95. Thank you.

CO-CHAIR ALDER: Thanks, Mike. Other public commenters?

(No audible response)

CO-CHAIR ALDER: Do we have any comments on the phone from the public? Oh wait, we have one more in the room. Is that correct?

No. Someone waving to Janice. Again, anyone on the phone from the public desire to comment?

(No audible response)

CO-CHAIR ADLER: Okay, with that we'll close the public comment period. We have an opportunity now on the agenda for remarks from the co-chairs. I think I made my remarks.

One of the things I think has been helpful for the group, and this is a comment for the liaisons, feedback from the liaisons has been particularly helpful in refining what is important to each of these subcommittees. So I encourage and thank all the liaisons from the NTIA that have been doing the work. I think that's been very, very valuable.

And they've also produced some feedback from these groups that have helped us have visibility. So again, I just wanted to thank the liaisons for their work and encourage their further good work. Mark, do you have anything?

CO-CHAIR GIBSON: I'd only like to

reiterate what I said earlier. And that is that first of all there are liaisons, and working with NTIA has always been good. But with the, again, I use CBRS as an example, the collaboration that's been going on has been just remarkable. And so I'd like to thank everybody that's involved for the driving to success.

I mean, it's been complicated, it's been difficult, but we're all moving in the same direction. And I think that takes a shared goal. So I say on the dais, thank you. That's why I'm standing up here. So thank you.

CO-CHAIR ALDER: With that, unless there's any other comments from ---

MS. ATKINS: Just thanks to all again. We really appreciate your inputs and your sage wisdom. So thank you very much.

CO-CHAIR ALDER: With that, we'll be adjourned.

MALE PARTICIPANT: You want to indicate the next meeting time?

MALE PARTICIPANT: It's in November.

MALE PARTICIPANT: November, yes. I don't think a dates been locked in. David, do we have a date?

MALE PARTICIPANT: It's in DC.

MALE PARTICIPANT: Dave, are you soliciting venues?

(Off the record comments)

MALE PARTICIPANT: If you're not, don't talk to Dave.

(Off the record comments)

MALE PARTICIPANT: All right, thanks, everyone. And hope you enjoy the clips.

(Whereupon, the above-entitled matter went off the record at 3:54 p.m.)

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C E R T I F I C A T E

MATTER: Meeting of the Commerce Spectrum Management Advisory Committee

DATE: 08-15-17

I hereby certify that the attached transcription of page 1 to 194 inclusive are to the best of my professional ability a true, accurate, and complete record of the above referenced proceedings as contained on the provided audio recording; further that I am neither counsel for, nor related to, nor employed by any of the parties to this action in which this proceeding has taken place; and further that I am not financially nor otherwise interested in the outcome of the action.

Neal R Gross
