United States Department of Commerce

National Telecommunications and Information Administration

Commerce Spectrum Management Advisory Committee (CSMAC)

Meeting

Thursday,

May 4, 2017

The Advisory Committee met at the National Association of Broadcasters located at 1771 N Street, NW, Washington, DC, at 1:00 p.m., Larry Alder and H. Mark Gibson, Co-Chairs, presiding.

Members 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

Mark E. Crosby, Enterprise Wireless Alliance

Thomas S. Dombrowsky, JR., DLA Piper, LLP

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*

Mark A. McHenry, Shared Spectrum Company

Donna Bethea Murphy, Inmarsat

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.

Kurt Schaubach, Federated Wireless

Steve Sharkey, T-Mobile US, Inc.

Bryan Tramont, Wilkinson Barker Knauer, LLP

Jennifer Warren, Lockheed Martin Corporation

Christopher Weasler, Facebook, Inc.

Robert Weller, National Association of Broadcasters

Also Present:

David J. Reed, NTIA, Designated Federal Officer

Paige R. Atkins, NTIA

Glenn Reynolds, NTIA

* participating via telephone

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Proceedings

(1:02 p.m.)

Call to order, welcome, and opening remarks

Co-Chair Gibson: All right. Well, the clock says a little after 1:00. Not everyone is here, but we will go ahead and get started.

So, as the name tag says, I'm Mark Gibson, and this is Larry Alder. This is Paige and this is Glenn Reynolds.

So, welcome to the CSMAC meeting.

This is May 4th. So, this is commonly known as Star Wars Day. May the 4th be with you. Ha, ha, ha.

They say open with a joke and that will be the last thing you do. So, a couple of people are not here yet, but, like I said, we will go ahead and start. That was pretty much the opening remarks. Again, Paige is going to have -- I'll be here all week.

Paige is going to make a couple of remarks. We would like to recognize some of the guests. Matthew Hussey is going to be speaking to us from OET. Glenn is here sort of sitting in for the leadership of NTIA. I think that is all the senior leadership.

Well, you're OSM, right? Maybe my run is going to end right now. They're here; they're going to say stuff. How's that?

The other thing to say is just there's an issue of what we wear in terms of wear ties or not. So, we are going to go with what Matthew is dressed as, no tie, and double-breasted for men. So, having dug myself into a hole, I now turn it over to Paige for her remarks.

Co-Chair Alder: Do you want to do, first --

Co-Chair Gibson: Oh, and I'm sorry. He wasn't sitting there. Bob's got some housekeeping

comments for NAB.

Member Weller: Okay. Thanks, Mark.

On behalf of the nation's radio and television stations, welcome to the National Association of Broadcasters. I'm Bob Weller, Vice President for Spectrum Policy.

Just two housekeeping items. First, the restrooms are across the lobby from this room. Just walk past the elevators.

Second, the microphones are the little black boxes on the table in front of you. They are activated or operated by the little red button. A red light means you're on the air. Two of the buttons are stuck on. So, if you happen to be seated next to one of those microphones, mind your manners.

That's it. Welcome.

Co-Chair Alder: Thank you.

Co-Chair Gibson: And thank you for a wonderful facility. It is always good to move it around. So, anyhow, I think with that, Paige.

Ms. Atkins: Okay. I would like to start off with just some very brief opening remarks, and they will be very brief.

But, on behalf of NTIA, I wanted to welcome everybody to this second meeting of the CSMAC, second meeting of this cycle as well as this year. And I also want to thank the National Association of Broadcasters for this wonderful facility and hosting this meeting.

I think we're off to a good start on this CSMAC term, and I thank you for all of your energy in rolling up the sleeves and diving in, signing up for the subcommittees, and really responding to the issues that we have teed-up to explore.

And there are new voices and perspectives on the

CSMAC as we welcomed new members this past January. I anticipate that will result in a good, robust discussion not only today, but over the next few months and couple of years.

I encourage for today's session, since we do have a relatively-light schedule, that you take advantage of that and engage, deliberate, and try to hash out as much as we can today, so the subcommittees can move full steam forward over the next few weeks and months.

We have a good set of topics and issues, representing many of the key challenges that are important to NTIA, but really important to the broader spectrum stakeholder community. So, I am really enthusiastic about the work that the Committee is undertaking and I look forward to the results at the end and the interim recommendations that you provide.

Your guidance really is invaluable to us. It represents the very best in public/private collaboration. That really is what is required to result in our best public policy for the nation. And that is the way we do business, the way we make progress, and the legacy and foundation I know you all will build upon.

So, again, welcome and I want to thank you for being part of the CSMAC and for being here today. So, thank you.

Co-Chair Gibson: Thanks, Paige.

Co-Chair Alder: Thanks, Paige.

So, some opening remarks from Mark and I, the Co-Chairs.

The main thing we wanted to go over is to review the schedule, which so far the progress to date, our goal was by this meeting to have formed the subcommittees, which we have done. So, I also want to thank everyone for signing up for the

subcommittees. And another goal was to have all the subcommittees meet in advance of this meeting, which has happened as well.

So, thanks to all the members, but particularly thanks to the Co-Chairs of the various subcommittees for stepping up. I know it is a significant amount of work to be a Co-Chair of one of these subcommittees. I've done it before. And so, thank you to all the Co-Chairs for your time and effort.

On a going-forward basis, we have a very aggressive schedule. So, the overarching principle is we are trying to do things on a one-year term. So, go through a whole cycle in one year, and we are going to try and not vary the schedule. We might have to vary the depth of the material and what we can accomplish in that time, but we are going to try to hold to the schedule.

So, the landmarks are in the next meeting, which is in August at the ISART -- I think it is going to be August 15th -- we hope to have some preliminary recommendations from the subcommittees. Obviously, very aggressive.

So, this period between May and August, which is a busy period socially, is also going to be kind of a real important period to get stuff done. And then, the following meeting, which will be the last meeting of the year, will be in the November timeframe. That's when we're hoping to have final recommendations closing out the year. CSMAC will then -- not CSMAC -- but NTIA will, then, respond to those recommendations in January.

So, that is the calendar, and I know it is going ot make everyone super-nervous. But we are going to see how it goes. So, Paige and Mark and I talked of it, and we said, the variable here is focus. So, if you feel that there is too much, focus the questions; narrow the work, and let's see what we can get done tangibly in the year.

For today's meeting, everyone sees the agenda. We are going to have our usual spectrum update. Matthew is also going to say a few words. Then, we will have the readouts from the committees. We do have a light agenda today. So, we are going to do a couple of things, encourage debate, questioning, with the goal of resolving what the question is as much as we can today or shortly after today.

We are also going to take a break in the middle sometime, so people can have hallway conversations. It helps to resolve any questions and stuff that we might have, because we feel like the prepared material will be a little bit light.

So, with that, that is our opening remarks. I think I have covered what we need to. I am going to turn it over to Paige for the spectrum update.

Oh, roll call. I apologize. The roll call. So, Matthew, why don't you start us with a roll call?

Mr. Hussey: Okay. Matthew Hussey, FCC.

Ms. Atkins: And please don't forget your microphones.

Mr. Hussey: Matthew Hussey, FCC.

Member Calabrese: Michael Calabrese, Open Technology Institute of New America.

Member Weller: Bob Weller, National Association of Broadcasters.

This is one of the microphones that is stuck on.

(Laughter.)

Member Bethea Murphy: Donna Bethea Murphy, Inmarsat.

Member Hatfield: Dale Hatfield, University of Colorado.

Member Weasler: Hi. Chris Weasler, Facebook.

Member Kolodzy: Paul Kolodzy, Kolodzy Consulting.

Member Crosby: Mark Crosby, AWA.

Member Povelites: Carl Povelites, AT&T.

Member Kahn: Carolyn Kahn, the Mitre Corporation.

Member Sharkey: Steve Sharkey, T-Mobile.

Member Dombrowsky: Tom Dombrowsky, DLA Piper.

Member Anuszkiewicz: Paul Anuszkiewicz, CTIA.

Member Brown: Mary Brown, Cisco.

Member Roberson: Dennis Roberson, Illinois Institute of Technology and Roberson & Associates.

Member Roy: Andy Roy, ASRI.

MEMBER McHENRY: Mark McHenry with Shared Spectrum.

Member Warren: Jennifer Warren, Lockheed Martin.

Member Tramont: Bryan Tramont, Wilkinson Barker.

Member Reaser: Ric Reaser, Raytheon.

Member Rath: Charla Rath, Verizon.

Member Schaubach: Kurt Schaubach, Federated Wireless.

Mr. Reynolds: Glenn Reynolds, NTIA.

Co-Chair Alder: Larry Alder, previous meeting was with Google, now with OneWeb.

Co-Chair Gibson: Mark Gibson, CommScope.

Ms. Atkins: Paige Atkins, NTIA.

Co-Chair Gibson: And as Larry accused me of being the microphone Nazi, please don't forget to push the buttons when you speak. Thank you.

Let's do on the phone. So, our CSMAC people on the phone?

Member Racek: Mark Racek, Ericsson.

Member Lewellen: Mark Lewellen, John Deere.

Member MacKenzie: Allen MacKenzie, Virginia Tech.

Member Allison: Audrey Allison, Boeing.

Mr. Thomas: Bob Thomas, USDA.

Mr. Willis: Kenneth Willis, Contractor Support, Marine Corps Spectrum Center.

Co-Chair Alder: Is that it?

Co-Chair Gibson: Yes, I think that's it.

Co-Chair Alder: These are not members.

Co-Chair Gibson: Yes.

Co-Chair Alder: Paige, why don't we go ahead, then, with the spectrum update?

Spectrum update

Ms. Atkins: Okay. As Larry mentioned, as always, we will start with the spectrum update before we engage in our primary focus here, which will be the topics in the subcommittees. And so, I am going to give you an update, as I normally do, since our last meeting, which was toward the end of January.

So, first of all, I wanted to note the conclusion of the FCC's 600 megahertz incentive auction, which closed finally late last month and brought in just short of $20 billion in bids for 84 megahertz of spectrum.

And the new licenses in this band will help anchor commercial broadband services, particularly in the rural and suburban areas, where greater coverage is a necessity.

I want to highlight that the Commission deserves a lot of credit for bringing this complex and pioneering auction to a successful conclusion. While the analysts continue to pour over the results and determine what they mean from a market perspective, the bottom line is the United States has taken a bold action to ensure that broadband providers have sufficient lower band spectrum. And for those keeping score, that means we now have made 340 megahertz of federal and non-federal spectrum since 2010.

Now, moving up on the chart, so to speak, government and industry stakeholders are continuing to make progress toward implementing the innovative sharing and licensing approach in the 3.5 gigahertz band. At the last meeting we noted that several Spectrum Access System, or SAS, administrators had been approved. And we are seeing interest from the wireless carriers, equipment makers, as well as groups like the CDRS Alliance that have been active in shaping the evolving and eventual ecosystem in this band.

A key component to the SAS will be the ability to rely on accurate propagation models to effectively enable dynamic spectrum sharing and access. Now, as we all know, any agreement to share spectrum bands really relies on these reliable predictions of how the spectrum will propagate and perform in the real world.

And I wanted to highlight that NTIA's Institute for Telecommunication Sciences, ITS, where we will host the next CSMAC meeting, recently released an advanced software model for radio wave propagation in urban environments. And it is a reference implementation of the Extended Hata Urban Propagation Model, or eHATA for short. It was created to predict propagation of new commercial broadband services in the 3.5 gigahertz band.

ITS released the software to the public by publishing the source code on GitHub, which is an

online open-source platform. So, everybody has access to it.

And the Wireless Innovation Forum's spectrum, or WinnForum's Spectrum Sharing Committee, which is developing technical standards for commercial operations in the 3.5 gigahertz band has proposed using eHATA to calculate coverage areas and areas of coordination with military radar systems that will be one of a couple of standard propagation models for the SAS systems. WinnForums and others can now use and adapt this ITS source code for propagation prediction and focus its efforts on developing other aspects of 3.5 gigahertz spectrum sharing.

Now ITS plans to continue to release software as it adds to the body of basic research, particularly on radio wave propagation, including in the millimeter wave band. So, they are committed to this open-source model and will continue to publish these capabilities.

And by providing open-source implementations that are freely available for use and reuse, we really hope to advance development of widely-accepted propagation models and, ultimately, improve and accelerate spectrum sharing over time. So, I think this is a key advance that is helpful to all of us.

Now, as I noted in the January CSMAC meeting, this progress in making low- and mid-band spectrum available is very important, but it really should be seen in context with a change in spectrum demand brought about by technology and standards advances as well as evolving business models.

Increasingly, 5G mobile networks are incorporating very high bandwidth, high-volume spectrum usage models to accommodate stressing requirements capacity requirements for streaming IOT and other related applications. And this is generating demand for high-capacity blocks of spectrum in the millimeter wave bands, as everyone is aware, and in some sense shifting the way we look at the

beachfront property on the allocation table.

And it turns out that the beach goes up a bit farther up the coast than it used to. And I will stress that we understand all of the bands, mid, low, and high, or mid, low, and high, are important to the ecosystem of diverse services that everyone is trying to provide.

So, to address the need for greater capacity, we continue to work with the Commission, agencies, and industry on making spectrum in the higher bands available for 5G and other services. As I think all of you know, this is really progressing down two tracks, a domestic FCC proceeding and internationally an agenda item on the next World Radio Conference for 2019.

The FCC's Spectrum Frontiers Report and Order and Further Notice has set a course in the U.S. in determining the best bands for 5G. Meanwhile, the ITU is actively beginning its review of the bands, many of which, though not all, overlap the bands that have been identified domestically.

And U.S. delegates have been preparing technical papers and are set to participate in international technical meetings later this month to closely examine the compatibility of bands above 24 gigahertz for terrestrial broadband.

We have a lot of work to do on both fronts, domestically and internationally, and we also know that others around the world are focused intently on the 5G future. So, we are on the thick of it, and we want to ensure that we continue leadership in this arena.

In addition, as everyone has seen, technical market trials associated with 5G and millimeter wave continue to ramp up and push the market closer to service launches. Multiple carriers are conducting tests, demonstrations, and pilots, showing that the beginning of the 5G evolution really is upon us, and 2018 is expected to be a watershed year for limited

service introductions, as the standards emerge. So, a lot of activity going on, exciting activity going on.

We also continue to work with the federal agencies to explore the strengths and weaknesses of various incentive mechanisms intended to result in more efficient and effective federal spectrum usage. We are conducting research on how to define spectrum efficiency which, for many of you, you will know is not an easy thing to do, particularly in the federal agency context, as well as better understand how the agencies make decisions regarding spectrum use from the very earliest stages of defining mission and system requirements through operational deployment.

The goal is to help the agencies to make smart spectrum decisions based on real-world measures that effectively support the agency business processes. And that also includes ensuring that we understand how that supports the budget acquisition and statutory processes and constraints that they operate within.

Ultimately, we understand that spectrum efficiency, although very important, is also just one element to the decision process that is required to deliver mission-critical capabilities and services. So, it is important, and we want to enable that process to be better, but we also have to put it in context of mission delivery as well.

As I have said before, we strongly believe the most optimal incentives are ones that give the agencies the necessary resources to research alternatives to their existing use of spectrum and upgrade to more efficient technologies. As discussed during our last meeting, the Spectrum Pipeline Act of 2015 broadened the scope of eligible expenses covered under the Spectrum Relocation Fund, or the SRF. This was a huge step forward and is bearing fruit, as we speak, as the federal agencies are seeking funds to create opportunities to enable additional spectrum access for commercial users that would

not have otherwise been pursued.

For example -- and I think I mentioned this last meeting -- the FAA, in partnership with DoD, DHS, and NOAA, is assessing the possibility of consolidating and relocating various radar capabilities, and this could eventually lead to freeing up at least a portion of 1300 to 1350 megahertz.

And I anticipate the transmission of additional agency pipeline plans through the technical panel process and OMB to Congress over the next few weeks and months. So, the agencies are interested. They want to look at opportunities, and this Spectrum Pipeline Act and the funds available are clearly helping to make that happen.

Now, last but not least, NTIA continues to modernize and improve our spectrum management processes, including enhanced automation and spectrum data quality, not only to help us do our day-to-day jobs better, and think of that operationally getting the frequency assignments to the agencies, certifying emerging major systems from a spectrum standpoint, but also to ensure we have the right tools and capabilities to support our future.

Some of these improvements have already had a direct and positive impact on many of the activities I described earlier, but we have a lot of work yet to do, and we continue that.

Now I also wanted to highlight an upcoming workshop to be held by the Wireless Spectrum R&D Interagency Working Group, affectionately known as WSRD. WSRD was established under the Networking and Information Technology Research and Development Program to help coordinate and address key national R&D challenges and priorities related to spectrum-sharing technologies.

The WSRD will hold the workshop tomorrow on radio receiver systems, R&D innovation needs, and impacts on technology and policy. That will occur at

the National Science Foundation in Arlington.

And the workshop will address various topics around receiver technologies and policy issues, identify gaps and make recommendations for additional research. That could include tools, techniques, experimentation, all related to trying to close the gaps that they have identified. And I know many of you do participate in the WSRD workshops, and we want to leverage the results of all of those workshops and discussions as appropriate to help us address the CSMAC topics that are before us.

From a receiver's standpoint, we ultimately will have to address the performance characteristics of spectrum receivers in whatever form that takes to most effectively use all of the available spectrum.

Now, looking forward, before we move on to the core discussion of the subcommittees, I want to underline the importance of the topics that we have established for this cycle. I believe that your work on these issues will help us move forward in terms of spectrum management and policy, and your guidance will be instrumental, as it always is, particularly as we move into this 5G era.

With regard to 5G, I have often said we have the opportunity to do this right from the beginning, and I truly mean that. The Subcommittee has a key task in examining what technologies included in or should be considered for evolving 5G standards could facilitate sharing between federal and non-federal systems, and what deployment models of commercial 5G broadband networks and services could potentially maximize shared use of 5G spectrum.

Getting recommendations in these areas will be very helpful as we explore sharing with emerging 5G services, particularly in the millimeter wave bands, with the understanding that 5G deployments will not just be constrained to millimeter wave bands.

Similarly, but in a somewhat broader scope, the Enforcement Subcommittee is looking at how to prepare ourselves for a more intensive and dynamic spectrum-sharing future. How do we enable automated enforcement mechanisms at the network and device levels? What steps should NTIA take to implement automated enforcement mechanisms? And where does the government role dovetail with the private sector activities?

Key questions here also include things like how should we address cybersecurity and private requirements. And that enforcement is a very complex and challenging area, and we have got some of our best and brightest on that Subcommittee.

That leads me to our third Subcommittee which is charged with attempting to define from an industry perspective what key characteristics we should look for when considering bands for commercial access. You can help inform us in terms of what is important to industry when thinking about the most appropriate bands for commercial deployments. Defining a set of guidelines or key characteristics that industry uses for their own business decisions could really help NTIA and the federal agencies as we assess bands for potential repurposing.

And I have already spoken about our ongoing incentives activities to improve efficiency and effectiveness. We want to hear back from the last Subcommittee on what additional policy actions NTIA should consider, including potentially building off of the additional funding flexibilities that were created as a result of the Pipeline Act, which could result in improved efficiency and effectiveness.

We also want to learn about best practices on how industry optimizes their spectrum efficiency across different bands, disparate networks, and a diverse set of service requirements. Industry's experiences could help inform the federal efforts to reach the most effective use of federal spectrum resources.

And though you have established these subcommittees to focus on the individual topics as I just described them, I expect and know you will identify areas of commonality or synergy across the different subcommittees. Please collaborate and take advantage of those synergies.

Now, to summarize or to sum up, I know you've already begun these efforts in the subcommittees. I'm looking forward to hearing how they are unfolding, and please let us know if there is anything we can do to assist or if you need additional information that we may be able to provide to help you accomplish the tasks at hand.

And as always, I thank everyone in this room for volunteering their time to be a part of CSMAC and your dedication. I know it is not easy, and we sincerely appreciate and value your input.

Thank you very much, and I would be happy to take any questions.

Co-Chair Alder: Feel free to raise your tent if you have questions for Paige.

(No response.)

Ms. Atkins: This is very unusual. No questions?

Co-Chair Alder: Okay.

Ms. Atkins: Wow, I'm not sure I have ever had one without any questions at all.

Co-Chair Gibson: Really? I think they are going to pounce on you at the break.

Co-Chair Alder: Okay. Then, if there are no questions for Paige, Matthew is going to give us a spectrum update from the FCC perspective. Hopefully, he will elicit more questions.

Mr. Hussey: I will just add a couple of addendums, too, because Paige touched on a couple of items that I was going to mention.

With the incentive auction, as mentioned, we raised significant funds, but also repurposed 84 megahertz of spectrum and that means about 70 megahertz of license spectrum. So, that will be going for wireless broadband.

And also, the Commission recently released the closing and channel assignment public notice to try to announce the formal closing of the auction as well as the auction results, channel assignments, and then, the transition dates. So, now begins the 39-month transition period in which the broadcasters that have voluntarily relinquished their spectrum will vacate or look at sharing opportunities and, then, the new wireless licensees will come on. It is, obviously, a floating timeframe, but within 39 months.

And then, also, with the spectrum frontiers, that was R&O and, then, further notice of proposed rulemaking was adopted back in July. There were a few additions for reconsideration, which the FCC is currently evaluating and obviously considering.

And now, obviously, the biggest issue is to provide a TAC update, since one of the purposes of the liaisons for the NTIA and FCC are for generating greater synergies between the group.

The first TAC meeting of 2017 will be held on June 8th at the FCC, and Dennis Roberson will continue at the helm as the Chairman. So, he can correct me on anything if I veer off or anything.

But 2016 was a very active year for the TAC. The various Working Groups actually ended up producing about six White Papers covering various issues, such as 5G cybersecurity, cyber mobile device security, an evaluation of theft prevention measures, and, also, report for granule networks and securing SDN and NFBs. So, all that information is available on the website.

Also, the TAC issued its own public notice on the effects of RF noise, which actually received, I think,

about 100 public comments. So, there was certainly some interest in that. Those are available on the FCC ECFS site.

And then, the TAC also initiated ongoing work with CTIA on theft prevention, resulting in the beginning developments of an information portal to share mobile theft data with consumers, law enforcement, and other stakeholders.

And to finish up the year, Dennis actually requested that the Working Group Chairs kind of boil down their recommendations into the highest priorities. And there is a list of those that are being considered by the Chairmen. All the recommendations were presented at the last meeting and are available on the website.

But of them that might be pertinent to the CSMAC are in regards to basically one of the Working Groups suggested that the FCC should engage in an annual study exercise to gain potential insights on the impact of emerging technologies and innovations for disruptive change in the communications sector.

Also, the FCC should work closely with the Administration and Congress to ensure a flow of spectrum balance across high-, middle-, and low-spectrum bands for commercial use, as well as for flexible use policies; and that the FCC should establish a technology watchlist of priorities for the U.S. market and use to guide an ongoing dialog with industry and other stakeholders to ensure that they are met in standardization of open-source activities.

Also, the Spectrum and Receiver Performance Work Group had similar recommendations, also including the FCC should initiate a policy statement setting forth on spectrum management guidance.

And there was also, with the explosion of UAS/UAVs, certainly, regular attention to that. And one of the recommendations is that the Commission

promote the use of existing communications infrastructure whenever possible to support small UAS communications functions and avoid unnecessary costs and regulatory delays.

So, again, those various recommendations can be viewed in more detail on the FCC website, but those were some of the ones that some of the Working Chairs felt were of high priority, that the FCC should consider, the Chairman should consider.

And so now, moving forward, we have a list of the new Working Groups for the most part, and I can go through there. There is a more detailed description on the FCC website. And I will just try to keep it fairly brief.

There is the continuation of the Mobile Device Theft Prevention Work Group. We will continue to focus on analyzing the theft of mobile devices and find preventative measures to kind of mitigate the theft of those devices.

Then, there is also the second new Working Group. It is the recommendations for removing obsolete or unnecessary technical rules. This Work Group is tasked with reviewing the FCC technical rules to identify and prioritize those that should be eliminated. Obviously, with the rapid pace of technology and innovation, sometimes the rules that even were adopted only a few months ago need a fresh look or need to be revised. So, that is the mission of that Work Group.

The third Work Group, Implications of Next Generation TV Broadcasting Technology, and we are probably pretty interested in that. Obviously, with the next generation ATSC 3, that really is a game-changer in broadcasting technologies. There is an opportunity for broadcasters to provide a whole array, a suite of new services. And so, this Working Group will be tasked with looking and considering of how ATSC 3 might fit into the overall communications landscape of the future, given the synergy and changes in technology and the services

that can be provided from it.

The fourth Working Group is Broadband Deployment Technology Challenges. This task force group will bring together technical experts from a cross-section of communications, industry to study and provide information on available technologies, their limitations, and any technical rules or policies that impeded broadband deployment. And that is, obviously, both wireless and wireline.

And then, the final Working Group is the Satellite Communications Plan. This Working Group will look at recommendations for processes and communications solutions to support both startup satellite ventures as well as massively-scaled satellite operations. So, just kind of looking at ways to streamline the regulatory process for satellite launches and communications in that area.

And that's basically what I have. I am happy to answer any questions. Like I said, if you want any additional information, more details, feel free to look at the FCC TAC website.

Co-Chair Alder: Dale, you have a question? Go ahead.

Member Hatfield: I'll break the ice. I'm, candidly, disappointed that the Commission is not continuing anything in the enforcement area. I know I'm sort of a one-trick pony sometimes these days with my emphasis on enforcement. But having worked on this Committee on enforcement and finding that the FCC is backing away in terms of this advisory enforcement sort of, like I say, dismays me.

Co-Chair Alder: Any response?

Mr. Hussey: Well, certainly, we will always be in the forefront of that issue. I would certainly just say that I believe that the Chairman, obviously, sees the importance of enforcement. And I'm sure that he should more than be happy to weigh-in with his staff to voice your concerns, and I am sure they

would be heard.

Member Tramont: Just to follow up on that, I do think there is a sense that perhaps the former regime might have been particularly enthusiastic about enforcement, and there is an overall reassessment about the approach to enforcement that may have spilled over into the deliberations of attack. Hopefully, they can recalibrate going forward and, with the benefit of your advice, then find appropriate balance.

Co-Chair Alder: Jennifer?

Member Warren: I was happy to cede to that comment.

(Laughter.)

Okay. Well, mine doesn't seem to be working, but I will try to project.

Jennifer Warren.

I guess my question -- and this is coming from a reference point from working with the WRC Advisory Committee; so, it is more procedural -- which is, does the FCC opine or have a view when it puts out the TAC recommendations? I mean, does it offer views on any of the recommendations. The WRC Advisory Committee at times chooses to give their views on some of the recommendations before they have gotten public consultation. And I must admit, I haven't looked at the back public notices to see how the FCC handled that. Can you just share that?

Mr. Hussey: Well, I would probably defer to Dennis on that.

Member Roberson: Yes, operationally, the recommendations come straight from the TAC with no -- other than the fact that there are liaisons for every Working Group, they are the work product -- I think I will get to your question. So, not to completion.

But, once those are in place, then there is a response that is expected and is provided by the staff and, ultimately, from the Chairman. It is very conveniently timed. I was just with the Chairman, and part of what we were doing was reviewing the recommendations from the past year and the preliminary staff response, which he has not fully embraced because this was his first viewing of both.

Just a word, and I'll state the obvious. But there has been a huge transition in the FCC and, with that transition, there are a lot of things that are being reconsidered. And so, things are not quite as smooth as perhaps in other years where there is more continuity. But that is to be expected. It is not an unusual change because there is a changing of the guard and there are different perspectives. And so, there is just timing of getting in place, and so on.

But I think the good news, at least for the TAC and for those involved with the TAC, is that our new Chairman of the FCC is very strongly supportive of the TAC. And since I was just there an hour ago, I can speak to that very directly. We spent 45 minutes, until one of his staff guys grabbed him and said, "You've got to leave."

But he was very engaged, very involved, very interested in not only the work product, but also the procedures, how we move forward and looking to continue to optimize those, and to be engaged, which was very, very good to see for me on behalf of the TAC.

And as we move to the coming years, I think there will be even more of the Chairman's imprint on what he wants to see and whether that is enforcement or other tasks, he recognizes in a way perhaps he didn't until an hour ago how much his personal imprimatur goes on the Working Groups for the TAC. And so, we will see him continue to be very involved, and he is looking forward to participating in future TAC meetings and all the rest.

Did I finally meander to answer your question or no?

Member Warren: Mostly. Thank you.

(Laughter.)

Mr. Hussey: I would also add, Jennifer, that at the TAC meetings also Julie Knapp mirrors what Paige does and kind of goes through the recommendations and what the FCC -- if any action has been taken, even in the form of that.

Member Roberson: Yes, and that was part of the review this morning, in preparation for a response on the June 8th meeting.

Member Weller: So, Bob Weller with NAB.

It is a little surprising to me that, with 100 comments received on a Notice of Inquiry dealing with RF noise, that no further activity is apparently planned or no action, recommendations are being made.

To quote from one of Chairman Pai's favorite movies, The Big Lebowski -- (laughter) -- I think we're "entering a world of pain" due to increasing levels of radiofrequency noise. And this has the potential -- and, hopefully, I am not mischaracterizing Professor Roberson's article in Spectra magazine -- but I think it has the potential of killing off the internet of things.

Frankly, there are two solutions to increasing noise levels. One of them is to increase the power level, which only makes the situation worse. And that is an untenable solution when you are dealing with IOT devices that are nearly passive in their characteristics and have a very limited ability to increase power. The other option is to reduce the level or at least control the level of noise itself.

So, I think 100 commenters expressing the need to look more deeply into the noise problem towards a

solution is a pretty strong endorsement of a need for the Commission to continue and for the TAC to continue looking into this problem.

Member Roberson: Now there were recommendations made exactly in this area, and recommendations specifically for FCC action. And I am being a little out of school here, but some of that action is already underway, which is good. So, at least for this year, the FCC has taken the baton and is running with it.

So, a little bit, it helped with the concern. Because the things that were expressed really did require FCC action more so than TAC action. It was teed-up by the TAC, and the FCC is taking action. So, in my mind, it is working just as it should, as the FCC does its thing, and perhaps next year, then, we will pick up the baton and run with it again. But we have teed-up about as much as the FCC can handle right now. Us providing more recommendations in this space would probably not be helpful while they take the ball and actually perform on the requested actions from last time around.

Ms. Atkins: Yes, and I want to reinforce that you will see that in the CSMAC as well, where we had enforcement being addressed and, then, we took a year from CSMAC looking at enforcement, so NTIA could address some specific actions. And now, we are revisiting enforcement within the CSMAC. So, I think that is a healthy balance because you want the Commission and NTIA to take actions against the recommendations.

Member Weller: Thanks.

Co-Chair Alder: Mark?

Co-Chair Gibson: Okay, I have two things. I want to go back to the CBRS. And I noticed that there are three Board members of WinnForum in here and one Board member for the CBRS Alliance.

So, I don't think it is unsafe to say that we

appreciate the work that the Commission and the NTIA are doing to support that. A lot of heavy lifting on your part. And so, the resources you put on all that work have made a big difference. And so, really, really appreciate it.

Matthew, so the Part 95 has been. There is a new order out, I believe. In that, you have renamed the Citizens Band Radio Service the CBRS. So now, there are two CBRSs in the Commission's rules. And so, that is causing a little bit of schizophrenia in the industry. So, I was just wondering if you can talk to that a little bit?

Mr. Hussey: I can't.

Co-Chair Gibson: Okay.

Mr. Hussey: But I have noted it.

Co-Chair Gibson: Thank you.

I am sure there will be at least petition for consideration or an ex parte on that, maybe two.

So, thank you.

Co-Chair Alder: All right. I think, with that, maybe we will move on to the next section of the agenda, where Mark is going to lead us through the Subcommittee work.

Subcommittee reports and discussion

Co-Chair Gibson: Okay. Mark Racek, are you there?

Member Racek: Yes, I'm here.

Co-Chair Gibson: Okay. So, if you could do the brief on 5G and we'll help you along.

Member Racek: Okay. So, I am Co-Chair of the 5G Subcommittee along with Mariam Sorond. And so, we apologize for not being there in person, I am happy to be able to participate on the bridge.

Co-Chair Gibson: Stand by, Mark. Stand by. There

is some packet loss going on. Hold on.

Can you speak up a little bit, Mark, more?

Member Racek: Yes. Is that better?

Co-Chair Gibson: That's better.

Member Racek: Because your end, it has a lot of gain on your end, so it is blowing my ears out.

So, what I wanted to talk about, the slides, are they posted? Because I am looking at the webcast and there's about a two-minute delay there. So, I can't really tell whether the slides are posted.

Co-Chair Gibson: Don't worry about the slides. Everybody here has a copy of them.

Member Racek: Okay.

Co-Chair Gibson: So, just assume we are following along with a bouncing ball.

Member Racek: Okay. That's good.

So, we just wanted to start out with the membership there. We welcomed our NTIA liaisons Rankin and Amy. And also, we have a new member that has been added as well. It is Donna Murphy, and welcome her as well.

We had our first meeting on the 12th of April. At that meeting we worked on the work plan. Specifically, we took a look at sort of the scope of the questions to identify sort of whether we understood the questions and we could actually begin working on the questions.

And we did come across a very good discussion. There was some uncertainty about sort of the scope of the questions. Because when we consider a sharing environment, then we are considering both sides of the equation. And in this case, we are talking about 5G standards and we are talking about federal systems.

So, we are looking at 5G standards. We raised that it is not only 3GPP that is actually producing standards; there are other organizations like IEEE and some public domain type of standardization activity that is also creating standards as well.

And so, part of the questions that have compiled are looking for more specificity, not just for the 5G standards, but the sharing is also with federal systems as well. And that is a pretty big issue there.

And so, under sort of the leadership of Larry, and in talking about the need to go ahead and have our recommendations by the November meeting, and we need to do the focus in our work as necessary, that we need to sort of have a better identification of what federal systems we are actually looking at.

And so, what we have done is we have looked at all of the questions. We came up with some, sort of identified some assumptions, some additional questions for clarifications, et cetera. We compiled this list from the members. We sent it back out to the members early this week, had them take a look at it. And they have until Friday to go ahead and provide any additional questions or maybe some improvements on sort of the way that we have sort of asked for questions. And that information will be forwarded on to our NTIA liaisons, so they can take a look at it and provide us with some additional, hopefully, some clarification.

So, if you look on sort of the last slide here on the work plan, this is going to need to be modified. We had the recommendations are due December 2017. Now we know that that is going to be in November.

And also, we had set up our next meeting. We have already sent out invites to everybody. So, our next meeting will be May 12th. We are looking forward to our members' participation in that activity.

And we are looking, probably at that meeting, to receive any sort of observations that NTIA may have on the questions that we will send them most

likely tomorrow, the compiled questions.

At that time, we will sort of have a better understanding of what the scope of our work will be, and we will at that time look to identify sort of volunteers or how to actually progress towards the recommendations.

And that's it for my briefing.

Co-Chair Gibson: Okay. Thanks, Mark.

Anybody else on the 5G Committee want to add anything to that?

(No response.)

Okay. Any questions for Mark or anybody else on the Committee? A comment? Okay. Paige has a comment.

Ms. Atkins: I appreciate that information, and we look forward, I know the liaisons look forward to working with the Subcommittee in addressing and clarifying the questions.

What I would ask is that I think sometimes we get too focused on specifics when we're trying to address issues. And I will say a little more from an abstract standpoint, and I know that is difficult when we talk spectrum and sharing.

But, for instance, sometimes we want specific systems identified and specific bands, specific services. What I would ask is that we think about, because these systems and capabilities will evolve over time, both on the federal side as well as the commercial side, that we think of it perhaps a little more in terms of categories of types of systems -- that may be airborne applications or terrestrial applications; it could be more localized or not -- as we think about what capabilities, wave forms, or other technologies could just enable sharing between different categories of services.

So, I want to caution that we don't want to focus on

very specific systems from a sharing standpoint, but try to abstract that a little bit. And that will help as we evolve our systems over time, I think.

So, just something to think about. And again, the NTIA liaisons will work with you to help clarify the questions.

Member Racek: That's great. I think we still have a lot of services to consider that the federal agencies actually have deployed. So, it still gives us sort of a number of choices here, but I understand what you are saying is less about the specificity, because we did have specific questions about whether the receivers, the performance of the 5G standards, and considering sharing, also applied to federal systems as well.

So, you know, what you are saying is that, basically, look sort of a little broader, a little bit more abstract, and look at the services standpoint. We may have to even narrow that down a little bit, but I understand what you are telling me.

Co-Chair Gibson: Okay. Thanks, Mark.

One thing I would do to exemplify what Paige just said is -- and I have seen this generally with the way we have been working with the liaisons is they are very good at helping to clarify the position that NTIA has and sort of interpreting what NTIA is looking for. Amy and Rankin on this one have done a pretty good job on that, to the extent that we only had one or two meetings.

So, I think that avenue can really be used to help. If we get wound down into a specific question, just rely on the liaisons to get clarity on that. So, I think that will help a lot.

Okay. Thanks, Mark.

Member Racek: Okay. Thank you.

Band key characteristics

Co-Chair Gibson: The next one would be the Band Key Characteristics. Who's got that one?

Member Dombrowsky: Charla and I are the Co-Chairs.

Co-Chair Gibson: Okay.

Member Dombrowsky: I think I will go first and let Charla come in behind.

Really, we did not have a written report, so don't look for a written report here. We did have two different calls, although I will say our first call happened within minutes after the FCC released the auction closing public notice. So, I would say our call was fairly distracted, to include the Co-Chairs.

(Laughter.)

So, we did have a good first call where we did sort of go through the questions, and it was put to the Subcommittee members to see if folks had questions about the questions. I think the only real clarifications that we got out of that was to make sure the focus was not limited to just certain services, to make sure it is licensed and a light terrestrial unlicensed broadly; and, also, to consider exclusive versus shared in each of the license discussions as well. So, broadening the scope and making sure we are not too focused on any particular sector when you look at the key characteristics that people are looking at for spectrum.

The other good news is on the second call we actually got down to sort of brass tacks because we have five different sort of sub-questions here. And thankfully, Charla and I have a very active group and everybody stepped up without me volunteering too many people to sort of address each of these questions.

So, we have now assigned people for each of the five questions to at least do an initial run-through of a draft, with the hope of at least having some sort of draft response by the end of this month. We actually asked for like a June 2nd turn-in for those first assignments, if you will.

And we already have another scheduled call for June 12th to sort of talk about those first drafts, to try to get feedback and see where things go. I think the big concern from the drafters' standpoint is, do we need recommendations right now or is it really drafting? And we sort of said, focus on the drafting because the recommendations sort of fall out of the drafting.

So, that is sort of our plan at this point, and I think we understand that we have that August timeframe to have something there. So, I feel like, if we get a decent set of drafts in early June, have an iteration, another run at it in July, by August we should have at least something to sort of go over in the August timeframe.

And I am going to let Charla talk a little bit about some of the other particular questions from the actual questions themselves.

Member Rath: Yes. No, I think one thing I would add to that, too, is that we took to heart some of the things I think you said from the last CSMAC, that quality was more important than quantity. And so, in this first round of drafts, the idea is that people, you know, even if it is bullet points, whatever it is, it is just so that we had something at our first meeting to really start to work with, rather than worrying about getting a lot of information in some sort of White Paper form.

That was clearly a question that came up with some of the people who were new this year to the CSMAC. So, I thought that was very good.

And then, in terms of the individual questions, I think we had actually gone through, and, I mean,

the two big things that came up were mostly just talking about -- and Carl is here; he can talk about this -- the whole discussion of low, medium, and high band. Actually, you know, we put that in there, and I think somebody -- you had said it. You know, the beachfront keeps shifting.

And so, certainly, from when I started this -- what? Three years ago, what was considered low band, medium band, and high band is a completely different set of bands than it is now. So, we are going to just have to set up a framework and we will make it up because we would like to know what it is. So, we will carefully create it, yes. We will stick to the facts.

The other question -- and, Tom, add if I am missing anything, and others who were actually in the Committee -- really was talking about, and I think it was Kurt who brought it up initially, was just to make that we really talk about all the different types of sharing; that sharing is not necessarily a single type of entity.

I think anybody who has been putting together systems for a while knows that we all have actually been sharing in a wide variety of ways for decades. So, I think was another important discussion.

Luckily, Kurt, then, volunteered to take on that question. So, the same thing with Carl and the other question.

Anything else that I'm missing or any folks around the table?

We thought that, if anybody in the larger CSMAC had any thoughts that they wanted to share on those two points or any of the other questions, it is really raising those two points to see if anybody had any other thoughts for us. That would be great.

Member Dombrowsky: Mark has a thought. Go ahead.

Co-Chair Alder: In our discussions -- and maybe this is clear, but I just want to reinforce -- you know, the CSMAC has kind of had a process for identifying bands, and maybe Paige can clarify. But my understanding is that kind of the output of this group feeds into that process.

So, if you think about that as a way of helping to focus the work, is: how would they take the output of what you are doing into feeding into their next step, which is actually to identify bands?

Ms. Atkins: Yes, that's correct. And I would also add that one interesting thing to think about that may be helpful is in the low, mid, high band discussion, as we have seen this evolving and changing landscape, are there indicators of what drives those changes? Is it technology maturation? Is it the services themselves, like driving the high-capacity requirements, for instance?

Historically, if there are some things that can help us not only understand what we think it looks like today, but what it might look like in the future, that would be helpful as well.

Co-Chair Gibson: Any more comments or thoughts on spectrum? Not spectrum. That's the wrong group to ask that question. "What do you think about spectrum?"

(Laughter.)

Okay. Well, we are at a break, an hour into this. So, do we want to take a break now?

Co-Chair Alder: Yes, I think it is a good time.

Co-Chair Gibson: Larry says yes. So, okay. Larry says.

So, I show about five after. How about we come back at 20 after? Fifteen minutes, is that good? Cool. See you in 15 minutes.

(Whereupon, the foregoing matter went off the

record at 2:04 p.m. and went back on the record at 2:25 p.m.)

Enforcement

Co-Chair Gibson: Okay. Mark Crosby and Dale. So, let's talk enforcement.

Member Crosby: No, Mark Crosby and Paul.

Co-Chair Gibson: And Paul. I'm sorry.

Member Crosby: Paul is my Co-Chair.

Co-Chair Gibson: I think Dale when I think enforcement. I'm sorry.

Gentlemen?

Member Crosby: I'm going to start and Paul is going to conclude the festivities.

Co-Chair Gibson: Okay. Thank you.

Member Crosby: We met on April 21. Not everybody attended, but we had a good start and there was a lot of questions.

Because at least from my perspective, and perhaps from Paul's, we think this is one where some of the questions should be focused, not expanded. Because I looked at the very first phrase and the very first question: "What options do you see for making enforcement more robust?"

I don't think we have time enough to answer that specific question because it will be really big. And so, we had some questions that would maybe help us focus. We want to create a good product, right, and be of value and give you really good information. And we thought tightening up some of the thoughts behind the questions would be helpful.

Before I get to that, you know, Mary Brown, Dale Hatfield, Mark McHenry, Janice Obuchowski, Ric Reaser, Dennis Roberson, Miriam Sorond, Brian

Tramont, Jennifer Warren, and Bob Weller are the members of this Subcommittee.

So, you know, and these may be the wrong questions, what we are asking, but it is sort of like: so, what is the goal? I mean, what is this automated? Is it to protect federal government incumbents and new users on shared bands? Is it to maximize the efficient use of the spectra? Or is it both?

Because I think if you narrow it down to there, I think we will stop worrying about other things we don't want to worry about like this. Personally, from the EWA's perspective, not the Committee's, I don't think you can do automated enforcement in public safety bands and probably not in broadcast bands and some other bands. But, in shared bands, it is probably a home run, right? So, I think that was one of them.

The other one is, what are the desired mechanisms? You know, forensics; we are trying to figure out what went wrong, how to protect it. So, I think that is all we are sort of asking, so that we can provide a work product that is valuable to the CSMAC and to NTIA.

We are going to meet again. I was just reminded I didn't put out a meeting notice, but I will do that when I get back to my office. I'll do that. And I will turn it over now to Paul.

Member Kolodzy: Yes, we are going to have another meeting coming up. We just got started. I mean, in a sense, we just started to run with the questions and try to have people's comments, and just started to kind of get an idea of what some of the challenges might be here, about why you have some of those questions.

We also wanted to make sure we at least understood, for at least some of the new members that are on the Committee, to understand at least what has happened in the past. So, at least you can

build a foundation versus trying to till soil that has been well tilled.

So, people were asking for like the 2015 portion of the Subcommittee reports, which we are going to be getting and passing it around.

Dale had made a comment about, hey, there's all this FCC TAC material from 2017. If you look at the last page I sent out, that is all materials that he sent out. And so, I spent one evening actually grabbing all that data area down and putting it in a common area, so folks could actually get access to it and actually see what some of the work that has been done.

When we actually got together and talked a little bit amongst ourselves, just to kind of get a feel for what some of the issues are, some people were commenting -- and this is something, again, don't take these as we are asking questions of the leadership here. It is more of this is some of the things we are kicking around. Okay? We probably should look at this.

And that is, hey, should this be national enforcement system? Should it be a localized enforcement system? How should the federal government interact with FCC? Are there state or local organizations which you identify and be involved in this? How do you leverage other resources? That is the kinds of things that could be a very big win if you can figure out that, listen, it is not just this monolithic organization that will figure it all out, but that there are other pieces.

We will be building networks of networks. We are building a lot of systems that are interconnected; ergo, why comms are so important. The question is, how do we exploit some of those systems and align them?

And then, if you can do that automatic stuff, you are trying to do automated enforcement, what things are off the table? Like what are you not

allowed to do? Shut people off? Because like the e911, for example, there's probably someone there saying, "No, you will not just automatically turn people off if there are possibly safety and life issues."

What is the role of the human investigator? Is that still valuable? Is that going to be cut way down? What is that role? How do you actually have the interaction?

And then, it goes back to one of these things that Dale was giving: what needs to be known and what are the baseline measurements that are needed? What is already known out there? What else do we need to know?

As you had said, Paige, before, let's step it up a level and try to look at this not as an individual case, what's going on, but ask the question, what in the general cases do we need to do?

I think that that needs to be taken in the context with what do we need to know and do we need baseline measurements now, or when you are building an enforcement system up, what kind of baseline measurements do you need?

And I will leave that up now. Anybody else on the Committee want to say what we did wrong or --

Member Crosby: Yes, these questions that Paul went through came from all members of the Committee. It wasn't just one person. So, they were a great Subcommittee, and everybody participated and gave us some really good questions.

Co-Chair Gibson: All right. Thanks.

Member Crosby: Jennifer said, "I would like to be on your Subcommittee." And I said, "Absolutely."

Co-Chair Gibson: Who can say no?

Member Crosby: Without hesitation.

Co-Chair Gibson: I would never say no.

Member Crosby: I know that Dale had some comments.

Co-Chair Gibson: Go ahead, Dale.

Member Hatfield: Oh, thank you.

And I apologize to both Mark and Paul that I got some of these comments in a little later, and they are not reflected in the document.

I have comments in four areas. The first is the need for more factual information on interference incidents. So, I'll talk a little bit about that, both past and what the trends are.

I think we need to be careful here. You threw the word "enforcement" around. So, the second point, I think we need to really be careful what we're talking about. Some people use "enforcement" in a very broad meaning, and some mean it more just when there's something, somebody going to be actually cited or something. So, we need to review that.

And third, we have done some work in the past in the TAC about the tools that have been used traditionally, and you don't want to restrict yourself to using past tools. But it's sort of benefit to go through what tools we used in the past and whether they're applicable today.

And then, another favorite topic, of course, is addressing squarely the issue of defining harmful interference. It's kind of hard to set a speed limit. It's kind of hard to enforce a speed limit if nobody tells you what the speed limit is. And that's sort of a fundamental problem I think we have.

But I'll expand it and I will hope somebody here, if I ramble on too long, will pull me up short.

Those basically are the four areas. The first, as I said, I feel we are being asked to answer questions and make recommendations regarding enforcement

without any basic statistical information or even extensive anecdotal information of what the heck are the big problems out there today and where are they likely to be in the future.

One of the earliest recommendations of the TAC, the Working Group and the TAC, was to have the FCC publically release more historical information on interference incidents and sources. And the FCC, to its credit, has taken steps in that direction, but they are pretty limited and they are mostly when there's public safety, a public safety incident involved.

So, I'm concerned. Here again, we are asked to be sort of designing sort of a next generation enforcement concept here without kind of knowing what the problems or what they are really out there.

We don't get root causes, for example. We can learn about somebody was issued a Notice of a Current Liability, but what was the root cause? Or what if it ever got to where it became subject to a formal investigation?

Another thing along these -- well, let me say, I think everybody, the research community here, everybody else would benefit if we think about these problems, so that we know what are the trends towards what are causing. This is just an example, and I'm not in any way suggesting there is any problem here.

But all these new electric vehicles on the highways are much different with the noise they generate. It would be much different than what you had information on emission. So, does that change the environment that we have to deal with? Those are the sort of things. So, I think we would all benefit from more information.

Along that line, I've been hanging around with and talking to a lot of professional interference hunters. It has sort of been sort of intriguing. We sometimes sit here in meetings talking about interference

hunting, and there's people out there, of course, who do it, do it for a living.

And one of the things that we proposed going back to the TAC was that the Commission facilitate the creation of an entity that would be made up of professional interference hunters that could exchange information about what they're seeing as the problems that are emerging. So, we are working so we have a better idea of what's happening. And with interference hunters working together, this would be including from carriers and from the Commission, depending on how you set it up.

But we had a conversation earlier. For example, I'm seeing in my mind this type of interference. I've identified it. I've tied it down to this type of switching powers, whatever. Here's the wave form I am seeing. And that could be exchanged with other people saying, "If you see this sort of thing, this is apt to be what the cause is." And that would be facilitated, then, by the exchange of information among interference, the people who are doing interference hunting professionally.

As a result of that idea, I actually sat down and created a paper which I think -- I don't know whether it was circulated or not -- talking about how an interference hunter's information exchange might work.

So, as a result of what I have just said, I think I have three points, I guess, I'm trying to give. I think it would be really useful to get from the FCC a progress report on what they are doing in terms of making interference information more widely available and more transparent. Here again, there is some of it now, but it doesn't often get to root causes. And I think that would be very useful.

Similarly, I think it would be very useful for NTIA to tell us what you are seeing in terms of interference. What interference incidents are you seeing? And I would be interested, too, in what constraints you feel in terms of releasing such information to us.

If I am thinking about how I am going to automate this, what sort of incident do I think about? And if you provided some information on those sort of incidents, use cases, that might help us in our use cases.

And, of course, I think it would be useful -- so, the third, one from the FCC on what they are doing. And then, third, I would be interested in NTIA's reaction to this interference exchange that was an outgrowth of the TAC group.

Second, I think as an early thing, I think this will help parse the problem. I think early on we need to look at the basic steps in enforcement. You all know what they are. They are detecting the interference, identifying it, classifying it, locating it, reporting it, and then, mitigating it, and then, remediating it. And by remediation, I mean actually the punitive step.

So, basically, what I am proposing is that very early on we sort of formally break it down because that would help us, then, looking at which of those sort of steps can be automated or not, and what is the current state of the art in terms of automating those steps.

Another thing that troubles me here a little bit when we talk about enforcement is there are steps -- this goes to the issue of what's the role of humans in this. We make judgments. When the traffic cop decides to pull you over for speeding, the police person will think of, you know, what are the conditions, and so forth; approach your car, and making a judgment, do I actually issue the ticket or just a warning? There's all sorts of steps here. And is my radar calibrated right? There's a whole bunch of things you have to go through before you decide to take this next step.

And those are interesting to me to try to think about what sort of algorithms do you try to write to try to automate some of this stuff that we do currently. Here again, the example, the speed limit, if you set

a speed limit, you know, you give the person -- in Colorado we generally say you can probably get away with 10 miles over the speed limit.

Co-Chair Gibson: Really?

Member Hatfield: It's sort of a judgment thing. And do you build a judgment like that into trying to do these things?

So, let me move on here because I feel like I am running over time.

Third, the point here, again, is we are going back and identifying traditional enforcement tools. We did this in the TAC. We went back in one of our early reports and just looked at the tools that are typically used in enforcement.

And just a few of them. Some of these are seriously outdated; some are not. Call signs and related identifiers, we just talked about that. What's the role of call signs in the future?

Construction permits, station licenses, requirements for professional installations. We used to, of course, license the people who worked on transmitters.

Equipment authorization and labeling is something we traditionally used.

Lobbying and record-taking, we had a little talk about that. I can remember my Ham radio, having to fill out the log of who I talked to and how long the conversation was. I wasn't sure what that was for, but I assumed if the FCC got an interference complaint, they could ask to see my log to see if I was on it at that particular time. So, still around.

Miscellaneous other tools, numerous databases, of course, that goes without saying, the ULS and your government master file.

The other on the XM is the educational efforts, outreach, advisories. In fact, when I think about the problem you have given us, it seems to me

distinguishing between what is ex ante and ex post is very important. If we can't get a tighter grip on stuff by voluntary, then we have got to expend more the other way of perhaps this better understanding of doing stuff ex ante rather than ex post.

Co-Chair Gibson: So, Dale, can I ask --

Member Hatfield: I'm sorry for the monologue.

Co-Chair Gibson: No, that's okay. You know, you get some runaway from monologue.

But have you given this into -- you're part of the Committee, right, the Subcommittee? So, I mean, I think Paul and Mark would certainly benefit from this.

Is this the first time you are hearing this, guys? I mean, I think what we are doing is we are having the Enforcement Committee meeting here now, and it is not really the purpose of this group at this point.

Member Hatfield: I was taking the advantage of you saying we had lots of time. You should never have said that.

Co-Chair Gibson: Well, Larry said that. I'm of the opinion that we have lots of time. That doesn't mean we need to take it, you know, profitably, but --

Member Crosby: The material from Dale, as well as the proposal for interference hunter information that Dale sent, the Committee has it all.

Co-Chair Gibson: Okay.

Member Crosby: It just came in after we had prepared the slide and think of things. And far be it from me to try to convert Dale's material and information into slides.

Co-Chair Gibson: Yes. I am hearing some awesome

points here, but let's try to work that out in the Subcommittee.

And Paige had some comments she wanted to make. So, let me let Paige go ahead, and then, we can have some other comments from the room, too.

Thanks.

Ms. Atkins: I could probably take as much time as Dale just did, but I will try not to.

So, a couple of key points. When I think of enforcement and how we tried to frame this topic, it is broadly-defined. So, it is not traditional enforcement in terms of from a legal sense, so to speak. But it includes -- and this will in some sense answer some of the questions in the slides -- it is, how do you protect the users that should be protected, whether they be federal or not? How do you maximize spectrum sharing, particularly to enable dynamic spectrum sharing? How do you identify and mitigate problems in near real-time or real-time or not so much real time? And then, how can you prevent interference from occurring in the first place?

So, it is ex ante, ex post. You know, it is kind of a broad discussion, but the emphasis is really in terms of trying to prevent it from occurring in the first place. So, it is very broadly defined.

As we talked about in the 2015 enforcement discussions, this is a very complex topic and it has to be decomposed in some way that we can get our arms around it. Our initial emphasis was in automation because we feel, our gut feeling is that is critical to where we want to go in the future.

But, then, there was some discussion around there are other piece parts that we may need to address in the context of automation. So, I think that that broad statement upfront was really to try to allow for some flexibility in that area.

I have also talked a lot about the cyber analogies in this space, cybersecurity analogies. If you look at some of the frameworks like the NIST framework, if you look at the ISACs, the Information Sharing and Analysis Centers, it is very much aligned, Dale, with what you were talking about.

So, there are models out there that I think we can leverage. In cyber, it is largely about automation. You can't detect and mitigate or attribute attacks unless it is really real-time. So, I encourage you to think about that analogy and perhaps some materials that could be leveraged right off the bat.

I agree that as much information we can provide we will. We do have some work that we have been doing on interference events that I think we can provide at least initially verbally. And we are working on a report, a limited set, but it may give you some insights.

The challenge with interference events is that in many cases interference is resolved at the lowest level and you never see it. It never bubbles up to the Commission. It doesn't bubble up to NTIA because it is resolved in a different way.

And so, characterizing what it looks like today may be a little difficult and, more so, it doesn't necessarily predict what it is going to look like in the future. So, those things we will have to balance.

And I think that is all I want to say, but just some pieces that, hopefully, provide a little more thought and context.

Co-Chair Gibson: Go ahead.

Member Hatfield: How about the definition of harmful interference? I don't see how you can do harmful interference unless, you know, somebody defines "harmful". And so, we are just kind of almost wasting our time if you don't have a sense. So, is the issue of, the definition of harmful interference, is that within the scope of what we are

trying to do or not?

Ms. Atkins: I will answer it in my way.

(Laughter.)

So, in my mind, automated enforcement -- and again, talking enforcement in a broad sense -- you can't have, I would assume you can't have automated enforcement with some form of definition of how you would define what the issue is and trigger against that issue. Harmful interference is a good example.

What I would say is in the exercise for this question and topic, it is not to delve down into the specific details of bands and services and those kinds of details. But, generally speaking, what is required to enable automated enforcement? If harmful interference is required, then how do you define it and characterize it, so it can be put into some sort of framework to actually automate the enforcement mechanisms?

Did that make sense? Or we can take that offline, I mean.

Co-Chair Gibson: Yes, let's, yes.

(Laughter.)

So, I would like to just make a comment.

Oh, yes, okay, Glenn.

Mr. Reynolds: Just a quick comment and, actually, Paige kind of talked on it. One comment and one commercial.

The cyber issue and, well, the enforcement hunters, the interference hunter issue, and the relationship to cyber. One of the things that NTIA has done over the last two years is a multi-stakeholder process trying to facilitate processes for companies to share information about cyber attacks in a way that could be secure, that avoids penalties associated with

that, but allows entities to share that information. So, those cyber attacks do not keep on going on and on. And people currently have incentives to hide the ball. So, I think it is kind of interesting whether there might be some lessons learned from that aspect of it.

Ms. Atkins: Yes. That also ties into the ISACs that I mentioned or operationally how they have implemented that today.

Mr. Reynolds: And then, the commercial, which seems appropriate since we're at NAB, is that a number of the issues that were touched upon, particularly the forensic issues, are going to be, I believe, front and center at the ISART conference. And so, hopefully, many of you will be able to come out for the CSMAC meeting and stay around for ISART for those conversations.

Co-Chair Gibson: All right. Thanks, Glenn.

So, I had two comments I wanted to make. One is I noticed that there is no SAS providers on the Committee. I think you will benefit from the input on the automated enforcement associated with SAS and CBRS. Because I see nobody on this Enforcement Committee that is a SAS provider.

Member Roberson: Oh, a SAS provider? Oh, sorry.

Co-Chair Gibson: Yes. Isn't that what I said? Maybe not. Okay, I'll say it again.

(Laughter.)

There is nobody on Enforcement that is a SAS provider. So, I am a SAS provider. So is Paul and Kurt. So, I will be there and, hopefully, provide some insight into the automated enforcement that we have to do for SAS to make NTIA happy, to make the DoD happy, and to make the FCC happy. So, that is all the spectrum masters out there that there are. So, one point.

Another point, we have heard this before, the notion of interference reporting, the interference hunter. Can we do interference hunting? And I mentioned this at the WSRD last year as an example, and I think your ISACs might be a perfect example.

But totally in a different vertical is NASA runs a database that is called the Aviation Safety Reporting System. And that database is used and it gives pilots and anybody that is in the aviation community autonomy and freedom to report aviation incidents, everything including somebody got too drunk on the aircraft, to a pilot that busted a flight clearance, and they get immunity if they report it within 72 hours of the event occurring.

And so, what NASA has done with that database is to improve the entire -- and this database has been out there since about 1985 or so. So, that is another area to look at in terms of the methodology and some of the guidelines on that. You might know about that, Andrew, yes. Anyhow, just a thought to keep looking at that.

So, go ahead.

Member Roy: Andrew Roy, ASR.

So, one of the things with the enforcement that we find in aviation particularly is the intelligence piece; the intelligence is the collection form of processing. Collection is always difficult because pilots are busy people; they have got a lot of things to do. If they get a blip or something, it is a big issue for them. And something, when it goes away, that's no longer the issue. And then, they never get a chance afterwards to sit down and do the paperwork. Because guess what? They have to get passengers off and a few other things they need to do as well with the aircraft. So, that is the big key.

The other thing I'm curious about with the Enforcement Committee is at the moment we have got a lack of information. With an automated enforcement collection process, you are going to

have the exact opposite. You have tons of information. How do you process that or even get an idea of what we've got? Suddenly, you are going to be swamped. Doing a human process is going to be very difficult for that. Once an automatic process kicks in, what is the heuristics you're looking at? You may be able to pull apart what is a legal broadcast, a broadband noise issue. It gets very complicated.

Member Crosby: Well, this is Mark.

I agree, Andrew, because right now there is a lot of just human intervention. And so, as a result of that, it is all prioritized. And so, only the top mission-critical things like the FAA -- remember that guy down in Florida was interfering with planes?

So, the top priorities get handled. But I think if they have some sort of automation, maybe stuff down lower in the pyramid that is very critical and have priorities to be resolved may also be addressed, because there isn't enough manpower or woman power -- sorry, Jennifer (laughter) -- and resources to do it. So, we have got to come up with a better or a new tact, I guess.

Co-Chair Gibson: Well, I want to move us along because, like I say, we are having an Enforcement Committee meeting right now, which is not the intent. But thank you. This is good feedback, everybody.

Did you get everything -- yes?

Ms. Atkins: I just want to mention again big data issues --

Co-Chair Gibson: Yes.

Ms. Atkins: -- cyber. There is so much that we can, I think, learn from this cybersecurity world that would be beneficial.

Co-Chair Gibson: Okay. Thanks.

So, I will be on the calls as a SAS provider. Are there other SAS providers here?

Spectrum efficiency

The last, but not least, is Spectrum Efficiency. Who wants to do that brief?

Member Tramont: Bryan Tramont is doing that brief.

Co-Chair Gibson: Bryan Tramont. Okay, Bryan.

Member Tramont: With help from Jennifer as needed.

Co-Chair Gibson: As needed?

Member Tramont: So, we are the Spectrum Efficiency Subcommittee.

If needed, as needed. We had two questions that were put forth by NTIA. We edited the first one briefly. That is what the underlined text is on slide 2. "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?" And on our first call, Carolyn volunteered to be the lead on that, pull together answers for that question.

And then, the second question, "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 I have agreed to lead that one.

Well, so after our conversations on the call, you see the one modification. We are happy if other people have ideas about the ways in which the questions are not completely clear or might be modified. We are happy to take those.

On the next slide, you will see the list of the

Committee members and the NTIA liaisons.

As I alluded to, we did have our first call on the 27th and modified question one and now have the two sort of working groups proceeding on question one and question two.

I think one of the big challenges -- and we just in the very useful 15 minutes that we had to chat with one another -- we were discussing how to tackle each of these. And I think there is going to be a big push from Committee members to reach out to each of you as members and your member organizations for inputs on these, because these are not the sorts of questions where there is an obvious answer or three obvious answers. But, instead, it is we want to gather the best ideas, particularly from the folks represented in this room and also from third parties to try to assemble a useful list.

Hopefully, the problem we will have is we will have 30 great ideas, and we will have to noodle it down to five that we give to NTIA. But I think the hope is to get the 30, so that we get to have a high-quality list of possible policy initiatives or practices that could be most usefully utilized by NTIA going forward.

So, our work plan envisions a lot of outreach with conference calls or in-person meetings with individual stakeholders, and then, with the idea that we would have draft reports available for the August 15th meeting, and then, obviously, ready for adoption come November.

So, I believe Jennifer will highlight any additional issues.

Oh, and then, I'm sorry. We also distributed background information on these topics. There has been a lot of work done on efficiency issues, both within CSMAC and at the FCC.

One issue that did come up which I think is consistent with the recent direction that Paige has

given, we are not going to attempt to define efficiency as part of this exercise. There has been a lot of work done on defining efficiency. Agreed that is an important issue. Agreed that will be a sub-text to a lot of the suggestions that come forward. But we are going to try to build on the existing academic and government work on defining efficiency and really focus on operational components, which we think NTIA was driving towards in their initial questions.

Co-Chair Gibson: Jennifer?

Member Warren: Nothing to add. Thank you.

Co-Chair Gibson: Wow.

Any questions for the to-be-defined efficiency team?

Dale?

Member Hatfield: I promise --

Co-Chair Gibson: I've got the clock running. No, I'm just kidding.

Member Hatfield: It seems to me that you mentioned here, I think on the first slide, about harming effectiveness. But one of the things is, I think, in some cases you may make a tradeoff of efficiency with resiliency, for example. It may be a very conscious decision. I'm going to be less efficient because I am going to make my network more robust, or whatever.

And I am not quite sure how one incorporates that one. I am not sure how one -- so, there are other dimensions that I could rattle off, but I am approaching my minute. So, I won't.

Member Warren: May I?

Co-Chair Gibson: Go ahead.

Member Warren: So, that was part of the nature of the discussion, though, why we did the clarification.

Because the original question didn't allow for some discussion that way, or at least we didn't see it structured that way. It looked like it was looking to improve both efficiency and effectiveness as opposed to recognizing that there are potentially trades.

And I think what you are saying is, if I understood it correctly, is that they make trades to be less efficient, to be more, as you said, resilient, just as radars may be less spectrally efficient but more effective for the purpose for which they are being deployed.

The same for the commercial or government, there are those kinds of trades that take place. And this isn't intended to say efficiency is king. That is really what this is intended to do.

Member Tramont: Well, I always believed effectiveness folded in other components.

Member Warren: Uh-hum.

Member Tramont: I thought effectiveness, it was not focused purely on any one vector, but would include things like resilience and things like that. The stakeholder would determine what those tradeoffs were as opposed to a third party.

Co-Chair Gibson: Is that your comment, Bryan? Yes?

Larry?

Co-Chair Alder: Yes, I just wanted -- and I think this has been clear -- but, obviously, for this question, it is not that the policies themselves have to improve the spectral efficiency, but could lead to, for example, the funding that was talked about in the earlier bill. And so, it is not necessarily just a task of this group to figure out how improve spectral efficiency, but I just wanted to make sure.

Co-Chair Gibson: Paige?

Ms. Atkins: And this is related to the earlier discussion. So, characterizing that we don't want to harm effectiveness I think is fine, but I believe we would want to clarify without harming or improving. Because in many cases, going back to the different trades that are made -- and I mentioned in my opening remarks that efficiency is valuable, but it is only one element of the decision process. And in some cases, if you are going to spend double the amount of money for a program to get efficiency, then you will want some benefit out of that. You will want additional operational effectiveness if you want to gain that efficiency.

So, I think you just don't want to bound it that the minimum or the only option is to not hurt it, but you also want to be able to improve it, if that makes sense.

Member Tramont: Yes, but, well, we can't say without harming or improving. We have to say --

Ms. Atkins: Well, you can tweak that, the language. I just want to make sure that is not the only threshold.

Member Tramont: No, okay, got it. Got it.

Co-Chair Gibson: Okay. Okay. Any other questions for Jennifer or Bryan?

(No response.)

Any other comments from the other Committee members on that?

(No response.)

They are having a meeting over there. So, join it. That's why you are sitting next to each other, right?

Okay. So now, I'm a referee here.

Okay. So, that is the Committee outbriefs. As you can see, we are at the nascent stage of our work. Hopefully, we will come back to continue.

With that, I thank you for all the work we are doing. It is fun. It is interesting. There is a lot of stuff hanging on it. Good work. Thank you very much.

We are now at the point where we look for any public comment.

So, actually, are there any comments from any CSMAC members that are on the phone, if they are already still left on the phone?

Member Lewellen: Yes. Larry or Mark?

Co-Chair Gibson: Any of them.

Member Lewellen: Hello.

Co-Chair Gibson: Hello.

Member Lewellen: Mark Lewellen from John Deere.

Co-Chair Gibson: Mark Lewellen? Yes.

Co-Chair Alder: Go ahead.

Co-Chair Gibson: Go ahead.

Member Lewellen: Just briefly, this all relates to the enforcement discussion. We had a real-life situation a couple of months ago. We were getting interference, one of our reference stations in Madagascar. And we were able to reach out to their spectrum regulator and have that enforced and taken care of. So, if they can get it right in Madagascar, maybe there is hope with us.

Co-Chair Gibson: Good. Thank you. We will go there and troubleshoot that anytime.

Any other questions or comments from the other CSMAC members on the phone?

(No response.)

Thanks, Mark.

Okay. So, comments around the room from guests?

I think it is guests, right? The public? Anybody in the room?

(No response.)

Any public comments from the phone?

(No response.)

Closing remarks by public comment

Okay. Closing remarks? Do you have any remarks?

Co-Chair Alder: I don't. Just thanks. Thanks, everyone, again, and we are looking for the August meeting to have a lot of good work between now and then, and we'll see everyone at the August meeting.

Co-Chair Gibson: Yes. Thank you very much for the work. It's always good seeing you, and I hope everybody makes it out to Boulder. It is a great place in the summer.

Paige, anything?

Ms. Atkins: Just reiterate, if you are coming out to Boulder, I encourage you to try to attend the ISART conference as well.

Co-Chair Gibson: Yes.

All right. We are out. Thank you.

(Whereupon, at 3:05 p.m., the meeting was adjourned.