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COMMERCE SPECTRUM MANAGEMENT ADVISORY COMMITTEE

(CSMAC) MEETING

Bridge Conference

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C O N T E N T S

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P R O C E E D I N G S

(1:00 p.m.)

CO-CHAIR RATH: Great, thank you. I wanted to start by saying, I mean, the first welcome should, obviously, be going over to the Acting Assistant Secretary, Remaley, but I apologize on behalf Jennifer Warren, who had a last-minute critical meeting that she had to attend, and is very apologetic, as though -- that she couldn't be here today, literally was at the exactly the same time, as this meeting. So, she couldn't even pop on, for some of it, and it's those of you who know Jennifer well, know that CSMAC is, you know, very important to her, and it -- we all know that it would of -- she would not have done it, but for a, you know, critical meeting that she had to attend.

So, without further ado, I wanted to express her apologies first, and then obviously move on with the meeting, and I will be a -- the Single Chair, not a Co-Chair today. So, if anything goes wrong, it is all my fault, so, over

to you Assistant Secretary Remaley.

MS. REMALEY: Charla, thank you. Thank you, and we're sorry to not have Jennifer today, but we certainly understand. So, let me just start by saying good afternoon to all of you, and welcome to this final meeting of the current CSMAC Term. I'm pleased to be here, as we conclude -- excuse me -- a productive to your cycle. I want to thank you, for your participation and hard work, as members, in this important Advisory Committee.

As all of you know, we will soon be transitioning to a new CSMAC as we recharter and reconstitute the membership of this group. It is a natural and useful exercise that helps to keep CSMAC ever green and nimble, as it tackles the most precedent questions of the day. This year, rechartering happens to coincide with the Presidential transition, a new Congress, a new Secretary of Commerce, Gina Raimondo, as well. We'll also be saying goodbye to some members and welcoming some new members, at the next meeting of

CSMAC, and we remind those listening in, and current CSMAC members, who desire to apply for another term, to please see the information posted on our website. The deadline to apply is April 16th.

Of course, NITA's need for expertise and advice, from our partners and collaborators represented here, will not change. We are reaching out to all stakeholders to make sure we continue to have diverse and experienced membership on the committee. We look forward to providing the newly constituted CSMAC, with a set of steady questions that will keep us on the cutting edge of spectrum policy and technology developments. And we hope you will help us to get the word out about the currently listing for this, as -- because as we said, we very much value the contributions of this group, and we look forward to having the exact and most diverse candidates possible.

So, another constant for all of us, in the Spectrum Policy Field, and in fact for

everyone working to maintain and enhance American's high-tech leadership, is the reliance on sound, well-researched, and unbiased compliance and engineering. This is the foundation for good Spectrum management and policy, and NTIA will always strive to maintain the integrity of its technical data gathering and analysis because we know that good public policy solutions come from accurate and careful engineering and information management.

We have always looked to the CSMAC to assist us in this, and we will continue to rely on your honest and professional insights, as we go forward. This will be important in an era when collaboration and trust are more important than ever. We need to work together, within and across government, and also with the private and nonprofit sectors, and academia. Together, we will continue leading the challenges of modernizing our Spectrum Management Infrastructure and providing Spectrum Resources for our burgeoning terrestrial wireless and space

industries, from 5G and 6G to the rapidly expanding satellite constellations, to new missions to the moon, and beyond.

We need strong partnerships and to be strong partners with the Federal Communication Commission, Federal Agencies, Congress, and the White House, and we need CSMAC to help us navigate through the challenges and opportunities to come. Speaking of valuable and smart partners, I want to take some time here, to personally thank our two Co-Chairs, Jennifer Warren and Charla Rath. Now, I know that Jennifer was unable to join us today, but I just want to note, Charla, your leadership, Jennifer's leadership, dedication, and professionalism in service of country have been inspiring, and CSMAC has done excellent work under your gavels.

With both of you at the helm, CSMAC has truly stood out as an ideal Federal Advisory Committee, and we congratulate you and thank you for making CSMAC's reputation and purpose at the highest level. It gives us all much confidence

and enthusiasm for continuing our work into the future. And with that, Charla, I will hand it back over to you, and I look forward to a productive and successful meeting this afternoon. Thank you.

CO-CHAIR RATH: Great, thank you. Thank you very much, and thank you for your kind remarks, and obviously much of the credit goes to the committee, itself, so with that, I'd like to move to the roll call, which, after several virtual meetings, I think we've finally got it down. So, it shouldn't take us to long to get through. But let me run through just everybody to make sure that we know who's here. So, starting with Claude Aiken?

MR. AIKEN: Present.

CO-CHAIR RATH: Audrey Allison?

MS. ALLISON: Present.

CO-CHAIR RATH: Donna Bethea-Murphy? Michael Calabrese?

MR. CALABRESE: I'm here.

CO-CHAIR RATH: Jeff Cohen? Mark

Crosby? Tom Dombrowsky? Mark Gibson?

MR. GIBSON: I'm here.

CO-CHAIR RATH: Dale Hatfield?

MR. HATFIELD: I'm here.

CO-CHAIR RATH: I know you're here, yup. I know you're there. Carolyn Kahn, I know your there.

MS. KAHN: Yes, Charla.

CO-CHAIR RATH: Paul Kolodzy?

MR. KOLODZY: Here.

CO-CHAIR RATH: Mark Lewellen? Jennifer Manner?

MS. MANNER: Here.

CO-CHAIR RATH: Mark McHenry?

MR. MCHENRY: Here.

CO-CHAIR RATH: Wayne Phoel?

MR. PHOEL: Here.

CO-CHAIR RATH: Carl Povelites?

MR. POVELITIES: Here.

CO-CHAIR RATH: Ruth Pritchard-Kelly?

MS. PRITCHARD-KELLY: Here.

CO-CHAIR RATH: Mark Racek?

MR. RACEK: Good afternoon.

CO-CHAIR RATH: Okay, good afternoon. Dennis Roberson?

MR. ROBERSON: Delighted to be with you.

CO-CHAIR RATH: Andy Roy?

MR. ROY: Good afternoon, all.

CO-CHAIR RATH: Kurt Schaubach? Steve Sharkey?

MR. SHARKEY: Here. Hey, Charla.

CO-CHAIR RATH: Hey. Mariam Sorond?

MS. SOROND: Hi, I'm here.

CO-CHAIR RATH: Bryan Tramont?

MR. TRAMONT: Enthusiastically present, thank you.

CO-CHAIR RATH: Where's your British accent?

MR. TRAMONT: It's with my students.

CO-CHAIR RATH: So, Jennifer Warren? Okay. Jennifer, we know is not here. And Chris Weasler? I see you Chris, I know you're here, so. Bob Weller?

MR. WELLER: Good afternoon, everyone.

Bob Weller here.

CO-CHAIR RATH: Great, and Chris, if you're on mute, would you just confirm that you're -- you are in listen mode, right now? Because I see your name up on the screen. We'll double check that later, but I do see him. Well, that's it, and again I'm doing -- yup.

MS. BROWN: Donna Bethea-Murphy.

CO-CHAIR RATH: Yup.

MS. BROWN: I didn't hear you call out my name.

CO-CHAIR RATH: I did, early, after Audrey.

MS. BROWN: I'm sorry, I missed it.

CO-CHAIR RATH: In the B's. No problem, I'm glad -- sorry?

MS. BROWN: Yes, this is Mary Brown, I think you skipped over me after Donna, you went to the C's.

CO-CHAIR RATH: Oh, you know, I did Mary, sorry.

MS. BROWN: That's okay.

CO-CHAIR RATH: You are right, okay. I got you, I knew you were here, though, and just to run back through I have Jeff Cohen, I don't think he's here, Mark Crosby, Kurt Schaubach, and I know -- Jenn --

MR. COHEN: Jeff Cohen is here.

CO-CHAIR RATH: Oh, okay great.

MR. COHEN: Great, thank you.

CO-CHAIR RATH: And I've got Jennifer is out, and Kurt Schaubach is out. So, if any of those folks are here, and I missed them, please let me know. And I did this in the Office of Directional, although I did say, you know, early, I do really appreciate, and I know Jennifer would be here saying the same thing, just all the incredible hard work that this committee has done, over the last two years. We have had some very interesting discussions, you know, both in the subcommittee level and in the full committee level, and have, you know, tackled issues of importance in the spectrum area, both in the macro-level, as well as in the micro-level. And

I, you know, also truly appreciate the nearly seamless way this entire group has managed to move from doing in-person meetings to doing remote meetings. So, thank you, all, for all of this, and with -- with that, I'd like to turn it over to Charles for the Spectrum Policy Update, please.

MR. COOPER: Thank you, Charla, and thank you to Evelyn Remaley for being here to kick off the meeting today, and also for underlining NTIA's to the commitment to the CSMAC. As Evelyn noted, we are in a time of transition, but the importance of CSMAC remains constant because our role in advising the Executive Branch on Spectrum Policy also remains constant.

We look forward to this new administration and also to a new CSMAC. First though, we have some unfinished business in this cycle, receiving the report from Subcommittee 4, on UAS. This is the last report from the four working groups, that we established during the cycle. So, this will complete our pleading, our pending work, prior to the rechartering of the

process. That doesn't mean we can't have a little review of our status, in the Spectrum Policy World. So, you won't be getting off that easy. So, here is a brief Spectrum update, from OSM's viewpoint. As always, feel free to ask questions or make comments, as you feel that they need to made. I will set aside some time, at the conclusion at the time of my summary.

Our primary focus for ongoing work, right now, within OSM, is the 3-gigahertz band, which is becoming a critical mass band for 5G. Over the past two years, industry has identified a critical need for consolidated and harmonized block of Mid-Band Spectrum. This followed earlier efforts in the millimeter wave bands, leading to a balanced portfolio of low, mid, and high-band Spectrum for carriers to utilize. A series of efforts to repurpose segments of 3-gigahertz came together last year. In 3550 to 3700, the FCC auction priority accessed licenses for CBRS, adding to the existing general authorization for licensing and operations.

This allows for full rolled out of CBRs operations, allowing us to see how the SESs and the sensor eco-systems will function in real time and in the real world. So, we continue to monitor that rollout as much. Meanwhile the FCC, proceeded to finalize plans to repurpose the extended C band, auctioning off licenses for Terrestrial Wireless, in 3700 to 3980. That auction is now -- that auction has now set new records for a Spectrum auction, with bids exceeding $80 billion. (audio skip) the packing of the band, to accommodate both the existing satellite operations and new terrestrial services.

And then, also last year, the process, involving the White House and the Department of Defense, resulted in an agreement to repurpose the 3450 to 3550-megahertz band. We are now working on implementation in advance of an auction, that the commission has set for October of this year. So, not that we're all counting, 2020 launched us toward a total of 530-megahertz Spectrum, being made available in three gigahertz (inaudible). Of

course, the big picture, total mask, a lot of policy and technical details, that have been worked out, and, of course, there's still some more to work out as well.

Still, I think, we are justified in noting that the government, including the FCC, the Executive Branch, and the Department of Defense, has responded to industries need for more Spectrum Access and to Congressional Mandates to provide it. From the commercial perspective, there will be tremendous commercial manufacturing efficiencies, once 5G services are grouped together in the contiguous Spectrum Block, as 3-gigahertz. Furthermore, grouping similar services together, minimizes concerns about non-compatible adjacent services potentially causing harmful interference.

We also continue to oversee current study efforts, such as the 1300 sensor and non-sensor pipeline programs, as well as the 1675 to 1680 NOAA Pipeline Plan. But perhaps at this time, even as we work to complete these current

efforts, to take stock of where we are. What additional Spectrum resources are needed to keep fueling our 5G infrastructure efforts? How can we make sure that wireless networks fulfill their role in closing the digital divide and boosting our economy? Are there additional bands that we should be looking at? Maybe the lower three gigahertz, that would be feasible and practical to study for repurposing, going forward.

On a technically side, what lessons can we draw from the operation of the SaaS, and sensor equipment, in the CBRS Band? How best can we move forward on a dynamic Spectrum Access, and see the best results from efforts, like our Incumbent Informing Capability Concept? Part of taking stock of where we stand on repurposing will be the preparation of the next annual report, on Repurposing Incidents, which we're already working on, and is certainly a best seller. This will be the third yearly snapshot of the progress of our purposing efforts and has been a good way to collect and document, analyze, and express it all,

in one single document. So, we're looking forward to finalize it and will issue it later this year.

In other policy news, we're closely monitoring the FCC's activities to address satellite launch and re-entering in the 2-gigahertz range. As you know, the Commission has teed it up for the next meeting in order, and NPRM, that would, among other things, add a secondary non-federal allocation, in 2200 to 2290 megahertz. Spectrum use for commercial use launches have become highly congested, resulted in an increased need for special temporarily authorities, in the Federal Spectrum. Also, on the flip side, we've got increasing Federal Missions and launches in this band, as well, leading to increased need for coordination.

We've been working with the commission on this issue, and it's one of the areas where we'll need to continue in close collaboration to ensure that we can both streamline commercial launches and maintain the needed Spectrum for increased Federal purposes. As the launch

cadences are increasing, we also support the FCC in refreshing the record on the utility of commercial launch operators, using the existing allocation of 2360 to 2395. The three channels, that are already available, may be particularly practical to use at new launch sites that do not have yet substantial legacy RF equipment installed. Federal Agencies are particularly concerned that the launch trajectory of some of these new sites, particularly those away from the coast, may make them more problematic for coordination, than the current Federal sites, in which case the 2360 to 2395 megahertz channels, would be very useful.

As I noted in our previously January Meeting, we are advancing our IT modernization program, which has been bolstered by the National Defense Authorization Act, NDAA, which passed late last year. NTIA, pursuant to the NDAA, is working through its Inner Agency Policy and Planned Steering Group to implement a process to establish goals for modernizing infrastructure related to

Federal Spectrum Management. By August of this year, NTIA will submit to Congress that our plan to modernize and automate infrastructure related to managing Federal Spectrum use. The report will include assessment of current infrastructure, an acquisition strategy, a timeline, and plans for enhancing security, reliability, automation, and workflows.

The other Federal Agencies will submit their own IT Modernization Reports to NTIA, by the end of this year. We are also working on our own IT Modernization, as well as concepts, such as Incumbent Informing Capability or IIC, which we are developing, actually with other agencies. IT modernization takes on an increased importance, in light of the Biden Administration's emphasis on decisions, basically, based on empirical data, science and engineering. As Evelyn noted in her opening remarks, this has been a hallmark of our experience within CSMAC and within all of our work here in NTIA.

The White House, on January 27th of this

year, issued a Presidential Memorandum reaffirming the importance of scientific integrity and evidence-based policy making. NTIA will work with the White House Office of Science and Technology and the Office of Management and Budget to implement all aspects of this memorandum. In our view, IT Modernization will work in tandem with this policy, ensuring more accurate and relevant data, and enabling us to analyze that data, and turn it into information, knowledge, and then policy guidance and proposals.

So, as I reach the end of the beginning for this meeting, I would like to echo, with thanks and praise, for our Co-Chairs, Jennifer and Charla, who definitely thought and brought their skills and experience to leading the CSMAC, this term. I also want to extend thanks to all the members, who have worked so hard on the questions we gave you when the cycle began. All of you have done such excellent work, and I look forward to hearing the discussion on this final report today, on Subcommittee 4, on UAS.

Looking forward, we are continuing the process of reconstituting the CSMAC, for yet another term. I'm sure many of you will be joining us again, along with some new members, as we develop another set of questions for your guidance and advice. I want to recognize Kurt Schaubach, of Federated Wireless, and some others, who may be not reapplying and stepping down after this session.

I want to thank you for your service and contributions to CSMAC and NTIA, which has been tremendously valuable. We look forward to and respond to the information and guidance from Antonio Richardson, our Designated Federal Officer, on our OSM Staff, regarding the timing and procedures for seeking renewed membership, on the CSMAC. So now, without further ado, back to you, Charla.

CO-CHAIR RATH: Thanks, Charles, appreciate the comments, and I'd like to turn it over to our Subcommittee Co- Chairs of the UAS Subcommittee, for their final report and the final

report for CSMAC, in this session. Over to you, Carolyn.

MS. KAHN: Okay, great, thank you. So, we are presenting our final report on Unmanned Aircraft Structuring. The -- this is a follow up to the draft that we presented at the last full CSMAC Meeting, in January, and so, we will summarize the updates that we've made since then, as well as summarize the findings and recommendations that we're putting forward.

So, an overview of the update is that -- so, since the draft was released, at the last full CSMAC Meeting, we received comments from CSMAC Members, we held discussions, and these comments and discussion were very helpful. They were useful conversations. To characterize, in general, the -- this feedback was often on commenting about the technology that exists today, versus what's considered an evolutionary devolvement, and so, we worked to timestamp our reports. UAS Industry is moving so fast, it's very broad, it's rapidly evolving, and so, things

are moving, as we speak, which is great, that there is so much rapid development in this area.

So, by timestamping our report and the statements within the report, it shows a snapshot in time, and so, that was a very helpful update that we made. We also received some comments about clarifying some different technologies and concepts, and we incorporated those comments, so, appreciate those of you who provide comments. We also made a deliberate effort to convey equal spots to all of the processes, all of the different Spectrum Access Models, and all the different elements that are in our report. And so, that balance is really important, and we think we achieved that.

In summary, kind of, in the end, our report, that we are presenting now, our final report is not that different from our draft report. But the comments received were helpful, and did help to improve the report, so, we appreciate that. The report also includes a summary of the interview notes, that -- based on

the interviews we conducted, and those are included in the appendix of our report, with the approval to do so, by these different groups.

So, I would like to thank all of our subcommittee members for their contributions to this work. That was really important. We appreciate all of the input, from all of the members of the subcommittee, the different perspective from Terrestrial Wireless, SATCOM, unlicensed, Dynamic Spectrum Access. We think the different perspectives really helped us to achieve the balance that we have in our report. We also would like to thank our NTIA Liaisons, Rich Orsulak and Dave Reed, for their coordination and assistance throughout this whole process, as well as Antonio Richardson, for helping to coordinate all of the work that we've been doing.

Our subcommittee held a lot of discussions, and we think that -- we also held a lot of meetings. We met a lot. We think these discussions really benefitted a report and the recommendations that we're putting forward. So,

thank you for -- to all of you and Andy Co-Chairing this with me, really appreciate it. So, these are the questions, a review the questions that NTIA provided our subcommittee to address. Part A focuses on background, as the FAA has responsibility to ensure the safe integration of UAS into our National Air Space and the importance that Spectrum plays to support command and control operations.

We were simply given two pieces of questions. The first part of the questions is, in B, which are what are appropriate Spectrum Access Models to support UAS Command and Control? Also, what are the important governance characteristics? Are there liability issues? And then the second part of the question is in C, which is around -- is there a need to create an entity to facilitate and support the different Federal Advisory Committees on the topic of UAS, and how such a structure -- how such an entity could be structured.

So, we scoped our work, around Spectrum,

for command-and-control operations, which were -- were called UAS Control and Non-Player Communications (NPC), the NPC, focusing on Spectrum Access options and looking across the different classifications for UAS. The approach that we took is a two-tiered approach. First, we identified different options for Spectrum Access for UAS. We evaluated these different options then, as far as different technology options that could support them, existing examples of the different models, possible UAS types that it might be better geared toward, possible evolutions of the technology and approach, as well as the different advantages -- advantages, disadvantages, and other observations.

And then the second part is to look at the current state of the UAS environment and the different committees supporting it. And as part of that, we conducted interviews with Federal Advisory Boards and other organizations to supplement the information that we gathered, all along our approach, with supervised complementary

value added to the already great work that's going on because, again, there is so much work going on in this area, so, trying to add to that.

So, our schedule, just a reminder, so, this CSMAC approached all of the working groups with a staggered start. So, our group kicked off a little over a year ago. We kicked off a little later than some of the other subcommittees. So, now, we're finishing today, on schedule, and throughout that we conducted interviews, like I mentioned. We analyzed information, reached out to different organizations, got a lay of land, of what's going on, developed them from all of the different inputs, and the CSMAC Subcommittee views, and perspectives, developed our draft report, which we then iterated on, received comments, conducted some follow-on work.

And generally, we met on a every two weeks, so, held a lot of meetings, and those discussions, again, were really helpful and valuable to the report. We've been providing updates at the full CSMAC Meetings, and then

reached out, to conduct outreach to some specific groups, listed here, which I'll talk about later in the briefing, as well, the FCC TAC, the RTCA, 3GPP, the FCC TAC, UAS EXCOM, and Department of Commerce, Office of Space Commerce, and those discussions are really helpful as well.

So, some background on the UAS Environment. It's moving dynamically, a lot of innovation, a lot of market evolution. It's an -- UAS is an emerging global market. It's important to our economy. There are also very important flight requirements, that are critically important to our country, as well, and so, meaning to advance UAS in a way that's safe and also helps facilitate the market evolution, at the same time.

So, technology is evolving at a rapid pace. There is so much unique elements, for UAS. It's anywhere from -- UAS can be anywhere from toys or hobbies to very sophisticated commercial and government applications. Small UAS, which can -- defined as under 55 pounds, regulated via part 107, with visual line of sight, all the way to

larger UAS, used for things, like package delivery, operating beyond line of sight, with part 135 regulations. It can -- they can range from single -- a single UAS to large leaps of UAS. They can fly at low altitudes, higher altitudes, so, really, a lot of diversity, and the Spectrum requirements, therefore, for UAS differ from non-aviation users because of this complex environment, again, safety of light, safety of flight, which is critical, the differences in altitude, different types of missions, very different operational types, different types of -- different ranges of size, multiple communication needs, and the scaling challenge with the large number of UAS, to anticipate it, as well as the important PNT requirements. So, all of these different elements are really important, that need to be coordinated, both domestically, as well as at the international level. So, I will turn it over to Andy to talk about UAS Spectrum Access Models.

MR. ROY: Great. Thank you, Carolyn.

And just to reiterate your comments at the start about the -- our thanks to the subcommittee for their input and support, obviously, the NTIA support staff and also for the external groups we got information from, which was very helpful in advancing -- in the work that we have here today, I think.

So, from the UAS Spectrum Access Models, if you go to the next slide, please, Carolyn, we -- we haven't had any additional models added to this since the draft report that we presented on at the last CSMAC meeting, so, still six proposed Spectrum Access Models. But to clarify, these are, and I think Carolyn mentioned before, at a fairly high level, looking at a snapshot in time of what is available.

Obviously, there are very -- a lot more specific technologies out there, that could potentially fall under these, and so forth. But to try and balance the work, we kept it at this level to ensure that we were not asking NTIA for a five-year extension to investigate all possible

technologies and options here. I do also want to reiterate, before we start getting into the detail of each of the Spectrum Access Models, that the order conveys no meaning or preference by the CSMAC subcommittee in the suggestion of different Spectrum Access Models. These all have options, and we believe may all have an aspect to UAS CAPC links in the future. Next slide, please, Carolyn.

So, on the third-party coordinator, and for each of these we will go through and I'll just describe the concept very quickly, to summarize it, give you an idea of what technology options exist at the moment, for each of these Spectrum Access Models, some examples of where they're in use at the moment, potentially, and what possible UAS types this is focused on at this particular moment, going forward, and then, lastly, we'll talk about potential evolutions and the advantages or disadvantages of this, as we go ahead.

So, from the third-party coordinator, from the concept is really an Aviation Spectrum Expert, will back the half -- on behalf of, excuse

me, FCC and NTIA to give out the necessary licenses and authorization to UAS CMPC links, on a demand basis. We're really trying to make sure that coverage is provided for each UAS, as they fly along their planned routes, with the necessary backups and so forth needed to achieve that. It's not too dissimilar to what's currently happening at the moment for the VHF bands, with the controller product data link, datacom program used by FAA, but obviously a more advanced concept with UAS.

Certainly, from a third-party coordinator, there's examples out there, at the moment, of both single and multiple third-party coordinators for giving Spectrum Access outs. And we see that going forward, potentially, from, as I mentioned, a CTDLC function. There's also flight test functions. And in our discussions with some of the organizations we reached out to, as well, some have already explored this, for example, RTCA, who talked about frequency management organization of a similar proposal, in some of

their documentation.

From the possible UAS types, really, given the technologies that generate design for the UAS and the requirements, large UAS platforms will be primarily where this will be focused at, particularly high altitudes integrating with FAA controlled air space. For the potential evolutions, and we'll talk about the advantages and disadvantages in a second, but, really, ultimate decisions on the backend will be a key, I think, to developing this sort of systems further forward and allowing appropriate response times to achieve the necessary coordination on this. Next slide please, Carolyn.

So, on the advantages, disadvantages, really, from a -- from the third-party coordinator is -- as I've mentioned, there's several examples of proven model, for what's -- aviation's doing already, in certain areas. Obviously, the UAS, though, is an extension of what aviation's doing, in many aspects. Such things normally allow for a known and planned RF environment, which enables

prioritization. But what really is a double-edged sword here is, in doing this often, from an aviation planning perspective, a worst-case location in propagation model assumption is made, which, on one side, does allow slack within the system, to allow for unforeseen events, maybe, without fully changing everything.

At the same time, though, on the other side that does mean that if nothing wrong happens, then you're not using that potential Spectrum. So, there is some inefficiencies in the system, as well, potentially, depending on how it's designed. Obviously, processing, as well, if there's human- in-the-loop processes, that could take a while. We've been told that UAS may need to be -- have frequencies back on a pretty rapid pace, so, you know, given a day or so, may be too long for those particular applications. Also, certification from aviation requirements and new ground infrastructure, if there are new systems, could also increase the cost of access, given the necessary rollout requirement for those sort of

systems. Next slide please.

On the Terrestrial Commercial Wireless Networks, so, as you'd expect here, we are using existing similar networks out there, provided commercially by licensed wireless networks providers, using those wideband channels to allocate within them the different resource blocks, and so forth, to allow for the appropriate level of UAS CMPC links, and so forth. Obviously, as they are controlled individually by each provider, that allows for that proper assignment and management of those systems, for each UAS operating within it. For those, the options, as you'd really expect, 4G, 5G, the main one is here, and with the National Terrestrial Carrier Networks, we've seen examples there, as well, about proposals for UAS, as well.

Similarly, at this time, small UAS seems to be the focus for that sort of area, but, obviously, with evolutions, that could include looking at coverage for higher altitudes, UAS specific standards, which we understand 3GPP are

working on, and even more advanced elements, like network slicing, could also provide better assurance of data for delivery to UAS operating employees, for the relevant requirements that they have. Next slide, please. Next slide please, Carolyn.

MS. KAHN: It's coming, sorry.

Mr. ROY: That's okay. I'll carry on reading, and then we'll go from there. So, on the advanced use, a real big advantage is a lot of the Terrestrial Networks are really already established now, in 4G or 5G, and they are using global standards and roaming agreements. So, there really is a lot of back end support here, in terms of multiband devices able to roam, to establish networks, cross international boundaries, and oversee outside main bands, as well. So, it does provide a significant advantage on the Terrestrial Commercial Wireless.

On the disadvantages, obviously, these current networks are primarily designed for land mobile users, i.e., users on the ground,

monitoring moving at the speeds of aircrafts, such as 600 miles an hour, or so forth. So, there might be elements that need to be looked at there. As I mentioned, there's not, in too many aspects, many UAS specific protocols that have been implemented, at this time at least, although that is, obviously, being worked on, and there is a need to identify how the UAS traffic would be shared. You know, obviously, as I mentioned, network slicing appears to be some -- provide some options for those processes, going forward. Next slide, please.

Commercial SATCOM networks. Again, as you'd expect, commercial SATCOM providers, using current and future SATCOM networks can provide UAS connectivity, either through dedicated or wideband channels. Within those channels, the UAS -- sorry, the SATCOM providers are ready to provide a certain amount of access control and coordination used to provide the necessary traffic management, going forward. And these services, obviously, overlap significantly, through coverage in large

areas, to provide coverage that Terrestrial Networks simply can't achieve, for the majority at least, through oceanic and remote areas, as well.

So, technology options, or the main ones, really, are nationwide and global, from geostationary, non-geostationary, and through multiple frequency bands, as well, that are established, at the moment, for STATCOM networks. And the existing example, although quite extensive, even for aviation, at the moment, we have L-bands services to traffic -- air traffic control, certified for the Civil Aviation Authorities. We have Protected Aeronautical Satellite Spectrums, aviation protected, for UAS C2, and even Ku and Ka SATCOM services also provide Wi-Fi to the back of commercial aircraft currently, at the same time. So, from a possible UAS-type, definitely larger platforms have been a focus here, at this point in time, flying above the tree line, especially in remote and oceanic areas, and FAA controlled air space, as well. And the evolution of this is going forward.

Definitely, the development of smaller antennas would allow support for smaller UAS and allow further integration through the different UAS ecosystem, going forward. Next slide, please.

And really, the advantages have extended that one here, for commercial SATCOM, is that coverage. It does allow a fantastic ability cover regions and countries for areas where Terrestrial may be significantly more difficult to deploy, for whatever reason, going forward. And it already has been used in aviation at the same time, as well, and does really show that hybrid access model, potentially, with other mechanisms, could be achieved to allow extended coverage and contingency planning.

From the disadvantages side, it's less robust coverage in urban canyons, obviously for those dense urban areas that may not be able to get the necessary view of the satellite to achieve the connectivity it needs. And although SATCOM has a lot of Ku/Ka SATCOM, I know other technologies are also starting to expand their

frequency or range, as well. Certainly, those frequency ranges are very susceptible to rain fade and need to be considered to ensure continuity of coverage and connectivity for those links to UAS. Next slide, please.

On the unlicensed side, really, as you'd expect from an unlicensed, all devices should be operating equally, trying to accept and mitigate the interferences, they receive it, and using their own individual sensing capability to overcome potential interference. Obviously, unlicensed rules vary on band and the purpose, but the individual user is not needing licenses, as per the very name suggests, to operate as the required system.

Now, we've heard all the options. The main ones you'd expect from Wi-Fi, 5G NR-U, and other ISM, as well, for the user. And existing examples, for any of you who have got a drone for Christmas, or so forth, you are probably using Wi-Fi or other system like that to control it, and there's a lot of extensive use out there,

especially for recreational, in the drone world. So, then possible UAS-type, certainly small UAS will be the focus, flying locally, especially in low population areas and for non-safety critical data, given the nature of the allocations that they would use. And then from an evolution, you could then, the group thought, perhaps, expand this out to have more of a centralized database system that would allow that to adjust system behaviors, performance, and enforce the measures, mainly to more allow better management for the unlicensed process, going forward. Next slide, please.

So, on the unlicensed access, really, the advantage is low cost and low technical barriers to achieve entry into the market, and from what it's doing, it is fairly Spectrum efficient. It's trying to make use of all the available resources that it can do, with what it's given, and the fairly robust for that nature, as well. It's designed to operate in an interference environment, going forward.

From the disadvantages, really, there is no regulatory guarantee, at the moment, for protections for these sort of devices. It's based on their own design and planning, going forward. And trying to achieve that in an unknown RF environment can be very difficult in the unlicensed bands. Certainly, this time may be not appropriate to state the critical data, given the lack of those protections and potential certification issues, as well. Lastly, a real big one here, as well, is many of the unlicensed bands also have restrictions on power and usage. So, that could, obviously, restrict the operational effectiveness and coverage for many UAS applications that are going further than just local activities. Next slide, please.

The Dynamic Spectrum Access and band partitioning, we view these two as sort of a little bit more complimentary to some of the other Spectrum Access Models, as well, but in terms of Dynamic Spectrum Access, as you'd expect, the radios are each looking for available Spectrum,

and each airborne link is independent, deciding on what it's going to operate on, based on its RF usage, using either licensed or unlicensed Spectrum, depending on the requirements, and also potentially primary and secondary UAS Spectrum users, as well. There's a lot of options, certainly, with those particular access model. Even integrating with others, such as third-party coordinators and others, to allow for assignments and secondary basis, as well, for noninterference. And as I mentioned, acting as a mobile line for other communications, technology was where we'd sort of see this, with CBRS and even DFS in the 5 Gigahertz band being good examples of it. Certainly, for the UAS types, we deem there could be an option here. Emergency operations, undeveloped regions, even congested RF environments, as well, Dynamic Spectrum Access could help those same scenarios and Spectrum Access Models to really get the best of what it's got, going forward.

And then, from the evolutions, you know,

the core policy and logic in the individual drones could also be controlled by that centralized database with just behaviors, depending on what's needing, and allow that augmentation of sensing for enforcement and other activities, as well, to further gain awareness of what's happening in the RF environment, to achieve a better system planning and coordination function. Next slide, please.

For the Dynamic Spectrum Access, on the advantages, it could be more efficient at all RF models, given it's got that sensing ability, when using the actual usage and propagation conditions consider it, and, obviously, there's a lot of rebuffs listed in that system, as well, to overcome assignment errors and interference, given the feedback that the coordination process is getting.

Obviously, on the disadvantage, UAS radio complexity would increase with the necessary supporting functions, and so forth. And given the detection of signals as a UAS mark, there's a very

rapid mark in new models being introduced. We need to ensure new signals are incorporated as those systems develop to -- it would ensure that protection mechanism can detect all available UAS, going forward. Next slide, please.

Lastly is band partitioning, really, is trying to ensure different models for using the same, potentially, frequency band, depending on operational requirements. You could either separate these by frequency or geographic separation, depend on what works best. A good example, at the moment, well, maybe not a good -- the strong word is still underdevelopment, but the European proposal is looking at combining SATCOM and Terrestrial CNPC links for UAS in the 5030-to-5091-megahertz band, going forward. And certainly, that would help in multi-role mission UAS. Effectively, you could use the same antenna, or system, or service provider, and fly in different areas, and using the best of different access models and capabilities, as you went through.

On the evolution side, Dynamic Partitioning may be a consideration here, as well, as uses requirements change, you know, peak traffic periods and so forth. They could modify that, although, definitely, additional studies would be warranted for this, going forward. Next slide, please.

For the advantage, it does allow partitioning to the band to accommodate different system requirements and, potentially, dynamically allows the most robust technology and capability to be used, depending on what's happening at the same time. On the disadvantages, and there are quite a few, unfortunately, with this one, the additional filters and transceiver complexity may be a consideration here, and, actually, ironically, may reduce the peak frequency band capacity by the necessary processes that are put in place to achieve the compatibility between two different services.

Also, at the same time, there have been some predictions that existing Spectrum capacity

may not be sufficient for with what's already proposed for UAS Spectrum. So, partitioning the band may not assist it and actually make it on the opposite direction. And we would note at the moment, there is a debate going on between European and U.S. Standards Groups on band partitioning in the 5030-91, as I mentioned with the European proposal that -- how that would work, and also the consideration for harmonization here, as well. We wanted to -- obviously, UAS being essentially global platforms, trying to harmonize their access and mechanisms in the regulatory environment they exist is pretty key to ensure as many -- as fewer limitations on the -- on the market as possible. Next slide, please.

So, lastly, on the findings in the Spectrum Access Models, as you can see from the discussion going through here, the multiple UAS Spectrum Models are appropriate, going forward, and the group definitely sees multiple overlapping approaches, going forward, as the UAS ecosystem develops, based on capabilities, functions,

Spectrum capacity, and so forth. So, they're going to be needed. It really is a wide and varied environment, not just an extension of the existing aviation, but a lot more considerations that need to be put in there.

At the same time, there is a Safety Spectrum consideration, which is going to be very much dependent on the regulatory mandates by the FAA and, potentially, at an international level, oversea AAs, as well. So, that needs to be looked at and considered, in how Safety Spectrum is applied to UAS, going forward. There are many governance characteristics for UAS Spectrum Models, but as you see in the report and the UAS environmental considerations, there is a lot of aspects that need to be considered. Again, it is not just another aviation system. It does expand the potential considerations in aviation to modern control systems and CNPC, as we're talking about here, with UAS. And just to go through there, the safety assurance, prioritization, enforcement coordination, all those elements, and especially,

also, contingency planning, again, to differentiate from current manned aviation, if you lose a -- a loss of COM, the no-COM function, you have a pilot on board who's able to still make decisions. For UAS, there's going to be a level of autonomy, but at the same time, that CNPC becomes very important to ensure that the contingencies are in place to continue operate.

One of the aspects we also considered, as well, in the report, briefly, is a third-party coordinator. It could be, actually, a broader, less specific role, than a specific technology, and actually look at the other access models and help coordinate that in the overlapping approach that we're talking about for the UAS ecosystems. That could be a consideration, going forward.

One of the questions asked by NTIA to the group, as well, was about potential liability issues. And really, from the group's perspective, it's obviously -- a lot of FAA regulations are still, although some have come out, there's still some under development, and so forth. But the FAA

and FCC regulations are going to be a significantly large component for that function to ensure that liability is kept to a minimum to those operators and they're complying in a safe manner, going forward.

There is also an element here that goes beyond, again, existing manned aviation, not just a FAA air traffic controller talking to a pilot, but we now have private UAS operators, CNPC links, service providers, potentially, and third-party coordinators, all involved in the provision of those links to aircraft. So, liability and different components of that will also be a consideration for that chain, effectively, in applying the CNPC links.

And as you can tell from all the discussion we've had here, there is going to be, potentially, an extensive number of parameters, we believe, for the FCC and the NTIA to consider and incorporate in to possible service rules for the UAS Spectrum to ensure that it's bringing all the relevant options that are available to a mature

UAS ecosystem, going forward, although we do believe that there is an urgent need to begin this, going forward, given the rate of UAS development. Even in the comparatively short time that we've been working on this as a topic, from our perspective, things have continued to move forward, very, very quickly, and so, we believe that getting ahead into the service rules and moving forward with those access to support the UAS ecosystem environment is a very important aspect for NTIA and other regulators to consider, going forward. And I think that is me. Carolyn, over to you.

MS. KAHN: Okay, great, and I'm going to reshare in a second, as well. Okay. So, maybe my mouse is stuck. Sorry, one second, my mouse is stuck, I apologize. Where's this going?

Okay, so, just finishing up. So, this is the second part of the questions on Federal Advisory and other Federal Committees for UAS. Sorry. There we go. Okay, so, we -- out -- conducted outreach to other Federal Advisory

Committees, as well as other Federal Committees for UAS. These are the different organizations that we extended outreach to. So, the FCC TAC, or Technical Advisory Committee, we interviewed them, and, and like Andy said, much appreciate all of these groups' inputs and contributions to our report.

The FCC TAC provides telecom policy advice to the FCC. Their scope is broad, in what they look at, but they did include a subgroup that looked at Spectrum Issues for UAS and identified areas that might need special attention by the FCC for Spectrum management functions by the FCC. Their activity was organized into three different working groups, commercial systems, technology analysis, and Spectrum analysis, in the TAC's initiatives, UAS work, in 2018, for the FCC. There is currently no ongoing UAS work within the TAC.

The FAA DAC provides independent advice to the FAA and DOT, and they respond to tasking directly to -- directly from the FAA. Their

advice and their tasking's all relate to improving efficiency and safety for integrating UAS into the national air space, and their responses are used to inform tactical and strategic planning purposes for that. We talked to UAS and connected outreach with UAS EXCOM. UAS EXCOM includes senior executives from different Federal agencies, including FAA, DOD, DHS, Department of Commerce, Department of Energy, Department of Interior, Department of Justice, and NASA. This is a dynamic forum for different -- for the different Federal Agencies to share information, as it relates to UAS research and development, as well as policy and procedures for safely integrating UAS into the map.

UAS EXCOM has two subcommittees, the UAS Integration Senior Steering Group, as well as the UAS Security Senior Steering Group, and they're supported by the SARP, which is the UAS Science and Research Panel, which includes a group of member agencies and experts who collaborate on technical approaches and partnerships, across the

Federal Agency Members, as well as with broader academic -- in the broader science community, as well. And they provide briefs and updates to the EXCOM, as well as those Senior Steering Groups. CSMAC is not aware of any Spectrum activities within UAS EXCOM.

We also talked to the NASA UPP, UAS Traffic Management Pilot Program, conducted outreach with them, and so, the goal of the UPP is to define an initial set of industry and FAA capabilities, requires support UTMs, specifically at flight level 400C. The UPP then transfers the research to FAA, to NASA research, to transfer it to FAA, with the intent of demonstrating the services to support UTM operations, under FAA guidelines.

We also conducted outreach with the PNT Advisory Board. This is the National Space-Based Position Navigation and Timing Advisory Board, which advises on GPS and related policy planning, program management, and funding activities, as it relates to national and international satellite

navigation services.

So, our findings is that there are many disparate Federal Advisory Committees, with ongoing UAS -- or recent UAS activity, and -- but that there is no one committee that's assuming leadership and guidance, providing that national focal point for UAS Spectrum, and that it would be more impactful if the different committees were more closely focused and aligned. And so, kind of establishing this North Star would help the diverse stakeholders and community pursue a common overarching and kind of purposeful direction, in the best interest of the U.S. And so, we noticed, both directly from input from the interviews, as well as just our own work, in trying to find points of contact, that it was difficult to find points of contact for the different areas of UAS. And so, it came out, both directly from the interviews, as well as our experience. So, therefore, we do think that there is a need to create an entity that supports and facilitates Spectrum-related collaboration, across the

different Federal Advisories and other committees, for UAS.

So, then we identified alternative mechanism -- identified alternative mechanisms in government structures, for such an entity, to help fill this gap to greater collaboration and national focus. So, these are some different alternatives that we developed. First is the possibility of designated -- designating a central point of contact. So, this central point of contact could be -- could coordinate information, facilitate information, sharing in collaboration about the different Federal Agencies, industry, academia, and other nonprofits, that are involved in working the UAS space.

This -- there's a possibility, also, that that option could then mature over time. It could start small with a central POC, but mature over time, into developing an office within a Federal Agency, which is that second option there. So, establishing an office within a Federal Agency could help to align, coordinate, synchronize the

different activities going on, again, across government, industry, academia, and other nonprofit organizations. It could convene stakeholders, bring together multiple, wide, and diverse perspectives, and serve as an industry advocate within the Executive Branch to support a whole nation approach to the UAS Spectrum space, in development. It would remain light touch in premises but would work towards sufficiently achieving goals that have been set forth in advance. And this governance structure is analogous to the Department of Commerce's Office of Space Commerce.

Another option is to create new executive steering committee. So, this could be created and charged with the responsibility of helping to reform how the different Socket Groups might work in a more collaborative manner. The Executive Steering Committees are a well-established approach to provide higher coordination across the different Federal Agencies. A Federal Government Executive

Committee on UAS could -- would represent all relevant stakeholders, such as NTIA, FCC, NASA, FAA, DOD, Department of Commerce, DHS, Department of Justice, Department of Interior, for instance. And it should be made aware of the activities going on in the various Socket Groups that are all working the UAS-related issues. If there is a need for an organization, beyond the Executive Steering Committee, then it could charter a new entity. And NTIA could serve as an initiator and call for this first meeting for the Executive Steering Committee.

The next option expands the charter of an existing Federal Advisory Committee. So, this is another option, where the charter of an existing Socket could be expanded to include supporting and facilitating collaboration across the disparate Federal Advisory Committees for UAS. Federal Advisory Committees are chartered by various government organization, and so, then the missions and the questions that each Socket Group is given is provided by their parent government

organization. So, given this, there are overlapping assignments for the different groups, and the groups, themselves, have limited authority to pursue efforts independent of the directions provided by the organization that they're supporting. So, therefore, this option may have limited sense because it would be difficult to coordinate, again, across the government entities, beyond the ones that the Socket is supporting.

The next option is expanding UAS EXCOM. So, this is an option that UAS EXCOM could be expanded, so that its scope of responsibilities include coordination across the different Federal Advisory and other committees for UAS, and then the last option listed on the slide is developing a new Federal Advisory Committee, which would be established to coordinate across the existing Federal Advisory Committees for UAS. This option would add, you know, yet another Socket Group.

So, this slide is presenting our recommendations, and they are copied here verbatim, but I'm not going to read exactly them.

I will summarize. So, we have two. Our subcommittee is putting forward two recommendations. The first recommendation is that -- we recommend -- CSMAC recommends that NTIA play a leadership role in coordinating across Federal government, in providing direction and resources to facilitate UAS Spectrum Access. So, this includes NTIA bringing together the Federal stakeholders to identify Spectrum requirements. It includes ensuring multiple Spectrum Access Models, and multiple bands can be leveraged to meet those needs.

As noted earlier, UAS Spectrum Access is a complex and essential issue. It requires significant Spectrum expertise and the prioritization of Spectrum topics and issues. NTIA must coordinate Federal Agency use of Spectrum, inform the FCC of Federal Agency UAS Spectrum requirements in a timely manner, and work with FCC and FAA to inter a Spectrum Access Model, maximize industries' ability to offer UAS solutions consistent with FAA's safety

requirements and FCC and NTIA regulatory requirements. So, an example of the coordination is more to like what Andy mentioned earlier about band partitioning and the need for coordination and to ensure compatibility and harmonization, which was noted by -- through the -- our engagement with different groups and the need to coordinate this at the international level.

So, our second recommendation is that NTIA initiate and champion designation of the central point of contact within the Executive Branch for UAS coordination, including Spectrum. So, this is to help coordinate across Federal Agencies, industry, academia, and other nonprofit organizations, bringing together multiple perspectives and serving as an industry advocate within the Executive Branch to support a whole nation and to support UAS. This could be -- could be assessed after a year to see if it should be matured, over time, into an office within a Federal Agency, again, remaining light touch and permissive, but working towards achieving UAS

goals, and would serve as a standing coordinating committee to advance UAS.

So, those are the recommendations we're putting forward. I think, at this point, I will open it up to the subcommittee to see if there are any additional points that anyone in the subcommittee would like to raise, and then, after that, we'll pass it back to Charla to put it forward for any questions and comments from the CSMAC, and then put it to vote. So, first, I'll open it up to see if there's anyone on the subcommittee that would like to comment. So, Charla, I will turn it to you.

CO-CHAIR RATH: Great. I don't think that's any indication of lack of interest. It's just that you had a pretty active subcommittee, over the last year. So, I'm glad that people feel like their views have been expressed well. One thing, though, I neglected earlier, to see if Charles would be willing to take a couple of questions from the NTIA? So, Charles, I see that you're still here. Are you able to address -- Bob

Weller actually had a question.

And also, just a reminder to people, that the way to let me know that you're interested, especially if you have your video off, I won't be able to see you waving your hand, but the way for you to let me know that you're interested in either making a point or asking a question is to just put a note in the chat. And you don't have to write out the whole question. You can just let me know, and we'll address it.

Charles, I see your video. I assume that means you're -- you're able to answer some questions.

MR. COOPER: Sure, yeah. Yes, I am available to answer questions.

CO-CHAIR RATH: And, Bob, you had a question, so. You wrote it in the chat, but why don't you go ahead and ask.

MR. WELLER: Yeah. Thank you, Charla, and thank you to Charles for the excellent update. Also, while I'm at it, thanks. Thanks to the UAS Subcommittee on their difficult work, difficult --

I should say challenging work, but -- and the excellent report. UAS support is used extensively in electronic media broadcasting, my industry, and we look forward to a more holistic approach to Spectrum use.

I did have a specific question for -- probably for Charles. Back in 2019, there -- NTIA initiated a review of specific agency frequency assignments, and there was a response period, I forget what it was, but it was quite a few months, I think. It had all those responses now come in. Was there a report published? If not, will there be a report published? That's my question. Thank you.

MR. COOPER: Thank you, Bob. And before I address that, I do want to also send my congratulations to the subcommittee for this very thorough report. I look forward to, within the Office of Spectrum Management, to reading and absorbing it. And we will also be passing along with our sister agency that may have a -- that may find this, as well, helpful in informing their UAS

systems, as we move forward.

But, but to Bob's question dealing with the -- dealing that report of request that NTIA made of our agencies, and we publicly identified a letter that we sent, back in 2019, as Bob noted, requesting a bit more granular information on two bands. That letter was actually prepared, pursuant to the Presidential Memorandum of 2018, which specified a few deliverables, that being one of them. Pursuant to that Presidential Memorandum, it said in there it was essentially at the discretion of the Department Secretary on how much, you know, there will be a summary issue to that. But what I can say is, yeah, we absolutely did receive all the responses that we needed, Bob.

And furthermore, you know, with one of those bands, the lower three gigahertz band, that was very important for us to get that information because it helped inform the Mobile Now Report, that we issued early last year, and then that also informed the -- aided the development for the 3.45 to 3.55. So, it was definitely a lot of lift for

the agencies, a lot of lift for OSM, but it already paid dividends. Thank you.

MR. WELLER: Excellent, thank you.

CO-CHAIR RATH: Great.

MR. WELLER: I thank you very much. Charles, my interest is actually in the other band, but we'll see what comes with that, I'm sure. Thank you, again. Back to you, Charla.

CO-CHAIR RATH: Great. Thanks. Thanks. And just to see if there are any other questions for Charles. I have seen nothing but kudos for our USA subcommittee co-chairs on the great work that they did. So, I don't -- I don't think there are any more questions for you, Charles, but -- you know, and I also extend, you know, my congratulations to the committee because, you know, not only were you diligent in how you approached this issue, you also did it with a fair amount of grace and aplomb, and that was greatly appreciated.

So, to that extent, do we have any questions for Andy or Carolyn? I don't see

anything yet, but a reminder, just, you know, indicate in the chat that you would like to speak, and this, of course, is for CSMAC committee members. We'll give it just a sec, if you guys are okay with that. So, I'm never quite sure, in this -- in this environment, how much time to give people to type, but it's looking like there are no questions for you.

If I'm reading that right, we can then move to the next stage, which is for a vote. And process-wise, I'd like to see if we can do it by acclamation. So, what I'll do is just ask if there's any opposition to -- to this report. And I will also give a moment here. You know, please, you can either throw it into the chat or, you know, just say, you know, say so. Remember to unmute yourself, if you have any opposition, and again, I'll give just, you know, a little bit of time. I have a feeling there won't be any opposition, but I don't want to -- to prejudge. So, if we all agree that that was enough time, we have approved your report by acclamation, and, you

know, again, truly appreciate the work of this committee. It's been a long time. I mean, you've had the assignment for two years. You've started over a year ago to work on it, and, you know, it's a fitting one to sort of end up our session here, as CSMAC members.

The next section that we are moving to is the opportunity for public comment, and, Antonio, I leave that to you, since you'll have to open up to see if there is anybody who wants to say anything. And I'm not quite sure -- I suppose we'll hear if somebody wants to say anything, and -- and again, I'm going to give it a little bit of time.

Thanks, Antonio. I'll give a little bit of time for -- for people to come off mute, if there is anybody who -- from the public. And if you do want to make a comment, please identify yourself and who you're with. Comment or questions. I know the dead time is --

MR. RICHARDSON: I don't believe we have anything.

CO-CHAIR RATH: The -- yeah, I know dead time is tough, but I still, you know, would run into it on the -- on these calls where it takes -- it takes a little bit for some folks to weigh in, but I'm going to give it just a little bit more time, Antonio, but I think we're -- we're probably not getting any questions from the public.

MR. RICHARDSON: Okay.

CO-CHAIR RATH: All right. I'm going to call that, no questions or comments from the public. So, you know, again, this is -- it's always -- you know, it's such an interesting time, when you -- you're finishing up a session, and, you know, on behalf of Jennifer and me, and I -- you know, again, I want to say, you know, how apologetic she was that she couldn't be here today, but, you know, she and I did talk about what we wanted to say to all of you.

And, you know, it's the end of the charter, so, obviously, an important component of this is to thank all of you for your work, you know, not just today, with what we've seen with

the, you know, UAS report, but also the other three subcommittees and the engagement on, you know, a number of very difficult and, you know, as well as very interesting issues, and as I mentioned earlier, just the incredibly tireless way that you all just sort of moved forward and started doing this remotely.

And in that, I also want to include a thank you to NTIA and particularly to Antonio for actually just making that process happen. So, I had certainly hoped that we would be live for our last meeting, but, you know, unfortunately, it didn't happen. So, just a few more acknowledgements, you know, as has been mentioned several times, there are -- you know, we're at the end of our charter. There is, you know, obviously, an opportunity for folks to reapply. We do know that Kurt is not going to come back, since he's indicated his -- that he's not intending to reapply. So, thank you, Kurt. I know you're not here, but thank you for your service, and to those of you who maybe just

haven't mentioned it yet, that aren't, you know, aren't coming back, I thank you, as well.

And also just, you know, generally, wanted to thank NTIA for how it actually handled just everything going forward, including, you know, particularly just a reminder of all the staff, you know, first, obviously, to, you know, the leadership, but I also wanted a reminder of the staff who was there, all the meetings, always willing, able, and just up front to answer questions, including, you know, for this session, obviously, Dave Reed started it, and then Rich Orsulak, also, was engaged.

But also, in subcommittee, we --one, you know, Chris Mattingly, and then, two, was Bruce Jacobs and LiChing Sung, and then, three was Bruce Jacobs. So, we really do appreciate the amount of participation, you know, Charles, that your team had in this, and it -- it was extremely helpful. So, last but not least, you know, again, thank you for Antonio stepping in as our DFO this year, and -- and also, you know, retired Dave

Reed, thanks to him, although, you know, he's long gone. I'm sure he's forgotten all about us, but I -- I couldn't end up the session without saying a thanks to Dave, as well. So, on that note, I don't -- you know, I'm seeing a lot of things in the chat, but I don't know if anyone else would want to add anything. But I think we are ready for adjournment. I think that's it.

MR. RICHARDSON: Yeah, I think that's it. Charles, if you don't have anything left, I think we can adjourn.

MR. COOPER: Thank you, everyone.

CO-CHAIR RATH: Great. Yeah, thank you. Thanks again for all your hard work.

MR. WELLER: Thank you, Charla.

MR. RICHARDSON: Thank you, Charla. Take care, all. Everyone have a safe summer.

(Whereupon, at 2:20 p.m., the PROCEEDINGS were adjourned.)

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CERTIFICATE OF NOTARY PUBLIC

COMMONWEALTH OF VIRGINIA

I, Mark Mahoney, notary public in and for the Commonwealth of Virginia, do hereby certify that the forgoing PROCEEDING was duly recorded and thereafter reduced to print under my direction; that the witnesses were sworn to tell the truth under penalty of perjury; that said transcript is a true record of the testimony given by witnesses; that I am neither counsel for, related to, nor employed by any of the parties to the action in which this proceeding was called; and, furthermore, that I am not a relative or employee of any attorney or counsel employed by the parties hereto, nor financially or otherwise interested in the outcome of this action.

(Signature and Seal on File)

Notary Public, in and for the Commonwealth of Virginia

My Commission Expires: August 31, 2021

Notary Public Number 122985