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RTCA Paper No. 031-24/SC230-080  
 5/13/2024

**RTCA SC-230 Plenary #36 Meeting Minutes (Feb 6-8, 2024)**

**Attendance list:**

<b>Feb 6<sup>th</sup></b>	
<b>Name</b>	<b>Company</b>
<i>Karan Hofmann</i>	<i>RTCA</i>
<i>Moin Abulhosn</i>	<i>FAA</i>
<i>Jean-Baptiste Berthier</i>	<i>Airbus</i>
<i>Mohammed Ahmed</i>	<i>Boeing</i>
<i>Jeff Finley</i>	<i>Collins</i>
<i>Mark Billsberry</i>	<i>Collins</i>
<i>Marius Irimia</i>	<i>Collins</i>
<i>Divesh Lakhi</i>	<i>Collins</i>
<i>Ven Sishtla</i>	<i>Collins</i>
<i>Mariusz Starzec</i>	<i>Garmin</i>
<i>Adam Lohofener</i>	<i>Garmin</i>
<i>Dawn Gidner</i>	<i>Honeywell</i>
<i>Jan Lukáš</i>	<i>Honeywell</i>
<i>Yahya Golestani</i>	<i>Honeywell</i>
<i>Ben Winstead</i>	<i>Honeywell</i>
<i>Rockee Zhang</i>	<i>OU</i>
<i>Matthew Lug</i>	<i>USAF</i>
<i>Marc Pos</i>	<i>Reliable Robotics</i>
<i>Bob Avjian</i>	<i>Mitre</i>
<i>Jared Adams</i>	<i>ALPA</i>
<i>Moustaph Soumare</i>	<i>DGAC</i>

<b>Feb 7<sup>th</sup></b>	
<b>Name</b>	<b>Company</b>
<i>Karan Hofmann</i>	<i>RTCA</i>
<i>Moin Abulhosn</i>	<i>FAA</i>
<i>Mohammed Ahmed</i>	<i>Boeing</i>
<i>Jeff Finley</i>	<i>Collins</i>
<i>Mark Billsberry</i>	<i>Collins</i>
<i>Marius Irimia</i>	<i>Collins</i>
<i>Divesh Lakhi</i>	<i>Collins</i>
<i>Ven Sishtla</i>	<i>Collins</i>
<i>Mariusz Starzec</i>	<i>Garmin</i>
<i>Dawn Gidner</i>	<i>Honeywell</i>
<i>Yahya Golestani</i>	<i>Honeywell</i>
<i>Ben Winstead</i>	<i>Honeywell</i>
<i>Matthew Lug</i>	<i>USAF</i>
<i>Marc Pos</i>	<i>Reliable Robotics</i>
<i>Bob Avjian</i>	<i>Mitre</i>
<i>Jared Adams</i>	<i>ALPA</i>

<b>Feb8<sup>th</sup></b>	
<b>Name</b>	<b>Company</b>
<i>Karan Hofmann</i>	<i>RTCA</i>
<i>Moin Abulhosn</i>	<i>FAA</i>
<i>Jean-Baptiste Berthier</i>	<i>Airbus</i>
<i>Mohammed Ahmed</i>	<i>Boeing</i>
<i>Jeff Finley</i>	<i>Collins</i>
<i>Ven Sishtla</i>	<i>Collins</i>
<i>Marius Irimia</i>	<i>Collins</i>
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## **2/6/24 – 2/8/24 SC230 WG-12 Plenary #36 - Virtual**

### **Action items – Day 1**

[Jeff/Dawn] Stated that we need to take an action to modify wording in the missed detection.

[Dawn] Took an action to wordsmith Section 5.

[Mohammed/Dawn] Look at multi-level failure levels and if we should come up with some then Dawn stated she would be happy to write content for it.

[Group] To all radar suppliers, action is, to research OEM squawks from airline who use Collins/HW/Garmin radars.

[Jeff] Stated he would help write the background section.

### **Action items – Day 2 & Day 3**

[Ven/Yahya] Action to pick a representative suite offline to ensure we are covering all cases.

[Group] To assign someone to write analysis and methodology that will help us validate in the working meetings. (Out of band interference activities).

[Ven/Mark B.] Will come up with in band delegation for out of band. Mark B. was specifically going to address 6G aspect, he said if it made sense to look at other out of band frequencies.

[Mark B.] took an action to review SC-239 report and what if any documentation needs to change to come up with plan for out of band similar to Ven for in band.

[Group/Ven] How are we going to create section 6? Ven said he can try to create it.

[Mohammed] To arrange in-person meeting in July and Karen will send out detailed instructions.



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## **High-level summary of effort and major discussion points:**

- Day 1
  - Welcome Remarks by Jeff
  - Rules and Regulations were discussed by Karan
    - Antitrust policy
    - Proprietary and copyright Policy
    - RTCA committee participation and membership policy
    - New rule: Recording plenary meetings or working group meetings is not allowed. RTCA notes are the only allowed official media. Chat is also not supposed to be recorded.
  - Presentation of and overview of Agenda was discussed
  - Introductions
  - Summary of action items compiled in the last plenary (October 31, 2023) presented. Meeting minutes approved without dissention.
  - Activities since last plenary:
    - Held several work group meetings, mostly planning sessions and starting work on white paper
  - Overview of WG12
    - Determine susceptibility of airborne weather radar to spectrum interference
    - White paper to be used to develop standards and policy for in- and out- of band x-band transmission sources and future international mobile telephone
  - Specific guidance requirements/overview
    - Characterize RF environment 9.3-9.5
    - Document impacts of increased in and out of band RFI levels on x-band weather radar
    - Make recommendations for limiting interference levels (may include but not limited to signal in space tolerance mask)
    - Potential RFI mitigation strategies for future weather radars
  - Went over SC-230 organization and past history / schedule.
  - Ven emphasized that it will good to review the white paper structure since not everyone was able to review it. Yahya and Ven were asked to lead the discussion going through the whitepaper.
  - Dawn asked where would we like to start, Ven stated we wanted to model the whitepaper as an inspiration for LRRR whitepaper. What was aimed to explain, OEM section in term of interference. It was agreed to go overall section of the whitepaper, Jeff stated to go through title/title.
  - It was mutually agreed that 9.3-9.4 GHz band is what we are trying to target.



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- There is older radar which are in C band, Jeff stated those are out of scope and as part of this white paper we will only be considering 9 GHz band.
- Section 5 was discussed which was deemed as primary area of what we need to concentrate on is the airport environment, weather detection, close to the ground. This section will help guide those activities. Yahya added that section 5 establishes a reason for performing RFI analysis.
- Under operational impact Mohammed stated to add reference to lightning, as an additional weather threats. Yahya stated if it made sense to combine it with hail because impact is different hence made sense to include it separately.
- Mariusz stated if missed weather detection is only failure behavior which need to accounted for in this table.
- Ven commented that performance will be impacted in the presence of RFI, this is the worst case.
- There was discussion in terms of older magnetron system which maybe illuminating radar, but these new generation have provision.
- In terms of missed detection, Dawn stated that inaccurate understanding may provide coverage of all the used cases, but question was open to the committee. Jeff stated we want to consider adding further discussion of the impacts of various types interference. Dawn added what are the impacts and how RFI can result from these interferences.
- There was some discussion on how tables were organized realizing how many questions were posed just within this meeting. Ven said if it was clear to consolidate weather related behavior in one table and another one for windshear. Jeff stated that important take away that we enroot related missed detection and near the ground, false alarm and missed detection is the take away from the tables in the section 5.
- Jeff went over TOR - and emphasized that we are somewhat limited to weather detection and ground mapping and operational impact to failure of those functions. That level of analysis for secondary impact may elaborate the scope of the exercise. Maybe we should look at it and maybe we shouldn't.
- By September we need to have a document ready for public comment. Jeff stated we focus on testing and analysis, if multi-layer increased the hazard level then of course we will need to keep in that scope of this document but consensus was we should focus on scoping our efforts on radar impacts.
- We continued to look at the headings of the sections.
- Document titled NATIONAL SPECTRUM STRATEGY was shared - what we would be considering for 6G interference. Jeff went through the content of the document, he agreed to share the document with committee. Page 8, Ven stated that there is information within the table reference on page 8.



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- Jeff said that Ed stated - 7.1-8.4 and 18.1-18.2 GHz telecommunication will be campaigning out on these bands.
- Yahya introduced Ben Winstead who is from Honeywell working LRRR, weather radar now. He stated he had some background on radio systems.
- Jeff said it would good to bring email from Ed Hahn. Power level were shared at 65 dBm/MHz rural and 62 dBm/MHz in non-rural areas. Outside US power level could be same but slightly increases. Further information existing within SC-239.
- Took break for 15 minutes
- After break Ven stated we should be using Tahiti radar use as a worse case.
- Jean Baptiste brought up if we can scope back the NSS paper and understand the scope little clearer. Jeff stated our efforts would be in line with 6G interference and in band interference. Ven shared that the Selex systems integration file and shared transmitter data (74 dBm). Factors we should take under consideration. He stated how polarization is impacted. Ground powered installation will be high powered installation. Yahya said ground-based radars are S band. We are considering outer band, Ven said not exactly. If the aircraft is landing and radar is blasting stated power what are the impacts? Jeff explained further, even portable system is becoming very popular where we have really high-power X band radar sitting right close to the airport.
- Gentlemen from DGAC was invited to SC-230.
- For In-band interferers, there was some discussion on how it interference with radar features. Jeff further explained and characteristics of in band interferer and explained how critical it is to determine position of the radar which is relative to our aircraft, and whether it is landing or taking off. There are two effects here, ARC your receivers and then there is operational ramification, further considering power density and percent of time for co-illuminating.
- There is going to be impact for rain scanner RS90 for those folks who have it.
- Ven went over ITU document, where we reviewed the characteristics for marine radars including ground based.
- There were some questions raised whether if there are any squawks from airlines who are using Collins/HW/Garmin radars. Jeff stated this was in line with TOR and how assumption was laid out to be in-scope.
- Jeff question what are we trying to do?
- Ven stated if we performed an analysis that separate low/med/high and led the analysis that airborne radar will NOT have issues with LMH. He further stated let's do the analysis and let us lead to the discussion. Have separate categories and how these categories impact performance.
- Assumptions with RF interferers which maybe contributing towards causing impact to performance. Tricky part is how to share results, Jeff asked how to address this issue and posed the question to co-chairs. Jeff added results should be compiled by 3rd party someone like



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Dawn to compile the results or report the susceptibility of the radar systems. Marc Pos asked if the charter is only in-band interference. Jeff said no. Information would be really helpful to design future products. Should be there any specifics for radar receivers in our MOPS? Jeff used an example of SC-239 to make that point?

- Following items were discussed and should be taken under consideration, relevant to set-up test for individual radars:
  - PRF, frequency hopping, non-linear FM chirp, all those kinds of modulation, scanning strategy, power density, beam width,
- There was discussion in greater length if it could this be extended to out band interferers.
- Ven and team formulated a list to assist with test set-up to determine the susceptibility, hand off the data to 3rd party to formulate the data.
- Mark Billsberry asked if it is in band and out of band. Today we are focusing on in band with tomorrow's discussion focusing on out of band.
- Ben - stated if polarization is same as oppose to what radar is expecting versus what RFI source would contribute.
- It was mentioned vulnerable frequencies; modulation characteristics needs to considered in terms how LRRR investigated was performed versus and WXR spectrum SOW.
  - Narrow focus with more focus on depth - this is how LRRR investigation was performed.
  - Broader focus with less depth, not dealing with strong out of band - WXR spectrum SOW
- Day 2 & Day 3
  - When Day 2 was kicked off, Yahya and Ven had lengthy discussion on the use cases for testing purposes.
  - One or two in weather mode and another one in windshear mode.
  - Page 11, system A7 was discussed with the team.
  - It was discussed to pick a representative suite offline to ensure we are covering all cases. Map out representative radar to consider used cases. From Takeoff or landing or en-route and understand the effect while examining weather detection including windshear. We agreed to use table of radar, based on these radars we are going to create representative test cases. Pick parameters, and from that we are going to come up with series of parameters and going to assume for inbound interferers and from that we are going to have test methodology. Ven volunteered that he was going to write the section for PWS for inbound analysis. Question was posed to all radar manufacturers since they are the ones going to perform the test.



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- We have suite of radars with appropriate references, next, after the table there is going to be paragraph with proposed used cases, takeoff and landing and en-route where there is possible impact on PWS, lower altitude cases, weather at high altitude. Based on 5 radars we agreed to propose geometry, propose levels for power modulation frequency that is consistent with 5 radars that we pick. There is slew of things we have to do, definition of used cases, paragraph documenting those used cases, geometry, etc. Definitive power levels, test cases which are specific to radar, there is going to be simulation regards of that based on the power levels and geometry we end up using. Definition of detailed test cases or procedure. Overall plan can be finalized and discussed next time.
- A10 was very low power, it was agreed that we will not consider in our evaluation.
- Ven stated that he picked A1 (high powered) and A7 (moderate) - airborne cases which we all agreed that we are interested in.
- Yahya asked if we need to ignore A13?
- Jeff asked if there is way to distinguish between pencil and fan - in fan illuminate large area, what kind of area is being covered. There is a difference between power density level.
- Ven mentioned if S8, peak power of 5 is low end, does it warrant us to take that under consideration for evaluation. S8 is also closer to MSL. Superscript 6 constitute to river category which is very close to sea level.
- There was some discussion on system G9, assuming as a challenging case. Jeff stated if this one of those radar which is 100 meters away and illuminate at us.
- Further discussion occurred on making use of Tahiti radar.
- Jeff asked for difference for CW and FMCW. Ben W. said there is nothing much, FMCW will have some chirp, spike in doppler spectrum. The whole reason to increase the noise floor, should we consider that part of the evaluation. Ven said it would be good to understand the impact on windshear.
- How much is the x band static, we have at Chicago and another busy airport. Is there a possibility to increase the noise floor as an aggregation to operate in a frequency of interest?
- Jeff used an example of people close to airport carrying x band cell in pocket, result in increasing the noise floor.
- Scenario where we are contaminating the whole spectrum - evaluate outer band.
- Jeff went on explaining how to justify auditorium noise and still be able to have conversation with someone next to you.
- Yahya asked if G17 is something we need to consider.
- Question was posed to Mark B. by Jeff what scenarios were considered for 5G. Mark stated when 5G testing was performed, used case was different.



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- Basically, two cases were considered, outer band interference and 5G spurious emission interfering with LRRR band.
- There was some discussion, picking up those radar what exactly are we trying to demonstrate.
- Question was posed, considering hazard, identifying it and then tracing is backwards?
- What is going to break predictive windshear? If there is a huge spike in the middle of the relevant band with respect to the noise floor present. If there is interference that will mask the micro burst in the area, nuisance alert just by interference and then masking of the micro burst with the presence of interfere.
- There was discussion on collecting ground clutter area, run it through simulation. Question was raised, if it is only simulation exercise or if we have ability to collect IQ data from the potential interference, simulate radar's ability to operate in the environment. Basically, super imposing simulated windshear condition and test conditions on the ground collected data.
- Jeff posed question to Ben and Mark B. when 5G was performed can we maybe use some lessons from SC-239?
- Out of band interference activities to be discussed after the break
- In band characteristics section 6 - SC-239 whitepaper
- There was much discussion happening on AVSI and possibly inviting Dr. Dave Redman, which is a side discussion.
- Yahya asked how do we handle threshold section 7, testing methodology?
- Timeline was discussed, Ven said he will put something together for next working together meeting to review.
- Jeff asked if timeline can be established, 12 months for FRAC resolution. October is timeline to have all of the documentation complete, backing it up from there puts up in September.
- Yahya and Ven took an action to get together to hatch this all out. Jeff alluded we should consider test parameters it will help our RF engineers to perform testing analysis.
- With regard to outer band interference, only guidance we have so far is from Ed Hahn from what is in SC-239 paper, geometry and power level which were analysis.
- Mark B. brought up concern of testing that special test equipment was purchased for LRRR testing, that we hitting radar pulse width. LRRR is only 9db for weather radar the signal levels will be much higher on the order of 25 db. EIRP and power levels, minimum separation of 5G tower on the approach versus aircraft. It was assumed that we have no control where cell tower is, inside the airport it is different situation.
- Assuming 5G modulation, bandwidth was assuming was 100 MHz wide. Mark explained different waveforms were evaluated, any intermodulation will very quickly block the receiver. He stated we need to look at the impact at the radar sensitivity. At some time, radar will get





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damaged due to very high duty cycle and peak voltage that receiver will fail. We may be okay with small fraction of the second, but may fail after that.

- There were issues with arcing in the receiver. Receive signals will be so high that arc could be witnessed, particularly on the receiver side.
- Jeff asked what waveform we would pump into the front end from 6G perspective. For susceptibility, we can use 5G waveform and say it is similar to 6G. maybe we look for the bandwidth.
- Mark B. mentioned two aspect to that question, 6G may have elevated noise for which there is specification for it yet for radar, however there is nothing we can do to fix it. We can test to determine what those levels are. Second item is very good clean way when there is no outer band where we test 6G level where bandwidth is important because it will block receiver.
- Ven asked in band on how it propagates through receiver chain or not?
- Jeff asked if frequencies separation helps us at all to simplify testing. Mark B. acknowledged it.
- Worse case would be windshear prior approaching to land. Learning from what LRRRA did, crossing the line of sight with cell tower.
- Mark B. took an action to help with out of band frequency.
- Jeff said we covered the assumptions for 6G interference.
- Omni reception, need to ensure we don't blow the front end due to power levels.
- We all agreed that we have received preliminary test plan and have assignment for it. We sort of agreed in principle of what we are going to do for windshear but there was some discussion on elaborating the use case on weather detection.
- Regarding use of AVSI, it was agreed that we need to rely on supply base to perform the analysis, money and budgeting could be an issue. Idea was to revisit it next time.
- Jeff suggest we increase the frequency of the plenary this year by one more. In person is going to be productive aiming to meet May, July, end of September (20<sup>th</sup>).
- Meeting in May, question was posed if there was any benefit to meet in person. Dawn wasn't going to meet in person.
- There was much preference to have December meeting in person.
- Plan next meeting virtual, for other meeting we can evaluate if it needs to be in-person or virtual. Two trips, one in December and another one July (Seattle). July in-person is good as it will be good as we will be finalizing the content within the project paper.
- May 14-16<sup>th</sup> will be virtual
- July 16-18, Seattle in person
- September 23-25, virtual
- Gives 2-3 weeks to clean the document and send out for public comment.
- Timing of the meeting will be 10:30-2:30pm Eastern time to allow all key players to join.



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## **Next plenary**

The next meeting is virtual – May, 14-19, 11:00 am – 3:00 pm ET

CERTIFIED as a true and accurate summary of the meeting.

Mohammed Ahmed, SC-230 Secretary

Jeff Finley, SC-230 Co-chair

Dawn Gidner, SC-230 Co-chair