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VIA ELECTRONIC FILING

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th St S.W., Room TW-A325
Washington, DC 20554

Re: *Ex parte* Presentation, Expanding Flexible Use of the 3.7-4.2 GHz Band, GN Docket No. 18-122

Dear Ms. Dortch,

On October 8, 2020, RTCA, Inc. submitted an *ex parte* filing in the above-referenced docket to provide the Commission with the benefit of its recently completed report entitled “Assessment of C-Band Mobile Telecommunications Interference on Low Range Radar Altimeter Operations (‘RTCA MSG Report’).¹ This report was the culmination of a six-month multi-stakeholder group (‘RTCA MSG’) effort – the 5G Task Force – that commenced in April 2020 when the RTCA Special Committee 239 (‘SC-239’) issued an invitation to the public to participate.² The Commission encouraged such multi-stakeholder efforts to examine spectrum coexistence issues with radar altimeters as noted in the Commission’s Report and Order in the matter of *Expanding Flexible Use of the 3.7-4.2 GHz Band* (‘Order’).³ The RTCA MSG Report was informed by technical parameters made available by the commercial wireless and aviation industries regarding their respective systems and was therefore able to more thoroughly examine issues of compatibility between existing radar altimeters and prospective flexible use licensees than were the earlier preliminary analyses submitted to the Commission. As explained in the RTCA MSG Report, the analysis found serious threats of harmful interference to currently installed radar altimeters from anticipated flexible use licensed deployments, including from spurious emissions into the radar altimeter band.

The RTCA MSG Report was subject to a public review process prior to its publication and received an extensive list of comments from various stakeholders, including CTIA, that were considered

¹ RTCA, *Assessment of C-Band Mobile Telecommunications Interference on Low Range Radar Altimeter Operations*, RTCA Paper No. 274-20/PMC-2073 (rel. October 7, 2020), attached to Letter from Terry McVenes, RTCA, Inc., to Marlene Dortch, FCC, GN Docket No. 18-122 (filed Oct. 8, 2020).

² See Letter from Terry McVenes, RTCA, to Marlene Dortch, Secretary, FCC, Notice of Multi-Stakeholder Group Meeting, GN Docket No. 18-122 (filed Apr. 20, 2020). The RTCA SC-239 Task Force leadership was pleased when members of the commercial mobile industry attended the first few meetings, but ultimately, for reasons unknown to the other participants and RTCA, the representatives from the commercial mobile industry stopped attending the RTCA MSG effort.

³ *Expanding Flexible Use in the 3.7-4.2 GHz Band*, Report and Order and Order Proposing Modification, 35 FCC Rcd (2020) at 2343 ¶ 395.

and discussed. All comments received, and the RTCA MSG agreed resolutions, were incorporated into the final version of the RTCA MSG Report.⁴ Subsequent to its publication and submission, CTIA submitted into the docket comments on the RTCA MSG Report that included both comments previously provided during the public comment period and additional comments not previously shared with the RTCA MSG.⁵ The CTIA Filing challenges the findings of the RTCA MSG Report without providing an independent technical analysis, thus the RTCA MSG Report remains the only analysis of radar altimeter and 5G flexible use coexistence that is based on technical parameters provided by both the radar altimeter and commercial mobile industry. As such, the RTCA MSG Report provides the only publicly available study for the Commission's further consideration of the protection of incumbent radar altimeters from flexible use services proposed under the *Order*.

RTCA, together with the Aerospace Vehicle Systems Institute ("AVSI"), who conducted the interference testing described in the RTCA MSG Report, submit this *ex parte* to the Commission to further clarify technical content that was questioned by the CTIA Filing. Namely, the additional information provided herein addresses several apparent misunderstandings, including the proper application of aviation safety analysis and the proper characterization of the empirical data used in the RTCA MSG Report. These clarifications confirm the validity of the analysis and further justify the conclusions reached in the RTCA MSG Report.

Based on review of the CTIA Filing, RTCA and AVSI summarize our joint responses to the concerns described in the CTIA Filing:

- Aviation is driven by safety as its primary goal, and this dictates a conservative methodology that many other industries do not normally have to incorporate on a daily basis.
- The combined interference tolerance masks ("ITMs") accurately characterize the potential for harmful interference. The ITMs used represent the performance of all altimeters in each Usage Category simultaneously. If the analysis shows a risk of interference for a scenario based on the ITM for a certain Usage Category, then this indicates that risk exists for one or more of the altimeters in that Usage Category.
- AVSI's interference tolerance threshold criteria appropriately evaluate the potential for C-band 5G interference. These criteria were developed to systematically and

⁴ See RTCA MSG Report Appendix C at 151-201.

⁵ See Letter of Kara Graves, Assistant Vice President, Regulatory Affairs, and Doug Hyslop, Vice President, Technology and Spectrum Planning, CTIA, to Marlene Dortch, FCC, written *ex parte* presentation, GN Docket No. 18-122 (filed Oct 27, 2020) ("CTIA Filing"). RTCA and AVSI note the CTIA filing made recently by Kara Graves, Assistant Vice President, Regulatory Affairs, to Marlene Dortch, FCC, written *ex parte* presentation, GN Docket No. 18-122 (filed November 17, 2020) on a meeting had between CTIA and the FCC on November 13, 2020. While not explicitly addressed in this RTCA and AVSI *ex parte* comments due to the timing of submission, many of the rebuttal points RTCA and AVSI make address the latest points made by CTIA.

quantitatively identify the thresholds at which the radar altimeter output was measurably affected by 5G interference, such that the performance requirements can no longer be reliably met.

- The interference is accurately apportioned in the final ITMs in the RTCA MSG Report. All but 6 dB of what CTIA misinterpreted as margins is included to account for testing factors and variability not related to 5G RF interference. The actual 6 dB margin is the International Civil Aviation Organization ("ICAO") recommended safety margin, which is applied only in certain scenarios in accordance with ICAO guidelines and not included in the ITMs.
- The RTCA MSG Report properly applies the worst-case landing scenario. This is an operationally relevant scenario and its inclusion is consistent with both ICAO documents and approved International Telecommunication Union – Radiocommunication Sector ("ITU-R") Recommendations.
- The scenarios examined in the RTCA MSG Report are required to accurately assess the risk from 5G operations in the analysis of aviation safety system performance. CTIA's belief regarding scenarios they consider to be "highly unlikely" does not provide a sufficient basis for dismissing analysis of these scenarios.

Additional clarification for each of these bullets is provided below. For the benefit of the Commission, this *ex parte* addresses both those points raised by CTIA prior to the finalization of the RTCA MSG Report and those raised for the first time in the CTIA Filing.⁶ RTCA and AVSI urge the Commission to take into account the results of the RTCA MSG Report in considering appropriate measures to ensure radar altimeters in the safety-of-life 4.2-4.4 GHz band are protected from interference as the Commission ushers in new entrants into the 3.7-3.98 GHz band.

I. Introduction

RTCA recognizes that the Commission stated in the *Order* that the 3.7 GHz Service technical rules and the spectral separation of at least 220 MHz from radar altimeter operations "are sufficient to protect aeronautical services in the 4.2-4.4 GHz band."⁷ The Commission's decision was made when only preliminary testing data was available in the public record indicating the need for further analysis before conclusions could be reached,⁸ and a critique which itself was preliminary

⁶ While the CTIA Filing included other comments, this *ex parte* focuses on the technical misunderstandings expressed in the CTIA Filing and does not address comments that were not in the scope of the RTCA MSG Report such as current operations outside of the 3.7-4.4 GHz range. RTCA and AVSI understand that there are additional on-going efforts to investigate coexistence of radar altimeters with services in other frequency bands.

⁷ *Order* at 2343 ¶ 395.

⁸ See "Behavior of Radio Altimeters Subject to Out-Of-Band Interference," attachment to Letter of Dr. David Redman, AVSI, to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 18-122 at 21 (Oct 22, 2019) ("AVSI Preliminary Report").

and recognized further analysis was needed.⁹ No detailed independent analysis was provided by any party demonstrating that the concerns about the potentially serious risk of harmful interference to radar altimeters raised in the AVSI Preliminary Report, and which required further study, was without merit. While the Commission did not take action based on the AVSI Preliminary Report, the Commission recognized that “further analysis is warranted” into “why there may even be a potential for some interference” given the 220 MHz separation and permitted power limits.¹⁰ The Commission encouraged AVSI and others to participate in an industry MSG to further assess coexistence issues.¹¹

The RTCA MSG Report represents the most comprehensive analysis of the potential for interference to radar altimeters caused by 5G. The RTCA MSG Report builds on the previously submitted AVSI Preliminary Report and AVSI Supplemental Report.¹² Furthermore, the RTCA MSG Report is based on technical parameters for 5G and radar altimeters provided by the respective industry sectors.¹³ The RTCA MSG Report shows an even greater risk of harmful interference than what was suggested by the earlier AVSI studies, including a risk due to 5G spurious emissions landing within the 4.2–4.4 GHz band — a factor which had never been considered previously. Consequently, by presenting this level of analysis which was not previously available to the Commission, RTCA and AVSI submit that the RTCA MSG Report presents a firmer foundation for the Commission to consider whether the 220 MHz separation and existing power levels permitted for future flexible use licensees are, in fact, sufficient. Contrary to the CTIA Filing’s comments,¹⁴ the RTCA MSG Report provides the only reasonable technical and analytical basis on which to make a decision about protection of radar altimeters.

II. RTCA MSG Approach to Analyzing the RF Interaction with Aviation Safety Systems

From the start of the process, the RTCA MSG was very clear that all necessary steps should be taken to ensure the assumptions and analysis used meet the stringent requirements of aviation safety.¹⁵ Aviation is driven by safety as its primary goal, and this dictates a conservative methodology that many other industries do not normally have to incorporate on a daily basis.

⁹ See Letter from Steve B. Sharkey, Vice President, Government Affairs, Technology and Engineering Policy, T-Mobile USA, Inc., to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (Jan. 22, 2020); *id.* at Attachment, “Alion Review of AVSI Report, ‘Preliminary Report: Behavior of Radio Altimeters Subject to Out-Of-Band Interference,’” Alion Science and Technology Corporation.

¹⁰ *Order* at 2485 ¶ 395.

¹¹ *Id.*

¹² See “Effect of Out-of-Band Interference Signals on Radio Altimeters,” attachment to Letter of Dr. David Redman, AVSI, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (Feb. 4, 2020) (“AVSI Supplemental Report”).

¹³ See RTCA MSG Report at 116-150.

¹⁴ CTIA Filing at 2 stating that the RTCA MSG Report “... fails to provide any reasonable basis for revisiting the Commissions conclusions.”

¹⁵ See RTCA MSG Report at 6.

Therefore, the approach taken was in accordance with ICAO standard practices, with the analysis considering all variables at their worst-case limits including necessary safety margins.¹⁶ Assumptions that such a method is overly conservative, or scenarios are ‘unlikely’, do not fully comprehend the level of assurance needed to maintain the levels of modern aviation safety to which the flying public has become accustomed.

III. Combined ITMs Are Sufficient to Accurately Assess the Potential for Harmful Interference

The purpose and findings of the RTCA MSG Report do not depend on access to individual radar altimeter performance data, contrary to the CTIA Filing comments that knowledge of specific altimeter models and associated underlying test data must be available in order to accurately assess the potential for interference.¹⁷ The primary goal of the study conducted by the RTCA MSG was to determine whether there existed any risks, across various operational scenarios, of harmful 5G interference to Technical Standard Order (“TSO”) approved radar altimeters currently in service—not to determine which radar altimeter models may be susceptible to such interference. CTIA’s comments might be correct if a different sort of analysis was being performed, such as identifying which specific altimeter models may be the most susceptible to 5G interference and evaluating mitigations targeted to these specific models. The RTCA MSG Report did not include any analysis, or draw any conclusions, that would require individual altimeter data in order to be valid. Therefore, this CTIA comment misinterprets the scope and intent of the RTCA MSG Report and provides no basis for dismissing its analysis or conclusions.

The testing considered a range of TSO-approved radar altimeter models, all of which were verified to perform according to their specifications in the absence of RF interference.¹⁸ All the radar altimeters tested are widely deployed in active service today.¹⁹ The radar altimeters were divided into Usage Categories based on the types of aircraft on which they operate. Because the

¹⁶ See ICAO Doc 9718, “Handbook on Radio Frequency Spectrum Requirements for Civil Aviation, Volume I: ICAO spectrum strategy, policy statements, and related information” – Second Edition at 9-8 (2018). (“ICAO Doc 9718”) Available from:

[https://www.icao.int/safety/FSMP/Documents/Doc9718/Doc9718_Vol_I_2nd_ed_\(2018\)corr1.pdf](https://www.icao.int/safety/FSMP/Documents/Doc9718/Doc9718_Vol_I_2nd_ed_(2018)corr1.pdf)

¹⁷ See CTIA Filing at 4-9. This comment from CTIA was already considered during the comment resolution process when creating the RTCA MSG Report. See RTCA MSG Report at 152; specifically, comment 51990 and related disposition.

¹⁸ See RTCA MSG Report at 35-36.

¹⁹ The RTCA MSG is uncertain as to the purpose of section II.B in the CTIA Filing, which questions specific radar altimeter properties (See CTIA Filing at 7-9). Issues such as approvals, obsolescence, and validity of approvals are all covered in both the FCC Certification Process and FAA TSO Process. The RTCA MSG Report at 36 states that all radar altimeter models that were tested were approved through the TSO process. The units under test were sourced from the manufacturers and confirmed to be flight worthy. The date of FCC certification and FAA TSO approval is irrelevant in the determination of radar altimeter airworthiness.

goal was only to determine if there was a risk of harmful interference to each Usage Category as a whole, the relevant metric for the analysis was the worst-case limit of the computed 5G interference level at the altimeter input relative to the interference tolerance threshold for each Usage Category. Within each Usage Category, all analysis parameters are the same, and thus the computed interference levels are the same for all radar altimeter models in that Usage Category.

If each radar altimeter model in a given Usage Category were analyzed individually, then an interference exceedance value would be determined for each model, defined as the difference between the computed interference level in a specific scenario and the interference tolerance threshold.²⁰ The relevant metric for each Usage Category used in the RTCA MSG analysis would then be the maximum exceedance value across all radar altimeter models in that Usage Category, which is sufficient to summarize whether or not there exists a risk of harmful interference to that Usage Category in the scenario considered. However, it is mathematically equivalent to instead aggregate the interference tolerance threshold values for all radar altimeter models in the Usage Category prior to computing the exceedance. Taking the minimum interference tolerance threshold across all radar altimeter models in the Usage Category and then computing the exceedance immediately results in the maximum exceedance value for that Usage Category, which is the only relevant metric needed for the analysis.

This approach of aggregating the interference tolerance thresholds for all radar altimeter models in each Usage Category based on the worst-case limit, rather than aggregating the resulting exceedance values for each radar altimeter model, is far more efficient since it allows the analysis steps of computing the interference levels and determining the exceedance to be performed just once per Usage Category, rather than having to be done for every radar altimeter model. Further, this allowed for the aggregation of test data by AVSI prior to sharing the data with the RTCA MSG, which eliminated any concerns regarding appropriate handling of data that could be considered proprietary by either the radar altimeter manufacturers or the AVSI project team.

IV. AVSI's Interference Tolerance Threshold Criteria Appropriately Evaluate the Potential for C-Band 5G Interference.

CTIA misunderstands the origin and purpose of the criteria used to determine interference tolerance thresholds in the AVSI tests.²¹ The AVSI interference tolerance threshold criteria ("AVSI criteria") in the RTCA MSG Report must be more stringent than the performance requirements for the radar altimeters being tested. These requirements, as stated in the performance standard itself, must be met across all operating conditions.²² Therefore a single environmental parameter

²⁰ Note that the "exceedance" value may be negative, which would indicate that the interference level is below the tolerance threshold.

²¹ See CTIA Filing at 9-13.

²² Aviation operating conditions include the parameters of environmental test as well as external environmental factors such as terrain, altitude, attitude, flight path and other variables that are not represented in the laboratory

-- in this case 5G interference --cannot consume the entire error budget. The AVSI Preliminary Report and AVSI Supplemental Report describe threshold criteria that were developed to determine the onset of harmful interference, not the point at which interference becomes so severe that it drives the radar altimeter performance outside the minimum operational performance specification.²³ Otherwise, the established thresholds could not guarantee that aviation systems would meet integrity, availability, and continuity requirements for safety critical systems under all operating conditions.

The primary goal of the AVSI criteria were to systematically and quantitatively identify the point at which the altimeter performance is measurably affected by 5G interference. To do so, a baseline operating condition was established, including the existing RF interference environment if applicable. Then the radar altimeter output was observed to determine the effects of varying power levels of 5G interference. The threshold identified is the lowest 5G interference power level at which the altimeter performance is affected to the point where it could fail to meet the required performance, produce hazardously misleading information (HMI) to the flight crew or aircraft systems, or at which the altimeter cannot track an altitude at all, leading to a loss of availability. Thresholds were determined by periodically turning RF interference on and off while increasing the interference power level. During periods when the RF interference was turned off, all tested radar altimeters reported the expected altitude within the accuracy tolerances specified by the applicable TSO. This allowed differential measurements of the effect of RF interference. Given this test setup and analysis, it was not possible that the radar altimeters could exceed AVSI criteria in the absence of RF interference.

V. Representation of 5G Interference in the Final ITMs in the RTCA MSG Report Is Warranted.

CTIA misinterpreted the accounting of 5G interference captured in the ITMs in the RTCA MSG Report.²⁴

The AVSI ITMs represent measured threshold values that are adjusted to accommodate measurement and statistical uncertainty, all of which are fully justified in the RTCA MSG report.²⁵ The ITMs do not include any unwarranted margin. The final threshold values account for measurement uncertainty, performance variation across environmental conditions, and unit-to-

environment. EUROCAE/ED-30, Minimum Performance Standard for Low Range Radar Altimeters, at 8, requires performance requirements must be met over all environments.

²³ Recommendation ITU-R M.2059, Operational and Technical Characteristics and Protection Criteria of Radio Altimeters Utilizing the Band 4 200-4 400 MHz, (02/2014) at 19 defines criteria for protection against desensitization from harmful interference of $I/N = -6$ dB, which is equivalent to a 1 dB rise in the noise floor of the receiver. This cannot be measured directly on the radar altimeter standard output. M.2059 available at <https://www.itu.int/rec/R-REC-M.2059-0-201402-I/en>

²⁴ See CTIA Filing at 13.

²⁵ See RTCA MSG Report at 40-41.

unit manufacturing variation. The ICAO safety margin is not applied in all cases, as discussed below.

The methods used by the RTCA MSG Report are compliant with the ICAO Handbook on Spectrum Requirements for Civil Aviation, which specifies that an additional 6 dB margin must be applied to account for modeling uncertainties for all RF interference analysis considering aviation safety services.²⁶ There is no distinction made between consideration of in-band or out-of-band interference threats. The only exception allowed by ICAO is if the analysis explicitly accounts for all factors with enough certainty that no margin is needed. In the RTCA MSG Report, some operational scenarios were judged to satisfy this criterion, but most did not. Therefore, the margin was needed in most cases. Furthermore, the level of spurious emissions allowed by the *Order*, which fall within the aeronautical band 4.2–4.4 GHz, is sufficient to harmfully interfere with radar altimeters.²⁷ Thus, application of the 6 dB aeronautical safety margin is warranted in the cases in which it was considered.

VI. The Report Properly Applies the Worst-Case Landing Scenario.

CTIA misunderstands the worst-case landing scenario (WCLS) used in the AVSI tests and analyzed in the RTCA MSG Report.²⁸

The RTCA MSG Report incorporates the WCLS developed during AVSI testing to determine potential sources of interference to radar altimeters during critical phases of flight. This scenario was developed by aircraft manufacturers, altimeter designers, air traffic controllers, safety regulators, and international spectrum regulators, and has been confirmed as representative in ICAO and ITU-R documents.²⁹ It accounts for the wide range of terrain³⁰ and ICAO-regulated airport configurations that may be encountered in actual aircraft operations.³¹ It describes a scenario that includes a high density of on-ground airplane radar altimeter frequency-modulated continuous wave ("FMCW") interference sources that radiate in the vicinity of the runway

²⁶ See ICAO Doc 9718 at 9-8.

²⁷ See RTCA MSG Report at 79 and 82-83.

²⁸ See CTIA Filing at 13-15.

²⁹ See ICAO, Radio Altimeter Interference Susceptibility Testing Status Update, ICAO FSMP Information Paper FSMP-WG07-IP15_WAIC Update (2018) available at https://www.icao.int/safety/FSMP/MeetingDocs/FSMP%20WG7/IP/FSMP-WG07-IP15_WAIC%20Update.docx.

See also ITU-R, Compatibility analysis between wireless avionics intra-communication systems and systems in the existing services in the frequency band 4 200-4 400 MHz, Report ITU-R M.2319-0 (11/2014) available at https://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-M.2319-2014-PDF-E.pdf.

³⁰ The reflection coefficient used to determine loop loss values is itself not an indication of "smooth" or "rough" terrain. It is only related to the portion of RF energy which is reflected off the terrain and back to the aircraft.

³¹ See RTCA MSG Report at 106-109.

threshold. The radiation from these sources is not confined to a 450-foot circle near the runway threshold as stated in the CTIA Filing.³² The *log-linear interpolation* (not linear extrapolation) between interference threshold measurements at 200 feet with FMCW interference and 1000 feet without FMCW interference is used to define the ITMs and accounts for the gradual roll off of these emissions above 200 feet.³³

VII. The Analysis in the RTCA MSG Report Properly Accounts for Proposed C-band 5G Operations.

The RTCA MSG Report incorporates all 5G technical parameters received from wireless industry representatives and accurately accounts for potential sources of 5G interference from both base stations and handsets, contrary to statements in the CTIA Filing.³⁴

All the interference analysis which was potentially affected by CTIA's input on the draft report circulated for public comment was rerun,³⁵ and the results were included in the RTCA MSG Report.³⁶ The updated analysis did not substantially change any of the fundamental conclusions of the original analysis.³⁷ The change to the Advanced Antenna System scan angle assumption actually *increased* the worst-case exceedance of the safe interference limit in all cases (e.g. by approximately 5 dB for Usage Category 1 and Usage Category 2)³⁸ and did not decrease it by 14 dB as CTIA suggests.³⁹ The only difference was a change to the specific scenarios and relative geometries between the aircraft and base station at which this worst-case exceedance occurred.

As stated previously, the RTCA MSG Report used rigorous aviation safety analysis methods to assess the potential for harmful interference in the worst-case limit across all operational scenarios. Given that the reliability of aviation safety systems must be demonstrated to levels as stringent as 1 undetected failure per billion flight hours,⁴⁰ the exclusion of any scenarios from such analysis must be done on the basis of quantifiable evaluation of their likelihood which can be traced to industry standards or regulations. The general comment in the CTIA Filing that some

³² CTIA Filing at 14.

³³ RTCA MSG Report at 41.

³⁴ See CTIA Filing at 15.

³⁵ See RTCA MSG Report at 167; specifically comment 52016 and related disposition.

³⁶ See RTCA MSG Report Appendix D at 203-217.

³⁷ RTCA MSG Report at 217 stating: "Overall, the additional analysis results show only minor differences from the original analysis in terms of operational impacts, and the fundamental conclusions drawn from the original analysis are unchanged."

³⁸ See RTCA MSG Report at 217.

³⁹ See CTIA Filing at 15.

⁴⁰ See RTCA MSG Report at 10.

of the scenarios which were considered in the RTCA MSG Report are "highly unlikely"⁴¹ does not meet these criteria. Therefore, as explained in the RTCA MSG Report, these scenarios are still considered.⁴² Further, it is critical to note that the scenarios to which the CTIA Filing refers ultimately have no bearing on the overall conclusions of the RTCA MSG Report.⁴³

On the discussion of the use of radio devices on board aircraft during takeoff and landing, while the use of radio devices on board aircraft during takeoff and landing is prohibited by both FCC and FAA rules, studies by the FAA, airline associations, and labor organizations show that there is a low compliance rate to these regulations.⁴⁴ Additionally, as noted in the RTCA MSG Report, "Although 47 CFR § 22.925 specifically prohibits the use of cellular telephones onboard any aircraft while that aircraft is airborne, this regulation applies in the context of current 800 MHz cellular services governed by 47 CFR § 22 Subpart H, and it is not clear how or if it would be extended to 5G operations in the 3.7–3.98 GHz band operating according to 47 CFR § 27 Subpart O."⁴⁵ Lastly, the *Order* established no design requirements that prevent even accidental use of handsets on aircraft that will prevent emissions on board an aircraft. Since this scenario is expected to occur, the safety analysis in the RTCA MSG Report was compelled to consider the potential impact of handsets on radar altimeter performance.

VIII. Conclusions

The RTCA MSG Report represents the most comprehensive analysis available to the Commission of the potential for interference to radar altimeters caused by 5G emissions while demonstrating the proper application of aviation safety analysis and the proper characterization of the empirical data used to support its conclusions.

The RTCA MSG Report is based on information exchanged between the commercial mobile industry and the radar altimeter communities. Yet, without any analysis of its own, CTIA would have the Commission reject the RTCA MSG Report, and rely on a preliminary critique of a preliminary AVSI analysis that signaled the potential for interference threats and highlighted the need for more study.⁴⁶ RTCA would be pleased to review any independent technical report from CTIA or its members analyzing compatibility between radar altimeters and 5G operations in the 3700-3980 MHz bands that provides a basis for its comments. RTCA is motivated to model the operational environment with the best technical data available and is open to revising the analysis and results of the report if further inputs are available in order to preserve the safety of the flying public.

⁴¹ CTIA Filing at 15.

⁴² See RTCA MSG Report at 203.

⁴³ See *Id* at 217.

⁴⁴ See RTCA MSG Report at 15, *note* 9.

⁴⁵ RTCA MSG Report at 15 (citations omitted).

⁴⁶ See CTIA Filing at 18.



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The RTCA MSG Report has been peer reviewed for accuracy and validity and is well suited for the Commission's further consideration of the protection of incumbent of radar altimeters from flexible use services proposed under the *Order*. The RTCA MSG Report demonstrates the insufficiency of the 220 MHz separation between the 4.2-4.4 GHz radar altimeter band and the 5G band at 3700-3980 MHz, and the permitted power levels intended to protect well-designed radar altimeters. RTCA and AVSI stand behind the RTCA MSG Report from a scientific and engineering perspective and its unbiased conclusions should remain pertinent for future FCC decisions. The RTCA MSG Report provides useful information for developing mitigations to protect radar altimeters from harmful interference, and RTCA and AVSI are ready to support the Commission's efforts to further ensure the protection of incumbent safety-of-life aviation systems.

Respectfully submitted,

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/s/ David Redman
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