1 Introduction

The Federal Aviation Administration (FAA) is requesting comment on proposed rulemaking under Docket No. FAA–2022–1647; Project Identifier AD–2022–01379–T "Airworthiness Directives: Transport and Commuter Category Airplanes" hereafter referred to as "NPRM AD".[1] AIA offers these comments on behalf of the undersigned members of the aerospace industry, hereafter referred to as the "Aviation Coalition."

2 Background

The Federal Communication Commission (FCC), responding to an act of Congress, requested comments to establish policy for flexible use of the frequency band 3700-4200 MHz. Aerospace industry members contributed comments to GN Docket 18-122 in response to this request that indicated the potential for harmful interference to radar altimeters operating in the frequency band 4200-4400 MHz as early as 2017. Despite this concern, the FCC authorized the auction of spectrum in the frequency band 3700-3980 MHz for flexible use, resulting in the licensing of this frequency band by wireless operators for new 5G services operating in accordance with the minimal rules established in the FCC's Report and Order[2] authorizing the spectrum auction. The aviation industry responded to the issued Report and Order with a Petition for Partial Reconsideration[3] of the Report and Order that would address the risk of harmful interference to radio altimeters. Further study of the potential for harmful interference from 5G emissions indicated that there was a quantifiable risk, which then prompted the FAA to issue Airworthiness Directive (AD) 2021-23-12 applicable to transport and commuter category airplanes to address the unsafe condition on radio altimeters.[4] This was followed by Notices to Air Missions (NOTAMs) restricting certain airplane operations at airports affected by new 5G emissions.

The FAA further requested input from aviation industry members in developing a stop-gap solution to define a common approach for requesting alternative means of compliance (AMOCs) to AD 2021-23-12 to preserve existing airplane operations. An ad hoc AMOC Task Force (TF) was formed and provided a series of inputs to the FAA to facilitate the transition to a more permanent solution to preserving the continued safety of the National Airspace System (NAS) during the laydown of the new 5G networks while minimizing the severity of the impact to aviation operations.

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[1] *See* 88 FR 1520.

[2] *Expanding Flexible Use in the 3.7-4.2 GHz Band*, Report and Order and Order Proposing Modification, 35 FCC Rcd 2343 (2020).

[3] Petition For Partial Reconsideration of the Aerospace Industries Association, Aerospace Vehicle Systems Institute, Air Line Pilots Association International, Airbus, Aviation Spectrum Resources, Inc., Garmin International, Inc., General Aviation Manufactures Association, Helicopter Association International, Honeywell International, Inc., International Air Transport Association, and the National Air Transportation Association, GN Docket No. 18-122 (filed May 26, 2020). Available from https://www.fcc.gov/ecfs/document/10527379225572/1.

[4] *See* 86 FR 69984.

The TF proceeded to work with the technical staff at the FAA to develop a series of temporary AMOC support processes of increasing fidelity as additional information became available. These processes began by assessing existing equipment against worst-case exposure conditions based on gross assumptions that were necessary due a lack of specific information concerning both sources of 5G emissions and radar altimeter (RA) behavior when exposed to potential emission levels. However, the TF quickly responded with additional data and with an approach to improve the radio frequency interference (RFI) tolerance of existing equipment currently in operation, with the cost of 5G compatibility assessments, related AMOC applications, and modifications falling solely on aviation. This allowed more airport access for certain airplanes but was still based on an unsustainable AMOC process that relied on voluntary concessions on wireless emissions from the 5G operators.

Further cooperation between the FAA, the TF, and wireless industry representatives led to a more sustainable approach based on (1) improving the RFI tolerance performance of existing altimeters and (2) voluntary constraints on 5G emissions beyond those specified in the Report and Order. This work has informed the development of the proposed AD, however the current draft text falls short of the goal of preserving safe operation of airplanes in the NAS in three primary ways:

- **The NPRM AD is an incomplete solution for maintaining safety of the NAS while preserving existing aviation operations and laydown of new 5G services.**
- **The NPRM AD does not identify sufficiently robust controls to ensure continued safety as both aviation operations and wireless services co-evolve.**
- **The NPRM AD effectively reallocates some responsibility for maintaining the safety of the NAS from the FAA to individual operators.**

These concerns are elaborated below with references to specific text in the NPRM AD as appropriate. The Aviation Coalition then offers recommendations for improvements to the NPRM AD text that address these concerns.

3 Aviation Industry Concerns

3.1 THE NPRM AD IS AN INCOMPLETE SOLUTION FOR MAINTAINING SAFETY OF THE NAS WHILE PRESERVING EXISTING AVIATION OPERATIONS AND LAYDOWN OF NEW 5G SERVICES

The NPRM AD does not clearly define a means to simultaneously preserve the safety of the NAS, the current and planned all-weather access to all airports therein, and the full deployment of 5G and future wireless networks.

3.1.1 The NPRM AD Does Not Comprehensively Address Erroneous Warning Safety Concerns Across All Operation

The NPRM AD provides an overview of approximately 100 incidents where 5G C-Band interference could not be ruled out as the potential source of radio altimeter anomalies and related flight deck effects. These effects included erroneous warnings (from Terrain Awareness and Warning System (TAWS), Traffic Collision Avoidance System (TCAS) and landing gear systems) and erroneous display of radio altimeter data.[5] The NPRM AD goes on to state the concern that continued deployment of 5G C-Band services may lead to such flight deck effects occurring more frequently, potentially leading to desensitization of flight crews to erroneous warnings and reducing the likelihood that flight crews will properly react to accurate warnings.[6] The FAA also states that the existing AD 2021-23-12 does not address other operations near airports such as Cat I ILS or VFR approaches.[7] Because of these concerns, "the FAA proposes to prohibit operations under [14 CFR] part 121 in the U.S. after February 1, 2024, unless such operations are conducted with a radio altimeter tolerant airplane."[8]

However, the analysis in the NPRM AD either ignores these same concerns for operating parts other than part 121 or, at the very least, does not explain its safety analysis (or lack thereof) relative to these concerns for other operating parts. To illustrate the issue, part 121 requires Class A TAWS equipment for all turbine-powered airplanes, regardless of seating capacity.[9] The NPRM AD specifies a remedy to mitigate the potential for erroneous TAWS warnings that may be the result of interference with a radio altimeter by requiring that airplanes operating under part 121 be tolerant to 5G C-Band signals.[10] Yet the NPRM AD is silent with respect to part 91 and part 135 operations that have a similar requirement to equip with Class A TAWS for certain airplanes.[11] These safety systems, which rely on accurate radio altimeter inputs for their intended function, are installed for the purpose of obtaining the same safety benefits described in the NPRM AD.[12] Additionally, many airplanes operated under parts 91, 125, and 135 have voluntarily installed Class A TAWS and/or TCAS and/or airborne windshear warning and flight guidance systems[13] mentioned in the NPRM AD. Furthermore, flightcrews operating under

[5] *See* 88 FR 1521.
[6] *See* 88 FR 1521-1522.
[7] *See* 88 FR 1522.
[8] 88 FR 1523.
[9] 14 CFR § 121.135.
[10] 88 FR 1523 stating "As explained earlier, the FAA expects erroneous system warnings due to a malfunctioning radio altimeter to lead to flightcrew becoming desensitized to system warnings. Such desensitization negates the safety benefits of the warning itself and can lead to a catastrophic event. To minimize the number of erroneous system messages and the unsafe condition they produce, the FAA is proposing to require all airplanes operating under part 121 meet the PSD performance curve to operate in the contiguous U.S. after February 1, 2024."
[11] 14 CFR § 91.1045 and 14 CFR § 135.154 require Class A TAWS for all turbine-powered airplanes configured with 10 or more passenger seats.
[12] 88 FR 1524 stating "The FAA required these systems to address hazards which have caused accidents and fatalities during … air transportation in the United States."
[13] *Id*.

parts 91, 125, and 135 will exhibit the same, or potentially greater, desensitization to warnings as part 121 flightcrews given their different levels of training.

3.1.2 The NPRM AD Lacks Sufficient Information to Demonstrate the Required Radio Altimeter Tolerances Are Met

The NPRM AD proposes a definition of a ‘‘radio altimeter tolerant airplane’’ as:

> *… one for which the radio altimeter, as installed, demonstrates the tolerances specified in paragraphs (g)(2)(i) and (ii) of this AD, using a method approved by the FAA.*[14]

Yet the tolerances specified in the NPRM AD lack sufficient information for radio altimeter manufacturers and airplane manufacturers to ensure that the “method approved by the FAA” will be equivalent to the method that has been previously agreed with industry and used to demonstrate to what is commonly “known within industry as a Group 4 airplane.”[15] More specifically, the NPRM AD states the following relative to the tolerance demonstration (“compliance criteria”):

> *(i) Tolerance to radio altimeter interference at or above the power spectral density (PSD) curve threshold specified in figure 1 to paragraph (g)(2) of this AD.*
> *(ii) Tolerance to an aggregate base station conducted spurious emission level of -48 dBm/MHz in the 4200–4400 MHz radio altimeter band.*[16]

The Aviation Coalition respectfully submits the following illustrative examples of the NPRM AD’s lack of information but note that these are not intended as an exhaustive list:

- The frequency range applicable to the figure 1 PSD tolerance curve thresholds should be specified. While 5G C-band emissions in the U.S. are limited to 3700-3980 MHz, the susceptibility of radio altimeters to harmful interference is higher for RF signals closer to the 4200-4400 MHz band. Hence, the figure 1 PSD tolerance curve may not be applicable to RFI signals in all frequency bands outside the 4200-4400 frequency band.
- Interfering signal waveform, duty cycle, bandwidth, and propagation model should be characterized for both the adjacent band tolerance described by figure 1 and the in-band (spurious) tolerance described by ¶ (g)(2)(ii).
- Guidance for validation of the measurement uncertainty of the test setup used to demonstrate unit compliance with the compliance criteria should be provided,

[14] 88 FR 1526, ¶ (g)(2).
[15] 88 FR 1522 stating “For purposes of this proposed AD, a ‘‘radio altimeter tolerant airplane’’ (also known within industry as a Group 4 airplane) is one for which the radio altimeter, as installed, demonstrates tolerance to radio altimeter interference at or above PSD curve threshold specified in figure 1 to paragraph (g)(2) of this proposed AD. A radio altimeter tolerant airplane also demonstrates tolerance to a spurious emission level of -48 dBm/MHz in the 4200–4400 MHz radio altimeter band.”
[16] 88 FR 1526, ¶¶ (g)(2)(i) and (g)(2)(ii).

especially concerning assumptions relating radiated or conducted bench testing results to "as installed" performance.

- Guidance for characterization of the radio altimeter unit-to-unit variation and environmental variation of the RFI tolerance should be provided to adequately demonstrate compliance across the entire operational design domain.
- Guidance for how the minimum installed radio altimeter receiver cable path loss, as determined by the radio altimeter manufacturer from permissible loop loss considerations, should be characterized to allow uniform evaluation of the attenuation of RFI signals at the input to the radio altimeter receive port.
- Guidance for how the maximum radio altimeter receive antenna gain and pattern for both in-band and adjacent band signals should be characterized.
- Other factors required to translate from the base station conducted spurious level to the necessary tolerance of the radio altimeter to such interference, including standoff distance, assumed base station radiation pattern, aggregation factor, etc. should be considered.

Additionally, ¶ (g)(2)(ii) specifies that the spurious emission tolerance must be met for *aggregated* base station conducted spurious emissions, which is inconsistent with the voluntary telecommunication companies' agreement for -48 dBm/MHz for a *single* base station. Voluntary compliance with a -48 dBm/MHz aggregate base station spurious emission level limit would require wireless operators to limit single base station spurious emission levels to -54 dBm/MHz due to an assumed aggregation factor of 6 dB.

3.2 THE NPRM AD DOES NOT IDENTIFY SUFFICIENTLY ROBUST CONTROLS TO ENSURE CONTINUED SAFETY AS BOTH AVIATION OPERATIONS AND WIRELESS SERVICES CO-EVOLVE

The NPRM AD defines 5G C-band Mitigated Airports (CMAs) as:

> *For purposes of this proposed AD, a ''5G C-Band mitigated airport''* [CMA] *is an airport at which AT&T and Verizon have agreed to voluntarily limit their 5G deployment at the request of the FAA. The FAA will provide a list of these airports in the United States through the FAA Domestic Notice system.*[17] [note that airports not on this list are designated "non-CMAs" herein]

The NPRM AD finds that "radio altimeter tolerant airplanes will not experience the unsafe condition at any airport identified by the FAA as a 5G CMA in an FAA Domestic Notice."[18] However, this finding is qualified: "… operations are safe for radio altimeter tolerant airplanes to perform at … airports as long as telecommunication companies transmit at parameters

[17] 88 CFR 1521, note 2.
[18] 88 FR 1522.

under the current voluntary agreements with the FAA and FCC."[19] Thus, the establishment of a mitigated 5G environment around critical aviation operational volumes is based entirely on strictly *voluntary* agreements between 5G wireless operators and the FAA and FCC. These voluntary agreements provide insufficient assurance upon which to base coexistence strategies when compared to controls established in regulation. Specific concerns include, but are not limited to:

- The voluntary agreements are documents established in principle only. Agreements between the FAA, FCC, and all C-band 5G operators will likely not be established prior to the effective date of the AD.
- Conditions of the agreements have not been made available for review by the aviation industry to assess the impact on operations at non-mitigated airports.
- The NPRM AD does not elaborate on the legal basis of the agreements and is silent on:
    - Uniformity of terms in individual agreements,
    - Legal binding, monitoring, and enforceability of the agreements,
    - Procedures to accommodate wireless operators that do not volunteer to enter into an agreement,
    - Notification procedures for the same.
- Certification of compliance with agreements for:
    - Initial 5G installations near 5G CMAs and non-CMAs,
    - Changes to transmission parameters for established locations,
    - 5G operator self-reporting requirements,
    - Interagency coordination controls to mitigate emergent unsafe conditions.

3.3 THE NPRM AD EFFECTIVELY REALLOCATES SOME RESPONSIBILITY FOR MAINTAINING THE SAFETY OF THE NAS FROM THE FAA TO INDIVIDUAL OPERATORS

Proof of the efficacy of the procedures established in federal regulation to ensure the safe development and operation of aviation equipment lies in the safety record achieved by the commercial aviation industry. This record is built on the FAA's uncompromising approach of establishing rules that identify and mitigate potential safety hazards to acceptably low levels of occurrence. The rapid introduction of ubiquitous C-band 5G has presented an unprecedented change to the operational design domain that was specified for the development, integration, and operation of existing radio altimeter equipment. While the introduction of new potential sources of harmful interference in frequency bands near, within and adjacent to the 4200-4400

[19] 88 FR 1523.

MHz radio altimeter band can be viewed as just another environment factor that must be accommodated in radio altimeter performance requirements, existing equipment was developed to operate reliably in the RF environment established prior to the introduction of C-band 5G services. New radio altimeters developed to accommodate the relatively higher levels of RF interference created by new fundamental and spurious 5G signals will not be available and deployed fleet-wide for many years.

Thus, special consideration for the near-term impact of these changes to the RF environment must be given in addition to the safety procedures that have served the aviation industry for decades. This consideration must be based on rigorous FAA regulation, guidance, and processes to provide both uniformity of affect and application across users of NAS. In this regard, the NPRM AD does not adequately address safety concerns for operations at airports not identified on the FAA's 5G CMA Domestic Notice, which has the effect of pushing this responsibility to airplane operators.

In the NPRM AD, the FAA has based protection of the intended function of a radio altimeter on required equipment upgrades that improve an airplane's tolerance of RF interference from 5G transmissions in the 3700-3980 MHz frequency band.[20] The proposed protections are further supported by suggesting to wireless operators certain limits on emissions when the emission sources are located within runway safety zones (RSZs) associated with all runways at 5G CMAs. The NPRM AD defines RSZs as:

> *… those areas around a runway where radio altimeters on transport and commuter category airplanes must function accurately and reliably during critical phases of flight where radio altimeter interference is most likely to result in a catastrophic accident.*[21]

These RSZ restrictions are intended to augment a limited set of nationwide restrictions on 5G base stations to address antenna pointing and spurious emissions that could land in the radio altimeter band. While airplanes will be allowed to perform all operations previously restricted by AD 2021-23-12 at 5G CMAs with an upgraded radio altimeter system,[22] including the prevention of erroneous safety system warnings,[23] there is no indication in the NPRM AD as to how to protect against erroneous safety system warnings at non-CMAs.

The NPRM AD correctly identifies that erroneous operation of TAWS, TCAS, aircraft configuration warning, and erroneous indication of radar altitude would lead to additional workload in a critical phase of flight, and that continued erroneous warnings would lead to flight crew "desensitization" to warnings, which has the effect of eroding the safety provided by these systems. However, as currently described, it appears that the NPRM AD only considers the areas in the immediate runway environment (e.g., "runway safety zone") in determining

[20] *See* 88 FR 1526, ¶ (g)(2).
[21] 88 CFR 1521, note 1.
[22] 88 FR 1527, ¶ (j)(1).
[23] *Supra* at n. 10.

the safety of operations at 5G CMA airports. Furthermore, the NPRM AD does not describe how the FAA intends to ensure these warnings are not impacted at non-CMA airports.

For example, when conducting operations in convective weather conditions, the airplane safety systems designed to prevent catastrophic outcomes under windshear encounters are reliant on a fully functioning radio altimeter, regardless of whether the operations occur at a 5G CMA or non-CMA runway. A radio altimeter that provides no data or erroneous data due to 5G C-Band interference could result in a failure of an airplane integrated safety system to perform its intended function. An additional potential outcome is that the flightcrew, relying on the radio altimeter height above ground and trend information, could misinterpret the current airplane energy state such that they extract insufficient performance from the airplane (e.g., in a low altitude windshear recovery procedure), potentially resulting in a catastrophic outcome.

Additionally, the impact of unmitigated C-band 5G emissions at non-CMAs could result in airplane manufacturer-imposed performance limitations on specific aircraft at those airports. This in turn may force operators to limit payload in and out of these airports and/or impact operational capability due to the risk of an unreliable radio altimeter.

If the NPRM AD is to provide an equivalent level of safety for airplanes operating at non-CMAs, then it must address mitigations to be employed uniformly across industry to ensure all necessary on-board aviation safety systems that are dependent on the radio altimeter operate correctly. It is not appropriate for the FAA to transfer this responsibility to operators to determine appropriate mitigations for their airplanes' respective safety systems when the airplane is exposed to a non-normal situation at a non-CMA. This approach could compromise safety as the mitigations developed by operators could be diverse and potentially ineffective. In addition to the desensitization of flight crews,[24] this would create multiple levels of safety, which would erode the confidence of pilots, operators and even the public in the safety of the system.

An additional concern is related to the claim in the NPRM that:

> *The FAA also anticipates that aircraft incorporating equipment approved under the new Radio Altimeter TSO will be able to operate in both 5G CMAs and non-5G CMAs with no 5G C-Band related AFM limitations.*[25]

Given that current understanding is that the FAA has no ability to determine where 5G transmitters are located at non-CMA airports, it is not clear that the new Radio Altimeter TSO will be able to tolerate C-Band 5G within the US such that radio altimeter equipment will continue to function correctly up to the point where an aircraft contacts the transmitter. Additionally, The NPRM offers no means to determine the minimum performance applicable at all non-CMAs but states that the future TSO will allow access to non-CMA without restriction. It

[24] *See* 88 FR 1521-1523.
[25] 88 FR 1523.

is unclear from the NPRM text how new TSO/MOPS requirements that obviate AFM limitations for non-CMA operations are to be determined without additional information on 5G sources.

Finally, the NPRM AD does not adequately address the use of RNP AR procedures for all airports. The proposed text states:

> *Therefore, this proposed AD would continue prohibiting the use of the same operations identified in the original AD (AD 2021–23–12) except for the prohibition of Required Navigation Performance with Authorization Required (RNP AR) Instrument Approach Procedures (IAP). After further analysis, the FAA has determined that 5G C-Band interference does not create an unsafe condition for an airplane conducting RNP AR IAPs because RNP AR operations do not rely on direct radio altimeter inputs to determine arrival at altitude minimums or the flight path of the airplane. Therefore, this proposed AD would no longer prohibit RNP AR IAPs.*[26]

However, at some airports in mountainous areas (e.g., KEGE – Eagle Co. Colorado), RNP AR approaches are the best option to gain access in poor weather conditions. While there may be other traditional instrument approaches available, they have higher minimums, and may not provide vertical guidance, which increases risk. Furthermore, some of these approaches are specific to individual airlines ("specials").

It does not seem reasonable to continue to perform these RNP AR approaches in an environment where TAWS may not be functional or may provide erroneous operation (either false alarms or missed detections). At the same time, expecting flight crews to use other types of instrument approaches may reduce safety and access to the airports.

4 Aviation Industry Recommendations

The Aviation Coalition recommends the following changes to the NPRM AD to address the concerns described in Section 3.

4.1 Recommendation: Provide Uniform Coverage of All Airplanes Equipped With RA-Dependent Safety Systems

As noted in Section 3.1.1, flightcrews operating under parts 91, 125, and 135 will exhibit the same, or potentially greater, desensitization to alerts as part 121 flightcrews given their different levels of training. Consequently, the Aviation Coalition recommends that the FAA extend its safety analysis for false alerts and erroneous height measurement arising from harmful 5G interference to other operating parts with TAWS Class A, TCAS II, and windshear safety systems, whether installed due to mandate or voluntarily, to determine if airplanes

[26] 88 FR 1521.

should be prohibited from conducting affected operations unless they meet the performance criteria for a radio altimeter tolerant airplane.

4.2 Recommendation: Clarify How to Demonstrate Compliance with Radio Altimeter Tolerant Airplane Requirements

To address the concerns identified in Section 3.1.2, at a minimum, the Aviation Coalition recommends that the final AD include:

1. The frequency range to which the figure 1 PSD tolerance curve thresholds applies,
2. Revising the spurious tolerance to apply to a single base station level instead of an aggregated base station level,
3. A new figure indicating the spurious tolerance necessary for the radio altimeter equipment at the airplane level. For example, a figure that is akin to the figure 1 PSD tolerance curve thresholds,
4. Specification of the altitude dependence for spurious tolerance, and
5. A reference to an Issue Paper, Advisory Circular, or other publicly available means of compliance document that has been appropriately vetted via a public comment process.[27]

Additionally, to help expedite approvals and make best use of resources, the Aviation Coalition recommends that the FAA structure the requirements and implementation to be based on TSO authorization of measures that improve radio altimeter tolerance (e.g., filters) and recognize installation of these measures as a minor change to type design if the installation meets the TSO equipment installation manual requirements.

4.3 Recommendation: Clarify How the Use of Voluntary Agreements Will Preserve Safety

As noted in Section 3.2, the FAA and FCC's voluntary agreements with the telecommunication companies are assumed to be designed to define an airport environment for a 5G radio altimeter tolerant airplane to coexist and perform all intended functions in all conditions at 5G CMAs. Consequently, the FAA should consider in this NPRM:

1. Clarifying how the FAA will obtain the cooperation of telecommunication companies to meet these voluntary agreements into the future,
2. Clarifying how the voluntary 5G transmission limitations will be enforced, including any coordination with the FAA on changes to transmitter parameters including (but not limited to) location, height, power, antenna elevation masks, spurious emissions limits, etc.,

[27] For example, the current FAA proposed rulemaking for Docket No. FAA–2022–1544; Notice No. 23–04 "System Safety Assessments", 87 FR 75424, is accompanied by several Advisory Circulars that are available for simultaneous review and comment.

3. Clarifying the legal basis, notification requirements, enforcement mechanisms, and specific terms for the voluntary agreements to establish enough rigor to ascertain that the NPRM AD is sufficient to ensure safety,
4. Clarifying if the only remedy for any changes to transmission parameters at 5G CMAs that result is removal of an airport from the 5G CMA list, resulting in potential loss of access to that airport, and further clarifying the process for changes at non-CMAs,
5. Clarifying the intent for using voluntary agreements to ensure continued safety of the NAS in future NPRMs (or if this is a unique and solitary solution specific to this AD).

4.4 Recommendation: Clarify the Procedures for Establishing and Maintaining the List of 5G CMAs

Section 3.2 and Section 3.3 identify concerns related to the assurances in the NRPM AD being dependent on conditions defined at specific 5G CMAs that are listed in a Domestic Notice. To address these concerns, the Aviation Coalition recommends that the processes for establishing and maintaining this list be further clarified. Specifically:

1. Identifying the criteria used to determine which airports are included in the 5G CMA Domestic Notice,
2. Clarifying the process for how airports will be moved into or out of the 5G CMA Domestic Notice,
3. Clarify how much lead time will be provided for changes to the list of airports that are included in the 5G CMA Domestic Notice prior to the effective date.

Additionally, the FAA should consider adding industry identified non-CMAs to the 5G CMA Domestic Notice list prior to the effective date of the AD.

4.5 Recommendation: Clarify How Safe Operations at Non-CMAs Will Be Preserved

Section 3.3 describes concerns with maintaining safety of operation at non-CMAs. While the Aviation Coalition acknowledges that guidance may be specific to the configuration of safety systems on board specific airplanes, the NPRM AD should clarify how it will ensure that safety systems, which have been installed on airplanes based on knowledge gathered from many accidents with significant loss of life, continue to provide undiminished safety when an airplane is outside of the immediate runway environment. This may be due to a windshear encounter or due to other “rare-normal” events such as one-engine-inoperative.

Specifically, the NPRM should:

1. Provide guidance to the industry on revised training for use of these systems,
2. Clarify the expectation that new Radio Altimeter TSO’d equipment will continue to perform its intended function in a close encounter with a 5G emission source.

As an alternative, the NPRM AD could provide additional mitigations to establish the same level of safety for those airplane safety systems that require a fully functioning radio altimeter for

use during non-normal operations at non-CMAs. These mitigations could be applied to non-CMAs by:

1. Enforcing coordination with the FAA for every tower location around non-CMAs to ensure compatibility with radio altimeter tolerant airplanes (also known as Group 4 airplanes), noting exceptions if appropriate power and beam limits at non-CMAs cannot be incorporated in the voluntary agreements, or
2. Defining a PSD curve similar to figure 1, or other criteria that enable derivation of a PSD curve, that radio altimeter tolerant airplanes must meet in order to be fully compatible with the FCC Report and Order.

4.6 Recommendation: Clarify How the Safety of RNP AR Operations Will Be Ensured

To address the concerns identified in Section 3.3, the NPRM AD should clarify how the FAA plans to ensure continued operational safety for RNP AR approaches. This could include, as necessary, how the FAA will prevent use of terrain impacted RNP AR approaches.

4.7 Recommendation: Acknowledge Constraints in Airplane Alteration

The NPRM AD text states:

> *In addition, the FAA learned about the aircraft alterations that can be accomplished quickly to improve a radio altimeter's tolerance to transmissions in adjacent or nearby spectrum bands.*[28]

This does not acknowledge that quickly accomplishing aircraft alterations depends on many factors, including adequate specification of the replacement equipment and availability of updated equipment. The text should be updated to acknowledge that there may be limitations to the schedule for radio altimeter upgrades to avoid creating inaccurate expectations. For example, the text could be revised to read:

> *In addition, the FAA learned about the aircraft alterations that can be accomplished quickly (subject to supply chain limitations) to improve a radio altimeter's tolerance to transmissions in adjacent or nearby spectrum bands.*

4.8 Recommendation: Correct Measurement Units

The NPRM AD text states:

> *The PSD curve, as depicted in figure 1 to paragraph (g)(2) of this proposed AD, represents the height over the ground and received power from a 5G C-Band emitter, at or below which the radio altimeter is expected to function reliably, measured in decibels per megahertz.*[29]

[28] 88 FR 1521.
[29] 88 FR 1522.

The phrase “decibels per megahertz” is not the correct unit of measurement. It is recommended that the phrase be revised to “decibel-milliwatts (dbm) per megahertz”.

5 Conclusion

The Aviation Coalition respectfully offers these recommendations to the FAA for consideration in the final AD. We find significant deficiencies in the existing text to adequately provide equivalent levels of safety for airplane operations in the NAS given the rapid growth of 5G C-band emissions in the United States. The members of the Aviation Coalition stand ready to work with the FAA and other stakeholders to craft improved guidance that will preserve both safety and airport access while supporting national goals for the deployment of 5G.

Aviation Coalition collected comments
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Aviation Coalition Members

Aerospace Industries Association
Allied Pilots Association
Air Line Pilots Association
Aircraft Owners and Pilots Association
Airborne Public Safety Association
Airbus
Aircraft Electronics Association
Airlines For America
Aviation Spectrum Resources Inc.
The Boeing Company
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