Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	GN Docket No. 25-59
Upper C-band (3.98 to 4.2 GHz)	)	
	)	

COMMENTS OF AEROSPACE INDUSTRIES ASSOCIATION, AIR LINE PILOTS ASSOCIATION INTERNATIONAL, AIRBUS OPERATIONS SAS, AIRCRAFT ELECTRONICS ASSOCIATION, AIRCRAFT OWNERS AND PILOTS ASSOCIATION, AIRLINES FOR AMERICA, ALLIED PILOTS ASSOCIATION, AVIATION SPECTRUM RESOURCES INC., THE BOEING COMPANY, CARGO AIRLINE ASSOCIATION, EMBRAER, FREEFLIGHT SYSTEMS, GARMIN INTERNATIONAL, INC., GENERAL AVIATION MANUFACTURERS ASSOCIATION, HONEYWELL INTERNATIONAL INC., INTERNATIONAL AIR TRANSPORT ASSOCIATION, LOCKHEED MARTIN CORPORATION, NATIONAL AIR TRANSPORTATION ASSOCIATION, NATIONAL BUSINESS AVIATION ASSOCIATION, REGIONAL AIRLINE ASSOCIATION, RTX (COLLINS AEROSPACE, PRATT & WHITNEY, RAYTHEON), AND THALES GROUP

January 20, 2026

EXECUTIVE SUMMARY

The Joint Aviation Community acknowledges the critical importance of efficient spectrum usage to support evolving communication technologies while maintaining the highest levels of aviation safety and operational integrity. In response to the Federal Communications Commission's ("FCC") Notice of Proposed Rulemaking ("NPRM") regarding the reallocation of spectrum adjacent to the radio altimeter band, the Joint Aviation Community is committed to providing constructive input to ensure a balanced and informed decision-making process.

Radio altimeters are vital to aviation safety, providing accurate height above terrain measurements that support critical flight operations, particularly in adverse weather or challenging environments. Any changes to spectrum allocation in proximity to the radio altimeter band necessitate careful consideration of potential interference risks and the operational impacts on aviation systems.

The aviation industry is actively working to improve spectrum efficiency through technological advancements and enhanced standards, and the Joint Aviation Community seeks to equip the FCC with realistic and actionable options to address potential challenges. Key considerations include the required timelines and incentives to achieve the compatibility of 5G emissions with the Federal Aviation Administration ("FAA") NPRM's new Interference Tolerance Mask proposed requirements and associated parameters, ensuring continued safe and reliable operations under the identified worst-case interference conditions. Additionally, Out of Band Emissions from commercial wireless licensees should be formally bounded to reflect the realities of advanced antennas to ensure a predictable radio frequency environment.

To minimize disruption, the Joint Aviation Community emphasizes the importance of aligning timelines for any radio altimeter equipment redesign and retrofit/replacement with a "one-and-done" approach, ensuring that radio altimeter equipment and affected aircraft undergo a single, coordinated change process. Additionally, any financial incentives or compensation mechanisms should adequately reflect the costs and operational impacts borne by the aviation sector to implement these equipment changes.

Finally, the Joint Aviation Community underscores the necessity of close coordination between federal agencies and affected industries to leverage aviation-specific expertise. By addressing these considerations, the Joint Aviation Community aims to support the FCC in advancing national telecommunications goals while ensuring that spectrum-related decisions maintain aviation safety and operational capability.

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The Aerospace Industries Association, Air Line Pilots Association International, Airbus Operations SAS, Aircraft Electronics Association, Aircraft Owners and Pilots Association, Airlines for America, Allied Pilots Association, Aviation Spectrum Resources, Inc., The Boeing Company, Cargo Airline Association, Embraer, FreeFlight Systems, Garmin International, Inc., General Aviation Manufacturers Association, Honeywell International Inc., International Air Transport Association, Lockheed Martin Corporation, National Air Transportation Association, National Business Aviation Association, Regional Airline Association, RTX (Collins Aerospace, Pratt & Whitney, Raytheon), and Thales Group, (the "Joint Aviation Community")[1] hereby respectfully submit these comments on the Commission's Notice of Proposed Rulemaking ("Upper C-band NPRM") in the above-captioned proceeding.[2]

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1 A description of all signatories is included in Exhibit 1 at the end of this submission.
2 *Upper C-band (3.98 to 4.2 GHz)*, Notice of Proposed Rulemaking, GN Docket No. 25-59, FCC 25-78 (rel. Nov 21, 2025).

I. INTRODUCTION

The Joint Aviation Community is fully committed to preserving the highest levels of safety while also advancing the Commission's broader goals for greater spectrum efficiency across multiple frequency ranges and systems. As part of these efforts, there has been extensive focus on radio altimeter systems and the use of next-generation designs and solutions to support improved compatibility with potential domestic and international spectrum changes outside the 4.2-4.4 GHz band.[3]

However, the Joint Aviation Community's ability to provide comprehensive analysis has been constrained by the timing of the Federal Aviation Administration's ("FAA") Notice of Proposed Rulemaking ("NPRM")—issued 45 days after the Commission's Upper C-band NPRM and just two weeks before the close of the Commission's initial comment window.[4] This misalignment has created substantial analytical and resource burdens, particularly given the far-reaching scope and operational implications of the FAA's proposal. Despite this, the Joint Aviation Community continues to work diligently to meet the congressionally mandated timeline for the Commission under the One Big Beautiful Bill Act ("Pub. L. 119-21").[5]

The Joint Aviation Community stands ready to supply the Commission with additional material as it is developed in parallel with the FAA NPRM comment process. In the sections below we outline meaningful updates on ongoing efforts to improve radio altimeter resiliency and provide clear, actionable recommendations to help the Commission advance its spectrum objectives while safeguarding the safety and efficiency of the National Airspace System.

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[3] The radio altimeter is often known as the radar altimeter given it detects the ground directly beneath the aircraft either with frequency modulated continuous-wave or pulsed radar emissions.

[4] *See* FAA, Department of Transportation ("DOT"), Requirements for Interference-Tolerant Radio Altimeter Systems, 91 Fed. Reg. 459 (Jan. 7, 2026) ("FAA NPRM").

[5] Public Law 119–21, § 40002(b)(2), 139 Stat. 72 (Jul. 4, 2025). As enacted, the law does not specify a "short title" but was commonly known as the One Big Beautiful Bill Act while being debated.

II. BACKGROUND

A. The Aviation and Aerospace Industry

The aviation industry is a crucial enabler to the United States ("U.S.") economy, supported by aircraft and avionics manufacturers and by aircraft operators. The aerospace manufacturing sector is a cornerstone of American industrial leadership, encompassing the design, production, and maintenance of aircraft, engines, and related systems. In 2023, the most recent year for which data has been released, U.S. aerospace manufacturers directly employed over 545,000 workers, with average earnings nearly twice the national average, while supporting a total of 1.6 million jobs across the broader economy through supply chain and consumer spending effects.[6] The manufacturing activity produced $306.9 billion in aerospace products and contributed $545.2 billion in economic output.[7] The sector is also a powerful engine for U.S. trade: aerospace products generated an $82.8 billion trade surplus in 2024, making it one of only three manufacturing categories to achieve a positive trade balance and by far the largest surplus of any manufacturing sector.[8]

The U.S. economy runs on the safe and efficient movement of people and goods both domestically and worldwide. The U.S. passenger and cargo airlines are an essential element, collectively transporting approximately 2.7 million passengers and 61,000 tons of cargo on about 27,000 flights daily, while employing over 1 million people.[9] Foreign carriers annually fly 48%

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6 *See* Aerospace Industries Association ("AIA"), Contribution of the Aerospace Industry to the U.S. Economy in 2023 (Report by PwC US Tax LLP) (Jun. 2, 2025) ("AIA Report") at 3, https://www.aia-aerospace.org/publications/contribution-of-the-aerospace-industry-to-the-us-economy-in-2023/. *See also* Airlines for America ("A4A"), "Jobs Impact of Commercial Aviation" website: https://www.airlines.org/jobs/ (last visited Jan. 19, 2026).

7 AIA Report at 3.

8 *See* AIA Report at 11-15.

9 *See* A4A, "Economic Impact of Commercial Aviation" website: https://www.airlines.org/impact/ (last visited Jan. 19, 2026). *See also* A4A, "Jobs Impact of Commercial Aviation" website: https://www.airlines.org/jobs/ (last visited Jan. 19, 2026).

of the 312 million available seats into and out of the United States.[10] Overall, commercial aviation drives 5% of U.S. GDP—the equivalent of $1.45 trillion in 2024.[11]

In addition to the airline community, the general and business aviation segments of the industry are equally critical to the U.S. transportation system. In 2024, there were over 200,000 general aviation aircraft in the U.S. flying over 28 million flight hours annually.[12] This industry segment is also responsible for over $339 billion in total economic output, as well as 1.3 million American jobs.[13]

Complementing these segments, the helicopter industry constitutes a distinct and economically significant pillar of the U.S. aviation ecosystem. Helicopter operations support mission-critical sectors including emergency medical services, law enforcement, firefighting, offshore energy, utilities, construction, tours, and disaster response—activities that contribute greatly to the annual economic output attributable to the aviation industry. The U.S. helicopter fleet conducts millions of flight hours each year,[14] enabling time-sensitive services that directly protect life, property, and infrastructure, while providing indispensable access to rural, offshore, and congested urban environments. These operations deliver considerable economic and public-value returns relative to fleet size, reinforcing the helicopter sector's essential role in national productivity, resilience, and public safety.

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[10] As calculated for the purpose of these comments by the International Air Transport Association ("IATA") for January - November 2025, based on the IATA Direct Data Solutions global database that captures airline sales, market and itinerary data by aggregating data contributed by carriers, IATA's Billing and Settlement transactions and Airlines Reporting Corporation's Area Settlement Plan.

[11] *See* A4A, "Economic Impact of Commercial Aviation" website: https://www.airlines.org/impact/ (last visited Jan. 19, 2026).

[12] *See* FAA, DOT, Air Traffic by the Numbers (Jun. 2025) at 2, available at https://www.faa.gov/air_traffic/by_the_numbers/air-traffic-by-the-numbers-FY2024.pdf.

[13] *See* National Business Aviation Association, et al., "CLIMBING. FAST. Business Aviation is an Essential Industry" website: https://climbingfast.com/ (last visited Jan. 19, 2026).

[14] *See* FAA, DOT, *General Aviation and Part 135 Activity Survey* Table 1.3 for rotorcraft total flight hours from 2012 to 2023, available at https://www.faa.gov/sites/faa.gov/files/2023GASurveyCh1_508Compliant_04DEC2024V1_0.xlsx (last visited Jan. 19, 2026).

B. Importance of Radio Altimeters to Modern Aviation Safety

Radio altimeters play an essential role in ensuring the safety, reliability, and operational performance of both civil and defense aircraft.[15] These avionics provide precise, real-time height above terrain data that supports critical flight crew decisions, flight operations and feeds numerous safety-essential aircraft systems. Any degradation or failure of these altimeters can disrupt numerous automated functions, delay terrain avoidance alerts, and lead to potentially dangerous misinformed flight crew decisions which can significantly increase safety and operational risks, especially for aircraft when operating close to terrain. Because aircraft and pilots rely on accurate altimeter data in a dynamic meteorological environment, uncertainty in altimeter performance can force operators to delay, divert, or cancel flights to maintain safety.

All large commercial aircraft are fitted with at least two radio altimeters, while many general aviation helicopters and light twin-engine piston airplanes are equipped with at least one radio altimeter. In the business aviation community, larger and more advanced turbojet and turboprop aircraft are generally equipped with at least one radio altimeter. As estimated by the FAA currently, this totals over 40,000 aircraft that operate in the U.S. airspace with nearly 60,000 separate radio altimeter units across nearly 14,000 owners and operators.[16] The Upper C-band NPRM and FAA NPRM affect all of these units and their operators, with potentially more to be discovered in private ownership.

More detailed information on radio altimeters and their essential roles in modern aviation safety is included in Annex A (Radio Altimeter Usage in Modern Aviation).

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[15] Civil aircraft include those used for commercial air transport as well as business and general aviation purposes.

[16] *See* FAA NPRM at 478.

III. EXISTING GROUP 4 ALTIMETERS WILL NOT BE SUITABLE FOR INCREASED 5G SPECTRUM USAGE

The most recent widespread radio altimeter modification was the direct result of the 3.7-3.98 GHz ("Lower C-band") auction proceeding,[17] a critical element of which involved, for operators conducting flights within and to the U.S., an agreement between the FAA and the U.S. 5G wireless carriers.[18] This agreement eventually removed or greatly reduced the operational restrictions on aircraft that had been impacted by Airworthiness Directives ("ADs") issued as a result of the Lower C-band deployment.[19] As part of that process, existing commercial airline radio altimeters were fitted with filters to improve signal isolation in the 3.7-3.98 GHz band.[20] This aviation equipment retrofit was combined with the 5G carriers implementing several mitigations: The most significant in achieving compatibility were (1) a national elevation mask for 5G antennas, and (2) a reduction of their conducted spurious emissions in the 4.2-4.4 GHz band from -13 dBm/MHz to -48 dBm/MHz.[21] Additional operational mitigations related to power and antenna directionality for wireless carriers were also put in place near airports and other sensitive airspace to mitigate potential interference scenarios.

The aviation industry, through its radio altimeter manufacturers, submitted receiver performance data for existing radio altimeters ("Group 4 Altimeters") to the FAA in early 2025, and work is ongoing to respond to the Commission's request for data in the Upper C-band

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[17] *Expanding Flexible Use of the 3.7-4.2 GHz Band*, GN Docket No. 18-122, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343 (2020) ("2020 C-band R&O").

[18] Additional details can be found at FAA, DOT, "5G and Aviation Safety" website: https://www.faa.gov/5g (last visited Jan. 19, 2026).

[19] *See, e.g.,* FAA, DOT, Airworthiness Directives; Transport and Commuter Category Airplanes, 88 Fed. Reg. 34065 (May 26, 2023) and FAA, DOT, Airworthiness Directives; Various Helicopters, 88 Fed. Reg 40685 (Jun. 22, 2023).

[20] Some additional radio altimeters used by helicopters and privately owned aircraft were also modified given their usage.

[21] Voluntary mitigations are currently necessary to ensure coexistence between C-band operations and radio altimeters. *See* Letter from Henry G. Hultquist, Vice President-Federal Regulatory, AT&T Services, Inc., et al. to Marlene H. Dortch, Secretary, FCC, GN Docket 18-122 (filed Mar. 31, 2023) ("5G Voluntary Commitments") Appendix at 3.

NPRM.[22] The subsequent analysis by the FAA was detailed in the FAA NPRM, with the FAA stating that "[e]xisting [radio altimeter] systems are not compatible with this envisioned [commercial wireless] use [above 3.98 GHz], and [ADs] issued by FAA in 2023 are insufficient to address the unsafe condition that will result from wireless services in the Upper C-band."[23] The Joint Aviation Community emphasizes the conclusion of the FAA in the FAA NPRM that "[a]llocating even 20 MHz of additional spectrum [above 3.98 GHz] to rural or non-rural wireless services would be incompatible with the current Lower C-band tolerant [radio altimeters] and would require more than 45% of Lower C-band tolerant [radio altimeters] to be modified or replaced."[24] Furthermore, the Joint Aviation Community notes that any additional spectrum deployed beyond the 20 MHz assessed by the FAA will dramatically increase the number of existing radio altimeter units rendered incompatible.

IV. RECOMMENDATIONS FOR ADJACENT BAND COEXISTENCE

To ensure the successful use of new 5G spectrum by the wireless industry, along with the accelerated rollout of new radio altimeter designs, the Commission should work hand in hand with the FAA to devise a prudent and effective spectrum regulatory regime consistent with the spectrum performance standards specified in the FAA NPRM.[25] As part of this work, the Joint Aviation Community reiterates the core principles needed as explained in the joint aviation comments on the Commission's Notice of Inquiry ("Upper C-band NOI")[26] in this docket.[27]

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22 The manufacturers providing radio altimeter avionics in the U.S. includes Collins Aerospace, FreeFlight Systems, Garmin International, Honeywell, and Thales. These manufacturers produce radio altimeters for almost all aircraft flying in the U.S. across all major airframe types. *See* Letter from Andrew Roy, on behalf of Radio Altimeter Manufacturers, to Marlene H. Dortch, Secretary, FCC, GN Docket 25-59 (filed Dec. 17, 2025).

23 FAA NPRM at 461.

24 FAA NPRM at 466.

25 *See* FAA NPRM at 468-469.

26 *Upper C-band (3.98 to 4.2 GHz)*, Notice of Inquiry, GN Docket No. 25-59, 40 FCC Rcd 1807 (2025).

27 *See* Comments of Air Line Pilots Association International et al. ("Aviation Industry Representatives") on the *Upper C-band NOI* (filed Apr. 29, 2025).

A. Industry and Federal Agency Collaboration

The Commission should actively promote and support engagement among the affected industries, the Commission, and any other federal agencies that have jurisdiction over one or more of the affected industries or which utilize the spectrum that would be affected. Multiple member organizations of the Joint Aviation Community have already initiated collaborative technical and operational discussions with several industries over their respective intentions for the Upper C-band.[28]

B. Ensuring Safe Coexistence

All control and/or coordination mechanisms under FCC authority to regulate the commercial wireless licensees must be codified in the Commission's rules to ensure safe coexistence with aviation safety systems, especially any technical parameters or control measures needed to maintain aviation safety outside of the FAA's purview. For example, this requirement includes 5G antenna fundamental and Out of Band Emissions ("OOBE") in the Effective Isotropic Radiated Power ("EIRP") domain and any additional commercial wireless mitigations (as needed) for the protection of radio altimeters.[29] As the FAA will regulate the minimum performance requirements for radio altimeters and specify the aircraft operations in which radio altimeters must perform their critical functions, the Commission must adequately regulate the characteristics and operations of Upper C-band emitters so as to be compatible with radio altimeters subject to those minimum performance requirements.

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[28] *See* Letter from Dorothy B. Reimold, Vice President, Civil Aviation, AIA, Sharon Pinkerton, Senior Vice President, Legislative and Regulatory Policy, A4A, and Umair Javed, Senior Vice President & General Counsel, CTIA—The Wireless Association to Marlene H. Dortch, Secretary, FCC, GN Docket 25-59 (filed Oct. 2, 2025) ("Joint Industry Consensus Letter").

[29] The term OOBE is used as specified in the Upper C-band NPRM, and includes all unwanted 5G emissions that may enter the 4.2-4.4 GHz band from both the spurious and the out of band domains as applicable based on the operated commercial wireless emission bandwidths up to the edge of any proposed commercial licenses.

C. Timelines and Resource Considerations

Affected industries, such as the aviation industry, must be provided with realistic timelines and sufficient resources for any potential equipment changes. This includes recognizing that different industries operate on different timelines for equipment redesign and retrofitting/replacement.

V. NEW RADIO ALTIMETER DESIGNS WILL SUPPORT GREATER SPECTRUM USAGE

The aviation industry has been working diligently to address long-term improvements in spectrum compatibility for radio altimeters and other aviation systems, given the growing demand for greater spectrum efficiency by all spectrum users.[30] As RTCA has noted, a significant international standardization effort is underway to develop new generation radio altimeter designs that modernize functions while ensuring the best possible spectrum compatibility in a global spectrum environment.[31]

As part of this process, the aviation industry had initiated work to develop the necessary timelines and accelerate the implementation of the work of RTCA and EUROCAE well in advance of the natural lifecycle of airframes and avionics equipment, which spans multiple decades.[32] This lifecycle is generically described in Annex B (Aviation Equipment Process Overview), which details the necessary steps in the avionics refresh and replacement process and how the aviation industry would normally implement new radio altimeter designs.[33]

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30 For example, the aviation industry has begun developing its own spectrum guidance under RTCA and EUROCAE for new and revised aviation standards designs to give globally harmonized guidance to aviation system designers on spectrum issues. Such spectrum guidance for improved coexistence and efficiency is potentially the first among other industries at this time. See RTCA's *SC-242, Spectrum Compatibility* at https://www.rtca.org/sc-242/ and EUROCAE's WG-124, *RF Spectrum* at https://www.eurocae.net/working-group/wg-124/ (last visited Jan. 19, 2026).

31 *See* Comments of RTCA, Inc. on the Upper C-band NOI (filed Apr. 29, 2025).

32 Aircraft product lifecycles can extend to 30 years or more for certain airframes.

33 The FAA provides its view of the necessary lifecycle activities in the FAA NPRM at 470-471.

However, the spectrum environment and its regulation have continued to change, both nationally and globally, requiring additional efforts from the aviation industry. In July 2025, Pub. L. 119-21 was signed into law and specifically directed the Commission to auction not less than 100 MHz in the 3.98-4.2 GHz band by July 2027.[34] As a result of these changes and the timeline, the aviation industry is working in an unprecedented fashion to accelerate the implementation of next generation spectrum compatible radio altimeter designs, which would result in improved use of spectrum by all aircraft flying in the Contiguous United States.[35] Additionally, the aforementioned FAA NPRM specifies the needed radio altimeter performance, proposing additional requirements and guidance on new radio altimeters. Based on these recently published requirements and scope of applicability, the aviation industry is conducting a rapid assessment of a timeline that aligns with the urgency of the Commission's intent while maintaining aviation safety and operational capability as mandated by the FAA. The aviation industry is working to provide holistic inputs to both the FCC and FAA rulemaking proceedings, even though the comment cycles are misaligned. This means that the aviation industry expects to supplement this initial submission with additional information and further data as it is developed for the FAA proceeding.

VI. ENSURING 5G COMPATIBILITY WITH NEW RADIO ALTIMETER DESIGNS

The aviation industry has been assessing the potential impact of full-power commercial wireless in the Upper C-band since the Commission released its NOI in February 2025. With the

[34] Pub. L. 119-21, § 40002(b)(2).

[35] Next generation spectrum compatible radio altimeter designs are interference tolerant radio altimeter systems that comply with the ITM from 3-5.6 GHz as specified in the FAA NPRM at 468-469. This could either be a current generation radio altimeter system updated to meet the ITM while maintaining the functional performance of existing FAA Technical Standard Orders, or a completely new radio altimeter system designed to meet both the ITM and the functional performance requirements specified in the new RTCA/EUROCAE radio altimeter performance standard, which will be referenced by new FAA Technical Standard Orders for the transceiver and antenna.

recently published Interference Tolerance Mask ("ITM") for the new interference tolerant radio altimeter systems specified in the FAA NPRM,[36] the aviation industry is assessing compatibility based on known and expected performance from aviation and 5G services. This includes further discussions with the wireless telecommunications industry. While the implications are still under review and discussions are ongoing with the wireless telecommunications industry, several core requirements have already been identified. As detailed below, the Joint Aviation Community recommends these requirements be incorporated into any Report and Order ("R&O") issued by the Commission. Ongoing work is expected to result in further refinement and detail of the aviation industry's proposals in this proceeding.

A. Fundamental 5G Emissions up to 65 dBm/MHz without Mitigations Are Feasible

As previously noted to the Commission in the joint aviation and commercial wireless industry presentation in September 2025 and also in the recent FAA NPRM, the new radio altimeter design offers significant improvements to adjacent band interference signal rejection, even with a potential 300,000 watts of 5G power at a separation distance of 35 feet.[37] As such, the Joint Aviation Community expects that fundamental 5G emissions should require minimal mitigations, if any, for a large portion of the proposed 5G spectrum as previously discussed with the Commission jointly with the commercial wireless industry.[38]

B. Worst-Case Conditions for Compatibility Studies Are Needed to Ensure Safety

Assessing compatibility between advanced 5G systems and complex operational and regulatory requirements of aircraft necessitates the inclusion and resolution of multiple variables. The aviation industry has consistently applied a worst-case approach given the mandate to ensure

36 *See* FAA NPRM at 468-469.
37 *See* FAA NPRM at 468-469 and 473-475.
38 *See* emitter height limits in the presentation attached to the Joint Industry Consensus Letter.

continued operational safety under all conditions.[39] The general public and the FAA expect no less, and the Commission should align with these expectations.

The Joint Aviation Community notes that the FAA, the expert aviation safety regulator, recommends a 35 foot Minimum Separation Distance ("MSD") between adjacent band 5G transmitters and radio altimeters as the most suitable and safest approach when considering reliable radio altimeter performance.[40] The proposed MSD is appropriate because it preserves the operational integrity of the radio altimeter and its associated integrated safety systems across all nominal, off-nominal, and emergency flight phases with the exception of scenarios where proximity of an aircraft to a wireless base station or its supporting structure results in a collision hazard that poses a greater risk than interference.

C. 5G Out of Band Emissions in 4.2-4.4 GHz Band Should Be Limited by Maximum EIRP

Members of the Joint Aviation Community have been working to not only bound performance of current and next generation altimeters, but also address the variables of 5G active antenna system ("AAS") Out of Band Emissions ("OOBE") falling into the 4.2-4.4 GHz band. At the time of this filing, 5G AAS emissions and directivity performance outside the commercial wireless licensed band remains unvalidated. While discussions with 5G stakeholders continue, it has become clear to the Joint Aviation Community that the use of an EIRP limit in the 4.2-4.4 GHz band, for OOBE in the Commission's rules, rather than a conducted power limit, would be essential to protect adjacent band users.

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[39] *See, e.g.,* FAA NPRM at 474 describing its rationale for using a "6 dB safety margin above the expected interference environment to account for unknown issues that could impact the safe operation of the [radio altimeter]."

[40] *See* FAA NPRM at 473-474.

An EIRP limit would negate the need to document and standardize 5G antenna performance in the Commission's record or rules in the short time the Commission is required to auction part of the band, especially if further refinement or testing is required. Additionally, an EIRP limit in the 4.2-4.4 GHz band would allow for further AAS innovation and network design freedom for 5G operators by being able to take credit for system performance elsewhere and to balance, or make trades within, their own systems with a single output value rather than creating rigid individual criteria based on assumptions. Further, an OOBE EIRP limit would give the needed assurance to adjacent band incumbents that would reduce assumptions related to the operations and performance of systems they do not use, own, or control. The Joint Aviation Community notes an EIRP limit has already been implemented for certain bands adjacent to commercial wireless operations in several countries, including the U.S. and Japan.[41] Notably, the FAA NPRM also uses EIRP in its OOBE calculations given the unknown 5G antenna performance outside any potential 5G allocation.[42]

As previously noted, while the FAA will regulate the minimum performance requirements for radio altimeters and specify the aircraft operations in which radio altimeters must perform their critical functions, the Commission must adequately regulate the characteristics and operations of Upper C-band emitters to be compatible with radio altimeters. In the absence of an EIRP limit in the 4.2-4.4 GHz band, prospective licensees should be required to provide further substantive details, validation, and standardization across different equipment providers of the current and future 5G AAS being deployed. Such information would be required not only by the FCC to manage adjacent band interference potential, but by both the

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[41] For examples of EIRP regulations, *see* Letter from Dr. David Redman, on behalf of Aviation Industry Members, to Marlene H. Dortch, Secretary, FCC, GN Docket 25-59 (filed Nov. 14, 2025) at Attachment B, slides 7-8.

[42] *See* FAA NPRM at 473-474.

aviation industry and the FAA to fully bound and assess the potential OOBE interference implications and impacts to maintain an equivalent level of aviation safety and operations into perpetuity. Without such information, it would create an untenable solution with no way to accurately assess the potential for harmful interference.

VII. IMPLICATIONS FOR EXISTING 5G SPECTRUM USAGE IN THE C-BAND

In light of the changes to the Upper C-band, the Joint Aviation Community also recommends several actions for the existing Lower C-band rules governing commercial mobile wireless operations in the 3.7-3.98 GHz to ensure suitable coexistence.

A. Harmonize the OOBE Rules of Lower C-band with the Updated Rules for the Upper C-band

With the updated information within the FAA NPRM, the Joint Aviation Community expects a 4.2-4.4 GHz OOBE limit in the eventual Upper C-band R&O that is compatible with the required ITM and operational scenarios specified by the FAA. By this extension, the Joint Aviation Community urges that the Commission ensure that any final value for Upper C-band OOBE limits is also applied to the existing Lower C-band licensee rules, including the change to the EIRP value, as that ensures a harmonized radio frequency environment to adequately protect radio altimeters in the 4.2-4.4 GHz band from all emissions within the 3.7-4.2 GHz band.[43]

While an exact OOBE EIRP value is still being assessed, the Joint Aviation Community notes that there remains significant flexibility for the Commission to modify the existing -13 dBm/MHz conducted OOBE limits from the 2020 C-band R&O in light of subsequent developments.[44] Firstly, the OOBE limits in the 4.2-4.4 GHz band are currently set at a

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[43] The FAA NPRM is predicated on a harmonized radio frequency environment. FAA NPRM at 475 states, "In the end state, after the [radio altimeter] retrofit proposed by this rule is complete, the updated [radio altimeter] systems will operate safely, *assuming the final Lower and Upper C-band wireless transmissions into the [radio altimeter] band are harmonized*" (italics added).

[44] 47 C.F.R. § 27.53(l)(2).

voluntary -48 dBm/MHz conducted,[45] and therefore any potential changes to the existing Lower C-band installations would not require any base station equipment modifications as they already would meet the lower -48 dBm/MHz limits.[46] Furthermore, the existing and expected requirements to protect adjacent Fixed Satellite Service operators below 4.2 GHz will also require efforts to lower 5G OOBE. Indeed, lower OOBE limits are not just feasible, but have already been acknowledged and advocated for by 5G equipment manufacturers in their own comments on the Lower C-band proceeding.[47] Lastly, the requirements of the 2020 C-band R&O specified that the Commission would "apply section 27.53(i), which states that the FCC may, in its discretion, require greater attenuation than specified in the rules if an emission outside of the authorized bandwidth causes harmful interference."[48]

B. Existing Voluntary Mitigations Should Remain in Effect until Transition to New Altimeters Is Complete

To ensure continued safe operation of aircraft, the Joint Aviation Community aligns with the FAA's position to seek an extension of the current 5G Voluntary Commitments by the 3.7-3.98 GHz licensees until the necessary radio altimeter redesign and affected aircraft retrofits

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[45] 5G Voluntary Commitments, Appendix at 3.

[46] The Joint Aviation Community notes that the improved radio altimeter performance as specified in the FAA NPRM would not require any further lowering of this level and is almost certainly going to significantly increase above these levels if aligned with the FAA analysis. *See* FAA NPRM at 474-475.

[47] *See* 2020 C-band R&O para 345 discussion noting Nokia and Ericsson "support emission suppression to levels lower than what [the FCC] adopt[s]". Furthermore, other public filings in the Lower C-band docket showed that 5G base station characteristics exceed the 3GPP standard Category B limit of -30 dBm/MHz. *See* Letter of Mark Racek, Sr. Director Spectrum Policy, Ericsson to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Sep. 13, 2021) at 1-2; Letter of Jeffrey A. Marks, Vice President, Regulatory Affairs, North America, Nokia to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Sep. 21, 2021) at 1; Letter of Robert Kubik, Ph.D., Sr. Director, Public Policy, Samsung Electronics to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Sep. 20, 2021) at 1.

[48] 2020 C-band R&O para 350.

have been completed.[49] By that time, the new FAA performance specifications will be in place, superseding the previous voluntary mitigations.[50]

VIII. ESTIMATED COSTS AND TIMELINES

The Joint Aviation Community continues to work through the potential costs and timelines to achieve compatibility with the proposed Upper C-band 5G services and the deployed Lower C-band 5G services considering the recently released FAA NPRM. The Joint Aviation Community emphasizes to the Commission that under the scope of the FAA NPRM for improved radio altimeter performance, every single aircraft operating with a radio altimeter within the Contiguous United States will need to be modified to meet the new FAA performance requirements, remove the radio altimeter system altogether, or be retired from operations in the Contiguous United States.[51] This is an extensive overhaul of most aircraft inside and visiting the U.S., and requires further planning for both timelines and cost than can be completed in the two weeks between publication of the FAA NPRM and this submission. However, the content in the FAA NPRM, and the associated Advisory Circular ("AC"),[52] provides the needed information to build this analysis, and the Joint Aviation Community anticipates that proposed timelines for radio altimeter redesign and retrofit/replacement will be available in future submissions to both the Commission and the FAA.

Estimated costs for updated radio altimeters are in development. These costs include procurement of retrofit/replacement radio altimeter equipment, transportation costs, installation

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49 FAA NPRM at 475 stating, "FAA intends to seek an extension of the terms of the voluntary commitment until the initial [radio altimeter] performance deadline."

50 Following the initial radio altimeter performance deadline, the FAA NPRM would require all commercial transport aircraft to have compliant radio altimeters, and any non-compliant aircraft would have operational restrictions imposed via new airworthiness directives to maintain safety.

51 *See* FAA NPRM at 472-473.

52 *See* FAA, Advisory Circular 20-199, Installation of an Airborne Low-Range Radio Altimeter System, open for public comment until Feb. 9, 2026, available at https://www.faa.gov/aircraft/draft_docs/achttps://www.faa.gov/aircraft/draft_docs/ac_20_199.

labor costs, and lost revenue for out-of-service aircraft during equipment redesign and retrofit/replacement. All of these costs are significantly impacted by the implementation timeline, and estimates will be made after the aviation industry timeline is available in the very near future.

IX. CONCLUSION

The aviation industry is taking decisive action to rapidly accelerate equipment development efforts in direct support of the Commission's statutory obligations and public-interest objectives. Retrofitting or replacing every radio altimeter system operating within the Contiguous United States is a complex, industry-wide endeavor—one that can only be achieved with the coordination of all affected federal agencies and support and collaboration off affected industry stakeholders.

As analysis of the recently issued FAA NPRM and accompanying guidance material continues to mature, the Joint Aviation Community plans to submit additional information to meaningfully strengthen the Commission's record. The Joint Aviation Community strongly urges the Commission to fully consider this evolving evidence as it evaluates the most effective pathway toward ensuring aviation safety and sustainable coexistence among all spectrum users.

The Joint Aviation Community remains committed to coordination and continued substantive collaboration to support the Commission's decision-making and uphold the highest standards of aviation safety.

Respectfully submitted,

AEROSPACE INDUSTRIES ASSOCIATION

By: /s/ Remy Nathan
Remy Nathan
Senior Vice President, Policy
1000 Wilson Blvd., Suite 1700
Arlington, VA 22209
(703) 358-1000
remy.nathan@aia-aerospace.org

AIR LINE PILOTS ASSOCIATION, INTERNATIONAL

By: /s/ Captain Steve Jangelis
Captain Steve Jangelis
Aviation Safety Chair
Air Safety Organization
7950 Jones Branch Drive
McLean VA, 22102
(800) 424-2470
eas@alpa.org

AIRBUS OPERATIONS SAS

By: /s/ Laurent Azoulai
Laurent Azoulai
Senior Expert Communication, Navigation, Surveillance
316 Route de Bayonne
31060 Toulouse CEDEX 9
France
+33 (0)6 83 57 62 87
laurent.azoulai@airbus.com

AIRCRAFT ELECTRONICS ASSOCIATION

By: /s/ Ric Peri
Ric Peri
Vice President, Government and Industry Affairs
3570 NE Ralph Powell Road
Lee's Summit, MO 64064
(816) 347-8400
ricp@aea.net

AIRLINES FOR AMERICA

By: /s/ Justin W. Madden
Justin W. Madden
Vice President, Operations & Safety
1275 Pennsylvania Ave. NW
Washington D.C. 20004
(202) 626-4099
jmadden@airlines.org

AIRCRAFT OWNERS AND PILOTS ASSOCIATION

By: /s/ Jim Coon
Jim Coon
Senior Vice President, Government Affairs and Advocacy
601 Pennsylvania Avenue NW, North Building, Suite 250
Washington, DC 20004
(202) 905-0975
jim.coon@aopa.org

ALLIED PILOTS ASSOCIATION

By: /s/ First Officer Nick Silva
First Officer Nick Silva
President
14600 Trinity Boulevard, Suite 500
Fort Worth, Texas 76155
(817) 302-2272
nsilva@alliedpilots.org

AVIATION SPECTRUM RESOURCES INC.

By: /s/ Andrew Roy
Andrew Roy
Director of Engineering
180 Admiral Cochrane Dr, Suite 300
Annapolis, MD 21401
(410) 266-6030
acr@asri.aero

THE BOEING COMPANY

By: /s/ Thomas M. Culligan
Thomas M. Culligan
Vice President, Aerospace Safety, Commercial Aviation & Corporate Policy
Government Operations
929 Long Bridge Drive
Arlington, VA 22202
(703) 465-3500
thomas.culligan@boeing.com

CARGO AIRLINE ASSOCIATION

By: /s/ Jennifer Thibodeau
Jennifer Thibodeau
Managing Director, Safety and Regulatory Policy
853 New Jersey Ave SE
Washington, DC 20003
(202) 293-1032
jthibodeau@cargoair.org

EMBRAER

By: /s/ Roberto Dias Pereira
Roberto Dias Pereira
Senior Avionics Engineer
Av. Brig. Faria Lima, 2170
São José dos Campos, SP
CEP 12227-901
Brazil
+55 12 99790 7806
roberto.pereira@embraer.com.br

FREEFLIGHT SYSTEMS

By: /s/ Behlul J. Poonawalla
Behlul J. Poonawalla
Vice President, Products & Services | Programs | Contracts
1333 Corporate Dr, Suite 300
Irving, TX, 75038
(214) 725 1829
bpoonawalla@freeflightsystems.com

GARMIN INTERNATIONAL, INC.

By: /s/ Edward Straub
Edward Straub
Staff Design Engineer for Aviation Technology and Certification
1200 E. 151st Street
Olathe, KS 66062
(913) 397-8200
eddie.straub@garmin.com

GENERAL AVIATION MANUFACTURERS ASSOCIATION

By: /s/ Jens C. Hennig
Jens C. Hennig
Vice President, Operations, Safety & Security
1400 K Street NW, Suite 801
Washington, DC 20005
(202) 637-1378
jhennig@gama.aero

HONEYWELL AEROSPACE TECHNOLOGIES

By: /s/ Robert Anchondo
Robert Anchondo
Vice President of Engineering, Electronic Solutions
21111 N. 19th Avenue
Phoenix, AZ 85027
(602) 436-2311
robert.m.anchondo@honeywell.com

INTERNATIONAL AIR TRANSPORT ASSOCIATION

By: /s/ Douglas E. Lavin
Douglas E. Lavin
Vice President, Member and External Relations, North America
900 19th Street NW, Suite 600
Washington, DC 20006
(202) 628-9292
lavind@iata.org

LOCKHEED MARTIN CORPORATION

By: /s/ Ryan Neels Terry
Ryan N. Terry
Director, Regulatory Strategy, Licensing & Policy
2121 Crystal Drive, Suite 100
Arlington, VA 22202
(703) 413-5747
ryan.n.terry@lmco.com

NATIONAL AIR TRANSPORTATION ASSOCIATION

By: /s/ Curt Castagna
Curt Castagna
President and CEO
1401 I Street NW, Suite 330
Washington, DC 20005
(562) 824-8554
ccastagna@nata.aero

NATIONAL BUSINESS AVIATION ASSOCIATION

By: /s/ Heidi Williams
Heidi Williams
Vice President, Air Traffic Services & Infrastructure
1200 G Street, Suite 1100
Washington, DC 20005
(202) 783-9255
hwilliams@nbaa.org

REGIONAL AIRLINE ASSOCIATION

By: /s/ Erik Strickland
Erik Strickland
Vice President, Safety, Operations, & Regulatory Affairs
50 F Street, NW, Suite 1200
Washington, DC 20001
(202) 367-1212
strickland@raa.org

RTX (COLLINS AEROSPACE, PRATT & WHITNEY, RAYTHEON) CORPORATION

By: /s/ Sai K. Kalyanaraman
Dr. Sai K. Kalyanaraman
Principal Technical Fellow
400 Collins Rd, N.E., MS 124-200
Cedar Rapids, IA 52498
(781) 962-7705
sai.kalyanaraman@collins.com

THALES GROUP

By: /s/ Sergio von Borries
Sergio von Borries
Vice President
2733 Crystal Dr, Suite 1200
Arlington, VA 22202
(206) 359-2280
sergio.vonborries@thalesgroup.com

ANNEX A – RADIO ALTIMETER USAGE IN MODERN AVIATION

Radio altimeters provide precise, real-time measurements of an aircraft's height Above Ground Level ("AGL"), enabling accurate situational awareness during critical flight phases such as low altitude operations, precision instrument approaches, and landings. Radio altimeters also supply indispensable data inputs to a broad range of aircraft systems, including those providing alerts to pilots for terrain, traffic, and windshear hazards, automatic flight control modes, autoland functions, and altitude callout systems. Radio altimeters produce absolute altitude data independent of barometric pressure or external navigation facilities, ensuring dependable performance in degraded visual environments such as fog, low illumination, and adverse weather conditions. Their high accuracy and continuous reliability support precision operations in civil, military, rotorcraft, and unmanned platforms alike.

Failure, degradation, or interruption of radio altimeter performance can have significant and immediate safety consequences due to the number of aircraft systems that rely on accurate altitude above terrain data. Inaccurate or unavailable data can lead to improper functioning or automatic deactivation of safety critical systems, including ground proximity warnings, automated landing operations, and low visibility autoland capability. During low altitude operations where pilot reaction margins are inherently compressed, erroneous radio altimeter inputs can delay terrain avoidance alerts, compromise automated flight control logic, and increase the risk of controlled flight into terrain. Defense aircraft, rotorcraft, and unmanned systems that routinely operate close to terrain or obstacles face heightened mission risk when radio altimeter integrity is compromised. These operational dependencies highlight the radio altimeter's vital role in maintaining aviation safety, supporting mission effectiveness, and ensuring reliable integration with modern avionics architectures.

Because radio altimeters are specifically relied upon during adverse and rapidly changing weather conditions, any uncertainty surrounding their performance creates a substantial operational risk for air carriers and other operators. Radio altimeters contribute to safe flight operations in low visibility environments such as fog, precipitation, and low illumination, where pilots cannot depend on visual cues and must rely on accurate, real-time altitude above terrain data. If operators cannot be confident that radio altimeters will function correctly at the precise moment they are needed, particularly during approach and landing phases, they may be forced to delay or discontinue arrival operations or cancel flights rather than risk degraded performance of safety critical systems that depend on radio altimeter inputs. This operational liability would arise not because radio altimeters are used continuously, but because weather conditions evolve quickly, and pilots cannot predict when low visibility conditions will emerge during a flight. As a result, any uncertainty about radio altimeter reliability directly undermines the ability of operators to plan and execute flights safely in dynamic meteorological environments. Additional and more specific information is detailed in the recent FAA NPRM.[53]

[53] *See* FAA NPRM at 465-466.

ANNEX B – AVIATION EQUIPMENT PROCESS OVERVIEW

AVIONICS EQUIPMENT STANDARDS DEVELOPMENT

Minimum Operational Performance Standards ("MOPS") are the primary document produced during aviation standards development. RTCA and EUROCAE are the lead organizations that develop the MOPS documents to support National Aviation Authority ("NAA") certification by regulators such as the FAA or European Air Safety Agency ("EASA"). Because a MOPS forms the basis for aviation safety equipment certification, it is subject to rigorous validation efforts to bound all variables from each involved manufacturer. This validation process regularly ends with needed revisions to the draft standard to adjust and correct the requirements in the MOPS, which then takes additional time to implement and finalize the MOPS. Giving the development standards process time to appropriately mature is essential, as any oversights could lead to improperly manufactured equipment, which would then require the MOPS to be re-opened and revised, further delaying eventual equipment production.

AVIATION REGULATOR CERTIFICATION

After completion of the MOPS, the NAA's airworthiness regulator for the equipment maker must develop and issue a Technical Standard Order ("TSO") that provides a full set of equipment requirements to be met by manufacturers. An avionics manufacturer must then build a specific equipment model accompanied by adequate design and verification data to the completed TSO. Required data specified in the TSO must be submitted to the airworthiness regulator and accepted to obtain the TSO Authorization, which is both design approval and production approval for the applicant's specific product design. Lastly, for installation into new-airplane production, an aircraft manufacturer must obtain a modified Type Certificate ("TC") following the equipment's TSO authorization, or for retrofits, the TSO equipment manufacturer or operator must obtain a Supplemental Type Certificate ("STC") from the airworthiness regulator to install or retrofit the new avionics on each aircraft model upon which the equipment will be installed. These TC and STC aircraft approvals are separate from any TSO Authorization and must be done individually for each aircraft type. An aircraft TC or STC certification process can take between 18-36 months depending on the scale and scope of the avionics system integration.

AIRCRAFT OPERATOR IMPLEMENTATION

Only after all of the above standards setting and equipment and aircraft certification processes have been completed may an aircraft operator (airline) or aircraft manufacturer begin procuring and installing the new avionics on their aircraft and seeking operation approvals for their use. A full fleet retrofit under a natural lifecycle process can take up to 30 years, depending on the airframes and equipment under consideration.

The process and its specifics are represented in the below chart.

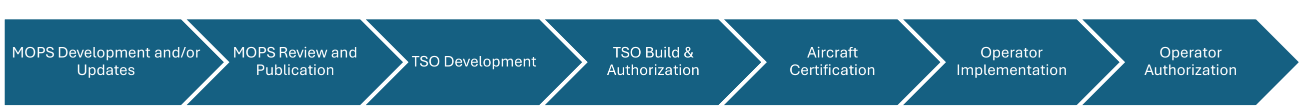

EXHIBIT 1

DESCRIPTIONS OF THE JOINT AVIATION COMMUNITY COMMENTATORS

Aerospace Industries Association ("AIA") represents hundreds of aerospace and defense companies, from America's leading manufacturers and developers of commercial aircraft, engines, avionics, and air traffic control systems to family-owned businesses across the supply chain.

Air Line Pilots Association, International ("ALPA") represents and advocates for more than 80,000 pilots at 42 U.S. and Canadian airlines, making it the world's largest airline pilot union. ALPA provides three critical services to its members: airline safety, security, and pilot assistance; representation; and advocacy.

Airbus is a global pioneer in the aerospace industry, operating in commercial aircraft, helicopters, defence and space sectors. The Company is a leader in designing, manufacturing and delivering aerospace products, services and solutions to customers on a worldwide scale.

Aircraft Electronics Association ("AEA") represents over 1,300 member companies in more than 40 countries specializing in the manufacturing, maintenance, repair and installation of aircraft electronics systems in general aviation aircraft.

The Aircraft Owners and Pilots Association ("AOPA") is a not-for-profit individual membership organization of General Aviation Pilots and Aircraft Owners. AOPA's mission is to effectively serve the interests of its members and establish, maintain and articulate positions of leadership to promote the economy, safety, utility, and popularity of flight in General Aviation aircraft. Representing two-thirds of all pilots in the United States, AOPA is the largest civil aviation organization in the world.

Airlines for America ("A4A") is the trade association for the leading U.S. airlines, both passenger and cargo carriers, prioritizing safety and security during this time of record passenger volumes and increased reliance on air cargo shipments. Every day, U.S. airlines operate 27,000 flights carrying 2.7 million travelers and 61,000 tons of cargo while supporting 10 million U.S. jobs and 5 percent of GDP.

Headquartered in Fort Worth, Texas, near Dallas/Fort Worth International Airport, the Allied Pilots Association ("APA") serves as the certified collective bargaining agent for the 16,000 professional pilots who fly for American Airlines. Founded in 1963, APA is the largest independent pilots' union in the world. APA provides a broad range of representation services for its members and devotes a significant portion of its members' dues to advancing the cause of aviation safety.

Aviation Spectrum Resources, Inc ("ASRI") is the communications company of the U.S. air transport industry and is owned by many of the major U.S. airlines and other airspace users. ASRI draws upon expertise and opinions from across the U.S. aviation sector to act in the interests of safe and efficient operation of commercial aviation radio communications systems in the radio frequency spectrum.

The Boeing Company is a leading global aerospace company and top U.S. exporter, Boeing develops, manufactures and services commercial airplanes, defense products and space systems for customers in more than 150 countries. With corporate offices near Washington, D.C., Boeing employs more than 170,000 people across the United States and in more than 65 countries.

The Cargo Airline Association ("CAA") represents the major U.S. all-cargo and express airlines to promote the safety, security, and economic growth of the air cargo market. Our carriers collectively operate in over 220 countries and territories, employing over 500,000 people and accounting for 35% of global trade value, using aircraft of various types and sizes depending on the route, airport, and cargo being transported.

Embraer is one of the world's aerospace industry leaders, operating in the Commercial Aviation, Executive Jets, Defense & Security, and Services & Support segments. With over 55 years of aeronautical expertise and a culture of excellence focused on safety, quality, and sustainability.

FreeFlight Systems is a leader in NEXGEN aviation systems that designs and manufactures high-performance avionics with a deep-rooted history specifically in Radar Altimeter technology that enhances flight safety. Our solutions deliver substantial safety and unmatched reliability, which are critical for modern flight operations. Founded in 2001 and based in Texas, we pioneered the first certified aviation WAAS/GPS receiver and the first UAT Link 2 compliant ADS-B transmitter system. Today, FreeFlight Systems is a global aerospace leader, specializing in state-of-the-art radio altimeters, surveillance applications and navigation retrofit and line-fit solutions, along with other NextGen aerospace avionics.

Garmin International, Inc., together with its worldwide affiliates, is a leading, worldwide manufacturer of radio altimeters and other products that are enabled by radio altimeters for the aviation industry. These products serve their customers and support aviation operations in general aviation, business aviation, and other aviation sectors throughout the world.

The General Aviation Manufacturers Association ("GAMA") represents over 150 of the world's leading manufacturers of business and general aviation airplanes, rotorcraft, engines, avionics, components and companies in the emerging sector of innovative/advanced air mobility. GAMA's members also operate repair stations, fixed based operations, pilot and maintenance training facilities and manage fleets of aircraft.

Honeywell International Inc. is a multinational industrial company with over 100,000 employees around the world. Honeywell Aerospace Technologies, the aerospace and defense business of Honeywell International Inc., is an industry-leading supplier of aircraft components including avionics, sensors, mechanical systems, power systems, turbine engines, and more. Honeywell develops future-shaping technology that enables reliable, effective, efficient, and safe operations for our customers. Honeywell's avionics offerings include Radio Altimeters for civil air transport, business aviation, general aviation, and military airplanes and helicopters.

The International Air Transport Association ("IATA") is the trade association of the world's airlines, representing some 360 airlines, more than 100 of which serve the U.S. market. IATA works with its U.S. and foreign airline members to promote safe, reliable, and secure air travel.

Lockheed Martin Corporation is a manufacturer and integrator of military, civil, and commercial fixed-wing aircraft and rotorcraft for both domestic and foreign operators.

The National Air Transportation Association ("NATA") represents nearly 3,700 aviation business locations across a broad cross-section of the aviation industry, including on-demand air charter carriers and fractional ownership companies, maintenance providers, fixed-base operators, flight training providers, general aviation airports, and other key industry stakeholders. For more information, please visit NATA's website at https://nata.aero/.

The National Business Aviation Association ("NBAA") is the leading organization representing companies that rely on general aviation aircraft to help make their businesses more efficient, productive, and successful. The association represents more than 11,000 member companies and professionals operating in the National Airspace System.

Regional Airline Association ("RAA") provides a unified voice of advocacy for North American regional airlines aimed at promoting a safe, reliable, and strong regional airline industry. Regional airlines are critically important to our country's economic health and provide the lone source of scheduled passenger air service for about two-thirds of the country's airports. Regional airlines carried more than 121 million passengers last year, providing most of the connections to our nation's non-hub and small-hub airports. RAA members use specialized, small equipment to serve communities that have too few passengers to support air service with larger aircraft, but where air service is critical to economic vitality and quality of life.

RTX is the world's largest aerospace and defense company. With more than 185,000 global employees, we push the limits of technology and science to redefine how we connect and protect our world. Through industry-leading businesses – Collins Aerospace, Pratt & Whitney and Raytheon – we are advancing aviation, engineering integrated defense systems for operational success, and developing next-generation technology solutions and manufacturing to help global customers address their most critical challenges. The company, with 2024 sales of more than $80 billion, is headquartered in Arlington, Virginia.

Thales Group is a global technology leader with more than 83,000 employees on five continents. In the markets of Defence, aerospace and space, cyber and digital, Thales provides solutions, services and products to help its customers – companies, organizations and governments – to carry out their critical missions. Thales multiple avionics solutions include Radio Altimeters for aviation.