Committee on Transportation and Infrastructure
U.S. House of Representatives
Washington DC 20515

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February 1, 2022

SUMMARY OF SUBJECT MATTER

TO: Members, Subcommittee on Aviation
FROM: Staff, Subcommittee on Aviation
RE: Subcommittee Hearing on "Finding the Right Frequency: 5G Deployment and Aviation Safety"

PURPOSE

The Subcommittee on Aviation will meet on Thursday, February 3, 2022, at 11 a.m. EST in 2167 Rayburn House Office Building and virtually via Zoom for a hearing titled, "Finding the Right Frequency: 5G Deployment and Aviation Safety." The hearing will examine how the C-band spectrum was reallocated for 5G wireless services, the aviation industry's safety concerns with the recent 5G deployment, and the effects of the recent deployment on the U.S. aviation industry and national airspace system (NAS). The Subcommittee will hear testimony from two panels. The first panel will feature the government witness from the Federal Aviation Administration (FAA). The second panel will include witnesses from: Aerospace Industries Association (AIA), Airlines for America (A4A), Air Line Pilots Association (ALPA), American Association of Airport Executives (AAAE), CTIA, Helicopter Association International (HAI), Regional Airline Association (RAA), and a telecommunications consultant.

BACKGROUND

I. FCC Auction of C-band for 5G

On November 18, 2019, Federal Communications Commission (FCC) Chair Ajit Pai informed Congress of the FCC's intention to hold a public auction of mid-band wireless spectrum from 3.7–3.98 GHz, also known as the C-band, to fuel the deployment of 5G.[1] At the time, many aviation stakeholders expressed concerns about potentially harmful radio frequency interference

[1] Marguerite Reardon, "FCC to auction C-band spectrum for 5G", CNET (November 18, 2019), *available at* https://www.cnet.com/tech/mobile/fcc-to-auction-c-band-spectrum-for-5g/.

with certain aviation safety equipment, including radio altimeters,[2] which operate in the adjacent 4.2–4.4 GHz band (aviation band).[3]

In response to the FCC's announcement, the FAA sent a letter on September 30, 2019, to the Interdepartment Radio Advisory Committee (IRAC), which is responsible for advising the National Telecommunications and Information Administration (NTIA) on spectrum decisions within the federal government, expressing reservations about the auction of the spectrum adjacent to the aviation band. In this letter, the FAA also notified the IRAC of testing that was being conducted by the Aerospace Vehicle Systems Institute on the resilience of a variety of altimeters against 5G interference.[4] Additionally, on December 1, 2020, the General Counsel (and future Acting Secretary) of the Department of Transportation (DOT), Steven Bradbury, and FAA Administrator Steve Dickson sent a letter to the NTIA urging the agency to delay the FCC's upcoming auction due to concerns over the impact it could have on aviation safety.[5] However, the NTIA did not enter the letter into the FCC docket for consideration.[6]

Following the FAA and DOT letters, the House Committee on Transportation and Infrastructure Chair Peter DeFazio sent a letter to FCC Chair Pai urging the FCC to postpone its scheduled C-band auction due to other federal agencies' concerns surrounding the potential harmful 5G interference with radio altimeters.[7] Nonetheless, on December 8, 2020, the FCC began its public auction of the C-band, which yielded 21 winning bids and $81 billion in revenue.[8]

II. Radio Altimeters

Radio altimeters are fundamental flight instruments found on most commercial aircraft and many general aviation aircraft that enhance safety and flight operations by providing measurements of an aircraft's clearance height above the ground terrain and any obstacles.[9] On approach during flight within 2,500 feet of the ground terrain, the radio altimeter serves as a pilot's primary altitude-

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[2] Radio altimeters are also known as radar altimeters or RADALT.

[3] Letter of Edward Yorkgitus, Aviation Spectrum Resources to Marlene H. Dortch, Secretary, Federal Communications Commission, GN Docket No. 12-122 (filed Oct. 25, 2019) *available at:* https://ecfsapi.fcc.gov/file/10620182163379/19062019%20Aviation%20Associations%20Joint%20Ex%20Parte%20Filing%20Dkt%20No%2018-122.pdf.

[4] Letter of Michael Richmond, FAA Interdepartment Radio Advisory Committee Representative to Peter Tenhula, Chairman, Interdepartment Radio Advisory Committee (filed Sept. 30, 2019).

[5] Secretary Steven Bradbury and Administrator Steve Dickson, *Expanding Flexible Use of the 3.7 to 4.2 GHz Band,* FAA & DOT (December 1, 2020), *available at:* https://www.faa.gov/sites/faa.gov/files/2021-10/DOT_Letter_to_NTIA_FCC3.7_GHz_Band_Auction.pdf.

[6] Fed Aviation Admin., FAA Statements on 5G (Jan. 2, 2022), *available at:* https://www.faa.gov/newsroom/faa-statements-5g.

[7] House Transportation and Infrastructure Committee, *Chair DeFazio Calls on FCC to Postpone Tomorrow's Scheduled Auction of a Portion of 3.7-4.2 GHz Radio Frequency Spectrum, Citing New Research That Amplifies the Safety Concerns of the Aviation Community* (December 07, 2020), *available at:* https://transportation.house.gov/news/press-releases/chair-defazio-calls-on-fcc-to-postpone-tomorrows-scheduled-auction-of-a-portion-of-37-42-ghz-radio-frequency-spectrum-citing-new-research-that-amplifies-the-safety-concerns-of-the-aviation-community.

[8] *See* FCC Public Notice, *Auction of Flexible-Use Service Licenses in the 3.7-3.98 GHz Band for Next-Generation Wireless Services*, AU Docket No. 20-25 (Aug. 7, 2020), *available* at https://docs.fcc.gov/public/attachments/FCC-20-110A1.pdf; FCC Announces Winning Bidders in C-band Auction, FCC (February 24, 2021), available at: https://www.fcc.gov/document/fcc-announces-winning-bidders-c-band-auction.

[9] RTCA Inc., *Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations* (October 7, 2020), *available at:* https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf.

measuring instrument and is used for all-weather approaches and landing procedures; radio altimeter(s) enable a pilot to verify descent progress and distance to the ground on an approach, detecting unsafe situations.[10] Use of a radio altimeter is critical in enabling safe arrivals, particularly during inclement weather, low cloud layers, or other instances of low visibility.

According to the FAA, the "receiver on the radio altimeter is typically highly accurate, however it may deliver erroneous results in the presence of out-of-band radiofrequency emissions from other frequency bands."[11] Such interference from adjacent bands, or out-of-band radio frequency emissions, could pose a hazard to aircraft in flight by causing faulty or erroneous radio altimeter readings.[12] Erroneous altimeter readings are a cause for concern at all phases of flight, particularly in automated flight deck systems that rely on accurate altimeter readings for a variety of systems and functions. For example, in 2009 a Turkish Airlines aircraft landing at Amsterdam-Schiphol Airport experienced a faulty radio altimeter reading that was fed into the automated flight deck system while on approach, contributing to the aircraft's fatal crash and resulting in nine deaths.[13]

Radio altimeters also provide height-above-terrain information, which can serve as a critical component for other systems on an aircraft, such as the Terrain Awareness and Warning System (TAWS).[14] Terrain warning is required in the U.S. for all air carrier operations due to numerous fatal Controlled Flight Into Terrain (CFIT) accidents,[15] and has been the subject of several National Transportation Safety Board recommendations.[16] Fortunately, there has not been a single passenger fatality due to a CFIT accident on an U.S. Part 121 aircraft equipped with TAWS since the system deployed in the late 1990s.[17] Prior to this time, CFIT accidents were the leading cause of fatalities in commercial aviation.[18]

In the fall of 2020, the Radio Technical Commission for Aeronautics (RTCA), a non-profit organization, completed a six-month study of radio frequency interference from 5G network emissions with radio altimeter performance.[19] The RTCA study stated that, without appropriate mitigations and guardrails, deployment of 5G wireless services in the C-band could cause

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[10] Jim Sparks, *Radio Altitude: The Instrument of Choice*, AviationPros (July 2003), *available at*: https://www.aviationpros.com/home/article/10387134/radio-altitude-the-instrument-of-choice.
[11] Fed. Aviation Admin., Safety Alert for Operators, Subject: Risk of Potential Adverse Effects on Radio Altimeters when Operating in the Presence of 5G C-Band Interference (Dec. 23, 2021), *available at:* https://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/media/2021/SAFO21007.pdf.
[12] Fed Aviation Admin., 5G and Aviation Safety (Jan. 2, 2022), *available at:* https://www.faa.gov/5g.
[13] Frances Fiorino, *Boeing Warns of Possible 737 Altimeter Fault,* Aviation Week (March 2009), *available at:* https://web.archive.org/web/20120322020140/http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=comm&id=news/ALT030509.xml&headline=Boeing%20Warns%20of%20Possible%20737%20Altimeter%20Fault.
[14] Hop Potter, *Implementation of Terrain Awareness and Warning System (TAWS) - Final Report to CAST*, Skybrary (May 2006), *available at:* https://www.skybrary.aero/index.php/SE001:_Terrain_Awareness_Warning_System_(TAWS)_-_Final_Report and subsequent analysis of aircraft accident databases since 2006.
[15] 14 CFR 121.354 (2022).
[16] Hop Potter, *supra* note 14.
[17] *Id.*
[18] *Id.*
[19] RTCA, Assessment of C-band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Operations, (October 7, 2020), *available at:* https://www.rtca.org/wp-content/uploads/2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf.

"catastrophic failures leading to multiple fatalities."[20] The RTCA study also concluded that the aviation industry cannot mitigate such a risk alone and suggested the FCC, FAA, and aviation and telecommunications (telecom) industries work together to ensure radio altimeters are safeguarded in the interest of public safety.[21] While the FCC offered the aviation sector a 220 MHz guardrail (3.98–4.2 GHz) between bands to help prevent harmful interference, many aviation stakeholders maintained that this mitigation measure alone was not enough.[22]

Since May 2021, the Department of Defense has been leading an interagency effort to test the potential effects of certain 5G technologies on radio altimeters, primarily on military aircraft, focusing on improving the performance of equipment to protect against harmful interference.[23] There have also been calls for developing performance standards for radio altimeters to ensure all altimeters are designed to filter out interference and are better performing given that no standards for radio altimeters currently exist. Although the RTCA is working on revising the minimum operational standards for altimeters, aviation stakeholders anticipate that the process of setting those standards and receiving approval from the FAA will take several years, after which more time will then need to be allotted for manufacturers to begin producing and installing these new altimeters.[24]

III. 5G Deployment and the FAA's Response

A. Special Airworthiness Information Bulletin and Initial 5G Deployment Delay

The current situation over 5G deployment escalated in November 2021 when the FAA issued a special airworthiness information bulletin alerting manufacturers, operators, and pilots that action may be needed to address potential interference with radio altimeters caused by 5G deployment.[25] Verizon and AT&T, which were expected to roll out 5G services in the C-band on December 5, 2021, subsequently announced they would delay their 5G rollout for 30 days, in order to provide additional time to address the aviation industry's concerns.[26]

B. FAA Airworthiness Directives (ADs) on Radio Altimeters

In early December 2021, the FAA issued a set of ADs, which included a directive that required revising flight manuals to prohibit certain operations requiring radio altimeter data when in the presence of 5G C-band signals, such as landing in low visibility conditions.[27] This AD would

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[20] *Id.* at 88.
[21] RTCA, *supra* note 19.
[22] Bevin Fletcher, *Aviation Wireless Industries Clash Over C-band Interference, Fierce Wireless,* (August 2021), *available at:* https://www.fiercewireless.com/regulatory/aviation-wireless-industries-clash-over-c-band-interference.
[23] Valerie Insinna and Aaron Mehta, *As 5G auction continues, Pentagon turns to safety planning,* Defense News (January 21, 2021), *available at:* https://www.defensenews.com/air/2021/01/21/as-5g-auction-continues-pentagon-turns-to-safety-risk-mitigation-plans/.
[24] Bani Sapra, *Bringing 5G to the skies is more complicated than it seems*, Wired (May 5, 2021), *available at:* https://wired.me/science/bringing-5g-to-the-skies-is-more-complicated-than-it-seems/.
[25] *Special Airworthiness Bulletin on potential adverse effects on radio altimeters*, Federal Aviation Administration (November 2, 2021), *available at:* https://rgl.faa.gov/Regulatory_and_Guidance_Library/rgSAIB.nsf/dc7bd4f27e5f107486257221005f069d/27ffcbb45e6157e9862587810044ad19/%24FILE/AIR-21-18.pdf.
[26] Cat Zakrzewski, *AT&T and Verizon will delay rollout over airplane interference concerns,* Washington Post (November 4, 2021), *available at:* https://www.washingtonpost.com/technology/2021/11/04/att-verizon-5g-delay/.
[27] FAA, *supra* note 12.

apply to areas and airports later identified through Notice to Air Missions (NOTAMs).[28] The AD was expected to prevent the dispatch of flights to certain airports and locations during times of low visibility—such as fog, rain, and snow—and result in significantly more flight diversions and cancellations.[29] A4A estimated at the time that if the AD had been in effect in 2019, approximately 345,000 passenger flights, 32 million passengers, and 5,400 cargo flights would have been impacted in the form of delayed flights, diversions, or cancellations.[30] HAI also estimated that a large portion of their fleet could have been grounded without significant relief from the FAA.[31]

C. December 2021 Information Sharing Agreement

One of the primary reasons the FAA issued a wide-reaching AD to mitigate potential harmful interference from 5G signals is because the FCC did not possess, and the telecom industry had not provided, data which contained the requisite critical information the FAA needed to provide an in-depth technical analysis.[32] This prevented the FAA from conducting the critical risk assessments needed to put the proper mitigations in place prior to the originally scheduled deployment. Finally, in December 2021, the FAA confirmed that the telecom industry had begun transmitting the technical data (such as 5G base station locations) for the FAA to accurately assess the risk to aircraft radio altimeters.[33]

On December 22, 2021, Verizon and AT&T announced, through the wireless industry trade association, CTIA, an agreement between CTIA, AIA, and A4A, to begin sharing otherwise confidential technical data amongst their member companies.[34] This information sharing agreement was critical for providing engineers and experts from the airlines and aviation manufacturers with previously unavailable data that allowed them to more accurately assess the potential risk of 5G signals to aircraft radio altimeters.

D. January 3, 2022, Agreement

On January 3, 2022, Verizon and AT&T announced another two-week delay of 5G deployment, from January 5, 2022, to January 19, 2022, after DOT Secretary Buttigieg and FAA Administrator Dickson called on both telecom companies to delay deployment for two weeks in a December 31, 2021, letter.[35] As part of that deal, Verizon and AT&T agreed to continue sharing the geographical locations of 5G ground stations and supply a more in-depth understanding of how the

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[28] *Id.*
[29] FAA, *supra* note 6.
[30] David Shepardson, *U.S. airlines warn 5G wireless could wreak havoc with flights*, Reuters (December 15, 20221), *available at*: https://www.reuters.com/business/aerospace-defense/us-airlines-warn-5g-wireless-could-cause-havoc-with-flights-2021-12-15/.
[31] HAI, Statement on FAA ADs Related to 5G Wireless Interference, (December 8, 2021), *available at:* https://rotormedia.com/hai-statement-on-faa-airworthiness-directives-related-to-5g-wireless-interference/.
[32] Briefing provided to Committee staff by FAA on January 3, 2021.
[33] Information provided to Committee staff by the FAA on Dec. 20, 2021.
[34] CTIA, Joint Statement from CTIA, AIA and A4A on 5G and Aviation Safety, (December 22, 2021), *available at:* https://www.ctia.org/news/joint-statement-from-ctia-aia-and-a4a-on-5g-and-aviation-safety#:~:text=December%2022%2C%202021-,Joint%20Statement%20from%20CTIA%2C%20AIA%20and,on%205G%20and%20Aviation%20Safety%20.&text=%E2%80%9COur%20belief%20is%20that%20by,5G%20while%20preserving%20aviation%20safety.%E2%80%9D.
[35] Associated Press, *AT&T, Verizon delay new 5G service after Buttigieg request*, (January 3, 2022), *available at:* https://www.boston.com/news/technology/2022/01/03/att-verizon-delay-new-5g-service-after-buttigieg-request/.

more powerful 5G signals of those stations would function within the C-band.[36] Additionally, the FAA, in consultation with aviation stakeholders, agreed to identify 50 priority airports which would be subjected to temporary 5G "exclusion zones," areas where 5G deployment would be prohibited within at least 1.25 miles beyond the ends of the runway and about a half mile to either side.[37] These priority airports were identified by the FAA and selected based on their traffic volume, number of low-visibility days, and role as a diversion location for other airports that may experience disruption.[38] This agreement was originally intended to only be in place for six months and gave the telecom industry the right to reject any of the originally agreed upon mitigations already in place. However, the terms of this agreement were later superseded by another agreement on January 18, 2022.

E. January 18, 2022, Agreement

On January 18, 2022, a day before the scheduled nationwide deployment of 5G, Verizon and AT&T announced they would delay deployment around certain airport runways.[39] This move was in response to an A4A letter expressing concern over the recently issued FAA NOTAMs that placed flight restrictions affecting a significant number of airports, not just the 50 priority airports previously covered under the January 3, 2022, agreement.[40] The new agreement,[41] which the DOT and FAA also helped broker, called for expanded exclusion zones that prohibit 5G deployment within at least two[42] miles of runways at all 87 airports affected by FAA NOTAMs.[43]

The expanded exclusion zones around specific airports were designed to allay the FAA's concerns with 5G interference enough to permit the agency to issue more alternative methods of compliance (AMOCs), which in turn would allow more aircraft to operate at those airports even in low visibility conditions.[44] According to the FAA, unlike the previous mitigation agreements that were agreed to, the terms of this agreement are not expected to expire until the FAA determines it is safe to deploy 5G within that two-mile radius.

IV. Current State of Play

Since the January 18, 2022, targeted delay, the FAA has issued a number of AMOCs which allow a large percentage of the commercial air carrier fleet to continue operations at all of the 87

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[36] *Id.*
[37] FAA, *supra* note 12.
[38] FAA, *supra* note 6.
[39] David Shepardson, *AT&T, Verizon pause 5G rollout near U.S airports to avoid flight disruptions,* Reuters, (January 19, 2022), *available at:* https://www.reuters.com/business/aerospace-defense/biden-administration-talks-head-off-5g-aviation-standoff-2022-01-18/.
[40] *See* David Shepardson, Major U.S. airlines warn 5G could ground some planes, wreak havoc, Reuters, (January 18, 2022), *available at:* https://www.reuters.com/technology/exclusive-major-us-airline-ceos-urge-action-avoid-catastrophic-5g-flight-2022-01-17/.
[41] While the FAA has briefed the Committee on the general outline of the January 18, 2022, agreement, some of the specific details of the agreement remain undisclosed.
[42] The actual area for which deployment is prohibited is approximately 3 miles, but this extra mile is to ensure that an aircraft's radio altimeter will be performing accurately within 2 miles of an affected airport's runway. The FAA also continues to refine these areas, based on evolving risk, and it may change over time.
[43] While there have been several different types of 5G-related NOTAMs recently issued by the FAA, this is specifically in reference to the Instrument Approach Procedure (IAP) NOTAMs that restrict specific low visibility approach operations at certain airports.
[44] FAA, *supra* note 12.

airports that received Instrument Approach Procedure NOTAMs.[45] In the case of 5G, an AMOC is essentially an exemption to the AD, allowing (a) a specific aircraft, with (b) a specific radio altimeter, to land at (c) specified airports, even in low visibility conditions, regardless of whether the airport has a 5G NOTAM or not.

The aircraft models that have received an AMOC and are approved as of January 31, 2022, represent at least 90 percent of the U.S. commercial fleet (compared to just 45 percent before the January 18, 2022, agreement) and include Boeing 717, 737, 747, 757, 767, 777, 787, MD-10/-11 models; Airbus A300, A310, A319, A220, A320, A321, A330, A340, A350 and A380 models; Embraer 120, 170, and 190 regional jets; CL-600/CRJ regional jets; DHC-8 turboprops and ATR turboprops.[46] However, those AMOCs are limited to the above aircraft models that possess one of 20 approved radio altimeters.[47] While helicopter operators have not yet received an AMOC and are still restricted by certain airspace related NOTAMs, the FAA did grant a two-year waiver to the AD to allow most medical emergency flights to continue under certain conditions.[48]

When the FAA originally announced the first round of AMOC approvals prior to the January 18, 2022, agreement, low visibility operations were only permitted at 48 of the 87 affected airports. This agreement has enabled the FAA to expand the list of airports to all 87 airports.[49] It is worth noting that even with these AMOCs, sporadic disruptions are still expected throughout the NAS. For instance, there are still a significant number of commercial aircraft, particularly regional commercial aircraft, that have either yet to receive an AMOC or received a limited AMOC that still prohibits or severely restricts the aircraft from operating in low visibility conditions at certain airports.[50] Additionally, as the FAA continues to receive and review additional information pertaining to the deployment of new 5G base stations, the agency will need to issue new NOTAMs for airports and areas that subsequently face higher risk of 5G interference for aircraft. As the potential risks of 5G interference to aircraft are determined, AMOCs—which expire at the end of each month—will need to be reviewed and reissued.[51]

Thus, continued collaboration between the FAA, FCC, and aviation and telecom stakeholders, and compliance with the known terms of the January 18, 2022, agreement is necessary to ultimately maintain aircraft safety and reduce further disruptions to the NAS.

V. International 5G Deployment

While 5G deployment has started to occur in as many as 40 other countries, there are several significant differences that make comparisons between those countries and the United States difficult. For instance, most of these countries either (1) use drastically lower 5G power levels than the United States, (2) have implemented other mitigation strategies *prior* to deployment to prevent interference, namely 5G antennas' angle requirements or expansive exclusion zones near airport

[45] FAA, *supra* note 6.
[46] FAA, *supra* note 12.
[47] *Id.*
[48] Helicopter Ass'n Int'l Partial Grant of Exemption, Regulatory Docket No. FAA-2021-1028, Exemption No. 18973 (Jan. 13, 2022), available at: https://rotormedia.com/wp-content/uploads/2022/01/Approved-HAI-5G-Partial-grant.pdf.
[49] FAA, *supra* note 6
[50] FAA, *supra* note 12.
[51] *Id.*

runways, or (3) operate their allocated frequencies for 5G farther away from the radio frequency band used by radio altimeters, thereby reducing the risk of interference. Additionally, they all have much less commercial aviation activity than the United States. Below are some examples of 5G deployment outside of the United States and the mitigations those regions have implemented:

- **Europe:** The 3.4–3.8 GHz band is utilized for 5G in Europe. However, there is a separation of an additional 100 MHz more than what will be provided in the U.S., reducing the risk of potential interference.[52] The power levels permitted in most of Europe are 23 percent less than those that would be permitted in the U.S.[53] The European countries specified below have additional mitigations in place.

- **France:** French regulators have imposed 5G exclusion zones (primarily around the Nice and Charles de Gaulle Airports) to protect public safety.[54]

- **Czech Republic:** Prague Airport has imposed 5G exclusion zones to protect public safety.[55]

- **United Kingdom (UK):** Power levels are significantly lower in both the frequency ranges 3.4–3.8 GHz, and 3.805–4.195 GHz by 62 percent and 99 percent, respectively.[56] The UK Civil Aviation Authority (CAA) has stated that 5G mobile base stations operating below 3.8 GHz pose a viable interference threat to radio altimeters.[57] The UK CAA also stated that lower power levels in the 3.8–4.195 GHz range may be an issue for helicopters, especially those used for emergency services.

- **Australia:** Compared to Europe and the United States, Australia operates farther away from the radio frequency band used by the radio altimeter. Additionally, the power levels permitted in Australia are 76 percent lower than allowed in the United States.[58]

- **Japan:** Japan has deployed 5G up to 4.1 GHz and the power levels permitted for 5G are at least 90 percent below those permitted in the United States.[59] The macro cell power levels are 96 percent below or only four percent of that permitted in the U.S., while the small cell power levels are less than one percent of what is permitted in the United States.

- **Canada:** Canadian regulators recently announced they would restrict certain 5G services around airports, placing "exclusion zones" around 26 airports where outdoor 5G base

[52] A4A, 5G Interference: Frequently Asked Questions, *available at:* https://www.airlines.org/5g-frequently-asked-questions/.
[53] *Id.*
[54] Ex Parte Letter from aviation stakeholders to Marlene Dortch, Secretary, Federal Communications Commissions, Docket No. 18-122 (filed Nov. 18, 2021), *available at:* https://www.airlines.org/wp-content/uploads/2022/01/Aviation-Industry-Reply-to-CTIA-11-19-2021-2022-01-03-15_57_10.pdf
[55] *Id.*
[56] *Id.*
[57] *Id.*
[58] *Id.*
[59] *Id.*

stations would not be permitted to operate—but indoor 5G operations would be allowed.[60] Canada also established "protection zones" where 5G operations would be allowed, with restricted power. Canada will now require, until it decides otherwise, that the 5G antennas tilt down, rather than horizontally or upward, so as not to interfere with radio altimeters.[61]

- **South Korea:** 5G is limited to 3.42–3.7 GHz and the maximum permitted 5G power is 95 percent less than the U.S. levels.[62]

[60] Diana Furchgott-Roth, *Canada Limits 5G to Protect Air Travel,* Forbes, (November 21, 2021), *available at:* https://www.forbes.com/sites/dianafurchtgott-roth/2021/11/21/canada-limits-5g-to-protect-air-travel/?sh=593ae2737247.
[61] *Id.*
[62] A4A, *supra* note 52.

WITNESSES

Panel 1

The Honorable Steve Dickson
Administrator
Federal Aviation Administration

Panel 2

Nicholas E. Calio
President and CEO
Airlines for America

The Honorable Eric Fanning
President and CEO
Aerospace Industries Association

Cathryn Stephens, A.A.E
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On behalf of American Association of Airport Executives

Captain Joe DePete
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Faye Malarkey Black
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James A. Viola
President and CEO
Helicopter Association International

The Honorable Meredith Attwell Baker
President and CEO
CTIA

Dennis Roberson
President and CEO
Roberson and Associates