



verizon^v

November 24, 2021

The Honorable Jessica Rosenworcel
Chairwoman
Federal Communications Commission
45 L Street NE
Washington, DC 20554

Re: Expanding Use of the 3.7-4.2 GHz Band, GN Docket No. 18-122

Dear Chairwoman Rosenworcel:

AT&T and Verizon will soon launch commercial 5G operations using mid-band spectrum that they acquired in the Federal Communication Commission's ("FCC's") record-breaking C-band auction.¹ Wireless carriers, including AT&T and Verizon, paid over \$80 billion for C-band spectrum—and have committed to pay another \$15 billion to satellite users for early access to those licenses—and made those investments in reliance on a set of technical ground rules that were expressly found by the FCC to protect other spectrum users. Our use of this spectrum will dramatically expand the reach and capabilities of the Nation's next generation 5G networks, advancing U.S. leadership, and bringing enormous benefits to consumers and to the U.S. economy. This spectrum will be the backbone of our 5G networks for many years to come.

We also recognize the paramount importance of air safety, and our use of the C-band spectrum will not undermine that imperative. Our networks will comply with the Commission's C-band service rules, which are carefully crafted to allow C-band 5G use to safely co-exist with aviation. As the FCC itself found—after 17 years of global study and interagency dialogue across all relevant federal agencies—"the technical rules on power and emission limits we set for the 3.7 GHz Service and the spectral separation of 220 megahertz should offer all due protection to [radio altimeter] services in the 4.2-4.4 GHz band."² Likewise, this spectrum is already used for 5G in dozens of countries with no reports of interference to aircraft, confirming that robust 5G deployment and air safety can coexist.

While we remain confident that 5G poses no risk to air safety, we are also sensitive to the Federal Aviation Administration's ("FAA's") desire for additional analysis of this issue. Thus, to allow time for that continued analysis while also ensuring no additional delay to the launch of

¹ Wireless Telecommunications Bureau Grants Auction 107 Licenses, *Public Notice*, DA 21-839 (rel. July 23, 2021).

² *Expanding Use of the 3.7-4.2 GHz Band*, 35 FCC Rcd 2342, 2485 (¶ 395) (2020) ("*C-band Order*") (also stating that "we are providing a 220-megahertz guard band between new services in the lower C-band and radio altimeters" that "is double the minimum guard band requirement discussed in initial comments by Boeing and [others]" and finding that "the . . . study [underlying claims of interference to altimeters] does not demonstrate that harmful interference would likely result under reasonable scenarios (or even reasonably 'foreseeable' scenarios)").

5G using C-band, AT&T and Verizon commit—for a period of six months³—to voluntarily adopt additional precautionary measures to supplement those protections already included in the FCC’s rules. As detailed below, these commitments include additional steps to minimize energy coming from 5G base stations—both nationwide and to an even greater degree around public airports and heliports. These precautionary measures should allay concerns about radio altimeter performance.

The Strong Safety Record for 5G and C-Band

AT&T and Verizon are voluntarily adopting the precautionary measures described below despite the absence of any credible evidence that 5G deployments in the C-band will adversely affect radio altimeters in aircraft, as is confirmed by real-world experience around the globe. Tellingly, 5G systems have been deployed in the C-band in nearly 40 countries—with hundreds of thousands of operating base stations—without any reported incidents of harmful interference to radio altimeters and without the FAA expressing any concern regarding the safety of U.S.-registered aircraft operating in those locations.⁴ For example, tens of thousands of 5G base stations in the C-band have been deployed in Japan with just 100 MHz separation from altimeter operations—as compared to the minimum 220 MHz separation in the U.S. and the 400 MHz separation for the initial launch of 5G systems being deployed in the near term.⁵ In Europe, where the 3400-3800 MHz band is harmonized for 5G, Spain, Denmark, and Finland have been operating 5G for up to three years without any interference claims, despite using spectrum included in the U.S. initial launch C-band segment (3700-3800 MHz) with permitted power limits higher than permitted in U.S. urban areas.⁶

Live flight testing has also confirmed that C-band 5G operations safely coexist today with radio altimeter operations. The French military conducted tests using a helicopter and an active 5G base station and concluded that “the emission of 5G NR base station had no impact on the operational behavior of the radio altimeter.”⁷ The Norwegian Communications Authority likewise used an active 5G base station with several different aircraft approaching Bergen-Flesland Airport that “showed no abnormalities on the radio altimeters during the test.”⁸ In fact,

³ This commitment by AT&T and Verizon will expire on July 6, 2022, unless credible evidence exists that real-world interference would occur if the mitigations were relaxed.

⁴ Letter from CTIA, GN Docket No. 18-122 at 1 (dated Nov. 3, 2021) (“*CTIA Nov. 3 Letter*”).

⁵ *Id.* at 2. Tens of thousands of sites have similarly been deployed in the C-band in Australia and South Korea in similar frequencies, with no impact to aviation altimeter operations. Denmark has achieved nationwide coverage using spectrum up to 3800 MHz, which completely overlaps the U.S. initial 5G launch band, with nearly 4,000 base stations transmitting at power levels within 1 dB/MHz of the U.S. limits. No interference issues with radio altimeters have been reported. *Id.*

⁶ 5G Wireless in the C-Band, CTIA; available at: <https://www.5gandaviation.com/wp-content/uploads/2021/11/Fact-Sheet-International-Use-of-5G-in-C-Band.pdf>.

⁷ *CTIA Nov. 3 Letter* at 5 (citing Outcome from preliminary trial on one type of radio altimeter fitted on helicopter, ECC PT1(21)(192) (issued Sept. 6, 2021), https://www.cept.org/Documents/ecc-pt1/65970/ecc-pt1-21-192_france-radioaltimeter)

⁸ *Id.* (citing 3 Results of the preliminary test of compatibility between MFCN operating in 3400-3800 MHz and Radio Altimeters (RA) operating in 4200-4400 MHz, ECC PT1(21)(184) (issued Aug. 2, 2021),

the FAA itself acknowledged the extensive C-band 5G deployments abroad and observed that “[t]here have not yet been proven reports of harmful interference due to wireless broadband operations internationally.”⁹

Radio altimeters also currently co-exist near other high-power radio uses in the United States without reports of harmful interference to radio altimeters. Two different Navy radars, for example, operate just below the C-band at power levels that are 10,000 times greater than 5G base stations.¹⁰ And, ground and airborne aeronautical mobile telemetry systems operate immediately above radio altimeters at power levels comparable to 5G base stations and—for ground stations—with antennas pointed at aircraft.¹¹ In fact, the aviation industry’s own Wireless Avionics Intra-Communications (“WAIC”) systems is designed to operate in the *very same* spectrum as radio altimeters. And these WAIC systems would not pass the tests applied by the radio altimeter interests (“RA Stakeholders”) to 5G systems.¹²

Indeed, the *RTCA Report*—which is the primary basis for the FAA’s and RA Stakeholders’ erroneous claims of harmful interference—has been thoroughly debunked¹³ and consistently dismissed by regulators around the globe.¹⁴ The *RTCA Report* has significant documented flaws

https://www.cept.org/Documents/ecc-pt1/65941/ecc-pt1-21-184_norway-results-of-the-preliminary-testof-compatibility-between-mfcn-operating-in-3400-3800-mhz-and-radio-altimeters-operating-in-4200-4400-mhz)).

⁹ Risk of Potential Adverse Effects on Radio Altimeters, Special Airworthiness Information Bulletin, AIR-21-18 at 1 (FAA dated Nov. 2, 2021) (also recognizing that in the U.S., mobile broadband commercial services already operate in the 3.550-3.700 GHz MHz band, just at the lower edge of the C-band, “with no known issues for altimeters to date”).

¹⁰ *CTIA Nov. 3 Letter* at 5; Letter from CTIA, GN Docket No. 18-122 at Annex A p. 19 (dated Sept. 3, 2021) (“*CTIA Sept. 3 Letter*”).

¹¹ *Id.*

¹² Letter from CTIA, GN Docket No. 18-122 at Attachment, p. 7 (dated Aug. 31, 2021).

¹³ See *CTIA Sept. 3 Letter* at Annex A.

¹⁴ The Australian regulator stated that it views the *RTCA Report* as “conservative” and “consider[s] that compatibility with radio altimeters can be successfully managed with [wireless broadband] services introduced up to 4000 MHz.” Australian Communications and Media Authority, Replanning the 3700-4000 MHz Band, Outcomes Paper at 3 (dated Jan. 2021); available at: https://www.acma.gov.au/sites/default/files/2021-01/Replanning%20the%203700-4200%20MHz%20band_Outcomes%20paper.docx. The Chief Expert, Avionics and Electrical Systems, for the European Union Aviation Safety Agency (“EASA”) determined there is no need for immediate action, stating “[w]e believe that just having the [RTCA Report] is not sufficient evidence. We’re not seeing many occurrences. In fact, on the 5G case we haven’t seen any, and we really need to have a solid basis in our regulatory system to take action.” 5G Signal Interference with Aviation Radar Altimeters (RADALTs) at 15:01; available at: <https://www.icao.tv/videos/anc-talk-5g>. EASA has also stated “[f]or the time being, EASA does not identify any conditions that compromise safety and reports no occurrences of interference from 5G base stations to aeronautical radio altimeters. EASA is following the issue closely and has issued a Continued Airworthiness Review Item addressed to all radio altimeter manufacturers.” Commission Activities related to radio spectrum policy, European Commission, Directorate-General for Communications Networks, Content and Technology, Radio Spectrum Policy Group, RSPG21-018 FINAL at 5 (dated June 16, 2021); available at: https://rspg-spectrum.eu/wp-content/uploads/2021/06/RSPG21-018final_commission_activities.pdf. A spokesman for the Civil Aviation Authority (“CAA”) in the United Kingdom said that “[w]e are aware of reports that suggest that the frequency band being used for 5G in a number of countries could potentially pose a risk of interference with aircraft radio altimeters,” but noted “[t]here have been no reported incidents of aircraft systems being affected by 5G

that more than negate all of RTCA's claims of harmful interference,¹⁵ including using unrealistic models of 5G networks, combining multiple worst-case inputs, creating implausible test scenarios, and utilizing extreme testing standards. The *RTCA Report* also lacks transparency and obscures key inputs. One of the key drivers in the report, for example, appears to be an altimeter model that the FCC has not certified in 40 years. Although wireless stakeholders have sought to work with the RA Stakeholders, the test data underpinning the report were withheld for over a year and then only provided to the FCC under a protective order that does not permit access by the wireless companies in the proceeding.¹⁶

The flawed nature of the *RTCA Report* is underscored by real-world experience. Assuming the conclusions of *RTCA Report* were accurate, then: the Navy radars discussed above would overload every aircraft with a particular altimeter flying within hundreds of kilometers of the radar;¹⁷ the AMT ground stations and airborne radars would exceed radio altimeter thresholds and overload any Cat 3 altimeters within 15 or 8 kilometers, respectively;¹⁸ and the WAIC system would show much more threshold exceedance than the 5G systems claimed to be problematic.¹⁹ In fact, even the commercial use of the Citizen's Broadband Radio Services ("CBRS"), which was recently licensed and operates just below the C-band, should be causing interference to radio altimeters today.²⁰ There's no evidence those things are happening.

The Importance of C-Band to 5G in America

C-band spectrum is of crucial importance to having robust, world-class 5G networks in the United States. This spectrum is located in the mid-band frequency range, which provides the high capacity and broad geographic range needed for broad and deep 5G coverage. The use of mid-band spectrum will therefore enable 5G to drive technological innovation. For these reasons, the FCC, Congress, and the Administration have found C-band spectrum is "critical" to the "5G buildout due to its desirable coverage, capacity, and propagation characteristics."²¹ Withholding the full promise of this spectrum would impair wireless connectivity for tens of millions of American consumers, slow entrepreneurship and innovation, and further undermine

transmissions in UK airspace." A spokesman for Ofcom, the UK spectrum regulatory authority, said "[w]e're aware that the aviation sector is looking at this; we've done our own technical analysis and are yet to see any evidence that would give us cause for concern." No evidence that 5G poses risk to planes, say regulators, The Daily Telegraph (dated Nov. 5, 2021); available at: <https://www.telegraph.co.uk/business/2021/11/05/5g-no-threat-uk-aircraft-safety-watchdog-insists/>.

¹⁵ *Id.* at Annex A, p. 3.

¹⁶ *Id.* at Annex A, pp. 3-4.

¹⁷ *CTIA Nov. 3 Letter* at 5-6.

¹⁸ *Id.*

¹⁹ *CTIA Sept. 3 Letter* at Annex A at p. 7.

²⁰ *CTIA Nov. 3 Letter* at 4.

²¹ *C-band Order*, 35 FCC Rcd at 2345 (¶ 3).

America's aspirations to global 5G leadership.²² As previously noted, wireless providers have committed \$95 billion access to C-band spectrum – including billions in premium for accelerated access to this spectrum – earlier this year, and that schedule has already been delayed once to put aviation concerns to rest. In addition to the negative impact to consumers, any further delay or impairment of 5G launch in the C-band would negate or severely impair the value of those investments.

Early deployment of C-band spectrum for 5G is also critical to the U.S.'s global leadership in 5G products and services, which, as recently highlighted by rip-and-replace mandates, has weighty national security implications. In particular, China's current market position with respect to 5G equipment has raised not only economic concerns, but also fears about whether security vulnerabilities in such Chinese equipment might pose threats to national interests beyond simple third-party hacking.²³ Unfortunately, any further delay in the launch of C-band for 5G will not only set back U.S. 5G leadership, it will also undermine the credibility of U.S. technology leadership, and, potentially, U.S. efforts to promote a more secure and trusted global communications infrastructure. We cannot afford to let China and other competitors gain an advantage due to a self-inflicted and unnecessary delay, especially for purported risks that have not been demonstrated in any other C-band deployment already operating in nearly 40 other countries around the world.

Supplemental Protections As Analysis Concludes

Given the years of study and widespread global experience with 5G using C-band, AT&T and Verizon believe that supplemental protection—beyond the existing FCC technical rules and the massive separation between 5G networks and radio altimeters—is unnecessary. Indeed, as the Helicopter Association International argues, there is also evidence that even if a problem did exist that is not evident from the record, that other simple mitigations might provide “[a]n equivalent level of safety . . . by the use of proper preflight planning, minimum altitudes, VFR visibility requirements . . . and the use of ground personnel to assist in hazard identification.”²⁴

AT&T and Verizon have already voluntarily deferred the commercial launch of C-band spectrum for their 5G networks by 30 days. Since that time, the companies have met with FAA representatives on numerous occasions and raced to provide the FAA with extraordinary access to their 5G network deployment designs, radiofrequency planning, and equipment performance.

²² 5G mid-band spectrum mess will put US further behind China in rollout, Eurasia Group (dated Nov. 18, 2021) (stating that further delay will “leav[e] US mobile operators and other technology companies aiming to rollout services that run on mid-band spectrum further behind Chinese counterparts in testing new applications and use cases for the technology”).

²³ See, e.g., National Security Implications of Fifth Generation (5G) Mobile Technologies, Congressional Research Service (dated June 4, 2021); available at: <https://sgp.fas.org/crs/natsec/IF11251.pdf>.

²⁴ Letter from Helicopter Association International to U.S. Department of Transportation, FAA-2021-1028-0001 at 3 (dated Oct. 29, 2021) (further stating that “HAI believes it is safer to fly at night with [night vision goggle (“NVGs”)] . . . without an operable/normally functioning radar altimeter than it is to flight at night with a fully functioning radar altimeter without the aid of NVGs”); available at: <https://www.regulations.gov/document/FAA-2021-1028-0001>.

AT&T and Verizon are also committed to continuing to work with the FAA and RA Stakeholders in modeling and testing going forward.

Nonetheless, to alleviate any safety concerns from the FAA as additional evidence from radio altimeter manufacturers is evaluated, AT&T and Verizon have worked with FCC staff and agreed to final set of additional precautionary measures on 5G networks in the C-band for a period of six months, unless credible evidence emerges that real-world interference would occur if the measures were relaxed. To that end, AT&T and Verizon commit to continuing our engagement with the FCC, FAA and other stakeholders to share testing and actual experience as we launch 5G in the C-band. These additional commitments are:

1. Limit C-band effective isotropic radiated power (“EIRP”) above the horizon for all 5G base stations to no more than the lesser of: (a) 62 dBm/MHz or (b) $48 + 20 \times \log_{10}(1/\sin(\Theta))$ dBm/MHz, where Θ is the elevation angle above the horizontal plane of the base station antenna.
2. Limit C-band EIRP below the horizon for all 5G base stations to no more than 62 dBm/MHz.
3. In addition, for all public use Airports with paved runways:²⁵
 - 3.1 Limit C-band power flux density (“PFD”)²⁶ to a maximum of -30 dBW/m²/MHz within the horizontal plane surface 300 feet above the established airport elevation described by swinging arcs of 1 nautical mile (6,076 feet) radius from the center of each end of the primary surface of each paved runway and connecting the adjacent arcs by lines tangent to those arcs.²⁷
 - 3.2 Limit C-band PFD to a maximum of -31 dBW/m²/MHz at the surface of all paved runways, within the boundaries of the runway edges and runway threshold lines.
 - 3.3 Limit C-band PFD to a maximum of -19 dBW/m²/MHz at the surface of all paved aprons and paved taxiways (i.e., movement and non-movement areas).
 - 3.4 Limit C-band EIRP from 5G base stations to no more than 37 dBm/MHz in a rectangular area centered on the runway centerline with a length extending to

²⁵ The public use airports will include those facilities identified by searching for “facility type” of “airport” and “facility use” of “public” from <https://adip.faa.gov/agis/public/#/airportSearch/advanced> as of the date of this letter, as well as any additional facilities agreed to by the FAA, AT&T, and Verizon.

²⁶ All PFD limits set in this document will be based on using minimum operational loss of no less than 2 dB below the maximum.

²⁷ This is the “horizontal surface” defined in 14 C.F.R. § 77.19(a), but with a horizontal plane 300 feet above the airport and with the radius of the arc being 1 nautical mile. See, e.g., United States Standard for Terminal Instrument Procedures, Order 8260.3E at p. 2-59, Figure 2-7-1 (FAA Sept. 17, 2020); available at: https://www.faa.gov/documentLibrary/media/Order/Order_8260.3E.pdf.

1,000 feet beyond the runway threshold at each end of the paved runway, and laterally from the extended centerline, up to and including 600 feet on either side.

- 3.5 Limit C-band EIRP from 5G base stations to no more than 55 dBm/MHz EIRP in the area from 600 feet laterally up to and including 1,000 feet laterally on either side of the runway centerline extended to 1,000 feet beyond the runway threshold at each end of the runway.
- 3.6 Base stations within the Final Approach Box (“FAB”), as defined below, at either end of all paved runways, will:
 - 3.6.1 Use C-band antennas that do not exceed a centerline height equivalent to a 50:1 approach surface above the touchdown zone elevation beginning at the primary surface, where the touchdown zone elevation is the highest elevation along the first 3,000 feet of the runway at that end of the runway²⁸ and the primary surface is a surface longitudinally centered on a runway that extends 200 feet beyond each end of that runway.²⁹
 - 3.6.2 Limit C-band EIRP above the horizon to no more than the lesser of: (a) 62 dBm/MHz or (b) $39 + [0.005788 \times (D_m - 305m)] + [20 \times \log_{10}(1/\sin(\Theta))]$ dBm/MHz, where D_m is the horizontal distance from the base station to the runway threshold and Θ is the elevation angle above the horizontal plane of the base station antenna.
 - 3.6.3 For purposes of 3.6.1 and 3.6.2, the FAB is defined as an isosceles trapezoid with its short side (top) orthogonal to the runway centerline (extended beyond the runway threshold), centered on the extended runway centerline, with the top positioned 1,000 feet from the runway threshold away from the runway, with a height of 5,100 feet, and with a long side (bottom) that is 3,772 feet.
4. In addition, for all public use Heliports,³⁰ limit C-band PFD to no more than -16 dBW/m²/MHz on the primary surfaces of helipads.³¹

We are committed to the rapid deployment of 5G and the safety of aviation. While we continue to believe the FCC’s current rules provide for both, we will, without waiver of our legal rights

²⁸ IFP Requirements (FAA last modified July 31, 2020), available at: https://www.faa.gov/air_traffic/flight_info/aeronav/procedures/ifp_initiation/ifp_requirements/.

²⁹ 14 C.F.R. § 77.19(c), for paved runways.

³⁰ The public use heliports will include those facilities identified by searching for “facility type” of “heliport” and “facility use” of “public” from <https://adip.faa.gov/agis/public/#/airportSearch/advanced> as of the date of this letter, as well as any additional facilities agreed to by the FAA, AT&T, and Verizon.

³¹ 14 C.F.R. § 77.23(a).

