**Testimony of**

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**on**

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Chairman DeFazio, Ranking Member Graves, Subcommittee Chairman Larsen, Ranking Member Graves, and Members of the Subcommittee, on behalf of CTIA and the U.S. wireless industry, thank you for the opportunity to testify today.

Congress and this Committee have been laser focused on critical investments to our nation's infrastructure. The Infrastructure Investment and Jobs Act (IIJA) recognized the key role that 5G plays in closing the digital divide and supported low-income households so they can stay connected. These historic investments in both our physical and digital infrastructure are integral to our connected future across America.

Your leadership is also critical in supporting the safest air traffic system in the world. We can—and must—have both safe flights and robust and reliable C-Band 5G. I appreciate you holding this hearing.

**There is Broad Support and Commitment to Advancing C-Band 5G and Aviation Safety**

Last month, President Biden emphasized the U.S. Government's "commit[ment] to rapid 5G deployment" while ensuring that aviation will "safely co-exist."[1] The wireless industry fully endorses the President's statement and is committed to working collaboratively with altimeter vendors, aircraft manufacturers, the airlines, helicopters, airports, the Federal Communications Commission (FCC), the Federal Aviation Administration (FAA), the White House, and Congress—in sum, *all stakeholders*—to enable full-scale C-Band 5G deployments while maintaining air traffic safety.

The hard work over the last several weeks demonstrates that the United States can achieve the dual imperatives of air traffic safety and C-Band 5G. On January 19, 2022, AT&T

and Verizon successfully launched 5G services in the initial tranche of C-Band 5G spectrum, the 3.7-3.8 GHz band, and Americans have continued to travel safely across the nation.

I am proud of how AT&T and Verizon responded in the face of concerns about C-Band 5G and the claims of potential interference to radio altimeters. Despite all available real-world evidence—including existing C-Band 5G networks operating abroad using the same frequencies with the same permitted power levels and with no reported incidents of interference to air traffic safety—AT&T and Verizon acted to allay public concern and to give the FAA and the aviation industry additional time to evaluate altimeter performance with 5G. Specifically, since the FAA issued its statement on 5G/altimeter co-existence on November 2, 2021, AT&T and Verizon delayed their launches twice and committed to three different sets of voluntary temporary measures.

I also want to thank the FAA for its actions in recent weeks to turn to an altimeter-by-altimeter review and keep Americans flying safely and with minimal disruption. As of January 28, 2022, the FAA has cleared 20 altimeter models and 90% of the U.S. commercial fleet for low visibility landings in the vicinity of C-Band 5G networks.[2] This clearance rate demonstrates co-existence is attainable.

With continued collaboration and enhanced transparency, and relying on sound science and good engineering, I firmly believe we will achieve an outcome that permits robust C-Band 5G and continued air traffic safety across the American skies. To that end, I am encouraged by recent statements from airline leaders. As United's CEO Scott Kirby said, "[w]hile I wish it happened earlier, the good news is we now have everyone engaged."[3] And

American Airlines CEO Doug Parker noted that technical experts working on 5G and air traffic safety "seem encouraged that we'll be able to address this in a way that allows for full deployment of 5G, including near airports."[4] The wireless industry is committed to working with our aviation counterparts, the FCC, the FAA, and all of government to do the work necessary to achieve both robust C-Band 5G and safe skies.

**The Promise of 5G and the Importance of C-Band 5G**

5G wireless broadband networks are transforming the way we live and work, with speeds up to 100 times faster than 4G networks, connectivity responsiveness that is five times quicker, and network capacity that can handle 100 times the number of devices. In the transportation sector alone, 5G is beginning to help foster driverless cars, increase the efficiency of public transportation, and improve roadway safety and save lives. 5G will help update and build the industries of the future, including healthcare, smart manufacturing, logistics, and agriculture. The Boston Consulting Group projects that 5G networks will add $1.5 trillion to America's economy and create 4.5 million new jobs over the next decade.[5]

Further, a recently released Accenture study quantifies the importance of 5G wireless services to addressing climate change.[6] Accenture concluded that in the U.S., use cases on 5G networks are expected to enable a 20 percent contribution toward carbon emission reduction targets, helping the country meet its climate change goals. Accenture finds that 5G use cases will have the same effect as taking nearly 72 million cars off the road for a year.

Rapid deployment of the C-Band is key to the U.S.'s global leadership in this developing 5G ecosystem, with economic and national security implications. Our global competitors

understand that wireless leadership means billions of dollars in economic growth and millions of jobs in the industries of tomorrow, such as Smart Cities and the Internet of Things. Unfortunately, other countries possess significant advantages in the availability of spectrum for wireless innovation—for example, China is freeing up hundreds of megahertz of mid-band spectrum for 5G.

Maintaining our global leadership in wireless and meeting the ever-growing demand for next-generation wireless requires access to spectrum, and the FCC on a bipartisan basis has made strides to open up new frequency bands that will power 5G. Mid-band spectrum is the "sweet spot" of spectrum innovation and is a key factor for 5G, as it provides high speeds over a broad coverage area, making sure no one gets left out of the New Economy. As a presidential candidate, Secretary Buttitgieg committed to "[s]peed up next generation wireless expansion … support[ing] clearing more government and other spectrum (like the C-band)."[7]

But America is playing catch-up, as the U.S. has a limited amount of mid-band spectrum available to power 5G networks. Across the globe, the C-Band is the mid-band workhorse for 5G. Nearly 40 countries are already using this spectrum with no threat to air safety. In the U.S., policymakers and industry stakeholders alike have been working to open up the C-Band for 5G for years, including international review dating back as early as 2003 and more recently as part of a 2017 FCC inquiry and the 2018 bipartisan MOBILE NOW law.[8] In February 2020, the agency adopted a comprehensive order enabling 5G in the C-Band with carefully crafted technical rules to allow C-Band 5G to safely operate with altimeters. The FCC reviewed the concerns expressed by the aviation industry and concluded that "the technical rules on power and

emission limits we set for the [C-Band 5G] Service and the spectral separation of 220 megahertz should offer all due protection to [altimeter] services in the 4.2-4.4 GHz band."[9]

In February 2021, the FCC completed an auction of 280 megahertz of C-Band spectrum that generated more than $81 billion for the U.S. Treasury—the largest spectrum auction in history. AT&T and Verizon won licenses in many of the most populated geographic areas in the 3.7-3.8 GHz band and, under the FCC's rules, paid incumbent users billions of dollars more to clear the spectrum by December 5, 2021. The remaining licenses, covering the full band from 3.7-3.98 GHz, are scheduled to become available for 5G by December 2023.

Following the auction, AT&T and Verizon sprang into action, investing billions of dollars to deploy C-Band 5G network infrastructure across the country, while thousands of employees worked to prepare the network, and thousands more were trained to engage with customers about C-Band 5G—all in the lead up to the scheduled launch, last December 5, 2021.[10]

**Wireless Providers' Voluntary Delays and Steps to Pare Back the C-Band 5G Launch Have Allowed Aviation Stakeholders to Verify 5G Can Co-Exist Effectively**

I am proud of AT&T and Verizon for their responsiveness to FAA and aviation concerns. The wireless providers have delayed launch twice, for a total of six weeks, and committed to voluntary measures restricting full-power C-Band 5G for six months in addition to the protections in the FCC's rules. The wireless industry remains confident that 5G poses no risk to air traffic safety but has taken these steps to allow the FAA time to evaluate altimeter performance with C-Band 5G.

On November 2, 2021, just over a month before AT&T and Verizon were set to launch the first C-Band 5G networks in the U.S., the FAA issued a pronouncement on C-Band 5G, a Special Airworthiness Information Bulletin (SAIB) identifying a potential risk of C-Band 5G resulting in adverse effects to altimeters.[11] The FAA sought information on altimeter design and deployment on aircraft, as well as testing results. The SAIB followed press reports a few days earlier suggesting there could be flight cancellations, delays or diversions if the FCC did not suspend C-Band operations.[12]

Although the FCC had conducted a rigorous analysis and found no harmful interference to altimeters, and the FAA's SAIB recognized that other nations' C-Band wireless networks have not resulted in any documented reports of interference, the FAA acted in large part based on a single, flawed industry study. In response, on November 4, AT&T and Verizon announced the first of what would become two delays in the launch of C-Band 5G. Specifically, the two wireless providers voluntarily postponed their C-Band launches for one month, from December 5 until January 5, 2022, as a show of good faith to help provide aviation stakeholders additional time.[13] The FCC and the FAA issued a joint statement, noting that "[a]viation safety and technology leadership are national priorities, and with today's announcement these companies have demonstrated their commitment to both."[14]

This first delay was followed by discussions with the government officials in which AT&T and Verizon provided vast and unprecedented access to their 5G network deployment designs, radiofrequency planning, and equipment performance.[15] On November 24, AT&T and Verizon announced they would supplement the FCC's restrictions with a set of voluntary precautionary

measures that would last for six months, or until July 5, 2022, unless credible evidence exists that real-world interference would occur if the measures were relaxed.[16] The temporary measures took two forms: the wireless providers agreed to (1) lower the power of C-Band transmissions across America including nationwide limits on power projected to the sky (where altimeters are in use), and (2) effectively curtail C-Band operations in broadly defined areas near public airports and helipads. AT&T and Verizon certified these commitments, making them enforceable by the FCC.[17] The FCC recognized these new temporary measures as among "the most comprehensive efforts in the world to safeguard aviation technologies."[18]

On December 7, 2021, the FAA issued two Airworthiness Directives, stating that "radio altimeters cannot be relied upon to perform their intended function if they experience interference from wireless broadband operations in the 3.7-3.98 GHz frequency band."[19] The wireless industry's temporary measures were not addressed at all in the directives. The Airworthiness Directives previewed restrictions that would be imposed on pilots with the release of Notices to Air Missions (NOTAMs) at a later date.

On January 2, 2022, following more discussions with the White House, the Department of Commerce, the FCC, the Department of Transportation, and the FAA, AT&T and Verizon announced a further set of additional voluntary precautionary measures for the same six month period, until July 5, 2022, again in the spirit of cooperation and good faith. The wireless providers adopted C-Band exclusion zones around runways at certain airports that mirror those that are already in use in France, one of the very few C-Band 5G nations with any airport mitigations, with slight adaptation to reflect the modest technical differences in how C-Band

is being deployed in the two countries.[20] And on January 3, 2022, AT&T and Verizon agreed to a second delay for the C-Band 5G launch, from January 5 to January 19. President Biden praised the agreement and noted, "we're grateful to all parties for their cooperation and good faith."[21] Secretary Buttigieg and Administrator Dickson thanked AT&T and Verizon for these voluntary steps that "will give us additional time and space to reduce the impacts to commercial flights."[22]

U.S. providers have agreed to airport exclusions zones .like France, large geographic protections for air traffic around airports, and a nationwide limit on power levels above the horizon for six months. No other country has such protections in place.

Beginning in early January 2022, the FAA issued nearly two thousand NOTAMs, restricting certain operations requiring altimeter data in the vicinity of airports and heliports.[23]

On January 18, a day prior to the C-Band 5G launch, AT&T and Verizon announced further voluntary temporary measures around airports.[24] Secretary Buttigieg noted, "[w]e recognize the economic importance of expanding 5G, and we appreciate the wireless companies working with us to protect the flying public and the country's supply chain."[25]

Secretary Buttigieg and Administrator Dickson also referred to the temporary measures as a better way forward, "while permanent fixes are rapidly put into place."[26] These voluntary delays and roll-backs of full-scale C-Band deployments have created economic burdens and disrupted network deployments, but AT&T and Verizon committed to these temporary measures in the public interest to give the FAA and aviation industry additional time to evaluate altimeter performance with C-Band 5G. And these steps put us in the position we are

in today: the FAA has now cleared 20 altimeter models and approved 90% of the U.S. commercial fleet for landing in low-visibility approaches in areas with C-Band 5G.[27]

**With Sound Science and Good Engineering,**
**the FCC Set Strong Rules to Protect Altimeters**

In the lead up to the 2020 *C-Band Order*, the FCC examined concerns raised about C-Band 5G/altimeter co-existence, taking into account comments by aviation interests, the nature of radio altimeters deployed on aircraft, and new C-Band 5G deployments. The FCC found—based on the record before it, global study of C-Band wireless dating back nearly two decades, and interagency dialogue—that "the technical rules on power and emission limits we set for the [C-Band 5G] Service and the spectral separation of 220 megahertz should offer all due protection to [altimeter] services in the 4.2-4.4 GHz band."[28]

These restrictions are rigorous and significant. The FCC adopted a substantial protective barrier, or guard band, that separates 5G C-band signals from aviation signals—a minimum of 220 megahertz from 3.98 GHz, the uppermost portion of C-Band 5G, to the 4.2-4.4 GHz altimeter band and, for the 3.7-3.8 GHz spectrum that AT&T and Verizon just launched, a separation of 400 megahertz. By way of reference, the *entire* FM radio band spans 20 megahertz. The 220 megahertz separation is more than twice the size of the separation requested by some aviation stakeholders in the FCC record.[29] And it is more than twice the size of the guard band in Japan, where 5G networks operate up to 4.1 GHz and down to 4.5 GHz, just 100 megahertz from the 4.2-4.4 GHz altimeter band, with no reports of interference to air traffic safety. The FCC rightly concluded that its large guard band and its carefully crafted

technical rules on power and emission limits would fully "protect aeronautical services in the 4.2-4.4 GHz band."[30]

The FCC's technical rules mandate that wireless emissions beyond the C-Band 5G frequency border are *sixty million times lower* than the maximum power allowed for in-band C-Band 5G operations. And leading equipment vendors have confirmed that out-of-band C-Band 5G transmissions at the 4.2 GHz band, the edge of the radio altimeter band, are *one and one-half billion times lower* than the maximum power per megahertz allowed for C-Band operations.[31] The C-Band rules and systems are designed to be very good neighbors, greatly limiting the amount of signals that reach spectrum users in adjacent bands, let alone altimeter users operating hundreds of megahertz away.

To rebut the FCC's findings, aviation interests primarily rely on a single industry study,[32] but that study applied flawed methodology and implausible scenarios to claim interference. That study's flaws are now well documented.[33] And most notably, the study's assertions are contradicted by real-world deployments of C-Band 5G in nations around the world.

**Real-World Evidence from Nearly 40 Nations Confirms C-Band 5G and Air Traffic Safety**

As stakeholders examine the possibility of interference to altimeters, it is important to account for the real-world experience of wireless broadband networks operating in C-Band spectrum in 38 countries in Europe and Asia with no reported impact on radio altimeters in the same 4.2-4.4 GHz band. The vast majority of these countries have no altimeter-specific restrictions on C-Band deployments. Many of these nations have C-Band 5G operations in the same band as AT&T and Verizon's Phase 1 spectrum (3.7 to 3.8 GHz) and with power limits that

are the same or allow higher power than what the FCC adopted, including Czech Republic, Denmark, Finland, France, Ireland, Romania, and Spain and, overlapping part of the band, Greece and New Zealand.[34] The flawed aviation study would predict rampant interference to altimeters in these countries, but there has been none. While some nations authorize C-Band 5G at lower power levels than the U.S., those lower power levels would still cause widespread interference, according to the industry study that aviation interests rely on. That study invented a "safe" level of C-Band 5G dramatically lower than any C-Band 5G rules permit in any country; as but one example, the United Kingdom exceeds the aviation-purported "safe" level by 40,000x—with no reported incidents of interference to air traffic safety.[35]

Every day U.S.-registered aircraft, carrying thousands of U.S. citizens, land in these nations without incident. The FAA's SAIB recognized that no interference has been documented to date due to wireless broadband operations internationally.[36] And the European Union Aviation Safety Agency, the EU's authority for aviation safety, reported in 2021 that "[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."[37] These real-world deployments, subject to regulation equivalent to or similar to the FCC C-Band Order's spectral separation and technical limits, show that the U.S. framework for C-Band 5G "protect[s] aeronautical services in the 4.2-4.4 GHz band."[38] If interference were occurring, engineers would have seen it long before now across the globe.

**Next Steps: Charting a Course for Resolution**

The steps AT&T and Verizon have taken in the last few months have put the U.S. in the position we are in today: C-Band 5G deployments in the 3.7-3.8 GHz band, to the benefit of U.S. consumers and industry, with continued safe and secure air travel. The temporary measures have given time for the FAA to clear altimeter models and approve aircraft models without widespread, significant disruption to air travel. As noted above, these temporary measures halt in July, and by then we will be less than 18 months from the December 2023 deadline for incumbent relocation that will pave the way for launch of all 3.7-3.98 GHz C-Band 5G operations.

The wireless industry is committed to working as a good partner to resolve aviation concerns, and to do so promptly. These discussions must be guided by sound science and good engineering, and informed by real-world experience. Our track record shows we are committed to C-Band 5G and air traffic safety. We urge government agencies to engage collaboratively with industry, to be transparent in their analysis and their actions, and to identify the information they are relying on in their decisionmaking. With this framework, I am confident that we will continue to have the safest air traffic in the world and robust, full-scale C-Band 5G. I am hopeful that the positive collaboration in the past few weeks provides a clear path to resolution in timely fashion—well in advance of any deadlines—for the full-scale, nationwide launch of C-Band 5G across the 3.7-3.98 GHz band.

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Thank you again for this opportunity to testify, and I look forward to your questions.

[1] Statement by President Joe Biden on 5G Deployment Agreement, The White House Briefing Room (Jan. 4, 2022) ("President Biden Jan. 4 Statement").
[2] FAA, 5G and Aviation Safety, https://www.faa.gov/5g (last updated Jan. 28, 2022).
[3] Chris Isidore, *Major airlines say the 5G doomsday scenario is over*, CNN Business (Jan. 21, 2022), https://www.cnn.com/2022/01/20/business/airlines-outlook-5g-truce/index.html.
[4] *Id.*
[5] Enrique Duarte Melo et al., *5G Promises Massive Job and GDP Growth in the US*, Boston Consulting Group (Feb. 2021), https://www.ctia.org/news/report-5g-promises-massive-job-and-gdp-growth-in-the-u-s. Conversely, delayed access to 5G spectrum has real impacts: every six-month delay in 5G deployment costs our nation's economy $25 billion in economic benefits over the next decade, risks America's competitiveness, and jeopardizes our ability to ensure global 5G leadership. *Id.*
[6] Monica Kuroki et al., *5G Connectivity: A Key Enabling Technology to Meet America's Climate Change Goals*, Accenture (Jan. 2022), https://newsroom.accenture.com/news/5g-enabled-technologies-could-solve-for-one-fifth-of-us-climate-change-target-by-2025-new-study-finds.htm.
[7] *Investing in an American Asset: Unleashing the Potential of Rural America*, Pete for America, Aug. 6, 2019, https://peteforamerica.com/policies/unleash-rural-opportunity/ [https://archive.ph/MiFF7].
[8] *Expanding Flexible Use in Mid-Band Spectrum Between 3.7 and 24 GHz*, Notice of Inquiry, 32 FCC Rcd 6373 (2017); MOBILE NOW Act, Pub. L. No. 115-141, Division P, Title VI, § 601 *et seq*. (2018).
[9] *Expanding Flexible Use of the 3.7 to 4.2 GHz Band*, Report and Order and Order of Proposed Modification, 35 FCC Rcd 2343, 2485 ¶ 395 (2020) ("*C-Band Order*").
[10] Letter from John Stankey, Chief Executive Officer, AT&T, Inc. & Hans Vestberg, Chairman and Chief Executive Officer, Verizon Communications, Inc., to Pete Buttigieg, Secretary, U.S. Department of Transportation & Steve Dickson, Administrator, FAA, at 2 (Jan. 2, 2022) ("AT&T Verizon Jan. 2 Letter"), https://www.politico.com/f/-?id=0000017e-1c36-dee4-a5ff-fe3e997f0000.
[11] FAA, *Special Airworthiness Information Bulletin; Risk of Potential Adverse Effects on Radio Altimeters*, AIR-21-18 (Nov. 2, 2021) ("SAIB AIR-21-18"), https://rgl.faa.gov/Regulatory_and_Guidance_Library-/rgSAIB.nsf/dc7bd4f27e5f107486257221005f069d/27ffcbb45e6157e9862587810044ad19/$FILE/AIR-21-18.pdf.
[12] Andrew Tangle & Ryan Tracy, FAA Plans Warnings to Pilots, Airlines Over New 5G Rollout, Wall St. J. (Oct. 29, 2021), https://www.wsj.com/articles/faa-plans-warnings-to-pilots-airlines-over-new-5g-rollout-11635524648.
[13] Cat Zakrzewski, AT&T and Verizon will delay 5G rollout over airplane interference concerns, Wash. Post (Nov. 4, 2021), https://www.washingtonpost.com/technology/2021/11/04/att-verizon-5g-delay/.
[14] Linda Hardesty, *AT&T, Verizon postpone C-Band rollouts until air safety review*, FierceWireless (Nov. 4, 2021), https://www.fiercewireless.com/operators/at-t-verizon-postpone-c-band-rollouts-until-air-safety-review#:~:text=-The%20FAA%20and%20the%20Federal,impact%20on%20aviation%20safety%20technologies.
[15] Letter from Joan Marsh, Executive Vice President of Federal Regulatory Relations, AT&T Services, Inc. & Kathleen M. Grillo, Senior Vice President – Public Policy & Government Affairs, Verizon, to Jessica Rosenworcel, Chairwoman, FCC, GN Docket No. 18-122, at 5 (filed Nov. 24, 2021).
[16] *Id.* at 6.
[17] Letter from Joan Marsh, Executive Vice President of Federal Regulatory Relations, AT&T Services, Inc. & William H. Johnson, Senior Vice President – Federal Regulatory & Legal Affairs, Verizon, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122, at 1 (filed Dec. 31, 2021) ("AT&T Verizon Dec. 31 Letter").
[18] *See* Matt Daneman, *AT&T, Verizon Limit C-Band Deployments Near Airports, Helipads Through July 6*, at 2, Commc'ns Daily (Nov. 26, 2021) (quoting FCC spokesperson).
[19] Airworthiness Directives; Transport and Commuter Category Airplanes, 86 Fed. Reg. 69984 (Dec. 9, 2021); Airworthiness Directives; Various Helicopters, 86 Fed. Reg. 69992 (Dec. 9, 2021).
[20] AT&T Verizon Jan. 2 Letter.
[21] President Biden Jan. 4 Statement.
[22] Letter from Pete Buttigieg, Secretary, U.S. Department of Transportation & Steve Dickson, Administrator, FAA, to John Stankey, Chief Executive Officer, AT&T, Inc. & Hans Vestberg, Chairman and Chief Executive Officer, Verizon Communications, Inc., at 1 (Jan. 3, 2022), https://www.faa.gov/sites/faa.gov/files/2022-01/USDOT%20Letter%20to%20ATT%20Verizon-_20220103.pdf.
[23] FAA, FNS NOTAM Search, https://notams.aim.faa.gov/notamSearch/nsapp.html#/ (last visited Jan. 21, 2022).

[24] *See* Ian Duncan & Lori Aratani, Wireless carriers to limit 5G near airports after airlines warn of major disruptions, Wash. Post (Jan. 28, 2022) https://www.washingtonpost.com/transportation/2022/01/18/airlines-disruptions-5g-verizon-att/; Letter from Airlines for America, to Brian Deese, National Economic Council Director, Pete Buttigieg, Secretary, U.S. Department of Transportation, Steve Dickson, Administrator, FAA & Jessica Rosenworcel, Chairwoman, FCC, at 1 (Jan. 17, 2022) , https://www.airlines.org/news/a4a-urges-immediate-action-to-address-5g-interference/.

[25] FAA, 5G and Aviation Safety, January 18, 2022 Statement from U.S. Transportation Secretary Pete Buttigieg (Jan. 18, 2022), https://www.faa.gov/5g.

[26] Letter from Pete Buttigieg, Secretary, U.S. Department of Transportation & Steve Dickson, Administrator, FAA to John Stankey, Chief Executive Officer, AT&T, Inc. & Hans Vestberg, Chairman and Chief Executive Officer, Verizon Communications, Inc., at 1 (Dec. 31, 2021), https://www.faa.gov/sites/faa.gov/files/2021-12/12.31.2021%20%20-DOT%20and%20FAA%20Letter%20to%20ATT%20and%20Verizon%20.pdf.

[27] FAA, 5G and Aviation Safety, https://www.faa.gov/5g.

[28] *C-Band Order,* 35 FCC Rcd at 2485 ¶ 395.

[29] *Id.* at 2484 ¶ 391 (citing Comments of The Boeing Company (Boeing Reply), GN Docket No. 18-122, at 5-6 (filed Dec. 11, 2018)).

[30] *Id.* at 2485 ¶ 395.

[31] *See* AT&T Verizon Dec. 31 Letter at 3 (citing Letter from Mark Racek, Sr. Director Spectrum Policy, Ericsson, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122, at 1-2 (filed Sept. 13, 2021); Letter from Jeffrey A. Marks, Vice President, Regulatory Affairs, Nokia, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122, at 1 (filed Sept. 21, 2021)).

[32] *See* RTCA, Inc., *Assessment of C-Band Mobile Telecommunications Interference Impact on Low Range Radar Altimeter Options*, RTCA Paper No. 274-20/PMC-2073, at 21 Table 6-4, 67 Figure 10-16, and 87 (Oct. 7, 2020), https://www.rtca.org/wp-content/uploads/-2020/10/SC-239-5G-Interference-Assessment-Report_274-20-PMC-2073_accepted_changes.pdf.

[33]*See, e.g.*, Letter from Kara Graves, Assistant Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122, at 3 (filed Nov. 3, 2021) ("CTIA Nov. 3 Letter"); Letter from Kara Graves, Assistant Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Oct. 27, 2020); Letter from Kara Graves, Assistant Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Sept. 3, 2021); *see also, e.g.*, Letter from Doug Hyslop, Vice President, Technology and Spectrum Planning, CTIA to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Aug. 26, 2020); Letter from Kara Graves, Assistant Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Oct. 30, 2020); Letter from Kara Graves, Assistant Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Nov. 17, 2020); Letter from Scott K. Bergmann, Senior Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Dec. 7, 2020); Letter from Kara Graves, Assistant Vice President, Regulatory Affairs, CTIA to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122 (filed Mar. 4, 2021). *See* Comments of CTIA, Docket Nos. FAA-2021-0953 & FAA-2021-0954 (filed Jan. 24, 2022) ("CTIA FAA Comments").

[34] *See* CTIA FAA Comments at 9-10. *See also* CTIA Nov. 3 Letter (noting that at least two hundred thousand 5G base stations are already operating today with technical rules and proximity to radio altimeter operations that the aviation industry's modeling assumptions would suggest should be seeing harmful interference, yet no known reports of interference exist); Letter from Jennifer L. Oberhausen, Assistant Vice President, Regulatory Affairs, CTIA, to Marlene H. Dortch, Secretary, FCC, GN Docket No. 18-122, at 1 (filed Dec. 31, 2021).

[35] *See* CTIA FAA Comments at 11.

[36] *See* SAIB AIR-21-18 at 1.

[37]European Commission Directorate-General for Communications Networks, Content and Technology, *Commission Activities related to radio spectrum policy* at 5 (June 16, 2021), https://rspg-spectrum.eu/wp-content/uploads/-2021/06/RSPG21-018final_commission_activities.pdf.

[38] *C-Band Order*, 35 FCC Rcd at 2485 ¶ 395.