Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of Enabling Next-Generation Terrestrial Positioning, Navigation, and Timing and 5G: A Plan for the Lower 900 MHz Band (902-928 MHz)	))))))	WT Docket No. 24-240

REPLY COMMENTS OF NEXTNAV INC.

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September 20, 2024

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NextNav Inc. ("NextNav") respectfully submits this reply in response to comments on the Federal Communications Commission's ("FCC" or "Commission") Public Notice[1] regarding NextNav's proposed updating of the 902-928 MHz band ("Lower 900 MHz Band").[2] Building on its opening comments,[3] NextNav reiterates its request that the Commission issue a Notice of Proposed Rulemaking to reconfigure the Lower 900 MHz Band to enable a 5G-based terrestrial positioning, navigation, and timing ("TPNT" or "terrestrial PNT") service that can be readily deployed and adopted to serve as a complement and backup to the U.S. Global Positioning System ("GPS") and support wireless broadband deployment and use.

INTRODUCTION AND SUMMARY

NextNav's proposal to rationalize the Lower 900 MHz Band has received wide public comment. The Commission will of course carefully consider the feedback from all commenters, as will NextNav, but the key takeaway is this: No one else has proposed a credible solution to the

[1] *Wireless Telecommunications Bureau and Office of Engineering and Technology Seek Comment on NextNav Petition for Rulemaking*, Public Notice, WT Docket No. 24-240, DA 24-776 (rel. Aug. 6, 2024) ("Public Notice").

[2] Petition for Rulemaking of NextNav Inc., WT Docket No. 24-240 (Apr. 16, 2024) ("Petition").

[3] Comments of NextNav Inc., WT Docket No. 24-240 (Sept. 5, 2024) ("NextNav Comments").

widely recognized and increasingly urgent problem that the United States has no widescale TPNT service to complement and back up GPS where the GPS signal is obstructed or when outages occur. Even many of those opposed to NextNav's Petition acknowledge that a terrestrial complement and backup to a satellite-based PNT service is critically important to safeguarding U.S. national security, public safety, economy, and way of life. As there is no prospect of the U.S. government funding a standalone terrestrial PNT network, NextNav offers the only concrete opportunity to enable a widescale terrestrial PNT service—one that has a clear path to availability in consumer devices such as cellphones—without spending taxpayer dollars.

In its Petition, NextNav proposed using its own licensed spectrum to leverage 5G-network infrastructure to enable a terrestrial PNT service based on the 3GPP standard. NextNav provided a detailed technical supplement with the performance characteristics of its 3GPP-standard 5G TPNT system in its Technical Appendix to its Petition.[4] As the Commission's 2013 order made clear, and as all users of the Lower 900 MHz Band are aware, the federal government is primary in this band, NextNav and other Location and Monitoring Service ("LMS") licensees are secondary to the federal government, amateur users are secondary to LMS, and unlicensed users occupy the bottom tier of usage priority.[5] Accordingly, as described in its opening comments, NextNav has actively engaged in ongoing dialogue with the federal government and licensed users in the Lower 900 MHz Band about the technical details of NextNav's proposed deployment.[6]

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[4] Petition at Exh. A.

[5] *In re Request by Progeny LMS, LLC for Waiver of Certain Multilateration Location & Monitoring Service Rules*, Order, 28 FCC Rcd 8555, 8559 ¶ 10 (2013) ("*2013 Progeny Waiver Order*").

[6] NextNav Comments at 21-25.

Identifying the technologies and use cases of unlicensed users operating in a band of spectrum is more challenging. For that reason, NextNav is grateful that the Commission has issued the Public Notice, so that NextNav may hear from unlicensed users of the Lower 900 MHz Band. While the comments identify numerous use cases for the Lower 900 MHz Band, they also indicate that there are a few core technologies in use in the band. Furthermore, these technologies can be accommodated in a modernized band plan, where opportunities for coexistence abound. For example, the power limit proposed by NextNav for the lower part of the band represents a substantial *reduction* from what is currently authorized for Multilateration Location and Monitoring Service ("M-LMS") licenses.[7] These and other features of NextNav's proposed terrestrial PNT system, compared against the information provided to date, suggest that NextNav's NextGen technology would, in fact, be compatible with continued unlicensed operations in the band. NextNav's proposed changes will lead to a different environment for coexistence, but not necessarily a worse environment. And part of being an unlicensed user is the obligation to accommodate these kinds of differences.[8]

To devise solutions, what the public interest requires, and what few commenters provide, are technical details sufficient to allow for a meaningful engineering analysis of the compatibility of NextNav's proposed use case with current unlicensed technologies. Unfortunately, many commenters provide only generalizations and selective storytelling. Taking NextNav's use of the term "underutilized" in its Petition out of context, some commenters accused NextNav of

[7] *See* NextNav Comments at 12-14.

[8] *See* 47 C.F.R. § 15.5(a)-(b); *see also 2013 Progeny Waiver Order*, 28 FCC Rcd at 8559 ¶ 10.

overlooking the presence of other users in the band.[9] This is far from the truth. NextNav recognizes, and values, both licensed and unlicensed users in the Lower 900 MHz Band. NextNav, however, does not believe that the promise of the Lower 900 MHz Band should stop with the services it supports today. The band can be modernized to allow more efficient and intensive use, including providing first responders, businesses, and consumers throughout the United States with long overdue access to a terrestrial PNT backup and complement to GPS, and American consumers with more robust broadband service offerings. NextNav therefore appreciates the opportunity to better understand the technologies operating in the Lower 900 MHz Band and how users can share the band while allowing licensed spectrum to be put to its highest and best use.

I. THE URGENT NEED FOR A WIDESCALE TERRESTRIAL PNT BACKUP AND COMPLEMENT TO GPS IN THE UNITED STATES IS WIDELY RECOGNIZED, AND NEXTNAV HAS PRESENTED THE *ONLY* ACTIONABLE PLAN TO MEET THIS NEED.

As noted in NextNav's Petition and opening comments in this proceeding, PNT services are vital to virtually every aspect of modern life, including America's public safety and national security.[10] GPS has become America's backbone for PNT service. The National Institute of Standards and Technology ("NIST") found in 2019 that the loss of GPS service would devastate the U.S. economy, costing roughly $1 billion per day.[11] Although no other PNT system can, or needs to, replace the unparalleled functionality of GPS,[12] a complementary terrestrial PNT will

[9] *See, e.g.*, Comments of ARRL, The National Association for Amateur Radio at 2, WT Docket No. 24-240 (Sept. 5, 2024) ("ARRL Comments"); Comments of E-ZPass Group at 7-9, WT Docket No. 24-240 (Sept. 5, 2024) ("E-ZPass Comments").

[10] *See* Petition at 6; NextNav Comments at 3-5.

[11] *See* Comments of GPS Innovation Alliance at 3, WT Docket No. 24-240 (Sept. 5, 2024) ("GPSIA Comments"); *see also* Alan C. O'Connor et al., *Economic Benefits of the Global Positioning System (GPS): Final Report*, RTI Int'l, at ES-4 (June 2019), https://www.nist.gov/system/files/documents/2020/02/06/gps_finalreport618.pdf.

[12] *See* GPSIA Comments at 8 ("[N]o universal terrestrial backup for GPS can exist.").

help protect the United States' public safety and national security interests against foreign, domestic, and naturally occurring threats and limitations. Currently, the United States has no widely deployed and adopted complementary or redundant system to provide TPNT in the event that GPS is rendered unusable. NextNav has the only viable proposal to create one. As President John F. Kennedy said in addressing Congress in 1962, "the time to repair the roof is when the sun is shining."[13] NextNav's Petition offers the United States a rare opportunity to take advantage of the current—likely temporary—sunshine and allow the deployment of a commercially funded complement and backup to GPS before disaster strikes, not after.

A. Commenters Acknowledge the Need for a Terrestrial PNT Service to Complement and Back Up GPS, as the Government Has Long Recognized.

Multiple commenters—even those who question the technology that informs NextNav's Petition—recognize that the United States urgently needs a complement and backup to GPS. The Resilient Navigation and Timing Foundation ("RNTF"), for example, wrote that "one or more complementary terrestrial PNT" services that can "operate independently from GPS and other global navigation satellite systems" are "needed for U.S. critical infrastructures and national security."[14] First responders note that "NextNav's approach could improve the availability and accuracy of indoor geolocation."[15] Others acknowledge that, despite any misgivings about the

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[13] *Annual Message to the Congress on the State of the Union*, January 11, 1962, Public Papers of the Presidents: John F. Kennedy, 1962.

[14] Letter from Dana A. Goward, President, RNT Foundation to Hon. Jessica Rosenworcel, Hon. Brendan Carr, Hon. Geoffrey Starks, Hon. Nathan Simington, and Hon. Anna M. Gomez, WT Docket No. 24-240 (Sept. 3, 2024) ("RNTF Comments").

[15] Comments of California Fire Chiefs at 1, WT Docket No. 24-240 (Sept. 5, 2024).

implications of NextNav's proposal on the Lower 900 MHz Band, "NextNav's technology has the potential to provide substantial value to the United States government and military operations."[16]

Indeed, the comments in this proceeding reflect the reality known by the U.S. government and foreign actors for decades: Although indispensable to our current way of life, GPS alone is vulnerable to attacks and anomalies as well as the physical limitations of satellite-based services, and the United States requires a terrestrial PNT system that operates independently to ensure continued PNT services during a GPS outage, as well as in areas GPS signals cannot penetrate.[17] Former President Bush acknowledged this reality as far back as 2004, when he directed the government to develop a GPS backup capability in the event of GPS disruption "to meet growing national, homeland, and economic security requirements, for civil requirements, and to meet commercial and scientific demands."[18] Subsequently, administrations of both parties and private actors have also recognized the need for a complementary PNT system.[19] Yet in the intervening

[16] Comments of Somewear Labs, Inc. at 2, WT Docket No. 24-240 (Aug. 28, 2024); *see also* GPSIA Comments at 3 (noting that multiple recent executive actions highlight the need for reinforcement of critical infrastructure).

[17] *See* Comments of AURA Network Systems, Inc. at 1; RNTF Comments at 2.

[18] *U.S. Space-Based Position, Navigation, and Timing Policy*, White House (Dec. 15, 2004), https://www.gps.gov/policy/docs/2004/.

[19] *See, e.g.*, *NSTAC Report to the President on Commercial Communications Reliance on the Global Positioning System (GPS)*, NSTAC, at ES-3 (Feb. 28, 2008), https://www.cisa.gov/sites/default/files/publications/NSTAC%20GPS%20Report_0.pdf; *National Space Policy of the United States of America*, White House, at 5 (June 28, 2010), https://www.nasa.gov/wp-content/uploads/2024/01/national-space-policy-6-28-10.pdf; Sarah Mahmood, *Critical Infrastructure Vulnerabilities to GPS Disruptions*, DHS, at 9 (June 4, 2014), https://www.gps.gov/governance/advisory/meetings/2014-06/mahmood.pdf; *Critical Infrastructure Security and Resilience*, DHS & Nat'l Coordination Off. For Space-Based Positioning, Navigation & Timing, at 12 (Nov. 2014); David Simpson, Rear Admiral (ret.) U.S. Navy, *Cybersecurity Risk Reduction*, FCC White Paper, at 12 (2017), https://docs.fcc.gov/public/attachments/DOC-343096A1.pdf; *National Timing Resilience and Security Act Roadmap to Implementation: United States Department of Transportation Report to Congress*, DOT at 2-3 (Jan. 2021) https://www.transportation.gov/sites/dot.gov/files/2021-01/NTRSA%20Report%20to%20Congress_Final_January%202021.pdf;

20 years, little concrete progress has been made, even as the urgency has grown. NextNav's proposal offers a unique opportunity to address this national problem, which has no other viable solution absent FCC leadership and timely action.

Threats to the GPS satellite constellation include attacks from hostile actors as well as accidents brought on by natural space events. In addition, jamming, spoofing, or cyberattacks by nefarious actors can render GPS signals useless.[20] In space, hostile parties could engage in a kinetic attack or use an electromagnetic pulse weapon to render the satellites unusable.[21] Even absent ill intent, severe space weather events or space debris collisions can render GPS satellites inoperable.[22]

Exec. Order No. 13905, 85 Fed. Reg. 9359, 9359 (Feb. 12, 2020); *Report on Positioning, Navigation, and Timing (PNT) Backup and Complementary Capabilities to the Global Positioning System (GPS)*, DHS, at vi (Apr. 8, 2020) https://www.cisa.gov/sites/default/files/publications/report-on-pnt-backup-complementary-capabilities-to-gps_508.pdf; *Memorandum on Space Policy Directive 7*, White House (Jan. 15, 2021), https://trumpwhitehouse.archives.gov/presidential-actions/memorandum-space-policy-directive-7/; Letter from Thomas Goode, ATIS General Counsel, to Hon. Jack Reed et al., U.S. Senate (May 7, 2021), https://atis.org/wp-content/uploads/2021/05/Senate-Re-Urgent-Need-for-Alternative-Positioning-Navigation-and-Timing-Systems-Funding.pdf; David Simpson, Rear Admiral (ret.), *A Day Without Space and a Call for Greater Positioning, Navigation, and Timing Resiliency in the United States*, Wireless @ Virginia Tech, at 1 (Sept. 3, 2024). https://wireless.vt.edu/news/a-day-without-space-simpson.html ("A Day Without Space"); *see also* Press Release, White House, *Presidential Policy Directive - Critical Infrastructure Security and Resilience* (Feb. 12, 2013), https://obamawhitehouse.archives.gov/the-press-office/2013/02/12/presidential-policy-directive-critical-infrastructure-security-and-resil (directing the government to take steps to "strengthen and maintain secure, functioning and resilient critical infrastructure"); Exec. Order No. 13636, 78 Fed. Reg. 11739 (Feb. 12, 2013), https://www.federalregister.gov/documents/2013/02/19/2013-03915/improving-critical-infrastructure-cybersecurity (directing federal agencies to create and coordinate plans to protect critical infrastructure in the United States from cyber threats).

[20] A Day Without Space, at 11.

[21] *Id.*

[22] *Id.*; *see also* Ken Eppens, *Space Debris Endangers GPS*, GPS World (May 25, 2021), https://www.gpsworld.com/space-debris-endangers-gps/.

These threats are not illusory. In July of 2019, the European Union's Global Navigation Satellite System ("GNSS") system, Galileo, suffered a weeklong systemwide failure, and a less-severe six hour failure in December of 2020.[23] The Russian Federation's GNSS system, GLONASS, fell largely dark for 11 hours in 2014 after experiencing technical issues.[24] Commenters have noted that "[o]utages of individual GNSS satellites are common and the systems are often subject to localized jamming and spoofing."[25] Even small failures have lasting results, as a "13-microsecond discrepancy" in 2016 caused by the retirement of an older GPS satellite "affected police and emergency communications equipment in parts of North America for hours and caused power grid anomalies."[26]

The Department of Homeland Security recognizes that "[a]ccurate PNT is necessary for the functioning of many critical infrastructure sectors."[27] As a result, much of the United States' critical infrastructure is "vulnerable to the intentional or unintentional disruption of the GPS signal."[28] As just one example, public safety infrastructure relies on GPS. Americans expect that when they call 911, operators will be able to dispatch first responders to their location. But signals from satellite-based geolocation systems are often "unintentionally disrupted" due to their inability to penetrate walls and ceilings, and therefore are not as accurate indoors or in dense urban

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[23] *See, e.g.*, Anusuya Datta, *Modern Civilization Would Be Lost Without GPS*, SpaceNews.com (Aug. 3, 2021), https://spacenews.com/modern-civilization-would-be-lost-without-gps/.

[24] *Id.*

[25] *Id.*

[26] *Id.*

[27] *Federal Positioning, Navigation, and Timing (PNT) Services Acquisitions Guidance (Version 1.0)*, DHS CISA, at 18 (Feb. 2024), https://www.cisa.gov/sites/default/files/2024-03/Federal%20 Positioning%20Navigation%20and%20Timing%20%28PNT%29%20Services%20Acquisitions %20Guidance%20%28508%29_0.pdf.

[28] Risk Management: *Positioning, Navigation, and Timing*, CISA, https://www.cisa.gov/topics/ risk-management/positioning-navigation-and-timing (last visited Sept. 16, 2024).

environments.[29] As a result, "the expectation that emergency services can pinpoint the precise location of a 911 caller is often unmet, particularly when the call originates from indoor locations where GPS signals are weak or obstructed."[30]

The looming possibility of hostile action to GPS also poses a security risk. As Commander of the U.S. Space Force, General Stephen Whiting, recently testified, China "is growing its military space and counterspace capabilities at breathtaking pace to deny American and Allied space capabilities when they choose" to do so.[31] Not *if*, but *when*. Further, Department of Defense CIO John Sherman has said that any "adversary is going to try and come at [GPS] on day one of any potential conflict, whether it's kinetically, whether it's in the [radio frequency] spectrum, whether it's using other mechanisms … they're going to try to use GPS to frustrate our ability to get long-range fires or other types of fires on target and to get our forces to where they need to be."[32] Meanwhile, China is also investing heavily in its GNSS system, BeiDou, "actively seeking to displace GPS as the world's dominant satnav system and, in doing so, to increase its own soft power influence on the nations that use it."[33]

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[29] *See* Shanée Dawkins et al., Nat'l Inst. of Standards & Tech., U.S. Dep't of Commerce, NISTIR 8400, *Voices of First Responders—Nationwide Public Safety Communication Survey Findings: Day-to-Day Technology, Phase 2*, Volume 3, at 73, 108 (Oct. 2021), https://nvlpubs.nist.gov/nistpubs/ir/2021/NIST.IR.8400.pdf.

[30] NextNav Comments at App. A at 1.

[31] Statement of Stephen N. Whiting, United States Space Command, Presentation to the Senate Armed Services Committee, *Fiscal Year 2025 Priorities and Posture of United States Space Command*, at 6 (Feb. 29, 2024), https://www.armed-services.senate.gov/imo/media/doc/whiting_statement.pdf.

[32] Billy Mitchell, *Pentagon CIO Places High Priority on Developing GPS Alternatives With Growing Threat of Great Power Conflict*, DefenseScoop (Mar. 21, 2023) https://defensescoop.com/2023/03/21/pentagon-cio-places-high-priority-on-developing-gps-alternatives-with-growing-threat-of-great-power-conflict/.

[33] Sean Gorman, *America is Losing its GPS Dominance to China's BeiDou Satnav*, Space News (Apr. 8, 2024) https://spacenews.com/america-losing-gps-dominance-china-beidou-satnav/.

As commenters to this proceeding have observed, China—and other nations—have recognized the risk of relying entirely on space-based PNT systems and have deployed or are integrating terrestrial PNT technologies into their broader PNT infrastructure.[34] To keep pace with its global allies and rivals, the United States too must take action to implement a terrestrial PNT complement and backup to its GPS system.

B. NextNav's Proposal Remains the Only Viable Terrestrial PNT Solution to Achieve Widescale Deployment and Consumer Device Access.

The record demonstrates that absent significant government intervention or taxpayer support, NextNav's proposal remains the only viable TPNT solution that presents a clear path towards widescale deployment and easy adoption by consumer devices to serve as a true complement and backup to GPS.[35] Commenters who dispute this statement have failed to put forth viable alternative solutions that can achieve these goals. Some commenters claim that other bands can support a similar or better TPNT solution, but they fail to explain the absence of any such deployment and remain silent on whether and how the economic incentives to develop such a system might ever emerge.[36] Others argue that reconfiguring existing wireless or broadcast

[34] RNTF Comments at 2 ("The United Kingdom, South Korea, China, and other nations are at various stages of implementing" complementary TPNT systems); *see also* Matt Higgins, President of the IGNSS Association of Australia, *Australian Update*, at 15-18 (Dec. 2023), https://www.gps.gov/governance/advisory/meetings/2023-12/higgins.pdf (describing Australian TPNT efforts); MohammadReza Azali, *Iran Launches Local Navigation System to Reduce the Country's High Rate of Road Accidents*, TechRasa (Sept. 13, 2017) https://techrasa.com/2017/09/13/iran-launches-local-navigation-system-reduce-countrys-road-accidents/ (describing the launch a "new radio navigation system" which utilizes cell phone towers to complement a nascent GNSS system).

[35] *See* NextNav Petition at 10-14; NextNav Comments at 5 ("NextNav intends to leverage the widespread availability of 5G network operations throughout the United States to deploy TPNT in the Lower 900 MHz Band using 5G NR-standard positioning reference signals ('PRS').").

[36] *See, e.g.*, Comments of VIAVI Solutions, Inc. at 1-3, WT Docket No. 24-240 (Sept. 5, 2024) ("VIAVI Comments"); Comments of EchoStar Corporation at 3-4, WT Docket No. 24-240 (Sept. 5, 2024) ("EchoStar Comments"); Comments of Southern California Edison at 6, WT Docket No. 24-240 (Sept. 3, 2024).

systems, such as by "having each cellular wireless sector transmitter include a timing element," are viable alternatives, despite the absence of scale and scope of such an approach to say nothing of the similarly bleak economic outlook for standalone systems.[37] Still others point to ongoing, over-the-horizon research to identify alternative PNT or GPS technologies that have yet to yield any product plans,[38] or existing government-facing terrestrial PNT services with no known intent of moving to the consumer market,[39] or other positioning technologies that do not purport to serve as a backup to GPS,[40] or niche positioning technologies that face geographic constraints or remain little more than notional ideas, years or decades from realization.[41] Even after these technologies complete development, no commenter has presented a feasible plan for mass-market adaptation and scaled adoption similar to what NextNav's proposed partnership model would enable.[42] Commenters' failure to identify terrestrial PNT solutions with the same technical sophistication and business logic as that of NextNav's solution only serves to further highlight the lack of another widescale PNT service solution available that can both operate in consumer devices and serve government entities.

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[37] VIAVI Comments at 1-3.

[38] *See, e.g.*, Comments of AICC "Alarm Industry Communications Committee" at 18-21, WT Docket No. 24-240 (Sept. 5, 2024) ("AICC Comments"); Comments of National Association of Broadcasters at 1-2, WT Docket No. 24-240 (Sept. 5, 2024).

[39] *See, e.g.*, AICC Comments at 21-22.

[40] *See, e.g.*, EchoStar Comments at 3-4.

[41] IEEE 802 LAN/MAN Standards Committee asserts that the type of widescale, resilient, and consumer access-friendly location services are already available through unlicensed operations using IEEE 802.11 and IEEE 802.15.4 standards but fails to provide any example of such products or services. *See* Comments of IEEE 802 LAN/MAN Standards Committee ("LMSC") at 2-3, WT Docket No. 24-240 (Sept. 3, 2024).

[42] *See* NextNav Comments at 2-3, 5.

Among other things, any complementary system must operate independently from GPS. As one commenter stated, to ensure continued PNT services in the event of GPS failure, the United States must create a "resilience triad for national timing and overall PNT—a diverse, continuously cross-checked, independently operating set of time reference signals delivered from space, fiber, and terrestrial broadcast to critical infrastructure, government, military, and other nodes."[43] Developing such a "system of systems" is crucial to reaching the goal of reducing critical dependency on, and provide a complement to, GPS.[44] No one system can solve *all* of these challenges everywhere all of the time; however, NextNav's NextGen technology offers an option that can help supplement GPS and protect against outages.

By relying on cellular base station infrastructure, NextNav's NextGen system remains more secure against certain types of disruptions, such as jamming and spoofing. When a GPS signal reaches receivers on earth, relatively inexpensive equipment emitting little power can jam it due to its weakness, rendering the GPS signal unusable. By contrast, jamming 5G signals from terrestrial devices would take several orders of magnitude more power, creating a significantly higher barrier to disruption. Further, NextNav's 5G-based solution will be deployed using tens of thousands of base stations. The geographic distribution of the system provides a further form of resiliency due to the diversity of signal sources. An attack on a PNT service in one area is much more likely to be contained to that local service area as compared to space-based solutions which provide far less diversity. Such an attack would also prove easier to detect and remedy than those

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[43] RNTF Comments at 2.

[44] Frank LoBiondo Coast Guard Authorization Act of 2018, Pub. L. No. 115-282, 132 Stat. 4192; *National Timing Resilience and Security Act Roadmap To Implementation United States Department of Transportation Report to Congress* (Jan. 2021) https://www.transportation.gov/sites/dot.gov/files/2021-01/NTRSA%20Report%20to%20Congress_Final_January%202021.pdf.

against space-based systems. Thus, a terrestrial 5G-based PNT service has more security from hostile actors than GPS alone and adds resiliency to the United States' critical infrastructure.[45]

II. THE COMMUNICATIONS ACT ESTABLISHES A LOGICAL HIERARCHY OF PRIORITY BACKED BY COMMISSION RULINGS AND REASONABLE RELIANCE INTERESTS THAT FAVOR GRANTING NEXTNAV'S PETITION.

Many opposing commenters improperly urge the FCC to depart from the statutory scheme and the FCC's existing practice and deny the Petition based on the complaints of subordinate or unlicensed users, effectively granting them superior rights.[46] So doing would not only undermine NextNav's license's superior rights—for which NextNav competitively bid and paid for upon winning—but also violate the plain text of the Communications Act, which expressly authorizes the FCC to promulgate regulations to prevent interference. The FCC has done so by establishing a licensing scheme to prioritize some licensees (including changes to the licenses needed to support technological advances) and, accordingly, subordinate the interests of other, lower-priority licensees and unlicensed users. Denying NextNav's Petition based on the objections of subordinate and unlicensed users would subvert the legally relevant reliance interests and harm the public interest.

A. Affording Subordinate or Unlicensed Users Superior Rights to a Primary Licensee Would Thwart the Statutory Scheme.

The legal regime is clear: NextNav and the other LMS licensees are the highest priority commercial licensees in the 900 MHz band, and as such, under the governing statutes and

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[45] *See* Bliley Technologies, *Assured PNT: Going Beyond GPS Timing* (Nov. 30, 2023), https://blog.bliley.com/assured-pnt-going-beyond-gps-timing.

[46] *See, e.g.*, Comments of Chamber of Commerce at 1, WT Docket No. 24-240 (Sept. 5, 2024) (claiming that licensed users "must coexist" with Part 15 unlicensed devices); Reply Comments of Wireless Broadband Alliance at 3, WT Docket No. 24-240 (Aug. 31, 2024) (claiming that "LMS priority is below Unlicensed FCC Part 15 priority"); Comments of Morse Micro Comments, WT Docket No. 24-240 (Sept. 5, 2024) at 2 (claiming that "LMS priority is below Unlicensed FCC Part 15 priority").

regulations, NextNav has superior rights to lower-priority licensees and unlicensed users of the band. NextNav acquired its initial licenses in the 900 MHz band via auction.[47] In doing so, it recognized the potential future value of M-LMS licenses in the band and chose to invest valuable resources to acquire primary rights that would protect it against interference from lower priority users of those frequencies.[48] That protection from interference is core to the statutory scheme Congress established to recognize distinct "class[es] of licenses"[49] to "promot[e] economic opportunity and competition."[50]

Subordinate and unlicensed users today argue that the potential disruption to their current usage of the Lower 900 MHz Band warrants turning the well-established license hierarchy upside down to favor *their* rights over NextNav's. But to accept those arguments as a basis not to modify NextNav's license would preference the interference concerns of subordinate or unlicensed users over the interests of NextNav as a license holder. Such a result would conflict with the statute and implementing regulations and frustrate Congress's purpose in establishing a competitive bidding system for spectrum.

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[47] *See* ULS File No. 0000006894 (Nov. 3, 1999); *see also Wireless Telecommunications Bureau Grants 228 Location and Monitoring Service Licenses to Progeny LMS*, Public Notice, 15 FCC Rcd 12807 (WTB 2000). *See generally VHF Public Coast and Location and Monitoring Service Spectrum Auction Closes*, *Winning Bidders Announced*, Public Notice, 16 FCC Rcd 12509 (2001); *Location and Monitoring Service Auction Closes, Winning Bidders in the Auction of 528 Multilateration Licenses in the Location and Monitoring Service*, Public Notice, 14 FCC Rcd 3754 (1999).

[48] *See generally* 47 C.F.R. § 2.105. Some commenters appear to operate under the assumption that the Commission has not already allocated the 900 MHz band for M-LMS use and assigned 900 MHz geographic-area licenses to NextNav and other M-LMS licensees through a competitive-bidding process. *See, e.g.*, Comments of Matt Beecher, WT Docket No. 24-240 (Sept. 5, 2024); Comments of Thomas Watson, WT Docket No. 24-240 (Sept. 2, 2024); Comments of Connor McKay, WT Docket No. 24-240 (Aug. 15, 2024); Comments of Eric Grams, WT Docket No. 24-240 (Sept. 5, 2024). These commenters are mistaken.

[49] 47 U.S.C. § 309(j)(3).

[50] *Id*. § 309(j)(3)(B).

In the Communications Act, Congress instructed the FCC to promulgate regulations "to prevent interference between stations."[51] The FCC has carried out that directive by establishing a licensing system, through regulations, that sets out distinct rights for "each class of licensees."[52] Pursuant to that system, priority license holders like NextNav bid on economic rights to use specific frequencies without harmful interference from subordinate or unlicensed users. The whole reason to "award[] licenses to operate in specific frequency ranges, or bands" is that Congress and the FCC recognize the reality that "transmissions can interfere with one another when they are broadcast in the same portions of spectrum."[53] That is precisely why establishing a scheme with primary and subordinate use rights is foundational to spectrum management. The FCC has long recognized that this system establishes an important "hierarchy of spectrum usage rights."[54]

To put a finer point on it, under the operative legal regime, secondary licensees "[s]hall not cause harmful interference to stations of primary services to which frequencies are already assigned *or to which frequencies may be assigned at a later date*."[55] Nor can secondary licensees "claim protection from harmful interference from stations of a primary service to which frequencies are already assigned *or may be assigned at a later date*."[56] An important corollary

[51] 47 U.S.C. § 303(f). The Communications Act elsewhere recognizes the importance of awarding certain types of licensees "primary status." *Id*. § 336(f)(1)(A)(ii).

[52] *Id*. § 309(j)(3).

[53] *Northstar Wireless, LLC v. FCC*, 38 F.4th 190, 197 (D.C. Cir. 2022), *cert. denied*, 143 S. Ct. 2693 (2023).

[54] Public Notice at 1.

[55] 47 C.F.R. § 2.105(c)(2)(i) (emphasis added).

[56] *Id*. § 2.105(c)(2)(ii) (emphasis added).

principle is that no secondary licensee has a "vested right to any specific terms" of its license.[57] A licensee's "secondary status … always pose[s] the possibility that [it] might be required to alter facilities or cease operation at any time."[58] That principle must be true for a hierarchy of license rights to work. After all, a license would have zero value were a subordinate or unlicensed user allowed to trump the rights of one who devoted significant resources to purchasing licenses.[59]

Congress also legislated regarding the specific purposes and interests that the FCC's competitive bidding protects—and those, too, support granting NextNav's Petition.[60] Specifically, Congress directed the FCC to design bidding to promote: "the development and rapid deployment of new technologies, products, and services for the benefit of the public";[61] "economic opportunity and competition";[62] "recovery for the public of a portion of the value of the public spectrum resource made available for commercial use";[63] and "efficient and intensive use of the electromagnetic spectrum."[64] And recognizing the economic investment that bidding for spectrum licenses entails for private entities, the statute requires the FCC "to ensure that interested parties have a sufficient time to develop business plans, assess market conditions, and evaluate the

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57 *PSSI Glob. Servs., L.L.C. v. FCC*, 983 F.3d 1, 9 (D.C. Cir. 2020) (quotation marks omitted); *see also Celtronix Telemetry, Inc. v. FCC*, 272 F.3d 585, 589 (D.C. Cir. 2001) ("[I]t is undisputed that the Commission always retained the power to alter the term of existing licenses by rulemaking.").

58 *Mako Commc'ns, LLC v. FCC*, 835 F.3d 146, 150 (D.C. Cir. 2016) (internal quotation marks omitted).

59 *In re Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Report and Order, 10 FCC Rcd 4695, 4699 ¶ 7 (1995) ("Part 15 [unlicensed] uses are permitted in this band, but are secondary to all other uses."); 47 C.F.R. § 90.361 (prohibiting harmful interference to licensees in the relevant band by unlicensed users).

60 47 U.S.C. § 309(j).

61 *Id*. § 309(j)(3)(A).

62 *Id*. § 309(j)(3)(B).

63 *Id*. § 309(j)(3)(C).

64 *Id*. § 309(j)(3)(D).

availability of equipment for the relevant services."[65] Congress thus specifically contemplated that those who acquired licenses would continue to develop their business plans and to deploy new technologies. That is precisely what NextNav is attempting to do here.

Congress was well aware that "[s]pectrum is a scarce resource, and thus every exclusive license granted denies someone else the use of that spectrum. This is what give[s] spectrum a market value."[66] The whole point of awarding spectrum licenses through competitive bidding was to "encourage innovative ideas, and give the proper incentive to spur a new wave of products and services that will keep the United States in a competitive position."[67] Thus, the contention that a subordinate or unlicensed user could have a superior legal claim to use of spectrum when NextNav is seeking to deploy innovative technology via its licenses acquired through competitive bidding is contrary to the statutory framework. Indeed, freezing the technological capabilities of a licensee is the antithesis of a statutory scheme that seeks to ensure spectrum can be used for new and changing technologies.[68]

In the face of a statutory and regulatory scheme that plainly establishes this license hierarchy, some unlicensed commenters cherry-pick one sub-part of one regulatory provision to argue that their usage is protected from interference by NextNav, the primary licensee.[69] But their

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[65] *Id*. § 309(j)(3)(E)(ii).

[66] H.R. Rep. No. 103-111, 249 (1993), *as reprinted in* 1993 U.S.C.C.A.N. 378, 576.

[67] *Id*.

[68] *See, e.g.*, 47 U.S.C. § 157 ("It shall be the policy of the United States to encourage the provision of new technologies and services to the public."); *Id.* §§ 303, 309(j).

[69] *See* 47 C.F.R. § 90.353(d) ("EA multilateration LMS licenses will be conditioned upon the licensee's ability to demonstrate through actual field tests that their systems do not cause unacceptable levels of interference to 47 CFR part 15 devices.") The FCC has made clear from the outset that this does not afford Part 15 users protection from interference. *See, e.g.*, *In re Amendment of Part 90 of the Commission's Rules to Adopt Regulations for Automatic Vehicle Monitoring Systems*, Memorandum Opinion and Order and Further Notice of Proposed Rule

reading of a single sentence in isolation ignores the relevant statutory and regulatory context. When the FCC established this framework for the 900 MHz band in 1995, it explicitly "rejected proposals to elevate Part 15 devices to co-equal status with M-LMS licensees."[70] While it stressed the importance of "coexistence of M-LMS and unlicensed operations," and "affirmed that unlicensed devices would continue to operate under Part 15 of the Commission's rules in this band," the FCC made clear that "persons operating unlicensed devices *must accept interference* from all other operations in the band including M-LMS, *and have no vested or cognizable right to continued use of any given frequency*."[71] That lack of right to particular bandwidths comes directly from the FCC's general conditions of operation, which equally apply to Part 15 devices.[72]

With that critical context in mind, the requirement that M-LMS licenses not cause "*unacceptable* levels of interference" must be read in harmony with the requirement that Part 15 devices, including those using the 900 MHz band that do not fall within a regulatory safe harbor,[73] not cause "*harmful* interference" to LMS systems in this band, as well as the provisions stating that Part 15 users must "accept interference" from licensees and "have no vested or cognizable

Making, 12 FCC Rcd 13942, 13968 ¶ 69 (1997) ("*1997 LMS Order*") ("The language in the Order on Reconsideration cited by Pinpoint does not mean that Part 15 devices are entitled to protection from interference. They are not. Rather, we were explaining our decision to place a testing condition on multilateration LMS licenses. The purpose of the testing condition is to insure that multilateration LMS licensees, when designing and constructing their systems, take into consideration a goal of minimizing interference to existing deployments or systems of Part 15 devices in their area, and to verify through cooperative testing that this goal has been served.").

[70] *2013 Progeny Waiver Order*, 28 FCC Rcd at 8559 ¶ 10.

[71] *Id.* (emphasis added).

[72] 47 C.F.R. § 15.5(a).

[73] 47 C.F.R. § 90.361.

right to continued use."[74] The Commission's rules define "harmful" interference to mean: "Any emission, radiation or induction *that endangers the functioning* of a radio navigation service or of other safety services *or seriously degrades, obstructs or repeatedly interrupts* a radiocommunications service operating in accordance with this chapter."[75] Thus, while not specifically defined in the Commission's rules, "unacceptable" interference must constitute more than "harmful" interference.

The FCC has made clear that commenters' "unacceptable interference" language requires M-LMS licensees only to reduce interference as much as practicable, but does not obligate primary licensees to "protect … unlicensed devices … from interference" at the expense of utilizing their primary licenses.[76] Specifically, the FCC considers whether the primary licensee has designed its system in a way that "*reasonably* minimizes the potential for interference to Part 15 devices" and whether the existing Part 15 devices "are able to make adjustments or take other steps to minimize or avoid receiving interference from the [primary licensee], as is incumbent with their unlicensed status."[77] This aligns with what the FCC has described as the purpose of the requirement—to ask licensees to "take into consideration a goal of minimizing interference" to Part 15 devices.[78] To

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[74] *2013 Progeny Waiver Order*, 28 FCC Rcd at 8559 ¶ 10 (emphasis added); 47 C.F.R. § 90.361 ("Operations authorized under Parts 15 and 97 of this chapter may not cause harmful interference to LMS systems in the 902–928 MHz band."); *see also* 47 C.F.R. § 15.5(b) ("Operation of an intentional, unintentional, or incidental radiator is subject to the conditions that no harmful interference is caused and that interference must be accepted that may be caused by the operation of an authorized radio station, by another intentional or unintentional radiator, by industrial, scientific and medical (ISM) equipment, or by an incidental radiator."); 47 C.F.R. § 15.15(c) ("Since the operators of Part 15 devices are required to cease operation should harmful interference occur to authorized users of the radio frequency spectrum…").

[75] 47 C.F.R. § 15.3(m).

[76] *See 2013 Progeny Waiver Order*, 28 FCC Rcd at 8564 ¶ 19.

[77] *Id*. at 8565 ¶ 20 (emphasis added).

[78] *1997 LMS Order*, 12 FCC Rcd at 13942 ¶ 69.

be clear, NextNav is committed to doing so, and has pledged to work with unlicensed operators to understand their spectrum requirements and enable them to continue to operate.[79] But the FCC has made plain that this consideration does not provide secondary licensees or unlicensed users with legal protections from interference based on a primary license that NextNav purchased.

As the FCC has put it:

> The field test requirement does not create an obligation that M-LMS licensees protect particular unlicensed devices or models from interference, and it does not require an M-LMS licensee to avoid causing interference to particular unlicensed systems or to particular circumstances of their operation. To require this would elevate the status of Part 15 operations in the band and undermine the established relationship between licensed and unlicensed operations. Such an approach would effectively enable individual unlicensed operators to block the introduction of M-LMS on the basis of interference to their particular devices or models, or their particular systems or circumstances of operation, giving them greater rights against a licensed service than they have against other Part 15 operations in the band – a result that is fundamentally inconsistent with the Commission's decision on the operating status of unlicensed devices in the band.[80]

That "fundamentally inconsistent" result is exactly what unlicensed commenters here advance. It is their position—not NextNav's—that would "cast aside [the FCC's] carefully crafted regime" regarding the license hierarchy for this band.[81]

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[79] Petition at 30-32.

[80] *See also 2013 Progeny Waiver Order*, 28 FCC Rcd at 8564 ¶ 19 (footnoted omitted).

[81] *See, e.g.*, Opposition of Itron, Inc. to Petition for Rulemaking at 12, WT Docket No. 24-240 (Sept. 5, 2024) ("Itron Comments"). As Itron has acknowledged itself in its filings with the U.S. Securities and Exchange Commission, "Part 15 devices are designed for use on frequencies used by others. These other users may include licensed users, which have priority over Part 15 users. Part 15 devices may not cause harmful interference to licensed users and must be designed to accept interference from licensed radio devices. In the United States, our smart metering solutions are typically Part 15 devices that transmit information to (and receive information from, if applicable) handheld, mobile, or fixed network systems pursuant to these rules." Itron, Inc., Annual Report (Form 10-K) (Feb. 27, 2023), https://investors.itron.com/static-files/6deaf390-6b92-4f1e-a54f-3d17725a21d2.

B. The Public Interest and Relevant Reliance Interests Favor Granting NextNav's Petition.

The public interest also favors granting NextNav's Petition. Congress established the FCC to make spectrum available "for the purpose of the national defense, [and] for the purpose of promoting safety of life and property through the use of wire and radio communications,"[82] and to ensure that the nation's spectrum can accommodate new technologies.[83] Under these statutory mandates, the Commission has broad authority to make band assignments (and reassignments) and modify licenses if the Commission determines that doing so would promote the public interest.[84] This broad grant of authority—which the Commission has routinely exercised in response to licensee requests[85]—reflects Congress's determination that license modifications and spectrum assignment updates can help promote public safety, national security, and technological innovation.[86]

Here, as the FCC has found in past band modernizations, "the proposed modification of [NextNav's] license in conjunction with 900 MHz band realignment … would provide a unique

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[82] 47 U.S.C. § 151.

[83] *See, e.g.*, 47 U.S.C. § 157 ("It shall be the policy of the United States to encourage the provision of new technologies and services to the public."); *id.* §§ 303, 309(j).

[84] *See id*. §§ 303; 309(j)(6)(C), (E); *see also PSSI Glob. Servs., L.L.C.*, 983 F.3d at 7 (holding that the FCC's power to modify licenses "enables the FCC to 'maintain the control of the United States over all the channels of radio transmission,' and to manage spectrum assignments 'as public convenience, interest, or necessity requires'" (quoting 47 U.S.C. §§ 301, 303)).

[85] *See, e.g.*, *In re Review of the Commission's Rules Governing the 896-901/935-940 MHz Band*, Report and Order, Order of Proposed Modification, and Orders, 35 FCC Rcd 5183, 5203-04 ¶ 44 (2020) ("*900 MHz R&O*"); *In re of Improving Public Safety Communications in the 800 MHz Band*, Report and Order, Fifth Report and Order, Fourth Memorandum Opinion and Order, and Order, 19 FCC Rcd 14969, 15010-15012 ¶¶ 63-68 (2004) ("*800 MHz R&O*").

[86] When allocating band frequencies for various purposes, the Commission has the challenging task of predicting how emerging technologies will unfold in the years to come. *See, e.g.*, *900 MHz R&O*, 35 FCC Rcd 5225-26 ¶ 102; *800 MHz R&*O, 19 FCC Rcd at 15019-20 ¶ 81. This necessitates flexibility when the FCC is considering proposals for band updates.

opportunity for [NextNav] to deploy innovative services" that would further these public interest goals.[87] By contributing to a "system of systems" that reduces critical dependency on GPS,[88] NextNav's proposal would help fill an important public safety and national security gap in the U.S., and promote much needed technological innovation.[89] Courts have consistently upheld the Commission's decision to modify or reassign licenses even when doing so affects the rights of incumbent licensees.[90] Courts have likewise confirmed that, in such circumstances, other licensees do not have ownership interests, meaning the FCC may modify their rights, including in order to grant a modification request in the public interest. It is blackletter: "An FCC station license permits the 'use' of specific frequency channels for a limited time, 'but not the ownership thereof.' The FCC may modify station licenses as necessary to 'promote the public interest, convenience, and necessity.'"[91] Where, as here, it is within the FCC's statutory authority to decide whether license

[87] *900 MHz R&O*, 35 FCC Rcd at 5225-26 ¶ 102.

[88] U.S. Dep't of Transp., *Complementary PNT Action Plan: DOT Actions to Drive CPNT Adoption* (Sept. 2023), https://www.transportation.gov/sites/dot.gov/files/2023-09/DOT%20Complementary%20PNT%20Action%20Plan_Final.pdf.

[89] *See* Petition at ii ("Private- and public-sector experts have concluded that the United States needs robust terrestrial PNT to complement and back up GPS because space-based PNT systems' coverage gaps and vulnerabilities pose significant risks to U.S. national security, economic, and public safety interests.").

[90] *See, e.g.*, *Teledesic LLC v. FCC*, 275 F.3d 75, 86 (D.C. Cir. 2001); *NTCH, Inc. v. FCC*, 950 F.3d 871, 881 (D.C. Cir. 2020) ("[T]he Commission retains the authority to forgo an auction, so long as it acts in the public interest." (internal quotation marks omitted)); *In re Expanding the Economic & Innovation Opportunities of Spectrum Through Incentive Auctions*, Report and Order, 29 FCC Rcd 6567, 6846 ¶ 687 (2014) (explaining that secondary licensees and unlicensed users would "not be entitled to any interference protection from operations of the primary … licensees."); *Intelligent Transp. Soc'y of Am. v. FCC*, 45 F.4th 406, 415 (D.C. Cir. 2022) (explaining that even reducing licensees' spectrum, as long as the reduction "leaves licensees with enough capacity to meet current and future needs," falls within the FCC's authority to modify licenses (quotation marks omitted)).

[91] *PSSI Glob. Servs., L.L.C.*, 983 F.3d at 4-5 (quoting 47 U.S.C. §§ 301, 316(a)(1)); *see also* H.R. Rep. No. 103-111, 249 (1993), *as reprinted in* 1993 U.S.C.C.A.N. 378, 586 ("This paragraph also clarifies that any license issued by the Commission pursuant to section 309 does not vest any

modifications that enable the use of spectrum to bring technological advances are in the public interest, the FCC's public-interest determinations are entitled to deference.[92]

NextNav recognizes that, as a practical matter, granting its Petition may impact current secondary and unlicensed users in the band. NextNav understands that unlicensed devices serve important purposes and is committed to taking steps where practicable to limit the potential impact of its proposal on such devices. However, it is critical to keep in mind that the statutory and regulatory scheme contemplates those consequences—secondary and unlicensed users of the affected 900 MHz frequencies have always known that their usage is subject to potential interference and, indeed, have designed features such as frequency hopping and channelization to account for precisely that risk.[93] Meanwhile, NextNav has invested and continues to invest in its business in reliance on the primary license for which it competitively bid—including the rights associated with that license.[94] The FCC should not undermine incentives for existing and future primary license holders to continue to innovate and devise technological solutions that enable the best use of the band for the public.

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property rights in the license holder and that state and local government entities shall not treat the license as the property of the licensee for tax purposes. This subsection is intended to clarify that all licenses or permits issued by the Commission are franchises that constitute Federal property and not property of the licensee.").

[92] *See, e.g.*, *NTCH, Inc.*, 950 F.3d at 881; *see also Loper Bright Enters. v. Raimondo*, 144 S. Ct. 2244, 2268 (2024) (explaining that the APA requires deference to agency policymaking).

[93] And of course, if the FCC can grant modifications and updates that affect other licensees, it can also do so when those modifications and updates affect unlicensed users. *See 800 MHz R&O*, 19 FCC Rcd at 15069 ¶ 188 (explaining that the "underlying goal [of] relocation plans [is that they] should appropriately balance the interests *of all licensees*." (emphasis added)).

[94] To the extent that unlicensed users have discounted the possibility of NextNav's success in offering a widescale TPNT service and are belatedly voicing concerns, the Commission need not give any weight to that misplaced reliance.

An agency is required to take reliance interests, engendered by its prior policies, into account, when making changes to preexisting policies or practice.[95] The FCC's previous award of superior rights to NextNav engendered serious reliance interests for the company based on the license hierarchy enshrined in statute and regulation, which prioritizes the interests of license holders over the interests of those who have made decisions to proceed with unprotected usage at their own risk.[96] It would be arbitrary and capricious not to give sufficient weight to those interests when deciding whether to grant NextNav's Petition.[97] Unlicensed users should not be permitted to entrench themselves in a band, without investing in a license, and then claim protection from interference on the basis of their own undue reliance on licensees' particular use of a band at any given time.

III. UNLICENSED USERS CAN CONTINUE TO OPERATE IN THE LOWER 900 MHZ BAND.

Not only do the assertions in the record about interference to unlicensed 900 MHz devices lack legal merit, the majority appear to exaggerate the interference environment that NextNav's

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[95] *See, e.g.*, *FCC v. Fox Television Stations, Inc.*, 556 U.S. 502, 515-16 (2009); *United States Telecom Ass'n v. FCC*, 825 F.3d 674, 710 (D.C. Cir. 2016) (explaining that the FCC was required to consider the effect of the regulatory status of broadband on investment and in the majority's view, the FCC did so).

[96] S*ee also 2013 Progeny Waiver Order*, 28 FCC Rcd at 8565 ¶ 20 ("For the various users of unlicensed Part 15 devices in the 902-928 MHz band, the potential for interference is ever present, and has been since they have operated in the band. Such users have long been aware that not only are they not entitled to interference protection from other users in this heavily used band, including licensed users, but also that they can and do experience interference from other unlicensed users under the Part 15 rules, and that, given their unlicensed status, they may need to find ways to make necessary adjustments to their systems." (footnote omitted)). Unlicensed commenters who resort to the regulatory "safe harbor" for Part 15 devices that meet certain technical requirements overlook that all Part 15 users, whether within the safe harbor or not, are required to accept interference, including from each other.

[97] *See, e.g.*, *DHS v. Regents of the Univ. of Cal.*, 591 U.S. 1, 33 (2020). For their part, federal courts have uniformly approved this practice of granting license modifications where reliance interests so favor.

NextGen system will create while underplaying the resilience of unlicensed devices in the band. Commenters assert or assume, generally without empirical support or study, that NextNav's proposal would worsen the interference environment for the Part 15 devices in the band.[98] On the contrary, as mentioned in its comments, NextNav's proposal would actually *decrease* the total power radiated by licensed users in the lower part of the band.[99] Under NextNav's proposal, both the maximum average radiated power and the radiated power limit in the five-megahertz uplink segment would be lower than are currently allowed, even if the current M-LMS licensee deploys only a single emission.[100] Indeed, 5G transmissions in the lower part of the band following adoption of NextNav's proposal would, in most cases, even fall well below the Part 15 limit of 36 dBm equivalent isotropically radiated power ("EIRP").[101]

5G traffic is bursty and intermittent. Contrary to the claims of commenters and the rudimentary technical studies submitted in the record to date, 5G technology does not produce constant transmissions at all times, neither from devices nor from base stations. Transmissions depend on traffic, and traffic is not constantly offered in either the uplink or downlink direction.

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[98] *See, e.g.*, Wi-Fi Alliance Comments at 2-5, WT Docket No. 24-240 (Sept. 5, 2024); Comments of WISPA - The Association For Broadband Without Boundaries at 6-7, WT Docket No. 24-240 (Sept. 5, 2024) ("WISPA Comments"); Letter from Jerry Sumiec, Continental Automotive Systems, Inc. and Marcus Lichtenberg, Continental Automotive Technologies GmbH, to the Secretary of the FCC, WT Docket No. 24-240 (Sept. 4, 2024); Comments of Silicon Labs at 3-4, WT Docket No. 24-240 (Sept. 3, 2024).

[99] *See* NextNav Comments at 13-14. The A block in the current Lower 900 MHz Band plan is 5.75 megahertz and the rules have allowed licensees to deploy multiple emissions at 30 watts peak effective radiated power each. 47 C.F.R. §§ 90.205(l), 90.353(d). In addition to reducing the power, NextNav's proposal also reduces the bandwidth where higher power operations are currently allowed by 750 kilohertz.

[100] *See id*.

[101] *See* 47 C.F.R. § 15.709(a)(2)(i)(B). 36 dBm EIRP for unlicensed devices equates to 4 watts EIRP or 2.4 watts effective radiated power ("ERP"), which is less power than the proposed limit of 3 watts ERP.

Those studies that assume, contrary to fact, that 5G transmissions are constant predict interference where none exists and overstate both the magnitude and the probability of interference to unlicensed devices should interference ever occur.

In any event, manufacturers of 900 MHz unlicensed devices have already had to anticipate interference from other Part 15 operations as well as from licensed services and have known to design devices to accommodate other operations. Only a few commenters purport to provide technical analysis. To the extent commenters address the issue at all, simply accounting for bursty 5G transmissions and features built into unlicensed devices to cope with interference suggests that unlicensed devices can, in fact, continue operating consistent with NextNav's proposed modernization of the Lower 900 MHz Band.

A. By Definition, Unlicensed Devices Must Be Resilient.

Unlicensed devices should be, and in most cases are, much more adept at handling interference than commenters appear willing to admit. Because these devices are not entitled to protection from harmful interference, they must be designed to be robust and adaptable to the ever-present interference from other unlicensed devices as well as from licensed operations that enjoy superior rights in the band. This is particularly true for unlicensed devices operating in the Lower 900 MHz Band which—as many commenters have pointed out—is used by many unlicensed and licensed LMS devices. In other words, unlicensed users are currently operating despite interference from many others, precisely because unlicensed technologies are designed and built to operate under such heavy interference conditions.

To illustrate, according to commenters, the Lower 900 MHz Band has billions of RAIN Radiofrequency ID ("RFID") tags,[102] millions of security cameras[103] and smart meters,[104] more than 120 million industrial IoT devices,[105] and more than 100 million Z-Wave devices,[106] among others. These include bandwidth-intensive use cases that make coexistence with other unlicensed devices challenging, such as HaLow supporting 4K video streaming,[107] wideband point-to-point and point-to-multipoint ("P2P/P2MP") connectivity supporting up to a 20 megahertz channel,[108] and millions of wireless cameras streaming live videos. Interference among unlicensed operations is also common due to collocation. In addition, these unlicensed devices currently must also co-exist with active non-M LMS licensed deployments thousands of frequency assignments.[109]

To operate in this highly contested spectrum environment and co-exist with other unlicensed devices and licensed users, unlicensed technologies built for the Lower 900 MHz Band use a number of commonly known techniques to avoid harmful interference from these other users of the band. Examples of some of these techniques include: (1) diversified access channels; (2)

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[102] Comments of the Ad Hoc RAIN RFID Coalition at 2, WT Docket No. 24-240 (Sept. 5, 2024).

[103] Letter from Don Erickson, Chief Executive Officer, Security Industry Association to Ms. Marlene Dortch, Secretary, FCC at 2, WT Docket No. 24-240 (Sept. 4, 2024).

[104] *See* Itron Comments at 5.

[105] Comments of WIKA Alexander Wiegand SE & Co. KG at 1, WT Docket No. 24-240 (Sept. 17, 2024).

[106] Letter from Jim Nye, Chief Product Officer, Vivint LLC, NRG Energy Inc. to Marlene H. Dortch, Secretary, FCC at 2, WT Docket No. 24-240 (Sept. 3, 2024).

[107] *Lose The Cables, Expand Your Coverage*, Lorex, https://www.lorex.com/pages/halow?srsltid=AfmBOopD43Gd064XpNWqZnt_RzHmP-nILHcaTFj3UOpJQXvHnyEDzkWF (last accessed Sept. 19, 2024).

[108] *PMP 450i 900 MHz: Access Point And Subscriber Module*, Cambium Networks, https://brandcentral.cambiumnetworks.com/m/71319387db389e55/original/PMP450i_900MHz_05042017.pdf.

[109] *See Universal Licensing System*, FCC, https://www.fcc.gov/wireless/universal-licensing-system (last accessed Sept. 15, 2024).

methods to improve frequency agility such as frequency hopping spread spectrum ("FHSS"); (3) direct sequence spread spectrum ("DSSS") and chirp spread spectrum; (4) data redundancy or repetition; (5) retransmission mechanisms; and (6) clear channel assessment.

Most unlicensed technologies access the Lower 900 MHz Band through multiple channels on different frequencies to minimize the likelihood of co-channel interference. The equipment used would usually have—at the very least—static channel configurability or FHSS capability, where multiple bits/symbols/packet(s)/message(s) are transmitted within a single frequency hop prior to switching to another frequency. The frequency switching is pseudo-random, but effectively appears as random to transceivers of another technology, making the probability of co-channel interference low. Part 15 devices commonly use FHSS that conforms to the Commission's section 15.247 frequency-hopping rules, and FHSS technologies operating in the Lower 900 MHz Band are no exception. FHSS transmissions can coexist with other unlicensed and licensed technologies because FHSS signals are resistant to interference. The signals hop to multiple frequencies, and they are difficult to jam if the frequency hopping pattern is not known.

Some Part 15 devices, such as those that conform to section 15.247 of the Commission's rules,[110] use direct DSSS that has an inherent ability to tolerate interference through processing gain. Some systems, in addition to using these FHSS or DSSS techniques described above, also use chirp spread spectrum within the channels to transmit at a low information rate while using the full-channel bandwidth. A spread-spectrum system broadens or "spreads" the energy of a modulated waveform across a wider frequency bandwidth than a modulated signal would naturally occupy. The ratio of the post-spread bandwidth to the original bandwidth of the modulated signal

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[110] 47 C.F.R. § 15.247.

plus any related coding gain is referred to as processing gain.[111] The jamming margin of a system is proportional to the processing gain.[112]

Unlicensed devices in the band also employ data repetition or more sophisticated redundancy through forward error correction codes, both of which provide additional processing gain to avoid harmful interference. These mechanisms enable detection and correction of errors in the presence of transient interference from other systems.

Finally, many unlicensed devices in the band are also able to operate in the presence of transient interference from other systems by retransmitting at the Medium Access Control ("MAC") layer and/or application layer(s) if confirmation of reception of a packet is not received from the remote end. This technique is sometimes used in conjunction with carrier sense or listen-before-talk schemes to avoid co-channel transmissions with other users in the band.

To put a finer point on it, if unlicensed devices in the Lower 900 MHz Band were as vulnerable to interference as commenters claim, then their vulnerability to change would raise serious security and reliability concerns warranting immediate attention. If unlicensed uses were not built to tolerate contentious frequency environments, existing licensed or unlicensed uses could disable systems. With off-the-shelf equipment and a small number of transmitters, an increase in the noise floor could be leveraged to create a ripple effect that causes substantial disruptions in utility services or transportation networks, leading to significant risks. In reality, of course, unlicensed devices are nowhere near as vulnerable as some of the commenters portray them to be and can support many important uses without risk of unacceptable interference.

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[111] *See* Matthew B. Shoemake & Chris Heegard, Alantro Communications, IEEE P802.11, *The Definition of Spreading and Coding and Their Relation to Processing Gain* (Mar. 11, 1998), https://bit.ly/4gwf2sG.

[112] John G. Proakis, Digital Communications 707-08 (3rd ed. 2016).

B. Commenters' Technical Information Supports Continued Unlicensed Operations.

In its Petition, NextNav proposed rules to enable a frequency-division duplex 5G NR system using a five-megahertz uplink and a 10-megahertz downlink configuration. NextNav provided draft rules to aid commenters in offering detailed assessments of compatibility with existing licensees and operations in the Lower 900 MHz Band.[113] 5G systems are also among the most exhaustively deployed and documented systems on Earth. According to the Global System for Mobile Communications, there are more than 250 commercial 5G networks worldwide, and Ericsson estimates more than 1 billion people had 5G subscriptions by the end of 2023.[114] Furthermore, the 5G NR standard has been thoroughly documented across several 3GPP releases with detailed specifications that span tens of thousands of pages and cover everything from physical layer ("PHY") protocols to network architecture and signaling procedures.[115] Leading academic journals have published countless research articles and technical guides that elaborate on 5G NR implementation, interoperability, and coexistence features. Given the exhaustive documentation in this proceeding and throughout the telecommunications sector, complaints from

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[113] *See* NextNav Petition; NextNav Petition Supplement.

[114] GSMA, *The Mobile Economy 2024* (2024), https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-economy/wp-content/uploads/2024/02/260224-The-Mobile-Economy-2024.pdf; *5G Mobile Subscriptions to Reach Close to 5.6 Billion in 2029*, Ericsson, https://www.ericsson.com/en/reports-and-papers/mobility-report/dataforecasts/mobile-subscriptions-outlook (last accessed Sept. 19, 2024).

[115] *See 5G NR is the Foundation to What's Next*, Qualcomm, https://www.qualcomm.com/research/5g/5g-nr#:~:text=5G%20New%20Radio%20(NR)%20is,and%20more%20responsive%20mobile%20experiences (last accessed Sept. 19, 2024); *5G System Overview*, 3GPP (Aug. 8, 2022), https://www.3gpp.org/technologies/5g-system-overview.

a handful of commenters that NextNav has somehow provided insufficient information about the planned 5G TPNT deployment ring hollow.[116]

Excuses for unrealistic assumptions in coexistence models fall similarly flat. The PrePass Safety Alliance ("PrePass"), for example, included in its comments a separate exhibit on the purported medical uses of the 902-928 MHz band.[117] In its exhibit, PrePass claimed that medical telemetry systems use the Lower 900 MHz Band to monitor vital patient data.[118] The appendix purported to identify the GE Healthcare ApexPro CH telemetry system as an example of the type of wireless medical telemetry systems that operates in the Lower 900 MHz Band.[119] In reality, however, the ApexPro CH website indicates the devices use only Wireless Medical Telemetry Service ("WMTS") spectrum for patient monitoring.[120] WMTS spectrum is a licensed-by-rule service that occupies the 608-614, 1395-1400, and 1427-1432 MHz bands.[121] The WMTS spectrum bands have nothing whatsoever to do with the Lower 900 MHz Band, and indeed the FCC identified the WMTS band precisely to avoid exposing patient monitoring services to contested radiofrequency environments. Remarkably, even the website for the device that PrePass

[116] *See, e.g.*, Comments of Neology, Inc. and Opposition to NextNav Inc. Petition for Rulemaking at 2, WT Docket No. 24-240 (Sept. 5, 2024) ("Neology Comments"); Georgia State Road and Toll Authority Comments at 1, WT Docket No. 24-240 (Sept. 5, 2024) ("GSRTA Comments"); Comments of Darricke Rayl, WT Docket No. 24-240 (Aug. 26, 2024), https://www.fcc.gov/ecfs/search/search-filings/filing/108262418107512.

[117] *Medical Uses of 902 to 928 MHz Band*, attachment to Comments of PrePass Safety Alliance, WT Docket No. 24-240 (Sept. 4, 2024) ("PrePass Medical Use Exhibit").

[118] *Id*.

[119] *Id*. at 3.

[120] *See ApexPro CH Telemetry System Expanding the Power of Telemetry*, GE HealthCare, https://www.gehealthcare.com/products/patient-monitoring/patient-monitors/apexpro-ch-telemetry-system (last accessed Sept. 19, 2024) ("ApexPro CH Telemetry System Webpage").

[121] *Wireless Medical Telemetry Service (WMTS)*, FCC, https://www.fcc.gov/wireless/bureau-divisions/mobility-division/wireless-medical-telemetry-service-wmts (updated Mar. 8, 2017).

cites as support for the proposition that the WMTS system uses the Lower 900 MHz Band shows exactly the opposite: the ApexPro CH website, a copy of which is reproduced below, includes a statement explaining why using WMTS spectrum is superior to using unlicensed spectrum to support dependable communication of vital patient information.[122]

Protected medical wireless spectrum

ApexPro CH telemetry offers a Wireless Medical Telemetry Service (WMTS)-protected, wireless patient monitoring system that helps protect against signal interference and dropout. The system operates in both the 608 to 614 MHz and 1395 to 1400 MHz ranges, giving you flexibility and scalability to reduce the possibility of external interference in any RF environment.

Read Less

Why WMTS instead of Wi-Fi?

According to the American Society for Health Care Engineering (ASHE) WMTS (Wireless Medical Telemetry Service) User Information Guide (V 10.1 December 2016) in the chapter titled "Why use WMTS?" considerations for use of WMTS spectrum (i.e., 608-614, 1395-1400, and 1427-1433 MHz) include:

- This is the only designated frequency spectrum for medical telemetry systems
- You are protected from interference due to other wireless devices
- There are comparatively fewer interference sources
- Both the FCC and FDA encourage use of WMTS
- Frequencies are coordinated to ensure interference-free operation

Read Less

The ApexPro CH website helpfully explains that wireless telemetry systems use WMTS because both the FCC and the FDA encourage the use of licensed WMTS spectrum to "help[] protect against signal interference."[123]

In a separate section of its comment filing, PrePass lists Wireless Patient Monitoring as a use case in the 902-928 MHz band and identifies Philips' IntelliVue telemetry systems as one product operating in the band.[124] But page 3 of the Philips' IntelliVue telemetry systems brochure

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[122] *See* ApexPro CH Telemetry System Webpage.

[123] *Id*.

[124] PrePass Medical Use Exhibit at 3.

suggests that the device actually uses the 1.4 GHz WMTS band, not the Lower 900 MHz Band.[125] The FCC's Equipment Authorization database likewise shows no Philips IntelliVue products are authorized for the 902-928 MHz band.[126] While Philips sold a home monitoring system that used a narrowband channel at 916.5 MHz to transfer readings from various medical devices to a central hub in the home so that information could be sent over a *phone line or 2G cellular connection* to the doctor nearly a quarter of a century ago, that system appears to be no longer in use because the FCC's equipment authorization database does not show any 3G or later version and most, if not all, 2G wireless systems have been retired.

Other commenters made similarly implausible, though less readily disproven, claims. The AICC, for example, claimed without citations to authority that the 900 MHz band supports unnamed medical monitoring devices that would leave patients facing paralysis if those devices cannot "timely relay" patient information to medical personnel.[127] ITS America likewise offered an unsupported assertion that the 900 MHz band "supports numerous retail and logistics capabilities, including […] wireless patient monitoring and medical device management in healthcare …"[128] Similar unsupported claims litter the record and may well be tied to PrePass's demonstrably untrue statements about WMTS use of the band.[129]

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[125] Philips, *Always in Touch, IntelliVue Telemetry System with Smart-hopping Technology, Surveillance of Ambulatory Cardiac Patients*, at 3 (2008), https://www.documents.philips.com/doclib/enc/fetch/2000/4504/577242/577243/577247/582646/583147/IntelliVue_Telemetry_System_Brochure_(US_only).pdf.

[126] *See OET Laboratory Division Equipment Authorization System (EAS)*, FCC , https://apps.fcc.gov/oetcf/eas/ (last accessed Sept. 19, 2024).

[127] AICC Comments at 15.

[128] Comments of Intelligent Transportation Society of America at 2, WT Docket No. 24-240 (Sept. 5, 2024) ("ITS Comments").

[129] The Z-Wave Alliance, for example, claimed that "Americans with disabilities use Z-Wave assistive technologies to automate their homes and monitor their health." Comments of Z-Wave

Whatever the genesis of these and other commenters' unsupported reliance on false, misleading, or out-of-date information, the FCC's Public Notice has served its purpose, which is to inform and to attract comments from all relevant stakeholders. NextNav is particularly grateful to those parties that have provided information about their use of the Lower 900 MHz Band and specific technical details about that use.[130] Even more encouraging is this: the technical analyses provided by commenters suggest that coexistence between NextNav's NextGen technology and unlicensed services is entirely possible once realistic assumptions are used. The coexistence possibilities between NextNav's NextGen system and unlicensed users are, of course, fact-specific, and depend on a multitude of factors such as desired signal level at the intended receiver,

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Alliance at 9, WT Docket No. 24-240 (Sept. 5, 2024) ("Z-Wave Alliance Comments"). Z-Wave provided no support for this purported use, and its website has no real information about this ostensible use case. *See generally* Z-Wave Alliance Comments. For their part, Open Technology Institute, Public Knowledge, and other public interest organizations list one of the 900 MHz use cases as, "[a]ssisted living through remote nurse-check ins and AI insights on patient behavior monitoring and alert devices that can enable aging populations to live alone safely." Comments in Opposition of Open Technology Institute at New America, Public Knowledge, *et al*. at 17, WT Docket No. 24-240 (Sept. 5, 2024) ("OTI Comments"). But their citation to a Z-Wave Alliance webpage that contains a total of 26 words used like hashtags for page views does not actually identify any hospital use of this product. *See id*. at 17 & n.50; *Market and Use Cases: Assisted Living + Home Services*, Z-Wave Alliance, https://z-wavealliance.org/market_use_case/assisted-living-home-services/ (last accessed Sept. 20, 2024). Elsewhere, the public interest organizations cited to a Medtronic Diabetes webpage for additional support, but the relevant webpage only shows a table of products and possible sources of interference. *See* OTI Comments at 15 & n.37; *Equipment Interference*, Medtronic, https://www.medtronicdiabetes.com/customer-support/equipment-interference (last accessed Sept. 19, 2024) ("Medtronic Equipment Interference Webpage"). Note 2 to the table lists the same frequencies that appear in the organizations' filing; however, note 2 appears to no longer apply to any of the products listed because, unlike other notes, note 2 no longer appears anywhere in the table. *See* Medtronic Equipment Interference Webpage. Absent additional information, it seems likely that the iPro line of products has either been discontinued or renamed because there is incomplete information on the Medtronic website referring to it.

[130] In contrast, WISPA, for example, does not include a single example of a WISP operating in the Lower 900 MHz Band, despite the fact that NextNav reached out to WISPA before comments were filed and asked for information about frequency, geography, use case, and technology. *See generally* WISPA Comments.

interference level experienced by the same receiver, underlying technologies and features, network geometry, and other environmental and operational factors. That said, unlicensed operations incorporate concrete technical features that can support coexistence:

RAIN RFID and Other FHSS-Based Technologies. FHSS transmitters and receivers hop among available narrowband frequencies within a wide channel in a pseudo-random sequence to resist interference and jamming.[131] Several unlicensed use cases in the Lower 900 MHz Band rely on FHSS technologies, including smart metering, P2P/P2MP radios, Supervisory Control and Data Acquisition, and RFID.

RFID systems identify and track tags attached to objects, often inventory. RFID devices operate at three different types of frequency ranges: low frequency (125 kHz to 135 kHz), high frequency (13.56 MHz) and ultra-high frequency (860 MHz to 960 MHz).[132] Ultra-high frequency RFID products, also referred to as "RAIN RFID," operate in the Lower 900 MHz Band in the United States. Commenters report that 80 billion items have been tagged with RAIN RFID tags in the United States.[133] Pursuant to section 15.247 of the Commission's rules, these devices use FHSS techniques across multiple channels in all or part of the 902-928 MHz band to mitigate interference from licensed and unlicensed users in the band.[134]

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[131] *See supra* at 28.

[132] *See* IMPINJ, *Types of RFID Systems*, https://www.impinj.com/products/technology/how-can-rfid-systems-be-categorized (last accessed Sept. 20, 2024).

[133] *See, e.g.*, Comments of Tageos Inc. at 2, WT Docket No. 24-240 (Aug. 12, 2024); Joint Comments of RAIN Alliance Inc. and AIM Inc. at 4, WT Docket No. 24-240 (Sept. 5, 2024) ("RAIN Alliance Inc. and AIM Inc. Comments"); Comments of Process Expert, Inc. at 1, WT Docket No. 24-240 (Sept. 5, 2024); Comments of SICK AG at 1, WT Docket No. 24-240 (Sept. 5, 2024); *see also* Comments of Avery Dennison Corporation on and Opposition to NextNav Inc. Petition for Rulemaking at 3, WT Docket No. 24-240 (Sept. 5, 2024).

[134] *See* 47 C.F.R. § 15.247; RAIN Alliance, *RAIN RFID System Design Guidelines Air Interface and Protocol Considerations*, 15 (May 2020), https://rainrfid.org/wp-content/uploads/2020/05/RAIN-Alliance-System-Design-Guidelines-V.1.0.pdf. ("RAIN RFID Design Guidelines").

In the RAIN RFID system, the interrogator/reader uses back-scatter from the tags in the same frequency channel for communication from tag to reader. The Slotted Aloha protocol is used for channel access by tags. To minimize collisions, tags, when queried in by the reader, randomly choose a slot in which to transmit within the maximum number of available slots.[135] When a collision is detected by the reader, the reader initiates retries through a random backoff scheme managed by the reader. The RAIN standard also allows for system configuration options to tradeoff throughput for higher resiliency to interference. For example, in some implementations,[136] dense reader modes along with a higher number of Miller-modulated sub-carriers per bit setting, may be used to improve resilience to interference.[137] These features will help the RAIN RFID system operate in the presence of bursty or transient interference in those channels overlapping the 5G system. For example, if bursty and transient interference on one frequency causes tag inventory or another communication process to fail due to interference from a 5G transmission, the same transaction could be re-tried in other channels, or the reader can use more robust reader modes to mitigate the interference.

The FHSS operation of RAIN RFID devices makes several comments about the potential effect of NextNav's terrestrial PNT proposal on RAIN RFID puzzling indeed. Boeing, for example, claims NextNav's proposal would somehow render the company's "entire RFID system inoperative."[138] Boeing makes this claim even though RAIN RFID systems use frequency hopping

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[135] *EPC® Radio-Frequency Identity Generation-2 UHF RFID Standard Specification for RFID Air Interface Protocol for Communications at 860 MHz – 930 MHz*, Release 3.0 (Jan. 2024), https://ref.gs1.org/standards/gen2/.

[136] James Skinner, *Reader Modes (RF Modes) Made Easy*, Impinj Support (Apr. 5, 2022), https://support.impinj.com/hc/en-us/articles/360000046899-Reader-Modes-RF-Modes-Made-Easy.

[137] *See* RAIN RFID Design Guidelines at 7.

[138] Comments of Boeing Company at 3, WT Docket No. 24-240 (Sept. 5, 2024).

spread spectrum technology that can hop across the entire band for the purpose of mitigating interference. And Boeing persists with its assertion even though NextNav has proposed to *lower* power in a five-megahertz segment of the band. Even if one were to ignore all of the 5G NR interference-mitigation techniques, such as beam forming, beam steering, channel control, adaptive modulation, power control, and more, based on Boeing's filing, it is unclear how NextNav's proposal could render Boeing's frequency-hopping RAIN RFID system "completely inoperable."

The RAIN Alliance Inc. and AIM Inc. ("RAIN Alliance") offer a similarly flawed analysis that, once updated with realistic assumptions, suggests there will be meaningful opportunities for coexistence between NextNav and their products. The RAIN Alliance provides a co-channel downlink interference analysis purporting to show that "absent an obstructed (e.g., dense buildings) separation distance of more than 11 kilometers, RAIN Readers are likely to experience harmful interference from a NextNav base station operating pursuant to the rules proposed in the Petition."[139] The analysis states that harmful interference will take place if the 5G signal level at the RAIN RFID device is higher than ~-80 dBm.

NextNav has reviewed this analysis and finds the level of interference projected to be extremely unlikely. The analysis makes several highly atypical assumptions about 5G deployment scenarios, which uniformly produce an increase in the resulting levels of interference. As one example, the analysis assumes boresight-to-boresight geometry, which fails to account for the significant reduction in interference that will occur in practice due to the off-axis gains of 5G transmitting antennas and the RAIN reader's receiving antennas. As another, the analysis assumes that the 5G base stations will operate at the maximum power level permitted in the proposed rules,

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[139] RAIN Alliance Inc. and AIM Inc. Comments at 10-12.

which would rarely occur under real-world equipment and deployments. Moreover, despite acknowledging that approximately 50% of RAIN RFID tags are deployed in retail,[140] the RAIN Alliance analysis did not factor in any Building Penetration Loss to 5G signals when they reach the RAIN readers. The path loss due to wall penetration can be 20 dB or higher in the 3GPP specifications and ITU-R recommendations, and additional path loss is added depending on the incident angle of the signal hitting the outside wall and the user equipment's location or, in 3GPP's parlance, its "depth" inside the building, including the number of interior walls the signal must penetrate.[141] A realistic analysis would have to correct for at least three egregious errors in RAIN Alliance's assumption. It would have to first use something other than a highly improbable boresight-to-boresight geometry, then relax the implausible assumption of maximum power operations, and next address the complete absence of any commonplace building penetration loss. Putting aside other errors and omissions in the RAIN Alliance's analysis too numerous to list here, accounting for just these three issues would mean that a RAIN receiver would be unlikely to receive power in the 5G downlink strong enough to cause harmful interference. Simply accounting for basic shortcomings will eliminate the risk of interference the RAIN Alliance claims to fear and, at a minimum, cause the probability of interference to RAIN RFID systems to plummet far below the levels that the RAIN Alliance's highly atypical assumptions generate.

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[140] *Id*. at 6. The RAIN receivers may be deployed in a warehouse which can result in an additional propagation loss for the 5G signal.

[141] *See* 3GPP, *3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Study on Channel Model for Frequencies from 0.5 to 100 GHz (Release 17)*, 3GPP TR 38.901 v. 17.1.0, 32, tbl. 7.4.3-3 (Dec. 2023), https://www.etsi.org/deliver/etsi_tr/138900_138999/138901/17.00.00_60/tr_138901v170000p.pdf; *Recommendation ITU-R P.2109-2 (08/2023)*, ITU-R, Annex 1, https://www.itu.int/dms_pubrec/itu-r/rec/p/R-REC-P.2109-2-202308-I!!PDF-E.pdf.

The extreme assumptions continue elsewhere in RAIN Alliance's analysis. For example, the RAIN Alliance's assumed tower height for NextNav's 5G partners' base stations of 100 meters, which is much taller than most 5G base stations and is not consistent with parameters in 4G and 5G specifications such as 3GPP TR 36.873 or TR 38.901.[142] The analysis also understated the signal level of RFID links, which can be substantially higher than those of the downlink 5G signal, often by orders of magnitude.[143] The RAIN Alliance itself has said that even a 10-fold signal level difference between interfering signal and RFID signal is sufficient for avoiding harmful interference.[144] This means the level of the 5G downlink signal the reader can overcome is a function of the received signal strength at the reader from the tags, and that signal could often be significantly stronger than the -70 dBm level the RAIN Alliance assumed in its analysis.[145]

Most importantly, the RAIN Alliance analysis does not discuss the significant mitigating effects that FHSS would have in scenarios where the RAIN readers experience interference in only some portion of the band, which is a capability specifically designed to allow RAIN systems to continue to operate in the presence of interference. When frequency hopping systems experience interference on a channel, they simply hop to another channel.

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[142] In these specifications, the base station height is 25 meters for what is referred to as the urban macro scenario.

[143] The range for RFID technology is targeted at up to 40 feet. Due to this relatively short range of communication, the received signal power of the RFID signal can be better than ~-30 dBm for one way communication and -40 dBm for two-way communication using passive technology. In contrast, the nominal power of the downlink 5G signal can be at ~-80 dBm for a good signal. Such signal strength would be reached in the frequency range corresponding to the downlink signal between 918 to 928 MHz. Outside this frequency range, the strength of the 5G signal is expected to be substantially lower.

[144] RAIN Alliance Inc. and AIM Inc. Comments at 10-12.

[145] *See id*.

For these reasons, the RAIN Alliance analysis does not accurately represent the potential for coexistence between NextGen and RAIN devices in the band and, indeed, even modest gestures toward actual operating parameters, cause the RAIN Alliance analysis to suggest a very promising coexistence picture for RFID operations in the band.

Z-Wave. According to the Z-Wave Alliance, Z-Wave is "the most widely used wireless protocol for the smart home and Internet of Things ('IoT') industries."[146] Several commenters report that there are 4,500 Z-Wave certified devices on the market operating in the 908 MHz portion of the Lower 900 MHz Band.[147] The Z-Wave system is based on Frequency-shift Keying and Gaussian Frequency Shift Keying modulation schemes for the "classic" Z-Wave and the DSSS processing and Offset Quadrature Phase Shift Keying (OQPSK) modulation scheme for the Z-Wave Long Range ("LR"). The classic Z-Wave system operates at fixed frequency channels at 908.42 and 916 MHz. According to the Z-Wave LR specification, Z-Wave LR allows for selection between 912 MHz and 920 MHz channels with 920 MHz as the backup channel for LR operation.[148] The Z-Wave standard specifies a clear channel assessment (listen-before-talk) capability that detects other transmissions in the channel to manage channel use.[149] In addition, MAC protocol supports re-transmission when the channel is not clear when the acknowledgement is not received. This listen-before-talk capability along with message acknowledgments provides

[146] Z-Wave Alliance Comments at 1.

[147] AICC Comments at 4-5; Z-Wave Alliance Comments at 4.

[148] *See* Z-Wave Alliance, *Z-Wave Alliance Announces New Z-Wave Long Range Specification* (Sept. 8, 2020), https://z-wavealliance.org/z-wave-alliance-announces-new-z-wave-long-range-specification/; Z-Wave Alliance, *What is Z-Wave Long Range and How Does it Differ from Z-Wave?*, https://bit.ly/3MO0tmS (last accessed Sept. 19, 2024); Silicon Labs, *How to Set Up Z-Wave Long Range* (Aug. 3, 2021), https://community.silabs.com/s/article/how-to-set-up-z-wave-long-range?language=en_US.

[149] *See Recommendation G.9959 (01/15)*, ITU-T, https://www.itu.int/rec/T-REC-G.9959-201501-I/en.

a mechanism for co-existence with other systems including unlicensed and licensed systems that might interfere with the Z-Wave system. In addition, the classic Z-Wave supports multi-hop mesh networking,[150] creating multiple redundant communicating paths between each end device and controller hub to support robust connectivity. In a mesh network, Z-Wave devices act as repeaters for one another, strengthening connectivity and boosting signal level.

Some Z-Wave proponents make a peculiar claim that Z-Wave is not subject to common interference and congestion because it uses the 900 MHz band, rather than other common unlicensed bands.[151] Certainly, greater interference and congestion in other unlicensed bands could have been motivation for Z-Wave to use the 900 MHz band, but cannot be a valid reason to oppose NextNav's planned 5G TPNT system in the interest of preserving whatever temporary conditions Z-Wave may have come to enjoy.

The Z-Wave Alliance also provided a technical appendix that includes a simplistic comparison of RF propagation under the current rules and under NextNav's proposed power limits. The Z-Wave Alliance's appendix is unavailing. First and foremost, the Z-Wave technology uses four frequencies in the United States: 908.42 MHz and 916 MHz for classic Z-Wave and 912 MHz and 920 MHz for LR Z-Wave.[152] Of these, only the backup LR channel, 920 MHz, overlaps with NextNav's proposed band plan. The other frequencies used in the U.S. will be in the adjacent band where 5G power levels will be out-of-band and much lower than in-band levels. Therefore,

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[150] *See* Silicon Labs, *Introduction of Z-Wave* (Sept. 1, 2021), https://community.silabs.com/s/article/Introduction-of-Z-Wave?language=en_US.

[151] *See* AICC Comments at 15, Z-Wave Alliance Comments at 4.

[152] Z-Wave Alliance, *Z-Wave Alliance Frequency and Region List* (July 5, 2022), https://sdomembers.z-wavealliance.org/document/dl/965; Anson Huang, *Z-wave Long Range (LR)*, Silicon Labs (Feb. 23, 2021), https://www.silabs.com/documents/public/presentations/tech-talks-design-with-z-wave-to-extend-wireless-range-1-mile.pdf..

co-channel operation with Z-Wave may only apply to one backup channel of the four channels used in the United States.

Second, the Z-Wave Alliance did not account for additional losses due to propagation through building walls, even though typical Z-Wave deployments are indoors. Third, the Z-Wave Alliance failed to account for the high probability that a Z-Wave device would not be aligned with the azimuth, polarization, and down-tilting of the 5G base station antenna array. Fourth, the analysis does not include any Z-Wave receiver characteristics needed to quantify the potential for harmful interference. Fifth, a 5G system's base stations and devices do not produce "persistent interference"[153] because of the bursty and transient nature of 5G network traffic. More realistic modeling would show that NextNav's NextGen technology would not interfere with Z-Wave devices and support the conclusion that coexistence with NextNav's proposed network is feasible.

LoRaWAN. LoRa is a physical layer, wireless communication technique based on Chirp-Spread-Spectrum ("CSS") used for IoT applications in conjunction with MAC and upper-layer LoRaWAN protocols.[154] CSS is a modulation technique that uses chirp signals to encode data. The number of chips per bit is called the spreading factor. The larger the spreading factor, the slower the over-the-air data rate, the better the receiver sensitivity, and the longer the potential communication range. LoRaWAN radios use this over-the-air modulation method by sweeping across the channel bandwidth. Therefore, LoRaWAN frames can be received well under the noise floor.[155] LoRaWAN systems generally exhibit a low duty cycle and remain, generally, an uplink-

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[153] Z-Wave Alliance Comments at 17.

[154] LoRa Alliance, *LoRa and LoRaWAn*, https://resources.lora-alliance.org/home/lora-and-lorawan (last accessed Sept. 20, 2024).

[155] *See* ETSI TR 103 526 V1.1.1, System Reference Document (SRdoc), Technical Characteristics for Low Power Wide Area Networks Chirp Spread Spectrum (LPWAN-CSS) Operating in the

dominated technology.[156] While the current LoRaWAN system uses full duplex frequency-division duplexing in the U.S., the LoRaWAN specifications are flexible and support various channel configurations, including half-duplex.[157] The LoRaWAN channel configuration in the United States has 64 uplink channels numbered 0 to 63 utilizing 125 kHz BW varying from DR0 to DR3 starting at 902.3 MHz and incrementing linearly by 200 kHz to 914.9 MHz, 8 upstream channels numbered 64 to 71 utilizing 500 kHz BW at DR4 starting at 903.0 MHz and incrementing linearly by 1.6 MHz to 914.2 MHz and 8 downstream channels numbered 0 to 7 utilizing 500 kHz BW at DR10 to DR13 starting at 923.3 MHz and incrementing linearly by 600 kHz to 927.5 MHz.[158] To better manage interference on the uplink, Carrier Sense Multiple Access ("CSMA") technology has been recommended to check if the channel is clear before transmission.[159]

The majority of these uplink channels also do not overlap with NextNav's proposed 5G TPNT uplink band, and where they do, NextNav's proposed rules, if adopted, would significantly lower the radiated power limit.

Because the LoRaWAN downlink overlaps NextNav's proposed 5G downlink, the LoRa Alliance provided a brief analysis concluding that 5G base stations will cause interference to

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UHF Spectrum Below 1 GHz (Apr. 2018), https://www.etsi.org/deliver/etsi_tr/103500_103599/103526/01.01.01_60/tr_103526v010101p.pdf.

[156] Pietro Spadaccino et al., *LoRaWAN Behaviour Analysis through Dataset Traffic Investigation*, 22 Sensors (Basel) 2470 at Table 3 (2022), https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9003208/.

[157] LoRa Alliance Technical Committee Regional Parameters Workgroup, *LoRaWAN 1.0.3 Regional Parameters* (July 2018), https://lora-alliance.org/wp-content/uploads/2020/11/lorawan_regional_parameters_v1.0.3reva_0.pdf.

[158] LoRaWAN also supports 8 uplink LR FHSS channels with 1.523 MHz bandwidth.

[159] *See* LoRa Alliance, *TR013-1.0.0 Carrier Sense Multiple Access (CSMA)*, https://resources.lora-alliance.org/technical-recommendations/tr013-1-0-0-csma (last accessed Sept. 20, 2024).

LoRaWAN devices within 5 kilometers.[160] This analysis once again relies on several unrealistic, worst-case assumptions, the combination of which is extremely unlikely to ever occur. The analysis, for example, assumed boresight-to-boresight geometry and failed to account for the significant reduction in interference that will occur in practice due to the lower off-axis gains of the 5G transmitting antenna. The analysis also assumed LoRaWAN operation at its minimum receiver sensitivity at all times, in conjunction with constant transmissions from 5G base stations at the full power level permitted by NextNav's proposed rules. In reality, LoRaWAN operation will typically have signal levels well in excess of the receiver's minimum sensitivity, and 5G base station transmissions will most often vary with traffic well below full power.

The lack of realism in the technical analysis provided by the LoRa Alliance can be seen by using the Alliance's methodology and assumptions to consider the apparent impact to LoRa devices from another Part 15 system operating at 4 W EIRP in 500 kHz bandwidth and overlapping the LoRa downlink.

The LoRa Alliance's analysis considered interference to a 200 kHz LoRa downlink channel and the interference power generated by a 5G base station operating at 1000 W/MHz ERP in a 200 kHz channel is one fifth of 1000 W/MHz or 200 W/200 kHz ERP. Converting the unlicensed power limit of 4 W EIRP to ERP gives ~2.5 W ERP, and under the current rules, an unlicensed transmission of 2.5 W ERP in 500 kHz bandwidth would produce a power of 2.5 W/ (500/200) = 1 W ERP in a 200 kHz channel. Thus, the interfering power of the unlicensed device is less than the 200 W/200 kHz ERP used in the LoRa Alliance's calculation by $10\log_{10}(200/1)$ = ~23 dB. The interference impact of an unlicensed interferer that is 23 dB weaker than an alleged 5G interferer can be assessed by using the received power curve provided in Annex 2 of the LoRa Alliance's

[160] Comments of LoRa Alliance at Annex 2, WT Docket No. 24-240 (Sept. 5, 2024).

submission and shifting the curve downward by 23 dB. According to the LoRa Alliance, the interference threshold for LoRa is -120 dBm/200 kHz and the 23 dB shifted received power curve crosses the -120 dBm line at about 1 kilometer on the x-axis. Thus, according to the LoRa Alliance's analysis, every LoRa device requires about one kilometer of separation from every other co-channel unlicensed device to operate. It seems highly unlikely that LoRa devices require that much separation given the uncontrolled nature and high density of other Part 15 devices in the 902-928 MHz band, as detailed by numerous commenters in this proceeding.

Smart Meters. Smart meters built by Itron and other manufacturers operate in the Lower 900 MHz Band. While Itron claims that it would be "irreversibly impacted adversely if the Commission were to adopt NextNav's proposals,"[161] Itron already employs substantial interference mitigation systems. Frequency hopping protocols used by smart meters are designed to work around interference sources such as those from existing unlicensed/licensed users or the proposed NextNav systems. Smart meters further utilize multi-node meshing protocols, such as the IPv6 Routing Protocol for Low-Power and Lossy Networks, which can route data to avoid localized sources of interference and through lesser impacted nodes.[162] Smart meters utilizing the IEEE 802.15.4g/e wireless PHY and MAC layers incorporate multiple provisions to further mitigate interference including a positive data acknowledgment and Carrier-Sense Multiple Access with Collision Avoidance ("CSMA/CA") protocol with retry mechanism to ensure delivery of a data packet when a transmission is affected by bursty interference.[163] Itron itself continues to

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[161] Itron Comments at 7.

[162] *See* M. Banaszek *et al.*, *RPL at Scale: Experiences from a Performance Evaluation on up to 700 IEEE 802.15.4 Devices*, https://www.carloalbertoboano.com/documents/banaszek24rpl.pdf (last accessed Sept. 20, 2024).

[163] *See* Silicon Labs, *UG235.02: Using Silicon Labs Connect v2.x with IEEE 802.15.4*, https://www.silabs.com/documents/public/user-guides/ug235-02-using-connect-with-ieee-802-15

tout the ability of its Riva CENTRON meter which uses IEEE 802.15.4g/e to "dynamically select the optimal link based on channel conditions and the target QoS."[164]

Furthermore, two aspects of smart meter operation make the use inherently more conducive to coexistence than Itron portrays—namely, the low endpoint duty cycle and the non-real time nature of the data. The duty cycle of smart meter transmissions is extremely low, on the order of <1% or even much less, according to real-world measurements.[165] This characteristic, in conjunction with the bursty and transient nature of 5G network traffic, has the effect of eliminating interference risk and significantly reducing the probability of any interference impact over the course of a fixed period of user time such as a day, week, or month. For many applications, the data carried between a smart meter and a collection/processing point is not used in true real time such as in milliseconds or seconds. Examples of this include demand response systems where customer notifications may be on the order of "a day ahead, or as quickly as a few minutes."[166] Companies such as Itron use application protocols such as Message Queuing Telemetry Transport ("MQTT") and the Constrained Application Protocol ("CoAP") which contain application-level

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-4.pdf (last accessed Sept. 20, 2024); NXP, *IEEE 802.15.4 Stack User Guide* (June 22, 2016), https://www.nxp.com/docs/en/user-guide/JN-UG-3024.pdf.

[164] *OpenWay® Riva CENTRON® Polyphase Meter*, Itron, https://na.itron.com/o/commerce-media/accounts/-1/attachments/3812681.

[165] Richard A. Tell & Christopher A. Tell, Richard Tell Associates, Inc., *An Evaluation of Radio Frequency Fields Produced by Smart Meters Deployed in Vermont* (Jan. 14, 2013), https://publicservice.vermont.gov/sites/dps/files/documents/Electric/Smart_Grid/Vermont%20DPS%20Smart%20Meter%20Measurement%20Report%20-%20Final.pdf.

[166] *Demand Response 101: Everything You Need to Know*, ENEL (May 2, 2023), https://www.enelnorthamerica.com/insights/blogs/demand-response-101-everything-you-need-to-know.

message retransmission capabilities which for non-real-time applications, can be used in conjunction with the lower layer wireless protocol methods to further enhance co-existence.[167]

The smart meter market also has wireless communication options outside of the 902-928 MHz band, such as those which support private and public cellular connectivity. The evidence suggests that the use of other radiofrequency bands is both supported and likely to accelerate. Smart meters offering connectivity using cellular technologies such as Cat-M, which operate at frequencies outside the 902-928 MHz band, are now available from major suppliers such as Itron and Landis+Gyr.[168] Furthermore, these suppliers are positioning cellular-based devices as having important advantages versus older technologies that operate in the 902-928 MHz band. For example:

- The Itron OpenWay CENTRON Cellular LTE-M meter with "improved coverage, deeper in-building penetration, higher capacity, and longer network longevity"[169]
- Landis+Gyr offering their Gridstream® Connect Cellular Communication Solution which "can be used to fill gaps in RF coverage without costly network infrastructure build-out, or to exponentially increase data capacity for high-end PLC consumers" and to "streamline network management, optimize coverage, and lower TCO"[170]

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[167] *See* EMQX, *MQTT QoS 0, 1, 2 Explained: A Quickstart Guide* (Jan. 12, 2023), https://www.emqx.com/en/blog/introduction-to-mqtt-qos#qos-1-at-least-once; Z. Shelby *et al.*, *The Constrained Application Protocol (CoAP)* (June 2014), https://www.rfc-editor.org/rfc/rfc7252.html; Itron, *MQTT Introduction* (May 11, 2020), https://www.youtube.com/watch?v=Fq8-8q7pmL8.

[168] Landis+Gyr, *Gridstream® Connect Cellular Communication Solution* (July 2020), https://www.landisgyr.com/webfoo/wp-content/uploads/2020/09/LG_Gridstream-Connect-Cellular-Solution-Brochure-Final-digital.pdf; *OpenWay CENTRON Cellular LTE-M*, Itron, https://na.itron.com/products/openway-centron-cellular-lte-m (last accessed Sept. 19, 2024).

[169] *OpenWay CENTRON Cellular LTE-M*, Itron, https://na.itron.com/products/openway-centron-cellular-lte-m (last accessed Sept. 19, 2024).

[170] Landis+Gyr, *Gridstream® Connect Cellular Communication Solution* (July 2020), https://www.landisgyr.com/webfoo/wp-content/uploads/2020/09/LG_Gridstream-Connect-Cellular-Solution-Brochure-Final-digital.pdf.

As members (and in the case of Itron, board members) of the Utility Broadband Alliance ("UBBA"), smart meter vendors Itron and Landis+Gyr have voiced support for meter solutions using private cellular networks "using standards-based LTE broadband technology."[171] Indeed, the UBBA has selected Itron to test advanced metering solutions using private cellular spectrum provided by Anterix at 896-901 MHz / 935-940 MHz and Omega Wireless in a 600 MHz band configuration.[172] Through their membership in UBBA, Itron, and Landis+Gyr have supported the February 2024 (Anterix-led) coalition petition to the Commission for expanded smart meter use of licensed spectrum, entitled "Expanding Broadband Opportunities in the 896-901/935-940 MHz Band."[173]

This timing of the smart meter industry support for cellular also appears to be aligned with an upcoming smart meter upgrade cycle in the U.S. With a typical lifespan of approximately 15-20 years,[174] smart meters deployed prior to 2011 may be considered targets for an upcoming replacement cycle. This represents a substantial portion of the smart meters currently deployed.[175]

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[171] *Advancing Safety and Resiliency for Critical Infrastructure Through Private Broadband Solutions*, UBBA, https://www.ubba.com//wp-content/uploads/2022/03/UBBA_Brochure-2022.pdf.

[172] Kelly Hill, *Itron to Test Private Cellular for Smart Metering*, RCR Wireless News (Aug. 28, 2024), https://www.rcrwireless.com/20240828/internet-of-things/itron-to-test-private-network-for-smart-metering.

[173] Ameren Services Co. et al. Petition for Rulemaking, INBOX-1.401 (Feb. 28, 2024): https://www.fcc.gov/ecfs/document/10229148220602/1; Reply Comments of The Utility Broadband Alliance, WT Docket No. 24-99 (May 20, 2024); Letter from John Griebling, Itron, Inc., *et al*. to Marlene H. Dortch, Secretary, FCC, WT Docket No. 24-99 (May 2, 2024).

[174] *See* Itron Comments at 9; SkyVision Solutions, *A Summary of "Useful Life" Values for Smart Electric Usage Meters (smartgridawareness.org)*, https://smartgridawareness.org/wp-content/uploads/2018/09/summary-of-smart-meter-useful-life-values.pdf (Sept. 2018).

[175] Yue Gao et al., *A Spatial Analysis of Smart Meter Adoptions: Empirical Evidence from the U.S. Data*, 14 Sustainability 1126 (2022), https://www.mdpi.com/2071-1050/14/3/1126.

With these meters nearing the end of their useful lives, the licensees thus have an opportunity window to adopt cellular-based meter connectivity solutions in line with the natural update cycle.

Perhaps Itron's Ty Roberts, VP Marketing and Network Solutions, said it best when he stated "We will see far more cellular being deployed [for electric AMI] in the next few years, maybe a little longer. The market will shift from mostly mesh to mostly cellular."[176]

Keyless Entry. Most keyless entry operations occur in other frequency bands, but certain systems operate in the Lower 900 MHz Band under Part 15 of the Commission's rules.[177] Operators of these systems have noted that coexistence with NextNav's proposed NextGen system is possible,[178] and NextNav has been actively engaging with these operators to discuss coexistence planning. Like other Part 15 devices in the band, keyless entry systems should, and as commenters have shown, are, designed to operate in a highly contested spectrum environment and accept interference from other devices.[179] While more studies are needed to fully assess the various coexistence possibilities between these systems and NextNav's NextGen system under the proposed new band plan, the initial analysis that an operator of these systems has submitted in the record suggests the feasibility of continued operations.[180]

Amateurs. Hundreds of individual amateur radio operators as well as "the nation's standard-bearer in amateur affairs," the American Radio Relay League ("ARRL"), expressed

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[176] James Blackman, *Smart Meters – The Most Important 'Thing' in the Internet of Things (a Creation Story)*, RCR Wireless News, https://bit.ly/3BaNZmJ (last accessed Sept. 19, 2024).

[177] *See* Comments of American Honda Motor Co., WT Docket No. 24-240 (Sept. 5, 2024) ("Honda Comments").

[178] *See* Honda Comments at 2.

[179] *See* Honda Comments at 1 (recognizing that "as a Part 15 device operator, we cannot claim interference rights").

[180] *See* Honda Comments.

concerns about the effect of NextNav's proposal on amateur radio. Most of the comments provide short statements of generalized concern. The ARRL, for example, said it had studied the issues but did not provide its supporting analysis. Nonetheless, ARRL claimed that interference would be "inevitable" and urged additional safeguards to protect amateur operators who "already too frequently cannot be accommodated in this band."[181] NextNav has contacted ARRL in an effort to secure additional technical details from amateurs about their use of the band to support further analysis to explore the potential for continued operations.

In the weeks to come, NextNav will continue to analyze these comments and may contact groups of unlicensed and amateur users with additional questions, to the extent it has not already.

IV. DISCUSSIONS CONTINUE WITH OTHER LICENSEES IN THE BAND.

NextNav contacted more than three dozen organizations and shared technical details about its proposal, as over a dozen comments acknowledged.[182] NextNav is aiming for solutions that minimize potential disruptions to existing licensed operations while enabling the benefits of its proposed terrestrial PNT system. NextNav continues to engage in technical discussions with incumbent licensees to exchange information regarding operating parameters and work together toward potential joint test plans.

Although operations vary by entity, the licensed non-M-LMS incumbent systems in the Lower 900 MHz Band can be generally categorized into two main segments: (1) freight railroad

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[181] AARL Comments at 2-4.

[182] *See, e.g.*, Comments of 6C Coalition at 3, WT Docket No. 24-240 (Sept. 5, 2024) ("6C Comments"); E-ZPass Comments at 8 GSRTA Comments at 2; Comments of Illinois State Toll Highway Authority, WT Docket No. 24-240 at 9-10(Sept. 5, 2024) ("IL Tollway Comments"); Opposition of the International Bridge, Tunnel & Turnpike Association at 16–17, WT Docket No. 24-240 (Sept. 6, 2024) ("IBTTA Comments"); Comments of Kapsch TrafficCom, WT Docket No. 24-240 at 2 (Sept. 4, 2024) ("Kapsch Comments"); Comments of Port Authority NY NJ Comments at 3, WT Docket No. 24-240 (Sept. 4, 2024) ("Port Authority Comments"); Comments of United Bridge Partners (& subsidiaries) at 2, WT Docket No. 24-240 (Sept. 6 2024) ("UBP Comments").

systems,[183] and (2) tolling and vehicle identification systems. With respect to freight railroad systems, NextNav is in discussions with the Association of American Railroads ("AAR") to assess the full scope of AAR-member operations in the band and best address interference concerns between its members' automatic equipment identification ("AEI") networks and NextNav's proposed operations. Broadly, NextNav understands that every fixed licensed location along the railroads' mainline track and within intermodal yards has a minimum of two AEI antennas, one on each side of the track. Each additional track employs two additional antennas, meaning three tracks in a multitrack location would have six antennas, each operating at different frequencies. Two potential interference scenarios follow: (1) from 5G base stations to a reader; and (2) from mobile devices to a reader. Both coexistence scenarios are aided by factors including: the reader locations on railroad property are distanced from general population in most circumstances, the natural obstruction provided by the train against interference given the proximity of the antennas, and the use of passive tags. Another concern is that railroad systems currently use at least three frequencies *within* the proposed downlink band. These frequencies may need to be re-tuned.[184] Other concerns that have been identified include non-retunable crystal-controlled fixed frequency transmitters, the minimum frequency separation requirements of existing or new AEI equipment, and the complexity of retuning or deploying new systems along railroad rights-of-way. To address

[183] According to the FCC's Universal Licensing System, of the 1,916 active licenses in the 902-928 MHz band, the railroads hold approximately 750 licenses. *See Universal Licensing System*, FCC, https://www.fcc.gov/wireless/universal-licensing-system (last accessed Sept. 20, 2024).

[184] The FCC encourages that receivers authorized for use should be designed to mitigate interference to mitigate receive overload. *See In re Principles for Promoting Efficient Use of Spectrum and Opportunities for New Services, Policy Statement*, ET Docket Nos. 23-122 and 22-137, 38 FCC Rcd 3682, 3686-3687 ¶¶ 12-14 & n.18 (2023) (noting that "interference is not solely a function of transmitter emissions" and "[a]ccordingly, receiver characteristics, especially the dynamic range of desired and undesired power over which receivers are designed to operate, can be as important as transmitter characteristics in enabling efficient spectrum use and co-existence among different services").

these railroad industry concerns, NextNav is in discussion with MxV, a subsidiary of AAR that conducts railroad equipment testing, to explore the possibility of performing empirical testing at their outdoor test track facility. The goal of possible testing is to better understand the potential impact of NextNav's proposal on AAR members' existing lower 900 MHz licensed and unlicensed network assets.

As for tolling systems, roughly 21 tolling service operators and vendors filed comments in response to the Public Notice.[185] Many operators highlight the revenue and capital investments of their business models and share their concern that more technically advanced 5G + TPNT systems may cause harmful interference to toll-collection systems.[186] NextNav appreciates the feedback submitted to date. NextNav would also like to reassure each of the toll-collection operators and vendors that, as explained in NextNav's Petition and again in its opening comments, NextNav expects to have to ensure each licensed incumbent can continue to provide service for its

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[185] *See, e.g.*, 6C Comments at 1; Comments of California Toll Operators Committee at 1, WT Docket No. 24-240 (Sept. 4, 2024) ("CTOC Comments"); E-ZPass Comments at 1; GSRTA Comments at 1; Golden Gate Bridge, Highway and Transportation District at 1, WT Docket No. 24-240 (Sept. 4, 2024); IL Tollway Comments at 1; IBTTA Comments at 1; ITS Comments at 1; Kapsch Comments at 1; Los Angeles County Metropolitan Transportation Authority Comments, WT Docket No. 24-240 at 1 (Aug. 30, 2024) ("LCMTA Comments"); Neology Comments at 1; Comments of OmniAir Consortium, Inc., WT Docket No. 24-240 (Sept. 5, 2024); PA Turnpike Comments at 1; Port Authority Comments at 1; Comments of PrePass Safety Alliance at 1, WT Docket No. 24-240 at 1 (Sept. 5, 2024) ("PrePass Comments"); Comments of Riverside County Transportation Commission at 1, WT Docket No. 24-240 (Aug. 22, 2024); Comments of TransCore, WT Docket No. 24-240 (Sept. 5, 2024) ("TransCore Comments"); UBP Comments at 1; Washington State Department of Transportation Comments, WT Docket No. 24-240 at 1 (Sept. 4, 2024) ("WSDOT Comments"); Comments of Western Regional Toll Operators at 1, WT Docket No. 24-240 (Sept. 4, 2024) ("WRTO Comments"); Comments of Wisconsin Motor Carriers Association at 1, WT Docket No. 24-240 (Sept. 5, 2024) ("WMCA Comments").

[186] *See, e.g.*, 6C Comments at 3; E-ZPass Comments at 8; GSRTA Comments at 2-5; IL Tollway Comments at 2; IBTTA Comments at 9-12; Kapsch Comments at 2; PA Turnpike Comments at 1-2; Port Authority Comments at 3; UBP Comments at 1; Neology Comments at 5; CTOC Comments at 1; PrePass Comments at 1; WMCA Comments at 1; LCMTA Comments at 1; WRTO Comments at 1; WSDOT Comments at 1.

customers.[187] Finally, NextNav would like to reiterate its intention to offer support that minimizes disruption and maximizes opportunity for toll-collection interests to sustain and grow their businesses alongside the use of the band for terrestrial PNT and 5G.[188] Achieving this objective will require detailed technical exchanges that have only begun.

NextNav identified four potential interference scenarios involving tolling and vehicle identification systems that could disrupt tolling transactions: (1) base station to reader interference; (2) base station to vehicle tag interference; (3) mobile device to reader interference; and (4) mobile device to vehicle tag interference. NextNav is reviewing each interference scenario to minimize disruption to operators. As one example, active tags run on battery and are expected to provide "several years of operation without battery replacement."[189] As some commenters note, however, potential interference via mobile devices to the tags (scenario 4) could result in faster depletion of battery life due to increased, unintended wakeups outside of a toll plaza area if the proposed network is deployed.[190] Based on NextNav's analysis, this theoretical concern seems unlikely to pose a serious challenge because reader pulses and 5G NR bands are widely different waveforms; however, testing promises to provide clear answers and offer concrete solutions.

Some commenters express concern about co-channel interference based on a downlink separation assumption of 100 meters.[191] But most frequency overlap simply is not co-channel.

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[187] Petition at 30-32; NextNav Comments at 23-25; *In re Review of the Commission's Rules Governing the 896-901/935-940 MHz Band*, Report and Order, Order of Proposed Modification, and Order, 35 FCC Rcd 5183-5217 ¶¶ 66-67 (2020) (explaining relocated licensees have to receive "comparable facilities").

[188] Petition at 31, 38-40, Exhibit A – Technical Appendix, A-3; NextNav Comments at 23-25.

[189] E-ZPass Comments at 15.

[190] *See, e.g.*, *id*. at 15; IBTTA Comments at 14-15.

[191] *See* Neology Comments at 6; IBTTA Comments at 12; PA Turnpike Comments at 2.

Tolling frequences will not overlap NextNav's proposed uplink unless operators use 902-904 MHz, and tolling entities have not advised they operate in that range.[192] And while some current tolling frequencies above 918 MHz overlap with NextNav's proposed downlink, the expectation is that those frequencies will be retuned where data and analysis prove that retuning is necessary.

Other commenters provide more detailed analysis, but their submissions suffer from faulty assumptions that uniformly disfavor coexistence. PrePass, for example, specifies received signal levels only before the receive antenna's gain, rather than accounting for attenuation in the antenna and uses free space loss as opposed to more realistic models that account for clutter.[193] The PrePass submission also ignores other material losses attributable to system geometry, antenna gain patterns and polarization mismatch.[194]

A more detailed example drawn from PrePass's data can help illustrate how faulty assumptions can lead to erroneous conclusions. The PrePass analysis states that the signal at the reader received from the tag is -64 dBm; the signal from a current NextNav beacon is -26.9 dBm; and the signal from a NextNav-proposed 5G base station will be -8.7 dBm.[195] These assumptions not only fail to account for the receive antenna gain, but also assume boresight-to-boresight geometry from a base station, which is extremely unlikely. If interference occurs at all, it will occur at the receiver, which cannot receive either the desired or undesired (interfering) signal until both have passed through the antenna. But because tolling antennas are directional and aimed

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[192] The tolling entities have cautioned that the railroads may use that spectrum, but rail operators' use of that spectrum has not been confirmed.

[193] PrePass Comments at 3-4. Free space loss represents a worst-case scenario and is generally acceptable where l00 meters line-of-sight separation exists, which is very unlikely to occur in this scenario.

[194] *Id.*

[195] *Id.*

down toward the target vehicle's tag, the desired signal from the tag will see the maximum antenna gain. The planned 5G TPNT antennas, by comparison, will generally be higher than tolling gantries, the interfering signal will come to the tolling antenna from above, and thus will always see much less gain than the desired signal. Off-axis differences in the horizontal plane will often add to the gain difference. Therefore, the desired and undesired signals received at the tolling receiver will be starkly different than is implied in PrePass's analysis.[196] In addition, the TPNT signal that is in-band to the tolling receiver will be much lower than PrePass assumes, because it is an out-of-band (not in-band) emission. NextNav's proposed rules are consistent with the rules for other sub-1 GHz bands, such as 600 MHz, 700 MHz, and 850 MHz and offer many opportunities for coexistence with tolling operations.[197]

While several tolling entities voice concern about the prospects of technological change in a band with established operations, the Commission's Public Notice provides a way forward. Commenters will want to provide information and technical analysis in light of the detailed technical specifications for a 5G system that NextNav provided. Some commenters have done so.[198] Many have not.[199]

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[196] *Id.* at 3-5.

[197] *See* NextNav Comments at 24-26.

[198] *See, e.g.*, PrePass Comments at 3-4 (explaining PrePass bypass tags "are licensed Part 90 devices with EIRP (Effective Isotropic Radiated Power) <10mW and receive sensitivity of -34 dBmd."); PA Turnpike Comments at 1-2 (noting that +23 dBm from proposed uplink may interfere with windshield mounted tags; higher sensitivity of ASTMv6 truck weigh stations; and reduction to 11 MHz would impair frequencies needed for backscatter with multiple readers at a single location); TransCore Comments at 2 (same); IBTTA Comments at 14-20 (noting concern over depletion of battery in active tags; effect on urban congestion relief measures; successful "read" timing, attempts, and error expectations); E-ZPass Comments at 11-13 (similar).

[199] *See, e.g.*, WRTO Comments at 2 ("The proposed changes would also significantly constrain future electronic tolling deployments, blocking planned expansions by state and local authorities."); Kapsch Comments at 2 (noting generally that technical aspects are "concerning").

Providing performance data and analysis in this proceeding or, more properly, as part of a notice of proposed rulemaking would allow the Commission to move past generalized apprehension and toward a more informed and data-driven discussion of how to solve for it.[200] A notice of proposed rulemaking would permit the Commission to gather detailed public input, assess specific proposals, and craft targeted solutions informed by evidence and stakeholder expertise.

Finally, a few tolling entities express concern that NextNav did not contact each of them prior to submitting its Petition or claim that NextNav failed to acknowledge how NextNav's proposal could affect their businesses.[201] NextNav's Petition anticipated that toll operations could be affected by the company's proposal, and NextNav explained that, consistent with longstanding Commission practices, modernization of the M-LMS spectrum would have to ensure that incumbent site-by-site licensees can continue to operate.[202] NextNav also contacted the primary associations that serve toll providers, including the E-ZPass Group and IBTTA, prior to filing the Petition or its appearance on the Public Notice. While it was neither feasible nor required to contact every tolling provider directly prior to submitting its Petition, NextNav stands ready to engage in discussions with any provider who wishes to do so. The purpose of a public notice is to

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[200] 47 C.F.R. § 1.407; *see, e.g.*, *In re Connect America Fund*: *A National Broadband Plan for Our Future High-Cost Universal Service Support*, Notice of Proposed Rulemaking, 37 FCC Rcd 6728, 6729, 6769 ¶¶ 1, 121 (2022) (seeking comments to determine if high-quality broadband can be deployed, including targeted inquiry into management and administration of program).

[201] *See, e.g.*, IL Tollway Comments at 10 ("NextNav has not contacted the Tollway independently to discuss potential impacts, its test results, or any potential protections it could offer or that might be feasible."); PrePass Comments at 5 ("NextNav has not reached out to PrePass Safety Alliance nor any of the organizations, associations, or coalitions it has contacted on this matter.").

[202] Petition at 30-37.

encourage stakeholder participation and elicit feedback.[203] The Public Notice of NextNav's Petition has done just that. NextNav anticipates that the parties who have come forward with concerns will engage in constructive cooperation to help ensure a sound regulatory decision.[204]

NextNav's next-generation terrestrial PNT offers considerable public interest benefits, ranging from enhanced national security and public safety to improved wayfinding and transportation services.[205] While more work remains to be done, engaging with NextNav's proposal with operating specifications and empirical evidence informed by reasonable assumptions will help ensure stakeholders' interests are fully and fairly addressed.

CONCLUSION

The United States is racing to identify a terrestrial backup and complement to GPS. While GPS represents an invaluable national asset, low-power, space-based signals are susceptible to jamming, spoofing, and interference. These vulnerabilities pose a risk to consumers, public safety, and critical infrastructure that only the rapid deployment of a robust, commercially scaled terrestrial backup can mitigate. Rapid deployment of a widescale terrestrial backup system would provide resilience by ensuring that PNT services are available even if GPS signals are degraded or unavailable and would help bring the United States in line with its foreign rivals, who are deploying their own terrestrial backups.

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[203] 47 C.F.R. §§ 1.403, 1.405; *Definitions of EDOCS Terms*, FCC, https://www.fcc.gov/edocs/definitions-edocs-terms (updated Feb. 14, 2024) ("Public notices contain information to inform the public promptly and succinctly about a wide variety of Commission actions."); *See* Maeve P. Carey, Cong. Rsch. Serv., R46190, *Petitions for Rulemaking: An Overview*, at 9 (Jan. 23, 2020), https://sgp.fas.org/crs/misc/R46190.pdf.

[204] 47 C.F.R. § 1.405.

[205] Petition at 8-16; NextNav Comments at 3-7.

Against this backdrop, NextNav's Petition offers a unique opportunity to solve a vexing national problem: the lack of a widescale terrestrial PNT backup and complement to GPS. By acting quickly and decisively to put the Lower 900 MHz Band into service for the public good alongside existing users, the Commission can protect consumers and businesses against disruptions, promote public safety, preserve critical infrastructure, and support emerging technologies. Technical analyses that use realistic assumptions indicate that both licensed and unlicensed users can continue to operate. NextNav is committed to being a good neighbor in the Lower 900 MHz Band and encourages stakeholders to continue sharing their expertise and insights, believing that a cooperative approach is essential to achieving an outcome that best serves the public interest.

As technology evolves, the Commission's rules must evolve along with it. Swiftly acting on NextNav's proposal for terrestrial PNT backup and complement to GPS will help address the needs of American consumers and businesses for resilient geolocation infrastructure and once again position the United States as the global technology leader in geolocation and broadband deployment and operations.

Respectfully submitted,

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September 20, 2024