

**Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554**

In the Matter of)	
)	
LightSquared Technical Working Group Report)	IB Docket No. 11-109
)	
LightSquared License Modification Application, IBFS Files Nos. SAT-MOD-20120928-00160, -00161, SES-MOD-20121001-00872)	IB Docket No. 12-340
)	
New LightSquared License Modification Applications IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091)	IB Docket No. 11-109; IB Docket No. 12-340
)	
Ligado Amendment to License Modification Applications IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091)	IB Docket No. 11-109
)	

**PETITION FOR RECONSIDERATION OR CLARIFICATION OF THE
NATIONAL TELECOMMUNICATIONS AND INFORMATION ADMINISTRATION**

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TABLE OF CONTENTS

I. INTRODUCTION.....	1
II. DISCUSSION.....	2
a. The <i>Ligado Order</i> Failed to Satisfactorily Address and Resolve Executive Branch Concerns Regarding the Risks of Harmful Interference to GPS	3
b. The FCC should acknowledge that further technical studies and testing are needed to ensure that Ligado’s actual terrestrial network would not cause harmful interference to GPS and other authorized services.....	12
c. The <i>Ligado Order’s</i> Conditions Must be Significantly Modified to Adequately Prevent or Remediate Harmful Interference to Federal GPS Devices	14
III. CONCLUSION	18

SUMMARY

Pursuant to section 405(a) of the Communications Act of 1934, as amended, and section 1.106 of the Commission’s rules, the National Telecommunications and Information Administration (NTIA), on behalf of the executive branch, particularly the Department of Defense (DoD) and the Department of Transportation (DoT), respectfully petitions the Commission to reconsider or, in the alternative, to clarify its *Order and Authorization* in the above-captioned proceedings.¹ NTIA also requests that the Commission rescind its approval of the mobile satellite service (MSS) license modification applications conditionally granted to Ligado Networks LLC (Ligado), which will cause irreparable harms to federal government users of the Global Positioning System (GPS).²

Separately, NTIA is seeking a stay in the proceedings to prevent Ligado from deploying its network until this petition is addressed and harmful interference concerns are resolved.³ A stay is appropriate because the Commission should meaningfully test its new and unproven harmful interference metric and overhaul unworkable grant conditions prior to deployment. It is crucial that the Commission acknowledge that further technical studies and testing must be undertaken to ensure that Ligado’s actual terrestrial network would not cause harmful interference to GPS and other authorized services before it is authorized to operate anywhere.

¹ See 47 U.S.C. § 405(a); 47 C.F.R. § 1.106; 47 U.S.C. § 902(b)(2)(J) (delegating to NTIA the “responsibility to ensure that the views of the executive branch on telecommunications matters are effectively presented to the Commission”). See also In the Matter of Ligado Amendment to License Modification Applications IBFS File Nos. SES-MOD-20151231-00981, SAT-MOD-20151231-00090, and SAT-MOD-20151231-00091, *Order and Authorization*, IB Docket No. 11-109, FCC 20-48 (Apr. 22, 2020) (*Ligado Order*).

² Those harms significantly outweigh the public interest benefits summarized in the *Ligado Order*. See *Ligado Order*, paras. 19-24.

³ See NTIA Petition for Stay, IB Docket No. 11-109 (filed May 22, 2020); see also Letter from Senators Inhofe, Reed *et al.*, at 2 (May 15, 2020), available at <https://go.usa.gov/xvS9t>.

This petition focuses on the problems in the *Ligado Order* that are uniquely related to the interests of DoD and other federal agencies and their mission-critical users of GPS. However, we also note that the Commission failed to consider the major economic impact its decision will have on civilian GPS users and the American economy.⁴ As the lead civil agency for GPS, DoT explained in the enclosed letter that Ligado's proposed operations would disrupt a wide range of civil GPS receivers owned and operated by emergency first responders, among others.⁵

Throughout the pendency of the LightSquared and Ligado applications and modifications thereto, various federal agencies and interagency groups have worked diligently to evaluate the difficult technical and regulatory issues raised by these applications and their potential impact on GPS.⁶ With regard to Ligado's December 2015 applications (amended in May 2018), NTIA's Office of Spectrum Management (OSM) solicited technical inputs from the federal agency member representatives and experts who serve on the IRAC. NTIA submitted into the record of this proceeding materials and information on the harms Ligado's operations would cause.⁷

⁴ See Letter from Douglas W. Kinkoph, Acting Deputy Assistant Sec'y for Commc'ns and Info., NTIA, to Hon. Ajit Pai, Chairman, FCC, IB Docket Nos. 11-109 and 12-340 (Dec. 6, 2019), available at <https://go.usa.gov/xvS5r> (NTIA Dec. 6, 2019 Letter).

⁵ See Letter from Steven G. Bradbury, DoT Acting Deputy Sec'y and Gen. Counsel, to Peter Tenhula, Deputy Assoc. Adm'r, Office of Spectrum Mgmt., NTIA, IRAC Doc. 44219 (Nov. 22, 2019) (Attachment 1 hereto). NTIA provided this letter directly to the FCC's Liaison Representative to the Interdepartment Radio Advisory Committee (IRAC).

⁶ See, e.g., Letter from Karl Nebbia, Assoc. Adm'r, Office of Spectrum Mgmt., NTIA, to Julius Knapp, Chief, Office of Eng'g and Tech., FCC, IB Docket Nos. 11-109 and 12-340 (July 1, 2014), available at <https://ecfsapi.fcc.gov/file/7521358954.pdf>; Letter from Lawrence E. Strickling, Assistant Sec'y of Commerce for Commc'ns and Info., U.S. Dep't of Commerce, to Hon. Julius Genachowski, Chairman, FCC (Feb. 14, 2012), available at <https://go.usa.gov/xvSnn> (NTIA Feb. 14, 2012 Letter).

⁷ On December 6, 2019, NTIA submitted into the record of this proceeding information on the likely detrimental economic and technical impacts that Ligado's proposal will have on GPS. See NTIA Dec. 6, 2019 Letter and enclosures.

I. INTRODUCTION

GPS has long been a critical technology that has supported national security, public safety, law enforcement, emergency first responders, critical infrastructure, and a variety of other uses by the general public. The GPS services that our military, other mission-critical users, and consumers depend on every day for life and livelihood are threatened if the low-power GPS satellite signals and their associated spectrum environment are not adequately protected from disruption. Degradation of these signals by new, terrestrial-only adjacent band operations will have a detrimental effect on military forces conducting critical Homeland Defense missions and their training for combat in the United States.

As recent DoD congressional testimony makes clear, ground-based transmitters adjacent to the GPS spectrum have significant potential to disrupt and degrade the operation of the approximately one (1) million GPS receivers in the DoD inventory, and therefore bring harm to military training, readiness, and DoD's ability to conduct operations.⁸

The *Ligado Order* acknowledged the need to ensure adjacent band GPS operations are sufficiently protected from harmful interference, but it prioritized the provision of “regulatory certainty to Ligado” to create a “path forward for Ligado” to harness its MSS network and ancillary terrestrial operations to deploy a low-power terrestrial network in support of industrial

⁸ See Testimony of Gen. John W. Raymond, Chief of Space Operations, U.S. Space Force, and Commander, U.S. Space Command, before the Committee on Armed Services, U.S. Senate, at 3 (May 6, 2020), available at https://www.armed-services.senate.gov/imo/media/doc/Raymond_05-06-20.pdf; Testimony of Dana Deasy, Dep't of Defense Chief Information Officer, before the Committee on Armed Services, U.S. Senate, at 6 (May 6, 2020), available at https://www.armed-services.senate.gov/imo/media/doc/Deasy_05-06-20.pdf.

IoT services and custom private network solutions over that need.⁹ The Commission found that it was “in the public interest to grant [Ligado’s] modification applications to facilitate the deployment of a low power terrestrial-based network in its licensed MSS spectrum” subject to a number of conditions that are intended to address any identified potential harmful interference concerns before ATC network operations commence.¹⁰

As the *Ligado Order* notes, NTIA previously stated during the LightSquared phase of this proceeding that interference concerns raise important spectrum management issues, requiring the Commission, NTIA, and the agencies working together to “strik[e] the right balance between interference caused by transmitters and the performance of GPS receivers.”¹¹ NTIA continues to urge the Commission, working with all stakeholders, to explore appropriate actions to mitigate the adverse impact on GPS and other receivers that would prevent the full utilization of spectrum to meet the nation’s broadband needs. To adequately fulfill the NTIA and FCC’s joint spectrum management responsibilities, more work here is required.

II. DISCUSSION

There are a number of procedural and substantive flaws in this proceeding and *Ligado Order*. The FCC repeatedly refused to consider the impact of the broader regulatory and policy issues under consideration in this proceeding, including national implications for GPS capabilities and alleged 5G benefits, through appropriate notice and comment rulemaking.¹² The

⁹ *Ligado Order*, paras. 1, 20, 156.

¹⁰ *Id.* at para. 2; *see also, e.g., id.* at paras. 18, 126, 157, 158.

¹¹ *Id.* at paras. 6 and 59, n. 216 (quoting NTIA Feb. 14, 2012 Letter at 6).

¹² *See, e.g.,* LightSquared Subsidiary LLC Request for Modification of its Authority for an Ancillary Terrestrial Component, SAT-MOD-20101118-00239, Call Sign S2358, *Order and Authorization*, 26 FCC Rcd. 566, 576-77, para. 20, and 585, para. 38 (IB Jan. 26, 2011) (providing a curt explanation that “the relief that [the International Bureau] grant[s] falls squarely within that provided in a licensee-specific waiver”).

Ligado Order effectively modifies the Commission’s MSS/ATC rules and policies for the L-Band, and these now should be addressed in that context subject to independent technical assessment and evaluation.

a. The *Ligado Order* Failed to Satisfactorily Address and Resolve Executive Branch Concerns Regarding the Risks of Harmful Interference to GPS

The *Ligado Order* failed to adequately consider and give appropriate weight to important and valid executive branch concerns about harmful interference to GPS. The Commission has a long and respectful history of coordinating closely with NTIA and generally deferring to the judgement and expertise of NTIA and other federal agencies, especially in matters affecting GPS or national security and defense. For example, in 2005 as part of the “genesis of this proceeding,”¹³ the Commission committed to coordinating “any change” requested by the MSS/ATC licensee with NTIA and other government agencies “to assure adequate protection of the GPS.”¹⁴ Then, when confronted with such a change requested by LightSquared, the Commission, through the International Bureau, kept its commitment to coordinate with NTIA and other federal agencies, ultimately proposing to disallow LightSquared’s request after NTIA concluded that there was no practical way to mitigate the potential interference to GPS from LightSquared’s then-planned nationwide mobile broadband network.¹⁵

¹³ *Ligado Order*, para. 3 (citing Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-Band, and the 1.6/2.4 GHz Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz Bands, *Report and Order and Notice of Proposed Rulemaking*, IB Docket Nos. 01-185 and 02-364, 18 FCC Rcd. 11030 (Feb. 3, 2003), *modified by Order on Reconsideration*, 18 FCC Rcd. 13590 (July 3, 2003), *reconsidered in part in Memorandum Opinion and Order and Second Order on Reconsideration*, 20 FCC Rcd. 4616 (Feb. 10, 2005)).

¹⁴ *Memorandum Opinion and Order and Second Order on Reconsideration*, IB Docket No. 01-185, 20 FCC Rcd. 4616, 4642, para. 71 (Feb. 25, 2005).

¹⁵ See International Bureau Invites Comment on NTIA Letter Regarding LightSquared Conditional Waiver, *Public Notice*, IB Docket No. 11-109, DA 12-214, at 4 (Feb. 15, 2012)

Other occasions when the Commission accepted NTIA's recommendations to ensure FCC regulations ensured adequate protection of GPS were in the context of authorizing ultra-wideband (UWB) devices and imposing limits on base stations in the 700 MHz band to suppress interference from second harmonics to GPS and other Global Navigation Satellite Systems (GNSS).¹⁶

Outside of the GPS-protection context, the *Ligado Order* represents an unexplained break from the healthy respect that NTIA and the executive branch have generally received from the Commission.¹⁷ This history of excellent cooperation has recently led to repurposing of federal spectrum in the 3550-3650 MHz band (Citizens Broadband Radio Service) and the 1695-1780 MHz bands (Advanced Wireless Services). As an additional example, in January 2011, the Commission, in response to a letter from NTIA's Office of Spectrum Management, on behalf of the Federal Aviation Administration (FAA), stayed the effective date of a new rule that

available at <https://www.fcc.gov/document/comment-sought-letter-ntia-regarding-lightsquared-network>.

¹⁶ See Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems, *First Report and Order*, ET Docket No. 98-153, 17 FCC Rcd. 7435, 7460, para. 65, 7470, para. 94, 7482, para. 132 (Apr. 22, 2002), *on reconsideration Memorandum Opinion and Order and Further Notice of Proposed Rule Making*, ET Docket No. 98-153, 18 FCC Rcd. 3857, 3863, para. 12 (Mar. 12, 2003). See also Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communications Through the Year 2010, *Third Memorandum Opinion and Order and Third Report and Order*, WT Docket No. 96-86, 15 FCC Rcd. 19844, 19889, para. 75 (Oct. 10, 2000) (noting the Congressional obligation to "protect the integrity of the [GPS] frequency spectrum against interference and disruption" (citing H.R. Conf. Rep. 105-746, Making Appropriations for the Dep't of Defense for the Fiscal Year Ending Sept. 30, 1999, 105th Cong., 2nd Sess, at 166-67 (Sept. 25, 1998), and the Commercial Space Act of 1998, Pub. L. No. 105-303 (Oct. 28, 1998))).

¹⁷ See *Ligado Order*, paras. 122-23 (quoting and referencing Memorandum of Understanding Between the FCC and NTIA (Jan. 31, 2003) and NTIA's "several formal responses in this proceeding" going back to 2011); see also 47 U.S.C. § 922 (National spectrum allocation planning).

prohibited emergency locator transmitters (ELTs) that transmit distress alerts on 121.5 MHz.¹⁸ Notwithstanding strong support for the rule by search and rescue authorities and their termination of satellite processing of distress signals from 121.5 MHz ELT beacons, the Commission sided with NTIA and FAA to stay the rule and augment the record with more recent data.¹⁹

In another case, in response to an urgent request from NTIA on behalf of DoD in 1997, the Commission relocated the Digital Electronic Message Service (DEMS) from the 18 GHz band to the 24 GHz band to ensure better protection of military satellite systems from harmful interference.²⁰ In light of the important military functions and sensitive national security interests, the Commission, on an expedited basis, amended its rules to accommodate NTIA and DoD's request, resulting in a win-win situation as not only were sensitive military operations protected, but this collaborative action had the practical effect of resolving potential interference concerns between non-federal satellite services and DEMS operations at 18 GHz.

Finally, in the only court case addressing a dispute about the protection of the federal government's access to the radio spectrum, the D.C. Circuit in 1959 overwhelmingly supported the FCC's actions respecting the "National trust and responsibility" provided to the President by

¹⁸ See Review of Part 87 of the Commission's Rules Concerning the Aviation Radio Service, *Order*, WT Docket No. 01-289, 26 FCC Rcd. 685 (Jan. 11, 2011).

¹⁹ See Review of Part 87 of the Commission's Rules Concerning the Aviation Radio Service, *Third Further Notice of Proposed Rule Making*, WT Docket No. 01-289, 28 FCC Rcd. 512 (Jan. 8, 2013); see also *Ex Parte* Comments of NTIA, WT Docket No. 01-289 (Feb. 5, 2014), available at <https://ecfsapi.fcc.gov/file/7521071297.pdf>.

²⁰ See Amendment of the Commission's Rules to Relocate the Digital Electronic Message Service from the 18 GHz Band to the 24 GHz Band and to Allocate the 24 GHz Band For Fixed Service, *Order*, 12 FCC Rcd. 3471 (Mar. 14, 1997), recon. denied, *Memorandum Opinion and Order*, 13 FCC Rcd. 15147 (July 17, 1998).

Section 305 of the Communications Act (since delegated to NTIA).²¹ In that case, at the request of the White House’s Office of Defense Mobilization (one of a long line of NTIA’s predecessor organizations), the FCC denied non-federal access to the 420-450 MHz band, changing its allocation based on the “determination by the Commission that the Government need is paramount and vitally transcends non-Government use of the frequencies here involved, even assuming the very substantial public interest in and need for [the system proposed by Bendix].”²² In upholding the FCC’s action on behalf of the executive branch, the court recognized “the depth of the conflict between the demands of the Executive on the one hand and of private but important non-Government entities on the other” and found that “the action complained of reflects compliance with the position of the Executive taken in the national interest.”²³

In this case, however, the *Ligado Order* markedly broke from this long history of productive collaboration as well as prior commitments and precedents, notwithstanding strong direct pleas from an Executive Committee established by the President, as well as two Secretaries of Defense, in exercising their statutory responsibilities to “provide for the sustainment of the capabilities of [GPS], and the operation of basic GPS services, that are beneficial for the national security interests of the United States.”²⁴ The *Ligado Order*, in two footnotes, rejected inputs from a cabinet secretary, as well as his statutory obligations, because they “do not provide any mention or discussion of any technical analyses in the record in this

²¹ *Bendix Aviation Corp., Bendix Radio Div. v. FCC*, 272 F.2d 533, 540 (D.C. Cir. 1959), *cert. denied sub nom. Aeronautical Radio, Inc. v. U.S.*, 361 U.S. 965 (1960).

²² *Id.* at 536.

²³ *Id.* at 539-40.

²⁴ 10 U.S.C. § 2281(a); *see* Letter from Mark T. Esper, Sec’y of Defense, to Hon. Ajit Pai, Chairman, FCC (Nov. 18, 2019) and Letter from Patrick M. Shanahan, Acting Sec’y of Defense, to Hon. Ajit Pai, Chairman, FCC (June 7, 2019).

proceeding”²⁵ nor “divest the Commission of its broad and well-established spectrum management authority over spectrum allocated for commercial use under Title III of the Communications Act.”²⁶ The *Ligado Order* ignored, however, the Communications Act purposes “of the national defense” and “of promoting safety of life and property through the use of . . . radio communications.”²⁷

The *Ligado Order* summarily dismissed legitimate federal agency concerns and entirely disregarded a broad stock of valuable information and data developed and analyzed by NTIA and an IRAC working group – of which it is authorized by statute to “officially notice.”²⁸ Nor did the Commission request that NTIA submit more information for the record as contemplated by the “shared jurisdiction” exception to the Commission’s *ex parte* rules.²⁹

For example, in paragraph 52 of the *Ligado Order*, the Commission reverses its previous policy developed earlier in the LightSquared phase of the proceeding to protect GPS from

²⁵ *Ligado Order*, n. 176. Compare FCC Press Release, “What They Are Saying About Chairman Pai’s Order on L-Band Spectrum” (Apr. 20, 2020), available at <https://go.usa.gov/xvuXr>; Statement of Comm’r Brendan Carr on FCC Approval of Ligado L-Band Application to Facilitate 5G & IoT (Apr. 22, 2020), available at <https://docs.fcc.gov/public/attachments/FCC-20-48A2.pdf> (referencing statements of other cabinet secretaries).

²⁶ *Ligado Order*, n. 422 (citing “Ligado Apr. 12, 2020 *Ex Parte* at 8-10”, apparently a reference to the Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene Dortch, FCC Secretary, IB Docket Nos. 11-109 and 12-340 (Apr. 12, 2020), available at <https://go.usa.gov/xvu9W> (citing and quoting from three irrelevant court cases dealing with the preemption of state laws conflicting with the FCC’s jurisdiction)).

²⁷ 47 U.S.C. § 151. The Order also overlooked prior examples and cases where two competing federal statutes could be accommodated when afforded appropriate consideration. See, e.g., *supra* note 16 (deferring to a provision in DoD’s FY1999 appropriations) and *FCC v. Nextwave Personal Communications*, 537 U.S. 293, 304 (2003) (holding that section 525 of the federal Bankruptcy Code did not conflict with the Communications Act, and that the FCC’s policy preference did not rise to the level of a statutory conflict with section 525).

²⁸ 47 U.S.C. § 309(a) and (d)(2).

²⁹ 47 C.F.R. § 1.1204(a)(5) note.

“overload interference” by relying, in part, on Ligado’s mistaken assertions “that NTIA and the Air Force long ago agreed that GPS receivers were not entitled to protection outside of their designated band.”³⁰ The Commission could have taken official notice of a number of non-public IRAC documents that explain the condition placed on the Air Force certification of spectrum support for GPS Block II-F³¹ or it could have requested that the explanation, if it was relevant, be placed on the record at the appropriate time. The *Ligado Order* notes that this is “a contention that NTIA has not refuted.” NTIA hereby refutes this inaccurate (and, in fact, irrelevant) contention.

Furthermore, there is not and never was a “Memorandum of Understanding” or “formal position agreed to by the Air Force” as alleged in more recent Ligado filings.³² Rather, NTIA’s Office of Spectrum Management, in 2008, was concerned about the Air Force’s request for Stage 4 certification for GPS Block II-F and the out-of-band (OOB) effects of the MSS space vehicle (SV) transmissions operating below 1559 MHz on GPS L1 receivers with the wider bandwidth.”³³ In response, the Air Force addressed “GPS space receivers and the ‘-70/-90 dB limit’ on MSS OOB emissions in the 1559-1610 MHz band to see if there is any impact with a wider GPS bandwidth.”³⁴ The Air Force response did not address OOB effects of MSS ATC or

³⁰ *Ligado Order*, para. 52 (citing Ligado July 19, 2018 Reply at 18).

³¹ IRAC Doc. 37187/1 (July 27, 2009) states that “pursuant to an agreement between NTIA with the Air Force” the latter “shall not claim any additional protection *beyond the level of protection that has been previously established for GPS receivers* and is based upon a bandwidth of 24 MHz for the L1 and L2 space-to-Earth *transmissions*.” (Emphasis added and referencing IRAC Doc. 36545/1 (July 16, 2008)).

³² See *Ex Parte* Letter from Valerie Green, Executive Vice President and Chief Legal Officer, Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109, at 6 (Nov. 21, 2019), available at <https://go.usa.gov/xwq2z>; Ligado Apr. 12, 2020 *Ex Parte* at 6-7.

³³ Spectrum Planning Subcommittee (SPS) Doc. SPS-16889/1 (Feb. 23, 2009).

³⁴ *Id.* The “-70/-90 dB limit” was a reference to an “agreement” documented in a “GPS Protection Plan”, IRAC Doc. 36545/1 (July 16, 2008); see also Amendment of Parts 2 and 25 to

stand-alone terrestrial base station transmissions operating below 1559 MHz. Indeed, as NTIA told the Commission in January 2011, grant of the LightSquared waiver would “create a new interference environment” that no party had anticipated in the previous ATC rulemaking proceedings.³⁵

Similarly, the *Ligado Order*'s dismissal of the issues raised in the Air Force's February 2020 memorandum misconstrued whether and how Ligado's proposed reduction of power for its base stations applies to previous testing and analysis.³⁶ In 2018, NTIA engineers, in collaboration with FCC and other agency subject matter experts, evaluated all of the GPS measurement data collected over the years, including the raw data produced in DoT's ABC Assessment.³⁷ This data show that a vast number of GPS systems would still be impacted even under the reduced power and “guard band” ultimately adopted by the Commission. The testing data reveal that even very low power levels from a terrestrial system in the adjacent band will degrade the functionality and performance of very sensitive equipment required to receive and process GPS signals, resulting in a range of adverse effects such as loss of lock, reduced accuracy, position error, and increases in satellite acquisition/reacquisition time.³⁸ Instead, the *Ligado Order* gave inordinate weight to Ligado-funded tests and unproven metrics.

Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements, *Report and Order and Further Notice of Proposed Rulemaking*, 17 FCC Rcd. 8903, 8926, paras. 56-59, and 8929, para. 66 (May 14, 2002) (adopting NTIA's recommendations for 2 GHz MSS OOB emission limits).

³⁵ Letter from Lawrence E. Strickling, Assistant Sec'y for Commc'ns and Info., U.S. Dep't of Commerce, to Hon. Julius Genachowski, Chairman, FCC (filed Jan. 12, 2011).

³⁶ See *Ligado Order*, para. 100.

³⁷ DoT staff offered to share the raw data with FCC staff, an offer which we understand still stands.

³⁸ See Drocella Declaration attached hereto.

The *Ligado Order* relied on a “performance-based” metric for evaluating interference, but its asserted explanation for doing so cannot withstand scrutiny. NTIA continues to believe that testing based on the use and application of a 1 dB carrier-to-noise density ratio (C/N0) degradation metric is valid and should not be disregarded. Every single deficiency the Commission identifies for the 1 dB metric applies equally if not more to the *Ligado Order*’s preferred “performance-based” metric approach. For example, the Commission claims that a performance-based metric approach more closely aligns with the Commission’s “harmful interference” definition and is more reliable.³⁹ But this new, untested and unproven metric is not directly correlated with the definition of “harmful interference” either, particularly since “performance degradation” is an element of the definition of “interference” – not “harmful interference” as defined by the Commission, the International Telecommunication Union (ITU), and NTIA.⁴⁰

As the Commission correctly notes, “harmful interference” is different and distinct from the definition of “interference.”⁴¹ Because GPS is a radionavigation service, a reliable metric of predicted (or actual) “harmful interference” would need to show that the interference will be (or

³⁹ See *Ligado Order*, para. 36.

⁴⁰ See *Ligado Order*, para. 49 (citing and quoting 47 C.F.R. § 2.1(c): “‘harmful interference’ is “[i]nterference which *endangers the functioning of a radionavigation service* or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with [the ITU] Radio Regulations” (emphasis added)). See also *ITU Radio Regulations*, Art. 4, 4.10 (“Member States recognize that the safety aspects of radionavigation and other safety services require special measures to ensure their freedom from harmful interference; it is necessary therefore to take this factor into account in the assignment and use of frequencies.”).

⁴¹ See *Ligado Order*, n. 120 (citing and quoting 47 C.F.R. § 2.1(c): “interference” is “[t]he effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, *manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy*” (emphasis added)).

is) so bad that it will endanger (or “endangers”) the “functioning” of GPS. On the other hand, an interference protection criterion (IPC), like the 1 dB metric, is not intended to determine or quantify a level of actual “harmful interference”.⁴² Therefore, the Commission’s attempt to impose a new and untested IPC for GPS should not be relied upon until proven — and abandoned if it would not garner general consensus among scientific and engineering professionals.

A large group of U.S. Senators recently concurred with this concern, stating that “[s]etting a standard of not causing interference does not guarantee the performance and safety of their use with statistical certainty. A data driven performance based standard for what constitutes harmful interference guarantees the need for case-by-case reviews—which will require detailed technical consideration of geographic, temporal, atmospheric and other unique factors that could change on a daily if not hourly basis.”⁴³ Moreover, the devices and systems tested over the years may have likely been or will be replaced with an ever increasing inventory of new equipment, technologies, and expanded capabilities across a number of federal agencies, especially in the area of high precision receivers. For example, the National Geospatial-

⁴² An interference protection criterion or IPC is “a relative or absolute interfering signal level defined at the receiver input, under specified conditions such that the allowable performance degradation [of the receiver] is not exceeded.” See Alakananda Paul *et al.*, *Interference Protection Criteria Phase 1 - Compilation from Existing Sources*, at 2-2, NTIA Report 05-432 (Oct. 2005), available at <https://go.usa.gov/xwqaB>. See also U.S. Air Force, *Background Paper on Use of a 1-dB Decrease in C/N₀ as GPS Interference Protection Criterion* at 3 (July 2017), available at <https://www.gps.gov/spectrum/ABC/1dB-background-paper.pdf> (“An interference protection criterion . . . is developed to ensure that a *harmful interference* level is prevented in the first place, so that systems operating in the same or adjacent bands do not interfere with one another.”); Expanding Flexible Use of the 3.7 to 4.2 GHz Band, *Report and Order and Order of Proposed Modification*, GN Docket No. 18-122, FCC 20-22, at paras. 363, 382, and 388 (Mar. 3, 2020) (setting IPC of -6 dB interference to noise ratio for OOB emission limits).

⁴³ Letter from Senators Inhofe, Reed *et al.*, at 2 (May 15, 2020), available at <https://go.usa.gov/xvS9t>.

Intelligence Agency's (NGA) GPS Monitor Station Network (MSN) provides around-the-clock real-time monitoring, data collection, and quality review of each GPS space station.⁴⁴ The MSN requires the most precise tracking data possible and nearby low-power terrestrial signals could deafen these GPS receivers. Within the DoD, there are many types of embedded and stand-alone GPS receivers, including timing receivers, but it is NTIA's understanding that the department is planning to embark on the large undertaking of obtaining an accurate inventory of active and new GPS receivers and has offered to provide NTIA and Commission leadership and staff classified briefings on this effort and initial results.

b. The FCC should acknowledge that further technical studies and testing are needed to ensure that Ligado's actual terrestrial network would not cause harmful interference to GPS and other authorized services.

None of Ligado's latest mitigation proposals, nor the conditions based on them, have been tested or evaluated by any independent party. The two studies relied upon in the *Ligado Order* predate Ligado's May 2018 amendment and showed GPS receiver impacts.⁴⁵ The *Ligado Order* itself, in its comparative analysis of the various technical studies, demonstrated the existence of a substantial and material question of fact as to the appropriate metric for accurately predicting the likelihood of harmful interference to a range of protected GPS receivers.

A more scientific way of resolving these technical disputes could be accomplished through further joint FCC-executive branch or independent testing based on Ligado's actual network and base station parameters. In 2011, the FCC's International Bureau conditioned the

⁴⁴ See NGA Products and Services, Global Positioning System Support, <https://www.nga.mil/ProductsServices/GeodesyandGeophysics/Pages/GPSSupport.aspx>.

⁴⁵ See *Ligado Order*, paras. 13, 37-38.

LightSquared grant on the satisfactory resolution of GPS interference concerns through a multi-stakeholder working group.⁴⁶ NTIA does not recommend trying that approach again.

As it has done previously on at least two occasions, at the direction of Congress, the Commission in consultation with NTIA could provide for a truly independent technical evaluation through well-planned and monitored laboratory and field testing conducted by an engineering firm or other qualified entity that is not affiliated with any interested party in this proceeding. For example, the Commission selected as an independent third party the Mitre Corporation to conduct field tests to validate the interference issues surrounding the establishment of the Low Power Radio Service.⁴⁷ The Commission had earlier engaged Mitre as the independent entity required by Congress to conduct technical analysis of potential interference to the Direct Broadcast Satellite Service (DBS) from new proposed terrestrial services in the same spectrum band.⁴⁸

⁴⁶ See LightSquared Subsidiary LLC Request for Modification of its Authority for an Ancillary Terrestrial Component, SAT-MOD-20101118-00239, Call Sign S2358, *Order and Authorization*, 26 FCC Rcd. 566 (IB Jan. 26, 2011); International Bureau Invites Comment on NTIA Letter Regarding LightSquared Conditional Waiver, *Public Notice*, IB Docket No. 11-109, DA 12-214, at 4 (Feb. 15, 2012).

⁴⁷ See Creation of a Low Power Radio Service, *Second Order on Reconsideration and Further Notice of Proposed Rulemaking*, MM Docket No. 99-25, 20 FCC Rcd. 6763, 6765, para. 6 (Mar. 17, 2005); see also Comment Sought on the Mitre Corporation's Technical Report, "Experimental Measurements of the Third-Adjacent-Channel Impacts of Low-Power FM Stations," *Public Notice*, DA 03-2277, 18 FCC Rcd. 14445 (MM July 11, 2003).

⁴⁸ See Comments Requested on the Mitre Corporation Report on Technical Analysis of Potential Harmful Interference to DBS from Proposed Terrestrial Services in the 12.2-12.7 GHz Band, *Public Notice*, ET Docket 98-206, 16 FCC Rcd. 8417 (OET Apr. 23, 2001); Amendment of Parts 2 and 25 of the Commission's Rules to Permit Operation of NGSO FSS Systems Co-Frequency with GSO and Terrestrial Systems in the Ku-Band Frequency Range, *Memorandum Opinion and Order and Second Report and Order*, ET Docket No. 98-206, 17 FCC Rcd. 9614, 9635 (May 23, 2002).

Even if the Commission chooses not to rescind the Ligado grant or call for further technical evaluations of the Ligado proposal's impact on GPS, it should, at a minimum, modify and clarify the conditions imposed on Ligado prior to its network deployment.

c. *The Ligado Order's Conditions Must be Significantly Modified to Adequately Prevent or Remediate Harmful Interference to Federal GPS Devices*

The license conditions imposed on Ligado will not adequately mitigate the risk of harmful interference to federal GPS devices, will shift the burden of fixing such interference to federal users, and are otherwise impractical for addressing actual impacts to national security systems. In light of the large number of federal GPS devices that potentially would be impacted by Ligado's network, the FCC conditions, even if modified, will be a high-cost, time consuming effort for Ligado and federal agencies. As written, the condition requiring the repair or replacement of government receivers, is impractical, infeasible, and potentially illegal. Similarly, the FCC's current coordination and notification requirements are inadequate and unreasonable measures to address the federal agencies' particular risks and concerns – especially the military's. Many of these conditions were based on privately negotiated agreements between Ligado and a handful of commercial GPS manufacturers who are incentivized to sell replacement equipment or components to federal (and non-federal) GPS users before the end of their current equipment's useful life. Neither NTIA nor any federal agencies were parties to those agreements.

The federal repair or replace condition set forth in the Ligado Order is impractical because it overlooks the classified nature of military GPS use, the sheer number of government receivers and military platforms affected, and the fact that many of these receivers are embedded within a wide range of complex hardware and weapons systems. As written, the condition is not

feasible to implement without significant mission impacts since agencies would need to undertake unprecedented accelerated testing, modifications, integration, and requalification of mission performance and readiness of replacement hardware components and software across multiple existing and forthcoming platforms. The exact costs and timelines for such activities are unknown at this time, but the burden placed on a military agency by the *Ligado Order* to “anticipate[] that its GPS devices may be affected by Ligado’s ATC operations” and to “evaluate whether there would be harmful interference from Ligado’s operations”⁴⁹ would significantly degrade national security.

Thus, if and when Ligado realizes the actual costs and potential delays associated with the program that it is required to launch, it will likely seek a waiver or modification to this condition. Not only should the conditions be modified or clarified as proposed herein, but they should be locked in for a minimum of ten years unless the agencies and NTIA otherwise agree to a subsequent change. Specifically, a new condition should be added that prohibits Ligado (and its successors and assigns) from seeking from the Commission any modification, waiver, or other regulatory action to change any of the license conditions until ten (10) years after the effective date of the Order on Reconsideration unless NTIA, FCC, DOD, and DOT/FAA jointly certify, after public notice and comment, that such proposed change would not impact certified aviation, national security, or safety-critical GPS devices and would not otherwise endanger the reliable functioning of other GPS devices.

The *Ligado Order* asserts that the repair or replace condition is executable, as a matter of “fiscal law”, referencing the same three Government Accountability Office (GAO) decisions

⁴⁹ *Ligado Order*, para. 144 (emphasis added).

cited by Ligado.⁵⁰ However, the Commission is not an expert agency when it comes to such specialized legal matters and should seek guidance from GAO before assuming the cases cited by Ligado provide an adequate remedial approach to the impacts and related costs incurred by federal agencies. Indeed, the GAO General Counsel's opinion and other cases cited in footnote 346 of the *Ligado Order* do not establish or directly support the proposition for which they are being cited by the Commission since the government property at issue here is GPS equipment that is currently in perfect working order and would not be damaged, physically or otherwise by Ligado. Instead, Ligado's network operations would endanger the reliable functioning of federal GPS devices and associated weaponry and equipment. Moreover, simple in-kind equipment replacements, even if authorized, will result in associated non-reimbursable testing and integration costs, including additional time and efforts related to tracking the particular assets and taking the systems off-line in a manner that does not disrupt military and mission-critical operations.

The other Federal agency coordination procedures and notification requirements, as written, are impractical in light of the large number of mobile and embedded GPS receivers in use by Federal agencies, which would be compounded by the fact that even military GPS users likely would not know if it was a Ligado base station or some other source that is disrupting their equipment in the first place or who to contact in such a situation. Thus, among other changes to

⁵⁰ *Ligado Order*, para. 99 and n. 346 (citing Maritime Administration—Disposition of Funds Recovered from Private Party for Damage to Gov't Bldg., File B-287738 (GAO GC, May 16, 2002), available at <https://www.gao.gov/assets/680/676784.pdf>; Bureau of Alcohol, Tobacco, and Firearms—Augmentation of Appropriations—Replacement of Autos by Negligent Third Parties, 67 Comp. Gen. 510, B-226004 (July 12, 1988), available at <https://www.gao.gov/products/449055#mt=e-report>; and Secretary of Commerce, B-87636 (Aug. 4, 1949), available at <https://www.gao.gov/products/B-87636#mt=e-report>). See also *Ligado Order*, para. 96, n. 323 (citing Ligado July 9, 2018 Comments at 16 (citing these and other GAO cases)).

the conditions, there should be an unpublished hotline phone number and other direct means of communication to Ligado that is only available to federal users.

As for the other conditions, NTIA proposes the following modifications or clarifications:

Downlink Power Levels: Condition 2.a. should be clarified to reflect that Ligado actually committed to be bound by all current and future MOPs and TSOs for equipment that the FAA allows to operate in the National Air Space (NAS) and reductions in power based on the results of coordination.⁵¹ Thus, the EIRP of 9.8 dBW (10 W) and 433 meter separation distance is a starting point and will likely be less at many downlink locations.⁵² Inaccurate attribution or references to DoT and FAA assessments or analysis should be removed.

Ex Ante Pre-Coordination With Federal Agencies: Conditions 4.a., 5.a., 5.b., and 7.b. need to be substantially modified to remove burdensome and unauthorized regulatory requirements on federal agencies. The Commission does not have the authority to direct any federal agency to identify affected GPS devices, exchange information, work with, or negotiate with Ligado, or otherwise modify NTIA authorized federal operations. This condition must: (a) reflect each affected agency's specific programmatic needs (*e.g.*, no deadlines); (b) include provisions certified by GAO as consistent with applicable statutes and regulations relating to each affected agency's ability to accept repairs, upgrades, or replacements; and (c) be contingent on the availability of appropriated funds to cover each affected agency's remediation costs (*e.g.*, for engineering costs, testing, recertification, requalification, etc.). These and other terms and conditions governing information exchange, repair and replacement, interference determinations, drive testing,⁵³ and any additional reporting and mitigation measures for any federal installation or other areas may only go into effect upon approval of such program by the head of each affected agency, or appropriate designee, and NTIA. Such approval would be contingent upon Ligado: (i) establishing and testing the database required by condition 5.a.;⁵⁴ (ii) submitting to NTIA and FCC the results of the independent audit (as Ligado

⁵¹ See Letter from Gerard J. Waldron, Counsel to Ligado Networks LLC, to Marlene H. Dortch, FCC Secretary, IB Docket No. 11-109 at Appendix B (June 5, 2017), *available at* <https://go.usa.gov/xwqTB> (“Ligado requested a license condition that would require Ligado to reduce the power of its transmitters operating in the 1526-1536 MHz band to whatever power level is necessary to ensure that Ligado’s operations do not exceed the power level mask of any MOPS that is incorporated into an active FAA TSO for a certified aviation GPS receiver, including legacy receivers authorized to continue operating under prior FAA TSOs.”).

⁵² See *Ligado Order*, para. 100-101, 134.

⁵³ The drive testing methodology under condition 5.b. must be approved by NTIA and each affected agency.

⁵⁴ As General Raymond recently testified, “[w]ithout solid data about the location of ground-based transmitters and antennas, DoD cannot begin to fully understand and work to mitigate the impact to existing systems, if any mitigation is possible.” Testimony of Gen. John W. Raymond,

previously committed);⁵⁵ and (iii) providing the same advance notice and “hold harmless” assurances provided to the GPS device manufacturers pursuant to conditions 4.b. and 1. Activation of any base station transmitting in the 1526-1536 MHz band shall not occur unless and until each affected agency and NTIA certify to the FCC that such activation is not expected to adversely impact each agency’s GPS functionality and capabilities.

Ex-Post Interference Complaints and Resolution: Conditions 4.c. and 5.c. must be customized to address the unique and time-critical needs of affected federal agencies that may be impacted by interference from Ligado’s base stations even if certified under the *ex ante* conditions addressed above. This would include separate, dedicated 24/7 toll-free telephone number, e-mail address, and other non-public real-time two-way communications to Ligado’s network operations center (NOC) for federal agency reports of suspected interference. The NOC must, at a minimum, meet the same requirements as set forth in 47 C.F.R. § 25.149(g)(2). In addition, NOC personnel shall have technical capability and operational authority to address, evaluate, and resolve federal agency interference issues within 30 minutes of receipt and be able to remotely reduce the power of or shut down activated base stations (or base stations under test) until interference issues are resolved to the satisfaction of the complaining agency.

Ideally, these conditions would not be necessary if the Commission rescinds the grant to Ligado. In the event the Commission does not do so, these and possibly additional changes and clarifications to Ligado’s current conditions are absolutely necessary to prevent harmful interference to GPS.

III. CONCLUSION

Historically, the Commission and NTIA have worked together to prevent harmful interference between or among radiocommunication services by controlling emissions from transmitters by, for example, regulating their locations, limiting power levels, and constraining unwanted out-of-band emissions. On the other hand, most Commission service rules do not

Chief of Space Operations, U.S. Space Force, and Commander, U.S. Space Command, before the Committee on Armed Services, U.S. Senate, at 3 (May 6, 2020).

⁵⁵ See Ligado June 5, 2017 *Ex Parte* at Appendix B (committing, for the first two years, to engage at Ligado’s expense a nationally recognized auditing and accounting firm to independently verify the calculation of the transmit EIRP limit for each proposed base station antenna sector).

directly regulate the performance of receivers.⁵⁶ The direct impact of the *Ligado Order* is, in effect, the adoption of a regulation of all federal and non-federal GPS receivers without adequate notice and comment.

The *Ligado Order's* incorrect or insufficient consideration of government-sponsored test results and inadequate license conditions will likely cause widespread harmful interference to millions of GPS receivers in the U.S., including those used to support national and homeland security operations as well as public safety. Even if there is no immediately recognizable interference to GPS operations, the mad scramble to prevent such interference on an involuntary and unfunded basis is bound to have profound impacts for years to come.

⁵⁶ See, e.g., Interference Immunity Performance Specifications for Radio Receivers, *Notice of Inquiry*, 18 FCC Rcd. 6039 (Mar. 24, 2003); see also General Accountability Office, *Spectrum Management: Further Consideration of Options to Improve Receiver Performance Needed*, GAO-13-265 (Feb. 2013), available at <https://www.gao.gov/assets/660/652284.pdf>; FCC Spectrum Policy Task Force, *Report*, ET Docket. No. 02-135, at 31 and 69 (Nov. 2002), available at <https://docs.fcc.gov/public/attachments/DOC-228542A1.pdf>.

For the forgoing reasons, NTIA respectfully requests the Commission rescind the *Ligado Order* or significantly modify the conditions set forth therein to ensure adequate protection to GPS.

Respectfully submitted,



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May 22, 2020

FOR AGENDA



**U.S. Department
of Transportation**

Office of the Secretary
of Transportation

1200 New Jersey Avenue, S E
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November 22, 2019

Peter A. Tenhula
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Chair, Interdepartment Radio Advisory Committee
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Re: Draft FCC Order and Authorization on Ligado Networks LLC's Mobile Satellite Services (MSS) License Modification Application

Dear Mr. Tenhula:

Thank you for providing the draft of a potential Federal Communications Commission (FCC) Order and Authorization on Ligado Networks LLC's Mobile Satellite Services (MSS) License Modification Application to the Interdepartment Radio Advisory Committee (IRAC) for review and comment.

The Department of Transportation (Department or DOT) offers the following comments on the draft order. DOT appreciates FCC's continued consideration of the important issues raised in this proceeding and we recognize that the Draft Order and Authorization represents [REDACTED]

However, as stated in the 2018 DOT GPS Adjacent Band Compatibility Assessment Report:

“[B]ased on the results of the OST-R testing and analysis of the other categories of receivers, the transmitter power level that can be tolerated by certified aviation may cause interference with, or degradation to most other categories of GPS/GNSS receivers including those used for General Aviation and drones, as detailed in the results set forth in this report.” DOT Report Executive Summary p. VIII.

This interference or degradation can include increased GPS and Global Navigation Satellite System (GNSS) satellite acquisition times, reduced position accuracy, or loss of signal lock

resulting in no position solution. On December 3, 2018, the National Space-Based PNT Executive Committee, aware of Ligado's most recent license modification request, wrote a letter to NTIA stating: "[I]t is clear that the proposed service would exceed the tolerable power limits necessary to prevent disruption of GPS receivers."

[REDACTED]

[REDACTED]

However, DOT notes that the majority of GPS receivers in use in the United States are not U.S. Government devices. Indeed, most of the GPS/GNSS devices used for critical infrastructure and commercial applications are not owned by the U.S. Government. The types of GPS uses that would experience interference include emergency response, commercial trucking, general navigation, general aviation, high-precision instruments for surveying, precision agriculture, machine control, scientific applications, and timing signals, as detailed below.

[REDACTED]

Unfortunately, this brief statement does not begin to acknowledge and account for the serious and widespread impacts this action would have on many important categories of existing GPS users. In considering such a proposal, the FCC should thoroughly assess and account for the economic costs and burdens that would result. Many GPS/GNSS receivers have integrated antennas into their receivers so that it is not possible to retrofit them with new antennas. Furthermore, many receivers are integrated into end-user applications making adversely affected GPS users unable to retrofit or replace their GPS receivers, even if they could afford to do so.

¹ The GPS receiver manufacturers who signed these agreements strongly endorse use of the 1 dB Interference Protection Criteria that DOT applied in its adjacent band compatibility assessment.

In this document, we put in perspective the applications that may be impacted by GPS/GNSS signals that would be interfered with and/or degraded by deployment of Ligado's network. DOT strongly recommends that any consideration of Ligado's proposed terrestrial nationwide network in the MSS band must include a rigorous effort to quantify the economic costs of these effects and balance them against any economic benefits of authorizing the proposed services.

1) Police, Fire, and Other Emergency Vehicles

GPS has become an integral part of all modern emergency response systems, from assisting stranded motorists to guiding emergency vehicles (police, fire, ambulance).

The ability to pinpoint the location of police, fire, rescue, and other vehicles or boats, and effectively to relate their locations to an entire network of transportation systems in a geographic area, has become critical to the operations of first responders. Location information provided by GPS, coupled with automation, reduces delay in the dispatch of emergency services and is essential to their operations.

2) Commercial Trucks and Buses

The trucking industry's use of GPS is extensive and widespread for applications such as fleet management, driver routing, and total asset visibility. The Federal Motor Carrier Safety Administration (FMCSA) does not have data on overall use of GPS by the Commercial Motor Vehicle (CMV) industry, but, according to FMCSA, there are over 580,000 interstate motor carriers and 12 million registered large trucks.

The GPS Innovation Alliance estimates that between 50 percent and 86 percent of all 'fleet owning firms' adopted GPS for fleet management. In addition, they estimate a total adoption rate of 67.9 percent of trucks (<https://www.gpsalliance.org/>). They do not separate adoption rate by truck class. Using these estimates provides a range of 7 million to 10.5 million medium and heavy trucks with GPS.

FMCSA regulation, 49 CFR 395.20, Appendix A to Subpart B, requires that an Electronic Logging Device (ELD) measure a commercial motor vehicle's position every five miles and record the position each hour to the log, as well as during events, such as a driver's changing of duty status from "driving" to "sleeper berth" or "on-duty not driving" with the precision of +/- 1 mile. FMCSA estimates 2.8 million to 3 million drivers are required to use ELDs in interstate CMV operations. Based on input from FMCSA, they are concerned that ELDs may be affected.

The American Public Transportation Association (APTA) has an extensive database of Transit/Commuter Bus with Automated Vehicle Location (AVL) units installed which are based on GPS technology. In 2019, there are over 57,000 buses with AVL units installed among 330+ transit agencies.

3) Automotive Navigation Systems

On October 23, 2018, the Auto Alliance sent a letter to the FCC stating: “GPS is a critical technology for many current and future vehicle safety systems, including both Advanced Driver Assist Systems (“ADAS”) and Automated Driving Systems (“ADS”). The

availability and accuracy of GPS offers increased safety for vehicles and other road users traveling on our nation’s roadways. Many of today’s vehicles are equipped with ADAS safety features or other systems that rely on precise GPS signals for position, navigation, in-vehicle security, remote diagnostics, emergency services and other applications. Ligado’s proposal could jeopardize the ability of GPS receivers to obtain an accurate signal, thereby putting such vehicle safety systems at risk.”

According to the National Highway Traffic Safety Administration (NHTSA), it is difficult to estimate with accuracy the precise total number of on-highway vehicles equipped with GPS-enabled devices. However, the figure is between 80 million and 140 million. Uses of GPS receiver chipsets includes onboard navigation units, telematics/ concierge systems (i.e., OnStar, Sync, Enform, Mbrace, BMW Assist, etc), and SiriusXM radio receivers (while the large majority of satellite radios includes GPS-enabled location services, a portion of the earliest satellite radios sold into the vehicle market do not).

For light duty cars, satellite radio comprises the largest portion of GPS devices, especially for older vehicles. Newer vehicles generally combine radio/navigation/other functions into a single unit, so it is difficult to make any distinction.

A few key data points:

- As of Jan. 2019, SiriusXM reports 117 million vehicles equipped with satellite radio, with 34M active subscribers.
- Since 2010, all GM cars have been equipped with OnStar, for a total production of 27.3 million cars and light trucks. Other OEs have followed the trend of equipping all cars with a telematics systems to varying degrees and at different times.
- As of 2016, 8 million cars were reported to have a fleet management systems (with GPS-enabled location included) and expected to double by the end of 2019.
- Automotive Business reported in 2009 that 7% of all light duty vehicles (7% of 220M=15.4M) had a GPS navigation unit.
- From 2015, 75 percent of new cars have SiriusXM radio installed as standard (75 percent of 82.9M = 62.2M).

Understanding that there is some double counting for the numbers above, it is reasonable to assume that there may be as few as 80 million, and as high as 140 million light duty vehicles equipped with some type of GPS receiver in the US.

These figures do not include the medium to heavy vehicles (trucks, buses, etc.) discussed above and excludes farming, mining, construction, or any other off-highway vehicles equipped with GPS/GNSS receivers.

4) General Aviation

According to the Federal Aviation Administration (FAA), the proposed power level of 9.8 dBW protects Instrument Flight Rules (IFR)-certified aviation receivers beyond 250 feet laterally and 30 feet above each base station antenna. However, the 9.8 dBW power level

does not protect non-IFR certified aviation receivers. Non-IFR certified aviation receivers that would be affected include Visual Flight Rules (VFR) panel mount, hand held, and Electronic Flight Bag (EFB) devices used for VFR navigation, display of electronic charts, and flight information. Virtually every general aviation aircraft carries at least one non-IFR certified GPS receiver, and air carrier aircraft typically carry two.

If Ligado were to deploy the system as described in the proposal, there are estimated to be 350,000 installed and portable VFR aviation GPS and EFB devices in both general aviation and commercial aircraft that would be affected.

5) Positive Train Control and Other Railroad Operations

GPS is an integral part of nationwide railroad operations. GPS is used in most aspects of railroad operations and maintenance and is relied upon for critical safety systems. Below is a high-level list of railroad systems that rely on GPS, according to the Federal Railroad Administration (FRA).

GPS interference would have a significant safety effect on railroad operations, as well as an effect on the efficiency of railroad operations, especially in highly congested areas such as the North East, Chicago, Kansas City, New Orleans, Los Angeles, etc. Users are estimated here:

Rail Operations:

- a) Positive Train Control (I-ETMS)—7 Class I Railroads and 16 Commuter or Class II/III Railroads, encompassing 54,000 route miles of track.
- b) Energy Management Systems (e.g. cruise control for locomotives)—7 Class I Railroads, all locomotives
- c) Remote Control Locomotive Systems (for operation in yards)—7 Class I Railroads, plus some shortline yards.

Maintenance Systems:

- a) Rail Integrity Testing (testing for broken rail with laser systems)—7 Class I Railroads and 4 Commuter Railroads, but this testing will be allowed under FRA regulations and could impact 28 Commuter Railroads and many shortlines.
- b) Automated Rail Testing (automating testing of track for geometry failures)—4 Class I Railroads (current), but this testing is planned to be allowed under FRA regulations and could impact all Class I railroads.

- c) Drones used for inspection, including bridge inspections—Class I railroads
- d) Asset Management and Asset Tracking systems, also supporting Emergency Response systems—Class I railroads.
- e) Infrastructure inspection (by FRA and railroads)—FRA and Class I railroads.

6) Maritime

Vessels navigating U.S. ports, inland waterways and coastal areas near a proposed Ligado transmitter may find themselves with a compromised GPS signal. These maritime applications include a variety of government, military, law enforcement, public and commercial vessels including the Maritime Administration (MARAD) National Defense Reserve Fleet (NDRF) for Strategic Sealift. The ability of these critical vessels, including 46 ships of the Ready Reserve Force (RRF), and others to navigate safely in U.S. waters is an essential operation.

These and other vessels operated under or in agreements under various programs for MARAD and Military Sealift Command are so vital to the nation that interfering with their reception of GPS signals (which could affect their ability to accurately move people and materials in times of crisis) is absolutely unacceptable.

Also of concern in U.S. port environments are numerous passenger ferries carrying tens of thousands of people every day, some at high speeds in a dynamic environment subject to strong currents, high winds, rough wave conditions, dense traffic and more. During operations in darkness when visibility deteriorates and is poor or restricted, the GPS signal becomes even more important, since much of the equipment helping navigate the vessel is using GPS to not only provide positioning information, but is also providing inputs to speed, heading, steering, radar and target information, Electronic Chart Display Information System (ECDIS), Under Keel Clearance (UKC information), Automatic Identification (AIS) information, and VHF radio communications.

Other vessels in U.S. ports and urban waterway areas could also seriously suffer from interference to the GPS signal, including high-speed recreational boaters, law enforcement responders (i.e., Blue Force Tracking and more), commercial vessels of all types and other watercraft. High-precision operations such as survey vessels, buoy tenders, dredges, surveillance craft, pollution cleanup vessels and others need a very accurate position input to ensure the accuracy of their operations.

For the St. Lawrence Seaway Development Corporation (SLSDC) operations, applications dependent on GPS include:

- Vessel tracking (via AIS)
- Vessel speed monitoring (via AIS)
- Vessel information required for Draft Information Systems (via AIS)
- Hydrographic surveying (kinematic GPS surveying system)
- Buoy positioning (via Differential GPS)

- General safety of navigation (via GPS by transiting vessels and Seaway vessels)
- Seaway's computer network (via GPS time servers-time synchronization of computer systems)

7) Surveyors and Construction Applications

Unlike conventional techniques, GPS surveying is not bound by constraints such as line-of-sight visibility between survey stations. The stations can be deployed at greater distances from each other and can operate anywhere with a good view of the sky, rather than being confined to remote hilltops as previously required.

GPS is especially useful in surveying coasts and waterways, where there are few land-based reference points. Survey vessels combine GPS positions with sonar depth soundings to make the nautical charts that alert mariners to changing water depths and underwater hazards. Bridge builders and offshore oil rigs also depend on GPS for accurate hydrographic surveys.

Land surveyors and mappers can carry GPS systems in backpacks or mount them on vehicles to allow rapid, accurate data collection. Some of these systems communicate wirelessly with reference receivers to deliver continuous, real-time, centimeter-level accuracy and unprecedented productivity gains. In addition, these types of high accuracy GNSS receivers have been incorporated into construction equipment to enable precision machine control with centimeter-level positioning.

8) Commercial Drones and Other Precision Uses, Including Precision Agriculture

Unmanned aircraft systems (drones) would also be significantly affected, particularly commercial high precision drones used for delivery, agriculture, mapping/survey and other high accuracy missions. High precision drones are particularly susceptible to adjacent band interference since they can operate at very low altitudes and use very sensitive, high-accuracy GPS receivers. Just under a half million UAS are used in professional applications, as well as approximately one million recreational UAS would be impacted.

GNSS-based applications in precision farming are widely used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications, and yield mapping. GPS allows farmers to work during low-visibility field conditions such as rain, dust, fog, and darkness.

Other high precision applications include a network of high-precision GPS/GNSS receivers the U.S. Geological Survey (USGS) has installed for early earthquake warning. In addition, NASA and NOAA are exploring radio occultation for measuring water vapor content by utilizing GNSS receivers on Low Earth Orbit satellites.

9) Timing Signals

Precise time is crucial to a variety of economic activities around the world. Communication systems, electrical power grids, and financial networks all rely on precision timing for synchronization and operational efficiency.

[REDACTED]

[REDACTED]

The FAA has identified over 3,000 GPS timing devices used in FAA mission systems and support applications would be impacted.

Consistent with the December 3, 2018 Space-Based PNT Executive Committee letter to NTIA, and the significant impact to a myriad of civil GPS applications, DOT recommends that the FCC reject Ligado's license modification application.

Sincerely,



Steven G. Bradbury
Acting Deputy Secretary and General Counsel

DECLARATION

I, Edward Drocella, am an electrical engineer with 33 years experience. I currently am the Chief of the Spectrum Engineering and Analysis Division in the Office of Spectrum Management (OSM) at the National Telecommunications and Information Administration (NTIA), and have held that position for 15 years.

I have reviewed technical documents and data related to “electrical interference” to the Global Positioning System (GPS) in the record in this proceeding and addressed in the forgoing Petition for Reconsideration or Clarification (Petition), and, to the best of my knowledge and belief, the conclusions set forth in the Petition that are based on such technical documents and data are reasonably derived.

Specifically, OSM set up and I chaired a Technical Focus Group (TFG) within the Interdepartment Radio Advisory Committee (IRAC) to study the extensive amounts of available test data collected from several measurement studies involving a wide range of GPS receiver devices. Engineers from OSM, in collaboration with subject matter experts from the Department of Transportation (DoT), Federal Aviation Administration, the Air Force, the Department of Energy, the National Aeronautics and Space Administration, the Department of Defense Office of the Chief Information Officer, and the Federal Communications Commission’s Office of Engineering and Technology, participated in the IRAC TFG.

OSM and the TFG assessed compatibility between different categories of GPS L1 coarse/acquisition (C/A) code receivers and proposed terrestrial deployments by examining the degradation in carrier-to-noise density ratio (C/N_0), loss-of-lock, position error, and increase in acquisition/reacquisition time. There are multiple ways interference can degrade the C/N_0 of a GPS receiver. However, it is difficult to isolate the specific cause for each GPS receiver in the different measurement programs without sufficient technical information, such as receiver design, radio frequency filter selectivity, and other specifications.¹ NTIA has previously relied solely on a 1 dB reduction in C/N_0 as an interference protection criterion (IPC) because there were no industry-specified performance metrics for terrestrial GPS receivers.²

The TFG and OSM subject matter experts analyzed interference measurement data for over 300 GPS L1 C/A code receivers to assess compatibility with Ligado’s proposed base station and user equipment operations. The GPS receiver categories measured included: high precision (HP), general location/navigation (GLN), timing (TIM), cellular (CEL), general aviation (GAV), and space-based (SPB). The measurements analyzed were from several different test programs

¹ DoT requested information on the receiver radiofrequency filter selectivity, the gain, noise figure, 1 dB gain compression point and third-order intercept point of the low-noise amplifiers from the GPS receiver manufacturers. See DoT, *Test Plan to Develop Interference Tolerance Masks for GNSS Receivers in the L1 Radiofrequency Band (1559-1610 MHz)* at 2 (Mar. 2016), available at <https://rosap.ntl.bts.gov/view/dot/37033>. The GPS receiver manufacturers were not under obligation to provide the information and did not do so.

² See, e.g., NTIA Feb. 14, 2012 Letter to FCC at 4, available at <https://go.usa.gov/xvSnn>.

including the DoT ABC Assessment referenced in the Petition as well as testing conducted by Roberson and Associates,³ the National Advanced Spectrum and Communications Test Network,⁴ the 2011 FCC Technical Working Group,⁵ and the National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum.⁶ The GPS receiver analysis consisted of data synthesis of the measurements from the different test programs for tracking and acquisition/reacquisition modes, effects of the antenna on measured interference power levels, and position error measurements.

The analysis incorporated the measured GPS receiver interference data in the single and aggregate base station and user equipment terrestrial deployment simulations, using statistical (*e.g.*, Monte Carlo) techniques. It then examined the relationship between the received interfering signal power at the GPS receiver that would cause a degradation in C/N_0 , the base station or user equipment EIRP, and the separation distance between a GPS receiver and a base station or user equipment. The base station and user equipment analysis results (*i.e.*, required separation distances) would not significantly change when a 1 dB, 3 dB, or 5 dB C/N_0 degradation criterion was applied to the measurement data collected from HP and GLN receivers.

Distance separations to avoid potential degradation in C/N_0 for all GPS receivers from a single base station in the 1526-1536 MHz band is: approximately 10 kilometers for an EIRP of 32 dBW/10 MHz, and between 1 to 2 kilometers for an EIRP of 10 dBW/10 MHz (or 40 dBm/10 MHz).

For an aggregate micro urban base station deployment with an EIRP of 10 dBW/10 MHz, 64 percent of measured HP receivers and 13 percent of measured GLN receivers within a cell would be expected to experience a 1 dB C/N_0 degradation (as reported by the receiver).

In sum, the measured data and analysis for the different GPS receiver categories showed:

- there is a wide range of interference signal power levels that could potentially cause degradation in C/N_0 within the HP and GLN receiver categories;⁷

³ See Roberson & Associates, LLC, Results of GPS and Adjacent Band Co-Existence Study (May 9, 2016), available at <https://ecfsapi.fcc.gov/file/60001841466.pdf> (Attachment A).

⁴ See W. Young *et al.*, NIST Technical Note 1952, LTE Impacts on GPS, Final Test Report (Feb. 15, 2017), available at <https://nvlpubs.nist.gov/nistpubs/TechnicalNotes/NIST.TN.1952.pdf>.

⁵ See GPS Technical Working Group, *Final Report* (June 30, 2011), available at <https://ecfsapi.fcc.gov/file/7021690471.pdf>.

⁶ National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum, *Follow-On Assessment of LightSquared Ancillary Terrestrial Component Effects on GPS Receivers* (Jan. 6, 2012), available at https://www.ntia.doc.gov/files/ntia/publications/npef_lsq_follow-on_test_report_final_public_release.pdf.

⁷ Each test program used different representations of the GPS signal constellation (*e.g.*, number of satellites in view and received signal power levels) and the interfering test signals. This lack

- in general, predicted degradations in C/N_0 can be correlated with expected increases in acquisition/reacquisition time and position error distribution;
- a 1 dB C/N_0 degradation is more likely to occur when the filtered GPS receiver bandwidth extends outside of the RNSS allocation;
- the potential degradations in C/N_0 do not appear to be the expected result of base station and user equipment “out-of-band emissions” in the 1559-1610 MHz RNSS band;⁸
- impacts to most HP and GLN devices would appear to be more likely when receiver bandwidth extends outside RNSS allocation (*i.e.*, HP and GLN receivers with higher combined out-of-band filtering between 1530 MHz and 1550 MHz could be less susceptible to interference centered at 1530 MHz);
- there are large variances in interference power levels expected to cause a 1 dB C/N_0 degradation for most GPS receiver categories (78 dB for HP receivers, 71 dB for GLN receivers, 51 dB for TIM receivers, and 25 dB for CEL receivers);
- external antenna filter selectivity would be a contributing factor to the interference power level that causes degradations in C/N_0 ;
- for HP and GLN receivers, the analysis of 1 dB, 3 dB, and 5 dB C/N_0 degradation criterion had similar results;
- signal acquisition/reacquisition time would be expected to be generally impacted at interference power levels corresponding to a 1 dB to 5 dB C/N_0 degradation;
- a loss-of-lock condition (*e.g.*, receiver stops reporting C/N_0) occurred in 30 percent of HP receivers measured; and
- the mean value of position error does not reflect the expected real interference performance impact to GPS receivers.

I declare under penalty of perjury that the foregoing is true and correct.

Executed on May 22, 2020

Edward Drocella

(Signature)

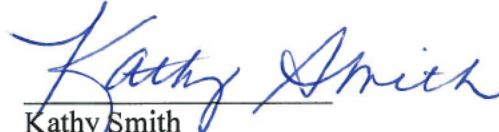
of standardization in the different test programs can be a contributing factor in the variability seen in the measured interference power levels.

⁸ According to the Commission’s rules, an out-of-band emission is an emission on a frequency or frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding a spurious emission. *See* 47 C.F.R. §§ 2.1, 25.253.

CERTIFICATE OF SERVICE

I, Kathy Smith, hereby certify that on this 22nd day of May, 2020, I caused a copy of the foregoing Petition for Reconsideration or Clarification to be served on the following:

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