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November 12, 2015

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: *Ex parte* presentation in IB Docket No. 12-340; IB Docket No. 11-109; IBFS File Nos. SAT-MOD-20101118-00239; SAT-MOD-20120928-00160; SAT-MOD-20120928-00161; SES-MOD-20121001-00872

Dear Ms. Dortch:

Attached are further comments that LightSquared submitted to the Department of Transportation addressing the comments filed in response to the Department's draft test plan for the Adjacent Band Compatibility Study. LightSquared submitted its further comments to highlight the significant problems with DOT's approach that were identified in the comments filed in the proceeding. In particular, the comments demonstrated that DOT's proposed metric of 1 dB C/N_0 lacks a solid technical foundation and that DOT must identify the specific devices being tested in order to enable other decision makers to make use of the test results, and for the test to be repeatable, verifiable, and able to be proven true or false.

Please direct any questions to the undersigned.

Respectfully submitted,

/s/Gerard J. Waldron
Gerard J. Waldron
Paul Swain

Counsel to LightSquared

Attachment

Before the
DEPARTMENT OF TRANSPORTATION
Washington, DC 20590

In the Matter of	)	
Draft Test Plan To Obtain Interference Tolerance Masks for GNSS Receivers in the L1 Radiofrequency Band (1559-1610 MHz)	)	Docket No. DOT-OST-2015-0099

FURTHER COMMENTS OF LIGHTSQUARED

LightSquared Subsidiary LLC ("LightSquared") respectfully submits these further comments concerning the draft test plan released by the Department of Transportation ("DOT"). LightSquared's Comments identified fundamental flaws with the draft test plan, including critical omissions with respect to the scope of the proposed testing, the testing schedule, device selection, transparency, independence of the testing process, testing procedures, the repeatability and verifiability of the testing regime, and the evaluation of test results, as well as a failure to measure what matters: the impact of any interference on device performance. The comments filed by others parties in this proceeding actually serve to highlight the significant problems with DOT's approach, and that is why we are submitting these further comments to bring these issues to the fore. In particular, the comments demonstrate that (1) DOT's proposed metric of 1 dB C/N_0 lacks a solid technical foundation, and (2) to enable other decision makers to make use of the test results, and for the test to be repeatable, verifiable and able to be proven true or false, DOT must identify the specific devices being tested.

I. The Comments Demonstrate that DOT's Proposed Metric of 1 dB C/N_0 Lacks a Sound Technical Foundation.

LightSquared's Comments establish that DOT's proposed use of 1 dB C/N_0 as its interference metric is misguided because it fails to measure what the expert agency and Congressionally-designated spectrum regulator—the Federal Communications Commission ("FCC" or "Commission")—considers when it evaluates "harmful interference": the ultimate impact of adjacent-band activity on the performance of the device. Despite this clear regulatory definition, the GPS Innovation Alliance ("GPSIA") files in support of the proposed metric, claiming that 1 dB C/N_0 finds support from International Telecommunication Union ("ITU") Recommendations.[1] This is incorrect on three significant levels. First, GPSIA in part has it backwards: many of the ITU Recommendations *begin* with user-measurable criteria and then derive interference levels.[2] Second, GPSIA confuses two kinds of interference. Some of the ITU Recommendations cited discuss levels for *in-band* interference, rather than adjacent-band interference, which is the subject of the instant proposed testing.[3] Third, and most importantly, *none* of the ITU Recommendations apply a 1 dB C/N_0 specification for adjacent-band signal effects on GPS devices, as argued by GPSIA.

Importantly, DOT and commenters in this proceeding have not shown a strong correlation between 1 dB desensitization and device performance. In fact, published literature

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[1] GPSIA Comments at 4, Appendix A.

[2] *See, e.g.*, ITU Recommendations ITU M-1460; ITU M-1461-1; ITU M-1462; ITU M-1463; ITU M-1465-2; ITU M-2059-0.

[3] *See, e.g.*, ITU Recommendations ITU M-1739; ITU M-1767; ITU M-1800; ITU M-1902; ITU M-1904.

shows the converse,[4] and, should DOT nevertheless decide to use a 1 dB desensitization measure, it must explain how it can do so in the face of such evidence. Moreover, if any such correlation exists, measuring position/timing accuracy as proposed by LightSquared would allow it to be demonstrated. Notably, some of the ITU Recommendations discuss or recommend RF filtering and compression levels of the receiver, which are critical for designing robust devices. However, there is no evidence that any GPS manufacturer has committed to conform to these Recommendations.

GPSIA, claiming that there is "widespread" industry support for 1 dB C/N_0, asserts that a filing by Roberson and Associates concerning Iridium supports the view that 1 dB C/N_0 may not be strict enough to protect CDMA systems.[5] Because GPS is a CDMA system, GPSIA claims that this applies to GPS as well.[6] However, GPSIA apparently misunderstands and thus misrepresents the Roberson filing on Iridium. The Roberson filing actually *supported* the use of a functional metric (satellite system capacity) and derived the signal-to-noise degradation criteria based on the functional metric, not the other way around. In that regard, the Roberson filing was similar to many of the ITU Recommendations, discussed above. In addition, the Iridium analysis was an analysis of *in-band* interference, not adjacent-band interference; the analysis would not apply to the present situation.

Instead of focusing on 1 dB C/N_0, the Department should look to the expert agency, to the industry standards bodies, and to what the GPS manufacturers promise their customers, and it

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[4] M. Rao *et al.*, *LightSquared Effects on Estimated C/N_0, Pseudo-Ranges and Positions*, GPS SOLUTIONS JOURNAL, Vol. 18, Issue 1, 1-13 (2014); Nyunook Kim, *Interference Effects on GPS Receivers in Weak Signal Environments*, UCGE REPORTS, No. 20234 (2006), *available at* http://www.ucalgary.ca/engo_webdocs/GL/06.20234.NKim.pdf.

[5] GPSIA Comments, Appendix A, at 2.

[6] *Id.* at 3.

will find that position/timing error is the appropriate metric. The FCC defines "harmful interference" based on the ultimate impact on device performance.[7] In fact, in the FCC's *AWS-3 Order*, in which the Commission set the rules that led to the most successful auction of spectrum in U.S. history, the FCC turned aside a proposal for tighter standards on the basis of *potential* risks of interference, finding that such speculative claims absent evidence of harmful interference did not warrant regulatory action.[8] Cellular standards body 3GPP also focus on position error.[9] Similarly, the device specifications that the GPS manufacturers provide to users warrant the positional accuracy of the devices, not that the users will not experience a 1 dB change in C/N_0.[10]

II. DOT Needs Receiver Design Information To Determine Interference Tolerance Masks.

The proposed test plan adopts LightSquared's suggestion that manufacturers provide detailed RF front-end information on the devices selected for testing. GPSIA objects to this requirement, arguing that such information should only be pursued in consultation with the manufacturer in the event that testing produces anomalous results.[11] Essentially, the GPS manufacturers represented by GPSIA want their receiver designs to be protected, but they are

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[7] *See* 47 C.F.R. § 2.1(c) (defining "harmful interference" as "[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 ITU Radio Regulations").

[8] *Amendment of the Commission's Rules with Regard to Commercial Operations in the 1695-1710 MHz, 1755-1780 MHz, and 2155-2180 MHz Bands*, Report and Order, GN Docket No. 13-185, ¶ 62 (Mar. 31, 2014) ("GPSIA's arguments that the proposed OOBE limit *may* present some risk of interference do not warrant deferring action on the proposed OOBE limit.") (emphasis in original).

[9] *See* 3GPP TS 34.171: Terminal Conformance Specification, Assisted Global Positioning System ("A-GPS"), Frequency Division Duplex ("FDD").

[10] *See* LightSquared Comments at 7-8.

[11] GPSIA Comments at 3.

unwilling to disclose what those designs actually are. They cannot have it both ways. As LightSquared explained in its Comments, it is essential for decision makers who will review any test results to have access to specific device information. Without such information, the Interference Tolerance Mask could be set based on the worst-performing GPS receivers, unnecessarily encumbering adjacent band services while doing nothing to encourage improved receiver design practices.

As a separate matter, DOT should be concerned about what such a process would imply for the verifiability and repeatability of its testing. Those are the hallmarks of valid testing, and without specific devices being identified with specific testing results, DOT's test results will be virtually useless for informing how interference and overload might be addressed. Yet GPSIA wants DOT to request only relevant information about device design under undefined but extraordinary circumstances, and then keep such information from the public. Such a process is neither open nor transparent, will not enable DOT's test to be repeated, verified, and proven true or false, and thus will not yield information that is in any way useful to informing proposals for interference tolerance masks.

GPSIA also raises concerns about the confidentiality of receiver-design information, noting that "the parties have not yet had an opportunity to review a proposed draft of a Non-Disclosure Agreement ("NDA"), and, indeed, the proceeding's schedule calls for release of the Final Test Plan before execution of an NDA."[12] LightSquared agrees that the specifics of the proposed NDA should be resolved prior to finalization of the test plan.[13] It is worth noting again, however, that LightSquared has already submitted a proposed Confidentiality and Non-

[12] GPSIA Comments at 3.

[13] *See* LightSquared Comments at 17-18.

Disclosure Agreement, which was distributed to all attendees prior to the March 2015 workshop.[14] This document could be used as a model to protect confidential information submitted by GPS manufacturers while enabling relevant information to be both accessed and protected by interested parties.

III. ATIS's Concerns Are Valid, and Solutions Have Already Been Identified.

The Alliance for Telecommunications Industry Solutions ("ATIS") raises concerns regarding the effect of LTE in adjacent bands on network timing devices.[15] LightSquared agrees with ATIS that this is an important issue the industry should address. In fact, LightSquared and the industry have already spent considerable time not only studying this issue but also developing solutions that in fact resolve any concerns.

As far back as 2010, one of ATIS's members, Alcatel-Lucent, issued an advisory notice (hereinafter, "2010 Alcatel-Lucent Notice") to its customers making them aware of a new antenna the customers could install that would resolve any issues with adjacent band interference and protect the network receivers.[16] The 2010 Alcatel-Lucent Notice came out of the dialogue that LightSquared was having at that time with the carriers on a coordination process. Not only does the 2010 Alcatel-Lucent Notice demonstrate that carriers and manufacturers have known about the timing issue for years, it also demonstrates that Alcatel-Lucent itself since 2010 has had compatible receivers. LightSquared looks forward to further dialogue with ATIS on this issue and will undertake additional testing if necessary.

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[14] *See id.*, Exhibit 3.

[15] *See* ATIS Comments.

[16] *See* 2010 Alcatel-Lucent Notice, attached hereto as Exhibit 1. (The company received this document from Alcatel-Lucent in 2010 in connection with discussions about resolving any interference issues, and the company's nondisclosure agreements with Alcatel-Lucent have long since expired.)

IV. Other Issues

A. Test Frequency Range/Dwell Time

In discussing Section IV of the draft test plan concerning the test frequency range, GPSIA states that adaptive filtering in the receiver "can be effective for in-band interference mitigation but at the expense of positioning performance" and encourages DOT to "consult with the relevant manufacturer" if any anomalies occur.[17] First, this possibility provides even more reason for GPS manufacturers to share receiver design data with DOT as discussed above. Second, this appears to be a recognition by GPSIA that adaptive filtering could produce inflated C/N_0 readings, and that the function of the device might be degraded even if there is high C/N_0. This supports LightSquared's position that the measurements taken by DOT should be based on user functional metrics (such as position/timing accuracy) rather than 1 dB C/N_0.

GPSIA "encourages DOT to ensure that an adequate dwell time is used to ensure collection of accurate results," observing that "fifteen seconds was mentioned as the likely period" and that "[d]ry-runs of the test should focus on confirming whether this dwell-time is sufficient."[18] LightSquared agrees that adequate dwell time is required and suggests that the dwell time should be at least 3 minutes to ensure that results collected are accurate.

B. OOBE

General Motors states that 4G LTE licensees in Band 24 and any future band classes that use L-band spectrum should be required to limit noise power in the L1 band, suggesting that Band 24 licensees be required to limit total power in the L1 band to less than -80 dBm.[19] LightSquared notes that DOT's proposed testing is primarily focused on the issue of receiver

[17] GPSIA Comments at 7.

[18] *Id.* at 8.

[19] General Motors Comments at 1.

overload, rather than OOBE, and that Band 24 already complies with strict OOBE limits in the RNSS band.

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Overall, the comments continue to assume that the DOT testing is broadly relevant to any future proposals for use of the band, though LightSquared continues to be the licensee of the majority of spectrum under test and the only party that has proposed use of the spectrum for LTE, which is the case study being tested. The comments just prove that DOT's efforts and time would be much more constructively focused on encouraging LightSquared and major GPS manufacturers to come to a resolution on transmission power levels and steps that GPS manufacturers might take to address overload and on supporting any such resolution that might occur. LightSquared requests that DOT reconsider and revise its draft test plan in light of the information provided herein and in LightSquared's initial Comments.

Respectfully submitted,

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November 9, 2015

EXHIBIT 1

2010 Alcatel-Lucent Notice

10−1151a GPS Interference when colocated with LightSquared transmitters

Type: Maintenance
Urgency: Urgent
Publish Date: 23 Nov 2010
Country: USA
Expiration: none
Product Category: Mobile

Reason for Reissue:
A solution has been tested and approved.

Overview:
LightSquared has recently issued a coordination notice advising that their L−Band base station transmissions may cause near−band interference with colocated GPS receivers. A GPS antenna with enhanced filtering is required to attenuate the strong near−band transmission to prevent the GPS receiver from being over driven. ALU has tested and approved a new GPS antenna for this application.

Impact:
Sites colocating with or within 1000 feet light−of−sight of LightSquared transmission antennas require a GPS antenna upgrade to avoid GPS signal degradation or loss. Las Vegas, Phoenix, Denver, Baltimore and Washington DC have been identified as the initial markets where this needs to be addressed before March 2011.

Context:
LightSquared equipment transmits in a near−band to the GPS spectrum. The filter in the standard ALU offered GPS antenna is insufficient to colocate with this equipment. Sites colocated with this antenna are expected to report frequent or CRITICAL flywheeling alarms caused by severe GPS signal degradation or a complete loss of signal reception. A new version GPS antenna having enhanced filtering has been tested and approved by ALU.

Cause:
The attached website link contains some information about the recent spectrum change (FCC allowing satellite spectrum for terrestrial use). This allows LightSquared to transmit (downlink) in spectrum adjacent to the GPS receive spectrum. Colocation presents a strong near−field, near−frequency signal to the GPS antenna which must be attenuated to avoid an overdrive situation.
http://connectedplanetonline.com/3g4g/news/lightsquared−inmarsat−spectrum−081810/

Action To Be Taken:
If notified that LightSquared equipment will be colocated or nearby, replace the GPS antenna with the new enhanced filter version antenna. ALU recommends that LightSquared be consulted to understand the specific location and number of sites in the area.

Solution Availability:
New enhanced filter GPS antenna orderable item codes (orderable Jan 1, 2011):
L112D − 26dB antenna − 849143987
L116C − 40dB antenna − 849143001
L126 − 26dB antenna w/mount kit − 849143995
L127 − 40dB antenna w/mount kit − 849143019
The new antennas will be visually identifyable by a colored band at the base of the radome.

Contact:
Alcatel−Lucent Technical Support
Please contact the technical support team for your country. If you are unsure of who that is, you can locate the correct number by using our Technical Support phone numbers look−up tool, at
https://support.alcatel−lucent.com/