Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

In the Matter of )
) IB Docket No. 11-109
LightSquared Subsidiary LLC )
) SAT-MOD-20101118-00239
Request for Modification of its )
Authority for an Ancillary Terrestrial Component )

REPLY COMMENTS OF DEERE & COMPANY

Catherine Wang
Timothy Bransford
Bingham McCutchen LLP
2020 K Street, N.W.
Washington, DC 20006
Office: 202.373.6000
Fax: 202.373.6001

Counsel for Deere & Company

Patricia M. Harris
Assistant General Counsel

Paul Galyean
Manager, System Engineering and IME/Robotics

Mark Rentz
Senior Systems Engineer

Rich Keegan
Senior Principal Engineer

Deere & Company
One John Deere Place
Moline, IL 61265

August 15, 2011
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>SUMMARY</td>
<td>1</td>
</tr>
<tr>
<td>I. THE COMMENTS CONFIRM THAT LIGHTSQUARED’S PROPOSED SERVICE, EVEN AS MODIFIED, WILL CAUSE WIDESPREAD INTERFERENCE</td>
<td>2</td>
</tr>
<tr>
<td>II. THE INSTANT RECORD, FCC PRECEDENT AND OVERWHELMING TECHNICAL ANALYSIS CONTRADICT LIGHTSQUARED’S WATERED DOWN DEFINITION OF GPS RECEIVER HARMFUL INTERFERENCE</td>
<td>6</td>
</tr>
<tr>
<td>III. BASED ON THE RECORD AND REAL WORLD TESTS, LIGHTSQUARED’S INTERFERENCE RANGE SHOULD BE CALCULATED USING A FREE SPACE MODEL</td>
<td>10</td>
</tr>
<tr>
<td>IV. COMMENTERS AGREE THAT LIGHTSQUARED’S NETWORK WILL CAUSE INTOLERABLE INTERFERENCE TO PRECISION RECEIVERS EVEN IF IT TRANSMITS ONLY ON THE LOW 10 MHZ FREQUENCIES</td>
<td>12</td>
</tr>
<tr>
<td>A. US Agriculture Depends on High Precision Farming</td>
<td>13</td>
</tr>
<tr>
<td>B. Aviation, Including The Wide Area Augmentation System (“WAAS”), Relies On High Precision GPS for Air Safety</td>
<td>15</td>
</tr>
<tr>
<td>C. High Precision GPS is Embedded in Construction Equipment Prevalent in Urban and Suburban Areas</td>
<td>16</td>
</tr>
<tr>
<td>D. Survey, Mapping and Infrastructure Projects all Depend on Precision GPS</td>
<td>18</td>
</tr>
<tr>
<td>E. High Precision GPS is Important to Scientific Research and Monitoring</td>
<td>19</td>
</tr>
<tr>
<td>V. THE PERFUNCTORY MITIGATION MEASURES PROPOSED BY LIGHTSQUARED OFFER NO MEANINGFUL INTERFERENCE PROTECTION</td>
<td>20</td>
</tr>
<tr>
<td>A. LightSquared Continues To Make Patently False, Unsupported Assertions That Not Yet Developed Filter Technology Could Prevent Interference To GPS Devices And Applications</td>
<td>20</td>
</tr>
<tr>
<td>B. LightSquared’s Comments Fail To Provide Even Basic Information Regarding Other Previously Proposed Interference Mitigation Techniques Such As “Frequency Coordination”</td>
<td>22</td>
</tr>
<tr>
<td>C. LightSquared Admits Its Terrestrial-Only Network Will Interfere With Deere’s Higher Priority MSS StarFire Terminals, But Offers No Solutions</td>
<td>23</td>
</tr>
<tr>
<td>VI. INTERFERENCE FROM HANDSETS THREATENS GPS AND MUST BE RESOLVED</td>
<td>24</td>
</tr>
<tr>
<td>VII. INTERFERENCE FROM LIGHTSQUARED’S OPERATIONS IS CONTRARY TO U.S. COMMITMENTS TO PROTECT GNSS</td>
<td>26</td>
</tr>
<tr>
<td>CONCLUSION</td>
<td>28</td>
</tr>
</tbody>
</table>
SUMMARY

The thousands of Comments filed in this proceeding reflect an outpouring of grave concern by a broad swath of parties that rely on GPS, including high precision GPS in many applications, and demonstrate that the severe interference identified in the Technical Working Group ("TWG") testing process will cause widespread harm to virtually all classes of GPS users. Many parties shared Deere's view that none of the mitigation measures proposed by LightSquared, including the promise to temporarily forego operations on its upper frequencies and to limit its initial roll out to a “Low 10 MHz” configuration, ensures effective protection for the hundreds of millions of GPS devices in use today. Moreover, LightSquared's persistent attempts to blame the GPS community for this interference while recklessly speculating that GPS manufacturers can make changes in GPS receiver equipment to resolve the interference problems are counterproductive and grossly misguided. Numerous parties debunked these misconceptions. LightSquared’s ongoing efforts to minimize the TWG Final Report’s very damning findings of interference to GPS may reflect its predictable single-minded commercial motivation to obtain an FCC “green light,” on its timeline, no matter the cost or harm. However, those efforts must not be allowed to deter the Commission from a dispassionate review of the technical evaluation and conclusions set forth in the TWG Final Report.

Having recently abandoned its original plan, LightSquared has boldly asserted that its new Low 10 MHz approach, with other measures, will resolve virtually all interference issues. The numerous Comments filed in the record echo Deere’s view that this representation is not credible. Multiple parties from different sectors, including parties that contributed to the TWG Final Report, expressed similar concerns. Together, these Comments show that LightSquared's mitigation Recommendations, launched amid disturbing half-truths and unsupportable claims, in
fact do not offer any meaningful solution to the interference that will be caused by LightSquared's base stations. While the 10 MHz approach was not subject to comprehensive testing in all seven TWG sub-teams, the Comments confirm that in instances where it was tested, even on a preliminary basis, the results were dismal.

Knowing that testing revealed a significant risk of massive interference even in the revised Low 10 MHz configuration, LightSquared resorts to attacking the methodologies and analyses that exposed such interference. Multiple parties were highly critical of -- and no party supported -- LightSquared's proposed relaxed 6 dB interference threshold for GPS receivers. Indeed, the current record, past FCC precedent, and most importantly indisputable real-world data, all strongly support a 1 dB interference threshold. With respect to propagation analysis, LightSquared argues that the Commission should use a different -- more favorable -- model when evaluating the extent of interference. However, LightSquared's preferred model essentially rests on inappropriate assumptions that manmade and natural structures will always mitigate interference. The vast majority of commenting parties addressing this issue did not support either of these tactics to discredit the TWG Report conclusions.

Testing of the Low 10 MHz configuration that was conducted on high precision GPS receivers showed intolerable levels of interference into all receivers under test. Neither LightSquared nor any other party disputed these findings. Contrary to LightSquared’s apparent view that high precision GPS receivers are a small, insignificant niche use of GPS which should be considered a minor problem, the Comments revealed a flood of concern by users that rely on embedded high precision GPS equipment in a wide range of applications: agriculture, construction, survey, science and aviation among others. The Comments made clear that interference to high precision receivers jeopardizes not only the extensive agricultural uses that
Deere has previously described, it also puts at risk aviation system like the Wide Area Augmentation System that rely extensively on high precision GPS receivers for aviation safety. High precision GPS equipment is also an integral part of the construction industry whose equipment is prevalent in urban and suburban areas. In addition, parties stepped forward from the survey, mapping, and transportation sectors to confirm that precision GPS is vital to their operations. Finally, universities and scientific research organizations called for protection of the high precision GPS equipment that plays a key role in important scientific projects and monitoring. These Comments demonstrate that high precision GPS uses are critical applications to safety, commerce, infrastructure and science. None of LightSquared's proposed mitigation measures would prevent harmful interference to these operations. On that basis alone, it should be clear that LightSquared has not satisfied the condition in its waiver.

Several Commenters shared Deere's concern that as negative as the TWG Reports may be, they did not reflect the full extent of problems raised by LightSquared's proposal. Deere and others urge the Commission to require examination of the potential impact of out of band emissions from LightSquared's handsets prior to permitting LightSquared to commence service. The potential interference from handsets was only lightly examined by the TWG and the Commission should impose a further condition on LightSquared's authority to require that these interference concerns be examined and addressed before LightSquared may initiate service. Deere also shares the concerns raised by others that the United States has an obligation to other countries to prevent interference to Global Navigation Satellite Systems ("GNSS"), as recently reaffirmed by President Obama. As a user of multiple GNSS systems worldwide, Deere has an interest in supporting compliance with the U.S.'s longstanding commitment to protect GNSS.
The interference from LightSquared's base stations and potentially LightSquared's handsets runs
counter to this commitment, thus calling into question global cooperation to protect GNSS.
Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington D.C. 20554

In the Matter of )
LightSquared Subsidiary LLC ) IB Docket No. 11-109
Request for Modification of its )
Authority for an Ancillary Terrestrial ) SAT-MOD-20101118-00239
Component )

REPLY COMMENTS OF DEERE & COMPANY


Deere appreciates the Chairman’s recently reported statements that the evaluation of the TWG Final Report and specifically whether LightSquared has satisfied the condition in the January 23, 2011 Waiver Order will depend on a “fact-based, engineering” inquiry.

---

3 Communications Daily August 10, 2011. This sentiment is consistent with the fact that the Bureau convened the Technical Working Group to address this issue and the study was undertaken in good faith,
LightSquared’s ongoing efforts to minimize the TWG Final Report’s very damning findings of interference to GPS may reflect its predictable single-minded commercial motivation to obtain an FCC “green light” on its timeline, no matter the massive economic cost or harm to the public interest and potential safety-of-life impact to others. However, those efforts must not be allowed to deter the Commission from a dispassionate review of the technical evaluation and conclusions set forth in the TWG Final Report. This must be the case even if the findings show, which Deere believes they do, that the L-Band cannot feasibly be used in the short-term or even the medium-term as a viable spectrum vehicle to support additional high power terrestrial broadband services without highly adverse consequences to the public interest.

I. THE COMMENTS CONFIRM THAT LIGHTSQUARED’S PROPOSED SERVICE, EVEN AS MODIFIED, WILL CAUSE WIDESPREAD INTERFERENCE

There is widespread agreement among the commenting parties on the TWG Final Report’s very negative findings of severe interference. Even LightSquared does not dispute the conclusion, arrived at after thousands of engineering hours spent testing and analyzing operations under LightSquared’s original plan, that its originally proposed services would cause intolerable interference to all GPS receivers. The incontrovertible technical conclusion reveals that LightSquared’s earlier assurances that interference to GPS was unlikely and/or that GPS interference issues have already been adequately addressed were simply not credible. It shows involving [100+] engineers working cooperatively over four months to assess the extent and impact of the interference that LightSquared’s transmission would have on a multitude of GPS receivers embedded in numerous applications.

4 See, e.g., Letter from Jeff Carlisle, Executive Vice President, LightSquared Subsidiary LLC, to Marlene Dortch, Secretary, FCC, File No. SAT-MOD-20101118-00239, dated December 20, 2010 (GPS interference is unlikely).

5 See, e.g., Consolidated Opposition of LightSquared Subsidiary LLC, SAT-MOD-20101118-000239, at 2 (filed March 14, 2011) (“the Bureau has taken appropriate action with respect to GPS interference concerns because the Commission considered the potential for interference to GPS in its ATC rulemaking and developed technical rules to protect GPS . . .”).
that LightSquared’s continual resistance to even considering the GPS interference issue did not reflect a reasoned technical judgment on LightSquared’s part regarding GPS receivers generally or high precision GPS receivers specifically. Indeed, it seems that at no time prior to the process leading up to the TWG Final Report had LightSquared adequately considered GPS interference issues raised by using L-Band satellite spectrum for high power ubiquitous terrestrial operations. It may be that a meaningful analysis of such issues was largely outside the core technical competency of LightSquared’s team which was, and still is, focused primarily on satellite, and recently, terrestrial communications rather than the fundamentally different navigation signals.

Having recently abandoned its original plan, LightSquared has boldly asserted that its new Low 10 MHz approach, with other measures, will resolve virtually all interference issues. The Comments echo Deere’s concerns and show that the Recommendations, launched amid disturbing half-truths and unsupportable claims, in fact do not offer any meaningful interference mitigation solutions that would justify giving LightSquared authority to proceed.

The Recommendations essentially declare first that hundreds of millions of government, commercial and individual GPS users across the nation employing GPS for aviation, agriculture, construction, scientific research, surveying, and consumer navigation, among other uses, are to blame for the interference that they will experience from LightSquared’s service. Deere and

---

6 For example, in December 2010 LightSquared asserted that the Commission “already addressed the GPS interference issue in the original MSS/ATC proceeding. To protect GPS, the rules adopted in that proceeding impose extensive and specific out-of-band emission (“OOBE”) limits on MSS/ATC operations.” Consolidated Reply of LightSquared Subsidiary LLC, SAT-MOD-20101118-000239, at 19 (filed December 9, 2010).

7 See Comments of Stansell Consulting, IB Docket No 11-109 at 2-3 (filed July 30, 2011, erratum filed August 6, 2011). Well-known GPS expert Thomas Stansell discusses the fundamental differences between bandwidth requirements of navigation signals as compared to communications signals and why navigation signals cannot be narrowed, particularly precision navigation signals, as suggested by LightSquared.

8 See Recommendations of LightSquared Subsidiary LLC, SAT-MOD-20101118-0239, at 2-3, 11-20 (filed June 30, 2011) (“Recommendations”) (arguing that GPS industry should have known in 2003 that MSS spectrum would be used for ubiquitous high power terrestrial operations in 2011 and should have designed GPS receivers accordingly). Apparently eager to divert attention away from the extremely negative technical evaluation,
others discussed in the Comments\(^9\) and previously\(^{10}\) why LightSquared’s self-serving position distorts the evolution of ATC and runs directly contrary to Commission precedent regarding the MSS service as well as the Part 25 rules. Deere also points out that the Commission has never undertaken to amend the Part 2 Table of Allocations to reflect a reallocation or co-allocation of the L-Band spectrum from its primary satellite service designation to a primary or even co-primary terrestrial mobile designation by issuing a Notice of Proposed Rulemaking laying out and seeking public input on the perceived benefits and costs of such a radical change in accordance with procedures required by the Commission’s own rules and the Administrative Procedures Act.\(^{11}\) It is noteworthy that the Commission rightly followed rulemaking procedures to accomplish just such a reallocation (making mobile and terrestrial operations co-primary) in the S-band in response to its Notice of Proposed Rulemaking in ET Docket No. 10-42.\(^{12}\)

---

\(^9\) See, e.g., Comments of Deere & Company, IB Docket No 11-109 at 8 (filed August 1, 2011) ("Deere Comments") ("Even a generous reading of the Commission’s orders, rules and contemporaneous Commissioner statements regarding MSS ATC authorizations reveals exactly the opposite plan -- the Commission was careful to adopt a scheme specifically designed to prevent ATC from becoming a ubiquitous terrestrial CMRS network overtaking the primary satellite purpose"); see also Comments of Trimble Navigation Limited, IB Docket No 11-109 at 7 (filed August 1, 2011) ("Trimble Comments") ("In fact, LightSquared’s version of history is demonstrably wrong. LightSquared continues to assert that it was well known as early as 2003 that MSS spectrum could be used to provide a nationwide high-powered terrestrial broadband network that was not integrated with a satellite service in any meaningful sense"); Comments of Garmin International, Inc., IB Docket No 11-109 at 19 (filed August 1, 2011) ("Garmin Comments") ("The FCC explicitly stated in this 2003 action that we do not intend, nor will we permit, the terrestrial component to become a stand-alone service.").

\(^{10}\) See, e.g., Comments of the U.S. GPS Industry Council, IBFS File No. SAT-MOD-20101118-00239 at 6 (filed December 2, 2010) ("At its outset, MSS ATC was essentially a gap filler, designed simply to bring reliable coverage to dense urban communities and other areas that due to terrain or other features could not obtain adequate service via the primary satellite facilities").

\(^{11}\) Absent any amendment to the Table of Allocations, the GPS receivers built by Deere and others have been designed in accordance with domestic and international Table of Allocations. See also, Comments of Lockheed Martin Corporation, at 12 (Lockheed Martin Radio Navigation Satellite Service ("RNSS") receivers reflect spectrum environment established in Table of Allocations.)

\(^{12}\) See Fixed and Mobile Services in the Mobile Satellite Services Bands at 1525-1559 MHz and 1625.5 and 1660.5 MHz, 1610-1625.5 MHz and 2483.5 2 -2200 MHz and 2000-2020 MHz, Report and Order, ET Docket No. 10-142, 26 FCC Red. 5710 (rel. April 6, 2011).
Second, in any event, according to the Recommendations, LightSquared’s three-prong plan will protect virtually all GPS users. The overwhelming response in the Comments confirms that, once again, LightSquared’s positions are not credible and should be rejected.

The core of LightSquared’s solution rests on its late-breaking announcement that it will temporarily forego base stations transmissions in the 1626.5-1660.5 MHz band and will initially roll out its services using only the 1526-1536 MHz band for its base station transmissions (“Low 10 MHz”) approach. This approach was not subject to comprehensive testing in all seven TWG sub-teams. However, the Comments confirm that in instances where it was tested, even on a preliminary basis, the results were dismal. Deere submits that testing showed, despite LightSquared’s argument to the contrary, severe, intolerable interference to virtually all classes of GPS devices in all applications. No party disputed test results showing that LightSquared transmissions at the Low 10 MHz caused intolerable interference to critical high precision GPS receivers (used in aviation, agriculture, construction, survey, etc.).

Some parties called upon the Commission to mandate that thorough and comprehensive testing must be conducted before the Commission may accept LightSquared’s bold assurances that the Low 10 MHz approach would avoid virtually all interference to GPS. Although there

---

13 LightSquared also proposed to operate base stations at reduced power, See Recommendations, at 25, but that element of LightSquared’s solution proposal was roundly criticized in the Comments as disingenuous and ineffective to resolve interference to GPS receivers. See, e.g. Deere Comments at 23 (“While LightSquared portrays a 32 dBW limit on base station EIRP as a significant reduction in power and a meaningful step toward reducing harmful interference to GPS receivers, no concession or reduction in power was actually proposed.”).

14 See, e.g., Comments of Aerospace and Flight Test Radio Coordinating Council, IB Docket No 11-109 at 3 (filed August 1, 2011) (urging the Commission to avoid taking action before analyzing the interference risk to aeronautical mobile telemetry ("AMT") operations from LightSquared’s revised proposal to concentrate all base stations in spectrum virtually adjacent to AMT); Comments of Aircraft Owners and Pilots Association and General Aviation Manufacturers Association ("AOPA/GAMA"), IB Docket No 11-109 at 22-23 (filed August 1, 2011) (explaining that testing is needed to show no interference to aviation); Comments of Association of Public Safety Communications Officials - International, Inc. ("APCO"), IB Docket No. 11-109 at 2 (filed August 1, 2011) (indicating that testing is needed to assess impact on E911 system); Comments of Aviation Spectrum Resources, Inc., IB Docket No 11-109 at 3-4 (filed August 1, 2011) (indicating that testing is needed to confirm no interference risk to FAA’s Wide Area Augmentation System ("WAAS") for aviation); Comments of Boeing Company, IB Docket No. 11-109 at 4-6 (filed August 1, 2011) (explaining that the Aviation sub-team could not determine
is conclusive technical data in the record today demonstrating that high precision GPS will suffer severe interference under the Low 10 MHz approach, Deere does not object to further testing provided that the procedures and methodologies reflect sound, objective engineering judgments. Deere does not see the utility of such testing since severe, intolerable interference has already been established for a significant portion of GPS receivers, but Deere understands that the Commission may want to complete the technical record.

II. THE INSTANT RECORD, FCC PRECEDENT AND OVERWHELMING TECHNICAL ANALYSIS CONTRADICT LIGHTSQUARED’S WATERED DOWN DEFINITION OF GPS RECEIVER HARMFUL INTERFERENCE

Knowing that testing revealed a significant risk of massive interference even in the revised Low 10 MHz configuration, LightSquared resorts to attacking the methodologies and analyses that exposed such interference. LightSquared asserts in its comments that “[u]sing a 1 dB C/N0 interference threshold is inappropriate, and unduly conservative, because the TWG Final Report test results show that a change of this magnitude does not result in any appreciable change in the [GPS] device performance.”15 Instead, LightSquared urges the Commission to substitute a greatly relaxed 6 dB C/N0 interference threshold in an effort to artificially dilute the interference impact of its Low 10 MHz configuration allowing the company to argue that it can

---

15 LightSquared Comments at 7.
proceed while protecting a majority of GPS receivers from interference (although still far less than the 99 percent it touts without support in its Recommendations).\textsuperscript{16}

Despite LightSquared’s transparent desire to relax the interference threshold for GPS receivers, the current record, past FCC precedent, and most importantly indisputable real-world data, all strongly support a 1 dB interference threshold.\textsuperscript{17} Setting aside LightSquared’s self-interested pleas, there is no support for its watered down 6 dB interference threshold.

With regard to the current record, Commenters with a much deeper technical understanding of GPS receiver performance relative to LightSquared concur that 1 dB is the appropriate interference threshold. For example, in its comments prominent GPS manufacturer Garmin explained that “1 dB of degradation is equivalent to a twenty percent reduction in the effective received signal power” and that “[d]egradation of GPS performance may occur… well before the point at which twenty percent of signal power is lost.”\textsuperscript{18} GPS pioneer and long-standing industry leader Trimble explained in its comments that given how harmful interference can occur due to an even more subtle increase in the ratio of carrier-to-noise at a receiver, “1 dB is arguably too high a threshold.”\textsuperscript{19}

Beyond the current record, an examination of FCC precedent shows that the Commission has historically held that a 1 dB degradation is the appropriate threshold for sensitive space-to-earth communications. During the Commission’s recent rulemaking to evaluate the compatibility of terrestrial Wireless Communications Service (“WCS”) networks in spectrum

\textsuperscript{16} See id.

\textsuperscript{17} As Stansell Consulting addressed in detail in its Comments, GPS-based navigation applications are more sensitive to changes in signal-to-noise ratio relative to communications/network timing applications. Specifically, “GPS navigation accuracy is not based on data demodulation. It is based on 'pseudorange' measurements, which are obtained by measuring the time of arrival of spreading code transitions,” and require sharp code edges to achieve extremely precise time-of-signal-arrival measurements. Sharp code edges require wider bandwidth and better signal-to-noise ratio, and leave navigation applications generally more susceptible to interference relative to communications receivers. See Stansell Consulting Comments at 1-4.

\textsuperscript{18} Garmin Comments at 41.

\textsuperscript{19} Trimble Comments at 49 (emphasis added).
immediately adjacent to space-to-earth frequencies assigned to Satellite Digital Audio Radio Service (“SDARS”) licensees, a 1 dB increase in the noise floor for SDARS receivers was deemed the appropriate threshold for interference.\textsuperscript{20} In fact, during the SDARS proceeding proponents for the introduction of adjacent, terrestrial wireless WCS service next to space-to-earth frequencies expressly acknowledged that a “1 dB figure is a typical value used by industry for noise floor protection.”\textsuperscript{21} Moreover, when implementing the present regulatory scheme for Part 15 Ultra-Wideband (“UWB”) devices that radiate very low levels of energy co-channel in GPS bands, the Commission concluded that a 1 dB increase in the noise floor was an appropriate threshold for determining at what point harmful interference had occurred to a GPS receiver.\textsuperscript{22}

Even if in the instant situation there was no directly relevant record or FCC precedent, both of which support a 1 dB interference threshold, empirical test data generated by the TWG that LightSquared conveniently chooses to ignore independently establishes an undeniable correlation between a 1 dB rise in the noise floor and a real-world degradation of GPS receiver performance. For example, during testing of LightSquared’s proposed Low 10 MHz configuration, 90% of high precision receivers under test lost 1 dB of sensitivity when the interfering LTE signal reached -25 dBm, however, 50% of the same receiver class completely lost the ability to track GPS satellites when the interfering signal was lower, at a signal strength of only -28 dBm, and 10% of the same receiver class completely lost the ability to track GPS satellites when the interfering signal was much lower, at a signal strength of only -54 dBm.\textsuperscript{23} In other words, many high precision receivers stopped working altogether in the presence of a

\textsuperscript{20} See Amendment of Part 27 of the Commission’s Rules to Govern the Operation of Wireless Communications Services in the 2.3 GHz Band, Report and Order, 25 FCC Rcd 11710, ¶¶ 89-115 (2010).

\textsuperscript{21} Id at 11749, n.218.


\textsuperscript{23} See TWG Final Report, Appendix H.1.11 figures 84 and 85.
simulated LightSquared signal that created far less than 1 dB of performance loss. High precision receivers, however, are not alone. Other classes of GPS receiver also experienced a meaningful degradation in their real-world performance when signal loss during TWG tests reached 1 dB. The Aviation sub-team noted that “receivers tested failed to meet key performance requirements (WAAS message-loss-rate) in the presence of LightSquared signals that resulted in 1 dB degradation of C/N₀.” The General Location / Navigation and Cellular sub-teams also reported significant degradation in the presence of 1 dB of signal degradation.

Tellingly, LightSquared failed to muster any support for its 6 dB interference threshold, even from its strongest and most engineering-savvy supporters. For example, neither Sprint (LightSquared’s network partner who provided technical assistance to the company during TWG tests) nor Open Range (one of LightSquared’s earliest customers and strongest advocates) expressed support for a 6 dB interference threshold for GPS receivers. Meanwhile, other members of the TWG strongly condemned the proposed 6 dB threshold in their respective comments. In addition to Deere, both Garmin and Trimble concluded that a 6 dB interference threshold, which represents a full 75 percent decrease in GPS signal strength, appeared to be plucked from the ether and lacked any scientific or engineering basis. Garmin warned that “LightSquared provides no citation from accepted technical literature or engineering texts for its novel” 6 dB interference threshold, and expressed concern that LightSquared was “ignor[ing]

---

24 TWG Final Report at 50.
25 See USGIC Comments at 22 (“Under the 1 dB C/N₀ degradation criterion that has scientific and regulatory precedent behind it, 20 out of the 29 devices tested by the General Location/Navigation sub-team would suffer harmful interference from LightSquared’s use of a single 10 MHz channel at 1526-1536 MH”).
26 See Deere Comments at 19-20; Trimble Comments at 49 (“degradation to GPS performance may occur well before the point where 20 percent of the signal power is lost, so 1 dB is arguably too high a threshold. Despite this, LightSquared suggests – particularly in the context of the General Location and Navigation sub-team test results – that a 6 dB loss in the Carrier-to-Noise ratio is acceptable, providing no sound basis in accepted technical literature or engineering for this 6 dB standard”; Garmin Comments at 47 (“All [TWG] tests clearly demonstrate that LightSquared’s proposed definition of “harmful interference” as a 6 dB of degradation in C/N₀ ignores clear and convincing evidence that harmful interference is actually experienced at a level of 1 dB”).
clear and convincing evidence that harmful interference is actually experienced at a level of 1 
dB.”27 Trimble added that LightSquared’s proposed 6 dB interference threshold “simply defies 
credulity.”28

III. BASED ON THE RECORD AND REAL WORLD TESTS, LIGHTSQUARED’S 
INTERFERENCE RANGE SHOULD BE CALCULATED USING A FREE SPACE 
MODEL

In a further attempt to downplay the scope of interference its proposed network will 
create, LightSquared argues in its comments that when evaluating the range of its base station 
signals the “use of a free space model improperly skews the [test] results, because in the real 
world attenuation does occur.”29 In other words, LightSquared assumes that buildings and trees 
will always limit interference. LightSquared asserts that a more “conservative” model should be 
applied when calculating its interference range.30 While Deere and other commenters recognize 
that attenuation may occur in real world settings, that does not make one of LightSquared’s more 
“conservative” propagation models appropriate for evaluating its interference range.31

First, there are real-world scenarios where LightSquared’s proposed base station signals 
would propagate with little or no attenuation from manmade or natural obstructions, and where 
the applicability of a free space model cannot be challenged. For example, in its own 
independent analysis the Radio Technical Commission for Aeronautics (“RTCA”) found that a 
free space model was the most appropriate propagation scheme for calculating interference 
between simulated LightSquared base stations and airborne GPS receivers where line of sight

27 Garmin Comments at 45, 47.
28 Trimble Comments at 50.
29 LightSquared Comments at 8.
30 Id.
31 Please see Exhibit 1 for a fulsome technical explanation of the distinctions between a free space 
propagation model and the alternative models promoted by LightSquared.
obstructions are unlikely to attenuate the interfering signal. Specifically, the RTCA determined that in the “high altitude en route scenario there is predominately clear line of sight to all the interfering cell towers. In such cases a free space path loss model is most appropriate.” Of course, the same principles would apply to a space-based receiver where manmade or natural blockage between the interfering base station and overhead satellite will not occur.

Second, as discussed extensively in Deere’s comments, even when attenuation from manmade or natural blockage is possible, there will be many instances where LightSquared’s interfering signal will propagate unimpeded. This was demonstrated during LightSquared’s own live sky tests in Las Vegas, where high precision receivers experienced interference at a range of 22 km, much closer to the interference range expected from a “free space” propagation model than one of the alternative models promoted by LightSquared. In addition, there were clear measurements recorded in Las Vegas during live sky testing where LightSquared’s signal actually exceeded anticipated levels calculated using a free space model, at ranges extending many kilometers from the transmitting antenna.

Just as with its flawed and self-serving proposal for a relaxed interference threshold, LightSquared failed to generate any support for its alternative propagation models from other commenting parties. Comments from LightSquared supporters fail to lend any support for LightSquared’s alternative propagation models. Conversely, several concerned commenters and former TWG members expressed strong opposition to LightSquared’s propagation models.

---

33 Consistent with the analysis herein, the TWG Space-Based sub-team used a free space propagation model for its tests.
34 See Deere Comments at 20.
35 See id. at 13.
36 See TWG Final Report at 260 (“Power data measured by Trimble, John Deere and LightSquared at the rural site in Las Vegas all show that the propagation model is very close to a free space model. In fact, due to multipath, the received power is often greater than a Live Sky model would predict”).
Garmin explained that LightSquared’s alternative propagation models were “drawn from the cellular industry, where they are used for cellular link-budget analysis to determine the probability of dropped calls. Such an approach is totally inappropriate when accuracy of GPS and all the attendant safety concerns are at issue.” 37 Trimble noted that both of LightSquared’s alternative propagation schemes underestimate real-world signal strength. 38

IV. COMMENTERS AGREE THAT LIGHTSQUARED’S NETWORK WILL CAUSE INTOLERABLE INTERFERENCE TO PRECISION RECEIVERS EVEN IF IT TRANSMITS ONLY ON THE LOW 10 MHZ FREQUENCIES

While not every TWG sub-team was able to conduct a full series of Low 10 MHz tests, the testing that was conducted by the High Precision, Timing and Networks sub-team showed intolerable levels of interference into virtually all high precision receivers under test. 39 According to the report even with the Low 10 MHz configuration, "31 of 33 High Precision and Network GPS receivers tested experienced harmful interference within the range of power levels that would be seen inside the network." 40 In its Comments, Leica Geosystems, Inc. concluded that the "use of the Lower 10 MHz frequencies is a problem for hundreds of thousands of Wide Band Precision Receivers." 41 LightSquared does not dispute these findings. Instead, it attempts to persuade the Commission that interference to high precision receivers is insignificant because,

---

37 Garmin Comments at 48-49.
38 See Trimble Comments at n.141.
39 The harmful interference started for some receivers at power levels as low as -75 dBm, corresponding to a distance of 60 km (however, the horizon would limit this to ~35 km for a 100 meter tower), from a single LightSquared base station. At a power level of -43 dBm (corresponding to a free space range of 1.5 km), 50% of the high precision receivers were suffering harmful interference.
40 TWG Final Report at 180.
by LightSquared’s reasoning, there are a trivial number of precision receivers to worry about\footnote{In relying on what appears to be a loose calculation of cellular handset GPS receiver unit volume, LightSquared simply ignores the many applications that rely on precision receivers to serve important safety, business, and scientific operations.} and/or such applications simply do not matter enough to protect.

Contrary to LightSquared’s mistaken view, the Comments revealed an outpouring of concern by high precision GPS users that rely on high precision GPS equipment in a wide range of applications: agriculture, construction, survey, science and aviation. As explained by Leica Geosystems, interference from LightSquared will “render these un-useable or worse unreliable.”\footnote{Leica Geosystems Comments at 2.} These Comments demonstrate that high precision GPS uses are not limited to niche applications that can be disregarded in searching for meaningful mitigation solutions, which is the apparent view held by LightSquared. Interference from LightSquared would “essentially eliminate the High-Precision GNSS industry - and the impact on the US economy would be catastrophic.”\footnote{Id.}

Furthermore, as recently confirmed in a letter to Chairman Genachowski from the National PNT Advisory Board, contrary to some statements, high precision receivers serving diverse critical applications are “imbedded in urban as well as rural environments.”\footnote{Letter from Honorable James R. Schlesinger, Chairman, National PNT Advisory Board and Dr. Bradford Parkinson, Vice-Chairman, National PNT Advisory Board to the Honorable Julius Genachowksi, Chairman, FCC, dated August 3, 2011. In its August 3, 2011 letter, the National PNT Advisory board highlighted the TWG test results demonstrating that LightSquared’s Low 10 MHz proposal caused harmful interference to “all 33 GPS of the high performance, productivity-enhancing sets that were tested.) Id. at 2.} High precision GPS operations generate important economic and public interest benefits, including safety-of-life benefits and cannot be overlooked in assessing LightSquared’s proposed mitigation solutions.

A. US Agriculture Depends on High Precision Farming

In the agricultural sector, use of precision GPS is critical. A group of 13 major agricultural organizations representing farmers and agribusinesses in all 50 states attested to the
critical importance of precision GPS to American growers.46 “This capability has produced remarkable increases in crop yields and decreases in input costs while advancing important environmental benefits.”47 The American Farm Bureau, representing more than 6 million families, explained that “[f]armers use GPS for accurate mapping of field boundaries, roads and irrigation systems, for precision planting and for targeting the application of fertilizer and chemicals to combat weeds and crop diseases. GPS also allows farmers to work despite low visibility field conditions such as rains, dust fog and darkness.”48

The Louisiana Farm Bureau Federation, Inc. made clear the practical application of precision GPS in agriculture: “[a] farmer cannot have a GPS auto-steer tractor operating without reliable GPS L-Band signal. . . intermittent GPS interference or jamming, especially in Louisiana agriculture, not only eliminates the utility of the GPS device but also compromises the safety of farmers and their employees where our GPS-guided machinery operate in fields in close proximity to water bodies, tributaries, pipelines, highways and overhead power lines.”49 Precision GPS is also a key technology in efforts to assure food safety and compliance with U.S. Food Safety Legislation requiring traceability of chemical applications and location of origin of harvested crops.50 The North Carolina Soybean Producers Association attested that the use of high precision GPS receivers “in addition to increasing efficiency and profitability on the farm . . . results in considerable environmental benefits as fertilizer and pesticides can be applied in the

46 Joint Comments by the American Soybean Association, the American Sugar Alliance, the National Association of Wheat Growers, the National Barley Growers Association, the National Corn Growers Association, the National Cotton Council of America, the National Council of Farmer Cooperatives, the National Potato Council, the National Sunflower Association, the North Harvest Bean Growers Association, the U.S. Canola Association, the USA Dry Pea and Lentil Council and the USA Rice Federation.
47 Id.
48 Id.
49 Id. at 1. The Bureau states that “farmers and others in our industry have invested thousands of dollars for GPS systems that are accurate to 1 inch.” Id.
50 Id.
51 Id. at 5.
most conservative and precise manner.” Similar points were echoed in comments filed by The Nebraska Farm Bureau Federation, the Missouri Farm Bureau Federation, Indiana Farm Bureau, and the National Potato Council.

B. **Aviation, Including The Wide Area Augmentation System (“WAAS”), Relies On High Precision GPS for Air Safety**

LightSquared completely ignores the fact that high precision GPS is embedded in equipment in extensive use in the aviation sector and that Low 10 MHz interference to such precision GPS will jeopardize an important part of air safety for the American flying public. The FAA relies on wideband precision GPS receivers for airfield and flight procedure surveys, flight test tracking, space weather monitoring and GPS timing for computing resources and mission critical systems. Augmented wideband precision receivers are used for the FAA’s Wide Area Augmentation System (“WAAS”) which provides precision GPS information for enhanced safety of flight in air navigation and air traffic control throughout the entire National Airspace System (“NAS”). Lockheed Martin’s Regional Positioning System (“RPS”) provides augmentation of GPS signals through the entire NAS to improve the accuracy, availability and integrity of the GPS space positioning, navigation, and timing (“PNT”) services.

Lockheed Martin, a participant in the TWG, confirmed in its comments that test results showed that LightSquared operations on the Low 10 MHz would cause “harmful interference into a significant number of GPS receivers across many device types and deployment scenarios.

---

52 AOPA/GAMA at 22 (quoting FAA impact statement). The Coalition of Geospatial Organizations representing more than 35,000 producers and users of geospatial data and technology, unanimously voted to express its urgent and critical concern over interference from LightSquared even at the Low 10 MHz frequencies. This community uses high precision GPS for mapping, geographic information systems (GIS) and surveying as well as to fly satellites and aircraft to collect imagery and other airborne and spaceborne sensing equipment. See Letter to Chairman Genachowski, Federal Communications Commission from Geney Terry, 2011 COGO Chair, Coalition of Geospatial Organizations, IB Docket No. 11-109, at 1-2 (filed July 27, 2011).
53 Lockheed Martin Comments at 5.
(including into high precision GPS receivers of the type Lockheed Martin uses at its WAAS reference stations).\(^{54}\) Interference caused by transmissions even under LightSquared’s Low 10 MHz approach would introduce a “substantial safety hazard to a significant portion of the, and potentially the entire, National Airspace System . . . quite possibly endanger[ing] safety of life and property.”\(^{55}\)

As noted by several commenters, the FAA also recently conducted its own analysis that found LightSquared’s proposed operations threaten existing GPS-based navigation tools that improve air travel safety, as well as next generation GPS-based navigation tools that are expected to yield additional dramatic safety improvements in air travel.\(^{56}\) Similar to the conclusion reached by Lockheed Martin, the FAA found that a Low 10 MHz configuration was incompatible with and a threat to its GPS receivers, including high precision receivers that would experience serious degradation or disruption in the presence of an interfering LightSquared signal.\(^{57}\) The FAA ultimately concluded that a 10 MHz configuration resulting in the degradation or disruption of GPS service could impact air safety, and estimated that up to 794 lives could be lost due to avoidable aviation accidents.\(^{58}\)

C. High Precision GPS is Embedded in Construction Equipment Prevalent in Urban and Suburban Areas

The Comments also revealed significant high precision GPS use in the construction industry. In the construction context, high precision GPS enables machine control and guidance systems that allow operators to grade sites with increased accuracy without the need for survey

---

\(^{54}\) Id. at 8.  
^{55}\) Id. at 6.  Position information provided by precision GPS mitigate three major aviation safety risks: approach and landing accidents, controlled flight into terrain and runway incursions. See Comments of Amir Line Pilots Association, Interntaional, IB Docket No. 11-109, at 2-3 (filed July 29, 2011).  
^{56}\) See e.g., Garmin Comments at 28, AOPA/GAMA at 8.  
^{57}\) Garmin Comments at 28-29.  
^{58}\) See id. at 28.
stakes. The Association of Equipment Manufacturers explained that precision GPS has become critical to improving the productivity, efficiency and safety on construction job sites.\textsuperscript{59} According to leading construction equipment manufacturer Caterpillar, Inc., for the past 14 years, it has incorporated GPS technology in its construction and mining equipment and today virtually all Caterpillar equipment is sold with precision GPS equipment.\textsuperscript{60} Caterpillar states that high precision GPS on construction sites has led to increases in productivity by as much as 50 percent.\textsuperscript{61} Caterpillar confirms that LightSquared’s transmissions will severely interfere with the operation of its earthmoving systems, fleet management systems and proximity and detection systems, among other equipment.\textsuperscript{62} Without reliable precision GPS receivers, construction workers would be exposed to greater hazards and construction projects, including infrastructure rebuilding projects, could take twice as long to complete at significantly higher costs.\textsuperscript{63}

Itself a major supplier of construction equipment incorporating high precision GPS receivers, Deere attests that such equipment is prevalent in urban and suburban areas throughout the United States where most building and infrastructure construction occurs. Look closely at construction sites in any metropolitan area and you will see a wide variety of precision-GPS enabled construction equipment. Significantly, any mitigation proposal that assumes that interference to high precision equipment can be avoided simply by limiting LightSquared’s initial roll out to urban areas completely overlooks the severe interference that will be caused to high precision GPS used in the construction and survey context.


\textsuperscript{60} Comments of Caterpillar Inc., IB Docket No. 11-109, at 1 (filed July 29, 2011) (“Caterpillar Comments”).

\textsuperscript{61} Id.  See also AEM Comments.

\textsuperscript{62} Caterpillar Comments at 2-3. Among other equipment, interference will impair precision GPS in Caterpillar’s Computer Aided Earthmoving Systems, Accugrade Systems, its Minestar Fleet Management system.

\textsuperscript{63} Id. at 3.
D. Survey, Mapping and Infrastructure Projects all Depend on Precision GPS

The Comments revealed extensive use of high precision equipment for survey, mapping, and in geographic information systems (“GIS”) applications. High precision GPS receivers are used extensively for geodetic control for highway projects, including roads, bridges and to establish vertical control in remote areas for flood plain determinations, among other things.64 The American Association of State Highway and Transportation Officials (“AASHTO”) representing departments of transportation in all 50 states, the District of Columbia and Puerto Rico, expressed grave concern that LightSquared’s operations will harm precision GPS widely used for transportation-related purposes.65 AASHTO’s members rely on precision GPS for accurate survey information to fix boundaries for personal, state, local, and tribal boundaries and even international borders.66 According to AASHTO, reverting to older methods of obtaining geodetic information and position will seriously impair building, roadway, rail and runway construction projects.67 AASHTO also highlighted the risk to its members’ decade-long project to implement vehicle-to-vehicle and vehicle-to-device communications for collision avoidance and in support of emergency responders. The New York State Geographic Information Systems Association (“NYSGISA”) advises the Commission that LightSquared’s proposal, if approved, would threaten the significant investment in GPS made in New York for the Department of Transportation Spatial Reference Network (“NYSNET”) GPS base stations as well as the local, governments that collect data vital to their operations.68 The Wisconsin Department of Transportation opposes LightSquared’s plans explaining that it jeopardizes the

64 See Comments of Shyka, Sheppard, & Garster, at 1. See also AASHTO Comments, at 2 (interference to precision GPS would harm construction because precision GPS is used for “measurements in preparation of surfaces for buildings, roadways, rail and runways.”).
65 Id.
66 Id.
67 Id. at 2.
approximately $20 million investment it has made in a Height Modernization Program that incorporates high precision GPS and permanent GPS reference stations, which are heavily utilized by the road construction industry, high precision agriculture and municipal and private surveyors who require two centimeter accuracy. 69 Comments by the Maricopa County Department of Transportation stated that the department uses high precision GPS receivers for land surveying daily in over 99% of projects to design, layout and maintain transportation infrastructure, including roads, bridges, culverts, land boundaries and Geographic Information Systems. 70

E. High Precision GPS is Important to Scientific Research and Monitoring

The Comments also reflect that interference from LightSquared will impair high precision GPS receivers currently in use for various important scientific research and monitoring projects. For example, UNAVCO, a consortium of over 90 U.S. universities and 65 organizations, funded by the National Science Foundation (“NSF”) and NASA to support and advance the geodesy community’s science goals, expresses grave concerns that use of the L-Band for LightSquared’s high power terrestrial network will disrupt the high precision instruments its members require for important earth science and atmospheric research. UNAVCO supports approximately 2000 high precision GPS monitoring stations in the U.S. “including the 1100-station Plate Boundary Observatory, the geodetic component of the NSF’s EarthScope Project in which $100 million was invested.” 71 UNAVCO estimates that its projects to date represent a taxpayer investment of $190,000,000 since 2003. 72 Similarly, the research

69 Comments of Wisconsin Department of Transportation, IB Docket No. 11-109, at 1 (filed July 28, 2011).
70 Comments of Maricopa County Department of Transportation, IB Docket No. 11-109, at 1 (filed July 30, 2011).
71 Comments of UNAVCO, IB Docket No. 11-109, at 1 (filed Aug. 1, 2011).
72 Id.
team from the University of Texas at Arlington stated in its Comments that it relies on GPS to measure “active deformation in Puerto Rico, the Dominican Republic Haiti and the U.S., and British Virgin Islands” and other countries to define seismic hazards in the northeastern Caribbean and Central America.\textsuperscript{73}

The Comments revealed that high precision GPS is embedded in a broad range of important applications. The Comments also clarify that the extensive use of high precision GPS occurs in a variety of scenarios – urban, suburban and rural. As Deere explained in its Comments, LightSquared’s has not proposed any meaningful mitigation solution for high precision GPS. Measured just in the private sector, high precision GPS generates economic benefits of billions of dollars every year. The harm resulting from the loss of high precision GPS to the U.S. agricultural community \textit{alone} would total between $14 - $30 billion annually.\textsuperscript{74} High precision use cannot be considered a small niche application, the loss of which would constitute unfortunate collateral damage to the pursuit of greater goals; it is worth tens of billions of dollars to the U.S. economy and is an enabling technology critical to multiple important sectors.

V. THE PERFUNCTORY MITIGATION MEASURES PROPOSED BY LIGHTSQUARED OFFER NO MEANINGFUL INTERFERENCE PROTECTION

A. LightSquared Continues To Make Patently False, Unsupported Assertions That Not Yet Developed Filter Technology Could Prevent Interference To GPS Devices And Applications

In its Comments, LightSquared repeats the patently false assertion that the GPS industry could have prevented the interference threat from its powerful LTE base stations by simply

\textsuperscript{73} Comments of University of Texas at Arlington, IB Docket No. 11-109 (filed July 31, 2011); see also Comments of University Corporation for Atmospheric Research, IB Docket No. 11-109 (filed Aug. 1, 2011).
\textsuperscript{74} See Ex Parte Letter to Marlene Dortch, Secretary, Federal Communications Commission from Barry Schaffter, SVP, Deere & Company, IBFS File No. SAT-MOD-20101118-00239, at 5 (filed July 5, 2011).
implementing inexpensive alternative filters into GPS receivers. Specifically, LightSquared asserts that “[h]ad GPS device manufacturers employed filters, whose cost could have been as low as $0.05 per device … the entire [interference] problem could have been avoided.”\(^{25}\) While Deere and other commenters have thoroughly discredited this assertion already, LightSquared continues to repeat itself, apparently hoping that its misstatements, in the process, will be perceived as the truth. Deere once again corrects the record.

LightSquared has alleged for months that inexpensive filters are available that would mitigate the massive interference its proposed base stations would create for GPS devices without ever citing a scientific or engineering publication to support its assertion or providing a working prototype.\(^{26}\) As many Commenters note, the reason that LightSquared refuses to provide more meaningful evidence regarding this aspect of its “solution” is because no such filter exists in the real world, nor is there any guarantee that one can be developed. With regard to filter technology, Verizon explained that the TWG, in which it participated, “did not identify any viable solution that is available today that would mitigate the interference caused by LightSquared terrestrial operations in the upper band to wireless handsets. Presuming that the development of these technologies is even possible – which has not yet been shown – it will take years to develop, test, and incorporate them into GPS devices. Further, if these technologies are developed ultimately, it would take even longer to replace the GPS receivers in legacy wireless devices.”\(^{27}\) Joint comments filed by The Aircraft Owners and Pilots Association (“AOPA”) and the General Aviation Manufacturers Association (“GAMA”) clarified that “[a]bsolutely no filters

\(^{25}\) LightSquared Comments at 11.
\(^{27}\) Verizon Comments at 8.
exist today that can reliably protect GPS from LightSquared interference.”28 Rockwell Collins added that “[no] viable filter exists to mitigate issues caused by LightSquared’s proposed plan,” and if such a filter “could be designed” it would be too large for many civil and military applications.29 Finally, Garmin added that “[d]espite LightSquared’s claims to the contrary, the filters that would be needed to protect GPS against the harmful interference that would be caused by LightSquared’s proposed operations simply do not exist.”30 Garmin explained that the Aviation and General Location / Navigation sub-teams evaluated hypothetical filter designs, “but that none of the proposed filter simulations yielded sufficient rejection to protect against interference from LightSquared” and the hypothetical designs under test also filtered “much of the desired GPS signals” which would seriously degrade the performance of GPS devices and GPS-based applications.31

Despite LightSquared’s assertions to the contrary, the FCC record speaks for itself: no filter exists capable of protecting GPS receivers from powerful LTE base station signals in the 1525-1559 MHz band, and it is unclear whether such filters can ever be developed.

B. LightSquared’s Comments Fail To Provide Even Basic Information Regarding Other Previously Proposed Interference Mitigation Techniques Such As “Frequency Coordination”

While it had more than sufficient time to elaborate on the alternative interference mitigation techniques discussed in brief in its Recommendations, and to address the serious concerns raised by many Commenters/third parties, LightSquared’s Comments make only a passing reference to these mitigation techniques, which have never been elaborated on in any

28 AOPA/GAMA Comments at 23.
30 Garmin Comments at 53.
31 Garmin Comments at 53-54 (internal quotations and brackets omitted).
meaningful detail.\textsuperscript{82} For example, even though LightSquared’s “frequency coordination” plan to avoid interference to high precision receivers is highly complex, and involves a still novel geolocation database to help coordinate frequency urban areas, LightSquared’s Comments spend less than a single sentence addressing the plan.\textsuperscript{83}

Given that LightSquared refuses or cannot provide additional details concerning these interference mitigation techniques, Deere urges the Commission not to consider them in its own broader analysis of LightSquared’s impact on GPS unless and until the company provides sufficient information to conduct a meaningful evaluation.

C. LightSquared Admits Its Terrestrial-Only Network Will Interfere With Deere’s Higher Priority MSS StarFire Terminals, But Offers No Solutions

LightSquared’s Comments assert that certain GPS manufacturers “intentionally designed their receivers to receive signals from across the L-band,” and that this “design decision” contributes to receiver “overload.”\textsuperscript{84} LightSquared’s assertion is incorrect and misleading. Receivers that are intentionally designed to downlink signals across the full range of space-to-earth L-band frequencies, including Deere’s StarFire system, are not exclusively GPS devices, they are also mobile satellite earth stations regulated under Part 25 of the Commission’s Rules, and as the primary commercial spectrum use for which the L-band is allocated, entitled to interference protection from all other L-band spectrum users, including LightSquared’s proposed terrestrial network.

While Deere and others have cautioned LightSquared that it must protect StarFire and other mobile satellite earth stations,\textsuperscript{85} and despite the TWG Final Report confirming that

\textsuperscript{82} LightSquared Comments at 14 (proposing the use of frequency coordination, re-design of GPS receivers and different spectrum from GPS links).
\textsuperscript{83} Id. at 14.
\textsuperscript{84} Id. at 11.
\textsuperscript{85} Deere Comments, at 9-10
LightSquared’s terrestrial-only network would create devastating interference for these higher priority systems.\textsuperscript{86} LightSquared has either ignored the problem, or attempted to deliberately confuse the issue by arguing that these receivers are somehow poorly designed or inappropriately using its spectrum, when in fact StarFire and other MSS systems are the highest priority use of the 1525-1559 MHz band.\textsuperscript{87} While LightSquared would like to paint in-band interference between a LightSquared base station and an MSS terminal as purely an “overload” problem, it is really co-channel interference that LightSquared has an affirmative obligation to prevent.

Given that neither LightSquared’s Recommendations nor its Comments address the co-channel interference its proposed terrestrial network will create for MSS systems, Deere once again urges the Commission to require LightSquared to address this serious problem and confirm that LightSquared’s terrestrial-only, conditionally authorized operations must avoid creating interference for licensed Part 25 mobile satellite services, including Deere’s StarFire network.

VI. INTERFERENCE FROM HANDSETS THREATENS GPS AND MUST BE RESOLVED

While this proceeding has largely focused on the interference threat that proposed LTE base stations operating in the 1525-1559 MHz band present to GPS, Comments from Deere and others examined the significant harmful interference that LightSquared handsets operating in the 1626.5-1660.5 MHz band will create for GPS receivers, a problem that was confirmed during TWG tests and that LightSquared refused to address in its Recommendations and Comments.

Several Commenters explained the effects that simulated LightSquared handset signals in the 1626.5-1660.5 MHz band have on GPS receivers. Stansell Consulting stated that “LightSquared handsets are likely to harm GPS reception even more than the already damaging

\textsuperscript{86} TWG Final Report, at 249, 263, and 277.
\textsuperscript{87} Deere Comments, at 30.
ATC transmitters. Published estimates of LightSquared out-of-band-emission (OOBE) into the GPS L1 band indicate that at a distance of 2 meters one handset will hurt GPS reception (reduce S/N) by 9.5 dB, which is devastating. With potentially millions of handsets in use, the impact would be far worse.”88 Garmin indicated that “simulated handset interference analyses show service degradation at distances of over one meter from a LightSquared handset.”89

As discussed in Deere’s own comments and those of Stansell Consulting, the interference created by LightSquared handsets is generated also by out-of-band emissions that extend into the 1559-1620 MHz GNSS/GPS band, not just by receiver overload or desensitization, making it impossible for LightSquared to assert that improvements in GPS receiver design will help alleviate the problem. With regard to OOBE handset-to-GPS receiver interference, only LightSquared can find a solution, if one exists.90 As succinctly stated by Stansell Consulting, LightSquared handset OOBE “will affect every type of GPS receiver, [and] GPS mitigations against such OOBE are not possible.”91

Given the magnitude of the interference threat to GPS devices and GPS-based applications, the Commission must not let this problem go unresolved simply because LightSquared was oblivious to it and now finds it inconvenient to investigate and address. Any authority LightSquared ultimately obtains going forward to operate handsets in the 1626.5-1660.5 MHz band must be conditioned on protecting GPS receivers from interference. The Commission cannot assert that it has resolved the interference issues in this proceeding without imposing such a condition on LightSquared.

88 Stansell Consulting Comments at 4 (emphasis added).
89 Garmin Comments at 49.
90 See Deere Comments at 31-32, Stansell Consulting Comments at 4.
91 Stansell Consulting Comments at 4.
VII. INTERFERENCE FROM LIGHTSQUARED’S OPERATIONS IS CONTRARY TO U.S. COMMITMENTS TO PROTECT GNSS

The European Commission, International Civil Aviation Organization, and United Parcel Service, among others, raised concerns that LightSquared’s proposal is inconsistent with the nation’s obligation and commitment to work with other countries to prevent interference to satellite-based navigation and timing services.\(^92\) Over the last several years, the U.S. has taken significant steps to strengthen its working relationship with other countries in connection with our mutual interest in the interference free use of satellite navigation and timing signals. As a part of that effort, the U.S., along with the European Union (which is developing the Galileo system), entered into an agreement in 2004 that obligates both parties to

work together to promote adequate frequency allocations for satellite-based navigation and timing signals, to ensure radio frequency compatibility in spectrum use between each other’s signals, to make all practicable efforts to protect each other’s signals from interference by the radio frequency emissions of other systems, and to promote harmonised use of spectrum on a global basis, notably at the ITU. The Parties shall cooperate with respect to identifying sources of interference and taking appropriate follow-on actions.\(^93\)

Based on information provided by the European Commission in this proceeding, testing conducted in Europe determined that “transmissions from LightSquared base-stations do indeed have considerable potential to cause harmful interference to Galileo receivers operating in the United States” as well as potentially cause problems with aviation applications.\(^94\) The U.S., and by extension the FCC, are required by the Galileo agreement to protect the Galileo signals from

\(^{92}\) See Comments of International Civil Aviation Organization, IB Docket No. 11-109, at 1-2 (filed July 29, 2011); Stansell Comments at 5.


interference. However, LightSquared’s proposed services fail to protect Galileo receivers in compliance with those obligations.95

Beyond its specific agreement with the E.U., the U.S. has a long-standing commitment of providing GPS for civil use by other nations. It confirmed that commitment in September 2007 by ending the procurement of future satellites that “have the capability to intentionally degrade the accuracy of civil signals,” and thereby providing GPS users with a “free global utility that can be counted on to support peaceful civil activities around the world.”96 Recently, President Obama reaffirmed this commitment in his National Space Policy, which provides that the “United States must maintain its leadership in the service, provision, and use of global navigation satellite systems (GNSS),” including the directive that the “United States shall [p]rovide continuous worldwide access, for peaceful civil uses, to the Global Positioning System (GPS) and its government-provided augmentations, free of direct user charges.”97 Most importantly, the policy requires the United States to “[i]nvest in domestic capabilities and support international activities to detect, mitigate, and increase resiliency to harmful interference to GPS.…”98

95 In addition to the E.U., the U.S and Japan have agreed in connection with Japan’s developing Quasi-Zenith Satellite Systems, to joint cooperation and working groups for the development of the system. See Joint Announcement on United States-Japan GPS Cooperation, Jan. 13, 2011 available at http://www.pnt.gov/public/docs/2011/japan.shtml.
98 Id. (emphasis added). In furtherance of this commitment, through the National Executive Committee for Space-Based Positioning, Navigation and Timing, the U.S. has agreed to work in joint cooperation with other countries, including Australia, China, Europe, India, Japan and Russia, to establish technical standards and coordinated use of GPS. See International Cooperation, National Executive Committee website, available at http://www.pnt.gov/international/ (describing the committee’s international GPS cooperation efforts with specific counties and international organizations); see also “U.S. GPS Policy and U.S. International Cooperation Activities,” presented by Maureen Walker, U.S. Department of States, National Space Based PNT Coordination Office to the U.S. States and Local Government Subcommittee, April 27, 2011, available at http://www.pnt.gov/public/2011/04/CGSIC/walker1.pdf (describing the U.S. government’s bilateral cooperation efforts with foreign countries and stating that “international cooperation is a priority” and “compatibility and interoperability [are] very important”).
As a user of GNSS around the world, Deere is interested in supporting the U.S.’s compliance with its long-standing commitment to protect GNSS from interference. As such, Deere supports and echoes the call for action made by the International Civil Aviation Organization and United Parcel Service, Inc. for the FCC to address “grave concerns” that the LightSquared’s use of this spectrum will significantly harm not only national but international use of GPS.

**CONCLUSION**

The TWG Final Report and extensive industry Comments in response to the TWG Final Report and Recommendations demonstrate that LightSquared’s proposed terrestrial-only and non-integrated operations would cause massive interference to GPS receivers and GPS-based applications, without any viable mitigation options. As such, the conditions of LightSquared’s waiver cannot be satisfied and the waiver should be rescinded.

Respectfully submitted,

/s/

____________________________

Catherine Wang
Timothy Bransford
Bingham McCutchen LLP
2020 K Street, N.W.
Washington, DC 20006
Office: 202.373.6000
Fax: 202.373.6001

---

99 See Letter to Mr. Julius Genachowski, Chairman, Federal Communications Commission from Roberto Kobeh Gonzalez, President of the Council, International Civil Aviation Organization, SAT-MOD-20101118-00239 (filed June 13, 2011) (“[T]he potential disruption to aviation use of GPS caused by the LightSquared system would have a far-reaching impact on current and future aviation operations. The impact would not only be limited to the United States. The international aircraft fleet flying into the United States would be directly affected and also similar development could arise elsewhere and propagate the disruption beyond their borders.”).

100 See Comments of United Parcel Service, Inc., LightSquared Technical Working Group Report, IB Docket No. 11-109, at 4 (filed July 29, 2011) (stating that the “international aviation community’s condemnation of the LightSquared proposal speaks volumes about the need for the Commission to correct this situation” and that “UPS shares these deep concerns and joins the international plea to the FCC”).
Counsel for Deere & Company

Patricia M. Harris
Assistant General Counsel

Paul Galyean
Manager, System Engineering and IME/Robotics

Mark Rentz
Senior Systems Engineer

Rich Keegan
Senior Principal Engineer

Deere & Company
One John Deere Place
Moline, IL 61265

August 15, 2011
**Propagation Model Comparison**

In order to predict the distance from the transmitter that the LightSquared signal will cause harmful interference, an RF propagation model must be selected. LightSquared suggests using the cellular RF planning model proposed by Korowajczuk and employed by CelPlan in their products. Alternatively, LightSquared suggests using the Walfish-Ikegami Line of Sight ("WILOS") model. The GPS community believes a Free Space propagation model for estimating interference levels is the only appropriate model to use.

The Korowajczuk model is used to predict the power levels of cellular transmitters to assist in the planning of a cellular system as to where base station siting should occur and what power level each base station should transmit to optimize signal coverage, *i.e.* to provide as complete coverage as possible within a given geographic region. Coverage is defined as providing the "minimum" signal level required for successful communications over the intended region. For the purpose of harmful interference prediction, it is important to know the "maximum" signal that may exist at any point within the region.

Furthermore, the Korowajczuk model employs complex cityscape morphology to predict the expected (or mean) received power levels across a particular region and does not attempt to predict the signal level for the general case, *i.e.* one without a defined cityscape morphology, so it is impossible to use it to predict the "maximum" distance from a LightSquared base station that harmful interference to GPS would exist. Any result obtained for a particular cityscape morphology would be unrelated to any other and hence, no general conclusions concerning power level vs. distance to a transmitter can be drawn.

Alternatively, LightSquared suggests using the WILOS model to predict signal level at a distance to the transmitter. This model is a general model based on distance and frequency that was, again, developed to assist in cellular system planning to guarantee coverage before sophisticated models like the Korowajczuk were available. During the Las Vegas live sky testing, it consistently underestimated the power levels of the LightSquared base stations and therefore should not be used to predict harmful interference.

The GPS community suggests using a free space propagation model since it is the only theoretical model that can be used to predict signal power vs. distance to a transmitter. To predict the presence of harmful interference it is important to estimate the "maximum" power that will be present. During the live sky testing in Las Vegas the model which consistently best fit the actual received power was a free space model, and even then there were occurrences of multiple reflected paths combining to produce power levels in excess of that predicted by the free space model. Therefore, the free space model does not even represent a "conservative" model to predict harmful interference but it the best available and should be used.
CERTIFICATE OF SERVICE

I, Tim Bransford, hereby certify that on August 15, 2011, I have caused a copy of Deere & Company’s Reply Comments to be served via U.S. Mail on the following:

Chairman Julius Genachowski  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Commissioner Michael J. Copps  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Commissioner Robert McDowell  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Commissioner Mignon Clyburn  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Julius Knapp  
Chief  
Office of Engineering & Technology  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Mindel De La Torre  
Chief  
International Bureau  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Robert Nelson  
Chief, Satellite Division  
International Bureau  
Federal Communications Commission  
445 12th Street, SW  
Washington, DC 20554

Mr. Jeffrey J. Carlisle  
Executive Vice President,  
Regulatory Affairs and Public Policy  
LightSquared Subsidiary LLC  
10802 Parkridge Blvd.  
Reston, VA 20191

Lawrence E. Strickling  
Department of Commerce  
NTIA  
1401 Constitution Avenue, NW  
Washington, DC 20230

Tim Bransford  
Bingham McCutchen LLP  
2020 K Street, N.W.  
Washington, DC 20006  
Office: 202.373.6000  
Fax: 202.373.6001