**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington D.C. 20554**

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

# 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


Dated: August 1, 2011

TABLE OF CONTENTS

Page

SUMMARY ..... IV

I. OBJECTIVES IN THE EVALUATION OF THE TWG FINAL REPORT AND LIGHTSQUARED RECOMMENDATIONS ..... 3

II. DEERE & COMPANY AND HIGH PRECISION SERVICES IN THE AGRICULTURE AND CONSTRUCTION SECTORS ..... 5

III. INTERFERENCE TO GPS CANNOT BE JUSTIFIED BY LIGHTSQUARED'S SPECIOUS ARGUMENTS THAT MSS ATC WAS ALWAYS INTENDED TO SUPPORT A UBIQUITOUS TERRESTRIAL NETWORK, THAT THE GPS COMMUNITY BY ITS "SILENCE" AGREED TO ACCEPT INTERFERENCE ARISING FROM SUCH A NETWORK, AND GPS MANUFACTURERS ARE TO BLAME ..... 7

IV. DEERE AND OTHER GPS INTERESTS HAVE WORKED INTENSIVELY AND COOPERATIVELY TO STUDY AND ANALYZE LIGHTSQUARED'S POTENTIAL INTERFERENCE TO GPS RECEIVERS AS WELL AS ANY PRACTICAL MEANS OF MITIGATING HARMFUL INTERFERENCE ..... 9

V. THE TWG FINAL REPORT CONFIRMS THAT LIGHTSQUARED'S PROPOSED NETWORK WOULD CREATE WIDESPREAD, HARMFUL INTERFERENCE FOR ALL CLASSES OF GPS RECEIVERS IN REAL-WORLD SCENARIOS ..... 11

A. LightSquared's Proposed Network Creates Massive Interference for High Precision and Augmented High Precision Receivers at Great Distances ..... 12

B. The TWG Final Report Aligns with Conclusions Reached in Other Independent Studies -- LightSquared's Proposed Network Creates Widespread Harmful Interference to ALL Classes of GPS Receiver ..... 13

C. LightSquared's Last Minute Introduction Of A "Low 10 MHz" Configuration In No Way Resolved Serious Interference Concerns – Many Receivers Experienced Harmful Interference During Low 10 MHz Testing ..... 16

D. TWG Test Methodologies Were Generally Sound and Developed by Consensus, and LightSquared's Attempts to Undermine Unfavorable Test Results By Casting Doubt On Tests It Helped Develop and Approve Should be Dismissed ..... 19

VI. LIGHTSQUARED'S "PROPOSED SOLUTION" IS NOT AN EFFECTIVE OR FEASIBLE MITIGATION PLAN ..... 21

A. LightSquared's Proposal to Reduce Power is Disingenuous – Supposedly Reduced Power Levels Are Actually the Maximum Levels Tested by the TWG and the Same Levels That Caused Widespread Harmful Interference ..... 23

TABLE OF CONTENTS
(continued)

Page

B. LightSquared's Offer To Impose a "6-Month Standstill" on the Upper 10 MHz Band Does Nothing To Resolve Interference Issues ..... 24

1. A 6-Month Deferral on Upper 10 MHz Operations Does Nothing to Mitigate Interference from Upper 10 MHz Transmission ..... 24

2. LightSquared's Assumption that GPS Receivers Can Be Radically Reengineered is Contrary to Worldwide GPS Signal and Receiver Technology Wideband Trends ..... 25

3. LightSquared Suggestions for GPS Receiver Technology Development Are Speculative and Unrealistic ..... 26

4. A Six-Month Standstill Does Not Prevent the Interference That Will Occur to Most GPS Receivers from Low 10 MHz Transmissions ..... 28

C. Moving LightSquared's Proposed Base Station Signal to a Lower Frequency In the 1525-1559 MHz Band Does NOT Effectively Mitigate Harmful Interference ..... 28

D. LightSquared's Vague Plan to Frequency Coordinate with High Precision Receivers Appears Unworkable and Technically Unsound ..... 30

E. TWG Test Results Demonstrate That LightSquared Handsets Transmitting in the 1626.5 – 1660.5 MHz Range Present a Separate, Real-World Interference Threat to GPS Receivers ..... 31

VII. THE FCC'S IMPROMPTU REALLOCATION OF THE L-BAND IN FAVOR OF TERRESTRIAL USE IS CONTRARY TO GLOBAL TRENDS TOWARD WIDEBAND GNSS SYSTEMS AND RECEIVERS AND THE U.S. COMMITMENT TO PROTECT GNSS SYSTEMS ..... 33

CONCLUSION ..... 34

## SUMMARY

Deere & Company (“Deere”) herein endorses the conclusions and analysis of the Technical Working Group ("TWG"), convened at the direction of the International Bureau, that LightSquared’s proposal to operate a ubiquitous nationwide, high-power terrestrial network in the 1526-1536 MHz (the “Low 10 MHz”), 1545.2-1555.2 MHz (the “Upper 10 MHz”) and 1626.5-1660.5 MHz bands will cause widespread harmful interference to Global Positioning System ("GPS") receivers, including high precision GPS systems used extensively in the agriculture, construction, survey and other segments of the private sector as well as in important government operations. These test results correlate with the results of other independent tests conducted by highly credible private and government organizations. Extensive testing by seven different sub-teams over an intensive four-month period conclusively demonstrated that LightSquared's base station transmissions will cause widespread harmful interference to all classes of GPS receivers operating in real-world scenarios. TWG tests also demonstrated that LightSquared handsets operating in the 1626.5 -1660.5 MHz band present a meaningful interference threat heretofore ignored by LightSquared.

Harmful interference occurred for all classes of receivers, including, but not limited to, receivers used in aviation, public safety, cellular phones, general navigation and high precision applications. In the case of high precision operations, tests showed dramatic interference. In live sky real world testing, high precision receivers experienced a complete loss of GPS signal tracking at long ranges -- as far as 15 kilometers, and were degraded in some cases at 22 kilometers away from a LightSquared base station. Augmentation signals used by high precision users, in Deere's case through FCC licensed earth station facilities, were severely degraded or

disrupted as far as 22 kilometers from the LightSquared base station. Significantly, the test results evaluating LightSquared's "eleventh hour" modified "Low 10 MHz" proposal do not reveal a resolution to these issues. High precision GPS receivers and all other classes of GPS receiver except for some narrowband timing receivers suffered harmful interference even under LightSquared's modified "Low 10 MHz" approach. In the face of objective test results, LightSquared's unsupported statements that its modified "Low 10 MHz" configuration protects 99% of GPS receivers are false and misleading.

Neither the TWG Final Report nor LightSquared's concurrently filed Recommendations offer any feasible plan that effectively mitigates the significant interference to the extensive installed base of GPS devices or future devices. With respect to high precision receivers that LightSquared concedes will suffer harmful interference regardless of what base station operating frequencies it chooses, LightSquared attempts to portray high precision receivers as a tiny, immaterial segment that perhaps should be considered collateral damage on the quest to achieve a higher goal. On the contrary, high precision systems are used extensively nationwide in agriculture, construction, survey, and mining in the private sector as well as in other government operations. In economic terms, in agriculture alone, loss of high precision operations is estimated to result in an annual $14-$30 billion adverse impact.

LightSquared's specific proposals for interference mitigation for high precision receivers are ineffective and unworkable. LightSquared points to new GPS receiver technology as one answer. However, there is no currently available GPS filter technology that can immunize high precision receivers from the dramatically higher powered signals from LightSquared's network. Indeed, Deere questions whether such a filter could ever be developed without severely degrading the performance of high precision receivers. LightSquared criticizes wideband

receivers but ignores the global trend toward wideband signals and wideband receivers. In any event, radical changes in receiver technology are not possible in the short term, and if this were to occur it would be a decade long process.

LightSquared's vague proposal to frequency coordinate with high precision receivers is also unworkable and technically unsound. Further, LightSquared's general assurances that its network will not adversely affect precision receivers because it does not plan to roll out service to areas other than densely populated urban and suburban areas for several years ignores the fact that many agricultural operations are in close proximity to populated areas, and that construction and surveying operations, and other high precision users are often concentrated in populated areas.

These deliberations are not about support or a lack of support for expanded broadband services. All parties involved would surely support the notion of expanded broadband services. Rather, these deliberations are about unnecessarily and hastily choosing a path that severely damages, contrary to international commitments, an incredibly innovative, efficient and beneficial technology already in widespread use for commercial, government, consumer and public safety purposes to achieve that objective. Deere believes that the Commission should not and need not approve LightSquared's network to accomplish its broadband goals. Deere submits that the Commission should focus its efforts on identifying other spectrum to support high powered terrestrial operations.

Deere welcomes the opportunity to address this important issue in an open, transparent and data-driven manner. This process must not be a rush to judgment in order to meet the internal commercial deadlines of a private party. In evaluating the best course forward, there should be no room for conjecture, speculation, promises or half-truths. Given the many critical

interests at stake in the commercial, public safety, aviation and military sector and the complexity of the technical issues, it is imperative that the Commission live up to Chairman Genachowski's oft-repeated public commitment declared at the beginning of his administration that under his Chairmanship the Commission's policymaking processes will be open, fair, and data-driven.

**Before the**
**FEDERAL COMMUNICATIONS COMMISSION**
**Washington D.C. 20554**

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

**COMMENTS OF DEERE & COMPANY**

Deere & Company ("Deere"), by its undersigned attorneys, and pursuant to the June 30, 2011 Public Notice in the above-captioned docket,[1] hereby submits comments on the final report of the Technical Working Group Report ("TWG Final Report") co-chaired by LightSquared Subsidiary LLC and the United States Global Positioning System Industry Council ("USGIC") and organized in connection with the grant by the International Bureau ("Bureau") of a conditional waiver to LightSquared of the long-established requirements designed to ensure that L-Band Mobile Satellite Service ("MSS") spectrum will remain primarily used for satellite services.[2] The Bureau's waiver was expressly conditioned on further study of the Global Positioning System ("GPS") interference issues raised by multiple government and nongovernment parties. By the terms of the Waiver Order, that condition will be satisfied once "the Commission, after consultation with NTIA, concludes that the harmful interference concerns have been resolved."[3] As discussed below, the extensive studies conducted in connection with the TWG Final Report, as well as other parallel technical studies undertaken by

[1] *Comment Deadlines Established Regarding the LightSquared Technical Working Group Report*, Public Notice, IB Docket No. 11-109, DA 11-1133 (rel. June 30, 2011).

[2] *In the Matter of LightSquared Subsidiary LLC Request for Modification of its Authority for an Ancillary Terrestrial Component*, Order and Authorization, at ¶ 43, SAT-MOD-20101118-00239 (rel. Jan. 26, 2011) ("Waiver Order").

[3] *Id.*, at ¶ 42.

highly credible private and government organizations, unequivocally demonstrate that LightSquared's proposed terrestrial network -- even as adjusted by LightSquared's "eleventh hour" "Low 10 MHz" modification -- will cause severe interference to GPS devices in use by hundreds of millions of American consumers and to major American industries, including, but not limited to, sectors that rely extensively on high precision systems for agricultural, construction and land and aerial survey applications.[4] High precision GPS systems in use by the federal government for military, aviation, and other purposes would also suffer severe interference and disruption.[5]

Deere's comments pertain to the TWG's original task of evaluating LightSquared's proposal to operate a ubiquitous nationwide, high-power terrestrial network using spectrum in 1526-1536 MHz (the "Low 10 MHz")/1545.2-1555.2 MHz (the "Upper 10 MHz") for base stations and 1626-5 MHz -1660.5 MHz for handsets.[6] In addition, to the extent possible, Deere also herein addresses a modified proposal that LightSquared announced very late in the TWG

---

[4] *See* Letter from Curtis W. Sumner, Executive Director American Congress on Surveying and Mapping/National Society of Professional Surveyors, to Chairman Julius Genachowski, FCC, IB Docket No. 11-109, at 1 (filed July 28, 2011) ("High precision GPS equipment is used by a vast majority of surveying and mapping professionals in their daily work.") *See also, id*. ("ACSM, NSPS, and their affiliated societies represent more than 40,000 public and private practice professionals in the surveying, mapping, and geosciences throughout the United States whose work serves the interests of the public's health, safety, and welfare. The maintenance of a robust GPS signal allowing high precision measurement and positioning is critical to that service.").

[5] *See* "LightSquared Aviation Impacts," Federal Aviation Administration, Navigation Services, at 7 (July 12, 2011) ("FAA Interference Report") ("LightSquared's operations at the lower channel would preclude the following critical capabilities that rely upon high precision GPS receivers: airfield and flight procedure surveys, flight test tracking, space weather monitoring, and GPS timing for computing resources and many mission critical systems.") *cited by* Melanie Trottman, "LightSquared Bid Stirs FAA Worry," THE WALL STREET JOURNAL ONLINE (July 28, 2011) ("In the FAA's recent assessment, it said LightSquared's most recent proposal would 'severely impact' NextGen, an FAA initiative to build a new national air-traffic control system that calls for satellite technology to replace ground-based facilities. NextGen, officially called the Next Generation Air Transportation System, relies heavily on GPS-based technologies. LightSquared's interference would not only erode existing GPS safety and efficiency benefits, but would also force the FAA to replan NextGen investments, the FAA said, resulting in additional development costs and delays.") *at* http://online.wsj.com/article/SB10001424053111904800304576472361793662904.html. *See also*, "LightSquared Plans Need Further Study, Says FAA," COMMUNICATIONS DAILY, at 9-10 (July 28, 2011).

[6] In the TWG first progress report to the Commission, the TWG stated that it would consider interference issues that arise by LightSquared base station and handset operations. *See* LightSquared February 25, 2011 Report to the FCC, at 4 (dated Feb. 25, 2011) *filed as an attachment to* Letter from Henry Goldberg, Counsel to LightSquared Subsidiary LLC, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239 (dated Feb. 25, 2011).

testing period as results unfavorable to its original proposal – namely, to the key assumptions that underpin that proposal -- began to pile up in the testing process. Under that modified proposal, LightSquared might defer operation on the Upper 10 MHz band of its planned frequencies for some unspecified period of time and will commence initial operations using only the Low 10 MHz band.

Neither the TWG Final Report nor LightSquared's concurrently filed Recommendations[7] offer any feasible plan, including LightSquared's recent "Low 10 MHz proposal," that effectively mitigates the significant interference to the extensive installed base of GPS devices or future devices. As such, the condition of LightSquared's waiver cannot be satisfied and the waiver should be rescinded.

## I. OBJECTIVES IN THE EVALUATION OF THE TWG FINAL REPORT AND LIGHTSQUARED RECOMMENDATIONS

These deliberations are not about support or a lack of support for expanded broadband services. All parties involved would surely support the notion of expanded broadband services. Rather, these deliberations are about unnecessarily and hastily choosing a path that severely damages an incredibly innovative, efficient and beneficial technology already in widespread use for commercial, government, consumer and public safety purposes to achieve that objective.[8]

Deere welcomes the opportunity to address this important issue in an open, transparent and data-driven manner.[9] Given the many critical interests at stake in the commercial, public

---

[7] *See* Recommendation of LightSquared Subsidiary LLC, SAT-MOD-20101118-000239, at 12-13 (filed June 30, 2011) ("LightSquared Recommendations.").

[8] While these comments are not focused on other spectrum band solutions to accommodate high power terrestrial networks, it is important to remember that LightSquared's L-band proposal is not by far the only option to promote expanded broadband services.

[9] A robust public process is a bedrock of sound policymaking. As stated before, Deere submits that any proposal to reallocate and repurpose the L-Band spectrum should be considered only through a rulemaking that allows comprehensive comment and feedback from all affected parties. While Deere appreciates the Commission's

safety, aviation and military sector and the complexity of the technical issues, it is imperative that the Commission reach a decision based on sound engineering data and principles that reflect the practical realities of technical development. The Commission must not resort to shortcuts. This process must not be a rush to judgment in order to meet the internal commercial deadlines of a private party. In evaluating the best course forward, there should be no room for conjecture, speculation, promises or half-truths. It is imperative that the Commission live up to Chairman Genachowski's oft-repeated public commitment declared at the beginning of his administration that under his Chairmanship the Commission's policymaking processes will be open, fair, and data-driven.[10]

In this case, the data are in. A dispassionate review of the results of the TWG testing and other credible studies by other government and private organizations leads to the inescapable conclusion that the ubiquitous, high-power network proposed by LightSquared is incompatible with the existing extensive satellite use of the L-Band. Without commenting on whether repurposing the L-Band for non-satellite uses is a good idea from a policy or technical perspective, Deere submits that it cannot be achieved in the short term absent very negative consequences that are highly adverse to the public interest. Any further discussion of this subject must take into account that such a change, if appropriate at all, would be at least a decade-long process.

---

decision to seek public comment on the TWG Final Report and Recommendations, it is no substitute for appropriate rulemaking procedures that apply to the decision to reallocate or repurpose the MSS spectrum.

[10] *See, e.g.*, Remarks of Chairman Julius Genachowski to the Staff of the Federal Communications Commission, at 4 (June 30, 2009) ("How we will work will be central to what we can achieve. We will be fair. We will be open and transparent. Our policy decisions will be fact-based and data-driven."); *See also, e.g.*, Remarks of Chairman Julius Genachowski on National Broadband Plan, at 1 (December 16, 2009) (referring to the preparation of the National Broadband Plan, "This process [will] also be data-driven, meaning there would be no pre-baked conclusions. The team [will] collect information and data and analyze it dispassionately.")

## II. DEERE & COMPANY AND HIGH PRECISION SERVICES IN THE AGRICULTURE AND CONSTRUCTION SECTORS

Deere (NYSE: DE), employing over 50,000 people, is a worldwide leader in the manufacture of agricultural and construction equipment with revenues of over $26 billion for 2010. Since 1837, John Deere has been an iconic American company known to deliver innovative products of superior quality built on a long tradition of integrity. Deere has been a pioneer and leading provider of state-of-the-art data and information solutions designed to greatly enhance productivity and environmental safety to those operating in the $133 billion agricultural sector and the $537 billion construction sector.[11]

In particular, Deere incorporates its high precision location technology in agricultural, construction and other equipment, which enables equipment operators to pinpoint their location to within 2-10 centimeters. This system employs GPS receivers and receive-only mobile earth stations that downlink augmentation signals from L-band satellites covering the United States and the entire world. These satellites provide correctional data that greatly enhances the accuracy of the GPS measurements.[12] In the agricultural sector, this high precision system enables growers to manage land, water, seed, fertilizer, pesticides and labor resources to significantly minimize costs and waste, greatly increase efficiency and crop yield, and responsibly manage important environmental concerns.

In response to steadily rising customer demand for this technology over the past fifteen years, high precision technology like the StarFire system is now becoming a standard equipment

---

[11] *See* Bureau of Economic Analysis, United States Department of Commerce, *Survey of Current Business* at 21 (Jan. 2011), *at* http://www.bea.gov/scb/pdf/2011/01January/0111_indy_accts_tables.pdf (last visited, Aug. 1, 2011).

[12] The StarFire system uses augmentation signals to compute correction information that enables Deere's platform (tractors, combines, sprayers, construction equipment, etc.) to navigate with very high accuracy while performing their functions. GPS-stand-alone positioning is insufficiently accurate for most of these functions.

feature for agricultural and construction equipment.[13] Today, high precision GPS is a critical part of all modern farming in the United States as well as in many other countries.[14] Deere and other companies in the U.S. agricultural and construction sectors alone have already invested billions of dollars to deploy high precision GPS technologies.

Deere believes that the expanded use of GPS is the most significant single technological advancement for American farm equipment in the past 15 years. The importance of high precision receivers used in critical applications cannot be weighed merely by calculating the number of receiver units. Deere estimates that the degradation or disruption of high precision GPS signals could result in a negative impact to U.S. farmers of $14 billion to $30 billion *annually*.[15] As a practical matter, interference means that many users who depend on high precision navigation will simply lose it. In some cases, this will result in reduced productivity and lower crop yields, but in some significant population of users, it will not be possible to conduct reasonable farming operations. Some of the farming equipment purchased in recent years is not equipped with the prior mechanical devices that enable manual guidance. That equipment depends solely on high precision guidance, without which they cannot properly operate. Impairment of high precision systems would ultimately push up consumer food prices, hamper U.S. competiveness in the agricultural sector, hinder progress to improve environmental

---

[13] In comments filed on July 29, Caterpillar, Inc. detailed the extensive use for high precision GPS in the construction community. *See* Comments of Caterpillar, Inc. Regarding the LightSquared Technical Working Group Report, IB Docket No. 11-109, at 1-2 (filed July 29, 2011) (High-powered GPS is used widely for: (i) computer aided earthmoving systems; (ii) AccuGrade systems that control machine and job site operation; (iii) accurate machine tracking and dispatching through the MineStar Fleet Management system; and (iv) for numerous safety uses, including providing proximity alerts of other machines and light vehicles, helping operators avoid collisions.).

[14] These systems and other enhanced farming techniques are used for similar purposes in other countries: to maximize crop yield, and minimize fuel, seed and other costs, and play an increasingly important role in averting global food shortages.

[15] This estimate, based on Deere's evaluation of field results and university studies, assumes GPS enables at a minimum $8 billion of savings in terms of fuel, seed and fertilizer, and at least $6 billion in improved yield. Based on these calculations, the *annual* loss to the agricultural community alone were GPS services to be disrupted would exceed LightSquared's entire estimated $14 billion network build.

safety of agricultural operations, and impede the efforts of U.S. growers to respond to worldwide demand for increased food production.

To be clear, Deere shares the Commission's strong desire to promote the expansion of broadband services, including rural services. However, expansion of broadband services must not come at the expense of GPS and high precision systems that today are critical to virtually all modern farming, construction and survey operations and the hundreds of millions of GPS receivers used by the government, business and the vast majority of American consumers. This is not a trade off that the FCC should make, and Deere submits, need not make to foster expanded broadband services.

## III. INTERFERENCE TO GPS CANNOT BE JUSTIFIED BY LIGHTSQUARED'S SPECIOUS ARGUMENTS THAT MSS ATC WAS ALWAYS INTENDED TO SUPPORT A UBIQUITOUS TERRESTRIAL NETWORK, THAT THE GPS COMMUNITY BY ITS "SILENCE" AGREED TO ACCEPT INTERFERENCE ARISING FROM SUCH A NETWORK, AND GPS MANUFACTURERS ARE TO BLAME

LightSquared has launched a volley of meritless criticisms in an attempt to discredit interference concerns raised by the GPS community. LightSquared repeats its theory that LightSquared and its predecessor companies as well as the Commission had all along intended that the L-Band MSS spectrum would be used primarily for a ubiquitous high-power terrestrial network.[16] LightSquared also suggests that the GPS community has somehow failed to speak up in the past about interference that would arise from such a network and therefore, in LightSquared's distorted view, no affected GPS stakeholder can now be heard to complain.[17] LightSquared goes on to criticize GPS manufacturers and high precision manufacturers in

[16] *See* LightSquared Recommendations, at 11-17.

[17] *See* LightSquared Recommendations, at 17-18. Among other publications and interviews, LightSquared made both assertions in the LightSquared Recommendations. *See id*., at 12-13.

particular for designing receivers that cannot withstand nearby signal powers nearly a *billion* times stronger in the L-Band.

Deere strongly disagrees with these gross mischaracterizations, and has so stated in the past.[18] 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.[19] Further, it is disingenuous for LightSquared to suggest that all GPS stakeholders therefore "knew" or even "should have predicted" all along that the Commission would waive the satellite integration criteria to permit a stand-alone high power network in the MSS band. Deere and other high precision receiver manufacturers have made sound design decisions -- indeed necessary design decisions -- in developing wideband receivers. High precision manufacturers design wideband receivers in order to capture more information integral to high precision navigation and positioning. Manufacturers contract for MSS band augmentation signals and design wideband receivers to meet the requirements of MSS satellite providers who need the flexibility to change on relatively short notice the frequencies assigned to the augmentation signal in order to address their own changing operational needs.

LightSquared's unjustified and highly misleading criticisms serve only to distract from the important matter at hand -- the fact that LightSquared's proposed network even under

---

[18] *See* Petition for Reconsideration of Deere & Company, SAT-MOD-20101118-00239, at 15-16 (filed Feb. 25, 2011) ("Deere Petition"); *see also* Reply of Deere & Company, SAT-MOD-20101118-00239, at 3-10 (filed March 29, 2011).

[19] *See, e.g., Flexibility for Delivery of Communications by Mobile Satellite Service Providers in 2 GHz Band, The L-band, and the 1.6/2.4 GHz Band*, 01-185, Report and Order and Notice of Proposed Rulemaking, 18 FCC Rcd 1962, ¶ 1 (2003). (ATC rules are designed to "ensure that the added terrestrial component remains ancillary to the principal MSS offering. We do not intend, nor will we permit, the terrestrial component to become a stand-alone service." The "gating criteria" which ensure that MSS will be the primary service has never been changed until the Commission granted the waiver in the Waiver Order permitting a stand alone terrestrial network.

LightSquared's modified "Low 10 MHz proposal" -- will cause severe interference to high precision systems as well as the GPS equipment used extensively in other applications. However, rather than reiterate in these comments the significant precedent that contradicts LightSquared's warped version of the history of ATC and prior discussions with certain GPS interests, Deere herein expressly supports and adopts the extended discussion of this matter put forth by the USGIC in its comments.[20]

## IV. DEERE AND OTHER GPS INTERESTS HAVE WORKED INTENSIVELY AND COOPERATIVELY TO STUDY AND ANALYZE LIGHTSQUARED'S POTENTIAL INTERFERENCE TO GPS RECEIVERS AS WELL AS ANY PRACTICAL MEANS OF MITIGATING HARMFUL INTERFERENCE

Since first becoming aware of the Bureau's decision to allow LightSquared to use MSS satellite spectrum for an extensive nationwide high power terrestrial network not ancillary or integrated in any way with its satellite operations, Deere has been engaged in intensive study and analysis of the interference ramifications of this change in spectrum use.[21] The likely significant adverse impact of locating such stand–alone, high-power operations in a spectrum neighborhood historically devoted to low-power satellite operations was immediately apparent. On February 25, 2011, Deere filed a timely Petition for Reconsideration of the International Bureau's order[22] asking the Bureau to reconsider its *sua sponte* grant of a conditional waiver in order to rectify its failure to address adequately the serious harm that the LightSquared network will cause to Deere's high precision navigation systems, other augmented high precision systems, and GPS receivers across many industries and users, including government and public safety users. In its Petition, Deere submitted a preliminary technical analysis of the nature and extent of interference

[20] *See* Comments of the United States Global Positioning System Industry Council, IB Docket No. 11-109, at 34-39 (filed Aug. 1, 2011) ("USGIC Comments").

[21] Upon learning of the proposal pending at the FCC to locate a high power network in a spectrum historically devoted to satellite signals, Deere joined the membership of USGIC in January 2011 to coordinate with other similarly situated members of the GPS community.

[22] *See* Deere Petition.

to the StarFire system predicting that LightSquared's operations would cause massive interference at long ranges.[23]

On multiple occasions thereafter, Deere has presented detailed results of technical studies and analysis to the staff of Commission's Office of Engineering and Technology, International Bureau, Wireless Telecommunications Bureau, and Public Safety and Homeland Security Bureau on the nature and extent of interference that LightSquared's terrestrial network will cause to GPS including augmented high precision GPS systems and problems with potential mitigation strategies.[24] That information reflected Deere's participation in technical testing conducted at Holloman Air Force Base and White Sands, New Mexico which demonstrated that LightSquared's proposed network will cause significant interference to GPS.[25] Deere reviewed the National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum ("NPEF") study confirming significant interference harm to GPS and so advised the Commission.[26] Deere personnel headed up the High Precision Sub-team and participated in the four-month process in the TWG including participation in testing conducted in Las Vegas.[27] Throughout this process, Deere has cooperated and interacted extensively with LightSquared including convening technical meetings between Deere and LightSquared teams, under

---

[23] In subsequent *ex parte* submissions, Deere submitted additional detail of its technical interference analysis. *See, e.g.*, Letter from Catherine Wang, Counsel to Deere & Company, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239 (dated March 18, 2011). Deere's preliminary analysis indicated that LightSquared transmissions would effectively disable high precision systems within an approximate radius of 21 miles *See also*, Deere Petition at 7, footnote 5 and Exhibit B (Engineering Analysis of Base Station Interference to Deere Receivers.)

[24] *See, e.g.*, Letter from Catherine Wang, Counsel to Deere & Company, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239 (filed May 27, 2011).

[25] *Id*. *See also*, Letter from Barry Schaffter, Sr. VP, Intelligent Solutions Group and Chief Information Officer, Deere & Company, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239, at 2 (filed July 5, 2011) ("Deere July 5 Ex Parte").

[26] *See* Deere July 5 Ex Parte, at 1.

[27] *See id*., at 2. *See also*, the Working Group Final Report, SAT-MOD-20101118-00239, at 99 (dated June 30, 2011) ("*TWG Final Report*").

nondisclosure agreements, to discuss the technical features of each party's network and equipment, interference issue and possible mitigation solutions. [28]

In short, Deere has devoted thousands of hours and substantial engineering resources to examining the impact of LightSquared's proposed operations on high precision GPS operations and the potential to adopt feasible mitigation solutions. Deere has cooperated with all parties, including LightSquared, and has significantly contributed to the Commission staff's understanding of nature and extent of interference to GPS.

## V. THE TWG FINAL REPORT CONFIRMS THAT LIGHTSQUARED'S PROPOSED NETWORK WOULD CREATE WIDESPREAD, HARMFUL INTERFERENCE FOR ALL CLASSES OF GPS RECEIVERS IN REAL-WORLD SCENARIOS

LightSquared's assertions that its proposed network would not interfere with GPS receivers, or that interference would be very limited and easily remedied, have been proven false.[29] TWG tests results confirm that LightSquared's proposed network creates widespread, harmful interference for all classes of GPS receivers.[30] While high precision receivers are dramatically affected, harmful interference was not limited to any subset of receivers -- all classes of GPS receivers experienced significant levels of interference during TWG tests. Further, harmful interference occurred during tests using the network configuration originally proposed in November of 2010, as well as the alternative "Low 10 MHz" scheme.

---

[28] *See, e.g., id.*; Letter from Catherine Wang, Counsel to Deere & Company, to Marlene H. Dortch, Secretary, FCC, IB Docket No. 11-109, SAT-MOD-20101118-0023 (dated July 15, 2011).

[29] *See* Letter from Jeff Carlisle, Executive VP, Regulatory Affairs & Public Policy, LightSquared, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-201 01118-00239 (filed Dec. 20, 2010) (noting that GPS interference is "highly unlikely.").

[30] The Commission's January 26 Order required the formation of a Technical Working Group co-chaired by LightSquared and the U.S. GPS Industry Council to evaluate interference from LightSquared's proposed terrestrial broadband network into GPS receivers. *See LightSquared Subsidiary LLC, Request for Modification of its Authority for an Ancillary Terrestrial Component*, SAT-MOD-20101118-00239, DA 11-133 at ¶¶ 40-43 (IB, rel. Jan 26, 2011).

Test results from the TWG Final Report, as well as independent test results, demonstrate that LightSquared's proposed network represents a serious and immitigable threat to GPS receivers and GPS-enabled applications, that LightSquared lacks a fundamental understanding of the sensitive environment in which its satellites operate, and why its predecessors committed to avoid competing directly with full-scale CMRS networks in this spectrum.[31] The TWG Final Report also reveals that the underlying engineering assumptions about GPS interference reflected in the Waiver Order are unsound and need to be carefully reevaluated.

### A. LightSquared's Proposed Network Creates Massive Interference for High Precision and Augmented High Precision Receivers at Great Distances

High precision augmented GPS receivers experienced severe interference from LightSquared signals at long ranges while under test.[32] The high degree of sensitivity these devices require to achieve near surgical, centimeter-level precision requires a more sophisticated receiver capable of capturing more energy over a wider swath of spectrum. Specifically, high precision GPS receivers are designed to capture wideband signals pushed to the outermost edge of the spectrum allocated to Global Navigation Satellite Systems ("GNSS").[33] Augmented GPS receivers require additional agility to capture signals throughout the 1525-1559 MHz band used for separate satellite augmentation signals.

During open air, "live sky" testing in Las Vegas high precision receivers under test experienced interference and lost the ability to track GPS satellites at ranges up to 15 kilometers away from the experimental LightSquared base station, and suffered severe interference up to 22

---

[31] *See, e.g., Flexibility for Delivery of Communications by Mobile Satellite Service Providers in the 2 GHz Band, the L-band, and the 1.6/2.4 GHz Band*, Notice of Proposed Rulemaking, 16 FCC Rcd 15532, ¶ 15 (2001) (LightSquared's predecessor, when originally seeking ATC authority, assured the Commission "[t]he satellite path would be the preferred communications link").

[32] *See TWG Final Report*, at 183.

[33] High precision GPS receivers utilize the entire L1 GNSS spectrum to enable GPS dual frequency operation, to gather information for multipath suppression – both needed to achieve the required accuracy for their applications – and in some cases to receive signals from the other satellite providers, such as GLONASS, Galileo, and Compass.

kilometers.[34] Radiated laboratory tests demonstrated that high precision receivers operating in an agricultural setting would be susceptible to interference and loss of satellite lock at distances of 22 kilometers.[35]

The space-to-earth 1525-1559 MHz L-band signal used by both Deere and others for the purpose of providing augmented high precision GPS service separately suffered from interference when LightSquared signals were present even at low levels, and also experienced intermodulation effects sufficient to degrade or disrupt performance.[36] In fact, a complete loss of the high precision signal occurred for all receivers in the TWG testing when the interfering signal reached -65 dBm, a level that was observed in the Live Sky testing at a range of 22 km from a LightSquared base station.[37]

Testing by the TWG ultimately demonstrated that high precision and augmented receivers, which in some cases operate pursuant to an FCC mobile earth station license giving them priority over ATC operations, are fundamentally incompatible with LightSquared base stations operating in the 1525-1559 MHz band. High precision GPS requires a commensurately high degree of receiver sensitivity, and powerful LTE signals pollute the 1525-1559 MHz band and massively interfere with this important category of GPS receiver.

### B. The TWG Final Report Aligns with Conclusions Reached in Other Independent Studies -- LightSquared's Proposed Network Creates Widespread Harmful Interference to ALL Classes of GPS Receiver

Despite LightSquared's assertions that interference was "highly unlikely," every class of receiver under test experienced harmful interference when simulated LightSquared signals were

---

[34] *See TWG Final Report*, at 255.
[35] *See TWG Final Report*, at 277.
[36] *See TWG Final Report*, at 249, 263 and 277.
[37] *See TWG Final Report*, at 251 Fig. 41.

radiated in the 1525-1559 MHz band. Harmful interference was experienced when LightSquared operated in Phase 0, Phase 1 and Phase 2 configurations.[38] Specifically:

- The Aviation Sub-team concluded that LightSquared's proposed deployment plan was "incompatible with aviation GPS" and "would result in a complete loss of GPS operations below 2000 feet above ground level (AGL) over a large radius" near LightSquared base stations.[39]

- The Cellular Sub-team found that LightSquared signals "caused GPS failure for a significant number of the tested devices."[40]

- The General Location / Navigation Sub-team concluded that "all phases of the LightSquared deployment plan will result in widespread interference to GPS signals and service and that mitigation is not possible."[41]

- As discussed above, the High Precision, Timing and Networks Sub-team found widespread harmful interference "over long ranges," determined that no mitigation technique is available for protecting the installed base of diverse receivers from LightSquared interference, and concluded that "no currently available receiver, filter, antenna or other mitigation technology would enable the construction of *future* wideband High-Precision, Timing or Network GPS receivers and augmentation systems that are compatible" with LightSquared's roll out plan.[42]

- The Spaced Based Sub-team determined that interference from LightSquared to its receivers "would be severely disruptive to NASA's science mission based on the test and analysis conducted in the TWG."[43]

The harmful interference affecting the above receiver classes did not occur at trivial distances. The receivers under test experienced harmful interference at significant ranges that would occur routinely during real-world operations. For example, cellular and general location

---

[38] LightSquared proposed a phased implementation of its terrestrial broadband network. Phase 0 involved the operation of a single 5 MHz LTE signal centered at 1552.7 MHz, Phase 1 involved operation of a pair of 5 MHz LTE signals centered at 1552.7 MHz and 1528.8 MHz, and Phase 2 involved a operation of a pair of 10 MHz LTE signals centered at 1550.2 MHz and 1531.0 MHz.

[39] *TWG Final Report*, at 27.

[40] *TWG Final Report*, at 55.

[41] *TWG Final Report*, at 122. (LightSquared dissented with regard to the conclusions reached by the General Location / Navigation Sub-team, disagreeing with the broader team's definition of harmful interference, and arguing that incorporating new filters into GPS devices may help alleviate interference. LightSquared did not provide actual filter designs.)

[42] *TWG Final Report*, at 181. (LightSquared dissented with regard to mitigation techniques for future high precision receivers, arguing that certain mitigation strategies or a combination of strategies *might* be feasible. LightSquared provided no scientific data to support its recommendations.)

[43] *TWG Final Report*, at 300.

receivers both experienced severe interference that disrupts satellite lock with overhead GPS spacecraft at distances in excess of a one kilometer from a simulated LightSquared base station signals in the 1525-1559 MHz band, a significant distance given the itinerant, roaming nature of these devices and the high probability that LightSquared base stations will be co-located on existing tower sites in close proximity to major road and transit infrastructure.[44] As discussed in greater detail above, high precision receivers were disrupted at distances of up to 22 kilometers, an area within which many agriculture, construction and survey activities occur.[45] Highly sensitive space-based GPS receivers were affected at distances of several hundred kilometers.[46]

These test results closely align with independent studies and tests performed by highly credentialed third parties evaluating the impact of LightSquared's proposed LTE signals in the 1525-1559 MHz band on GPS receivers. On behalf of the National Executive Committee ("EXCOM") for National Space-Based Positioning, Navigation and Timing ("PNT") The National PNT Systems Engineering Forum ("NPEF"), prepared an assessment of LightSquared's potential impact on GPS receivers and GPS-dependent applications that similarly concluded interference would occur at significant distances and recommended that the FCC prevent LightSquared from proceeding with its planned deployment.[47] The Radio Technical Commission for Aeronautics ("RTCA"), a private, not-for-profit organization that develops recommendations regarding communications, navigation, surveillance, and air traffic management (CNS/ATM) system issues, filed its own study regarding interference to GPS

---

[44] *See TWG Final Report*, at 18.

[45] *See TWG Final Report*, at 251.

[46] *See TWG Final Report*, at 300.

[47] NTIA submitted a public version of the NPEF report on July 6, 2011. *See* Letter from Lawrence E. Strickling, Administrator, NTIA, to Chairman Genachowski, FCC, SAT-MOD-20101118-00239, at 12 (dated July 6, 2011) ("*NPEF Interference Assessment*").

receivers onboard aircraft, concluding that LightSquared's current "authorization would be incompatible with the current aviation use of GPS."[48]

### C. LightSquared's Last Minute Introduction Of A "Low 10 MHz" Configuration In No Way Resolved Serious Interference Concerns – Many Receivers Experienced Harmful Interference During Low 10 MHz Testing

As extensive evidence of damaging interference began to accumulate during testing, as Deere predicted it would, LightSquared attempted a late change in tactics and sought to test a single 10 MHz LTE signal centered at 1531 MHz ("Low 10 MHz" configuration), hoping that moving more of its energy toward the bottom of the 1525-1559 MHz MSS band would resolve its interference issues and alleviate GPS concerns. The Low 10 MHz configuration failed to achieve LightSquared's objectives and did NOT eliminate the interference its network creates into GPS receivers.

LightSquared's assertion that a Low 10 MHz signal protects in excess of 99% of GPS receivers[49] is patently false and disingenuous. While not every sub-team was able to conduct a full series of Low 10 MHz tests, the testing that was conducted still showed unacceptable levels of interference into diverse categories of GPS receivers. All high precision receivers under test experienced harmful interference from a Low 10 MHz signal. 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 ~22 km), from a single LightSquared base station.[50] At a power level of -43 dBm (corresponding to a range of 1.5 km), 50% of the high precision receivers were suffering harmful interference.

---

[48] *See RTCA Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations*, released June 3, 2011 in RTCA DO-327, at p. 51 ("*RTCA Interference Assessment*").

[49] *See TWG Final Report*, at 2, 4 and 10.

[50] *See TWG Final Report*, at 22. Certain modified narrow band receivers using high rejection PCTEL antennas were less susceptible to overload. These devices use GPS signals for network timing purposes only, and therefore by design have narrow filters that would not support high precision or general navigation applications.

Significantly, LightSquared does not dispute the level of interference affecting high precision receivers in the presence of a Low 10 MHz signal. Instead, it attempts to marginalize the high precision receivers by suggesting that there are simply not enough of them to merit meaningful protection, and their absence will go unnoticed. Examining receiver unit volume alone, however, is not a meaningful metric for evaluating the economic importance and public benefits derived from high precision GPS technology. High precision receivers are now standard equipment on a large percentage of agricultural and construction implements manufactured by Deere and other companies, and measured just in the private sector, generate economic benefits of billions of dollars every year. The harm resulting from the loss of high precision GPS to the U.S. agricultural community *alone* would total between $14 - $30 billion annually.[51] By other measures, high precision GPS systems are integral to maintaining U.S. competitiveness in the agricultural sector and in enabling U.S. growers to respond to increased demand for worldwide food production. High precision GPS is a critical feature to survey operations, mining Geographic Information Systems ("GIS"), etc. 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.[52]

High precision receivers were not the only class of receiver that suffered interference in the presence of a Low 10 MHz signal. Contrary to LightSquared's misleading claims that the Low 10 MHz approach effectively resolves interference for 99% of receivers, TWG testing demonstrated that 20 out of 29 General Location receivers under test experienced harmful interference in the presence of a Low 10 MHz signal. Moreover, six of 39 cellular receivers

---

[51] *See* Deere July 5 Ex Parte, at 5.

[52] For example, high precision receivers are used for hazard monitoring, including for such geological events as earthquakes and volcano eruptions.

under test experienced harmful interference.[53] Given the extent of harmful interference affecting both high precision receivers, and the Cellular and General Location classes of GPS receiver, LightSquared cannot assert with any degree of confidence the extent to which a Low 10 MHz configuration resolves its problems, and certainly cannot credibly claim that its hastily proposed and partially tested alternative network scheme protects 99% of GPS receivers.

The independent studies prepared by NPEF and RTCA agree that a Low 10 MHz configurations still presents an interference threat. The RTCA studied a Low 10 MHz scheme and determined only that there may be a "small positive margin" with regard to satellite tracking.[54] The NPEF was more blunt, stating that for certain receivers "GPS loss of function still occurs at unacceptable distances to LightSquared towers" and that wideband, next generation receivers remain susceptible to interference in the presence of Low 10 MHz signals.[55]

There appears to be little or no factual basis for LightSquared's assertion that a Low 10 MHz configuration would protect 99% of GPS receivers. While LightSquared makes the assertion on three (3) separate occasions in its Recommendations filed on June 30th, it provides no citation or other empirical evidence explaining how it derived the figure.[56] In the Technical Appendix to its Recommendations it asserts that there are 400 million GPS receivers in the United States today, of which less than one million are Timing, Precision and Network and/or Aviation receivers that are susceptible to Low 10 MHz interference,[57] but then readily admits that "accurate numbers are difficult to obtain" and its figures are a "best guess."[58] In any event, Deere disputes that Cellular and General Location receivers are fully protected from interference

---

[53] *See TWG Final Report*, at 77, 177.
[54] *See RTCA Interference Assessment*, at 51.
[55] *See NPEF Interference Assessment*, at ii and 11.
[56] *See TWG Final Report*, at 2, 4 and 10.
[57] *See TWG Final Report*, at Technical Appendix, 2.
[58] *Id.*

in a Low 10 MHz scheme. As described above, a significant number of Cellular and General Locations devices experienced a marked degradation in their performance in the presence of a Low 10 MHz signal.

### D. TWG Test Methodologies Were Generally Sound and Developed by Consensus, and LightSquared's Attempts to Undermine Unfavorable Test Results By Casting Doubt On Tests It Helped Develop and Approve Should be Dismissed[59]

Faced with an overwhelming volume of damaging test data that demonstrates its proposed network (even under the alternative Low 10 MHz approach) will cause widespread harm to GPS, LightSquared now seeks to discredit its own tests that generated the unfavorable results. The Commission should reject LightSquared's transparent efforts to undermine test methodologies and protocols that were developed under its own leadership and guidance.

LightSquared belatedly argues in its Recommendations that interfering signals should only be considered harmful if they create degradation of 6 dB or more in carrier-to-noise ratio ("$C/N_0$").[60] Contrary to LightSquared's assertions, a degradation of 1 dB, which is roughly equivalent to a 20% loss of carrier-to-noise ratio, is the appropriate metric for measuring interference. A degradation of 6 dB in $C/N_0$, a 75% loss of carrier-to-noise ratio, relative to a LightSquared LTE signal is very strong degradation, and would make GPS satellite acquisition impossible in many instances. In other FCC rule parts involving space-to-earth communications the FCC defines interference as 1 dB or more of degradation, and given the highly sensitive nature of GPS receivers, the same metric should be applied in the instant situation.[61]

---

[59] Deere feels that test methodologies and protocols were sound, with the notable exception of certain cellular tests led by LightSquared itself. The "pass/fail" methodology, as well as other test methodologies used by LightSquared, did not yield sufficiently granular data to comprehensively review LightSquared's impact on cellular infrastructure and devices.

[60] *See* LightSquared Recommendations, at 18.

[61] *See, e.g., Establishment of Rules and Policies for the Digital Audio Radio Satellite Service in the 2310-2360 MHz Frequency Band,* IB Docket No. 95-91, 50 CR 650, at ¶ 99 (2010).

LightSquared also argues that the free-space model used to calculate the propagation of its LTE signals by the Sub-teams does not take into account man-made and natural blockage that will attenuate its LTE signals in the real world. While Deere acknowledges that signal attenuation does occur in real world environments, testing against worst case scenarios is critical for the purpose of determining whether LightSquared's proposed network is viable and safe. It would not be consistent with sound engineering principle to assume in this analysis of the impact of a nationwide network that attenuation from man-made *(e.g.* buildings) and natural (*e.g.* trees) obstacles will prevent interference. Power measurements made during Live Sky testing showed many instances of power matching or exceeding the free-space model. Current GPS receivers and GPS-based applications ensure human safety, and new applications coming online in the near future will further increase our reliance on GPS as a navigation tool for commercial and passenger transportation systems (*e.g.*, next generation aeronautical navigation and automobile collision avoidance systems both rely on GPS).[62] Given that GPS forms the backbone for next generation commercial and passenger navigation, and its disruption or degradation presents a potentially serious threat to human safety, LightSquared must test against and fully understand the worst-case propagation range for its LTE signals, and a free-space model is the proper way to assess that range.

Moreover, by LightSquared's own conservative "best guess," there are 400 million largely itinerant GPS devices in operation today. With 40,000 LTE base stations proposed, and 400+ million itinerant GPS receivers moving freely about in the same physical space, statistically improbable interference encounters will occur more frequently than LightSquared expects.

[62] *See* Letter Tom Schaffnit, President, Vehicle Infrastructure Integration Consortium, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239, at 1 (dated June 11, 2011) ("A GPS device is a critical element of each DSRC crash avoidance system anticipated to be incorporated in millions of motor vehicles.").

## VI. LIGHTSQUARED'S "PROPOSED SOLUTION" IS NOT AN EFFECTIVE OR FEASIBLE MITIGATION PLAN

LightSquared claims that it has developed a three-part solution that offers a "middle ground" allowing it to go forward "without material harm to GPS." Unfortunately, LightSquared's modified proposal is meritless as a means to introduce high power terrestrial signals in the L-Band without causing severe interference to GPS systems. In the face of extensive scientific evidence of the widespread interference caused by LightSquared signals, offering this "plan" as a meaningful resolution borders on false and misleading

LightSquared boldly claims that its new modified plan "poses no risk to the users of over 99% of GPS devices" but provides no meaningful basis for this statement. To the extent that LightSquared has arrived at this figure from a disingenuous calculation counting estimated cellular handsets that it considers to be immune from LightSquared interference under its deeply flawed analysis, the figure is not credible and should be disregarded as the marketing ploy that it is. All classes of GPS receivers tested with the Low 10 MHz configuration experienced harmful interference. It is simply not the case that the Low 10 MHz approach removes the interference threat for "the vast majority of GPS users."

In any event, LightSquared concedes that interference occurs over long ranges to high precision, timing and network GPS. To address interference to high precision receivers, LightSquared floats a number of vague and speculative possible "solutions" none of which provides any meaningful solution at all. LightSquared's first strategy is to convince the Commission that severe interference to high precision receivers simply does not matter arguing that such receivers represent only "a small fraction of the overall installed base of GPS receivers."[63] As discussed previously, LightSquared is wrong when it assumes that the high

[63] LightSquared Recommendations, at 32.

precision GPS users that will suffer severe interference represent only a tiny, immaterial segment that perhaps should be considered as collateral damage on the quest to achieve a higher goal. Apart from extensive use in agriculture, construction, mining, land and aerial survey and other operations referenced earlier, high precision GPS receivers are used for airfield and flight procedure surveys, flight test tracking, space weather monitoring and GPS timing for computing resources and many mission critical aviation systems.[64]

LightSquared goes on to make the erroneous and speculative statement that high precision users need not worry about interference because "a substantial percentage of precision GPS receivers are used in applications such as precision farming and precision mining that are highly unlikely to be near a LightSquared base station -- and certainly not in the next several years given the expected roll out of LightSquared's network over time."[65] For example, LightSquared states that its plans "necessarily focus initially on population centers and only gradually begin to cover less densely populated areas where most precision agriculture and precision mining are practiced."[66] Such hazy assurances about "substantial percentage" of high precision receivers that may be "unlikely" to experience interference for some time do not even rise to the level of a proposal and certainly are wholly inadequate as a "solution" that could be seriously considered to address interference to high precision receivers.

Moreover, the basic assumptions behind such a concept are erroneous. High precision applications are not limited to sparsely populated areas. High precision location is used extensively in construction equipment much of which is often clustered in densely populated urban and suburban centers. Survey use of high precision GPS is likewise present in populated areas in connection with infrastructure and other development. Aviation use of high precision

---

[64] *See* FAA Interference Report, at 1-7.

[65] LightSquared Recommendations, at 32.

[66] *Id*.

GPS is also not limited to sparsely populated or remote areas. Indeed, it is not at all uncommon for even agricultural uses to be in the vicinity in which severe interference is relevant (*e.g.* 22 km) of urban and suburban population centers. Even if there was merit to LightSquared's assumptions about the deployment of high precision GPS, it has not offered -- and certainly has not committed to -- any details regarding how its network rollout would in fact prevent interference. The most that LightSquared can muster to address the devastating interference that high precision systems will undoubtedly suffer is a plan based on conjecture and promises that solutions can be worked out later.

### A. LightSquared's Proposal to Reduce Power is Disingenuous – Supposedly Reduced Power Levels Are Actually the Maximum Levels Tested by the TWG and the Same Levels That Caused Widespread Harmful Interference

LightSquared Recommendations commit to limit base station Effective Isotropic Radiated Power ("EIRP") in a 10 MHz channel limited to 32 dBW.[67] 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. 32 dBW EIRP was *always* the maximum level of spectral density LightSquared contemplated for its network. Network deployment plans circulated by LightSquared in early 2011 (long before the start of TWG tests) reflected 32 dBW as the maximum EIRP level for the final phase of LightSquared's proposed terrestrial network,[68]

[67] *See* LightSquared Recommendations, at 25.

[68] *See, e.g.*, Second GPS Working Group Progress Report, at 4 (dated April 15, 2011) *filed as an attachment to* Letter from Henry Goldberg, Counsel to LightSquared Subsidiary LLC, to Marlene H. Dortch, Secretary, FCC, SAT-MOD-20101118-00239 (dated. April 15, 2011) (reflecting 32 dBW as the maximum EIRP for LightSquared's terrestrial network after Phase 2 deployment, the final phase in LightSquared's original roll out plan).

32 dBW was the maximum EIRP level at which all sub-teams tested, and 32 dBW was the level at which all sub-teams experienced and reported massive interference.[69]

### B. LightSquared's Offer To Impose a "6-Month Standstill" on the Upper 10 MHz Band Does Nothing To Resolve Interference Issues

LightSquared concedes that a significant number of GPS devices in the field are jeopardized.[70] However, LightSquared expressly confirms that it has every intention and the business need to use "a full complement of frequencies" to operate its LTE network.[71] As its concession to the installed base of GPS devices that will experience massive interference from LightSquared's network, LightSquared's plan proposes a "standstill period" during which it "will not deploy the Upper 10 MHz band on it terrestrial network without receiving explicit approval from the FCC, acting in consultation with NTIA." [72] LightSquared directs that during that time GPS device manufacturers "must begin the process of improving their equipment by adding appropriate filtering or other technology necessary to reject signals that operate outside the GPS frequencies."[73] This approach provides absolutely no constructive substance and is merely a weak attempt to portray LightSquared as an aggrieved party willing to compromise for the greater good.

#### 1. A 6-Month Deferral on Upper 10 MHz Operations Does Nothing to Mitigate Interference from Upper 10 MHz Transmission

At the outset, it strains credulity to consider seriously LightSquared's demand that it should be permitted after six months to deploy high power transmitters in the Upper 10 MHz

---

[69] *See e.g., TWG Final Report*, at 15, 28, 29, 38, and 51.

[70] "A significant number of legacy receivers are at risk." LightSquared Recommendations at 25. Deere objects to LightSquared's attempt to inaccurately portray the installed base of fielded high precision receivers as devices relying on old and outmoded technologies by referring to them as "legacy" receivers.

[71] *Id*.

[72] *Id.*, at 25-26.

[73] *Id*., at 26.

band. This request flies in the face of undisputable detailed evidence in the TWG Final Report and other studies showing that operations on the Upper 10 MHz will cause massive interference threatening disruptions to all GPS applications including those integral to public health and safety and aviation.[74] There is no justification whatsoever supporting such an approach and in light of the extensive unquestioned evidence that high power operations in the Upper 10 MHz are wholly incompatible with GPS, Deere suggests that the Commission affirmatively prohibit high power operations in this band.

### 2. LightSquared's Assumption that GPS Receivers Can Be Radically Reengineered is Contrary to Worldwide GPS Signal and Receiver Technology Wideband Trends

Further, LightSquared's wholly inadequate six-month standstill proposal reveals a fundamental lack of understanding of GPS and receiver technology. According to LightSquared, six months should be enough time to for manufacturers to begin the process to "improve" filters. As an initial matter, LightSquared is simply wrong to the extent it is insinuating that the interference caused by LightSquared is because GPS receivers are defective or poorly designed. They are not. It must be recognized that the trend in GPS receivers is increasingly driven toward wideband receivers to accommodate upgraded satellite technology coming on line with Russia's GLONASS, Europe's Galileo and eventually China's Compass systems, as well as the modernized GPS signals.[75] Regulatory requirements that attempt to force GPS receiver manufacturers to adopt sharp filters -- assuming such filters could in fact be developed in an attempt to reject LightSquared's high power signal -- would run directly contrary to the worldwide trend and place U.S. GPS users at a huge disadvantage. Moreover, high precision

---

[74] *See, e.g.*, Comments of the National Public Safety Telecommunications Council, IB Docket No. 11-109, at 3-6 (filed July 30, 2011); Letter from Richard Taylor, President, National Association of State 9-1-1 Administrators, to Chairman Julius Genachowski, FCC, IB Docket No. 11-109, at 1-2 (dated July 20, 2011); *RTCA Interference Assessment*, at 51.

[75] *See* discussion of international GNSS trends at Section VII.

GPS receivers are specially designed to receive wideband signals in order to capture more data, including in some cases, augmentation signals that can be located anywhere in the L-Band as dictated by L-Band satellite operators to support precision location measurements. Sharp filtering is inconsistent with these functions and Deere is seriously concerned that sharp filters are not possible to develop for implementation in high precision receivers without causing such a degradation in service that the receiver would be rendered essentially useless for its intended high precision purpose.

Regardless of improvements in the performance of GPS receiver filters, the introduction of LightSquared's proposed powerful signals in the L-band will create intermodulation problems that may disrupt or degrade nearby GPS devices. Specifically, LightSquared's proposed Orthogonal Frequency Division Multiplexing ("OFDM") architecture is known to create a large number of intermodulation products,[76] and the frequency bands chosen by LightSquared have the potential to generate a significant number of intermodulation products in the GPS/GNSS frequencies.[77] No foreseeable filter will mitigate this problem.

### 3. LightSquared Suggestions for GPS Receiver Technology Development Are Speculative and Unrealistic

In any event, all of the deliberation regarding possible GPS receiver changes is sheer speculation because no such filter technology is available today. No prototypes exist. No modified filters exist. There are some conceptual designs that have been floated (by LightSquared). Such embryonic concepts may be interesting but are a far cry from technology that can actually be tested, much less from receiver products that can be installed in the field as a "solution" to LightSquared's interference to GPS. Further, it is cannot be assumed that GPS

[76] O'Droma, M., and Lei, Y., Analysis of Inter-modulation Products and Nonlinear Distortion in RF OFDM Transmitter Systems, 69th IEEE Vehicular Technology Conference. Barcelona Spain, April 2009, pp. 1-5.

[77] LightSquared's OFDM architecture will potentially generate upwards of 100 million third order intermodulation products inside the GPS band.

filter technology could *ever* be developed to prevent interference from a high power network such as that proposed by LightSquared. The proposed LightSquared signals will be a *billion* times more powerful than the quiet GPS satellite signals transmitted 12,000 miles away in space.[78] Deere knows of no way to mitigate interference to satellite-based services[79] from such extremely high–power. A filter which is sufficiently sharp to prevent overload and intermodulation would have the undesired side effect of distorting the waveforms which pass through it. Low distortion is essential when precisely measuring the arrival time of GPS signals.

Moreover, there is widespread agreement in the GPS community, including government, agriculture, aviation, general location, and others segments, that fundamental changes in GPS receiver design to prevent interference from high power network - *even if they could be made* – would most likely take a minimum of ten years. Accordingly, a six-month timeframe to develop "improved" GPS receiver filters that reject LightSquared's powerful transmission is absurd. The "standstill proposal" is little more than window dressing that does nothing to avoid extensive interference to GPS.

Deere appreciates LightSquared's statements regarding its support for the location of MSS augmentation signals in a "safe" portion of the L-band and its stated interest in funding GPS receiver development.[80] While discussions of these and other ideas are generally constructive, there is no proposal or actual development in this direction that resolves the potential for severe interference to GPS devices demonstrated in the Final TWG report. Accordingly, discussion of these and other preliminary ideas do not constitute feasible mitigation solutions relevant to the conditional waiver under consideration.

---

[78] LightSquared's signal is >90 dB stronger than the StarFire augmentation signal when near a base station.

[79] LightSquared offers to "assist" with the development of future receivers do not overcome any of the practical realities of receiver development.

[80] LightSquared Recommendations, at 32-35.

#### 4. A Six-Month Standstill Does Not Prevent the Interference That Will Occur to Most GPS Receivers from Low 10 MHz Transmissions

Finally, LightSquared's idea for a six-month standstill period also simply ignores the severe interference arising from operations using the Low 10 MHz band. LightSquared's erroneous assumption is that operations on the Low 10 MHz sufficiently avoids interference to GPS. It does not. Deere reiterates in Section VI.C below why LightSquared's Low 10 MHz plan is not a solution to the severe interference problem. In short, to the extent that the Low 10 MHz option was tested in the TWG, results showed that all classes of GPS devices were harmed except for some narrowband timing devices. Therefore, LightSquared provides no relief from the severe damage across a broad range of GPS devices including all high precision devices.

### C. Moving LightSquared's Proposed Base Station Signal to a Lower Frequency In the 1525-1559 MHz Band Does NOT Effectively Mitigate Harmful Interference

The centerpiece of LightSquared's "solution" is its proposed "Low 10 MHz" configuration, which centers a single 10 MHz LTE signal at 1531 MHz, and avoids emitting base station signals on frequencies above 1536 MHz. According to LightSquared, this approach "immediately addresses interference concerns."[81] To the contrary, LightSquared grossly exaggerates the interference mitigation potential of a Low 10 MHz configuration. While not every sub-team completed a full battery of tests to evaluate a Low 10 MHz configuration, the tests that were conducted provide indisputable empirical evidence that many GPS receivers still experience dramatic, harmful interference in the presence of a single 10 MHz LTE signal centered at 1531 MHz.

Although LightSquared's Low 10 MHz configuration proved ineffective as a means of interference mitigation for a significant percentage of consumer oriented GPS receivers, and

[81] *See* LightSquared Recommendations, at 27.

would potentially disrupt or degrade millions of these devices,[82] it showed even less potential as a mitigation technique for industrial-grade high precision receivers and licensed MSS receivers that are used to augment high precision receivers. Low 10 MHz signals with moderate field strength markedly degraded the performance of high precision receivers under test.

- Ten percent of high precision receivers under test began to experience harmful interference in the presence of an interfering Low 10 MHz signal with received power of a faint -67 dBm.[83]

- Ten percent of high precision receivers under test lost the ability to track GPS satellites completely in the presence of interfering Low 10 MHz signals as weak as -54 dBm.[84]

Low 10 MHz signals proved even less effective at protecting the space-to-earth MSS signals that Deere's StarFire and other augmentation receivers downlink from L-band satellites. In the presence of a Low 10 MHz signal StarFire and OmniSTAR MSS receivers under test became degraded when the interfering signal reached levels between -83 dBm and -64 dBm, depending on the receiver.[85]

Based on the severe interference that Low 10 MHz signals create for high precision receivers, Deere strongly disagrees with LightSquared's assertion that this type of signal configuration "immediately addresses interference concerns."

Nor does Deere believe that a Low 10 MHz configuration will necessarily provide meaningful protection in the future. GPS and other GNSS systems are transitioning to wideband formats that improve precision by providing additional data and pushing energy to the very edge of the 1559 – 1610 MHz band. Even if sharp filters that did not degrade the GPS navigation

---

[82] During Low 10 MHz testing, 6 of 39 cellular receivers, or approximately 15% of the receivers under test, experienced harmful interference. Given that there are conservatively by LightSquared's own estimates well over 100 million GPS enabled cellular devices in the United States, millions of cellular devices would be at risk for interference if LightSquared deployed a nationwide Low 10 MHz LTE signal.

[83] *See TGW Final Report*, at Appendix H.1.1.10, Figure 31.

[84] *See TGW Final Report*, at Appendix H.1.1.10, Figure 25.

[85] *See TWG Final Report*, at Appendix H.1.1.13.

function and could reject the massively disproportionate LightSquared power could be developed, which is speculation at this point, modernized wideband GPS signals such as those that will be used by the Federal Aviation Administration's ("FAA's") Next Generation Air Transportation System ("NextGen"), will necessitate a wide filter, not the narrow type of filter LightSquared deems desirable. Nor will a Low 10 MHz configuration ever offer meaningful protection to existing mobile satellite receivers such as Deere's StarFire systems that operate on a priority basis in the 1525-1559 MHz band and experience co-channel interference from LightSquared's proposed network.

### D. LightSquared's Vague Plan to Frequency Coordinate with High Precision Receivers Appears Unworkable and Technically Unsound

LightSquared speculates that frequency coordination is an "especially appropriate solution for addressing interference concerns."[86] However, LightSquared provides scant detail about its plan beyond suggesting that the FCC should impose "a good faith frequency coordination obligation upon both [itself] and precision GPS users."[87] Does LightSquared expect the FCC to coordinate between the hundreds of thousands of itinerant high precision receivers roaming the country and LightSquared's 40,000 proposed base stations? Even if the FCC had the resources and desire to become LightSquared's frequency coordinator, which it likely does not, how would "frequency coordination" occur? Successful coordination between spectrum users requires, at a minimum, that the coordinator know the location of the potentially interfering parties, and the FCC has no practical way of tracking the hundreds of thousands of itinerant high precision GPS receivers that move about the United States.

To the extent that the FCC was able to develop a frequency coordination system, how would the Commission resolve interference disputes, which are likely to occur frequently given

---

[86] LightSquared Recommendations, at 35.

[87] *Id.*

that high precision GPS receivers used in construction and surveying applications are deployed *en masse* in the larger, densely populated urban markets where LightSquared will likely deploy base stations immediately, and agricultural receivers will be in closer proximity to initial base stations than LightSquared has assumed?[88] Will LightSquared allow the FCC to power down its base stations if they interfere with high precision receivers? Will augmented high precision receivers that are licensed and should have priority over LightSquared's ancillary terrestrial use of mobile satellite frequencies have priority?

It also unclear what utility LightSquared's proposed automated database will provide to high precision and augmented high precision GPS receivers, and exactly what role it plays in LightSquared's frequency coordination plan. Is LightSquared proposing a dynamic database comparable to what the FCC has begun to implement in the TV broadcast bands that will let incumbent GPS devices power down or adjust LightSquared's base station output levels if interference occurs? If not, what useful purpose does this "database" serve? If it is nothing more than a reference tool for high precision GPS users to confirm the source of their interference, but offers no practical and immediate way to mitigate that interference, LightSquared's "database" mitigation solution appears to be nothing more than smoke and mirrors.

### E. TWG Test Results Demonstrate That LightSquared Handsets Transmitting in the 1626.5 – 1660.5 MHz Range Present a Separate, Real-World Interference Threat to GPS Receivers

While greater emphasis has been placed on the interference potential of LightSquared's proposed base stations to GPS receivers, TWG tests demonstrated that LightSquared handsets operating in the 1626.5 - 1660.5 MHz frequency range present a meaningful independent interference threat. The General Location / Navigation and High Precision Sub-teams both

[88] LightSquared's Recommendations fail to appreciate that many agricultural high precision receivers operate in relatively close proximity to large urban areas. For example, Kansas City has a large greenbelt of agricultural activity encircling the city.

evaluated the impact of simulated LightSquared handset emissions on GPS receivers. The General Location / Navigation Sub-team found that GPS receivers began to experience harmful interference at a maximum range of nearly 10 meters from a LightSquared handset, and all devices under test experienced harmful interference at a range of 15 centimeters or less.[89] The High Precision team found that GPS receivers under test began to experience interference when the interfering signal from the simulated LightSquared handset was as weak as -77 dBm, which could potentially affect a GPS device at a distance of 1400 meters.[90]

Given that proposed LightSquared handsets would routinely come in close contact with general location / navigation devices (*e.g.*, first responders using GPS to navigate may have phones in their pockets and/or elsewhere inside the vehicle) and high precision receivers (*e.g.*, tractor operators with mobile devices sit directly beneath Deere StarFire receivers), the interference ranges above present a serious problem. LightSquared has, to date, chosen to simply ignore this problem, making no reference to the negative test results regarding its handset interference in the LightSquared Recommendations filed on June 30th. Deere urges the Commission to mandate that LightSquared more thoroughly investigate and address this problem. In addition, it appears that the out of band emissions from LightSquared handsets may also constitute a serious interference problem for GPS receivers. This was not addressed in the TWG testing, due to the schedule pressure under which the TWG operated, but subsequent analysis by Deere indicates that this may be as important a source of interference as the base station signals.[91]

---

[89] *See TWG Final Report*, at p. 142, Figure 3.3.8.
[90] *See TWG Final Report*, at p. 310.
[91] Please see **Exhibit 1.0**.

## VII. THE FCC'S IMPROMPTU REALLOCATION OF THE L-BAND IN FAVOR OF TERRESTRIAL USE IS CONTRARY TO GLOBAL TRENDS TOWARD WIDEBAND GNSS SYSTEMS AND RECEIVERS AND THE U.S. COMMITMENT TO PROTECT GNSS SYSTEMS

The introduction of powerful and incompatible signals in frequencies adjacent to GNSS presents a fundamental incompatibility issue for the FCC and NTIA that needs to be addressed. Next generation GNSS systems, including modernized GPS, as well as the European Union Galileo, Russian GLONASS and Chinese Compass constellations all employ wideband signal schemes that push energy to the outermost edge of the 1559-1610 MHz band, making it difficult or impossible to build filters that roll off sharply enough to avoid picking some level of energy in the adjacent bands not expressly allocated to GNSS. While not a problem when the adjacent bands are used exclusively for MSS, which is not an application that creates high levels of spectral density, the introduction of powerful terrestrial base station signals in the 1525-1559 MHz band appears incompatible with wideband GNSS systems.

Going forward, any expanded or revised use of the L-band or Big LEO frequencies should involve coordination at the international level to ensure that other multimode wideband GNSS systems are not adversely affected by changes to the adjacent bands. This will help prevent degradation or disruption of GPS, as well as disruption to other international GNSS systems that may be used in the U.S. to supplement GPS navigational data. It will also help ensure that the United States fulfills its various obligations to harmonize operations and prevent interference into GNSS frequencies as the U.S. has specifically committed to do in treaty and other international agreements.[92] The European Commission ("EC") and European Positioning Navigation and Timing Industry Council ("EPIC") have already voiced strong concerns about the interference threat that LightSquared presents to Europe's Galileo constellation of GNSS

[92] *See, e.g.*, Agreement on the Promotion, Provision and Use of Galileo and GPS Satellite-Based Navigation Systems and Related Applications (signed by Secretary of State Powell on June 26th, 2004).

satellites. The EC explained that its own independent tests have concluded that "LightSquared base stations do indeed have considerable potential to cause harmful interference to Galileo receivers."[93] The EC added that pursuant to international obligations "ITU Member States are expected not to cause harmful interference to systems of another country that operate in accordance with the Radio Regulations."[94] EPIC expressed concern that allowing LightSquared to move forward with its proposed network would create "severe interference" to GNSS equipment and have "international repercussions."[95] EPIC further explained that the FCC had given no "warning of [LightSquared's plans] whatsoever through the ITU, ICAO, UN Office for Outer Space Affairs, International GNSS Committee or other international bodies" prior to granting LightSquared its conditional authority in January 2011.[96]

## CONCLUSION

The Final TWG Report demonstrates that LightSquared's proposed terrestrial operations cause massive interference to GPS receivers and GPS-based applications, regardless of the operating frequency selected by LightSquared, without any viable mitigation options. As such, the condition of LightSquared's waiver cannot be satisfied and the waiver should be rescinded.

---

[93] *See Letter* from Heinz Zourek, Director General, European Commission, Directorate General for Enterprise and Industry, to Chairman Julius Genachowski, FCC, SAT-MOD-20101118-00239, at 1 (dated July 19, 2011).

[94] *Id.*, at 2.

[95] *See* Letter from John Wilde, Chief Executive, European Positioning Navigation and Timing Industry Council, to Chairman Julius Genachowski, FCC, SAT-MOD-20101118-00239, at 1, 2 (dated July 4, 2011).

[96] *Id.*, at 2.

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

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

An aspect of the LightSquared system that has not been sufficiently tested, if at all, is the interference that may be generated by handsets in the vicinity of a GPS receiver. In particular, the OOBE specification of the handset is not as strict as that for the base station. The OOBE of the handset has not been tested since no actual handsets exist. The OOBE specification of the handset will be difficult to achieve in a small handheld form factor.

Since any particular handset may only be transmitting on a single Resource Block (180 kHz) at any given time, it is difficult to easily model the potential ensemble of out-of-band emissions presented by many handsets nearby a GPS receiver. If we look at a worst case situation of 50 handsets transmitting simultaneously on one Resource Block each with an average distance to the handset of 10 meters, the Noise Floor degradation caused by the OOBE would be 13.2 dB.

| | | | |
|---|---|---|---|
| 1 | OOBE Specification | -60 | dBm/MHz |
| 2 | OOBE power density | -120 | dBm/Hz |
| 3 | OOBE power density / handset @ 10 meters | -176.5 | dBm/Hz |
| 4 | 50 handsets | 17 | dB |
| 5 | Total OOBE power density @ 10 meters (3+4) | -159.5 | dBm/Hz |
| 6 | Thermal Noise power density | -174 | dBm/Hz |
| 7 | Noise Figure (example) | 1.5 | dB |
| 8 | Equivalent Thermal Noise power density | -172.5 | dBm/Hz |
| 9 | Total power density (5 + 8) | -159.3 | dBm/Hz |
| 10 | Noise Floor Degradation (8 – 9) | 13.2 | dB |

Even at an average of 50 meter separation, the Noise Floor degradation would be over 4 dB (A slight liberty has been taken with average distance causing a linear relation between total handsets and total OOBE).

If the number of handsets is reduced to only 10 simultaneous users with an average distance of 10 meters, which is a very realistic use case, the noise floor degradation is still significant at 7 dB.

| | | | |
|---|---|---|---|
| 1 | OOBE Specification | -60 | dBm/MHz |
| 2 | OOBE power density | -120 | dBm/Hz |
| 3 | OOBE power density / handset @ 10 meters | -176.5 | dBm/Hz |
| 4 | 10 handsets | 10 | dB |
| 5 | Total OOBE power density @ 10 meters (3+4) | -166.5 | dBm/Hz |
| 6 | Thermal Noise power density | -174 | dBm/Hz |
| 7 | Noise Figure (example) | 1.5 | dB |
| 8 | Equivalent Thermal Noise power density | -172.5 | dBm/Hz |
| 9 | Total power density (5 + 8) | -165.6 | dBm/Hz |
| 10 | Noise Floor Degradation (8 – 9) | 7 | dB |

Even more interesting is that a single user within 1 meter of the handset, such as what would be encountered by a car navigation user, the noise floor degradation is more than 16 dB. Route guidance won't function under this interference.

| | | | |
|---|---|---|---|
| 1 | OOBE Specification | -60 | dBm/MHz |
| 2 | OOBE power density | -120 | dBm/Hz |
| 3 | OOBE power density / handset @ 1 meter | -156.5 | dBm/Hz |
| 4 | Thermal Noise power density | -174 | dBm/Hz |
| 5 | Noise Figure (example) | 1.5 | dB |
| 6 | Equivalent Thermal Noise power density | -172.5 | dBm/Hz |
| 7 | Total power density (3 + 6) | -156.4 | dBm/Hz |
| 8 | Noise Floor Degradation (6 – 7) | 16.1 | dB |

Furthermore, a major concern is whether these handsets will actually meet the OOBE specification. Even if they are initially compliance tested, which can be guaranteed, and factory tested, which is not guaranteed, what happens over their projected lifetime and typical use case (or user abuse case)?

## CERTIFICATE OF SERVICE

I, Tim Bransford, hereby certify that on August 1, 2011, I have caused a copy of Deere & Company's Application for Review 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