Stansell Consulting

30110 Via Rivera
Rancho Palos Verdes, CA
90275-4456

Phone: (310) 541-0523
E-Mail: Tom@Stansell.com

August 6, 2011

VIA ELECTRONIC FILING
Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, DC 20554

Re: **LightSquared Subsidiary LLC Request for Modification of its Authority for an Ancillary Terrestrial Component, IB Docket No. 11-109; IBFS File No. SAT-MOD-20101118-00239**

Erratum to Stansell Consulting Comments

Dear Ms. Dortch:

On August 1st, 2011, Stansell Consulting submitted comments ("Comments") in response to the Commission's June 30, 2011 Public Notice seeking comment on the Final Report of the Technical Working Group ("TWG") co-chaired by LightSquared and the United States Global Positioning System Industry Council ("USGIC") evaluating the interference impact of LightSquared's proposed terrestrial wireless network on GPS receivers and GPS-based applications in the above-referenced proceeding. Stansell Consulting hereby submits this erratum clarifying that precision agriculture requires 10 centimeters of navigation accuracy, which is the equivalent of 0.1 meter.

An amended copy of the Comments as modified by this erratum is attached for the sake of clarity and convenience.

Please direct any questions to the undersigned at (310) 541-0523.

Very truly yours,

Thomas A. Stansell, Jr.
Stansell Consulting

BEFORE THE
Federal Communications Commission
WASHINGTON, DC 20554

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

To: The Commission

COMMENTS OF STANSELL CONSULTING

1. INTRODUCTION

This document responds to the Commission's June 30, 2011 Public Notice seeking comment on the Final Report of the Technical Working Group ("TWG") co-chaired by LightSquared and the United States Global Positioning System Industry Council ("USGIC") evaluating the interference impact of LightSquared's proposed terrestrial wireless network on GPS receivers and GPS-based applications.

This response is focused on five items: (1) the significant difference between bandwidth requirements for communication as compared with navigation, (2) the fact that LightSquared handsets are likely to interfere more with GPS than the ATC transmitters, (3) the wideband M-code signal development, (4) the U.S. treaty obligation to protect the European Union (EU) Galileo signals, and (5) the need for extensive new testing not only of the recent LightSquared proposal to transmit only a low-10 LTE signal but also of the significant potential for interference due to OOBE from LightSquared handsets and protection of Galileo signals.

2. COMMUNICATION VERSUS NAVIGATION BANDWIDTH REQUIREMENTS

Extensive testing was done and the results were documented by the Technical Working Group (TWG) and by the National PNT Engineering Forum (NPEF). The results are there for all to see, but conclusions offered by LightSquared and by the GPS community are quite different.

For example, LightSquared suggests that GPS receiver bandwidths should be narrowed to avoid interference and that GPS should tolerate a signal-to-noise (C/N_0 or S/N) reduction of 6 dB. Reducing LightSquared power by 6 dB would reduce the coverage area by a factor of four or more, but LightSquared suggests a 6 dB reduction in GPS S/N should not be considered harmful.

A reason these perspectives are so different may be that communication and navigation are fundamentally different. If GPS were a communication system it would be entirely reasonable to filter the incoming C/A code signal to recover the energy inside the ±1 MHz first nulls and rapidly attenuate signals outside that 2 MHz band. Most of the C/A signal power is within that bandwidth, and data demodulation would be excellent. Why can't civilian GPS users be satisfied to operate with a narrow RF bandwidth? Even noting that the P(Y) code has its first nulls at ±10.23 MHz, why shouldn't GPS RF filters roll off very quickly outside that 20.46 MHz bandwidth?

The answer is that navigation accuracy is not based on data demodulation. It is based on "pseudorange" measurements, which are obtained by measuring the time of arrival of spreading code transitions. Most consumer navigation sets provide an accuracy of about 3 meters (3 m) RMS. The average measurement time precision, therefore, must be better than 3 m divided by the speed of light ("C"). In round numbers, C is approximately 300 meters/microsecond (300 m/μsec). Thus, (3 m)/(300 m/μsec) = 0.01 μsec or 10 nanoseconds (10 ns). It is remarkable that consumer receivers can measure time of arrival to such precision with bandwidths on the order of a few MHz, but it is being done.

The problem is more difficult for high precision applications. For example, the FAA's Wide Area Augmentation System (WAAS) is intended to provide aircraft with approximately half-meter RMS positioning accuracy. This accuracy requires average time-of-signal-arrival measurements to better than 0.5/300 = 0.0017 μsec or 1.7 ns, which is six times better than a consumer receiver. In addition, these measurements must have very high integrity for an airplane to land safely in bad weather.

However, half-meter accuracy isn't the most stringent requirement. Today, precision agriculture requires 0.1 m (10 cm) navigation accuracy, and systems such as StarFire and OmniSTAR achieve this by providing GPS orbit and clock corrections through downlink data in the MSS band. The time precision needed to achieve 10 cm accuracy is better than 0.1/300 = 0.00033 µsec or 0.033 ns. This is 30 times better than required for consumer navigation.

If the GPS signal in space and the GPS receiver could have a bandwidth of one gigahertz (GHz), it would provide code edges with a one ns rise time. Without interference and with extremely high speed signal processing, this would be ideal for precise positioning. This bandwidth obviously is not feasible. However, through sophisticated signal processing, GPS receivers achieve this precision with narrower bandwidths. Even so, it should be evident that a wider bandwidth and better S/N are vital to achieve these accuracy requirements. The LightSquared demand to reduce RF bandwidth and allow GPS S/N to be degraded by up to 6 dB would be devastating to accuracy.

GPS has enabled remarkable improvements in science, safety, productivity, and environmental protections, and these as well as important future advances should not be sacrificed in a rush to give away extremely valuable spectrum to LightSquared, a for-profit communication service.

The discussion above focused on rise time and S/N. However, accuracy also is greatly affected by multipath interference. A wide RF bandwidth is essential to enable effective multipath mitigation. In other words, the wide RF bandwidth of GPS high precision receivers is intentional and effective rather than the result of sloppy design as claimed by LightSquared.

Wide, interference-free bandwidth is vital to current and future precise GPS applications. It should be noted that with the advent of GPS (and other GNSS) signals at three frequencies, the promise of consumer products giving 10 cm accuracy is in sight. This could lead to fewer accidents and fatalities on our nations' roads and highways. We must be careful to protect not only current GPS capabilities but also those coming in the future.

3. LIGHTSQUARED HANDSETS EMIT DAMAGING GPS INTERFERENCE

LightSquared handsets are likely to harm GPS reception even more than the already damaging ATC transmitters. Published estimates of LightSquared out-of-band-emission (OOBE) into the GPS L1 band indicate that at a distance of 2 meters one handset will hurt GPS reception (reduce S/N) by 9.5 dB, which is devastating. With potentially millions of handsets in use, the impact would be far worse. Note that handset interference is not from the adjacent MSS band, it is directly within the GPS L1 spectrum, so it will affect every type of GPS receiver. GPS mitigations against such OOBE are not possible.

The threat to GPS from individual and collections of handsets needs to be seriously evaluated and tested before LightSquared should be allowed to proceed. Therefore, a significant quantity of manufactured handsets must be tested with the many types of GPS receivers.

4. THE WIDEBAND M-CODE SIGNAL

Beginning in the mid 1990's, the GPS Joint Program Office began developing a new, modernized military signal known as M-code, which is slated to become the principal military GPS signal. M-code is now being transmitted from ten GPS satellites. It is important to note that the M-code has a wider bandwidth than the P(Y) Code, with its first nulls at ±15.345 MHz, even closer to the MSS band. Since the M-code development began well before any authorization of ATC in the MSS band, clearly it was assumed the adjacent MSS band would continue to be allocated for satellite-to-earth signals only, certainly not 40,000 or more 1600 watt (effective isotropically radiated power or EIRP) terrestrial transmitters. In addition to the current P(Y) military signal, the FCC must consider the impact of any LightSquared activity on M-code, which will form the foundation for our nation's modernized military GPS capabilities.

5. PROTECTION OF THE GALILEO PRS SIGNAL

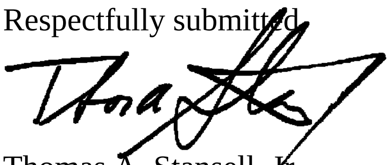
In 2004 the U.S. signed an agreement (effectively a treaty) with the European Union (EU) regarding GPS and Galileo. Key principles underlying the agreement were for civilian signals to overlay each other for optimum interoperability but for military or other encrypted signals to be spectrally separated. Since the U.S. already had defined the M Code, the Galileo Publically Regulated Service (PRS) signal was located above and below the M Code. The lower portion of the PRS signal is centered 15.345 MHz below the L1 center frequency, with its lowest null 17.9025 MHz below L1. In other words, a significant portion of the PRS signal is within the MSS band. The U.S. is obligated by the agreement to protect Galileo signals from interference. Article 11 of the agreement states: ". . . make all practicable efforts to protect each other's signals from interference by the radio frequency emissions of other systems." On 19 July 2011 the European Commission (EC) issued a complaint about LightSquared interference. It may be that both LightSquared ATC transmitters and handsets violate this international treaty. Additional testing clearly is needed to verify U.S. compliance with the EU/US Agreement.

6. EXTENSIVE NEW TESTING IS NEEDED

It seems that LightSquared and the FCC are convinced that important GPS applications cannot practically coexist with interference from the upper 10 LTE band. Therefore, it appears that authorization of only the lower 10 LTE band with a maximum EIRP of 32 dBW is being contemplated. Evidence already exists that the lower 10 will cause harmful interference to some GPS applications. Therefore, additional tests will be needed to determine the extent of interference and whether further changes to the LightSquared emissions or changes to GPS receivers could mitigate all the interference. Also, a significant amount of testing is needed to determine the extent of harmful OOBE interference from LightSquared handsets. In addition, testing is needed to determine if the U.S. obligation to protect Galileo signals is compatible with deployment of LightSquared ATC transmitters and handsets. These tests are likely to require months of work, partly because production LightSquared handsets are not available.

If changes to GPS or Galileo receivers could mitigate the LightSquared interference, it will be necessary to determine the time and cost to retrofit or replace fielded receivers. Industry estimates are that this will require up to 10-15 years.

Respectfully submitted,



Thomas A. Stansell, Jr.
Stansell Consulting
30110 Via Rivera
Rancho Palos Verdes, CA 90275-4456

Tel: 310-541-0523
Email: Tom@Stansell.com