# COMMITTEE ON SCIENCE, SPACE, AND TECHNOLOGY
# U.S. HOUSE OF REPRESENTATIVES

## *Impacts of the LightSquared Network on Federal Science Activities*

Wednesday, September 8, 2011
2:00 p.m. – 4:00 p.m.
2318 Rayburn House Office Building

**Hearing Purpose**

The purpose of this hearing is to examine the concerns and issues associated with interference on the Global Positioning System (GPS) signal from the proposed LightSquared LLC terrestrial broadband network related to Federal scientific activities.

The committee will review the results of recent testing on the impact of the LightSquared network on the GPS signal. Potential interference could disable the GPS signal used for critical U.S. Government services and science missions such as the Next Generation Air Transportation System, Earth and space science missions, communications and navigation, space mission operations, weather predication and climate observation, search and rescue, disaster response and public safety, navigation, geodesy, and marine research platforms and services. In addition, the Committee will examine measures and costs necessary to implement and prioritize mitigation strategies at Federal departments and agencies.

**Background**

LightSquared is a Mobile Satellite Service (MSS) telecommunication company owned by Harbinger Capital Partners Funds that was formed in 2010 with plans to provide a wholesale, nationwide 4G wireless broadband network through their existing mobile satellite communications services and a ground-based wireless communications network that uses the same L-band radio spectrum as their satellites. LightSquared's predecessor companies include SkyTerra Communications, Inc. (SkyTerra), Mobile Satellite Ventures (MSV), Motient Services Inc. and American Mobile Satellite Company (AMSC).[1]

LightSquared operates its satellite service using two geostationary satellites that cover North America and is also authorized to operate a "next-generation" satellite called SkyTerra-1, launched on November 14, 2010.

The new LightSquared terrestrial network will be located in the same frequency band as their satellite service, which is adjacent to existing GPS spectrum, and transmitted through approximately 40,000 base stations located primarily in major city markets. A number of GPS stakeholders have raised concerns with the Federal Communications Commission (FCC) that the proposed LightSquared business plan will interfere with existing GPS-based services.

[1] FCC DA 11-133, January 26, 2011.

In 2003, the FCC adopted initial rules allowing commercial satellite service providers to operate a ground network integrated with their satellite service. These integrated ground networks are referred to as an Ancillary Terrestrial Component (ATC) of a Mobile Satellite Service (MSS) and were intended to "fill-in" gaps and boost the penetration of the original satellite signal within dense urban environments. The integrated ATC network would simply augment the satellite signal.

The initial ATC ruling permitted MSS providers to enhance their satellite service but was not intended to become an independent terrestrial network. The FCC stated in the 2003 ruling:

> *The purpose of our grant of ATC authority is to provide satellite licensees flexibility in providing satellite services that will benefit consumers, not to allow licensees to profit by selling access to their spectrum for a terrestrial-only service.*[2]

In 2004, the FCC granted LightSquared (then known as MSV) conditional approval to build its integrated ATC ground-based wireless network using its satellite spectrum near the GPS signal.[3] At that time, the GPS industry concluded that interference with GPS signal would be manageable as the ATC would simply augment the satellite signal.

MSV changed its name to SkyTerra in 2008.[4] In 2010, Harbinger Capital Partners Funds became the principle owner of SkyTerra[5], and subsequently renamed the company LightSquared. The newly formed company also developed a new business plan to provide a wholesale, nationwide 4G wireless broadband network through their existing mobile satellite communications services and an integrated ground-based wireless communications network that uses the same L-band radio spectrum as their satellites.

On January 26, 2011, the FCC granted LightSquared a conditional waiver of its ATC authority "integrated service rule" meaning its customers could offer terrestrial only services.[6] LightSquared maintains that its network will continue to offer both satellite and terrestrial services bundled together but that its wholesale customers could sell smartphones and similar devices that are only capable of transmitting and receiving with the terrestrial base stations.[7] The approval also required LightSquared to form a Technical Working Group (TWG) and issue a GPS interference assessment report, due to the FCC on June 15, 2011.

In March 2011, LightSquared formed the TWG with industry representatives and government officials to conduct testing and report the results of impacts on the GPS signal. Comments and responses on the TWG report were due on August 15th. Recent congressional testimony on the report's findings indicate significant interference between the LightSquared signal and the GPS signal.[8]

Independent of the FCC-ordered study, the U.S. government's National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum (NPEF) conducted its own testing of the

[2] FCC 03-15, February 10, 2003.
[3] FCC DA 04-3553, November 8, 2004.
[4] "Notice to Noteholders – Name Change," SkyTerra Press Release, December 8, 2008.
[5] FCC DA 10-535, March 26, 2010.
[6] FCC DA 11-133, January 26, 2011.
[7] Ibid.
[8] Hearing titled "GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens," Committee on Transportation and Infrastructure, U.S. House of Representatives, June 23, 2011.

potential interference to military and civilian GPS users from LightSquared's terrestrial network. The NPEF completed its report on June 1, 2011 and concluded that harmful interference to the GPS signal would result from the LightSquared network. The NPEF report recommended that the FCC withhold authorization for LightSquared to commence commercial operations and stated;

> *The U.S. Government should conduct more thorough studies on the operational, economic and safety impacts of operating the LightSquared Network.*

In light of the test results from the TWG and the NPEF reports, LightSquared has proposed a new plan to initiate commercial operations utilizing the lower 10MHz of its L-band spectrum that the company believes will minimize interference with the GPS signal.[9] While LightSquared maintains its new proposal will significantly reduce interference to a large percentage of the GPS user community, its impact on aviation, space-based, and high precision users, such as the FAA NextGen, NASA Earth Science missions, GPS meteorology, seismology, and NOAA weather satellites and marine surveyors remains uncertain. While these users represent a small percentage of the overall GPS community their services are critical to U.S. government operations and science missions.

The latest LightSquared proposal would first utilize the lower 10 MHz of its L-band spectrum allocation that is the farthest away from the GPS signal at reduced power. Over time, provided interference concerns with the GPS signal could be sufficiently mitigated, LightSquared would then start operations across its entire upper and lower spectrum allocation. Although not specifically tested, the TWG report contains numerous recommendations (see Appendix 1) to conduct additional testing on the impact on the GPS signal if the FCC were to authorize LightSquared's latest commercial operations proposal.[10]

On July 6, 2011, the National Telecommunications and Information Administration (NTIA) sent a letter to the FCC stating that, based on the government testing and analysis, earlier concerns about GPS interference remain unresolved and additional testing is necessary. NTIA recommended that the FCC continue to withhold authorization for LightSquared to commence commercial operations, stating:

> *NTIA supports the [National Executive Committee for Space-Based Positioning, Navigation, and Timing] EXCOM's recommendation that additional tests be performed and recommends that the FCC continue to withhold authorization for LightSquared to commence commercial operations until all the available test data can be analyzed and all valid concerns have been resolved.*[11]

On May 11, 2011, the National Executive Committee for Space-Based Positioning, Navigation, and Timing requested Departments and agencies assess the impacts of LightSquared's concept for operations. The PNT-NCO asked Departments and agencies to answer the following questions;

1. Summarize and quantify current and future benefits provided by use of GPS-based application and any cost-benefit analyses.
2. Summarize and quantify total sunk costs in GPS-based infrastructure (prior years to date) and planned investments going forward.

[9] FCC Proceeding filing 11-109, June 30, 2011.
[10] Final Report of the Technical Working Group, June 30, 2011.
[11] NTIA Letter to FCC, July 6, 2011.

3. To the extent possible, qualify, quantify, and describe risks to your agency's GPS-based mission capability, including "lost benefits" if GPS performance were degraded (or lost) due to LightSquared's signals including the costs to modify (or replace) GPS receiver infrastructure and the time frame required to replace that infrastructure.

As stated previously, comments on the TWG report were due on July 29, 2011, and responses to comments were due on August 15, 2011. At this point, the FCC can rule on whether to approve LightSquared's proposal at any time. While it is possible that the FCC could approve LightSquared's proposal, the Commission has stated that it "will not permit LightSquared to begin commercial service without first resolving the Commission's concerns about potential widespread harmful interference to GPS devices. The FCC International Bureau's Order of January 26, 2011 *(Order)* outlines our interference concerns, and unambiguously conditions LightSquared's commercial operation on first resolving those challenges to our satisfaction. Under no circumstances would I put at risk our nation's national defense or public safety."[12]

## Issues

### Mitigation

While LightSquared announced that their new proposal (which offers to delay the use of the upper band of their spectrum) mitigates interference with 99 percent of GPS receivers, the GPS industry has challenged these claims.[13][14] There would still be interference, however, with high precision users – the primary users of GPS that the Committee is concerned with. Recent statements by LightSquared indicate that the remaining interference can be minimized by the use of filters. Questions remain as to whether this is actually possible, whether such a plan would require additional testing, how much this would cost, who would bear the costs of developing these filters, and who would be responsible for retrofitting impacted receivers.

### Spectrum Use

LightSquared's new proposal also states that they will, "delay incorporating into its terrestrial network the upper 10 MHz of its frequencies in which transmissions may jeopardize legacy GPS usage," but will "work with the FCC, NTIA, and other government agencies to explore all options for using a full complement of terrestrial frequencies."[15] Assuming LightSquared's proposal is allowed by the FCC, it is uncertain whether the FCC will prevent LightSquared from operating in the upper 10 MHz, or if this prohibition will be self imposed. Issues also exist relative to how to determine an acceptable level of interference, who makes this determination, and when this determination can be made.

### Spectrum Encroachment

High precision GPS receivers utilize a technique that receives augmentation signals over a wide swath of Global Navigation Satellite System (GNSS) spectrum in order to achieve sub-

[12] Letter from Chairman Genachowski, FCC, to Senator Grassley, May 31, 2011.
[13] FCC filing, Recommendation of LightSquared LLC, June 30, 2011.
[14] http://www.saveourgps.org/pdf/TWG_Final_Report_2_Page_Summary.pdf
[15] FCC filing, Recommendation of LightSquared LLC, June 30, 2011.

centimeter accuracy.[16] These receivers also "look" across the spectrum allocated to LightSquared. While regulations exist to restrict broadcasts to certain portions of the spectrum, no regulations exist related to receivers. Therefore, LightSquared argues that interference "is not caused by emissions from LightSquared's base stations into the GPS band, but from the failure of these legacy GPS receivers to reject transmissions from LightSquared's licensed frequencies, which are adjacent to the spectrum allocated for use by GPS." Conversely, the GPS industry argues that the LightSquared spectrum was originally planned to be for a Mobile Satellite Service (MSS), which, by design, can coexist with the GPS signal since it is of a similar strength. Furthermore, the GPS industry claims that the out-of-band spectrum that high precision GPS receivers use in LightSquared's spectrum can coexist without interference as long as the signal strength used by LightSquared in its spectrum remains predominately satellite based as originally planned. Although FCC waivers have allowed satellite providers to operate ancillary terrestrial components (ATC) to augment satellite signals, agreements were made to prevent interference with not only other bands, but also interference with a provider's own satellite signal.[17] With LightSquared's proposal to operate a predominately terrestrial network, bundled with a satellite service, adjacent to a low-level GPS signal, these interference issues have now become problematic.

## Witnesses

- Mr. Anthony Russo, Director, National Coordination Office for Positioning, Navigation and Timing
- Ms. Mary Glackin, Deputy Under Secretary, National Oceanic and Atmospheric Administration
- Mr. Victor Sparrow, Director, Spectrum Policy, Space Communications and Navigation, Space Operations Mission Directorate, National Aeronautics and Space Administration
- The Honorable Peter Appel, Administrator, Research and Innovation Technology Administration, Department of Transportation
- Dr. David Applegate, Associate Director, Natural Hazards, U.S. Geological Survey
- Mr. Jeffrey J. Carlisle, Executive Vice President, Regulatory Affairs and Public Policy, LightSquared
- Dr. Scott Pace, Director, Space Policy Institute, George Washington University

[16] FCC Filing SAT-MOD-20101118-00239, Feb 25, 2011.
[17] Letter to the Office of Spectrum Management, NTIA, from Mobile Satellite Ventures L.P. and the U.S. GPS Industry Council, July 25, 2002.

**Appendix 1**

## *GPS Technical Working Group (TWG) Final Report – 6/30/2011 (Excerpts)*

### *2.7.5 Space-based Receivers*

*In NASA's view, the interference to space-based GPS receivers used for [radio occultation (RO)] RO would be severely disruptive to NASA's science missions based on the test and analysis conducted in the TWG. Space-based GPS receivers used for navigation and precise orbit determination would receive a lesser amount of interference, though interference would occur.*

*NASA is of the view that, although the TWG members worked diligently and in good faith throughout the period prescribed by the FCC, it was impossible to adequately evaluate and thoroughly investigate potential interference mitigation options for space-based and high precision science receivers.*

### *3.1 Aviation Sub-Team*

*Compatibility of aviation GPS operations with a single lower 10 MHz channel could not be determined definitively without additional study.*

### *3.4 High Precision, Timing, and Networks Sub-Team*

*1.1 GPS Community Positions*

*5) In the lower 10 MHz channel configuration, 31 of 33 High Precision and Network GPS receivers tested experienced harmful interference within the range of power levels that would be seen inside the network. High precision receivers fielded today would experience harmful interference at up to 5km from a single LightSquared base station.*

*With respect to possible mitigations:*

*4) We believe more study is required on the feasibility of building future wideband High Precision, Network, and Timing receivers and augmentation systems that would be compatible with LightSquared terrestrial signals and which would provide the same performance as today's receivers and systems. We do not foresee any possibility that LightSquared signals near the GPS band could ever be compatible with wideband receivers.*

*6) The viability of proposed future concepts to accommodate high precision GPS and MSS augmentations in the presence of interference from LightSquared terrestrial operations only in the lower 10MHz band has not been tested or validated as part of this study.*

**Appendix 2 - Legislation**

- **HR 2596. Commerce, Justice, Science Appropriations Act**

  **Committee Report 112-169:**

  *Spectrum interference issues.*—The Committee is aware that NTIA and the Federal Communications Commission (FCC) are in the midst of a regulatory process with respect to the Global Positioning System and that a technical working group is reviewing potential interference issues. NTIA is directed to report to the Committee following completion of the technical working group activities, but no later than August 1, 2011, regarding the discoveries of this technical working group and the scientific steps necessary to address any potential interference concerns.

- **HR 2434. Financial Service Appropriations Act**

  **Section 633**
  None of the funds made available in this Act may be used by the Federal Communications Commission to remove the conditions imposed on commercial terrestrial operations in the Order and Authorization adopted by the Commission on January 26, 2011 (DA 11-133), or otherwise permit such operations, until the Commission has resolved concerns of potential widespread harmful interference by such commercial terrestrial operations to commercially available Global Positioning System devices.

  **Committee Report 112-136:**
  The Committee is aware of concerns related to possible interference to Global Positioning System (GPS) devices due to terrestrial broadband service. The Committee remains engaged on this issue and awaits the final report by the Technical Working Group.

- **HR 1540. National Defense Authorization Act, 2012**
  **Committee Report 112-78:**

  The committee is aware that the Federal Communications Commission (FCC) issued a conditional order to a commercial communications company on January 26, 2011, authorizing it to provide broadband voice and data communications services that potentially interfere with GPS. The committee recognizes that the Armed Forces are highly dependent on GPS capabilities and services. The committee believes that any space-based or terrestrial-based commercial communications service that has the potential to interfere with GPS should not receive final authorization to provide service within the United States by the FCC unless and until the potential interference with GPS is resolved. Such commercial services are planned to be transmitted from 40,000 land-based towers across the United States. The committee understands, based on information received from the Air Force, that the signal strength of such service is estimated to be one billion times more powerful than the GPS signal. Though the commercial service would broadcast on a frequency adjacent to GPS, it may still overwhelm GPS receivers, potentially causing a denial of service for millions of users in the United States relying on GPS navigation and

timing services. Such users included the military, emergency responders, maritime and aeronautical emergency communication systems, banking transactions, air traffic and ground transportation systems, and myriad commercial applications. The committee understands that the Deputy Secretary of Defense sent a letter to the Chairman of the Federal Communications Commission on January 12, 2011, highlighting the ''strong potential for interference to . . . critical national security systems,'' and ''strongly recommend[ing] deferral of final action on [the FCC order and authorization] until the proper interference analysis and mitigation studies can be conducted.''

- **HR 2112. Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Act, 2012**

**Committee Report 112-101:**

*GPS Interference.*—The Committee recognizes that the use of the Global Positioning System (GPS) is critical to USDA's mission, including natural resource monitoring, forest firefighting, law enforcement, and research. In addition, precision agriculture would not be possible without GPS. It is estimated that U.S. farmers and ranchers have invested more than $3 billion in GPS technologies.

The Committee is aware of a decision by the Federal Communications Commission that may disrupt the use of GPS, causing significant problems for USDA and our Nation's farmers and ranchers. The Committee directs USDA to ensure the FCC is aware of these concerns and to work with other Federal agencies, such as the Department of Defense and the Department of Transportation, to address them.

## Appendix 3 - International Perspective

### European Commission

On July 19, 2011, the head of the European Commission's Directorate General for Enterprise and Industry, Heinz Zourek, the agency that oversees all operations of the Galileo program, has filed an official comment with the FCC regarding the proposed LightSquared network. The Commission expressed grave concern over interference with GPS and the future European Galileo satellite navigation system. The filing states:

> *"I am writing to express our deep concerns about the LightSquared system that is proposed for operation in frequencies immediately below the radionavigation-satellite service (RNSS) allocation at 1559-161OMHz. This band is the core band used by global satellite navigation systems including GPS and you are no doubt aware that Europe is at the advanced planning stage for its own system, Galileo, which will be operational by 2014/15, and that will also use this RNSS allocation. The LightSquared proposal for a terrestrial network deployment in MSS spectrum would completely change the nature of radio transmissions in the band."*

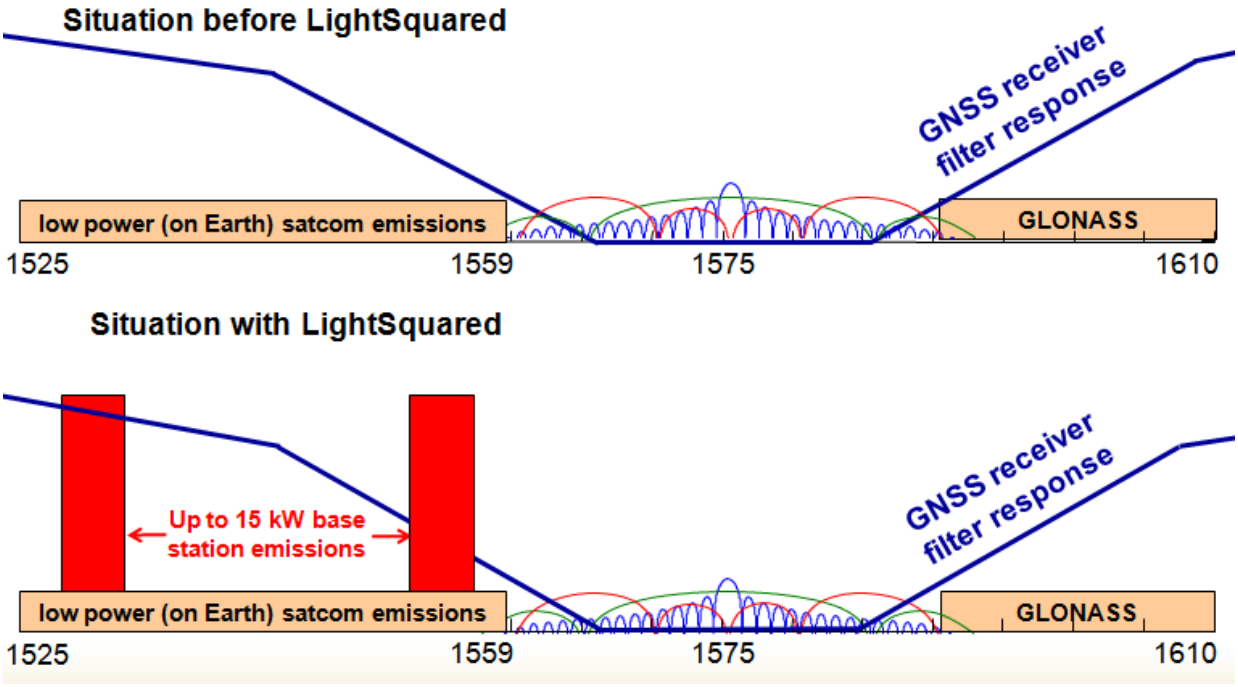
### EUMETSAT

The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) is an intergovernmental organization to establish, maintain and exploit European systems of operational meteorological satellites**.**

On July 26, 2011, EUMETSAT filed a comment with the FCC in response to the LightSquared proposal. The filing stated:

> *"In reviewing the results and conclusions of the Technical Working Group Report regarding space-based GPS receivers in section 3.5 of the report, EUMETSAT shares the concerns expressed by NASA, that interference to space-based GPS receivers used for Radio Occultation (RO) would be severely disruptive also to the GRAS instrument on Metop."*
>
> *"Furthermore, the initial assessment of interference mitigation options have shown that even a restriction of the LightSquared operations to the lower 10 MHz channel would not mitigate the amount of interference to an acceptable level. Thus, EUMETSAT supports the view of NASA that the only mitigation technique which would resolve interference to space-based GPS receivers used for Radio Occultation is to relocate high power terrestrial operations to a different frequency band."*

## Appendix 4 - Illustration of Concerns with LightSquared




**Source: Chris Hegarty, MITRE (Mar 2, 2011)**