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GPS RELIABILITY: A REVIEW OF AVIATION INDUSTRY PERFORMANCE, SAFETY ISSUES, AND AVOIDING POTENTIAL NEW AND COSTLY GOVERNMENT BURDENS

(112–38)

JOINT HEARING

BEFORE THE

SUBCOMMITTEE ON
AVIATION

AND THE

SUBCOMMITTEE ON
COAST GUARD AND MARITIME TRANSPORTATION

OF THE

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TRANSPORTATION AND
INFRASTRUCTURE
HOUSE OF REPRESENTATIVES

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Washington, DC 20515

June 20, 2011

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MEMORANDUM

TO: Members, Subcommittee on Aviation
Members, Subcommittee on Coast Guard and Maritime Transportation

FROM: The Honorable Thomas E. Petri, Chairman, Subcommittee on Aviation
The Honorable Frank LoBiondo, Chairman, Subcommittee on Coast Guard and Maritime Transportation

SUBJECT: Joint Hearing on GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens, Thursday, June 23, 2011, at 9 a.m. in room 2167 Rayburn House Office Building.

PURPOSE

The Subcommittees on Aviation and the Coast Guard and Maritime Transportation will receive testimony from Federal government and industry witnesses regarding LightSquared's mobile broadband internet infrastructure plans and concerns with Global Positioning System (GPS) interference associated with those plans; the possible impacts on GPS reliability, NextGen, and aviation job creation; and the potential remedies to GPS interference.

BACKGROUND

GPS and LightSquared: Spectrum Neighbors

The Global Positioning System (GPS) is a space-based navigation system that provides position and timing information at any place on the globe with a high degree of accuracy. First developed by the military during the Cold War, President Ronald Reagan declared that GPS would be also made available for civilian use after Korean Air Lines flight 007 was shot down in 1983 for straying into Soviet airspace due to imprecise navigation.[1] All 269 people aboard the aircraft were killed, including then-sitting U.S. Congressman Lawrence McDonald. Subject to

[1] The Washington Post: "Now we know where we stand, and it's about time", Curt Suplee, November 3, 2009.

President Reagan's order, the Department of Defense (DoD) began to repurpose GPS for civilian use. GPS was made available for civilian use at its intended accuracy level, free of charge by Presidential Decision Directive NSTC-6 in 1996.[2] Since then, GPS has evolved into an important part of everyday life as new capabilities have developed. GPS functionality can be found in just about everything with an "on-off" switch, including cell phones, cars, Automated Teller Machines (ATM), farming equipment, and of course, aviation and maritime surveillance and navigation equipment.

The use of GPS in the aviation and maritime communities results in critical safety and efficiency benefits by providing highly reliable, more accurate position information compared to the legacy surveillance systems. In aviation, GPS will soon replace radar as the primary surveillance method and the Department of Transportation (DOT), the Federal Aviation Administration (FAA), and the United States Coast Guard (USCG) already utilize GPS technology in a broad variety of surveillance, navigation, safety, and efficiency applications.[3]

Billions of dollars of Federal and private-sector investment and millions of U.S. jobs are at stake in the future of GPS infrastructure. According to press accounts, the DoD investments into GPS have topped $35 billion since its introduction and continue at roughly $1 billion annually.[4] In addition, the FAA has invested $3.1 billion in GPS to date. FAA investments include:

- $1.7 billion in the Wide-Area Augmentation System, which will enhance the accuracy of GPS and permit aircraft to perform precision approaches in poor-visibility conditions;
- $1.1 billion in automatic dependent surveillance-broadcast (ADS-B), a GPS-based system for air traffic control that will ultimately replace controllers' use of radar to track aircraft in flight;
- $100 million in the implementation of performance-based navigation procedures, which allow aircraft to fly fuel-efficient routes and flight profiles, saving time, expense, and greenhouse gas emissions; and
- $200 million in the Ground-Based Augmentation System, which allows for more precise navigation after takeoff and on approach.

Additionally, the FAA's Capital Investment Plan calls for $2.2 billion of further investment in GPS-related NextGen systems until fiscal year 2013.[5] The FAA estimates by 2013, up to $10 billion of public and private sector investments will have been made in GPS. According to the FAA, over 360,000 civil aircraft are currently equipped with GPS-enabled avionics.[6] According to a recent study, the GPS industry supports over 3.3 million U.S. jobs annually. The direct

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[2] Presidential Decision Directive NSTC-6, The White House, March 28, 1996.
[3] GAO Report: Global Positioning System: Challenges in Sustaining and Upgrading Capabilities Persist, September 2010 (GAO-10-636).
[4] "LightSquared Plans Hinge on Outcome of GPS Interference Debate" by Peter B. de Selding, Space News International, March 4, 2011.
[5] Fed. Aviation Admin., *National Airspace System Capital Investment Plan, FY 2012-2016* (May 2011), *available at* http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/operations/sysengsaf/cip/files/FY12-16/FY12-16_CIP_Complete_May_2011.pdf.
[6] This figure includes 5,800 Passenger, Cargo, and Regional carriers, 2,800 International carriers, and 352,000 General Aviation and Air Taxi operators.

economic benefits of GPS technologies on commercial GPS users are estimated to be over $67.6 billion per year in the U.S.[7]

The Federal Communications Commission (FCC) is the independent federal agency, subject to Congressional oversight, with the responsibility to regulate interstate and international communications by radio, television, wire, satellite and cable. The FCC also oversees the allocation and use of telecommunications spectrum for government and private sector users. Radio spectrum is divided into bands with specific end points to each dedicated or allocated use. The common unit of measure on the radio spectrum is mega-hertz (MHz). GPS is one of many uses of radio spectrum, and its allocation is from 1560-1610 MHz. The FCC is led by Chairman Julius Genachowski, appointed by President Obama and sworn into office in June 2009.[8]

LightSquared

LightSquared Subsidiary LLC[9] (LightSquared) stated goal is to deliver more mobile broadband internet capacity. However, the location of the spectrum allocated to LightSquared by the FCC, and the resulting potential for disruption of GPS receivers, has stirred controversy among the GPS industry.

LightSquared plans to provide a wholesale, nationwide 4th-Generation ("4G") wireless broadband network integrated with satellite coverage. According to LightSquared representatives, the company has raised approximately $4 billion from capital investments, of which it has already spent $3 billion. LightSquared plans to invest a total of $14 billion over the next eight years to build out the network that it hopes to complete over the next five years. LightSquared executives expect to generate 15,000 jobs per year for each of the five years.[10] By contrast, the aviation industry accounts for approximately $1.2 trillion in annual economic impact, and contributes 11 million jobs to the U.S. economy.

LightSquared's network would be the first wholesale wireless 4G network. The company plans to sell services (i.e., access to its network) to retail companies that will provide services directly to consumers.

LightSquared intends to combine existing mobile satellite service (MSS)[11] with a ground-based wireless communications network of approximately 40,000 base stations that use the same "L-Band" radio spectrum as the satellites. Specifically, LightSquared is authorized by the Federal Communications Commission (FCC) as a MSS in the 1525-1559 MHz downlink band

[7] "The Economic Benefits of Commercial GPS Use in the U.S. and the Costs of Potential Disruption" by ndp consulting. Author is Nam D. Pham, Ph.D. June 2011. According to the report, 3.3 million jobs rely on GPS technology. 130,000 in GPS manufacturing and 3.2 million in downstream commercial GPS intensive industries.
[8] www.fcc.gov
[9] LightSquared's predecessors include SkyTerra Communications, Mobile Satellite Ventures, Motient Services Inc. and the American Mobile Satellite Company.
[10] http://www.lightsquared.com/about-us/
[11] MSS is a radio communication service: (1) between mobile earth stations and one or more space stations, or between space stations used by this service; or (2) between mobile earth stations by means of one or more space stations. 47 C.F.R. § 2.1(c) (2011).

and 1626.5-1660.5 MHz uplink bands.[12] On Chart 1 (below), you can see that GPS's spectrum allocation between 1560-1610 MHz is immediately adjacent to LightSquared's downlink band.

It is worth noting that L-Band frequency has been historically reserved for low power communications between satellites and mobile earth stations.[13] According to the DoD, the frequency band 1525-1559 MHz was originally allocated exclusively for MSS Space-to-Earth signals (for example: Inmarsat and Iridium) and terrestrial systems were not permitted. Beginning in 2003, the FCC authorized terrestrial transmissions in the MSS band as Ancillary Terrestrial Component (ATC) transmissions, which were intended to fill in gaps in the coverage of satellite signals. The initial FCC MSS ATC service rules were designed to ensure that terrestrial parts of the networks remained truly ancillary and as mitigation for potential interference to other systems such as Inmarsat and GPS.[14]

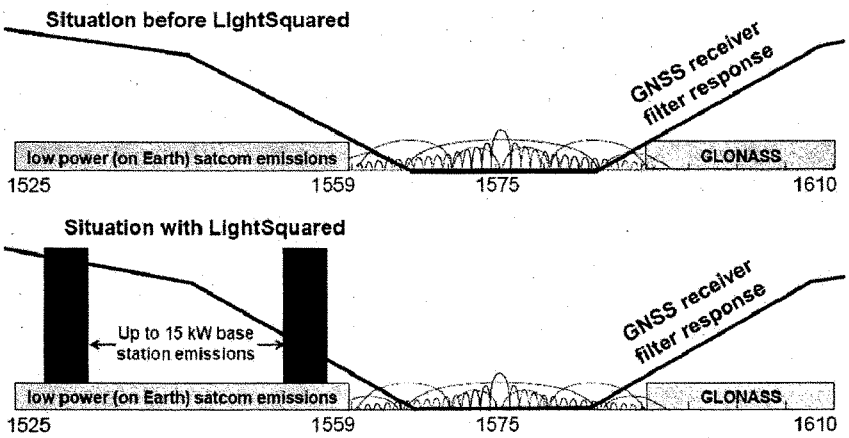

Chart 1: Illustration of Spectrum
Source: Position, Navigation, and Timing National Coordination Office (PNT NCO).

The possibility that LightSquared's ground-based transmissions may overpower the relatively weak GPS signal from space concerns the aviation and maritime users in the GPS community. Although LightSquared will operate in its own radio band, that band is so close to the GPS signals that many GPS devices could pick up the stronger LightSquared signal and become overloaded or jammed. Some are also concerned that the FCC may approve a technical solution to the problem that requires millions of existing GPS users to upgrade or replace their devices.

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[12] In 1989, the initial L-Band license was authorized to American Mobile Satellite Company and is currently held by LightSquared.
[13] "L-Band" broadly refers to the frequency range from one to two gigahertz, a portion of which is allocated for MSS operations. Specifically, 1525-1559 MHz is domestically and internationally allocated for transmission from satellites to mobile earth stations and 1610-1660.5 MHz for transmission from mobile earth stations to satellites.
[14] GPS Interference Information Paper, Office of the Secretary of Defense, March 11, 2011.

FCC AUTHORIZATIONS OF INTEGRATED SATELLITE-TERRESTRIAL BROADBAND

LightSquared's proposed 40,000 ground-based stations collectively form the ancillary terrestrial component (ATC) of its satellite network. As the ground-based component of a satellite broadband network, the ATC must ordinarily remain strictly supplemental – or ancillary – to the satellite-based MSS, under an FCC rule known as the integrated service rule.[15] In other words, the ground-based component should exist merely to fill in gaps in satellite coverage – not as the primary means of wireless broadband access for individual consumers. In authorizing integrated MSS/ATC services, the FCC has proceeded with the expectation that "MSS/ATC operators will only install ATC base stations in areas where the satellite signal is substantially affected. This would include where there is blocking or where consumers demand more communications paths than the satellite can provide. These are the precise situations for which [the FCC] authorized ATC."[16] LightSquared's authority to deploy a nationwide network of powerful ground-based stations transmitting in an area of the spectrum reserved for satellite communication evolved over a series of FCC orders.

2003 FCC Order

By order in 2003, the FCC first adopted rules providing for the deployment of integrated satellite and ground-based wireless broadband networks.[17] The FCC emphasized, in the order, the strictly ancillary nature of the ground-based component: "We do not intend, nor will we permit, the terrestrial component to become a stand-alone service. . . . As we have repeatedly indicated, we intend to authorize ATC only as an ancillary service to the provision of the principal service, MSS."[18]

At the time, the FCC recognized, on the basis of comments submitted by GPS stakeholders, that integrated satellite and ground-based networks would likely cause interference with aeronautical and other uses of GPS. The aviation and maritime policy concerns at issue in this hearing revolve around the likelihood that ground-based transmissions from LightSquared's terrestrial component will cause potentially irremediable interference with GPS receivers (the devices in aircraft and on marine vessels, among others, that receive and interpret relatively weak signals from GPS satellites). However, the majority of comments submitted to the FCC in the proceeding that culminated in the 2003 order tended to focus on a different technical issue: the effects of so-called out-of-band emissions (OOBE – i.e., emissions of radio signals that bleed into the frequencies used by GPS) that would emanate from the point of transmission.[19] In fact, at the time, LightSquared's predecessor company had already agreed to observe limitations on OOBE that were more stringent than existing limitations imposed by the FCC, which the predecessor company believed would mitigate the issue.[20]

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[15] 47 C.F.R. § 25.149(b)(4) (2011).

[16] *See In re 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 Bands,* 20 FCC Rcd 4616, 4626 (F.C.C. 2005) (*Flexibility Order II*).

[17] *In re 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 Bands; Review of the Spectrum Sharing Plan Among Non-Geostationary Satellite Orbit Mobile Satellite Service Systems in the 1.6/2.4 GHz* Bands, 18 FCC Rcd 1962 (F.C.C. 2003) (*Flexibility Order I*).

[18] *Id.* at 1965-66.

[19] *Id.* at 1965-66, 2028. (emphasis added)

[20] *See Amendment of Parts 2 and 25 to Implement the Global Mobile Personal Communications by Satellite (GMPCS) Memorandum of Understanding and Arrangements, Report and Order and Further Notice of Proposed Rulemaking,* 17 FCC Rcd 8903, 8936 (F.C.C. 2002) (establishing limitations on OOBE in general); *Flexibility*

2005 FCC Order

On multiple parties' petitions for reconsideration of the 2003 order, the FCC in 2005 issued a second order refining some of the technical requirements for deployment of integrated networks. The FCC outright eliminated a limit on the number of allowable terrestrial base stations that could be constructed as part of the ground-based component (the 2003 order imposed a restriction that would have effectively limited the number of LightSquared ATC base stations to 10,000 nationwide),[21] and it increased the permissible power level of ATC base stations,[22] thereby allowing companies such as LightSquared to deploy an unlimited number of ground base stations at higher power levels than previously permitted.

At the same time, the Commission declined to further address GPS interference, allowing that future rulemaking, if necessary, could "produce a more complete record upon which to establish final GPS protection limits for MSS ATC licensees."[23] Moreover, the Commission observed that it does not regulate GPS receivers and declined to premise an MSS licensure decision on the potential for interference with receivers.[24]

2011 Order

In 2010, LightSquared began to move forward with deployment of a ground-based component to supplement its existing MSS.[25] LightSquared sought in 2010, and received in 2011, a conditional waiver of the integrated service rule upon revealing that many of the end users of its network would be individual consumers who would use only the ground-based component, instead of the satellite and terrestrial services together, as required by the rule.[26] In other words, despite the supposedly "ancillary" nature of LightSquared's ground infrastructure, most of its retail customers would likely provide services to consumers who would utilize only the terrestrial portion of the network. The GPS industry has expressed concern that LightSquared's network, with transmissions in a band of frequencies reserved for satellite communications, will be used primarily for ground-based wireless access.

On January 26, 2011, the FCC conditioned a grant of LightSquared's waiver request on mitigation of GPS interference, which by then was known to include receiver-jamming, and directed a technical working group comprised of government and industry experts to submit periodic reports and recommendations. The group's final report was originally due on June 15, 2011, but the FCC, on LightSquared's motion, granted a two-week extension. The FCC is expected to solicit public comments before making a final decision on LightSquared's application for a waiver.

Order II, at 4641 (recounting LightSquared predecessor's voluntary agreement to observe more stringent OOBE limitations).

[21] *Flexibility Order II* at 4634; Flexibility Order I at 2037-38.

[22] *Flexibility Order II* at 4635-36.

[23] *Id.* at 4636.

[24] *Id.*

[25] *See In re SkyTerra Comms., Inc.*, 25 FCC Rcd 3059, 3089 (F.C.C. 2010).

[26] *See In re LightSquared Subsidiary LLC Request for Modification of its Authority for an Ancillary Terrestrial Component,* 26 FCC Rcd 566 (F.C.C. Jan. 26, 2011).

FCC final approval of the waiver would provide a more lucrative business model for LightSquared, in that its retail customers would have added flexibility to provide terrestrial-only service to consumers. Nevertheless, LightSquared has indicated that, regardless of the FCC's final decision on the waiver application, it is prepared to move forward with integrated MSS/ATC deployment.

Without the waiver, consumers would have to subscribe to integrated satellite and terrestrial wireless services, but interference with GPS receivers would occur regardless of whether end users subscribe to ground-only or to integrated satellite and ground components. So while the 2011 waiver has served to immediately galvanize and focus the attention of the GPS community on this issue, many in the GPS community also cite the earlier 2003 and 2005 orders originally authorizing LightSquared to deploy a terrestrial network in the L-Band as problematic and charge that the issue of GPS interference was never fully vetted. Many in the GPS community have expressed concern that the FCC's conditional waiver, coupled with its prior orders, effectively provides a backdoor for powerful terrestrial broadband services to be provided in a lower power portion of the spectrum reserved for satellite communications.

Interference Testing Results

A. The LightSquared Technical Working Group Report

Pursuant to the FCC's January 26, 2011, Order and Authorization, LightSquared conducted a series of tests in April 2011, in coordination with the GPS industry and government stakeholders, to evaluate the potential for GPS interference.

On June 15, 2011, the deadline for LightSquared to issue its Working Group report, LightSquared filed a request to the FCC for a two-week extension. GPS industry members of the Working Group expressed their opposition to the extension of the deadline, saying that the lion's share of data and analysis needed for the report has been completed and was ready for filing on time.[27] Nevertheless, the FCC granted LightSquared's request on the same day, setting a new deadline for LightSquared's report on interference and mitigation strategies of July 1, 2011.[28]

B. The RTCA, Inc. Report

Parallel to the Working Group established by LightSquared, the RTCA, Inc., a non-profit Federal Advisory Committee, conducted an independent evaluation of interference issues at the request of the Federal Aviation Administration (FAA). The RTCA report, submitted to the FAA on June 3, 2011, focused solely on aviation-related GPS impacts, details significant concerns with the LightSquared authorization.

According to the RTCA, the impact of LightSquared's proposed use of the upper channel of the LightSquared authorization "is expected to be complete loss of GPS receiver function." While the results of the study indicate that it could be possible to use the lowest 5 MHz wide

[27] Comments of the U.S. GPS Industry Council, June 15, 2011, FCC Docket number SAT-MOD-20101118-00239.
[28] FCC Decision: Grant Extension of Time, June 15, 2011, FCC Docket number SAT-MOD-20101118-00239.

channel without significant interference, the RTCA recommends that "from an aviation perspective, LightSquared upper channel operation should not be allowed."[29]

U.S. Government Concerns

A. GPS Reliability Issues Faced by the Department of Transportation (DOT):

Much of navigation and operation of transportation systems today are dependent on GPS. In the aviation sector, GPS also provides more accurate position information than legacy surveillance systems (including radar). With the higher degree of accuracy and precision offered by GPS for aeronautical surveillance and navigation, the safety of the national airspace system has been greatly improved. In addition, GPS usage within the aviation industry is widespread. According to the FAA, over 360,000 civil aircraft are currently equipped with GPS-enabled avionics.[30]

In its joint letter with the DoD, the DOT expressed concerns about how interference testing would be carried out by the Working Group, and how current and future LightSquared business plans might affect aviation safety and airspace modernization.[31] The Committee believes that the safety of flight concerns associated with GPS interference are paramount.

In addition to concerns regarding the effect of GPS reliability and interference on current operations, the DOT must also weigh potential negative impacts on the Department's NextGen program. For the past several years, the FAA has been implementing the DOT's planned modernization of the national airspace system, known as NextGen. The FAA's plans for NextGen include a transition from radar-based aircraft surveillance and management to a satellite-based system to achieve both safety and efficiency benefits. Billions of taxpayer and industry dollars have already been invested in the NextGen program. A chief concern at the DOT is that GPS interference problems might cause delays in much-needed NextGen benefits, or jeopardize the NextGen effort altogether.[32]

According to airline industry estimates, the U.S. airline industry has lost 160,000 jobs over the last ten years. Implementation of NextGen would create nearly the same amount of jobs nationwide over the next four years. If U.S. airlines were required to install filters and or replace GPS receivers on approximately 7,000 commercial aircraft to accommodate the LightSquared network, NextGen implementation would be delayed by up to ten years, thereby prohibiting this job growth.

The United States is also a signatory member of the United Nations' International Civil Aviation Organization (ICAO), an important institution to ensure international harmonization in aviation standards and regulations. The President and Secretary General of ICAO cosigned a letter to the FCC Chairman expressing concerns about the potential impact of GPS interference

[29] Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations, RTCA, Inc, June 3, 2011.
[30] This figure includes 5,800 Passenger, Cargo, and Regional carriers, 2,800 International carriers, and 352,000 General Aviation and Air Taxi operators.
[31] Deputy Secretary of Transportation John D. Porcari and Deputy Secretary of Defense William J. Lynn, III letter to FCC Julius Genachowski, March 25, 2011.
[32] According to the FAA, NextGen Programs at risk include ADS-B, RNP/RNAV, WAAS, LAAS, Cockpit Display of Traffic Information (CDTI), and Ground-Based Augmentation System (GBAS).

to current aviation operations, as well as modernization efforts underway in the United States and Europe.[33]

B. GPS Reliability Issues Faced by the United States Coast Guard and Maritime Industry:

Impact on Maritime Transportation

As with aviation, users of the marine transportation system are highly dependent on GPS. The vast majority of the 12 million recreational vessels, 30,000 fishing vessels, 40,000 commercial vessels, and 9,260 foreign vessels that call on U.S. ports rely on at least one, if not several GPS based systems for navigation, collision avoidance, and safety of life at sea.

The United States Coast Guard relies heavily on GPS data to successfully conduct its operations. The Coast Guard uses GPS technologies as the primary means of safely navigating its aircraft, cutters and small boats. In addition, the Service maintains several GPS dependent technologies which are essential to successfully conducting its search and rescue, environmental stewardship, drug and migrant interdiction, ice breaking, aids-to-navigation, ports and waterways security, and other missions.

During tests of the LightSquared signal, the Coast Guard has observed varying levels of interference with GPS signals. Depending on signal strength, frequency, distance, and terrain, the Service observed that the LightSquared signal could impact the following GPS dependent technologies:

1. *Automatic Identification System (AIS):* AIS is a very-high-frequency (VHF) line-of-sight system required by federal law and international standards to be carried on most commercial vessels. It enables the Coast Guard to track the movement of the vessels and helps the vessels themselves avoid collisions. It is dependent on position and timing information received by GPS satellites

2. *Differential GPS (DGPS):* DGPS augments the GPS system used by the Coast Guard and vessel operators to more precisely ascertain position using GPS receivers. Most recreational boaters rely on the signal provided from this system to hand held GPS devices to safely navigate. The Coast Guard uses the system for many of its operations including the setting of aids-to-navigation.

3. *Rescue21:* Rescue 21 is the Coast Guard's primary maritime distress system. It allows the Service to focus search and rescue efforts by determining a vessel's location based on a distress call over the radio. The system utilizes Digital Selective Calling to receive GPS position transmissions from vessels in distress. As such, it is dependent on both position and timing information received from GPS satellites.

4. *Search and Rescue Satellite-Aided Tracking (SARSAT):* SARSAT is a system of satellites that transmit distress calls and GPS position data from devices such as Emergency Position Indicating Radio Beacons (EPRIB) to the Coast Guard and other first responders. Most commercial vessels are required to carry EPIRBs under federal law.

[33] ICAO President and Secretary General letter to FCC Chairman Julius Genachowski, June 13, 2011.

5. *Vessel Management System (VMS):* VMS is as satellite-based system used to track commercial fishing vessels and ensure their compliance with restrictions on fishing locations. It relies on GPS for position and timing information to guide enforcement actions.

6. *Electronic Navigation Systems:* Federal law and international standards require all large commercial vessels to be equipped with electronic navigation systems. These vessels, as well as smaller commercial vessels and a sizeable portion of recreational vessels navigate solely using an electronic navigation system. These systems typically include an electronic charting system coupled with a GPS feed that shows the vessel's location on the chart, the direction of its motion, and its speed. While the charting function will still work without GPS, there would often be no way for a vessel to determine its position.

Back-Up System

Long Range Aids-to-Navigation (LORAN) was a VHF based position and timing system operated by the Coast Guard. It served as the primary means of electronic navigation for vessels and some aircraft from WWII until the advent of GPS, at which time it continued to operate as a back-up system. The FY 2010 Department of Homeland Security Appropriations Act (P.L. 111-83) gave the Coast Guard the authority to terminate the transmission of LORAN signals upon certification by the Commandant that termination of the signal would not adversely affect maritime safety and certification by the Secretary that LORAN infrastructure was not needed to house another system to act as a back-up to GPS. Those certifications were made and the signal was terminated on February 8, 2010. The Coast Guard has since begun to dismantle the system.

With the termination of the LORAN signal, DHS initiated a study to determine whether a back-up system is needed for GPS. Section 219 of the Coast Guard Authorization Act of 2010 (P.L. 111-281) required the Department to complete its determination as to whether a back-up system is needed by April 10th, 2011. The determination has still not been made, and at present, the Coast Guard and users of the marine transportation system remain reliant exclusively on GPS for geospatial data critical to navigation safety. Given the absence of a back-up system for maritime safety, GPS interference concerns posed by the LightSquared proposal are of particular concern to the Committee.

C. GPS Reliability Issues Faced by the DoD:

As the custodian of the GPS services, the DoD's primary concern is the continued availability and reliability of the GPS signal to Federal, commercial, and personal users. Specifically, the DoD is concerned the ground-based system will transmit a high-powered signal that will prevent GPS receivers from successfully receiving the GPS signal. According to the DoD, the increased signal via the ground network traffic for commercial mobile voice and Internet service will effectively appear like a GPS jammer and potentially degrade accuracy or cause a GPS receiver to completely lose lock. Potential harmful interference to GPS receivers from LightSquared could come in many forms, for example: Loss of Service due to GPS receiver

front end saturation due to insufficient filtering of ATC signals, or Loss of Accuracy as a result of loss of GPS signals.[34]

The Department's concerns apply to both civil and military receivers. DoD has also cited concerns with the FCC allocation processes and intergovernmental dispute resolution process.

Moving Forward: Potential Mitigation Strategies

Given the multiple government and industry reports of GPS interference issues posed by the LightSquared network proposal, LightSquared and GPS industry stakeholders have begun to discuss potential mitigation options to allow LightSquared to proceed with the roll-out of a mobile broadband network. Mitigation strategies being discussed include:

A. Filters

The disruptive interference posed to the GPS community results from high-powered transmissions within the range of spectrum that GPS receivers detect. In concept, a filter could prevent the interference by allowing the GPS receiver to only detect the GPS information, and filter out the high-powered neighboring signal.

Critics of this approach, however point to three major challenges. First, such filters have not been certified for use in aviation, and the standards-writing and certification process could take anywhere from ten to fifteen years to complete. Avionics manufacturers have also questioned the feasibility of designing such a filter. Second, adding new filtering equipment to aircraft would be expensive. The International Air Transport Association initial estimate put the potential cost to be between $2 billion and $7 billion for civil aviation alone. Costs would include the cost of the equipment coupled with associated labor and out of service costs. It is unclear who would be responsible for bearing the cost burdens associated with installing new filters. For government GPS retrofits, that cost would likely be borne by taxpayers. Were the FCC to allow LightSquared to proceed with this option, the new government burden falling on the fragile aviation industry could threaten job creation in the aviation industry. Finally, it is possible that filters could harm the fidelity of the position information or the ability to quickly lock onto satellite signals, thus limiting receivers' intended usefulness.

B. Limiting the Use of LightSquared's Allocated Spectrum

LightSquared's current plan calls for use of four channels of spectrum, each 10 MHz wide. Two of these channels would be used for uplink to satellites, and the other two channels would be used for downlink from the satellites. The two channels for proposed use in uplink currently do not pose any interference problems.

RTCA testing indicates that the two 10 MHz downlink channels within the satellite-purposed L Band of the spectrum, if used to the full terms of the FCC's January 26, 2011 conditional waiver authorization, would pose interference problems with GPS. Specifically, the higher of the two 10 MHz downlink channels is incompatible for use alongside GPS.

[34] GPS Interference Information Paper, Office of the Secretary of Defense, March 11, 2011.

However, according to the RTCA report, testing suggests that if LightSquared uses only a 5 MHz channel of its allocated spectrum that is furthest away from the GPS band, there would likely be no interference issues with aviation GPS receivers.[35] If LightSquared were to agree to such a limitation, they would be agreeing to only use roughly a quarter of their planned capacity. Further, while technical issues with GPS avionics receivers would likely be solved, other GPS functions (precision agriculture, architectural and construction surveying equipment, etc.) could still suffer interference.

C. Relocation of LightSquared Spectrum

The source of the interference problems posed by the LightSquared plan is the proximity of the spectrum allocated by the FCC for LightSquared's use to the spectrum that has long been allocated for use by GPS. A potential solution might be to relocate part of LightSquared's spectrum to another band. While demand for radio spectrum is high, a possible solution would be to swap spectrum allocations with a more GPS compatible spectrum holder. The FCC would have to oversee any such allocation swap.

Since LightSquared has not yet submitted the Working Group Report, there may be other mitigation strategies to be further explored.

[35] Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations, RTCA, Inc, June 3, 2011.

Witnesses:

Panel I

The Honorable Roy Kienitz
Under Secretary for Policy
U.S. Department of Transportation

The Honorable Teri Takai
Acting Assistant Secretary for Networks and Information Integration
Chief Information Officer
U.S. Department of Defense

Rear Admiral Robert E. Day, Jr.
Assistant Commandant for Command, Control, Communications, Computers & Information Technology & Chief Information Officer
United States Coast Guard
U.S. Department of Homeland Security

Panel II

Ms. Margaret Jenny
President
RTCA, Inc.

Mr. Phil Straub
Vice President Aviation Engineering
Garmin International Inc.

Mr. Craig Fuller
President
Aircraft Owners and Pilots Association

Mr. Thomas L. Hendricks
Senior Vice President of Safety, Security and Operations
Air Transport Association

Mr. Jeffrey J. Carlisle
Executive Vice President, Regulatory Affairs and Public Policy
LightSquared

GPS RELIABILITY: A REVIEW OF AVIATION INDUSTRY PERFORMANCE, SAFETY ISSUES, AND AVOIDING POTENTIAL NEW AND COSTLY GOVERNMENT BURDENS

THURSDAY, JUNE 23, 2011

HOUSE OF REPRESENTATIVES, SUBCOMMITTEE ON AVIATION, JOINT WITH THE SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION, COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE,

Washington, DC.

The subcommittees met, pursuant to notice, at 9:00 a.m. in room 2167, Rayburn House Office Building, Hon. Thomas E. Petri (Chairman of the Subcommittee on Aviation) presiding.

Mr. PETRI. The subcommittee will come to order. We will be joined as we get into the proceedings by the chairman of the Coast Guard Subcommittee, but he is detained at another meeting.

Today we will explore LightSquared's plan to build out terrestrial broadband Internet service, and its potential impacts on GPS users, safety, and NextGen.

Safety is the top priority of the Aviation Subcommittee. Sadly, advancements in aviation safety have often come only after fatal accidents.

Over the years, the FAA has shifted to a risk based data driven safety system in order to act proactively and to prevent the loss of life.

The subcommittee supports this proactive effort to identify and address safety issues before there is an accident.

When a potential safety issue is brought to our attention, we must seek information and work with the community and the FAA to ensure the risk is properly addressed.

The Global Positioning System, or GPS, serves a critical role in aviation safety and airspace modernization known as NextGen.

Aviation infrastructure and efforts to update it with the Department of Transportation's NextGen program are a platform for growth in the U.S. economy and a key driver of economic activity. NextGen is also a key component for job creation within the aviation industry.

It is important that the Government does nothing to limit NextGen's efforts, both in terms of impacting job creation and undermining or delaying important advancements in air traffic management.

New burdens on the aviation industry as a result of FCC approval would likely stifle NextGen efforts, and the resulting eco-

nomic growth and job creation. As such, new and costly burdens on aviation users are simply unacceptable.

Due to various concerns raised by GPS users, the LightSquared proposal we are considering at today's hearing has been the subject of Government and industry expert field testing and review.

Analysis conducted by two independent technical teams show significant GPS interference would result if LightSquared were to roll out its terrestrial network as originally planned.

In fact, the Government team, the National Space-Based PNT Systems Engineering Forum or NPEF, recommended that the FCC rescind the waiver which allows LightSquared to proceed in its plans to offer service in the spectrum neighboring GPS.

The Government team further recommended that the FCC readdress the effects of the FCC's authorization for LightSquared service in the neighboring spectrum.

The team said, "At the conclusion of this NPEF effort, significant concerns remain that operation of an ancillary terrestrial component integrated service as originally envisioned by the FCC cannot successfully coexist with GPS."

In the face of these results, LightSquared announced on Monday, June 20, that they would revise their roll out plans to address GPS interference concerns.

However, that revised plan has not been subject to a full evaluation.

The RTCA, which is represented on our second panel of witnesses, also conducted testing of potential GPS interference.

The RTCA's initial testing reportedly showed a smaller portion of LightSquared's spectrum allocation than they are currently contemplating for use would be suitable for assuredly safe operation.

I would like to hear the full details of LightSquared's revised plan today, so that the subcommittees and appropriate GPS, Government and industry experts can evaluate the technical aspects of the plan.

I spoke a month ago about the importance of GPS for both the safety and efficiency of the national airspace system, as well as the importance of the national airspace system as a platform for growth in these United States.

Based on the testimony provided to date to the subcommittee regarding the potential negative impact of LightSquared's presence within the L-Band spectrum neighboring GPS, and based on the importance of GPS, the subcommittee may request the FCC allow time for full comprehensive testing of the plans announced on Monday for potential harmful interference impacts.

To be fair, LightSquared's goal of providing more broadband Internet capacity is an additional platform for commerce, but it must not interfere with aviation safety, job creation, or NextGen.

In aviation, there is no room for error.

The impact of LightSquared's revised plans should be independently and thoroughly tested to ensure the FCC does not approve plans that would introduce unacceptable risks into the aviation system or leave the aviation GPS users with new and costly burdens.

Finally, before I recognize Mr. Costello and the chair and ranking member of the Coast Guard Subcommittee for their opening

statements, I ask unanimous consent that all Members have 5 legislative days to revise and extend their remarks, including extraneous material for the record of this hearing.

Without objection, it is so ordered.

I recognize Mr. Costello for any opening remarks he chooses to make.

Mr. COSTELLO. Mr. Chairman, thank you. I thank you and Chairman LoBiondo for calling this hearing this morning.

In the interest of time, I have an opening statement that I will submit for the record. I will also ask unanimous consent to insert Mr. Larsen's statement in the record as well.

Mr. Chairman, I look forward to hearing the testimony of our witnesses today, and just would note that any solution, any technical solution, that we arrive at to address this issue will have to have the input and agreement of the aviation community.

With that, Mr. Chairman, I yield back the balance of my time.

Mr. PETRI. I ask unanimous consent to incorporate statements by Mr. Costello and Mr. Larsen into the record.

We will begin with the first panel. To accommodate the witnesses' schedules, we have moved this up to a little earlier than normal congressional time, although working at 9:00, nothing is bad with that.

The first panel consists of The Honorable Roy Kienitz, who is a well known figure to those of us in transportation. He is the Under Secretary for Policy for the Department of Transportation.

Teri Takai, who is the Acting Assistant Secretary for Networks and Information Integration and Chief Information Officer of the U.S. Department of Defense.

Rear Admiral Robert E. Day, Jr., who is Assistant Commander for Command, Control, Communications, Computers and Information Technology and Chief Information Officer of the United States Coast Guard, U.S. Department of Homeland Security.

We thank you very much for joining us today. We understand the time pressures you are under. You are all familiar with the congressional procedure here, and we invite you to summarize your prepared statements in 5 minutes, beginning with Mr. Kienitz.

TESTIMONY OF THE HONORABLE ROY W. KIENITZ, UNDER SECRETARY FOR POLICY, U.S. DEPARTMENT OF TRANSPORTATION; TERESA M. TAKAI, ACTING ASSISTANT SECRETARY OF DEFENSE FOR NETWORKS AND INFORMATION INTEGRATION AND CHIEF INFORMATION OFFICER, U.S. DEPARTMENT OF DEFENSE; AND REAR ADMIRAL ROBERT E. DAY, JR., ASSISTANT COMMANDANT FOR COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, AND INFORMATION TECHNOLOGY AND CHIEF INFORMATION OFFICER, U.S. COAST GUARD, U.S. DEPARTMENT OF HOMELAND SECURITY

Mr. KIENITZ. Thank you, Mr. Chairman, and Mr. Chairman Emeritus. I am the one who needed the time moved, so I am very appreciative, as you know.

I would like to begin with a brief outline of GPS, which is of course the reason we are here today.

As most people know, GPS was developed by the U.S. military. Today, it is still operated and mostly paid for by the Air Force.

In 1983, President Reagan announced that GPS would be available to users worldwide. In 1994, President Clinton decreed that GPS would be free to users worldwide.

Finally, in 2000, the positional accuracy of the civil signal was greatly increased and new industries based on precision navigation and timing were born, and as a result, today, GPS is everywhere.

Since it is used as a matter for the free market, this is a key point, no one actually knows how many commercial uses it has, because anyone can access it anywhere for free at any time without Government monitoring.

What we do know is worldwide yearly sales of GPS navigation devices exceed $20 billion and an estimated $3 trillion worth of commerce relies on GPS for tracking, timing, and navigation.

Whatever the actual numbers are, the decision to provide GPS for free is one of America's great economic gifts to the world since the Marshall Plan.

As we all here know, GPS plays a key role in transportation. Many millions of U.S. drivers use GPS to navigate, including over 6 million cars equipped with GM's OnStar system.

Positive Train Control, which enhances safety for rail transportation, also relies on GPS. DOT is converting over a multiyear period the air traffic control system from an analog radar based system to a digital system built around GPS, which is our NextGen system that you referenced.

We estimate that soon as many as 60,000 aircraft will be equipped with GPS.

So far, FAA and the aviation industry have invested over $8 billion in NextGen, and there are many billions more to come on both the public and private side.

The uses of GPS go far beyond transportation. It is essential for first responders, search and rescue, weather tracking, financial transactions, surveying and mapping, and industries like precision agriculture, where the ability to water and fertilize crops with great accuracy reduces pollution and saves American farmers up to $5 billion a year.

To achieve the accuracy necessary for many of these uses, GPS receivers are designed to pick up signals and cross the entire range of the licensed GPS band.

The limits of engineering and physics to some degree are such that the receivers that do this are also sensitive to some signals in adjacent bands, including what is called the MSS band (mobile satellite systems), which is set aside for satellite phones.

Until now, this was not a problem because both in the GPS band and in the MSS band, these are what are called "quiet bands," limited to weak signals coming from satellites, and when those signals reach the ground, they register at a tiny fraction of a watt. The filtering devices that are on GPS units easily filter out the satellite signals in the neighboring bands.

To get more out of the limited spectrum that exists, the FCC has been encouraging for a long time more use of the MSS band, as with many other parts of the spectrum. This has included in MSS allowing telecom companies to set up some ground based antennas that would cover areas that are difficult to serve with satellite reception, such as hilly terrain or urban canyons.

By contrast, the ground signals coming from these antennas can be very powerful, more than a billion times the strength of a signal coming from a satellite, and as such, these signals can and easily do overwhelm the filters on a lot of current GPS receivers.

To guard against this, the FCC had restricted ground antennas to a subordinate role in any use in that band in such a way that they could not interfere with satellite transmissions. This was called the "integrated service rule."

As long as this rule was being observed, satellite signals in the MSS band were protected from interference from ground stations. If they were protected, by extension, so was GPS, which was in the neighboring band.

Now, we fast forward to today. LightSquared has asked the FCC for permission to use the MSS band for mobile broadband service under a waiver of this integrated service rule.

Their goal of providing widespread mobile broadband across the country is, as the chairman said, consistent with our policy of trying to give up to 98 percent of Americans access to mobile broadband.

It is not without its problems. Indeed, in January of this year, the FCC approved this concept contingent on resolving any interferences with GPS.

The technical working group, which the chairman mentioned, is going to be reporting next week, I think. In addition, as he said, we commissioned RTCA to do a study, and we participated in this broader Federal study looking at all potential uses.

The tests mostly focused in three areas. The first is this basic question of leakage. Are the LightSquared's signals sent out in their band leaking over into the GPS band?

The news there appears to be good, that is not happening. LightSquared has spent a lot of time and energy on engineering very good filters to make sure it does not leak out of their band. That seems to be working.

The second question is called overload interference, which is interference with GPS receivers that are sensitive to transmissions in these neighboring bands next to GPS.

The news here was not very good. The powerful signals from LightSquared's ground antennas overwhelmed the filters in most GPS units tested, causing them to either report inaccurate location data or not report anything at all.

Third, the test looked at what is called intermodulation. LightSquared plans to transmit under the original plan in two discrete frequencies in the MSS band. These are each 10 MHz-wide blocks with a buffer between them.

In the world of transmissions, two powerful parallel signals like that can create an echo effect when the two of them are going at the same time, and that can show up outside the spectrum band.

The tests that we have done so far showed that when both powerful signals were on, it did indeed create intermodulation interference within the GPS band.

Our conclusion from all of this is that the original LightSquared proposal made to the FCC is not compatible with the current operation of the GPS system.

Thomas Edison famously tested and rejected thousands of potential filaments before finding one that made the light bulb work.

In the same vein, we have now tested one proposal here, and we found unfortunately it did not work as originally hoped. That does not mean the story is over.

As you mentioned, on June 20, LightSquared offered an alternative plan where they would start out by using only one of their two bands, the so-called "lower 10" band, which is furthest away from GPS.

What phase two of their plan would look like is not so clear. This idea, indeed, may have promise. That said, and this is really the key point, since it was not part of the original plan submitted to the FCC, it has not been tested, and the one sure thing in all of this is any plan needs to be thoroughly tested before it goes forward.

Our goal at DOT is to look for a win-win, where we can have much better broadband service nationwide, but to do so without disrupting GPS and vital services it provides like NextGen.

Thank you.

Mr. PETRI. Thank you.

Ms. Takai?

Ms. TAKAI. Good morning, Mr. Chairman, and distinguished subcommittee members. Thank you for the opportunity to testify this morning regarding the importance of the Global Positioning System or GPS to U.S. national defense capabilities.

My testimony today will focus on the importance of GPS reliability to the Department of Defense, in ensuring that our war fighters and mission partners have the critical capabilities they need and which only GPS can effectively deliver.

GPS is vital to national security and is relied upon by our Service men and women for a wide array of capabilities. Simply put, it is integrated into almost every aspect of U.S. military operations.

It is designed to deliver extremely accurate information of three dimensional positioning, velocity, speed and direction, and precise timing to virtually all DOD aircraft, ships, land vehicles and personnel on the ground.

Used throughout all Services and combatant commands, GPS supports all training and contingency operations, ranging from tactical to through strategic levels.

To provide but a few examples, GPS signals are used to ensure the accuracy of precision guided munitions, to guide troop movements, to synchronize communication networks, to enable battle space situational awareness, and to conduct search and rescue operations.

I want to ensure the subcommittee that DOD takes its stewardship role for GPS very seriously.

We also know that civil and commercial sectors have long embraced GPS for its public safety capacities and economic advantages.

Consequently, we have developed a partnership with civil and commercial sectors, and really appreciate our partnership with those speaking with me today on this very critical issue.

To deliver GPS service to all DOD and civil and commercial users who rely upon it, DOD maintains and continuously upgrades

a constant constellation of 24 satellites composed of a minimum of four satellites in each six planetary orbits at a very cost effective budget currently of $1.7 billion annually.

Radio frequency spectrum is essential to DOD, not only for GPS, but also we use federally allocated spectrum for command and control operations, communications, intelligence, surveillance and target acquisition, and other military activities on land, at sea, under sea, airborne, and in space.

Military spectrum requirements are diverse and complex, given the variety of missions the Department must support.

In the Continental U.S., GPS is essential to military readiness, allowing our forces to properly train as they must fight and support contingency operations overseas.

We must also ensure that we have interoperability with our military allies.

All of these are driving DOD's spectrum requirements, much the same way as consumer mobile broadband demand is a major factor today.

DOD fully supports the national economic and security goals of the President's 500 MHz initiative, and we are committed, as my colleagues, to the implementation of more effective and efficient use of the finite radio frequency spectrum and the development of solutions that ensure no loss of critical national security capabilities, including GPS.

With my colleagues, in February 2011, the executive group of the National Executive Committee of Space-Based Positioning, Navigation and Timing tasked the National PNT Engineering Forum to conduct an assessment of the effects of LightSquared's planned deployment.

I co-chair that executive group along with my counterpart at the Department of Transportation. An executive committee for PNT is co-chaired by my Deputy Secretary and the Deputy Secretary at Transportation, and includes members from Departments of State, Interior, Agriculture, Commerce, Homeland Security, the Joint Chiefs of Staff, and the National Aeronautics and Space Administration.

Our role is to advise the Departments and the Executive Office regarding strategic policies and requirements, security of all U.S. positioning, navigation and timing.

We strongly support PNT and NPEF by tasking the Air Force Space Command along with Naval Space Warfare System Center to rapidly ramp up and conduct testing of the effects of the proposed LightSquared network upon a cross section of DOD, civil aviation, public safety, and commercial GPS receivers.

This testing was performed at our White Sands Missile Range and at Holloman Air Force Base in New Mexico in cooperation with PNT, other Federal agency members, and civil and commercial industry advisory members.

The results of these tests were submitted to the spectrum regulator, NTIA, on June 15. This test data does indicate that the proposed LightSquared terrestrial operations would cause harmful interference to the GPS operations, as my colleague from the Department of Transportation has explained.

For example, GPS receivers of various types and manufacture operated by DOD, the National Geospatial Intelligence Agency, U.S. Coast Guard, FAA, and the State of New Mexico Public Safety, as well as commercial aviation and precision fishing systems all showed varying degrees of degradation of GPS accuracy, interruptions to GPS signal acquisition, or total loss of GPS tracking and positioning, depending upon the GPS receiver's proximity to the tested LightSquared signal transmitter.

The potential for interference to GPS from the proposed LightSquared terrestrial network exemplifies the complicated technical policy and regulatory challenges in re-purposing longstanding spectrum allocations.

The Department will continue to work with the administration and NTIA, as well as with Congress, to address long-term solutions regarding the balance between Federal spectrum requirements and the expanding demand for mobile broadband services.

We have a wealth of institutional and personnel expertise in radio frequency engineering, and we look forward to continuing to work with the organizations to further ensure all proposed mitigation's or alternatives are thoroughly tested to ensure no harmful interference.

The ability of GPS to operate without interference remains of paramount importance to DOD.

I thank you for your interest in our efforts, and would be pleased to answer any questions.

Mr. PETRI. Thank you for your very informative statement.

Rear Admiral Day?

Admiral DAY. Good morning, Mr. Chairman, distinguished subcommittee members. Thank you for this opportunity to testify on the vital importance of the Global Positioning System to our maritime domain.

My testimony today focuses on our and the Department of Homeland Security's concerns with the current proposed business plan for LightSquared, and its potential to disrupt GPS reliability.

We must ensure that mariners, Coast Guardsmen, and the officers and agents in our sister DHS services have the capabilities that they require upon in our modern operating environment in the maritime, and GPS, reliable GPS, is a key enabler of that operational capability.

The Coast Guard, too, participated in two interagency testing events in New Mexico and additional testing in Las Vegas, where we tested representative Coast Guard GPS equipment within the initial proposed LightSquared signal environment of transmitting in a dual channel mode at 1.5 kilowatts.

The results demonstrated this: a typical Coast Guard surface unit, their GPS unit, demonstrated degraded performance within 3,300 meters of that source.

A commercial solace grade mariner receiver demonstrated degraded performance also within 3,300 meters.

A typical Coast Guard DGPS site receiver showed degraded performance within 7,500 meters of that source.

A reliable and an accurate GPS signal is a core enabler to the proper operation of numerous maritime safety and navigational

systems, which not only commercial mariners and the boating public use, but the Coast Guard and our DHS partners rely on.

For this reason, any form of interference, not just potentially from LightSquared, but any form of interference to the GPS signal has the potential to impact the proper operation of the following systems that we use that are critical:

Global maritime distress and safety systems and digital select calling radios, their distress alert functions could be impacted. GMDSS includes equipment including the SARSAT as well as digital selective calling radios.

New DCE marine radios use GPS input, and when they hit an alert, that alert takes that GPS input and transmits it over that DSC radio to our command centers.

Again, many, many smaller and passenger vessels, fishing vessels, and recreational boats heavily rely on GPS to determine their safe navigation and their location.

Our automated information system. This system is used on ships and by our vessel traffic system, by which we take and manage traffic coming into our major ports. This system again relies on GPS input into the radios that transmit this position.

We rely on AIS to build our understanding of our maritime domain awareness, what vessels are in our waters, what vessels are in our inner harbors and keeping track of them. We essentially rely on AIS which relies on GPS to build our maritime domain awareness.

Our differential GPS system is a precision capability that allows us to take and place our aids to navigation. This is absolutely critical. This is another source of navigation GPS radar, but the visual source of navigation for vessels to safely come in and out of our ports and navigate.

Not only that, the electronic chart systems aboard most of the vessels that are out there, again, commercial as well as our own, they leverage GPS so they can safely navigate and plot.

We have been very pleased to be involved and are committed to continue our participation in the testing, and working with FCC, NTIA, and other interested parties in this test and evaluation process to identify possible mitigation's that will eliminate these interference issues.

Based on the preliminary results and new strategies recently announced by LightSquared, there is much more work to be done.

The Coast Guard is committed to assisting DHS and the National Telecommunications and Information Administration as they continue to support the FCC proceedings on this matter.

Thank you for the opportunity to testify today, and I look forward to answering your questions. Thank you.

Mr. PETRI. Thank you. Thank you all for your testimony. My co-chairman, chairman of the Coast Guard Subcommittee, Frank LoBiondo, has asked that his full statement be made a part of the record, but he has some questions, and I would like to recognize him for them at this time.

Mr. LOBIONDO. Thank you, Mr. Chairman. I would like to thank the panel and also apologize. I am facing a markup in a few minutes. I wanted to at least be able to come in and thank the panel on this important topic and important hearing.

Admiral Day, I have just a couple of questions. Several of the departments and agencies have come forward and expressed their concern with LightSquared's proposal and its impact on GPS, including the Department of Defense, Department of Commerce, NASA.

However, the Department of Homeland Security has not made one comment.

Admiral, I appreciate your coming here today very, very much, and expressing the Coast Guard's concerns with this proposal. However, why has DHS as the department responsible for maritime safety and security, still not voiced any opinion on this matter?

Admiral DAY. Sir, we have discussed this issue with the Department, and we have been carrying a lot of the water because of the maritime nature. Again, in my statement I did say that many of our other partners, obviously CBP, ICE, and other agencies do have an interest.

Exactly why the Department has not represented directly, I cannot provide that at this time, but I can provide it for the record.

[The information follows:]

> Coast Guard concerns with the LightSquared (LSQ) proposal involve two issues: Interference to GPS operations and interference to Inmarsat terminals used in maritime operations.
>
> Regarding interference to GPS operations, the Coast Guard, through its Spectrum Management and Telecommunications Policy Division, became aware of the likelihood that proposed LSQ operations would cause interference to GPS operations in December 2010, following the FCC's grant of a waiver to LSQ permitting operation of its satellite system with an Ancillary Terrestrial Component (ATC). The Coast Guard reviewed the FCC Order, and in accordance with established protocol for spectrum matters, discussed its concerns with the National Telecommunications and Information Administration (NTIA) and other Federal agency representatives on the Interdepartmental Radio Advisory Committee (IRAC). The Coast Guard IRAC representative signed a multi-Federal agency letter to IRAC in early January 2011, opposing the FCC action.
>
> With respect to interference to Inmarsat terminals used for maritime operations, the Coast Guard has been in discussions with LSQ and its predecessor, SkyTerra, since early 2008. As Inmarsat is the licensee of the particular frequencies that LSQ desired for use, and these frequencies are part of the same band of frequencies that Inmarsat uses for satellite terminals serving the maritime community, including the Coast Guard for the Global Maritime Distress and Safety System (GMDSS), the Long Range Information and Tracking (LRIT) system, and general communications, the Coast Guard worked closely with LSQ and Inmarsat to reach agreement on how Inmarsat maritime terminals would be protected. These negotiations

> led to an FCC Order, released in March 2010, that provided for the protection of Inmarsat maritime terminals from LSQ operations near navigable waterways. Negotiations on these issues continue as the details have not been worked out despite the protections afforded in the FCC Order.

We have been working very closely with the Department, as I say, carrying most of this water in this area, sir.

Mr. LOBIONDO. Another question. In determining the need for a backup for GPS, in the Coast Guard authorization bill, which we passed, there was a requirement that the Department complete its determination as to whether a backup system is needed, and that determination by law was to have been met by April 10, that just passed this year, 2011.

Can you tell us what the status of the Department's determination on a backup GPS is, and do you know where this determination is in the process and when it will be delivered?

Admiral DAY. Sir, I do not have the exact information. We know it is in the Department being reviewed. I will get back to you as soon as possible for the record as to exactly where it is. I understand it was due on the 11th, but last I knew, it was in the Department, sir.

[The information follows:]

> To meet the determination required by Section 219 of the Coast Guard Authorization Act of 2010, DHS continues its efforts to analyze Federal requirements to determine a need for a backup to GPS. This has primarily been accomplished through an indepth survey of the current position, navigation, and timing requirements for major Federal stakeholders. All data has been collected, and the Department is actively working with the Administration to finalize the report. The final report will be forwarded to the Committees soon after its release.

Mr. LOBIONDO. I want to thank you again, Admiral Day. Again, I thank you, Mr. Chairman.

It is really frustrating when the Department of Homeland Security is totally pretending as if the Congress and the authorization and oversight committees do not even exist. We cannot get answers. We cannot get comments. Deadlines are missed. I do not know what additional action can be taken, certainly not at the fault of you or the Coast Guard, Admiral Day.

It is just a reflection of frustration that we share in trying to understand. This is some pretty serious information that we need here.

Mr. Chairman, I thank you for the accommodation and I yield back.

Mr. PETRI. Thank you. I have just one or two initial questions. The first one is for the whole panel, and is basically how do you recommend we proceed going forward?

On Monday, LightSquared announced their lower 10 MHz solution, and indicated their analysis is it would solve the interference concerns for 99.5 percent of all GPS users.

Do you agree or do you feel additional study is needed? What is the responsible thing to do at this point?

Mr. KIENITZ. I will start out on that. We are following a very careful protocol here. They made a specific and very detailed technical proposal to FCC earlier in the year. That proposal was then run through very specific and detailed testing.

What we had on the 20th was, I think, a well intentioned announcement of a general strategy, but it has not yet turned into a specific and detailed filing through the FCC process.

If that happens, presumably, we will all get it. All the technical people will sit down and look at it, recommend what kind of testing needs to be done and by whom, and then we will follow the tests wherever they lead us.

Very preliminary thinking indicates that if they are transmitting in a zone that is much farther away from the GPS band, the interference is likely to be less, but if there are 500 million GPS units out there and we are only interfering with 1 percent, that is 5 million. That is still a lot.

That is phase one of some plan, and what is phase two? That is something we are interested to know. That is not information we have seen yet so we do not really know and cannot really say anything about it.

Ms. TAKAI. Let me just add to what my colleague from the Department of Transportation said. As you know, we do work through a fairly rigorous process, working with our colleagues at NTIA and FCC.

We are anticipating following the final filing of the results from LightSquared on July 1, as well as the results of our own testing.

As we understand it, the FCC will need some period of time to review all the results of the testing, and then will come back to us with a specific request around what they would like for us to look at from a testing perspective, and if it is in fact a lower 10 MHz, then we would address that.

That is extremely important because I think as my colleagues and I have stated, it is pretty impossible to do just wide range testing of everything. We need to really know very specifically not only what the plan is but also what the power levels will be and more detail to really be able to comment on the results of that testing.

Secondarily, to add to what my colleague from the Department of Transportation said, we also are aware that working through only the lower 10 MHz is really only a part of the solution that will be needed.

We are anxious to hear what the testing would be for that lower 10 MHz and then what the ultimate plan might be to actually get the 20 MHz that LightSquared has indicated they need.

Admiral DAY. Both of my colleagues covered pretty much the major issues there. We have not done the testing in the lower band. The business plan still calls for the need for a second band out there. We will continue that testing and find out exactly what the issues are and what the interference issues are.

We have more work to do. I agree with both of my colleagues.

Mr. PETRI. Thank you. You all referred to not only testing the initial band but the thing going forward. You would like to see a clear plan for LightSquared to achieve their objective, but to do it

in a way that you can assure us, I assume, that it will be as safe as humanly possible for the traveling public and what is under your areas of responsibilities.

Is that correct?

Mr. KIENITZ. That would certainly be our preference. We do not have any unique view into what the underlying economics of their business are necessarily, but to the degree we have looked at it on a surface level, the economics of their plan appear to require more bandwidth than just 10.

I am not an expert on that. I cannot really speak to that. With that hanging out there, we are very much wondering what phase two is. Maybe there is no phase two that is necessary. I do not know. You will have to ask them, I think.

Ms. TAKAI. Yes, sir. Just to comment on your statement, I agree with you completely, and I think that is what my colleagues and I are saying, that we are concerned that we need to look at the complete picture of what the requirements would be, as well as understanding in the level of detail that we have on the upper 10 MHz, what they would have planned, and then be able to conduct the tests to validate that we would not see the interference that would cause us a problem.

Mr. PETRI. One last question for Mr. Kienitz. What do you envision as your role and the role of the Department of Transportation in this whole process?

This committee, under Jerry Costello's leadership, was very aggressive in the last Congress in trying to raise NextGen, its importance, within the Department. I think they have been very responsive. It is starting to gain momentum.

The advantages to the aviation sector and to the country are enormous for its rapid and proper deployment, and a lot of thought and work is now going into it.

We want to be having follow up hearings on all of that.

How does that all fit in with proposals like this, and our basic responsibility to ensure the public of the safety of aviation?

Mr. KIENITZ. I would say there are two main avenues for that. The first of which is obviously in programs directly under the authority of DOT's FAA, the air traffic control system, and NextGen being, I think, the largest of those.

GPS is used in trains, trucking, shipping containers, on roads, transit. Everybody in the transportation business uses it now.

We are both looking very specifically at NextGen, because that is an intensely safety critical system. It absolutely has to work 100 percent of the time if you are landing airplanes.

That is something that obviously is a major focus of ours. The transportation industry is also focused.

The second is the governance within the United States Government of the GPS system is this complicated thing, because there is so many uses and so many agencies.

A while ago, in an attempt to streamline it, they created a structure in which DOD essentially talks with and represents all of the national defense agencies that have an interest in GPS, and DOT was named the co-chair, speaks with and represents all of the civilian agencies which have interests and actions in GPS.

Our folks co-chair these various committees up and down the levels of seniority. We also have a responsibility to actually reach out, understand and then represent in the management of the system all the concerns of all the other civilian agencies. The net result is it is not just transportation. It is agriculture, it is public safety, search and rescue, weather satellites, all those other things as well.

Mr. PETRI. Thank you. Mr. Costello?

Mr. COSTELLO. Mr. Chairman, thank you.

Mr. Kienitz, the taxpayers have invested billions of dollars in GPS related programs at DOT specifically.

What is your view—is it the Department's responsibility to do something to protect that investment as far as GPS is concerned when it comes to FAA related programs, and what is the Department doing to make certain that it is protected and the investment in GPS is not put at risk?

Mr. KIENITZ. Yes. Obviously, our principal responsibilities are number one and ahead of everything else the safety of the traveling public. As I mentioned, specifically in the aviation area, that is a big deal to Secretary LaHood and to everyone who works for us.

Our number one focus right now is making sure that absolutely nothing happens to GPS which compromises public safety in the aviation industry or anywhere else.

You, as much as anyone else certainly in our department, has spent many, many years up until this point, and unfortunately, it is going to be a bunch more years creating, designing and implementing NextGen, and that will be in the tens of billions of dollars of taxpayer funds, and in the tens of billions of dollars in private sector investment by airlines and other folks to equip their planes.

Those are big numbers. Those folks made those investments based on the understanding that they thought this was going to be a stable system that would exist in perpetuity as it exists now. That is a serious responsibility as well.

I know if Secretary LaHood were sitting here, what he would say is safety is absolutely our number one goal.

Mr. COSTELLO. Back to the question, what is DOT doing right now? What is the plan to protect that investment?

Mr. KIENITZ. That gets to once again these odd governmental arrangements. The question of licensing a spectrum is not in our hands. The question of licensing a spectrum is something that the FCC does.

What we do is testing, make our points as strongly as we can to the other partners within the Government to make sure FCC is hearing it.

What they will do, I do not pretend to know.

Mr. COSTELLO. Anyone else on the panel want to try to answer the question?

Ms. TAKAI. I would answer just to add a couple of items to what my colleague from the Department of Transportation said.

At DOD, we have significant expertise as it relates to spectrum. One of the things that we are constantly doing is to really validate any additional uses for us against the uses spectrum we have today. The Air Force has considerable expertise.

One of the things that we do with that is to continue to monitor and look for whether are not there are ways not only to be con-

cerned about the interference with the current spectrum but also how we can use our spectrum more efficiently.

It is always an issue for us that we are a significant user of spectrum, and we feel it is important for us to look ahead. One of the things that we are doing is to actually look and utilize some of our research capabilities to look at use of spectrum, what the issues would be around reducing our dependence on the spectrum that we have today.

In fact, we already have some studies underway based on other FCC requests around spectrum to look at how we can move out of some of the existing bands we are in.

We see that as a continuing effort. We see it as being important to be able to work through and be able to provide the kind of DOD participation in the President's initiative, and to do that, it really requires us to do technical studies ahead of time to look at how we can be more efficient in our use of spectrum.

Mr. PETRI. Thank you. Mr. Cravaack?

Mr. CRAVAACK. Thank you, Mr. Chairman, and thank you, Mr. Costello, for having this very important meeting today. It is kind of near and dear to my heart, so I appreciate the panel for coming here today.

Admiral Day, thank you for all the good service the Coast Guard provides to us on a daily basis that we actually know nothing about. Thank you for protecting us.

In that vein, what I am very concerned about is the augmented GPS. I was a Navy helicopter pilot. I know how important it can be to our SAR rescues.

Can you comment a little bit about that, the effect of what LightSquared could potentially do on our SAR rescues?

Admiral DAY. Again, our aviation assets rely heavily on GPS services, for prosecuting a search pattern, getting to exactly the right place where an emergency position beacon has gone off, and any impact in that accuracy is going to one, potentially put the crew in harm as well as delay possible rescues.

Any interference. Not just LightSquared interference. It could be anybody's interference that is interfering in that band.

It is a critical element of not only planning a search but executing a search and rescue mission.

Mr. CRAVAACK. The augment in GPS in particular, the DGPS, is essential. It can bring down 2 to 10 feet, something like that, pinpointing a SAR rescue, which is essential, especially in weather when you have heavy winds and waves.

Admiral DAY. That DGPS system is highly reliant on the original GPS systems, such to put the corrections out to provide the additional accuracy in the receiver. That is correct, sir.

Mr. CRAVAACK. Essential. Also, sir, could you please tell me on the potential to mitigate the interference concerning LightSquared, would it be possible to mitigate the impact for LightSquared's signal for all maritime GPS and dependent technologies?

Admiral DAY. Sir, it is probably beyond my level of expertise and more in the area of the GPS manufacturers as to what exactly needs to be done.

The further you can keep the signal away from the primary bands, the better. In some cases, filtering can be used, but again,

it is not my level of expertise, and probably a good question for those GPS manufacturers as to what it would take and how much it would cost.

Mr. CRAVAACK. You have no idea on the potential?

Admiral DAY. I do not, sir.

Mr. CRAVAACK. Not even to take a wag at it?

Admiral DAY. Given the variety and number of systems out there, pretty difficult.

Mr. CRAVAACK. Can you please tell me in your professional opinion, on the potential of the conduct of the missions that the Coast Guard projects with the interference of LightSquared, or like you said, any type of interference, how it truly can impact the mission of the Coast Guard and our safety at large?

Admiral DAY. As I laid out in my oral statement, there are very few systems, from our MDA systems to those that are used aboard each and every cutter platform as well as aircraft out there, that is not highly relying on accurate positioning to conduct their missions.

Additionally, for maritime commerce, the mariners that come in and work with us on our ports and actually use our ports are highly relying on it, as we are in keeping track of where they are, who they are, and where they are going.

There is almost not an element in the Coast Guard mission that I can come up with that does not have a reliance on GPS.

Mr. CRAVAACK. Can you comment on this, too, as well, you are in a rescue situation. GPS goes down. Do you have a good plan B?

Admiral DAY. Again, there are multiple uses. Are you talking from an aviation standpoint or——

Mr. CRAVAACK. Any standpoint. Say you have heavy weather and you are out there, a typical rescue. You have sent out air assets. You have maritime assets out there as well. GPS is scrambled for some reason. Could you comment on how that would interfere with your mission?

Admiral DAY. Prudent navigators use a variety of different techniques. Obviously, we have become very reliant on GPS. Mariners rely on radar bearings. They also rely on visual bearings, as well as dead reckoning plotting, the old fashioned way of doing business.

We have become very reliant on GPS. There are other alternatives out there. Again, I think we have put a lot of our stock in that GPS signal, sir.

Mr. CRAVAACK. I figured as much. I am a brown shoe so I do not know about that maritime stuff. I apologize for that.

I will yield back my time.

Mr. PETRI. Thank you. Ms. Hirono?

Ms. HIRONO. Thank you, Mr. Chairman. I think this is a very timely hearing that has elicited a lot of very specific information, especially as a number of us, including yourself, Mr. Chairman and Ranking Member Costello and I have sent a letter to the FCC expressing concerns about their waiver in this regard.

Admiral Day, I have some very specific questions to ask you. We know the recent test results conducted by the RTCA strongly indicates that signals transmitted from LightSquared's ground based transmitters could interrupt or degrade GPS.

For the record, I would like to ask a series of questions, if you could respond very briefly.

These are on your systems that you expect could be impacted or would be impacted by transmissions from LightSquared, specifically, would the Coast Guard's automatic identification system, AIS, for vessels be affected?

Admiral DAY. Yes, ma'am. AIS requires GPS input, which tells the radio where the vessel is located and then retransmits it.

It also relies on it for timing. There is a circular timing chain in which each of the vessels in an AIS area report. If there was a loss of the timing signal as well as obviously the loss of GPS input, AIS would not report out to the Coast Guard or to other vessels who are monitoring the vessel's position.

Again, the timing piece could also scramble such we could have confusion in the reporting process.

Ms. HIRONO. Next question. With the differential GPS, DGPS, which provides greater precision for spacial information, would it be negatively affected?

Admiral DAY. Yes, ma'am. Again, that system relies on a solid GPS signal such that it can develop the appropriate corrections that it is going to broadcast out to enhanced positioning.

Ms. HIRONO. Would the Coast Guard's Rescue 21 distress system be compromised?

Admiral DAY. Rescue 21 could be compromised because again its network relies on timing signals that are derived from GPS to keep everything in alignment.

Ms. HIRONO. Would the search and rescue satellite aided tracking system, SARSAT, be disrupted?

Admiral DAY. SARSAT is one I am going to have to get back to you on the record, ma'am. I am quickly trying to come to a conclusion here, but I want to make sure I give you a correct answer.

Ms. HIRONO. I appreciate that. Would the vessel management system, VMS, be interfered with, and would the Coast Guard's fisheries enforcement activities suffer?

Admiral DAY. Again, the vessel management system requires GPS input such that those vessels can report their positions. Generally, for fisheries management, such that we can monitor where they are fishing, would be problematic in that we would not know exactly where they are if that signal is degraded.

Ms. HIRONO. Would electronic navigation systems utilized by Coast Guard vessels and commercial ships be disrupted and what would be the impact to safe marine navigation if such disruption occurs?

Admiral DAY. Again, if within the signal there is such a degrade to the GPS receiver, our operations and their operations would be impacted in terms that they would lose GPS positioning.

As I discussed with the other Member, prudent mariners use other mechanisms to validate their positions, all the way from radar to visual, but at the same time, they would lose one of those elements for safe navigation.

Ms. HIRONO. Are there any other GPS dependent technologies utilized by the Coast Guard that could be disrupted by LightSquared's transmissions? You have 4 seconds.

Admiral DAY. Ma'am, if there are any others, I will get back to you in the record and tell you what they are.

Ms. HIRONO. Thank you very much, Mr. Chairman.

Mr. PETRI. Thank you. Mr. Landry?

Mr. LANDRY. Thank you, Mr. Chairman. Admiral, thank you for your service and everything that the Coast Guard does, especially in the Gulf Coast.

I have four questions and 5 minutes. Could you just briefly describe the basic information provided by AIS to the Coast Guard?

Admiral DAY. It is a lot more than positioning. It is crew. It is also cargo they are potentially are carrying. Again, this is if they are inputting the right information in. What their intended home port is, their port of destination.

There is a lot more information that is provided in there than just the GPS piece, and we use that for vessel management. That's correct.

Mr. LANDRY. Are there any drawback's to AIS to the Coast Guard?

Admiral DAY. Drawback's? No. It is a very useful tool for us.

Mr. LANDRY. When AIS is turned on, does the technology provide quality domain awareness for the maritime industry and the Coast Guard?

Admiral DAY. Absolutely. The Coast Guard is not just the only user of that information.

Mr. LANDRY. If we assume that AIS is turned on or activated on every vessel, does AIS accomplish the same goals of NOA?

Admiral DAY. Could you describe that last acronym, please, sir?

Mr. LANDRY. If we assume based upon all the information you told me that AIS has the capability of providing for the Coast Guard——

Admiral DAY. I understand, sir, for advanced notification of arrival.

Mr. LANDRY. Correct.

Admiral DAY. Probably not because of the 96-hour requirement. The AIS coverage is not such that it would get the 96, other than some satellite notifications.

Mr. LANDRY. Not in a broad sense, maybe my question was too broad. Specifically for the problem that we are having with NOA, which I was grateful on working with the industry on, when it comes to supply of vessels in the Gulf of Mexico and as they move from port onto OCS and then from rig to rig, or hopefully from rig to rig if we can get it back up and drilling again.

Do you see what I am saying? Would that be a nice augmented approach to NOA specifically for American vessels that are operating in that type of environment?

Admiral DAY. Sir, it is sort of mixing a policy question and a technical question here. Technically, AIS does a great job, if properly used by the mariner, and gives us great information of who is coming in, where they are going, and where they are at right now.

Mr. LANDRY. You let me know if you get in trouble for answering that. I think you are right on.

Admiral DAY. On the policy side, I do no think I can answer that for you, but we will get back to you on that one, sir.

Mr. LANDRY. Thank you so much. Mr. Chairman, I yield back.

Mr. PETRI. Thank you. I have just one follow up question. It may be more appropriate for the next panel, but I appreciate any of you that would care to comment.

There has been some talk about we are more intensively using the spectrum, about filters and how they work, and how they may accommodate more use.

Could you discuss that? Are there filters? Is it one filter or is it certified? How does that process work? Are we talking about an easy solution or is it something that is basically in the future?

Mr. KIENITZ. I can address that a little bit, although I am not sure any of us up here are the world's greatest technical experts here.

There is filtering on transmissions and there is filtering on receivers. Transmitters, there tend to be fewer of them. They are bigger. They are more expensive. If you need to put on a very high-tech somewhat expensive filtering system, that is potentially possible, and I think part of LightSquared's plan has been to make sure to have very high-quality filters so their signals do not leak out of their band.

I think that technology is not necessarily cheap or easy, but it is around.

The idea that you can put good filters on receivers—like my BlackBerry has a GPS unit in it, and it is a tiny little thing that is this big (indicating). Every cell phone has a GPS receiver in it.

Finding filtering technology that can protect every single kind of GPS receiver from every single kind of use, who knows, the geniuses out there may be able to invent something right now. Unfortunately, we have 500 million units out there that do not have it.

Even if someone invents something in the next couple of years and we start installing it on all the new stuff, you still have an enormous problem because these devices last. They do not wear out. These devices are going to be around for a long, long time. You are going to inevitably have a problem.

Mr. PETRI. There is no certified or recognized protocol or technology right now? It is something that is contemplated and would have to go through the approval process?

Mr. KIENITZ. That is another odd thing. There are lots and lots of smart people who are starting to think about this stuff right now. I assume there is a lot of technology out there that should there become a demand for it, it could potentially grow.

In the FAA world, we do certify devices. Anything that goes into the cockpit of an aircraft has to be tested to 99.9999 percent accuracy.

Most GPS devices are not certified. There is no standard. It is a private sector business. The manufacturers make whatever they think will sell at whatever price point they want to sell it at.

Mr. PETRI. As far as aviation is concerned, there is nothing that has been certified?

Mr. KIENITZ. I think there are avenues that people understand, if we needed to do this, what avenues you would start going down, and they would pursue that. Right now, it is not readily available off the shelf.

Mr. PETRI. Very good. We have been joined by the senior member of the Coast Guard Subcommittee, Mr. Larsen, from Washington State. Mr. Larsen.

Mr. LARSEN. Mr. Chairman, thanks for the recognition, and thank you as well for allowing me to put my statement into the record.

I have a hearing at 10:00, as well as I have been running around all morning. There is an Afghanistan hearing in Armed Services that I need to get over to.

I just wanted to alert the witnesses and committee that in our subcommittee as well, we are very concerned about this issue. I have met with some of the folks who are involved with this issue over the last couple of days.

As this progresses as well, on behalf of the Coast Guard and Maritime Transportation Subcommittee, we will be tracking this issue fairly closely as well, to ensure that these concerns get addressed, and a 100 percent solution is found to the problem, not just maybe a 99 percent solution. It is that important.

I appreciate it very much, Mr. Chairman, Mr. Ranking Member, and I yield back. Thank you.

Mr. PETRI. Thank you. I would like to thank the panel. I hope you can make your schedule.

Mr. KIENITZ. I would like to thank you for finishing exactly at 10:00 so I can make my flight.

Mr. PETRI. Very good. Thank you all.

The second panel consists of Ms. Margaret Jenny, President of RTCA, Inc.; Mr. Philip Straub, Vice President, Aviation Engineering, Garmin International; Craig Fuller, President of the Aircraft Owners and Pilots Association; Thomas L. Hendricks, Senior Vice President of Safety, Security and Operations, Air Transport Association; and Jeffrey J. Carlisle, Executive Vice President, Regulatory Affairs and Public Policy of LightSquared.

I thank all of you for accepting our invitation to appear today. Thank you for the effort that went into your prepared statements, and invite you to summarize those statements in approximately 5 minutes, beginning with Ms. Jenny.

TESTIMONY OF MARGARET T. JENNY, PRESIDENT, RTCA, INC.; PHILIP STRAUB, VICE PRESIDENT, AVIATION ENGINEERING, GARMIN INTERNATIONAL, INC.; CRAIG FULLER, PRESIDENT AND CEO, AIRCRAFT OWNERS AND PILOTS ASSOCIATION; THOMAS L. HENDRICKS, SENIOR VICE PRESIDENT FOR SAFETY, SECURITY, AND OPERATIONS, AIR TRANSPORT ASSOCIATION OF AMERICA, INC.; AND JEFFREY J. CARLISLE, EXECUTIVE VICE PRESIDENT, REGULATORY AFFAIRS AND PUBLIC POLICY, LIGHTSQUARED

Ms. JENNY. Good morning, Chairmen Petri and LoBiondo, Ranking Members Costello and Larsen, and members of the subcommittees.

My name is Margaret Jenny. I am President of RTCA. I want to thank you for inviting me to participate in today's hearing on GPS.

RTCA is a not for profit organization founded in 1935, and utilizes the Federal Advisory Committee. It is a premiere public/private partnership venue for developing consensus among diverse

competing interests on critical aviation modernization issues in an increasingly global enterprise.

Our deliberations are open to the public. We provide two categories of recommendations. The first, policy and investment priorities for facilitating implementation of air traffic management system improvements, and the second are minimum performance standards used by the FAA as a partial basis for certification of avionics.

It is important to note here today that in my role as President of RTCA and in keeping with our time honored consensus process, I am authorized only to present the consensus findings of our deliberations, not my personal views or the views of individual members of the RTCA committee.

It should also be noted that LightSquared was part of this consensus.

My testimony today will summarize the findings of the study conducted by RTCA at the request of the FAA on the impact of the proposed LightSquared terrestrial wireless broadband network on GPS receivers onboard aircraft.

The RTCA study assumed the three phased development plan as described by LightSquared, and concluded that all three spectrum deployment phases described by the planned terrestrial are incompatible with the current aviation use of GPS.

However, modifications could be made to the LightSquared system to coexist with aviation use of GPS.

The impact of the LightSquared upper channel spectrum deployment is expected to be a complete loss of GPS receiver function. The LightSquared upper channel interference from phase zero deployment exceeds the GPS receiver minimum operation performance standards related to the environmental limit by a factor ranging from 18,000 to 380,000, depending on the operational scenario that was involved.

Further, because of the size of the single station deployment, GPS base stations below 2,000 feet would be unavailable for a large radius around the metropolitan deployment center.

This means that if the GPS receiver will not be able to provide a position with any sort of continuity if at all, GPS based operations cannot be undertaken.

Given the situation in the high-altitude East Coast scenario, GPS based operations would likely be unavailable for a whole region of altitude at which aircraft normally fly.

However, the results of this study also indicate that terrestrial based station operations at the lower 5 MHz wide channel is compatible with aviation GPS operations for all the representative scenario's.

Further, the study indicates that for terrestrial based stations using only the lower 10 MHz channels, there is a small positive margin for GPS tracking, not necessarily initial acquisition, in the presence of a mean aggregate terrestrial network interference.

But, and this is an important but, these conclusions are based upon specific assumptions about the system operation provided by LightSquared to the committee.

Worse impacts would result if LightSquared were to operate at the limits allowed by the FCC authorization.

Let me give you two examples. The study assumed LightSquared base stations operate at 1.6 kilowatts channel per sector, whereas the FCC license allows up to 16 kilowatts.

Second, the number of base stations per unit area was limited for the model provided by LightSquared for the study, whereas the FCC license does not limit density.

In fairness and to enable a consensus to be reached, GPS receiver mitigation's were also explored. The RTCA committee found, however, that the only viable option is through the invocation of more stringent performance requirements for GPS antenna/receiver combination that would require manufacturers to layer filtering throughout the receiver front end.

This approach would take many years to be installed on the entire fleet, since it would require new standards to be developed, TSOs to be issued by the FAA, new receivers to be built and certified to the new standard, and finally, installed on the entire fleet.

This would be extremely disruptive to aviation, since it would cost billions of dollars and take somewhere between 10 and 15 years to finish.

Let me summarize. The recommendations from the study, number one, from an aviation perspective, LightSquared upper channels operations should not be allowed.

Further study is recommended to determine refined terrestrial base station power versus frequency limit. This is particularly important in verifying the committee's conclusion for the LightSquared operation in the 10 MHz channel.

In closing and on behalf of the hard working committee volunteers, and particularly their chairmen, Chris Hagarty and George Ligler, I thank you for the opportunity to testify here on this important topic, and I would be pleased to answer your questions.

Mr. PETRI. Thank you.

Mr. Straub?

Mr. STRAUB. Mr. Chairman, ranking members, and members of the committee, I am Philip Straub of Garmin International.

I appreciate the opportunity you have given me to speak with you today as you assess technical opportunities and challenges we face in a similar but slightly different way than we do in industry.

We are here to help you understand both the technical and policy issues resulting from the use of spectrum by competing technologies.

Before I continue, I, like most people, want more options for broadband. I pledge the resources of my company to work with anyone in or out of Government to help achieve that goal in a way that is compatible with existing spectrum.

Turning to specifics, LightSquared's proposed terrestrial network is just not a good neighbor to the GPS environment that is so critical to aviation and maritime safety.

I would like to leave you with two thoughts today. One, LightSquared's proposed broadband terrestrial network will cause catastrophic and perhaps life threatening harm to reliable GPS services.

And two, LightSquared's claim to reduce the risks, the so-called mitigation, is not proven technically or practically. In short, their claims are not feasible.

Why? A quick technology review. GPS signals come from solar powered satellites that are at a distance of over 12,000 miles away. GPS signals leave the satellite with a power of about a 50 watt light bulb. GPS receivers, therefore, must be very sensitive to detect, acquire and hold on to a signal of a small fraction of a watt.

After such a great distance, listening requires it to be very quiet, and where accuracy is paramount, some GPS devices must use a wide band GPS receiver.

Adjacent strong signals overload GPS capacity that hear those signals, much the way loud talk drowns out a whisper. If you concentrate hard enough, you might hear the whisper, but chances are not enough to make any sense of it.

And to the topic at hand, LightSquared's proposal is sort of like running a lawnmower in a library where people whisper.

Speaking as an engineer, at 800 meters from a LightSquared transmitter, its signal is 4 billion times stronger than a GPS signal.

GPS receivers are just not designed to exclude such strong signals, something that was never contemplated before the LightSquared waiver.

Our test of LightSquared's proposed system, at nominal power against a FAA certified Garmin receiver, showed harmful interference at 13.8 miles and a complete loss of GPS position at 5.6 miles.

And yes, we did submit this data to the FCC in a timely fashion.

Turning to LightSquared's claim that filters are the answer, let me be emphatic and clear. Filters do not exist that would protect GPS receivers from LightSquared's proposed transmissions, none, not at all, not even prototypes.

This is more promotion and PR than reality. We cannot test this claim.

Let's also be real. If real filters do appear, they will have to be tested against stringent requirements imposed on all products, but especially those installed in the aircraft environment.

They must withstand extreme conditions, temperature ranges, intense vibration, and even lightning strikes. They must also meet strict size and weight limitations.

Add to that, time for certifications and approvals and retrofitting, it would take years and years, stressing both FAA and the industry.

Plus, due to design variances, there is no one-size-fits-all solution to this problem. Numerous filters would be required to fit a variety of GPS receivers.

So even if we actually see one, the barriers are just too numerous to make filter use practical.

Let me turn briefly to the latest solution that their initial service will only use the lower 10 MHz.

The RTCA report says operation of a single lower 5 MHz channel *might* be compatible with aviation GPS receivers. That is based upon an assumption that LightSquared would operate at one-tenth of its authorized power limit, something their other statement recently put into question.

RTCA simply did not reach any conclusion on the compatibility of a single lower 10 MHz channel with aviation use.

So in conclusion, along with others, we've dedicated millions in resources, worked in good faith with technical working groups, and so far, results confirm the potential harm, confirm the degree of difficulty, and demonstrate the impracticality of their proposal.

Just as Congress is in no mood for wasteful spending, we in the GPS industry are not either.

Please do everyone a service, help put an end to this dysfunctional exercise, work to ensure the FCC's rescission of LightSquared's conditional waiver, as well as an overall review of ATC operations in the L-Band spectrum.

At a minimum, LightSquared's proposed service should be moved to different frequencies outside of the MSS L-Band, away from GPS.

Thank you for the opportunity to speak to the committee on this matter of vital importance to the reliability and the safety of our Nation's transportation system.

Mr. PETRI. Thank you.

Mr. Fuller?

Mr. FULLER. Good morning, Mr. Chairman, thank you, and Ranking Member Costello, thank you, and members of the committee for this hearing.

I have submitted a statement for the record, and I am joined by my colleagues in the general aviation community at the National Business Aviation Association, General Aviation Manufacturers Association, EAA, and NATA, who concur in that statement.

I would like to spend my few minutes here talking a little bit about the policy process. Ironically, 28 years ago, I was the head of the Office of Cabinet Affairs in President Reagan's White House, where the GPS policy was circulated, debated, discussed among all the Federal agencies, including the FCC.

The decision was made to open this up to civil use. We had absolutely no idea that it would amount to the trillions of dollars of investment and utilization of GPS, and the hundreds of thousands of jobs over this 28-year period.

I was a pilot at the time, and was not even sure it would be that valuable to me.

It was not immediately valuable. In fact, two individuals, one named Gary and one named Min, took a few years, about 6, to form their company, called Garmin.

Ten years after the decision had been made by President Reagan, we began to see hand-held Garmin GPS units in our aircraft. Ten years later, a 2003 Bonanza that I fly today, has two of them. It allows me to fly instrument approaches using nothing but the GPS signal, avoid weather, and avoid other obstacles.

Throughout this 28-year period, administrations and Congresses, leadership on both sides, have protected a policy which I would call the "do no harm" policy. In other words, they recognized the use of GPS as a national asset and said do no harm.

As I listen to the experts this morning and the testimony of this panel, I think there is an analogy with drug manufacturers in an odd sort of way perhaps.

In the drug manufacturing world, we encourage investment. We benefit by investment, research, study, and testing of new drugs.

There is an agency that looks at that process, and when a drug does harm, it does not come to market. Billions sometimes are invested, but if the drug does harm, it does not come to market, and if it does come to market for some reason that was not foreseen, and it is found to do harm, it is recalled.

We have had a policy process that I characterize as a petition to use a satellite based transmission for datacom. Seems kind of reasonable. Then it seemed to need some ground transmitters, as has been discussed, to supplement that satellite based signal.

Then it seemed to need more ground transmitters, like about 40,000. Then it seemed it might cause interference, so filters would have to be used. Oh, the filters actually have to be used on the GPS units, not the transmitters that the new company is going to design.

By the way, filters do not actually exist, but we think there is a way to get a hold of them. Oh, actually, there is a big problem, so we are not going to use the initial allocation we were given, we are going to switch to another allocation.

I think we are probably working with a very innovative company. They move very rapidly through a whole series of alternatives.

My biggest beef, frankly, is with the Agency that is supposed to control the policy process. The Agency that is supposed to control the policy process is the FCC, and they can and should do better than that because for 28 years, from 1983, when they were part of the original decision, through multiple administrations, we have seen fit to protect this technology.

Mr. Costello asked a very good question, so what do we do now. We have certainly gone to the FCC in advance of them granting the waiver and told them the extent of the problem, told them they are putting jobs at risk, told them they are putting lives at risk, told them they are putting GPS at risk.

We will continue to do that, but in all honesty, like the FDA, I think they need to issue a recall. I think they need to say we want innovation, we like innovation, but this is simply a toxic drug. This will not work in the system we have today. Let's pull it back. Let's go back to the drawing board.

We in the general aviation community are certainly willing to work with any company on innovation for datacom services.

I also think that given the 28-year history and the importance, as you have heard today, in terms of jobs and investment in GPS, that the Congress ought to investigate this policy path we have been on.

It is very confusing. We cannot on an ad hoc basis simply look at new proposals and say well, we hope it works, so let's go down that path.

Thank you very much for your time. I look forward to your questions.

Mr. PETRI. Thank you.

Mr. Hendricks?

Mr. HENDRICKS. Good morning, Chairman Petri, Ranking Member Costello and members of the subcommittees. Thank you for the opportunity to testify in this matter which is so critical to the airline industry, as well as other transportation modes, commercial enterprises, and recreational users.

My name is Tom Hendricks. I am the Senior Vice President of Safety, Security and Operations for the Air Transport Association of America, representing the major passenger and cargo airlines of the United States.

Prior to joining ATA, I was a pilot for Delta Airlines for 23 years, as well as a military pilot for both the Navy and the Air Force.

I want to emphasize at the outset that while the U.S. airline industry supports public and private sector efforts to expand wireless broadband service across the country, we strongly oppose any proposed service that would compromise the integrity of the Nation's Global Positioning System.

Given that 5,600 commercial aircraft and tens of thousands of business and general aviation aircraft are GPS equipped, the continued unimpeded use of GPS is indispensable to the future of aviation.

With respect to the U.S. airline industry, over 86 percent of our aircraft are already equipped with GPS. This has been achieved without any regulatory mandate and is based entirely on the remarkable capabilities of this navigation system.

We are using GPS based arrival and departure procedures that are more precise and fuel efficient than radar and surface based navigation system procedures, and enable increased aircraft throughput.

Today's commercial and general aviation users are heavily committed to GPS, and its importance to aviation will intensify over the coming decade.

As the subcommittee knows, the civil aviation community has embarked upon the most ambitious transition in air traffic management ever undertaken.

The system, known as NextGen, utilizes the positioning function of GPS to provide continuous navigation signals to airplanes, which then down link a position report at least once a second to air traffic control. This is a significant enhancement over the existing radar based system, enabling improved air traffic management. GPS will be used in all phases of flight, departure, in route, terminal area, approach and landing.

GPS is a core technology behind NextGen, and will allow the national airspace system, which is increasingly constrained, to accommodate growing air traffic demand reliably and efficiently, while at the same time reducing greenhouse gas emissions.

GPS spectrum has been protected until the Federal Communications Commission in a highly unusual regulatory action effectively revised its own rules for LightSquared, subject to certain tests and conditions.

This provision, which the FCC characterized as a waiver, opens the door to the construction of 40,000 high-powered ground-based transmitters that will effectively render GPS signals unusable over the populated areas of the United States.

This is not an exaggeration. Recent tests by RTCA, the Federal Advisory Panel on Aviation Navigation and Air Traffic Management Policy, definitively concluded that LightSquared's network would render GPS unusable by aviation users below 2,000 feet, in the vicinity of a single city deployment, and at all altitudes in dense metropolitan areas.

Similarly, the National Space-Based Positioning, Navigation and Timing Systems Engineering Forum concluded that LightSquared's system "Cannot successfully coexist with GPS."

Given the multiple Government and industry reports of GPS interference issues posed by LightSquared's proposed system, LightSquared and GPS industry stakeholders have begun to discuss potential mitigation options.

While well intentioned, the cost to the U.S. airline industry and other GPS users to implement the potential mitigation's far outweigh the benefits of allowing LightSquared to deploy its wireless broadband network.

The first mitigation option would allow LightSquared to operate in the lower part of its currently licensed frequency spectrum at a reduced power setting. While this may be feasible, it is fraught with technical challenges not yet fully understood.

Significant research and modeling is required to fully define this mitigation and conclusively prove whether it would achieve the desired effect.

The second mitigation option would be to equip GPS receivers with filters to preclude interference from LightSquared's high-powered neighboring signal.

Avionics manufacturers have questioned the feasibility of designing such filtering equipment, which do not currently exist for commercial aviation.

It is possible that filters could interfere with the precision of the GPS signal, thus, limiting the usefulness of GPS receivers.

Even if the development of filtering equipment proves technically feasible, the U.S. airline industry simply cannot afford to purchase and install it in over 7,000 aircraft, which would cost billions of dollars.

This is not a viable option for an industry that has lost $55 million and 160,000 jobs over the last decade.

Moreover, it would take at least a decade for filters to be developed, tested, and then certified by the FAA.

This process would grind NextGen implementation to a halt, along with the creation of at least 150,000 U.S. jobs.

The bottom line is that the U.S. airline industry and other GPS users did not cause this interference problem. We have relied on longstanding U.S. Government policy and international standards in the development and implementation of GPS equipment.

If the FCC is determined to allow LightSquared to launch its wireless broadband network, the Agency should find alternative spectrum that will not compromise the GPS network.

We ask the Congress to ensure that this vital national resource known as GPS, which is critical to commercial aviation and many other industries and relied upon by millions of consumers, be fully protected from any encroachment that could possibly compromise its effectiveness.

I look forward to hearing your questions.

Mr. PETRI. Thank you.

Mr. Carlisle?

Mr. CARLISLE. Chairmen Petri and LoBiondo, Ranking Members Costello and Larsen, and members of the subcommittees, thank you very much for giving me the opportunity to appear before you

today to discuss our plans to bring services to American consumers in a manner that is fully compatible with uses of GPS.

Members of the committees, I want to be absolutely direct, clear and unequivocal. LightSquared has no intention of operating its system in any way that will compromise Government or commercial aviation or maritime operations in the United States, nor do we believe the FCC would ever allow us to do so.

LightSquared is investing $14 billion over the next 8 years to build a wireless broadband network that will allow Americans to communicate anywhere any time through integration with its satellite.

This investment is going to support over 15,000 jobs a year for each of the 5 years that it will take to construct the network.

When completed, our ground network will cover 260 million people and provide over $120 billion in benefits to American consumers.

It is important to understand that coexistence of our system and GPS is not a new issue. It did not just come up in the last 6 months. We have worked with the GPS industry for 10 years, and I have provided this history as Attachment 1 to my testimony.

As a result of this work, we restricted our signal from intruding on the GPS band 9 years ago. In 2005, the FCC authorized us to transmit at the power levels we are going to use. We could have built the same network in 2005 that we are building today.

In September 2010, the GPS Industry Council first raised a different issue. Certain GPS receivers are designed to not only capture GPS signals in the GPS band, but also capture signals in our band, and as a result of this design, these receivers can be desensitized or overloaded by our signals in our licensed spectrum.

I have provided illustrations of this effect as Attachment 2 to my testimony, and they are on the screens to the side and the back.

What followed was perhaps the most extensive set of studies of interference ever conducted. The technical working group cochaired by LightSquared and the U.S. GPS Industry Council, and comprised of dozens of engineers from across several industries and Government, tested over 130 devices representing all GPS receiver categories. Numerous devices were also tested in independent testing by Government and private entities.

Data that is publicly available from independent reports points the way to mitigation. The vast majority of GPS receivers look only at that part of LightSquared's spectrum that is immediately adjacent to GPS, the spectrum we had planned to use first.

However, the recent Government Engineering Forum report, referred to as the NPEF report, RTCA, and a report by the National Public Safety Telecommunications Council, indicate that our operation in the lower part of our band, furthest away from GPS, does not cause interference.

We believe that of the 400 to 500 million GPS receivers that are estimated to be in use today in the United States, operation in the spectrum farthest away from GPS will avoid overload for over 99 percent of the receivers, including those used for aviation and maritime operations.

LightSquared believes the TWG results will largely confirm the direction pointed to by these tests and reports.

Accordingly, we are proposing a three part solution. One, we will operate at the same power levels the FCC authorized us to operate in 2005 and voluntarily give up using higher power levels.

Two, we will agree to a standstill in terrestrial use of the upper 10 MHz immediately adjacent to GPS, and we will not incorporate those frequencies into our terrestrial network until the FCC and NTIA are satisfied this can be done without risk to GPS.

Three, we will commence terrestrial operations on the spectrum farthest away from GPS.

The remaining less than 1 percent of devices are comprised of high-precision network and timing devices. There are filtered antennas available today for timing devices, and there are technical and operational solutions that can be used for high-precision and network devices.

We can coordinate our roll out so that high-precision agricultural receivers will not be near base stations for several years.

For those uses in urban areas that may be affected sooner, we can work out coordination of operations and spot replacement of high-precision and network receivers.

These are activities that wireless companies do every day when they are rolling out in an area where there are incumbent users.

We will also work with MMARSAT to find a place in our band where the augmentation signal for high-precision and network receivers can be isolated from terrestrial operations and can have a much higher certainty for their ongoing operations than they have today.

LightSquared takes seriously the sincere concerns expressed by the GPS community. We will not interfere with aviation or maritime operations in the United States.

The steps I have outlined that we are taking are not easy and they are not inexpensive, but they can and must be done and we are willing to do them.

We are stepping up to this commitment so that Americans can get the benefit of our investment in critical infrastructure and continue to have all the benefits of a robust GPS system. Americans across the country should have both.

Thank you very much, and I look forward to your questions.

Mr. PETRI. Thank you. Thank you all for your statements. Our colleague, Mr. Cravaack, actually had an opening statement, if you would like to do that, and then begin questions to the panel.

Mr. CRAVAACK. It is not your fault, Mr. Chairman, I was out of the room. I apologize.

Thank you, Mr. Chairman, and Ranking Member Costello, once again for this valuable and informative hearing, and I look forward to the testimony of the panel. Thank you very much for that.

As a former Navy and commercial airline pilot, this issue specifically has some interest for me.

From the outset, I want to be clear in stating that I appreciate LightSquared's goal in creating a nationwide 4G broadband network. Coming from a rural area up in Minnesota, it would be nice to have that.

At this point, I am greatly concerned about the impact LightSquared's proposed network would have on our Nation. After looking into this issue and researching it, it is apparent that the

interference from LightSquared's network has the potential to endanger our Nation's transportation system, which is heavily dependent upon GPS technology.

The last thing a pilot wants to hear is that horn going off when he has lost signal coming in on an approach and in heavy weather.

Talking of mitigating LightSquared's interference with some form of a filter, quite frankly, at this time—that is not available as I understand it—should be dismissed and is not an option.

Even if a filter should be designed to block the interference and permit GPS use, the cost of the proposed filters would be harmful to our Nation's aviation industry, both commercial and general, and would put another burden on the general aviation pilots as well.

In addition, I am gravely concerned about how LightSquared's interference could impede the work of the Coast Guard and other important Department of Homeland Security operations.

According to written testimony by Assistant Secretary Takai, interference from LightSquared's operations could also pose a problem for our national defense. Our national security is paramount in importance to me, and I will be looking at it closely.

I appreciate your comments in regard to LightSquared. I would like to jump right into that, Mr. Carlisle.

I note that the RTCA's report concluded that the interference to aviation GPS might be avoided only if LightSquared was limited to the lowest 5 MHz of the L-Band spectrum; is that correct?

Mr. CARLISLE. Congressman, the RTCA report concluded that the lowest 5 MHz is compatible with aviation uses. The next 5 MHz requires further analysis to determine if acquisition of the GPS signal is possible with regard to our operation.

Mr. CRAVAACK. You proposed the use of the next 10 MHz as well; is that correct?

Mr. CARLISLE. What I am suggesting is the five that RTCA has said is compatible with aviation use and the next five that is under consideration, so both of those 5 MHz groups add up to 10.

Mr. CRAVAACK. What would you use the other five for? You said you are using five now; correct?

Mr. CARLISLE. We are not using it now.

Mr. CRAVAACK. You plan to use the lower five?

Mr. CARLISLE. Right.

Mr. CRAVAACK. The next five, you said there is a proposal for that; is that correct?

Mr. CARLISLE. Right. It would be used for our broadband service.

Mr. CRAVAACK. Do you have any data saying if that would interfere with GPS at this point?

Mr. CARLISLE. Actually, yes. The technical working group has tested for a number of receivers, including aviation receivers, at the lower 10 MHz, and that data will be filed with the FCC next week.

Mr. CRAVAACK. Can you give us a little hint?

Mr. CARLISLE. I can say what was publicly released by the RTCA report, which I believe is consistent with what the technical working group report will show, that aviation receivers actually performed significantly better than the minimum performance standards that were analyzed.

That is not a justification to not analyze the worse case scenario used by the minimum performance standards, but it does indicate the bottom 10 could be used without interference to aviation operations. Further work needs to be done.

Mr. CRAVAACK. Let me ask you a question. If LightSquared does not really plan to use the higher frequencies, and if you find out the next five frequencies—I am assuming we are going to have a lot of testing with this.

Would LightSquared commit to us today and inform the FCC in writing that you or any subsidiary or future entities of LightSquared would not deploy a terrestrial system in the higher channels, if those prove to be harmful to GPS?

Mr. CARLISLE. What we would like to do is be able to move forward with our deployment on the spectrum farthest away from GPS. For the spectrum that is closest to GPS, the 10 MHz closest, what we would want to do is have further discussion of whether there is a possible glide path forward, not over 6 months or a year, but over several years for use of that spectrum consistent with GPS operations, and that is going to require further discussion of whether there are mitigation options, whether there can be modifications to our operations.

We believe that discussion should occur, and will need more time to occur.

However, I would be very clear on this. We would not be able to use that upper 10 unless we were specifically authorized to do so. The FCC would have to consult with NTIA, FAA, DOD, the Coast Guard, all the affected Government agencies, before they did so, just as they consulted with them over the 4 years when they created these rules, 2001 to 2005.

Mr. CRAVAACK. I just wanted to make sure that—you sound like you definitely want to do the right thing for the right reasons. I appreciate that.

I just want to make sure that if we do find a problem, that LightSquared is ready to shut it down if we have to. That is the question I am asking your company.

Mr. CARLISLE. Congressman, I appreciate that question. As I said at the beginning of my testimony, we have absolutely no intention of operating this network in a way that will cause danger to the American public. We want to operate it responsibly and deploy it responsibly.

That is why we have engaged in this process to test it out. It sounds like a relatively recent process that started. This is actually the 10th year of the work that we have been doing with the GPS community in order to work with GPS and in order to handle GPS interference, and we will continue that work.

Mr. CRAVAACK. Thank you, sir. Appreciate it. If I can just have indulgence for just one more question.

Ms. Jenny, if you can answer this question. Being an old pilot, backup to the GPS is LORAN–C, and that is what I used to fly with in South China Sea.

I was wondering if you could tell me, do we have a possible backup plan if GPS is affected?

Ms. JENNY. I think I would like to defer. I am really here to try to explain what the study showed for interference on GPS. I think the policy on the backup for GPS is still being determined.

Mr. CRAVAACK. Currently, there is no backup?

Ms. JENNY. No, I did not say that. I think it is probably a better question for the Department. For the study in question, the assumptions here were that GPS would be the primary means. The only question was what kind of interference would we get from LightSquared's deployment for GPS receivers onboard aircraft.

Mr. CRAVAACK. Can anyone on the panel answer that question, backup to GPS?

Mr. FULLER. As a practical matter, we do not have LORAN in our aircraft any more. We do obviously have VOR ground receivers that are still there, although they are being decommissioned.

I would take this opportunity to add that the considerable interest and direction we have been moving with NextGen has at the very heart of it the utilization of the global positioning satellite system, GPS, in the aircraft, and indeed, it is the GPS signal that is so much more accurate in the aircraft than what our controllers have on the ground, that we want to get into the hands of the controllers.

Putting that at risk puts at risk the whole NextGen effort as well.

Mr. CRAVAACK. Thank you for the Chair's indulgence, I yield back, sir.

Mr. PETRI. Thank you. Mr. Costello?

Mr. COSTELLO. Mr. Chairman, thank you.

Mr. Straub, in your written testimony, you conclude that LightSquared's proposed operation should be moved entirely to a different frequency away from GPS; is that correct?

Mr. STRAUB. That is correct.

Mr. COSTELLO. I wonder if I could ask the other panelists, with the exception of Mr. Carlisle, if you agree with that. Ms. Jenny?

Ms. JENNY. Yes. The study conducted, it did indicate that it is compatible at the lower five, provided they stayed within their power levels that we tested to, which were not the same as what they are authorized, and the density of the transmitters is what they told us they would do in the study.

If those two things are true, then the lower five is compatible. The lower 10, if you add another five, needs more study.

Mr. COSTELLO. Mr. Fuller?

Mr. FULLER. I am not a technical expert. I stand with what I said earlier. I think the technical experts at the Agency responsible for this policy, FCC, have to engage in very robust and active tests.

We appreciate the notion that their company would work with people in the GPS community or who use GPS, but working with and concurring in are two different things. I do not know of anybody in the GPS community that believes that at least the approach as fully tested today would satisfactorily solve the conflict problem with these signals.

Mr. COSTELLO. Mr. Hendricks?

Mr. HENDRICKS. Yes, thank you. I would just offer that we have created the safest form of transportation in the United States that exists. It has been a long process for the Congress, for the Depart-

ment, for the Federal Aviation Administration, and for the industry itself.

We have all worked together to shape the policies. As long as we can be guaranteed protection through our processes of certification done by the FAA in future avionics, then we would be satisfied with whatever proposal comes forward.

I would like to emphasize the growth of GPS in the aviation community without question has increased our safety margins due to the highly accurate positioning function that we are able to achieve with it.

Mr. COSTELLO. Thank you, Mr. Chairman.

Mr. PETRI. Mr. Graves?

Mr. GRAVES. Thank you, Mr. Chairman. My questions are for Mr. Carlisle. I have two concerns about your statement.

In your opening statement, you said "LightSquared can coordinate its roll out so high-precision agricultural receivers will not be near LightSquared's base stations for several years."

What does that mean? What happens in several years?

Mr. CARLISLE. What that means, Congressman, is that during the first 2 or 3 years of this deployment, we will primarily be focusing on urban areas where we can quickly meet our coverage requirements, and then ultimately, we will move out to less dense areas.

That means there are several years available in order to work on technical solutions for precision receivers that will result in more resilient units that will not go all across our band like they do today.

Mr. GRAVES. You are hoping you will find a solution before that happens. What do you define as an "urban area?" Are you going to deploy in smaller communities? What is a "smaller community?" What is an "urban area?" Obviously, you are going to go after those areas that have a little bit more density than just plain rural.

Mr. CARLISLE. Ultimately, we will. Again, for the first 2 or 3 years, we are not going to be deploying near where the majority of those agricultural devices are used.

Mr. GRAVES. Two to three years is different from several years, to be quite honest. That concerns me.

The next thing you said is "LightSquared will address this issue for over 99 percent of the receivers currently used." Ninety-nine percent, that is a pretty high mark. That means there are going to be some out there where it is not going to work.

You talk about filters. Do you understand the process of how you get something certified for an aircraft and how expensive that is, and how expensive it is going to be for me to buy the damn thing to put in my aircraft?

It is a long process. It takes a lot of money. Whatever that company is that comes up with that filter, they are going to have to ensure product liability, because if something happens and somebody gets in an accident, then the finger is going to be pointed at them.

You have product liability and then you have the certification process. The certification process takes a while. Again, it is very, very expensive, for a piece of equipment that I am going to have

to add to a piece of equipment that I already have, that is working well.

I do not know if you understand that process and what it takes to get a piece of equipment into an aircraft. It is not as easy as just developing a filter and slapping it in there.

Mr. CARLISLE. Congressman, I absolutely hear your serious concern about this. We do understand the certification process is very involved and takes a long time.

Let me make clear that the proposal we have made to move to the bottom 10, we are making it because of the indications that we are getting that aviation receivers, use of aviation receivers, would be compatible with that use, and would not require additional filtering.

On the upper 10, the 10 closest to GPS, it seems likely that filtering would be required for that. Part of this discussion has to be exactly what that process would be and if it is feasible. We want to engage in that conversation with the industry and figure out what the costs are and the benefits, and what the alternatives are.

Mr. GRAVES. Both of those statements concern me. We know there is going to be a problem out there. You have obviously demonstrated there could be a potential problem out there, and that concerns me for all those pilots that are going to have to buy another piece of equipment for their airplanes.

It is getting tougher and tougher to be able to afford what we need to be safe in the air the way it is. Now, some are going to have to have a filter, and it concerns me for agricultural aviation, too.

For 2 or 3 years, it is not going to be a problem, but it is going to be a problem after 2 or 3 years. We do not know if there is going to be a solution.

In my part of the country, we depend heavily on agricultural aviation, and it is a very important aspect.

I am not a technical wiz either. I just know what stuff is going to cost me, and I know it is getting harder and harder to fly.

I know if it is affecting agricultural aviation, when it comes to GPS, I know it is going to affect other types of GPS for agriculture, because we use the same high-precision stuff when we are farming, and that means that is going to cost me more money to be able to fix that. If it is affecting agricultural aviation, again, I am not a technical genius, but it tells me it is going to get closer than I would be comfortable with when it comes to affecting other areas.

I am terribly concerned about this. I will be honest with you, I am not comfortable with it whatsoever. I am not supportive whatsoever.

I appreciate the opportunity, Mr. Chairman.

Mr. PETRI. Thank you. Mr. Lipinski?

Mr. LIPINSKI. Thank you, Mr. Chairman. I want to thank you and Ranking Member Costello for holding this hearing today.

I just want to say I concur with some of the concerns that Mr. Graves has about the certification process for general aviation.

I want to focus on something else here. I think everyone can agree that GPS is critical to our national defense and affects virtually every mode of transportation.

Billions of dollars have been invested in this system and billions of dollars depend on it.

The bottom line is we need to do everything possible to ensure that GPS absolutely works, both now and in the future.

As a member of the Aviation Subcommittee, I am particularly concerned about LightSquared's potential impact on aviation, and what it will mean for NextGen.

As everyone here knows, NextGen is a satellite based aircraft surveillance in GPS, and it really is critical that we move forward on NextGen so that we can realize all of the savings in time, fuel, and safety increases we can have with NextGen.

I want to ask Mr. Straub, Mr. Hendricks and Mr. Fuller a couple of questions. I would like each of you to comment on how the LightSquared proposal would impact efforts to boost NextGen.

Will the proposal lead to any delays in implementation in your view, and if so, why would this occur?

Mr. Straub?

Mr. STRAUB. Thank you, Mr. Lipinski. I think one first clarification point on the lower 10 MHz of testing that was done, I want to first point out that was only done at one-tenth of the FCC authorized power limit, so one-tenth of the power was used here, and we found that there are at the minimum operational performance requirements, initial acquisition performance problems and degradation. So, we cannot at all say there is no issues in that lower 10 MHz.

As to NextGen, one of the key attributes of GPS is its availability as a system. It has to be there. As the pilots know, when you fly an instrument approach, if the approach cannot be completed, you must go on to an alternate location, and each step like that takes away one safety net from the completion of the flight.

That is a very serious concern. Also relating to NextGen is our ADSB system, basically, knowing where the aircraft are. The "D" in ADSB is dependence upon GPS, so it has to be there. It has to be precise. You have to count on its continuity of availability. If we cannot count on those things, then I think we have to go back to the drawing board of NextGen and determine where we are and how we go forward.

Thank you.

Mr. FULLER. That is a very good question. Today and every day this week, the FAA's air traffic control system will manage something on the order of 50,000 aircraft over a 24-hour period.

These are commercial aircraft and general aviation aircraft. One aspect of all those flights is they rely on GPS systems to navigate.

In the aviation community, if you say well, there is only a 1 or 2 percent problem, would you really want to go flying today if I told you that somewhere between 500 and 1,000 aircraft are likely to lose their signal?

Would you like us to rely on the instrumentation that is a fundamental part of NextGen technology to land aircraft when 500 or 1,000 of them might lose their signal on approach, flying low over urban or rural areas?

I think not. I think that is a standard in the aviation community we just do not accept.

I know it will be said, well, it does not look like aviation has a problem. Yet, the very people who make the systems that we rely on in our planes that are certified by the FAA are saying we are not sure, we do not know. We do not see a solution.

I think that has to weigh very heavily on us, and I guarantee you that if anything causes concern about the reliability of the GPS system that is in place, it will absolutely interfere with the development and advancement of NextGen.

Mr. LIPINSKI. Thank you. Mr. Hendricks?

Mr. HENDRICKS. Congressman Lipinski, thanks for the question. I appreciate it very much.

I would like to offer my perspective on this. I am privileged to co-chair the Aviation Rulemaking Committee on ADSB and also I co-chair the NextGen Advisory Subcommittee. I am very engaged on NextGen activities.

The process of certification that Congressman Graves spoke to a few moments ago highlights how we have been able to create this very safe system in the United States. It is very deliberate. It is very thorough.

We build great confidence in any component we put into our commercial aircraft today that it is going to work as it has been designed and certified by the FAA.

In fact, Congressman LoBiondo's constituents in his district at the FAA technical facility in Atlantic City play a key role in this process.

It is a deliberate process. It takes time, but it builds confidence and it has proven to be an important underpinning of the safe operations we have been able to develop over years, and they are just getting safer.

Another key element of this is if NextGen is delayed, and by some estimates, if we go through this certification process, NextGen could be delayed up to 10 years, we are going to forego the opportunity to create what we estimate are 150,000 jobs in the United States as a result of moving towards NextGen.

We have very serious concerns. GPS is the cornerstone of how we are going to modernize our national airspace system and go to an even safer system than we have today.

Mr. LIPINSKI. Thank you, Mr. Hendricks. I just want to say I am concerned about those job losses. I think this delay could really hurt American manufacturers, put them behind in developing and getting out their aviation products to market.

There might be a role that DOT and DOD should play in the FCC process when it comes to matters that potentially impact GPS. I think it is something we certainly should look at.

When I am out running with my Garmin on my wrist, concern about losing the signal certainly is not that detrimental, but when we are looking at other matters of concern, such as aviation, it certainly is. I think we all agree upon that.

Thank you, Mr. Chairman.

Mr. PETRI. Thank you. Mr. Hultgren?

Mr. HULTGREN. Thank you, Mr. Chairman, and thank you all for being here. Just a couple of questions.

The big issue that we are facing is job loss and really getting this economy rolling again. I just wanted to address my first question to Mr. Hendricks.

In the airline industry, I wondered if you could discuss quickly what you would see as the impact on job creation if new cost burdens associated with interference mitigation would be born by the industry, what is your best guess of what the impact would be?

Mr. HENDRICKS. Yes, thank you for the question. We are very concerned about the cost to certify, purchase, and equip any new capability in the aircraft to compensate for the spill over of signals into the GPS spectrum as we currently use it today.

Estimates for the U.S. commercial airline industry are as high as $2 billion in additional costs. Our economists estimate that for every billion dollar of cost, we put 12,500 U.S. airline industry jobs at risk.

I would just refer to my previous comments that NextGen for the country, we estimate that over a 10-year period, we would create 150,000 jobs.

Job loss, the lack of job creation is a serious concern if NextGen is impacted the way we feel it could be.

Mr. HULTGREN. Switching gears a little bit, Mr. Hendricks, in your opinion, are there currently available technical solutions that would fully protect those GPS devices from LightSquared's interference?

Mr. HENDRICKS. I am unaware of any certified equipment available today to accomplish this task.

Mr. HULTGREN. Mr. Straub, if I can ask you quickly, it seems to me that if the entire aviation industry were to have to equip avionics with GPS filters to meet new standards, manufacturers like Garmin could make a lot of money, but is it even feasible, are there technical solutions out there to address this GPS interference?

With this interference, if you could help me understand a little more functionality, what would really be the impact, if there are filters there, how would it impact the functionality?

Mr. STRAUB. Let me begin by saying right now, we know of no filters. We have seen PowerPoint presentations and hypothetical filters, but nothing that works.

Without getting into a lot of the technical details, some of the things that have been proposed simply cannot work with the system. The antennas and the GPS receivers work together as a system to provide the required performance function.

The upper 10 MHz is especially troublesome because it is immediately adjacent to the GPS band. We are talking about, if you can think of that 4 billion to 1 ratio, a terrestrial based high-power transmitter just is not compatible with a very weak 50 watt light bulb in space type signal.

We simply do not see a path at all to allow that to happen, regardless of what type of new filter innovations could ever exist. That is not touching necessarily upon the practical deployment side if such a thing did exist.

Mr. HULTGREN. Thank you again. I appreciate you all being here. I yield back, Mr. Chairman, thank you.

Mr. PETRI. Thank you. I have a couple of questions and then we will have another round as well.

Mr. Straub, I guess you have been looking at this. It has been discussed for a number of years. It is not just something that came up last week. You have been working in this area for most of your life, I assume, professional life.

You did not mince words. You had a rather strong statement talking about lawnmowers and trying to help people understand the technology of it.

I just wanted to give you an opportunity, if you refer to the testimony of Mr. Carlisle and their efforts to modify their approach to accommodate aviation and other industry concerns, I just wonder if you could give us your analysis of that, if you see any problems with it and the like.

Mr. STRAUB. I think we sincerely come to the table to try in goodwill to reach a compromise or a solution that can work. But, some of the challenges we have encountered—as I mentioned earlier, the FCC authorization was for up to 72 dBm of power. I think LightSquared had said they would execute at a maximum of 62, which is where the RTCA testing and analysis was done.

In the recent press release this week said, well, we will come out at only 50 percent of what was authorized, I believe. That is actually 69 dBm versus the 62 we tested out.

Not to get into engineering speak and technical terms, but that is on a logarithmic scale. So, 10 dBm is a factor of 10.

In reality, what they are proposing at this point is still far above what the testing and analysis was done at.

That raises troubling concerns about what does that power spectrum really look like, and we simply do not know. If it is at that level, that is a very challenging level to deal with.

We have invested millions of dollars, as I said, in basically understanding the proposal and how can we mitigate issues, and are just coming to the end that we do not see a means to do that.

We look at it as an industry, a company, we realize that LightSquared must also be profitable in the end. And if they've said before their deployment is dependent upon being able to use all the spectrum out there to have the up links and down links of the required bandwidth they need.

If that is a requirement and that upper spectrum is just not compatible at all with GPS, we just do not understand how they can get to a successful deployment over time.

I guess it is the proverbial camel's nose under the tent. Eventually, the whole camel is going to be in the tent. In this case, that means GPS would cease to function.

Mr. PETRI. It is my understanding that the studies showed they could use one-fourth of their capacity at one-tenth of the power, but they are certified at half the power by the FCC.

You would object to them going forward without modifying the FCC authority to put it down to one-tenth, but even then, it is 99.5 percent safe, and there is the worry, as Mr. Fuller and Mr. Hendricks pointed out, that in aviation, we do not shoot for 99.5 percent. That is not acceptable when you are dealing with human life and the like.

You would object and feel that the FCC authorization should not be allowed to go forward under any circumstances unless it is sig-

nificantly modified, and even then, there would be some risks; is that correct?

Mr. STRAUB. I think we want to remove all the ambiguity about what are the limits, what can it be authorized at, and then let us do that analysis and testing.

I guess I keep coming back to the point of if 5 MHz is not adequate for the business case to deploy ubiquitous broadband coverage, we would like to have some reassurance of what the plan is to make that happen.

Because this is obviously a very costly—many industries, companies, ourselves, have spent millions and millions of dollars on this defending and protecting the GPS user base.

We would want to have assurance of what is that plan to achieve the end goal.

Mr. PETRI. Mr. Fuller, are there any legislative areas or problems? We are basically here doing oversight. This is an area where it was basically FCC dealing with radio stations, and suddenly, we are dealing with conflicts between major corporations, between major sectors of our economy, becoming a hugely important economic infrastructure, so to speak, use of spectrum, and different capabilities that are built into how we lead our lives.

Is there need for some review or study as to how we go about the process of resolving these conflicts or should it be left up to the FCC without modification as it currently appears to be done?

Mr. FULLER. Since we are sort of flashing back to the 1980s, I will use the phrase "trust but verify." It is very promising that a company would say they want to work with us, and we want to work with them.

It is sort of curious to me that the FCC would grant authority and waivers but say go see if you can work with these people and reduce the problems.

Again, I think the FCC should do better than that. Nothing that I have heard says anything is coming off the table. We are going to voluntarily do this. We are going to explore that.

Six years from now, we might have a different idea or a different plan.

I think there is such a fundamental flaw in the policy process that legislatively, top of mind, I actually think the Department of Transportation, the FAA, and DOD should be required to sign off on something that is going to be a threat to this national asset we call GPS.

It is going to fundamentally disrupt the whole NextGen initiative.

I actually think there is something to be learned in the process we have gone down, where a company that is agreeable to working with everybody finds themselves in a position where they are allowed to go down a path and invest a lot of money.

My view is just because a company has invested a lot of money, like the drug manufacturers, it does not mean we have to say well, gee, let's try to see if something will work, even though it might be dangerous.

I do think there is a role for Congress both with respect to oversight and investigation and putting very clear requirements on the FCC, which apparently has gotten away from the interagency

clearance process that used to exist, to make sure that before they take any further action, they clearly have requirements to get concurrence and sign off by other agencies that are going to be affected.

Mr. PETRI. Thank you. Did you have additional questions?

Mr. COSTELLO. Mr. Chairman, actually, I had a question but you just asked it. That is the exact question I was going to ask, from a legislative standpoint, is there something we ought to be doing.

Mr. PETRI. You might have suggested it to me.

Mr. COSTELLO. We have the extension coming up on Friday, we could put it in the FAA extension this Friday.

I do not have a question, but I agree with you, Mr. Fuller. Mr. Chairman, I think it is something the two of us can work on and we should work on.

In the interest of fairness, since we have four to one here, I am going to ask Mr. Carlisle if he wants to respond to any comment that has been made here.

Mr. CARLISLE. Thank you very much, Congressman. I very much appreciate that.

I would make two main responses. One to comments by Mr. Straub and other comments that have called into question the power levels, and I want to be very clear about this.

The testing was conducted at the power levels we were authorized to use in 2005, 1.6 kilowatts. The commitment that we have made is to only use that power level going forward, even though we are authorized by the FCC today to transmit it up to 15 kilowatts.

We are giving that up, and we would seek a modification of our license so it is binding on us, so we would only move forward with the 1.6 kilowatt power level.

The other thing that I would respond to is concept that Mr. Fuller brought up. We absolutely have an obligation to operate safely and operate without causing harmful interference outside of our bands.

When this service was first authorized under FCC rules, that was not an overnight process. It was 4 years. It started in 2001. The rules were finalized on reconsideration in 2005.

There were thousands of pages of comments from the airline industry, from the GPS industry, from the cellular industry, from the satellite industry.

Moreover, part of that process was our voluntary agreement to limit our emissions out of our band in order to protect GPS because that is what the GPS Industry Council told us at the time, they needed to protect GPS receivers.

In 2005, the FCC made two very important decisions. It lifted any limit on the number of base stations that could be deployed in this network and it established the current power levels of 1.6 kilowatts.

That decision was not appealed. It was not reconsidered. There was no subsequent petition for rulemaking, and nobody approached us to seek a further modification of our agreement on our power levels for the next 6 years.

In fact, in 2009, when we sought the increased power levels, the GPS Industry Council participated in that proceeding and with-

drew. They did not object to power levels that were 10 times higher than what we are planning to use.

That was in 2009. That was not 6 years ago. That was a very recent opportunity to come in and talk about this issue.

The important thing about this is certainty. When we invested $4 billion in this company, in developing this spectrum, the GPS Industry Council had withdrawn without objecting to higher power levels less than a year before.

We came in, we invested the money to develop this network. Now, if there is extraordinary action taken on a legislative or regulatory basis as a result of this—let's make one thing perfectly clear. If the waiver went away tomorrow, it would not make any difference to the interference issue. We would still be broadcasting at the same transmission level with the same number of base stations. The waiver did not in any way impact the interference issue.

If there is extraordinary regulatory or legislative action taken, if we are not allowed to try to work this out on a cooperative basis, certainty on spectrum and the valuation of spectrum will be severely undermined in this country, severely undermined, depending on what version of the budget you look at, it is assumed that between $23 billion and $28 billion of revenue would come into the Federal Government over the next 10 years on the basis of auctions of spectrum. That is not going to happen if investors cannot have some measure of certainty in the value of spectrum.

What I would ask is that we be allowed to try to work this out on a cooperative basis going forward. We have made a reasonable proposal. We are willing to talk about that reasonable proposal.

Thank you very much for your time and your patience.

Mr. PETRI. Thank you. Mr. Cravaack?

Mr. CRAVAACK. Thank you, Mr. Chairman. Thank you, Mr. Carlisle. Appreciate that statement. Thank you very much.

One of the things I am hearing from the panel is the filter systems have not really materialized yet. I understand from the GPS point of view, hey, we have been using GPS quietly, nobody has been bothering us.

This comes in and there may be a potential problem. As I understand it, there may be a potential filter associated with this.

The problem I see, like Congressman Graves was saying, this is an added expense to general aviation, to commercial aviation, you name it, whoever uses GPS.

My question is would LightSquared be willing to pay for those filters going forward in the future?

Mr. CARLISLE. Thank you very much for the question, Congressman. We will detail this more as we detail our proposal at the FCC. As I mentioned briefly in my testimony, we are willing to underwrite the development of filtering technology for the new receivers and work on that cooperatively with the industry.

On the question of available filtering, we know sitting here today filters are available. Filters for these devices are less than a nickel. There are filters for timing devices that are available on the market today for $100, from two different suppliers.

There may not be filters for every type of GPS receiver, but there are filters available out there. Let's make no mistake. We also know as a result of the testing that certain receivers are much

more resilient to this type of interference than others. There are best practices in the industry in terms of front-end design and filtering and other methods of eliminating this kind of effect.

We know that is possible, and it has been possible for the last 6 years, certainly.

Thank you for the question.

Mr. CRAVAACK. Thank you for the answer.

In your press release on Monday, you stated the new development plan involves a 50 percent power reduction on base station transmitters for the lower 10 MHz of the spectrum furthest from the GPS.

Is this 50 percent reduction what LightSquared committed to the technical working group or from the FAA authorized level?

Mr. CARLISLE. In 2005, we were authorized to—I will give you both numbers. The number in the FCC order in 2005 was 32 dBW. That equates to approximately 1.6 kilowatts.

In 2010, we were authorized to transmit at 42 dBW or approximately 15 kilowatts, so 10 times higher.

This is the level that we will not be using. We did not engineer our network to operate at it. We actually have engineered it to use the 2005 power levels.

The only cell transmitters that exist are transmitters that operate at that level.

That is the level we will use going forward, let me be very clear. That is what we are committing to going forward. If we have to clarify that further, we will do so.

Mr. CRAVAACK. Are there any comments from the rest of the panel on that? It seems pretty clear.

Mr. STRAUB. I think that is the clarity we are looking for, at least as a basis to understand where they propose going forward.

There was ambiguity, it was not clear. As you asked, Congressman, is it 50 percent below that initial level? I have 16 kilowatts, 15, whatever that is; or is it something in between that and the 2005 level?

I think that is the spirit of cooperation and that we need to know so we can analyze those effects.

Mr. CRAVAACK. Thank you very much, panel, and thank you very much, Mr. Chairman.

Mr. PETRI. Any further questions?

[No response.]

Mr. PETRI. If not, we thank you very much for a very informative discussion. This hearing is adjourned.

[Whereupon, at 11:15 a.m., the subcommittees were adjourned.]

STATEMENT OF
THE HONORABLE JERRY F. COSTELLO
SUBCOMMITTEE ON AVIATION HEARING ON
"GPS RELIABILITY: A REVIEW OF AVIATION INDUSTRY PERFORMANCE, SAFETY ISSUES, AND AVOIDING POTENTIAL NEW AND COSTLY GOVERNMENT BURDENS"
JUNE 23, 2011

- I want to thank Chairman Petri and Chairman LoBiondo for calling today's joint hearing on "GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens."

- In recent months the aviation industry, the Department of Defense and the Department of Transportation have expressed serious concerns regarding LightSquared's plan to broadcast powerful ground-based signals using frequencies reserved for far weaker satellite transmissions. In fact, recent studies by the RTCA and the U.S. Government validate these concerns, concluding that LightSquared's planned signals would disrupt the reception of Global Positioning System (GPS) signals.

- We all know that the ongoing effort to implement the Next Generation Air Transportation System (NextGen), which will transform our airspace, will require a transition from ground-based to satellite-based capabilities. However, the Federal Aviation Administration (FAA) and airspace users have **already made substantial investments** in GPS-based technologies that are enhancing safety and efficiency **today**.

- Looking forward, performance-based navigation and automatic dependent surveillance (ADS-B) – both of which rely on GPS - have been described as the "backbone of NextGen." NextGen systems will help permit aircraft operators to save 1.4 billion gallons of fuel and cut carbon emissions by 14 million tons. Further, the Nation's 567,000 airline industry workers have a vested interest in the cost savings that NextGen promises.

- Mr. Chairman, it is in the Nation's vital economic, security and safety interests to have a fully functioning global positioning system. I hope that we can reach a solution to mitigate GPS interference issues that are at issue in today's hearing. However, any technical solution must be workable for the aviation community, the maritime industry, the Department of Defense, and the Department of Transportation. Moreover, a technical solution should not impose undue costs on the aviation community or in any way degrade GPS-related capabilities.

- Thank you, Chairman Petri and Chairman LoBiondo. I look forward to hearing from our witnesses.

Rep. Rick Larsen

Opening Statement

Hearing

Subcommittee on Coast Guard and Maritime Transportation

"GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens"

June 23, 2011

Thank you, Mr. Chairman, for holding this morning's hearing to review the relationship between the future reliability of the Global Positioning System (GPS) and a new proposal to expand broadband internet access in the United States.

Since the time I was first elected to the Congress, I have been working to implement strategies that support investments and innovations in new technologies and business to spur long-term economic growth and maintain U.S. global economic leadership. I look forward to hearing more about LightSquared's proposal to expand broadband Internet access and increase competition in the information industry.

Increased access and competition can only benefit the economy. However, we must understand how this increased access and competition interacts with existing elements of the economy, and what trade-offs might be required.

The Federal Government and the private sector have invested billions of dollars to develop, build and operate a reliable, efficient and safe transportation system, and that system in many respects remains the envy of the world.

Investments made in our aviation sector, in our ports and maritime industries, and in our rail and highway networks, combined with investments in telecommunications and geospatial information technologies, especially GPS, are each vital to sustained economic growth.

GPS is fully integrated within the context of global economic and national security sectors. In fact, it is estimated that the worldwide GPS market will total more than $75 billion by 2013. Any new development that could potentially compromise that integration is a risk that deserves our attention. That is the purpose of today's hearing, to learn whether LightSquared's proposal for a broadband network will have an adverse impact on existing GPS uses.

Several of today's witnesses will assert that the new ground-based broadband transmissions proposed by LightSquared could disrupt GPS signals, and furthermore, that this degradation could have variable impacts on a wide assortment of GPS-dependent technologies, including some that are currently in use by the United States Coast Guard and that ensure the safety of maritime commerce.

I will look forward to learning from our witnesses how the LightSquared proposal might impact transportation safety and what the costs might be to both industry and the casual users of GPS. I am also interested to learn whether there are viable technical, affordable and timely options to address the perceived risks to GPS, or, whether our witnesses believe that LightSquared's present business model and technology might simply be incompatible with maintaining the varied uses of GPS.

If the question before us, Mr. Chairman, was whether or not to support the expansion of affordable broadband wireless service, my guess is that most members would. Of course, that is not the purpose of today's hearing.

If a transmission from LightSquared's proposed ground-based broadband network could interfere with GPS technologies, it is incumbent upon the members of these two subcommittees to fully understand the ramifications and trade-offs.

We have an important responsibility to ensure the safety and reliability of our transportation system. Safety and reliability have been among this Committee's longstanding priorities, and it is from this perspective that we will carefully review the potential impacts of this new venture.

Thank you, Mr. Chairman

Statement of the
Honorable Frank A. LoBiondo
Chairman
Subcommittee on Coast Guard and Maritime Transportation
Joint Oversight Hearing on
"GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens"
June 23, 2011

Thank you, Chairman Petri.

As a member of the Aviation Subcommittee, I would like to echo Chairman Petri's concerns on the effects of GPS interference on our aviation system as a whole. As the Chairman of the Coast Guard and Maritime Transportation Subcommittee, I feel it is important that we also focus on the effects of GPS interference in the maritime realm. As with aviation, the marine transportation system is highly dependent on GPS. The vast majority of the 12 million recreational vessels, 30,000 fishing vessels, 40,000 commercial vessels, and 9,260 foreign vessels that call on U.S. ports rely on at least one, if not several, GPS based systems for navigation, collision avoidance, and safety of life at sea. For instance, vessel pilots rely on GPS to guide fully loaded LPG tankers up the Delaware River ship channel and under several bridges to their berth in south Philadelphia. The Coast Guard relies on GPS to navigate their aircraft and vessels and to pinpoint the location of boaters in distress.

During tests of the LightSquared signal, the Coast Guard observed varying levels of interference with GPS dependent technologies critical for search and rescue, port security, maritime safety, and environmental stewardship. I look forward to hearing testimony from the Coast Guard this morning elaborating on the issue of interference and what can be done to mitigate it.

I want to take a moment to express my extreme disappointment with the Department of Homeland Security in its handling of this issue. The Department, whose mission it is to ensure the safety and security of the maritime transportation system, has failed to formally weigh in on this matter. The Departments of Defense, Transportation, Commerce, and Interior, as well as NASA and other federal agencies were all able to publicly express their concerns prior to the FCC granting a conditional waiver to LightSquared in January. But nearly six months later, the Department of Homeland Security is still "examining" the issue. I find that unacceptable.

I am also very frustrated the Secretary continues to drag her feet in determining the need for a back-up to GPS. The Administration shut down LORAN, the nation's only GPS back-up system, in February 2010 with no plan for putting in place a new system or even a determination of whether a back-up is needed. Pursuant to the Coast Guard Authorization Act of 2010, this determination was required by April 10, 2011. The potential disruptions to GPS that we are meeting here today to discuss underscore how imperative it is that the Department completes this review as soon as possible.

Finally, I understand LightSquared has proposed in recent days to limit the signal strength and the frequency they intend to use in an effort to resolve some of these issues. I commend them for that, but I have concerns that this may still interfere with critical GPS dependent technologies. I urge LightSquared, the federal government, and all those affected to actively participate in the testing of this revised proposal to ensure it will not affect the safety and security of our nation. I thank the Chairman for holding this hearing with me today and I look forward to hearing from our broad range of witnesses on the potential solutions to this problem. I yield back.

TESTIMONY

OF

JEFFREY J. CARLISLE

EXECUTIVE VICE PRESIDENT, REGULATORY AFFAIRS & PUBLIC POLICY
LIGHTSQUARED

SUBCOMMITTEE ON AVIATION AND SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION, HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

2167 RAYBURN HOUSE OFFICE BUILDING

JUNE 23, 2011

Chairmen Petri and LoBiondo, Ranking Members Costello and Larsen, and Members of the Subcommittees, I am pleased to appear before you today to discuss our plans to bring exciting new telecommunications services to the United States and its adjacent waters, in a manner that is fully compatible with users of our critical GPS system. Much has been written and stated about LightSquared's plans and interference with the GPS network. Please allow me to be direct, clear, and unequivocal: LightSquared has no intention of conducting its operations in a way that interferes with government or commercial aviation or maritime operations in the United States, nor do we believe the FCC would allow us to do so.

LightSquared hears the sincere concerns expressed about interference, shares them, and will continue to devote considerable time and resources to solving them. This past Monday, we announced our plans to begin operations only in the lower 10MHz of spectrum, which is farthest away from the L1 Band used by GPS operators. In the meantime, we will work cooperatively with the government and affected stakeholders to either find alternative spectrum to allow our complete build out, or permit a long-term, phased approach to using the upper frequency band only in a manner that is widely acceptable, technologically compatible, and financially cost-effective.

We believe that ubiquitous, reliable, 4G LTE wireless broadband service can live harmoniously with current and expanding uses of GPS for the mutual benefit of our citizens and each affected industry. Enlightened and responsible spectrum management will give the American public the best of both worlds – a world class wireless broadband network and a GPS service that continues to enrich and protect our lives.

I. LIGHTSQUARED IS BUILDING CRITICAL INFRASTRUCTURE FOR THE 21ST CENTURY

LightSquared is investing $14 billion over the next eight years to build a nationwide next generation 4G wireless broadband network. This investment will support over 15,000 jobs a year for each of the five years that it will take to construct this network. When completed, our ground network will provide over 260 million people with wireless broadband service at expected speeds of 5 to 10 megabits per second. We believe this new electronic highway system, built with private sector money, will add significantly to our country's economic growth, consistent with important public policy goals of expanding deployment of broadband service.

This state-of-the-art 4G network is the culmination of years of hard work and billions of dollars of private investment. LightSquared has been authorized to use spectrum for mobile satellite services (MSS) since 1989, and launched its first satellite in 1996. For the last 15 years, we have provided voice and data services over our satellites to federal, state and local governments, transportation and maritime industries, and others who need reliable communications when a ground network is unavailable.

In 2003, the FCC first authorized the use of LightSquared's spectrum for ground networks, and since then LightSquared has worked hard to bring its network to market. We coordinated spectrum and developed technology to support an integrated satellite and ground network. We have also spent several years working with the FAA and the U.S. Coast Guard to protect the use of aviation and safety services within the band where LightSquared operates. For example, we agreed to limit our own emissions into adjacent bands well beyond those standards required by law.

Now we are ready to move forward, and this investment is coming at a particularly crucial time. The U.S. is seeing, today, the beginning of an almost vertical growth in data usage.

The industry predicts that data usage will jump from under 2 million terabytes per year to almost 14 million terabytes in 2015. Spectrum is needed to carry that data, and spectrum is severely limited. The FCC has already identified a need for at least 500 MHz of additional spectrum to be freed for broadband use over the next ten years, and some have said the FCC's projections significantly understate the need.

We are bringing 40 MHz of spectrum to be used for broadband services – a substantial down payment on the FCC's ten-year goal. We will do this in a way that is completely different from other wireless companies in two ways.

First, LightSquared will be the only wireless broadband network with an integrated satellite/land-based system. The first of our two next generation satellites was launched in November 2010, with the largest dish ever placed on a commercial spacecraft – seven stories tall. This allows a smartphone, tablet, data stick, or other device to link to the satellite when the ground network is not available, either because the device is out of range, or when ground networks have been destroyed by natural disasters. Our satellite operates up to 200 nautical miles offshore. The size and cost of satellite-enabled devices will be the same as that of regular cellular devices and will replace today's satellite phones, which currently resemble more of a brick than a cell phone. The seamless terrestrial/satellite functionality will provide substantial benefit to government, public safety, the maritime community and individual consumers.

Second, LightSquared will be the first wholesale-only network. We will sell capacity to wireless companies, retailers and other companies that want to provide broadband services, and they can then provide the integrated network to their consumers. When we build our network, we're not just enabling LightSquared as a competitor; we're enabling dozens of competitors in the marketplace.

What LightSquared is doing is making a massive private investment in critical U.S. infrastructure, making better and more efficient use of spectrum, and enabling wireless competition, all to the benefit of American consumers, public safety, and the nation as a whole.

II. GPS INTERFERENCE HAS BEEN STUDIED COMPREHENSIVELY

Part of LightSquared's spectrum is directly adjacent to the spectrum used by GPS. This is not a new development. When LightSquared first proposed using satellite spectrum for a ground network ten years ago, the FCC sought public comment, including review by federal government spectrum users. The GPS community, represented by the US GPS Industry Council (USGIC), asked us to voluntarily limit our energy that might bleed over into the GPS band. If we did nothing, comparatively powerful base stations used in cell sites could drown out faint GPS signals. So, in 2002, we voluntarily accepted USGIC's proposal to limits on emissions out of our band into the GPS band that are 1000 times stricter than what the FCC required, and designed our network around this agreement. The GPS industry applauded our agreement and urged the FCC to grant our license. I have provided a chronology with citations to source materials as Attachment 1 to my testimony for additional background.

The current concerns about interference do not stem from our out-of-band emissions from us into the GPS band. Rather, in September 2010, the USGIC raised a different issue that it had never raised before, regarding certain GPS receivers that are designed to not only capture GPS signals in the GPS band, but also capture signals in our band. As a result of their design, these receivers can be desensitized, or overloaded by our signals in our licensed spectrum. I have provided illustrations showing this effect as Attachment 2 to my testimony.

The FCC's normal policy is to expect receiver manufacturers – GPS or otherwise – to protect themselves from signals outside their band through careful design of their receivers. We

did, however, recognize the potential seriousness of the issue and committed to work collaboratively to solve it.

In January of this year, the FCC accepted our commitment to work with the GPS community and federal agencies to determine the scope of the problem and possible mitigation, and ordered us to establish a cooperative testing group.

What followed was an extensive study of interference conducted by perhaps the most comprehensive group ever assembled for such a study. The Technical Working Group (TWG), co-chaired by LightSquared and the USGIC, comprised 37 individuals with strong technical expertise representing a full range of GPS receiver categories, installed user groups, and other interested parties. It included representatives of all the major GPS manufacturers, the four major wireless companies, two public safety organizations, the Department of Defense, FAA, NASA, Boeing, Rockwell, and Lockheed Martin. The TWG also relied on advisors representing a full range of GPS stakeholders including manufacturers, user groups and individual experts. Over a three-and-a-half month period, the TWG tested over 130 devices across seven GPS receiver categories — aviation, cellular, general location and navigation, high precision, networks, space-based receivers, and GPS timing receivers. Following a two-week extension, the Final TWG Report is due to be filed by July 1.

Separately, the Department of Defense, RTCA (the not-for-profit aviation safety standards organization) and the Jet Propulsion Laboratory conducted their own analysis and tests of dozens of GPS receivers. LightSquared provided equipment and engineering expertise for each of these tests. Several reports or summaries have already been made public including reports from RTCA, the NPEF (National PNT Engineering Forum) Report of government

receivers derived from the DoD tests, and a report by the National Public Safety Telecommunications Council (NPSTC).

III. LIGHTSQUARED CAN DEPLOY ITS SERVICE AND CAUSE NO INTERFERENCE TO AVIATION AND MARITIME USE OF GPS

Although the TWG tests have not yet been released, existing public information points the way towards mitigation that will fully address the concerns of the aviation and maritime communities, while allowing LightSquared to bring this important broadband network to hundreds of millions of Americans

Mitigation options are built upon the understanding the vast majority of GPS receivers look only at that part of LightSquared's spectrum that is immediately adjacent to GPS – the spectrum comprising the upper portion of the FCC-allocated spectrum. LightSquared's original plan, before USGIC raised the overload issue in September 2010, was to use this spectrum first, and then bring additional spectrum located in the lower range of the band online two to three years later, when it needed further spectrum to serve capacity needs. This additional spectrum in the lower range of our licensed band is as far away as we can possibly operate from the GPS band. Indeed, the upper edge of these frequencies is a full 23 MHz removed from the bottom of the GPS frequency,

Unsurprisingly, then, publicly available reports have concluded that LightSquared's *planned* deployment would cause interference with a broad range of different types of GPS receivers, because the planned deployment would have started close to the GPS band. They also show, however, that our operation in the lower part of the band does not cause interference for the vast majority of GPS receivers. We believe that of the 400-500 million GPS receivers in use today in the United States, less than one percent are susceptible to harmful interference from our lower channel operations. The NPEF recommends further testing of the 10 MHz furthest away

from GPS, as the testing conducted by the federal government agencies on receivers so far has shown minimal or no interference. Similarly, the RTCA report stated that the 5 MHz furthest away from GPS does not cause a problem for aviation receivers even under worst-case analyses, and that further analysis is needed to confirm that the next 5 MHz is similarly clear. The RTCA also concluded that aviation receivers tested performed significantly better than the minimum performance standards. LightSquared is optimistic that this further analysis can be concluded in the next few weeks and will confirm the ability to use the lower 10 MHz channel without potential impact to aviation receivers.

Separately, NPSTC, having looked at results from testing of public safety receivers, filed a letter with the FCC on June 15 stating that initial tests have suggested that operations at the 5 or 10 MHz farthest away from GPS do not negatively impact public safety devices.

The potential for interference from our operation on the lower channel is almost exclusively limited to receivers in the categories referred to as "high-precision," "network," and "timing." We do not minimize the importance of these devices, but we estimate that they represent no more than roughly one million devices. Filtered antennas are available for timing devices that will permit them to continue to be used without interruption. Precision and network GPS receivers represent a more difficult problem because they have been designed to listen to both the GPS signal and to signals from another satellite operator in our band, to augment the precision of their GPS device.

LightSquared believes the TWG results will largely confirm the direction pointed by these tests and reports. Accordingly, we are proposing a three-part solution.

- First, LightSquared will operate at lower power than permitted by its existing FCC authorization, voluntarily relinquishing the right to operate at power levels approved in early 2010.
- Second, LightSquared will agree to a standstill in the terrestrial use of its upper 10 MHz immediately adjacent to the GPS band and will not incorporate those frequencies into its terrestrial network until the FCC and NTIA are satisfied that this can be done without risk to GPS. This additional time can be used to determine a glide path for use of this spectrum.
- Third, LightSquared will commence terrestrial commercial operations only on those portions of its spectrum that pose no risk to the vast majority of GPS users and will coordinate and share the cost of underwriting a workable solution for the relatively small number of legacy precision measurement devices that may be at risk.

In addition and contrary to the claims of some of the GPS manufacturers, there are technical and operational solutions that are available to allow us to deploy our network while retaining the benefits provided by these high-precision GPS devices. For example, LightSquared can coordinate its rollout so high-precision agricultural receivers will not be near LightSquared base stations for several years. Additionally and as part of our overall mitigation proposal I've already discussed, for those uses in urban areas that may be affected sooner, LightSquared can work out coordination of operations and spot replacement of high-precision and network receivers. LightSquared is prepared to underwrite the development of filtering technology for new receivers that can then be used consistently with the placement of our network. LightSquared will also work with Inmarsat to find a place in our band where the augmentation signal for high-precision and network receivers can be placed over the long term,

isolated from terrestrial operations and where they can have a much higher certainty for their ongoing operations than they do today. We are already working with Inmarsat and the U.S. Coast Guard to ensure maritime safety communications are not adversely affected.

IV. CONCLUSION

LightSquared takes seriously the sincere concerns expressed by the GPS community over the interference issues raised by the design of GPS receivers and readily accepts its obligation to be a good neighbor, no matter however or whenever this issue arose. By taking the steps I've outlined in my testimony, LightSquared will address this issue for over 99% of the receivers currently used, including receivers used today in aviation and maritime applications. These steps are not inexpensive to us, and they are not easy, but they can and must be done. We are stepping up to this commitment so that Americans can get the benefit of our significant investment in critical infrastructure, and continue to have all the benefits of a robust GPS system, and we hope the GPS industry will do the same.

* * * *

Jeff Carlisle is Executive Vice President for Regulatory Affairs and Public Policy for LightSquared, where he is responsible for all domestic and international regulatory and policy matters including those at the FCC, Congress, the Executive Branch, the ITU, and in foreign markets.

Before joining LightSquared, Jeff served as Vice President of Regulatory Affairs for SkyTerra Communications. Before joining SkyTerra, he served as Vice President, International Public Policy and Government Relations of Lenovo, the global computer manufacturer. Jeff headed Lenovo's Washington office from 2005 until 2008.

From 2001 to 2005, Jeff served as Deputy Chief and then Chief of the FCC's Wireline Competition Bureau. At the FCC, he managed the development of the Commission's policies on broadband and competitive entry into the local exchange market, and he was the architect of the Commission's policies on Voice over Internet Protocol (VoIP) and bankruptcy of common carriers. From 1995 to 2001, he practiced law at O'Melveny & Myers and independently, starting as a transactional attorney and then specializing in broadcast and telecommunications law.

Jeff has spoken at numerous events on telecommunications, trade and security policy issues. He received a B.A. in History, magna cum laude and with honors, from UCLA; a J.D. from Boalt Hall at the University of California, Berkeley; and an M.A. in Law and Diplomacy from The Fletcher School.

ATTACHMENT 1

CHRONOLOGY

Attachment 1

LIGHTSQUARED AND GPS – THE FACTS

For the last decade, LightSquared has planned to deploy a terrestrial network, and worked with the GPS community to make sure its network would not interfere with GPS.

LIGHTSQUARED'S SERVICE HAS BEEN EXPECTED FOR ALMOST TEN YEARS

- In 2001, LightSquared proposed using satellite spectrum for a fully-capable ground network. In 2002, after discussions with the GPS industry representatives, LightSquared agreed (http://fjallfoss.fcc.gov/ecfs/document/view?id=6513283601) to curtail any portion of its signal that crossed into GPS frequencies. This agreement imposed restrictions that were 1000 times stricter than what the FCC rules eventually required. http://edocket.access.gpo.gov/cfr_2010/octqtr/pdf/47cfr25.253.pdf.

- In 2003, the FCC adopted initial rules allowing LightSquared's ground network to operate near GPS. http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-15A1.pdf. These rules were adopted after a full review by DoD, FAA and all other interested government agencies. As the FCC said recently, "extensive terrestrial operations have been anticipated in [LightSquared's spectrum band] for at least 8 years." *FCC MSS Flexibility Order*, ¶ 27 (Apr. 6, 2011). http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-57A1.pdf.

THE GPS INDUSTRY UNDERSTOOD THE SCOPE OF LIGHTSQUARED'S NETWORK

- The 2003 rules allowed LightSquared to deploy over 10,000 base stations. ATC Report and Order, FCC 03-15, at ¶¶ 144-47 (February 10, 2003). http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-03-15A1.pdf.

- In 2003, the U.S. GPS Industry Council ("USGIC") stated that the restrictions of the 2002 agreement were necessary to protect GPS against "[t]he increased user density from potentially millions of MSS mobile terminals operating in ATC mode . . . [and] *potentially tens of thousands of ATC wireless base stations*." Reply Comments of USGIC, IB Docket No. 01-185, at 2 (Sept. 4, 2003) (emphasis added). http://fjallfoss.fcc.gov/ecfs/document/view?id=6515082621.

- In 2004, the USGIC supported the LightSquared application for authority to operate a ground network under the 2003 rules, stating that the 2002 agreement was "intended to protect GPS receivers and at the same time allow [LightSquared] to maximize the utility of its ATC [ground network] service to its users." Letter from USGIC to FCC (Mar. 24, 2004). http://licensing.fcc.gov/myibfs/download.do?attachment_key=366878.

- In 2005, the FCC removed all limits on the number of base stations LightSquared could build and increased their permissible power to 1.6 kw, the level at which LightSquared now plans to operate. *ATC Order on Reconsideration*, FCC 05-30, at ¶¶ 48-50, 53 (February 25, 2005). http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-05-30A1.pdf. Again, this

decision was reviewed by all interested government agencies and was not challenged by USGIC.

- Beginning in 2006 and continuing to 2010, LightSquared disclosed its intent to build a wireless network using tens of thousands of base stations in its annual filings with the SEC http://www.sec.gov/Archives/edgar/data/756502/000119312506067030/d10k.htm and http://www.sec.gov/Archives/edgar/data/756502/000119312510041110/d10k.htm.

THE GPS INDUSTRY KNEW ABOUT LIGHTSQUARED'S PLANNED POWER LEVELS AND DID NOT OBJECT

- In 2009, LightSquared asked the FCC to increase the power levels of its base stations by approximately 10 times to 15 kw, to match the power levels at which other wireless networks are permitted to operate. http://licensing.fcc.gov/myibfs/download.do?attachment_key=-164606.

- USGIC did not object to even those higher power levels. It objected only to the possibility of interference into the GPS band from low-power indoor femtocells, an objection it withdrew (http://licensing.fcc.gov/myibfs/download.do?attachment_key=738501) in August 2009 after reaching agreement with LightSquared. http://licensing.fcc.gov/myibfs/download.do?attachment_key=731265.

- In March 2010, the FCC approved LightSquared's increased power levels. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-10-534A1.pdf. As with all previous FCC proceedings, the order was issued after a public proceeding and was fully coordinated with all interested federal government agencies. Neither USGIC, nor any other party, filed for reconsideration or review of this order.

- Also in March 2010, the FCC required LightSquared to build a ground network reaching 260 million people by the end of 2015. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-10-535A1.pdf. Neither USGIC, nor any other party, filed for reconsideration or review of this requirement.

LIGHTSQUARED IS DOING EVERYTHING IT CAN TO WORK WITH GPS TO ADDRESS ISSUES RAISED ONLY A FEW MONTHS AGO

- In September 2010, USGIC raised for the first time (http://fjallfoss.fcc.gov/ecfs/document/view?id=7020912452) -- in a general mobile satellite proceeding -- the possibility that some GPS receivers may be subject to interference because they can be overpowered by signals transmitted by LightSquared inside the spectrum the FCC licensed to Lightsquared.

- In November 2010, LightSquared applied (http://licensing.fcc.gov/myibfs/download.do?attachment_key=852869) to allow devices onto its ground network that do not also communicate with its satellite. This application did not change the power, number, deployment or any other technical characteristic of LightSquared's base stations. USGIC raised the same objection it raised in September. http://licensing.fcc.gov/myibfs/download.do?attachment_key=854795.

Attachment 1

- Although the interference issue was irrelevant to this application, LightSquared, in January 2011, proposed a rigorous program of testing to determine the extent of the susceptibility of GPS receivers to LightSquared's transmissions, which the FCC made a condition of granting LightSquared's application on Jan. 26, 2011. http://hraunfoss.fcc.gov/edocs_public/attachmatch/DA-11-133A1.pdf.

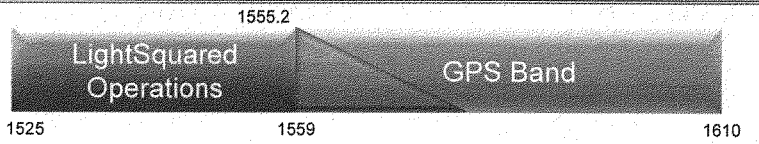
- The FCC validated the GPS testing process a few weeks ago by unanimous Commission vote, noting USGIC's September 2010 comments and the cooperative testing program, and stating that "responsibility for protecting services rests not only on new entrants but also on incumbent users themselves, who must use receivers that reasonably discriminate against reception of signals outside their allocated spectrum." *FCC MSS Flexibility Order*, ¶ 27 (Apr. 6, 2011). http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-11-57A1.pdf.

ATTACHMENT 2

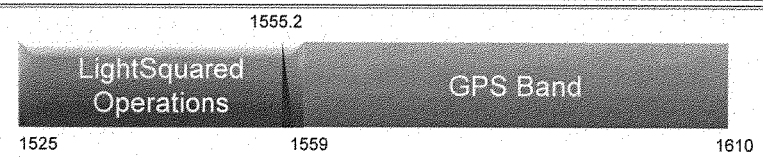
ILLUSTRATION

The Two Sides of the Equation: Transmitters and Receivers

Transmit

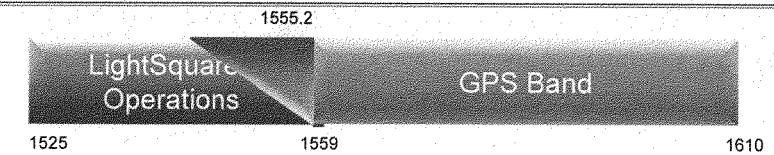


The power emitted by an FCC licensee is generally allowed to fall off at a gradual rate into an adjacent band – this is known as Out of Band Emissions.



In 2003, LightSquared reached agreement with the US GPS Industry Council to severely limit LightSquared's Out of Band Emissions into the GPS band (to -100 dBW/MHz).

Receive



The characteristics of the receivers operating in the adjacent band are critical as well. If receivers are not designed with proper filtration that prevents them from looking into an adjacent band, receivers can become overloaded by the higher power adjacent band signal.

Images are for illustration and are not drawn to scale

LightSquared

U. S. Department of Homeland Security

United States Coast Guard

Commandant
United States Coast Guard

2100 Second Street, S.W.
Washington, DC 20593-0001
Staff Symbol: CG-0921
Phone: (202) 372-3500
FAX: (202) 372-2311

TESTIMONY OF REAR ADMIRAL ROBERT DAY
ASSISTANT COMMANDANT FOR COMMAND, CONTROL, COMMUNICATIONS, COMPUTERS, AND INFORMATION TECHNOLOGY

POTENTIAL DISRUPTION TO GPS

BEFORE THE
HOUSE COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION
AND THE
SUBCOMMITTEE ON AVIATION

23 JUNE 2011

Good morning Chairman LoBiondo, Chairman Petri and distinguished Members of the Subcommittees. I am Rear Admiral Robert Day, Coast Guard Chief Information Officer (CIO) and the Assistant Commandant for Command, Control, Communications, Computers, and Information Technology. Thank you for inviting the Coast Guard to discuss the new terrestrial service proposed by LightSquared and its potential to interfere and impact the spectrum used by the Global Positioning System (GPS).

Although test results are still preliminary, and the testing was conducted at power levels below those at which LightSquared is authorized to operate, the Coast Guard believes that without mitigation, there could be adverse affects on its surface operations in coastal and inland waterways in the vicinity of LightSquared transmission sites, and on its aviation operations in areas surrounding the LightSquared towers. In fact, Coast Guard missions are just a portion of the many DHS operations and regulated activities that rely on GPS and could be affected.

The Coast Guard is assisting DHS and the National Telecommunications and Information Administration as they continue to support the FCC proceedings on this matter.

Thank you for the opportunity to testify today. I look forward to your questions.

AIRCRAFT OWNERS AND PILOTS ASSOCIATION
421 Aviation Way • Frederick, MD 21701-4798
Telephone (301) 695-2000 • FAX (301) 695-2375
www.aopa.org

Statement of Craig Fuller, President and CEO

Aircraft Owners and Pilots Association

Before the

Subcommittee on Aviation and Subcommittee on Coast Guard and Maritime Transportation

U.S. House of Representatives

Concerning

"GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens"

June 23, 2011

Statement Highlights:

1. The availability of a reliable Global Positioning System (GPS) signal is critical to the safety of the national air transportation system, and multiple studies have demonstrated that signals transmitted by LightSquared on frequencies close to those used by GPS cause significant interference with the aviation GPS signal.
2. Since LightSquared requested a modification of its authority for ancillary terrestrial broadcasting, AOPA has been clear and on the record that, based on proven interference, LightSquared should not be allowed to proceed with its November 2010 plan to operate in the bands of 1525 to 1559 MHz and 1626.5 to 1660.5 MHz frequency range.
3. The FCC received AOPA's strongly stated concerns about the threat to GPS ***prior to*** that agency's granting of an unprecedented waiver to LightSquared on January 26, 2011. In addition, the Department of Transportation, Department of Defense, National Telecommunications and Information Administration (NTIA) and Department of Homeland Security have all raised significant concerns about interference from the LightSquared system on GPS frequencies.
4. Thirty-three U.S. Senators have sent a letter to the FCC expressing their concern and requesting that "the FCC ensure the uninterrupted operation of our nation's critical GPS system." And 80 Members of the U.S. House Representatives have also signed letters to the FCC expressing their concern.
5. We call on Congress to fully investigate just how this process has proceeded to a point where the nation's GPS system is being put at risk by a single agency in the face of overwhelming government, private sector and citizen concern.
6. In addition we recommend that, in view of the importance of GPS to the safety and utility of our national transportation system, the FCC rescind the waivers granted to LightSquared immediately and that Congress require the FCC to receive FAA and DOD concurrence before providing any approvals of the LightSquared application.

The Aircraft Owners and Pilots Association (AOPA) is a not-for-profit individual membership organization representing more than 405,000 members. AOPA's mission is to effectively represent the interests of its members as aircraft owners

and pilots concerning the economy, safety, utility, and popularity of flight in general aviation (GA) aircraft.

Each year, 170 million passengers fly using personal aviation, the equivalent of one of the nation's major airlines, contributing more than $150 billion to U.S. economic output, directly or indirectly, and employing nearly 1.3 million people whose collective annual earnings exceed $53 billion.

While AOPA members fully support the expansion of broadband services, especially to underserved and rural communities, such expansion cannot take place at the expense of the safety of the hundreds of millions of Americans who rely on our national air transportation system.

Those Historic Questions....

- What did they know?
- When did they know it?
- (to which we would add) When will they get it?

On behalf of all who use the air transportation system, we want to be very clear: Putting the nation's GPS system – which is a national treasure and absolutely critical to the safety of airborne transportation of all types – at risk is unacceptable.

For one agency of the federal government to have engaged in a procedural process at an accelerated pace that puts our GPS system at risk is confounding. That the same agency actually issued waivers to allow a company to proceed in the face of clear and substantial objections from users, including multiple federal agencies and millions of citizens, is inexplicable.

We call on the Congress, on behalf of millions of Americans who utilize and benefit from the GPS system, to stop this process now and ask for a full investigation of how we have arrived at this point.

Statements suggesting "everyone knew what was being planned" are absurd on their face. And, suggesting fixes on an ad hoc basis while providing regulatory approvals to march forward gives our community real concern with regard to whether the full implications of the actions already taken are understood by the agency granting the waivers. Frankly, there is far too much at stake to simply hope the FCC can sort out the facts on its own.

Importance of GPS to pilots

General aviation pilots rely on GPS in all phases of flight. From takeoff through landing, GPS provides navigation information that allows for the safe and efficient operation of general aviation aircraft for business and personal transportation as well as medical, firefighting, law enforcement, humanitarian, and agricultural operations. Approximately 70 percent of AOPA's members rely on GPS as their primary means of navigation while many of the remainder use it as a backup form of navigation.

In addition, thousands of GPS-based instrument approaches are in use at airports nationwide, with more such approaches being added each year. For general aviation, the availability of GPS and Wide Area Augmentation System (WAAS) precision instrument approaches has allowed all-weather access into more than 2,000 airports nationwide at a fraction of the cost of traditional ground-based approaches. WAAS represents the world's only satellite-based augmentation system certified for 24-hour per day operations. This system has been embraced by the general aviation community, with more than 74,000 WAAS units sold to date.

As of March 2011, there were a total of 9,748 approaches that rely on GPS operating in the United States, compared to only 4,825 ground-based instrument approaches. Without reliable access to GPS in all areas and at all altitudes, thousands of airports would no longer be accessible in low weather conditions, critically diminishing the utility and safety of general aviation flying.

GPS is also a foundational technology in the FAA's ongoing efforts to modernize the air traffic system, an effort known as NextGen. As the FAA continues to move away from a ground-based system and toward a satellite-based system, pilot and air traffic controller reliance on GPS will necessarily increase exponentially, making it vital that we protect the integrity of the GPS system not only now, but also far into the future.

Incompatibility of LightSquared proposal with GPS

Multiple reports have shown that the broadband communications network proposed by LightSquared causes serious interference with the GPS signals that are integral to the safety of the national air transportation system. These studies have

demonstrated effects ranging from the inability to acquire and receive GPS signals over large areas to interference with signals at low altitudes—those most critical for safety in low weather conditions.

A special advisory committee of the not-for-profit organization RTCA that serves as a federal advisory panel on navigation and air-traffic management policy concluded that elements of the cellular network proposal by LightSquared are "incompatible" with aviation because of GPS signal interference. AOPA, a member of RTCA, served on the committee that conducted the review.

Similarly, a report issued by the National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum concluded that LightSquared's system "cannot successfully coexist with GPS."

An FCC-mandated report from LightSquared detailing the interference problem has been delayed until July 1 after LightSquared received an extension of the original June 15 deadline. But a June 20 press release from LightSquared acknowledges the problem of interference.

With so much of the early evidence showing that LightSquared's proposed network would potentially endanger nearly every flight operating in U.S. airspace, it seems evident that no further development of this system can be allowed.

While some reports have indicated that modifications to the proposed communications network might reduce the interference problem, no acceptable solutions have been identified at this time. While some have begun to suggest "fixes" that include narrowing the bandwidth used by LightSquared and adding filters to GPS receivers, there is absolutely no evidence that these actions would effectively safeguard the GPS system at a time when reliance on that system is rapidly increasing. Indeed, the "solution" proposed by LightSquared in its June 20 press release indicates that, even when moving its signals to a lower block of frequencies, some high-precision GPS receivers would continue to experience interference. We have also heard preliminary evidence that some levels of interference would still be possible with mass market GPS receivers, with unknown effects.

Clearly, such partial solutions are inadequate. Much more study and testing is needed before any potential solution can be implemented, and with the safety of so many people in the balance, extreme caution must be used in determining what constitutes an adequate resolution.

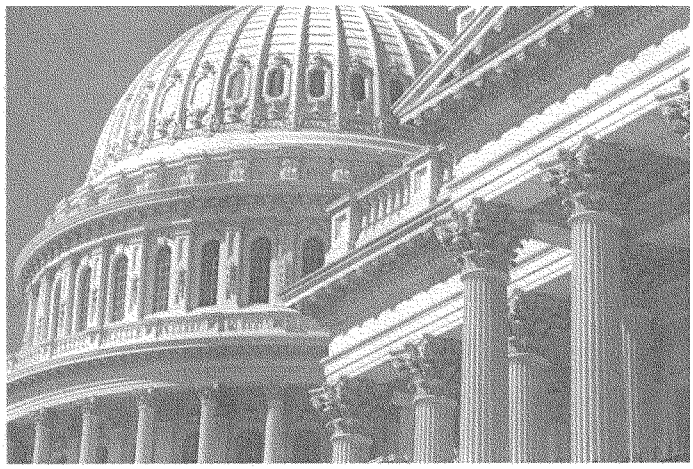
Any potential solution must ensure that existing aviation GPS units can continue to acquire and receive GPS signals with at least the same degree of reliability as they do today. In addition, the burden for implementing any solution must not fall on aircraft operators. Requiring changes to FAA-approved equipment, the purchase of new equipment such as filters, or procedural changes to the way pilots operate would be wholly unacceptable, creating unnecessary expense and potential new safety concerns.

Conclusion

On behalf of the members of AOPA, thank you for your leadership in protecting the integrity of the GPS system that forms a critical safety component of the national air transportation system. We urge you to move expeditiously in halting the proposed development of the LightSquared broadband network. We strongly recommend that the FCC immediately rescind the waivers issued to LightSquared in light of the negative impacts on GPS already identified by RTCA and others. We also ask that Congress require the FCC to obtain concurrence from FAA and DOD before approving any new or revised LightSquared application. Further, we ask Congress to investigate the process that has brought us to a point where the nation's entire GPS system is threatened.

ATA TESTIMONY

GPS Reliability



Statement of The
Air Transport Association of America, Inc.
before the
Subcommittee on Aviation and Subcommittee on Coast Guard and Maritime
Transportation, Committee on
Transportation and Infrastructure,
U.S. House of Representatives
Concerning
"GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and
Avoiding Potential New and Costly Government Burdens"

June 23, 2011

AIR TRANSPORT ASSOCIATION

Good morning and thank you for the opportunity to testify on this matter, which is so critical to the airline industry, as well as other transportation modes, commercial enterprises and recreational users.

My name is Tom Hendricks. I am the Senior Vice President for Safety, Security and Operations for the Air Transport Association of America, representing the major passenger and cargo airlines of the United States. Prior to joining the ATA, I was a pilot for Delta Air Lines for 23 years, as well as a military pilot for both the Navy and the Air Force.

GPS Is Indispensable to the Future of Aviation-Expansion of Wireless Broadband Services Should Not Sacrifice Known Benefits of GPS

I want to emphasize at the outset that while the U.S. airline industry supports public- and private-sector efforts to expand wireless broadband service across the country, we strongly oppose any proposed service that would compromise the integrity of the nation's Global Positioning System (GPS). Given that nearly 6,000 commercial aircraft and tens of thousands of business and general aviation aircraft are GPS-equipped, the continued unimpeded use of GPS is indispensable to the future of aviation.

The Department of Defense (DOD) created GPS for military purposes. It was subsequently authorized for civilian use by President Reagan after Korean Air Lines Flight 007 was shot down in 1983 for straying into Soviet airspace due to a navigation error. This access proved to be one of the finest examples of "turning swords into plowshares" in modern times. GPS has revolutionized navigation for aviation and millions of other users in what has been a true miracle of technology.

GPS signals are generated from a constellation of satellites orbiting 12,600 miles in space. Powered by the sun, GPS satellite transmitters operate at very low power levels – less than the energy output of a 50 watt light bulb. This low-power, long-distance combination means GPS receivers must be extremely sensitive in order to function properly and determine an airplane's position accurately. GPS receivers are built to international standards developed over the last 30 years. The fragile nature of GPS signals has been recognized by government regulators and in international standards and agreements. Accordingly, we were not surprised by several public- and private-sector reports demonstrating that GPS signals would receive substantial interference from LightSquared's radio signals, **which are approximately one billion times more powerful than GPS signals**.

GPS is the world's premier satellite-navigation system because of its dependability and the U.S. government's policy of making both the signal and the receiver design specifications available to the public free of charge. The Federal Aviation Administration (FAA) has continuously improved the accuracy of GPS for aviation users. Thus, we have a long-standing public policy that has very purposely created the environment in which GPS has thrived.

With respect to the U.S. airline industry, over 86 percent of our aircraft are already equipped with GPS. This has been achieved without any regulatory mandate and is based entirely on the remarkable capabilities of this navigation system. We are using GPS-based arrival and departure procedures that are more precise and fuel-efficient than radar and surface-based navigation system procedures and enable increased aircraft throughput.

Discussions of the existing benefits of GPS often focus on congested airspace around major metropolitan areas. But we should also recognize that GPS has enabled new instrument approaches to be introduced at many general-aviation airports and, when augmented by Required Navigation Performance capability, it has enabled the approval of far more precise – and safe – instrument approaches at airports with nearby terrain challenges, such as Juneau, Alaska and Palm Springs, California.

GPS IS A CRITICAL ELEMENT OF NEXTGEN, WHICH WILL IMPROVE SAFETY, REDUCE DELAYS AND MAKE FLYING MORE ENVIRONMENTALLY-FRIENDLY

Today's commercial and general-aviation users are heavily committed to GPS, and its importance to aviation will intensify over the coming decade. As the subcommittee knows, the civil-aviation community has embarked upon the most ambitious transition in air traffic management ever undertaken. The system, known as NextGen, utilizes the positioning function of GPS to provide continuous navigation signals to airplanes, which then downlink a position report at least once a second to air traffic control. This is a significant enhancement over the existing radar-based system, enabling improved air traffic management. GPS will be used in all phases of flight: departure, enroute, terminal area, and approach and landing. GPS is a core technology behind NextGen and will allow the national airspace system, which is increasingly constrained, to accommodate growing air traffic demand reliably and efficiently while, at the same time, reducing greenhouse gas emissions.

GPS spectrum had been protected until the Federal Communications Commission (FCC), in a highly unusual regulatory action, effectively revised its own rules for LightSquared, subject to certain testing conditions. This revision, which the FCC characterized as a waiver, opens the door to the construction of 40,000 high-powered, ground-based transmitters that will effectively jam the GPS network over the populated areas of the United States. This is not an exaggeration. Recent tests by RTCA, a federal advisory panel on aviation navigation and air-traffic management policy, definitively concluded that LightSquared's network would render GPS unusable by aviation users below 2,000 feet in the vicinity of a single-city deployment, and at all altitudes in dense metropolitan areas. Similarly, the National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum concluded that LightSquared's system "cannot successfully coexist with GPS."

SUGGESTED MITIGATION SOLUTIONS ARE UNPROVEN AND COST-PROHIBITIVE, AND WOULD DELAY MUCH-NEEDED NEXTGEN BENEFITS

Given the multiple government and industry reports of GPS interference issues posed by LightSquared's proposed system, LightSquared and GPS industry stakeholders have begun to discuss potential mitigation options. While well-intentioned, the costs to the U.S. airline industry and other GPS users to implement the potential mitigations far outweigh the benefits of allowing LightSquared to deploy its wireless broadband network.

The first mitigation option, proposed by LightSquared earlier this week, would allow LightSquared to operate in the lower part of its currently licensed frequency spectrum at a reduced power setting. While this may be feasible, it is fraught with technical challenges not yet fully understood. Significant research and modeling is required to fully define this mitigation and conclusively prove whether it would achieve the desired effect.

The second mitigation option would be to equip GPS receivers with filters to preclude interference from LightSquared's high-powered neighboring signal. Avionics manufacturers have questioned the feasibility of designing such filtering equipment, which does not currently exist for commercial aviation. It is also possible that filters could interfere with the precision of the GPS signal, thus limiting the usefulness of GPS receivers.

Even if the development of filtering equipment proves technically feasible, the U.S. airline industry simply cannot afford to purchase and install it in approximately 6,600 aircraft, which would cost billions of dollars. This is not a viable option for an industry that has lost $55 billion and 160,000 jobs over the last decade. Moreover, it would take at least a decade for filters to be developed, tested and then certified

by the FAA. This process would grind NextGen implementation to a halt – along with the creation of at least 150,000 U.S. jobs.

CONGRESS SHOULD PROHIBIT LIGHTSQUARED FROM DEPLOYING THEIR SERVICES IN ANY MANNER THAT INTERFERES WITH GPS

The bottom line is that the U.S. airline industry and other GPS users did not cause this interference problem. We have relied on long-standing U.S. government policy and international standards in the development and implementation of GPS equipment. If the FCC is determined to allow LightSquared to launch its wireless broadband network, the agency should find alternative spectrum that will not compromise the GPS network. Congress should ensure that there is no interference with GPS from wireless broadband deployment.

RTCA, Inc.
1828 L Street, NW
Suite 805
Washington, DC 20036
Telephone: 202-833-9339
Fax: 202-833-9434
www.rtca.org

STATEMENT OF
MARGARET T. JENNY
PRESIDENT, RTCA, INC.

Before a Joint Hearing of the

U. S. HOUSE OF REPRESENTATIVES
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
SUBCOMMITTEES ON AVIATION
and
COAST GUARD AND MARITIME TRANSPORTATION
on
GPS RELIABILITY: A REVIEW OF AVIATION INDUSTRY PERFORMANCE, SAFETY ISSUES, AND AVOIDING POTENTIAL NEW AND COSTLY GOVERNMENT BURDENS

WASHINGTON, D.C.
June 23, 2011

INTRODUCTION

Good morning, Chairmen Petri and LoBiondo; Ranking members Costello and Larsen; and Members of the Subcommittees. My name is Margaret Jenny, President of RTCA, Inc. Thank you for inviting me to participate in today's hearing on "GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens."

RTCA BACKGROUND

RTCA is a not-for-profit association founded in 1935 and utilized as a Federal advisory committee. We are the premier Public-Private Partnership venue for developing consensus among diverse, competing interests on critical aviation modernization issues in an increasingly global enterprise.

RTCA works closely with the Federal Aviation Administration (FAA) to develop comprehensive, industry-vetted and endorsed recommendations for the government on issues ranging from technical performance standards to policies for air transportation. Our deliberations are open to the public and our products are recommendations, developed by aviation community volunteers functioning in a consensus-based, collaborative, peer-reviewed environment.

RTCA provides two categories of recommendations to the government: (1) policy and investment priorities to facilitate implementation of air traffic management system improvements, and (2) minimum performance standards, reports, and guidance documents used by the FAA as a partial basis for the certification of equipment.

OVERVIEW

My testimony today will summarize the findings of a study conducted by RTCA on the impact of the proposed LightSquared terrestrial wireless broadband network on GPS receivers onboard aircraft. The RTCA report identified specific adverse effects on the use of GPS in aviation.

In my role as President of RTCA, I am here today to present the consensus findings of Special Committee 159 (SC-159), and not my views or even the views of individual members of the committee. The time-honored RTCA process is designed to welcome all views to the table, and work through to a consensus or, in cases where a consensus cannot be reached, to include a minority report. In the case of the LightSquared study, the committee, which included members from LightSquared, was able to make some compromises to reach a consensus and that consensus is what I will discuss today.

RTCA LIGHTSQUARED REPORT OVERVIEW

In a letter (Appendix A) dated March 3, 2011, from Robert A. Frazier, Acting Group Manager, Spectrum Engineering Services, FAA, RTCA was requested to conduct a study (Appendix B - Executive Summary) to address the issue of compatibility between operation of a terrestrial wireless broadband network in the bands 1525-1559/1626.5-1660.5 megahertz (MHz) by LightSquared, pursuant to its FCC Order and Authorization, DA 11-133, January 26, 2011, and GPS receivers onboard aircraft utilizing the GPS Link 1 (L1)[1] signal centered on 1575.42 MHz for navigation and positioning within the National Airspace System.

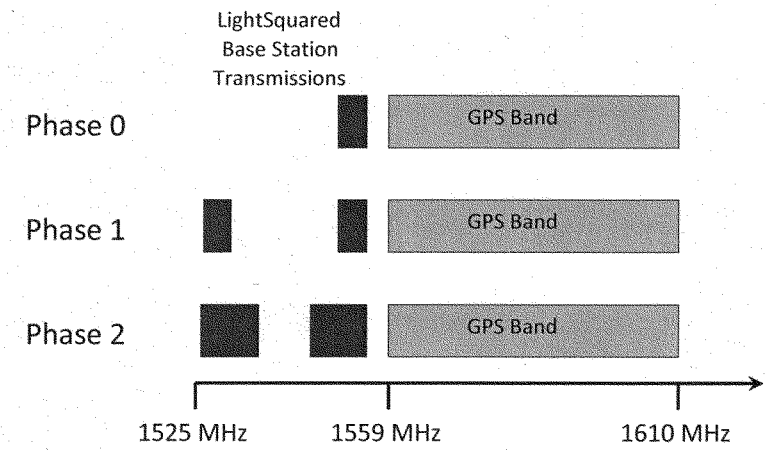
This Tasking was assigned to RTCA SC-159, Global Positioning System, under the leadership of Co-Chairs Chris Hegarty, The MITRE Corporation, and George Ligler, Project Management Enterprises. The Special Committee, originally formed in 1985, has over two-decades of experience resolving issues associated with GPS and conducts its work in accordance with the requirements of the Federal Advisory Committee Act (FACA), which allows for an open, participatory process. During the months of March through June of this year, the members of SC-159 developed a document titled *"Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations."* The study was released on June 3, 2011 as RTCA Document 327 (DO-327). It concludes that the current LightSquared terrestrial authorization would be incompatible with the current aviation use of GPS; however, modifications could be made to allow the LightSquared system to co-exist with aviation use of GPS. As previously mentioned, the committee welcomed new members from LightSquared to participate in the development of this report, and they are a part of the final consensus documented in the report.

Adhering to the scope of the request from the FAA, the report addresses the issue of compatibility between the proposed operation of a terrestrial wireless broadband network in the bands 1525-1559/1626.5-1660.5 MHz by LightSquared, pursuant to its Federal Communication Commission (FCC) license, and GPS receivers onboard aircraft. The report addresses the issues analytically, based on existing domestic and international standards and incorporates the test results of four certified aircraft GPS receivers.

The RTCA study assumed the spectrum deployment plan illustrated below for the base stations within the proposed LightSquared terrestrial wireless broadband network. In the first spectrum deployment phase, Phase 0, the base stations would transmit within a 5 MHz channel from 1550.2-1555.2 MHz. Phase 1 would add to Phase 0 a second 5 MHz channel from 1526.3-1531.3

[1] The L1 center frequency is 1575.42 MHz.

MHz. During Phase 2, the two channels would be broadened from 5 MHz each to 10 MHz each, spanning 1526-1536 MHz for the lower channel and 1545.2-1555.2 MHz for the upper channel. These base station transmissions are in a frequency band just below the frequency band that contains the L1 frequency used by Civil Aviation and the base station transmissions are planned[2] to be at a radiated power level of 1.6 kilowatts per channel per base station sector. Importantly, the RTCA assessment was based strictly upon LightSquared's deployment plans as provided to RTCA by LightSquared representatives who participated in the consensus development of DO-327. As outlined in Section 2.4 of the report, the FCC authorization permits higher power levels, which would make the results far worse if they were considered.



As the LightSquared participants on the committee explained the plans, LightSquared is planning to deploy approximately 36,000 base stations throughout the United States, covering hundreds of millions of people, and an important component of the RTCA study was to assess the aggregate LightSquared signal power that would be seen from all visible base stations by a GPS receiver on an aircraft in various typical operational scenarios. These scenarios included high altitude cruise, low altitude cruise, precision approach, and airport surface operations. The received power assessment was conducted using data provided by LightSquared regarding the technical characteristics of their base station antennae and the densities of base stations to be deployed in urban, suburban, and rural environments.

[2] The FCC license allows up to 16 kW per sector.

To evaluate the impact of the LightSquared base station transmissions on GPS avionics, the aggregate received power levels were compared to allowable interference limits, which were derived from: (1) applicable domestic and international regulations, including RTCA Minimum Operational Performance Standards (MOPS) referenced below, and (2) standard spectrum management practices. In 1991, RTCA completed GPS MOPS for avionics to support the introduction of GPS into civil aviation which was declared an operational capability for civil aviation in 1993. The FAA has invoked these MOPS in various Technical Standard Orders (TSOs) that are used as a basis for equipment certification. The latest suite of GPS MOPS includes RTCA/DO-316 for stand-alone GPS avionics, RTCA/DO-229D for GPS avionics augmented by the Wide Area Augmentation System (WAAS)[3], and RTCA/DO-253C for GPS avionics augmented by the Local Area Augmentation System (LAAS)[4].

All three of these MOPS include the same requirements for receiver interference susceptibility, and are harmonized with the requirement levied within the International Civil Aviation Organization (ICAO) Standards and Recommended Practices (SARPs). The ICAO SARPS are used by numerous foreign civil aviation authorities as a basis for equipment certification. These global standards help ensure that the same receiver onboard an aircraft will work in flight anywhere around the globe. These interference requirements, as applicable to the LightSquared base station transmissions, have not changed materially since they were first published in 1996 in the initial issuance of RTCA/DO-229. GPS avionics have been certified using the DO-229 interference requirements (with performance requirements from earlier MOPS) since 1997, and the first-generation of airborne equipment built in complete conformance with the DO-229 MOPS certified by the FAA in 2002.

The MOPS interference requirements dictate that certified equipment must meet all applicable performance requirements, as demonstrated through testing, in the presence of specified interference power levels. These power levels generally become larger for interference center frequencies that are further removed from the GPS L1 frequency. Since the interference power level that can be tolerated by a MOPS-compliant receiver is greater as the center frequency of the interference becomes further away from L1, the receiver will be more susceptible to disruption from channels which are closer to the L1 frequency.

[3] WAAS is a navigation aid introduced by the FAA to augment GPS with the goal of improving its accuracy, integrity, and availability.

[4] LAAS is an all-weather landing system based on GPS that improves integrity and accuracy of the signal in the vicinity of an airport, enabling precision approaches.

Importantly, the implication of these requirements is that airborne GPS receivers are expected to be more susceptible to disruption from the upper LightSquared channels than the lower LightSquared channels.

Aviation spectrum management practices aim to ensure that GPS avionics never experience interference from transmissions that are right at the maximum power level for which the GPS receivers have been tested. Consistent with this practice (see, e.g., the International Telecommunication Union Radiocommunication Sector [ITU-R]'s Recommendation M.1477), the RTCA study used interference power limits that were the MOPS test levels adjusted by a standard safety margin.

REPORT CONCLUSIONS

The study concludes that all three spectrum deployment phases described above for the planned LightSquared terrestrial are incompatible with the current aviation use of GPS. However, use of a single 5 MHz lower channel could allow the LightSquared system to co-exist with aviation's use of GPS.

The impact of a LightSquared upper channel spectrum deployment is expected to be complete loss of GPS receiver function. The LightSquared upper channel interference from Phase 0 deployment exceeds the GPS receiver MOPS-related environmental limit by a factor ranging from 18,000 to 380,000, depending upon the operational scenario involved. Because of the size of the single-city station deployment, GPS-based operations below about 2000 feet will be unavailable over a large radius from the metro deployment center (assuming no other metro deployments are nearby). This means that, since the GPS receiver will not be able to provide a position with any sort of continuity (if at all), GPS-based operations cannot be undertaken. Given the situation in the high altitude U.S. East Coast scenario, GPS-based operations will likely be unavailable over a whole region at any altitude at which aircraft normally fly.

The results of this study indicate that terrestrial base station operation at the lower 5 MHz-wide channel (1526.3-1531.3 MHz) is compatible with aviation GPS operations for all the representative scenarios (including both signal tracking and initial acquisition). Initial acquisition is acquiring enough satellites in the constellation to provide an initial GPS-based position, and signal tracking generally refers to tracking GPS satellites as they and the aircraft move to continue to be able to provide a GPS-based position for the aircraft.

The study indicates that for terrestrial base stations using only the lower 10 MHz channel at 1526-1536 MHz, there is a small positive margin for GPS tracking (but not necessarily initial acquisition) in the presence of mean aggregate terrestrial network interference. As noted

above, these conclusions are based upon specific assumptions about LightSquared operation and worse impacts would result if the LightSquared network was operated at the limits allowed per the FCC authorization. The specific assumptions include geographical distribution of base stations, base station transmission frequencies, and base station transmit power levels which are below those in the current FCC authorization. Two examples: The study assumed LightSquared base station towers at 1.6 kW per channel per sector, whereas the FCC license allows up to 16 kW per sector. Also, the number of base stations per unit area was limited per the model provided by LightSquared for this study, whereas the FCC license does not limit the density.

EVALUATION OF POSSIBLE MITIGATION

Unlike the receivers used for many non-aviation GPS applications, the airborne GPS receivers typically use multiple separate filters (for example, there are generally two filters in the antenna) and are generally considered quite robust to out-of-band interference. But, they still are adversely affected by emissions in the LightSquared band. Should LightSquared deploy as planned, many aviation receivers would be completely inoperable over very large swaths of airspace meaning that, in general, the receivers would be unable to provide a GPS position.

Airborne GPS receiver mitigations were also explored in the report, but the findings indicate that the only viable option is through invocation of more stringent performance requirements for the GPS antenna/receiver combination that would require the manufacturers to optimally layer filtering throughout the receiver front-end. This approach would take many years to get installed on the entire fleet of aircraft, since it would require new standards to be developed, new TSOs to be issued by the FAA, new receivers to be built and certified to the new standard, and finally installed within the fleet of aircraft that operate within U.S. airspace. This would be extremely disruptive to NextGen implementation, since it would cost billions of dollars and likely 7-10 years to retrofit the aircraft fleet after several additional years to develop new standards.

Thus, no viable short-term options based on changes to GPS receivers or antennae were identified in the report.

REPORT RECOMMENDATIONS

The main recommendations from this aviation GPS receiver operational assessment are:

1. From an aviation perspective, LightSquared upper channel operation should not be allowed.

2. Further study is recommended to more carefully determine a refined terrestrial base station power versus frequency limit to verify the conclusions for a LightSquared deployment scenario that involves only the lower 10 MHz channel at 1526-1536 MHz.

On this last point, the study indicated that terrestrial base station operations at the lower 5 MHz wide channel (1526.3-1531.3 MHz) is compatible with aviation GPS operations for all the representative scenarios (including both signal tracking and initial acquisition).

CONCLUSION

On behalf of the hard working and committed volunteers of SC-159, thank you for the opportunity to testify on this important topic. As the President of RTCA, I am gratified by the trust the FAA places in our committees to forge consensus on such challenging and critical aviation issues. The work of this committee, conducted in a very short three months, determined that the proposed LightSquared terrestrial wireless broadband network would have adverse effects on GPS receivers onboard aircraft.

I'd be pleased to respond to your questions.

REFERENCES

RTCA Document No. RTCA/DO-327, "Assessment of the LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations," issued June 2011.

RTCA Document No. RTCA/DO-316, "Minimum Operational Performance Standards (MOPS) for Global Positioning System/Aircraft Based Augmentation System Airborne Equipment," issued April 2009.

RTCA Document No. RTCA/DO-229D, "Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment," issued Dec. 2006. (Initial issuance, January 1996)

RTCA Document No. RTCA/DO-253C, "Minimum Operational Performance Standards for Global Positioning System/Local Area Augmentation Airborne Equipment," issued December 2008. (Initial issuance, January 2000)

APPENDIX A FAA Tasking Letter for LightSquared Study

U.S. Department
of Transportation
Federal Aviation Administration

RTCA Paper No. 047-11/PMC-881

MAR 3 2011

Ms. Margaret Jenny
President
RTCA Inc.
1828 L Street, NW., Suite 605
Washington, DC 20036

Dear Ms. Jenny:

The 1525-1559 MHz and 1626.5-1660.5 MHz bands have been allocated for many years for mobile satellite service (MSS) communications (e.g., Inmarsat).

A few years ago a United States satellite company "LightSquared" (previously called Mobile Satellite Ventures (MSV), then SkyTerra) started a process with the Federal Communications Commission (FCC) to also allow terrestrial communications in the 1525-1559 MHz band. These "ancillary terrestrial components", or *ATC*[1], were terminals that were an integral part of the MSS network. The stated intent was to act as "gap fillers" to allow the company to service users in areas where the satellite signals had difficulty reaching (e.g., cities and "urban canyons" where buildings caused blockages of the satellite signals). After considerable study that approach was approved, and in fact was recently updated based on agreements between LightSquared and Inmarsat.

In November 18, 2010, LightSquared requested to the FCC to amend their license to allow them to service terminals that are not combined MSS/terrestrial, rather are simply just purely terrestrial terminals. In the longer term that capability could be leased-out by LightSquared making it impossible for the *ATC* portion to be an "integral part of the satellite network", rather it would simply become another cellular-type service. This raised the concern that the number of such terminals will increase. In fact, the current projection is that the number of these terminals will explode to an order of magnitude more than previously proposed. This presents a potential interference threat to the aviation community which is increasingly relying on Global Positioning System (GPS) L1 for navigation for not only approach and landing, but for enroute (automatic dependent surveillance broadcast) and surface navigation on airport tarmac.

The Federal Aviation Administration (FAA) believes that studies using the new assumptions need to be undertaken to ensure protection of the GPS. These studies should include

[1] For this document *ATC* in italics refers to ancillary terrestrial component and not air traffic control. Due to confusion on the topic some have started writing the acronym as ATCt and the international term for *ATC* is complementary ground component (CPG).

receiver vulnerability, as well as scenario studies including aggregate effects of LightSquared transmissions on GPS receivers used in aircraft.

After reviewing the current terms of reference, we have determined that the evaluation of this potential interference is already within the scope of Special Committee 159. Therefore, I would like to add this issue to those already being addressed by SC 159. In order to provide timely input to the FAA, this evaluation will need to be completed quickly. LightSquared is required by the FCC to help organize and fully participate in a working group that includes the GPS community and federal agencies to study the potential for overload to GPS devices and to identify any measures necessary to prevent harmful interference to GPS. LightSquared will submit a final report by June 15 to the FCC. The RTCA evaluation should proceed in parallel, with a deliverable to the FAA by June 3.

Please let me know as soon as possible your response to this request at (202) 267-9722 or by e-mail at robert.frazier@faa.gov.

Sincerely,

Robert A. Frazier
Acting Group Manager, Spectrum
Engineering Services

APPENDIX B Executive Summary RTCA DO-327

Executive Summary

This report documents a study conducted by RTCA Special Committee 159 in response to a request from the Federal Aviation Administration to address the issue of compatibility between the operation of a terrestrial wireless broadband network in the bands 1525-1559/1626.5-1660.5 MHz by LightSquared, pursuant to its FCC license, and GPS receivers onboard aircraft. The report addresses the issues analytically based on existing domestic and international standards and includes results of tests of four certified aircraft GPS receivers.

The study concludes that the current LightSquared terrestrial authorization would be incompatible with the current aviation use of GPS, however modifications could be made to allow the LightSquared system to co-exist with aviation use of GPS. The study's conclusions and recommendations are strictly based on an assumed set of operational parameters for the LightSquared system and identified source mitigations. These operational parameters would produce less Radio Frequency Interference (RFI) than if LightSquared were to operate at its fully-authorized limits.

In addition, the analysis is based upon the assumption that all equipment is minimally compliant with the interference rejection requirements in harmonized domestic and international standards. Additionally since GPS is an aviation safety service, the analysis includes a 6 dB safety margin as is standard practice. Results from the four receivers tested show that these receiver models are significantly more resilient to interference from the LightSquared terrestrial base stations than limits derived from the standards.

The impact of a LightSquared upper channel spectrum deployment is expected to be complete loss of GPS receiver function. Because of the size of the single-city station deployment, GPS-based operations below about 2000 feet will be unavailable over a large radius from the metro deployment center (assuming no other metro deployments are nearby). Given the situation in the high altitude U.S. East Coast scenario, GPS-based operations will likely be unavailable over a whole region at any normal aircraft altitude.

The results of this study indicate that terrestrial base station operation at the lower 5 MHz wide channel (1526.3 – 1531.3 MHz) is compatible with aviation GPS operations for all the representative scenarios (including both signal tracking and initial acquisition). The study indicates that for terrestrial base stations using only the lower 10 MHz channel at 1526-1536 MHz, there is a small positive margin for GPS tracking (but not necessarily initial acquisition) in the presence of mean aggregate terrestrial network interference. As noted above, these conclusions are based upon specific assumptions about LightSquared operation.

The main recommendations from this aviation GPS receiver operational assessment are:

1. From an aviation perspective, LightSquared upper channel operation should not be allowed.
2. Further study is recommended to more carefully determine a refined terrestrial base station power versus frequency limit considering:
    a. determination of the lowest path loss for the low altitude enroute scenario,
    b. confirmation of acceptable receiver susceptibility for GPS initial acquisition and signal tracking in the presence of the 10 MHz bandwidth terrestrial network interference,
    c. computation of the cumulative probability distribution function for the aggregate path loss.

STATEMENT OF

THE HONORABLE ROY W. KIENITZ
UNDER SECRETARY FOR POLICY
U.S. DEPARTMENT OF TRANSPORTATION

BEFORE THE

SUBCOMMITTEES ON AVIATION AND
COAST GUARD AND MARITIME TRANSPORTATION
COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE
U.S. HOUSE OF REPRESENTATIVES

HEARING ON

GPS Reliability: A Review of Aviation Industry Performance, Safety Issues and Avoiding Potential New and Costly Government Burdens

June 23, 2011.

Chairman Petri, Chairman LoBiondo, Ranking Members Costello and Larsen, and Members of the Subcommittees:

The Global Positioning Satellite (GPS) system was originally developed by the U.S. military. Today it is still operated, and primarily paid for, by the Air Force.

In 1983 President Reagan announced that, as a matter of national policy, the United States would make GPS available to users world-wide. In 1994, a year before GPS became fully operational, President Clinton went a step further and decreed that GPS would be offered as a free service. Finally, in 2000, the accuracy of the civil signal was increased, and new industries based on precision navigation were born.

Today, the use of GPS is ubiquitous. Indeed, no one knows how many commercial uses are built around GPS; worldwide sales of GPS navigation devices exceed $20 billion, annually, and an estimated $3 trillion worth of commerce relies on GPS for tracking, timing and navigation. Whatever the actual number, the decision to provide GPS as a free service constitutes one of America's greatest economic gifts to the world since the Marshall Plan.

As with so many other technologies that we have pioneered, our leadership in GPS technology and application is opening new doors to American R &D and creating countless new jobs. Each new satellite that we launch, and each new ground augmentation we develop, not only makes our nation safer and more efficient, but increases our leadership potential exponentially.

Many GPS applications are vital to transportation safety and efficiency. Tens of millions of drivers across America use GPS to navigate; over 6 million cars are equipped with General Motors' On-Star system, alone. The Federal Aviation Administration (FAA) estimates that by 2013, some 60,000 aircraft will be equipped with GPS to navigate the skies over America. Positive Train Control, and improved safety for rail transportation, will increasingly rely on GPS.

The Department of Transportation has committed to deploying NextGen to modernize America's air traffic control system. NextGen relies on GPS. Precision GPS will improve safety, reduce fuel costs, and effectively increase the capacity of crowded airports without the need to add runways or other expensive infrastructure. So far, the FAA and industry has invested as much as $8 billion into NextGen. The FAA conservatively estimates that the benefits of NextGen will total $23 billion by 2018, and over $120 billion by 2030.

Since 2004 the Department of Transportation has been the lead federal agency for all federal civilian uses of spectrum, including GPS. The Deputy Secretary of Transportation, along with the Deputy Secretary of Defense, co-chairs the National Executive Committee for Space-Based Position, Navigation & Timing, which includes representatives from seven cabinet agencies, NASA, and the Joint Chiefs of Staff. GPS is essential for the operations of first responders, search and rescue, resource management, weather tracking, energy independence, critical infrastructure such as dams and power plants, financial transactions and banking, surveying and mapping, and industries such as precision agriculture, where the ability to water and fertilize plants with centimetric accuracy increases conservation, reduces waste run-off, and saves American farmers up to $5 billion, annually.

Transportation security, public safety and front line workers use GPS-enabled technologies and services every day to protect the U.S. transportation infrastructure, facilitate the flow of cargo, and to protect the traveling public across all modes of transportation.

In its recent correspondence to the Federal Communications Commission, the National Public Safety Telecommunications Council stated that "public safety relies on the reception of GPS for wireless 9-1-1 location, dispatch of 'closest responder' based on GPS location, mapping/response directions to responders based on GPS, synchronization of simulcast systems across the country based on GPS time signals and a myriad of other mission critical functions."

To provide the accuracy necessary for precision navigation, GPS receivers must be designed with a "wide front end" that picks up signals across a range of 20Megahertz or more. In order to pick up this wide range of signals, the limits of physics and practical engineering are such that the precision receivers also pick up signals from the adjacent band, reserved for Mobile Satellite Systems (MSS), such as satellite phones.

Until recently, these limitations did not create a conflict. The GPS and MSS band were both designed to be 'quiet', limited to weak satellite signals, a tiny fraction of a watt when they reached the earth. GPS receivers easily filtered out the MSS signals.

Since 2003, the Federal Communications Commission has taken several steps to increase the effective use of the MSS band. These steps include allowing "ancillary terrestrial components" (ATCs) to provide supplementary signals in urban canyons and other areas where satellite signals cannot reach. The ground-based signals from ATCs can be powerful, more than 1 billion times the strength of a satellite signal, and would overwhelm the filter of any GPS receiver that was picking up the signal. However, to protect the primacy of mobile satellite service, the FCC in 2003 and 2005 restricted the ATCs to a subordinate role; ATCs could supplement, but not interfere with, MSS transmissions. As long as MSS operations were protected from interference, so was GPS.

In March, 2010 President Obama announced an administration goal to free up 500 MHz of federally-owned spectrum and make it available for mobile broadband, in support of a goal to provide at least 98% of Americans with access to 4G high-speed wireless service, and to especially provide access to underserved rural communities.

Consistent with these goals, LightSquared proposed that the FCC allow the company to broadcast broadband signals in the MSS band. The concept is appealing; if feasible, LightSquared would develop the first wholesale-only wireless 4G-LTE broadband network, reaching over 260 million people by the end of 2015. The network would be "open," allowing anyone to develop devices and applications to run on it, creating new business opportunities for retailers, device manufacturers, and others.

In January, 2011, the FCC approved the concept, contingent on LightSquared conducting tests with the GPS industry and affected federal agencies to identify and mitigate any interference with GPS. The LightSquared-led Technical Working Group (TWG) is due to report its findings to the FCC on July 1st.

FAA technical staff participated in the TWG testing. In addition, the FAA commissioned RTCA to study the impact of LightSquared's proposed operations on aviation. DOT also joined a joint federal study – the NPEF – to assess the impact on a broad range of common government and commercial GPS receivers.

By all accounts, LightSquared's technical cooperation in all three of these studies was exemplary. The company shared proprietary business plans, as well as technical data and equipment, to inform the federal tests and modeling. And the tests showed that LightSquared's design and filters effectively prevented "out-of-band" emissions; in other words, their powerful broadband signal was not 'leaking' into the adjacent GPS band.

The tests also examined "overload interference" – interference with the GPS receivers that 'listened in' to the adjacent MSS band. Unsurprisingly, the powerful broadband signal overwhelmed filters and effectively blocked GPS signals in most devices tested. In broad terms, the most modern and most accurate devices, picking up the widest range of signals, tended to be the worst affected. Less accurate "narrow band" GPS receivers, such as those commonly built into cell phones, were less affected.

The final stage of LightSquared's operating plan involves parallel broadband transmissions on two 10-MHz-wide blocks, with a 9 MHz buffer between them. Two powerful, parallel signals can create an echo effect, called 'intermodulation,' elsewhere. The tests showed that, depending on the transmitter and receiver designs, these parallel transmissions could create an echo in the GPS band, overlapping the GPS signal. Such interference would make the original LightSquared proposal incompatible with current GPS operations.

America's greatest inventor, Thomas Edison, famously tested and rejected thousands of potential filaments before finding one that made the light bulb work. In the same vein, we have now tested one proposal from LightSquared, and found that it did not work as originally hoped. But there are alternatives and potential mitigations that may be worth exploring.

On June 20th, LightSquared offered one alternative, proposing to initially broadcast only on the "lower ten" to avoid many of the interference issues. This alternative has promise, especially in limiting interference with aviation. However, this alternative was not part of the original operating plan that was analyzed. More testing would be

needed to fairly assess the impact on the full range of civil GPS equities, by both "lower ten" broadcasts, and by whatever end-state LightSquared proposes for full operations.

The Department of Transportation would like to work towards a "win-win" – if one exists -- that allows for increased broadband access, without disrupting existing and planned GPS-based services, such as NextGen. Any alternative must be robustly tested, as was the original plan. It is critical to define the operational, safety, and economic impacts to all known applications and user communities. Should the FCC and the NTIA deem LightSquared's June 20th proposal worthy of further consideration, DOT will participate in, and as necessary lead, any required testing.

The Department of Transportation is responsible to represent the interests of other civilian federal agencies as well as our own. There are many applications, including scientific and space, precision agriculture, mapping and surveying, which require access to both GPS and MSS signals. Billions of dollars of public and private funds have been invested in these sectors. Their challenges may be the most difficult to resolve. The Department of Transportation will look for solutions to their challenges, as well as our own, in interagency discussions.

The review of LightSquared's proposal, and other incidents, such as the truck with a GPS jammer affecting operations at Newark Airport last year, remind us of how vulnerable GPS can be to interference. Going forward, as the FAA and the aviation industry continue to invest billions of dollars in NextGen, Deputy Secretary Porcari has committed the Department of Transportation to work with other federal agencies to ensure that we have a plan in place to ensure that the GPS systems in development now will not be compromised by interference in the years to come.

Written Testimony of Philip Straub
Vice President, Aviation Engineering
Garmin International, Inc.

Before the Transportation and Infrastructure Subcommittees on
Aviation and Coast Guard and Maritime Transportation
United States House of Representatives

Joint Hearing: "GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens"

June 23, 2011

My name is Philip Straub, and I am Vice President, Aviation Engineering, for Garmin International, Inc. ("Garmin"). Today, I would like to address the serious threats to the aviation and maritime industries' use of the Global Positioning System ("GPS") posed by the proposal of LightSquared Subsidiary LLC ("LightSquared") to offer a nationwide terrestrial broadband network. Garmin is not opposed to the roll-out of improved broadband service in this country. We just believe it should be done in other ways that will not eviscerate GPS service.

I. For Two Decades, Garmin Has Been Designing and Manufacturing Reliable GPS-Enabled Aviation and Maritime Products

Garmin is the leading manufacturer of GPS products for the general aviation industry in the United States and is a leading supplier of GPS-enabled products for the maritime market. It has been manufacturing GPS-enabled navigation devices since 1991.

Over the past two decades, Garmin's aviation business has grown, and today Garmin has a larger installed user base of GPS equipment than all other manufacturers combined. Garmin provides a full suite of avionics for General Aviation aircraft, helicopters, and Part 25 business aircraft, including:

- Fully integrated "Flight Decks," like the popular G1000, which provide pilots with instrumentation, navigation, weather, terrain, traffic, and engine data on large-format, high-resolution displays;
- GPS navigation/communication devices, like the GNS 400 and 500 product lines that have been the General Aviation standard since 1998 (over 115,000 sold) and their successors, the recently certified GTN 650 and 750. These aid pilots with high-resolution terrain mapping, graphical flight planning, geo-referenced charting, traffic display, and satellite weather;
- Mode S transponders which feature the extended squitter broadcast that enables the transponders to automatically transmit more accurate, and more useful, traffic surveillance data to support Automatic Dependent Surveillance-Broadcast ("ADS-B"), including aircraft flight identification, position, altitude, velocity, climb/descent, and heading information; and

- Many other GPS devices that assist pilots in monitoring every element of their flight conditions.

Garmin also manufactures a broad line of GPS-enabled products for the marine market. These include Chartplotters, Sounders, Fishfinders, RADAR, Autopilots, Marine VHF Communications, Automatic Identification System ("AIS") transceivers, products utilizing XM® signals, and Cellular Data Link products.

II. GPS-Enabled Aviation Products Have Revolutionized Aviation Safety, Particularly for the General Aviation Market

It is unquestioned that the introduction and use of GPS-enabled devices, like Garmin's, have brought important advances in aviation safety, particularly for the General Aviation market. GPS has become ubiquitous and indispensable in the years since Garmin introduced its first aviation GPS receiver. Virtually all types of aircraft utilize GPS for navigation and approaches. Some 190,000 General Aviation aircraft are equipped with GPS, which represents over eighty percent of the active U.S. fleet.[1] For the majority of these aircraft, GPS is the primary means of navigation. Almost eighty percent of air carriers' planes utilize GPS. Nearly all military aircraft include GPS for navigation, weapon system integration, or command and control. Most foreign aircraft that enter U.S. airspace are fitted with GPS.

The position information computed by GPS receivers provides pilots with a reliable and accurate navigation source. When it is integrated with other systems in the cockpit, GPS enables a multitude of capabilities that enhance safety and improve operating efficiency. As the Aviation Subcommittee knows, GPS is the foundation for the Federal Aviation Administration's ("FAA's") new NextGen System. The existing uses of GPS that are described below have made critical differences in the ability of pilots to ensure safety of life in the skies; proposed improvements in future devices will only enhance these benefits.

GPS provides pilots with the ability to fly point-to-point instead of following ground-based radio navigation aids that require longer flight paths between airports. GPS also gives pilots the ability to immediately orient where an aircraft is located relative to terrain or obstacle features when the GPS position is paired with map details. This combination provides "instant" orientation without the mental gymnastics that were necessary before GPS was introduced into the cockpit. This is a significant safety enhancement because it frees the pilot to concentrate on flying the airplane instead of working to stay oriented. During in-flight emergencies, GPS systems can provide immediate navigation to the closest airport, even in areas where there are no ground-based navigation aids.

GPS-based instrument approach procedures, both standalone and those enhanced by the Wide Area Augmentation System ("WAAS") or Ground-Based Augmentation System ("GBAS"), allow aircraft to land safely at airports throughout the country. GPS approaches require substantially less ground infrastructure than those approaches utilizing ground-based

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[1] There were 223,877 total active General Aviation aircraft as of 2009. *See* http://www.faa.gov/data_research/aviation_data_statistics/general_aviation/CY2009/, Table 1.1 (last visited June 20, 2011).

navigation aids such as the Instrument Landing System ("ILS"). GPS/WAAS-based Lateral Navigation ("LNAV")/Vertical Navigation ("VNAV"), Localizer Performance with Vertical guidance ("LPV"), and GBAS approaches provide both horizontal and vertical guidance that improve aviation safety by allowing the pilot to fly a stabilized approach to a safe landing. There are, in fact, now more LPV approaches in the United States that require GPS/WAAS, than Category I ILS approaches. All told, the FAA has published over 10,000 approach procedures that use GPS,[2] at roughly 3,000 airports and heliports across the 50 states and U.S. territories. Over 900 of these airports and heliports have only GPS-based approaches; in other words, instrument approaches are not possible at these airports without GPS. GPS navigation also enables the use of repeatable curved approach and departure paths to and from airports which shortens flight paths, requires less fuel burn, results in lower costs to operate, and creates a smaller carbon footprint. In summary, GPS navigation improves airport capacity, access, and efficiency.

Availability, integrity, and accuracy are all necessary for GPS to function as a primary means of navigation and to ensure aviation safety. When weather is poor and a pilot cannot see outside the aircraft beyond the tips of the wings, he or she must rely on the plane's navigation system to keep the aircraft in safe airspace. During an approach, the pilot works hard to follow the FAA-prescribed flight path to the runway and must be able to rely on the GPS and have confidence in the system. Improperly executed instrument approach accidents are consistently among the most common causes of lethal descent and approach accidents.[3] The loss of the GPS signal during this critical time is clearly a hazard to safety. Without it, pilots have to scramble to stay ahead of the airplane by tuning to the frequencies of alternate navigation equipment and shifting their mindset to alternate navigation methods instead of relying on GPS.

The federal government has recognized the extensive benefits GPS brings to aviation safety. The FAA is in the process of implementing the NextGen program, which uses airborne GPS as an enabling technology for a new Air Traffic Control system. ADS-B equipment broadcasts GPS-derived position reports to other aircraft in the vicinity and to Air Traffic Control centers on the ground. ADS-B will enable increased safety, precision, capacity, and capability for Air Traffic Control with a reduced cost of operation since it is not dependent on ground-based radar systems. The FAA has mandated that all aircraft operating in class A, B, or C airspace be equipped with ADS-B by 2020.

GPS is also used as an input to many traffic awareness systems, particularly those derived from ADS-B. These systems can enhance safety by providing pilots with timely alerts of potential collisions with other aircraft so that they can be avoided. Additionally, GPS supplies position, altitude, and velocity information to many terrain awareness systems. Such systems greatly reduce the likelihood of controlled-flight-into-terrain incidents by providing the pilot with audible alerts of potential terrain and obstacle conflicts along the flight path and a picture of

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[2] *See* http://www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/index.cfm, update effective June 2, 2011.

[3] Aircraft Owners and Pilots Association Air Safety Institute, *2010 Nall Report: The Joseph T. Nall Report of Accident Trends and Factors*, at 24, 26, http://www.aopa.org/asf/publications/nall.html.

the aircraft's position relative to the surrounding terrain and obstacles. GPS also enables synthetic vision systems to display external topography from the perspective of the flight deck, enhancing situational awareness when pilots are flying in instrument conditions.

Many aircraft are equipped with electronic multi-function displays that depict the aircraft's location on a map. GPS is a primary source of position data for these displays, which reduce pilot workload by improving situational awareness through pictures that show an aircraft's position on a map that can be overlaid with weather radar and traffic information while airborne. Other GPS-enabled map displays, such as Garmin's SafeTaxi®, provide the flight crew with a detailed picture of the runway and taxiway environment while on the ground to prevent runway incursions. When visibility is poor, it is difficult to remain oriented when taxiing. SafeTaxi®'s moving map display makes it easy.

In General Aviation aircraft, GPS is also used in conjunction with low cost inertial sensors to provide reliable, inexpensive, and lightweight attitude and heading systems. These devices replace spinning-mass gyroscopic instruments that have notoriously poor reliability and that otherwise would provide a pilot's primary means for determining attitude and heading during instrument flight.

Finally, GPS is a crucial technology for airborne search and rescue operators. GPS allows search and rescue aircraft to fly precise, predetermined search patterns at any location, day or night, under all weather conditions. Accurate GPS position reports allow rescue personnel to quickly reach the correct location once the victim is found.

I use GPS in the personal and business sector and have become highly dependent upon the system. Our business uses many types of aircraft, from single-engine to light jet aircraft, to facilitate a broad range of business endeavors. These aircraft are predominantly utilized by working-level professionals and often carry these individuals to areas not well served by the airlines and locations lacking sophisticated infrastructure. To be valuable business tools, we expect these aircraft to complete their mission under a wide range of weather and operational conditions. GPS enables these aircraft to reach remote destinations under adverse weather conditions while enabling GPS-dependent safety technologies such as enhanced flight vision systems displays, terrain awareness and warning, runway incursion prevention and next generation traffic awareness systems. My personal single-engine airplane is based at an airport served only by a World War II era non-directional beacon ("NDB") circling approach. The GPS overlay capability for this approach provides incalculable safety enhancements over flying that approach with only an NDB receiver. My experience as a pilot is very typical.

III. GPS-Enabled Marine Products Have Brought Similar Improvements in Boating Safety

The introduction and use of GPS-enabled devices have similarly enhanced safety in the operation of all types of watercraft. The United States Coast Guard mandates that most boats have on board a VHF radio that is enabled with Digital Selective Calling ("DSC"). DSC depends on GPS to send accurate position information over VHF frequencies in emergencies such as capsize, piracy, overboard loss of passengers, and numerous other situations. These

devices replace the need for boaters to rely on rough estimates of their position transmitted verbally over a radio.

GPS-enabled devices have become even more critical for marine safety with the United States Coast Guard's termination on February 8, 2010 of the Loran-C system, a low-frequency hyperbolic radionavigation system.[4] Established in 1957, the Loran-C system provided navigation, location, and timing services for both civil and military marine users. In decommissioning Loran-C service, the Department of Homeland Security and the Coast Guard noted that technological advancements and the emergence of GPS had rendered the system unnecessary.[5]

Like avionics, modern marine electronics, through GPS, are also able to expand a boater's situational awareness beyond knowledge of just the basics of a boat's location to provide additional information about its position relative to fixed hazards like rocks or shoreline. Dynamic weather overlays also provide information necessary to avoid hazardous situations, and GPS-enabled equipment informs the boater where he or she is relative to such disturbances.

When visibility is low, marine surface radar overlays on charts allow boaters to differentiate between fixed (charted) obstacles and other vessels. Marine collision avoidance systems such as the marine Automated Identification System ("AIS") further enhance situational awareness and incorporate alerts that help prevent accidents when two vessels come within close proximity. To operate, these systems require the accurate position, speed, and course information that GPS provides.

As with aviation, GPS is also a crucial technology in facilitating rescue operations at sea, allowing rescue personnel to reach endangered craft and their passengers quickly. The Global Maritime Distress Safety System ("GMDSS") relies heavily on GPS position information as a primary feature in many of its component systems, including Emergency Position-Indicating Radio Beacons (EPIRBs), DSC, and AIS.

In addition to collision avoidance, marine AIS facilitates the tracking and management of large international shipping vessels when they enter United States coastal waters. Any degradation to the GPS signals on which this system relies poses a serious threat not only to the safety of the vessels in question, but also to the nation's border security.

IV. Given the Technical Characteristics of GPS Signals, Receivers Are Extremely Sensitive

The GPS signals used by civilian receivers are transmitted in the GPS L1 Band, located at 1559-1610 MHz. This band is directly adjacent to the L-Band frequencies LightSquared is

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[4] Navigation Center, U.S. Department of Homeland Security, United States Coast Guard, *Loran-C General Information*, http://www.navcen.uscg.gov/?pageName=loranMain (last visited June 19, 2011).

[5] Terminate Long Range Aids to Navigation (Loran-C) Signal, 75 Fed. Reg. 998 (Jan. 7, 2010).

proposing to use at 1525-1559 MHz. Both of these bands historically have been reserved for space-to-earth signal transmissions.

Space-to-earth transmissions need a very quiet interference environment because the signals reach earth at extremely low power levels. The only means of powering GPS signals from satellites is via solar panels, and GPS signals are sent out from satellites using 50 or fewer watts, about the same wattage it takes to power a light bulb. The GPS signal then travels 12,600 miles before being received. GPS receivers must be designed to be very sensitive in order to pick up these weak signals, in some instances using a wide bandwidth to improve measurement accuracy. For example, FAA-certified GPS/WAAS equipment is allowed to receive satellite signals across 20 MHz of bandwidth.[6]

GPS receivers are extremely sensitive to strong signals operating on nearby frequencies. The GPS receivers are "listening" very hard for relatively weak GPS signals, so strong signals overload their capacity to "hear" those signals the same way that standing next to a lawnmower makes it impossible to hear someone whispering in your ear. LightSquared's proposal essentially is to start a lawnmower in a library. At ground level, GPS signals have a minimum guaranteed strength of -128.5 dBm; LightSquared signals, on the other hand, are authorized at +72 dBm, although LightSquared initially plans a power level of +62 dBm. Earlier this week, LightSquared proposed a fifty percent (3 dB) reduction in its authorized transmitter power limit, lowering it from +72 dBm to +69 dBm; however, such a proposed reduction is immaterial as it does not affect the proposed deployed power level of +62 dBm, which has been conclusively shown to cause harmful interference for many GPS receivers.[7] At 800 meters from its transmitters, LightSquared's power is predicted to be 96 dB higher than GPS. That translates to a LightSquared signal that is four billion times stronger than a GPS signal. GPS receivers of all types are not designed to exclude such strong signals, something never contemplated before LightSquared sought its waiver to offer its new terrestrial broadband service in an area of the spectrum historically reserved for weak space-to-earth signals.

V. LightSquared's Threat to GPS

A. For Years, the Terrestrial Component of MSS Has Been Both Ancillary to and Integrated with MSS Operations

As Garmin's lawyers have explained to me, the Federal Communications Commission ("FCC") International Bureau's January 26, 2011 decision granting LightSquared a waiver to offer a widespread terrestrial broadband service represented a fundamental change in FCC policy. LightSquared proposes to operate its high-power terrestrial broadband network in spectrum historically allocated to the Mobile Satellite Service ("MSS"), which is located at 1525-1559 MHz and 1626.5-1660.5 MHz. These frequency ranges in the "L-Band" are adjacent

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[6] RTCA/DO-229D, Minimum Operational Performance Standards for Global Positioning System/Wide Area Augmentation System Airborne Equipment, December 13, 2006, sections 2.1.4.5.1 and 2.1.4.5.2.

[7] Press Release, LightSquared, Inc., *LightSquared Solution to GPS Issue Will Clear Way for Nationwide 4G Network*, June 20, 2011, http://www.lightsquared.com/press-room/press-releases/ ("*LightSquared June 20, 2011 Press Release*").

to or near the frequency band used for low-power GPS signals. MSS carriers provide satellite communications services that are interconnected to the public switched telephone network in rural areas unserved by terrestrial commercial wireless telephone services. MSS signals are characterized by very low power at ground level, which makes them entirely compatible with other satellite services like GPS that operate in an adjacent spectrum. The low-power MSS signals, however, typically make the service unsuitable for voice communications in densely populated urban areas that are the most profitable to serve.

In 2003, the FCC sought to make offering MSS in underserved areas more attractive by permitting MSS carriers to use L-Band frequencies to provide an "Ancillary Terrestrial Component" ("ATC") to their satellite service that would "fill-in" gaps in geographic areas where the satellite service would not work. The FCC made clear that it was not seeking to reallocate MSS to terrestrial service. Instead, it was trying to strengthen MSS by allowing add-on terrestrial service in limited areas. The FCC explicitly stated in this 2003 action that "[w]e do not intend, nor will we permit, the terrestrial component to become a stand-alone service."[8]

To ensure that the ATC portion of the service remained truly "ancillary," the FCC adopted what is known as the Integrated Service Rule, requiring any MSS carrier offering ATC service to do so only by offering "an integrated service of MSS and MSS ATC." In other words, if an MSS operator offers a service plan that includes ATC service, the FCC's rules require that plan to include satellite service as well. To make absolutely clear what this integrated service requirement meant, the FCC adopted a "safe-harbor" rule providing that the integrated service requirement would be satisfied if the MSS used a "dual-mode" receiver capable of communicating using both the satellite and ATC components of the service.

As a final warning to service providers who might see the ATC component as a back-door way of providing competitive terrestrial wireless service, the Commission stated that:

> [W]e intend to authorize ATC only as an ancillary service to the provision of the principal service, MSS. We have established a number of gating requirements to ensure that ATC may only operate after the provision of MSS has commenced and during the period in which MSS continues to operate. . . . While it is impossible to anticipate or imagine every possible way in which it might be possible to "game" our rules by providing ATC without also simultaneously providing MSS and while we do not expect our licensees to make such attempts, we do not intend to allow such "gaming."[9]

No one read these unequivocal FCC statements as anything other than assurances to operators in the L-Band and adjacent bands that the agency was committed to maintaining a spectrum environment hospitable to low-power satellite services like MSS and GPS.

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[8] *See* 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, *Report and Order and Notice of Proposed Rulemaking*, 18 FCC Rcd 1962, 1964-65, ¶ 1 (2003) ("*MSS ATC Order*").

[9] *Id.* at 1965 & n.5.

In 2005, the FCC reiterated that "ancillary" must remain "ancillary":

> The purpose of ATC is to enhance MSS coverage, enabling MSS operators to extend service into areas that they were previously unable to serve, such as the interiors of buildings and high-traffic density urban areas. We will not permit MSS/ATC operators to offer ATC-only subscriptions, because ATC systems would then be terrestrial mobile systems separate from their MSS systems.[10]

In the same order, the Commission again explicitly stated that MSS ATC operators were required to "control self-interference sufficiently to maintain satellite service."[11]

Given this history and the underlying rules, other users of the MSS and adjacent spectrum, such as GPS providers, had every reason to expect that ATC operations would enhance – not interfere with – MSS operations. The Integrated Service Rule assured that any ATC service provider would, through its use of dual-mode or integrated handsets, protect against "self-interference" to the integrated MSS component. GPS providers reasonably concluded that any power levels or filtering of the ATC service that was sufficient to protect the MSS component from interference would likewise be sufficient to protect GPS signals in the adjacent spectrum band.

B. LightSquared's Terrestrial Proposal Is Anything But Ancillary

On November 18, 2010, LightSquared filed a letter with the FCC that fundamentally undercut these expectations. In its filing, LightSquared informed the FCC that it had developed a new business plan that would involve offering ATC service on a wholesale basis to retail wireless providers. LightSquared's proposed network would operate from 40,000 terrestrial transmitters located nationwide. Most importantly, LightSquared would no longer commit to satisfying the Integrated Service Rule by offering service only for use with "dual mode" handsets. Instead, it contended that it would be offering an "integrated service" merely because it would continue to offer MSS in the rural and sparsely populated areas where its ATC service would be unavailable.

Without the provision of "dual mode" handsets, LightSquared would no longer need to avoid self-interference, a crucial requirement basic to the GPS industry's willingness on several prior occasions to work with MSS applicants to ensure their ATC service did not result in harmful out-of-band emissions. LightSquared's November 2010 filing transformed its proposed service into an offering that would severely degrade GPS service for the millions of individuals, businesses, and government agencies that rely upon it.

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[10] 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, *Memorandum Opinion and Order and Second Order on Reconsideration*, 20 FCC Rcd 4616, 4628, ¶ 33 (2005).

[11] *Id.* at 4633, ¶ 46.

C. The FCC Rushed To Allow LightSquared's Proposed New Service Without Evaluating Interference Concerns and Ignored Evidence of Interference and Numerous Objections, Including Those From Key Federal Offices

The FCC's International Bureau responded to LightSquared's November 2010 letter by deeming it an application for a change in LightSquared's authorization, but the agency did not treat the letter according to the Commission's typical application processing policies. In place of the thirty days usually allowed for public comment and petitions to deny, followed by additional periods for oppositions and replies to those oppositions, the Bureau merely gave the public ten days to submit initial comments and an additional seven days for reply.[12] The Bureau surprisingly put the letter on public notice the very day after it was filed, meaning that, in this case, the comment period included the Thanksgiving holiday weekend. Ultimately, the Commission granted a very brief, three-day extension of the comment period, but the period was still much shorter than normal for an application of this consequence.[13]

Despite the truncated deadlines, a wide range of parties, including the U.S. GPS Industry Council, Verizon Wireless, AT&T, and CTIA-The Wireless Association filed comments discussing the massive problems that would be caused by LightSquared's proposed operations and arguing that such a wholesale rule change, as LightSquared was requesting, should more appropriately be handled in a broader rulemaking proceeding allowing opportunity for wide notice and comment. Following the comment deadline, oppositions continued to pour in from both individual GPS users and organizations representing them.

On January 12, 2011, the National Telecommunications and Information Administration ("NTIA") wrote the FCC, informing it that the Departments of Defense, Transportation, and Homeland Security had expressed concerns about LightSquared's impact on GPS and wanted the FCC to defer action on modifying LightSquared's authorization until the FCC evaluated the scope of the problem.[14] Attached to NTIA's letter was another letter from the Department of Defense requesting that NTIA oppose grant of LightSquared's request and suggesting that the FCC defer action until a rulemaking proceeding could be conducted. Rather than follow the Defense Department's recommendation, however, NTIA told the FCC Chairman that if the FCC intended to grant LightSquared's requested modification, it should simultaneously establish a process for analyzing the scope of the potential interference and establishing solutions before allowing LightSquared to commerce operations.

On January 20, 2011, the U.S. GPS Industry Council filed test data compiled by Garmin demonstrating that LightSquared's proposed operations would cause harmful interference to GPS devices. In experimental testing using the technical details of the proposed LightSquared system, an FAA-certified Garmin aviation receiver experienced harmful interference at power

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[12] Policy Branch Information, Applications Accepted for Filing, *Public Notice*, Report No. SAT-00378 (rel. Nov. 19, 2010).

[13] LightSquared Subsidiary LLC, *Order*, SAT-MOD-20101118-00239, DA 10-2243 (rel. Nov. 26, 2010).

[14] Letter from Lawrence E. Strickling, Assistant Secretary of Commerce for Communications and Information, to FCC Chairman Julius Genachowski, dated Jan. 12, 2011.

levels expected at a range of 13.8 miles and entirely lost its position at an estimated 5.6 miles from a LightSquared transmitter.

Despite this evidence and the growing opposition from private and government parties, the FCC's International Bureau granted LightSquared's request on January 26, 2011, subject to the condition that LightSquared engage in a process with interested parties to identify the scope of anticipated interference and propose solutions for mitigating it.[15] The Bureau directed LightSquared, as chair of the group, to make periodic reports to the Bureau on its progress, with a final report due by June 15, 2011. In essence, the FCC delegated its core function – expert interference analysis for purposes of spectrum allocation – to a LightSquared-led non-governmental group. Moreover, the Bureau's order did not require that GPS interference be solved before LightSquared begins offering service; it merely required that LightSquared complete the "process for addressing interference concerns related to GPS."[16] The Bureau left itself the option of allowing LightSquared to commence service even if it turned out that GPS interference could not be remediated. In the view of Garmin and many other parties, this unprecedented action amounted to an abdication of the FCC's responsibilities to police interfering uses of spectrum.

Following the decision, numerous parties, including Garmin, asked the full FCC to review the Bureau's order. On March 25, 2011, the Departments of Defense and Transportation also wrote FCC Chairman Genachowski objecting to the lack of inclusion of federal agencies in the LightSquared-led working group process and advising that a comprehensive study of "all the potential interference to GPS is needed."[17]

At today's hearing, Garmin fully expected to be able to discuss with the Subcommittees the final working group report to the FCC. Unfortunately, on the day the report was due, LightSquared sought and was granted an extension of time until July 1, 2011 to file the report, despite the GPS Industry Council's comments, on the part of its members who had been actively involved for months in the working group process, that the group's technical report was final and ready for submission.[18]

This month, both the International Civil Aviation Organization ("ICAO") and the International Air Transport Association ("IATA") have notified the FCC Chairman that they have serious concerns about LightSquared's proposed service. IATA expressed "strong opposition" to any waiver of the Integrated Service Rule for LightSquared, particularly because

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15 LightSquared Subsidiary, LLC, *Order and Authorization*, 26 FCC Rcd 566, 586-87, ¶¶ 41-43 (2011).

16 *Id.* at 588, ¶ 48.

17 Letter from William J. Lynn III, Deputy Secretary of Defense, and John D. Porcari, Deputy Secretary of Transportation, to FCC Chairman Julius Genachowski, dated Mar. 25, 2011.

18 Comments of the U.S. GPS Industry Council, File No. SAT-MOD-20101118-00239, filed June 15, 2011.

of the threat it creates for NextGen.[19] ICAO, terming its concern "grave," discussed the "far-reaching impact on current and future aviation operations" caused by the LightSquared proposal and urged that the United States government's long-standing commitment to provide GPS Standard Positioning Service for aviation throughout the world not be "jeopardized by the introduction of the LightSquared system and the ensuing impact on GPS use by aviation."[20]

VI. Testing Conducted on Aviation GPS Equipment Conclusively Demonstrates Serious Problems

Given the potentially devastating consequences that the LightSquared system poses for the aviation industry, multiple groups have conducted tests -- besides those done by the LightSquared-led working group -- to assess the true impact. All of the testing performed to date confirms that the LightSquared system, as currently proposed, will result in a widespread degradation of GPS receiver performance and severely limit the GPS utility as we now know it.

At the request of the FAA, RTCA, Inc. ("RTCA"), a standards setting body for the aviation community, performed tests and analysis to assess the impact of the LightSquared system on aviation GPS operations. The results of this effort were published on June 3 as RTCA/DO-327[21] and showed a severe impact to aviation GPS operations. The tests included a set of four aviation receivers from both the General Aviation and Air Transport sectors. All of the tested receivers experienced significant degradation when exposed to the LightSquared signals. Every receiver was significantly degraded at interfering signal levels that will be seen within 1.1 kilometer of a single LightSquared transmitter, but some receivers were impacted at interfering signal levels corresponding to ranges of 6.2 or 25.8 kilometers. Several of the tested receivers experienced a loss of satellite tracking in the presence of LightSquared signal levels that would be expected during routine low altitude operations such as during instrument approaches to landing. The RTCA analysis considered the effects of multiple LightSquared transmitters and showed that significant degradation would be experienced at aircraft altitudes below 18,000 feet over large regions of the country where LightSquared plans to deploy. In light of these findings, the RTCA report concluded that use of the upper LightSquared channel is incompatible with aviation GPS operations. Until this week, all of the proposed LightSquared deployment phases included the use of the upper channel. While the RTCA report stated that the operation of a single lower 5 MHz channel might be compatible with aviation GPS operations, the statement was based on an assumption that LightSquared would operate at $1/10^{th}$ of its authorized power limit. RTCA did not reach any conclusion on the compatibility of a single lower 10 MHz channel with aviation use; it said further study was needed.

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19 Letter from Giovanni Bisignani, Director General and CEO of the International Air Transport Association, to FCC Chairman Julius Genachowski, dated June 5, 2011.

20 Letter from Raymond Benjamin, Secretary General, and Robert Kobeh González, President of the Council, International Civil Aviation Organization, to FCC Chairman Julius Genachowski, dated June 13, 2011.

21 RTCA/DO-327, Assessment of LightSquared Ancillary Terrestrial Component Radio Frequency Interference Impact on GNSS L1 Band Airborne Receiver Operations, June 3, 2011.

Separate from the RTCA effort, the Department of Defense coordinated two sets of tests to assess the LightSquared impacts. The first of these was a series of laboratory tests conducted at White Sands Missile Range, New Mexico, from April 4 to April 7. Simulated LightSquared signals were broadcast to the GPS receivers being tested in an anechoic chamber, which is specially designed to eliminate reflecting signals. The tests included filters on the broadcast signal that were provided by LightSquared. LightSquared's engineers were present to assess the test setup, and they concurred that it was appropriate. These tests included FAA-certified aviation receivers, all of which demonstrated a complete loss of function with interfering signal levels that would typically be seen in airborne operations.

The White Sands testing was followed by open-air tests at Holloman Air Force Base in New Mexico from April 14 to April 17. As with the White Sands tests, LightSquared was an active participant; it provided representative LightSquared transmitter equipment, and its engineers were on site to support the tests.

The data from these two Defense-coordinated tests, along with the results from RTCA, were analyzed by the National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum ("NPEF"), which recently released its own assessment of the LightSquared effects on GPS.[22] The data showed that significant degradation of aviation GPS performance will occur at distances up to 27.2 kilometers from a single LightSquared base station and that a complete loss of service can be expected at distances up to 12.2 kilometers. As shown in Figure 1 below, when the data are superimposed against a proposed deployment in the greater District of Columbia metropolitan area, they show a denial of aviation GPS service over the entire area.

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[22] National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum ("NPEF"), *Assessment of LightSquared Terrestrial Broadband System Effects on GPS Receivers and GPS-dependent Applications*, available at http://www.govexec.com/pdfs/061711bb1.pdf (last visited June 19, 2011). The National Space-Based Positioning, Navigation, and Timing Systems Engineering Forum is a multi-agency technical forum that supports policy and managerial decisions regarding the evolution of GPS. The NPEF is co-chaired by the Department of Defense (Air Force) and the Department of Transportation (Federal Aviation Administration) and comprised of representatives from various government agencies.

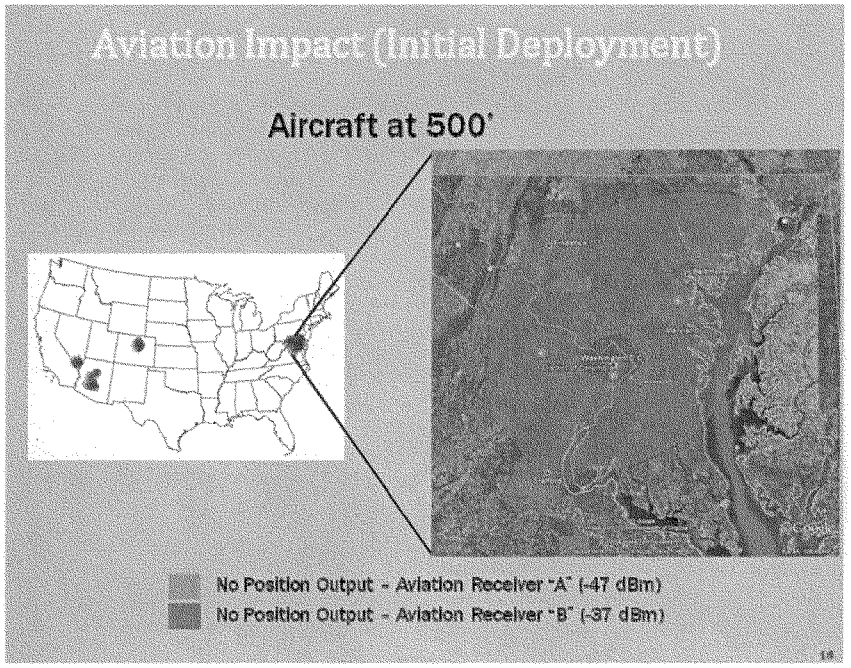

Figure 1

The NPEF report looked at potential mitigations that might allow GPS to coexist with the LightSquared system. The addition of filtering was considered and was determined to be excessively costly and likely to sacrifice the levels of performance achieved by existing GPS equipment. The report stated that, for many applications of GPS that require the use of a wide pass-band, a practical receiver design with sufficient filtering will not be possible. The potential for mitigation by limiting LightSquared to operations using a single 5 MHz or 10 MHz in the lower portion of the LightSquared band was also evaluated. The NPEF noted that while some applications such as aviation may be compatible with this strategy, it will not work universally across the wider range of GPS applications. The only mitigation strategy that the NPEF identified as compatible with all GPS applications was the relocation of LightSquared to another band more suitable for high power terrestrial operations (*i.e.*, not the MSS band).

Based on these findings the NPEF made the following recommendations to the National Executive Committee for Space-Based Positioning, Navigation, and Timing ("PNT"):

1. Move to rescind the FCC conditional waiver (FCC Order DA 11-133) of January 26, 2011 authorizing terrestrial only ATC operation in the Mobile Satellite Service (MSS) 1525 - 1559 MHz Band.

2. The U.S. Government should conduct more thorough studies on the operational, economic and safety impacts of operating the LightSquared Network, to include additional ATC signal configurations not currently in LightSquared planned spectrum phases, effects on timing receivers, as well as transmissions from LightSquared handsets.

3. Based on testing of representative ATC equipment which became available for the first time during this NPEF evaluation, it strongly recommended the FCC revisit and readdress the effects of the 2003-2010 ATC authorizations within the MSS L-Band spectrum on GPS applications.

These recommendations, made by the U.S. government's own experts on GPS and its critical importance to the nation's infrastructure, clearly show that LightSquared poses a dangerous threat to the continued operation of GPS.

VII. The Concept of Mitigation Cannot Be Supported

The aviation and GPS communities themselves have invested a significant amount of time, effort, and money not only in testing the effect of LightSquared's proposed service but investigating potential mitigations that might allow GPS to coexist with LightSquared transmissions in the MSS L-Band. They have found that the concept of mitigation cannot be supported.

LightSquared has suggested that filters might effectively protect GPS receivers from its transmissions. There are no filters in existence that would protect aviation GPS receivers from LightSquared's proposed transmissions. Since no filters exist – not even prototypes – the aviation community has not been able to test this mitigation proposal; however, as filter proposals surface, it is important to evaluate them in light of the stringent requirements imposed on products installed in aircraft. In addition to the challenging filter selectivity constraints required to reject LightSquared signals adjacent to the GPS band, aviation filters must reliably preserve the GPS spectrum, be able to withstand extreme temperature variations, endure the rigors of intense vibration, survive electrostatic discharge and lightning events, and meet strict size and weight limitations. To achieve the high level of rejection required to eliminate the high power LightSquared transmissions from the GPS receiver, any potential filter must necessarily reject some of the GPS signal as well. Improving out-of-band signal rejection comes at the cost of other performance requirements that are critical to the operation of the GPS receiver.

LightSquared has stated that there are companies willing to build filters that meet the aforementioned constraints. The aviation and GPS communities have only received one proposal thus far. The proposal was comprised of two facets; it was evaluated carefully and found to be completely infeasible. First, this proposal suggested the use of an in-line cavity filter. The insertion loss of this cavity filter is much too large for use as an antenna preselect filter, and it does not provide sufficient protection against 3rd order intermodulation when installed in-line after the antenna module. In addition, the size and weight of the cavity filter present serious challenges for airframe certification. Second, this proposal suggested an unconventional antenna module with an up-conversion approach to reduce the filter size. This approach requires converting GPS signals to another frequency, filtering them, and then

converting them back to the GPS frequency. It would significantly increase the complexity of the antenna design with an unconventional approach that may not be well suited to the stringent operational requirements described above. It also would fail to address the 3rd order intermodulation concerns. In addition, it draws significantly more power than conventional aviation antenna modules and would, therefore, require a re-design and re-certification of the GPS receiver in addition to the antenna.

The filters needed to protect GPS from LightSquared do not exist. There are no commercially available parts that will work. We have yet to even see a prototype. Furthermore, many of the proposals that have surfaced reject a large portion of the GPS signal in order to sufficiently attenuate LightSquared's powerful signal. Meanwhile, LightSquared continues to make claims that GPS receivers "look into its spectrum." Essentially, LightSquared is instead proposing that the GPS community add filtering to GPS receivers that would restrict them to using only a fraction of the frequency band allocated to GPS. These proposed filters actually filter out much of the desired GPS signals. This is hardly an acceptable compromise.

Even if a suitable filter could be developed, it would take many years to obtain all of the necessary certifications and approvals.[23] Furthermore, the task of retrofitting the entire fleet of GPS-enabled aircraft in the United States would take years.[24] Any aircraft from other countries flying to U.S. destinations would also need to be retrofitted. Equally important, there is no one-size-fits-all solution to this problem, so numerous filters would be required to meet the needs of various aviation GPS receivers.

In summary, there are numerous obstacles to filter-based mitigations that lead Garmin to conclude that such a proposal is completely impractical. Specifically, these obstacles are:

Technical obstacles:

1. Appropriate filters do not exist. All discussions in the FCC-mandated technical working group process have focused on proposals derived from simulations.
2. Proposed filters reject portions of the GPS signal in addition to the LightSquared signal.

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[23] Joint Planning and Development Office, NextGen Avionics Roadmap, Version 1.2, September 21, 2010) at 3 (under heading "System Safety – Avionics Constraints: *Historical* Communication Navigation and Surveillance (CNS) Lead-Times" states "it is important to highlight that many past efforts involving avionics system upgrades have spanned long periods (15-25 years with an average of 18 Years - as shown in the figure below)"), http://www.jpdo.gov/library/20101008_ARM_v_1.2.pdf.

[24] For example, the FAA's ADS–B Out Performance Requirements to Support Air Traffic Control Service Discussion of the Final Rule, Section II.N.1 includes the following statement: "[a]fter reviewing all the comments, the FAA finds that a 2020 compliance date remains appropriate because [National Airspace System ("NAS")] . . . users need time to equip to the requirements of the rule." Automatic Dependent Surveillance – Broadcast (ADS-B) Out Performance Requirements to Support Air Traffic Control (ATC) Service, 75 Fed. Reg. 30176 (May 28, 2010).

3. The physics of filter design make it virtually impossible to reject a signal four billion times stronger than and closely proximate to the very weak GPS signal without harming the GPS signal to some degree.
4. Proposed filters are considerably larger than existing ones, making any retrofitting of existing receivers virtually impossible.
5. Handheld units would have to be scrapped because the antenna is integral to the unit.
6. The proposed filters do not address third-order intermodulation issues.
7. Proposed filters would require a different power design than presently exists, requiring new receiver designs to power the filter and antenna.
8. It is impossible to design one filter that will address all of the diverse requirements of the existing GPS user base.

Cost and time obstacles:

1. The time and expense of developing numerous filters to meet the needs of different aviation receivers.
2. The time required to obtain necessary certifications and approvals.
3. The time, expense, and feasibility of retrofitting the entire fleet of aircraft in the U.S. and aircraft flying here from other nations.
4. The loss of revenue and impact on jobs while aircraft are out of service for the installation and retrofit.
5. The difficulty in determining who would be responsible for funding the extensive development and retrofit costs when the changes offer no improved benefit or greater operational capabilities.

The remaining mitigation discussions with LightSquared focused on modifications to its deployment plans that would move it to spectrum further away from the GPS band. One proposal discussed the possibility of LightSquared only utilizing its lower 10 MHz channel, centered at 1531 MHz. RTCA has concluded that not enough information exists today to decide whether this option is viable and that more study is needed.

Earlier this week, LightSquared issued a press release setting forth what it termed a "comprehensive solution" to the problem of interference with GPS receivers.[25] While the details remain vague, this solution involves initially limiting LightSquared to using the lower 10 MHz channel, along with, as noted above, a 3 dB (50%) reduction in its maximum authorized transmit power of 42 dBW. This proposal is no solution at all, given that the RTCA analysis was unable to show that the lower 10 MHz channel is compatible with aviation GPS operations due to a negative margin for initial GPS signal acquisition. The proposed reduction in power is an illogical conclusion given that the RTCA analysis was based on LightSquared's previously stated plan to limit base station transmissions to 1/10th (32 dBW) of its authorized transmit power. LightSquared's latest proposal would allow it to transmit at five times the power levels assumed in the RTCA analysis. Moreover, this "comprehensive solution" conveniently ignores much of the existing user base, especially users of high precision GPS equipment.

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25 *LightSquared June 20, 2011 Press Release, supra*, n. 7.

The only fail-safe mitigation strategy proposed to date is for LightSquared to move to entirely different frequencies outside of the MSS L-band, away from GPS.

VIII. Allowing LightSquared To Proceed Will Have Profound Consequences for Aviation and Marine Safety, As Well As Harmful Economic and International Implications

Aviation Safety of Life. Given the way that GPS-enabled aviation products have revolutionized aviation safety, it is not an understatement to say that allowing the LightSquared proposal to proceed, in any form within the identified spectrum, will have serious implications for aviation safety of life. To ensure their products consistently meet safety objectives, Garmin and others in the industry design their devices to not only meet minimum requirements but also include margins, redundancy, and other backup design elements. Any threatened erosion of these critical elements, as would occur with LightSquared's proposed operation, would produce extremely serious consequences for integrity and availability of GPS service. Not only is NextGen likely to be seriously delayed, if not compromised entirely by any roll-out of LightSquared's proposed network, the possibilities in individual circumstances are alarming:

1) NextGen would be slowed or stopped completely if the GPS signal does not meet the availability and integrity requirements of the National Airspace System. NextGen programs at risk include ADS-B, Required Navigation Performance ("RNP")/Area Navigation ("RNAV"), WAAS, GBAS, and Cockpit Display of Traffic Information ("CDTI"). These programs already have proven extremely beneficial to aircraft operators because of the GPS-based capabilities bring improved safety and airspace/airport capacity and reduced passenger delays, carbon emissions, and noise impact.

2) Losing GPS while on approach would be more than an inconvenience; it would cause significant distraction and require pilots to revert to a less precise ground-based navigation system that has few of the capabilities of GPS. Furthermore, loss of GPS would deny approach coverage at hundreds of airports and heliports that previously had no instrument approach because they were not in proximity to a ground-based navigation aid and could not afford to purchase a standalone instrument approach system of their own.

3) The inability of GPS to acquire position while on the ground would prevent the functioning of SafeTaxi® and similar applications, increasing the probability of runway incursions.

4) Without GPS, the Terrain Awareness and Warning System ("TAWS") will not work for General Aviation, and Air Transport TAWS effectiveness will be degraded, increasing the likelihood of controlled flight into terrain.

5) Loss of GPS means that, for General Aviation, cockpit displays of aircraft position would be gone, and, therefore, a pilot would lose the very valuable situational awareness associated with a moving map display and a relative display of weather and traffic.

6) Loss of GPS would disable a synthetic vision system's ability to display external topography from the perspective of the flight deck, thus reducing a pilot's situational awareness.

7) Poor GPS availability would preclude low cost AHRS systems and promote the return to spinning mass gyroscope instruments with their notoriously poor reliability and safety record.

8) Without GPS, pilots would lose the ability to fly precise predetermined search patterns at any location night or day under all weather conditions.

9) Loss of GPS would mean rescue personnel could not determine a precise location for rendering emergency help and would greatly delay their ability to save lives.

Marine Safety of Life. Equally concerning is the effect that impairment of GPS service would have on safety of operations on the nation's lakes and waterways and along its coasts. Any degradation or interruption of GPS signals would erode the integrity and availability of critical positional information. Again, the possibilities are alarming:

1) Losing GPS-enabled DSC service would mean boaters would have to return to reliance on rough estimates of location conveyed verbally over a radio.

2) Without GPS, boaters who depend on marine surface radar overlays with their GPS components to supply information on hazards instead would have to rely simply on visual identification, which becomes impossible at night or in fog.

3) Loss of GPS would render boaters unable to make the decisions necessary to avoid weather squalls based on marine weather information geo-located via GPS.

4) Without GPS, marine collision avoidance systems such as DSC and AIS (Class B) for small vessels, and AIS (Class A) for large vessels would be rendered useless.

5) Loss of GPS would cripple GMDSS component systems (*e.g.* EPIRB, DSC, and AIS) and make marine search and rescue efforts much less likely to reach emergency locations and stranded individuals or vessels.

6) Without GPS, marine AIS (Class A) used to track large international shipping vessels would be unavailable, affecting national security.

Other Serious Implications. Disruption of GPS has profound economic and international implications. The GPS community, the aviation industry, and numerous other business sectors have already spent significant resources over the last half year to analyze LightSquared's proposed broadband terrestrial network to compensate for the FCC's failure to do so prior to its issuance of the LightSquared waiver on January 26, 2011. The distraction from the business of developing, designing, and implementing new products has diminished economic competitiveness. In the event that any aspect of LightSquared's proposal is allowed to proceed, these businesses will be forced to expend critical resources continuing to study this issue while facing diminishing profit margins due to degradation in GPS receiver performance. The cumulative effect is a massive delay in the development of new GPS technology beneficial to consumers, businesses, governments, and the safety of life. Some parties have even begun to harbor concerns that, because of LightSquared, GPS users in the U.S. may actually find it more cost effective to switch to other global navigation systems, such as Russia's GLONASS, given

the different frequencies that system uses, further eroding American leadership in space-based navigation and timing.

Moreover, any FCC decision that allows or promotes GPS degradation will affect foreign aircraft operating in affected U.S. airspace. If LightSquared is allowed to proceed, these aircraft will require the same costly retrofit (if adequate mitigation is technically possible) with whatever new system U.S. aircraft will be forced to employ to retain GPS functionality. Complex U.S.-based standards for GPS-enabled aviation devices are harmonized with other countries and through international organizations, like ICAO, and accepted abroad. Any necessary modification of U.S. standards for GPS-enabled avionics means that the whole system of worldwide standards would need to be revised.

Similar problems will occur in the marine context. Marine GPS receivers used in safety-of-life applications such as AIS are required to undergo international GPS receiver certification per International Electrotechnical Commission ("IEC") 61108-1.[26] Furthermore, many agencies, including the US Coast Guard and the FCC, rely on international standards written by the Radio Technical Commission for Maritime Services ("RTCM") to regulate GPS performance as it relates to AIS, DSC, and EPIRB, to name a few. Modification of these standards due to harmful interference from LightSquared would have far reaching international consequences for other countries that adopt these same standards.

IX. Conclusion

Garmin's experience based on its participation in the GPS industry's review of LightSquared's operations over the past half year confirms what its original tests in January 2011 showed: operation of LightSquared's proposed broadband terrestrial network will cause catastrophic harm to GPS service, and this potential harm cannot be mitigated in any practical manner. Garmin and numerous other companies have cooperated in good faith to evaluate these concerns, spending millions of dollars that should have been more productively directed toward increasing jobs and advancing their own business goals and objectives. At this point, Congress should put an end to this dysfunctional exercise and, as NPEF recommended, work to ensure the FCC's rescission of LightSquared's conditional waiver and an overall review of the effects of Ancillary Terrestrial Component operations in L-Band spectrum. At a minimum, LightSquared's proposed operations should be moved to entirely different frequencies outside of the MSS L-Band, away from GPS.

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[26] IEC 61108-1 Ed. 2.0 en: 2003, Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 1: Global positioning system (GPS) - Receiver equipment - Performance standards, methods of testing and required test results.

STATEMENT FOR THE RECORD

TERESA M. TAKAI

DEPARTMENT OF DEFENSE CHIEF INFORMATION OFFICER

BEFORE THE

COMMITTEE ON TRANSPORTATION AND INFRASTRUCTURE

SUBCOMMITTEE ON AVIATION

SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION

ON

GPS RELIABILITY: A REVIEW OF AVIATION INDUSTRY PERFORMANCE, SAFETY ISSUES, AND AVOIDING POTENTIAL NEW AND COSTLY GOVERNMENT BURDENS

June 23, 2011

Good morning Mr. Chairmen and distinguished Subcommittee members. Thank you for the opportunity to testify before the Subcommittees on Aviation and on Coast Guard and Maritime Transportation regarding the vital importance of the Global Positioning System (GPS) to U.S. national defense capabilities. My name is Teri Takai and I am the Acting Assistant Secretary of Defense for Networks and Information Integration (ASD(NII)) and the Department's Chief Information Officer (CIO).

My testimony today will focus on the importance of GPS reliability to the Department of Defense (DoD) in ensuring that our warfighters and mission partners have the critical capabilities they need and which only GPS can effectively deliver.

Importance of GPS:

GPS is vital to national security and is relied upon by our service-men and –women for a wide array of capabilities. Simply put, GPS is integrated into almost every aspect of U.S. military operations. To provide but a few examples, GPS signals are used to ensure the accuracy of precision-guided munitions, to guide troop movements, to synchronize communications networks, to enable battle-space situational awareness and to conduct search and rescue operations.

I want to assure the Subcommittee that DoD takes its stewardship role for GPS very seriously. We do so for the sake of our soldiers, sailors, marines, and airmen who use the system daily and rely upon its essential military capabilities for our national defense and preparedness. We know also that the civil and commercial sectors have long

embraced GPS for its public safety capacities and economic advantages. Consequently, we have developed a partnership with the civil and commercial sectors where we share our GPS knowledge and expertise, as much as possible. DoD continues to upgrade GPS to deliver a more robust signal, with increased accuracy and greater integrity.

Importance of Radiofrequency Spectrum to the Department of Defense

Spectrum access is critical to DoD not only for GPS operations, but for all U.S. military operations. DoD uses spectrum for command and control, communications, computing, and intelligence (C4I), surveillance, target acquisition, and reconnaissance on land, sea, undersea, airborne and in space. Military spectrum requirements are diverse and complex given the variety of different missions the Department must support around the world. In theater, our warfighters often require a rapidly deployed, but fully-formed mobile C4I infrastructure to provide secure communications and support combat operations in austere environments, for very large numbers of users, and over extended distances. DoD spectrum access requirements are global and must be interoperable with U.S. military allies. Each of these factors are driving DoD spectrum requirements to increase much in the same way as consumer mobile broadband demand, but with a much different mission to support war-time operational requirements, to include GPS.

GPS Considerations regarding the proposed LightSquared broadband service

Prior to the January 26, 2011 Federal Communications Commission (FCC) order that granted LightSquared a conditional waiver for its terrestrial network, the National Telecommunications and Information Administration (NTIA) Administrator in a letter

to the FCC Chairman on January 12, 2011, and the Deputy Secretary of Defense in a similar letter on that same date, raised concerns regarding the potential interference effects to GPS presented by the LightSquared terrestrial only service. To that end, the Deputy Secretary strongly recommended deferral of final action on this ruling until the proper interference analysis and mitigation studies could be conducted based on the new business model. However, the FCC granted LightSquared a conditional waiver with the direction that LightSquared & U.S. GPS Industry Council would establish a Working Group to study the potential interference to GPS. The LightSquared Working Group study was required to be filed with the FCC by June 15, 2011. LightSquared has since been granted a two-week extension to file the results of this study.

Additionally, U.S. Air Force Space Command and the National Positioning, Navigation & Timing (PNT) Engineering Forum (NPEF), independently conducted both laboratory and operational testing at White Sands Missile Range in April 2011. The report of those test results was submitted to our spectrum regulator for federal agencies, NTIA, on June 15, 2011. The test data and results collected over the last four months via a series of laboratory and field environment testing of a sampling of both military and civilian GPS receivers indicates the proposed LightSquared terrestrial operations will cause harmful interference to GPS operations

The potential for interference to GPS from the proposed LightSquared terrestrial network exemplifies the technical, policy and regulatory challenges in repurposing

long-standing spectrum allocations to facilitate new broadband services. DoD is currently working with the FCC, NTIA and industry to resolve this issue.

Summary

In general, the Department is continuing to work with NTIA on behalf of the Administration and with other Administration Partners, as well as with the Congress to address long-term solutions regarding a balance between Federal spectrum requirements and the expanding demand for mobile broadband services. DoD will remain an active participant in the process to find appropriate solutions for LightSquared without undue interference to GPS receivers, or other military spectrum requirements. However, the ability of GPS to operate without harmful interference remains of paramount importance to the Department. The Department will continue to support the FCC proceedings on this matter and will respond in earnest to further guidance from FCC and NTIA after their review of the findings from the LightSquared Working Group and the interagency reports.

I want to thank you for your interest in our efforts and I would be pleased to answer any questions you may have.

PRESIDENT'S DEPARTMENT
AIR LINE PILOTS ASSOCIATION, INTERNATIONAL
1625 MASSACHUSETTS AVENUE, NW ☐ WASHINGTON, DC 20036 ☐ 1-888-FLY-ALPA (1-888-359-2572)
FAX 202-797-4007

June 22, 2011

The Honorable Tom Petri
Chairman
House Aviation Subcommittee
2251 Rayburn House Office Building
Washington, D.C. 20515

Dear Chairman Petri:

As you prepare for the Subcommittee's hearing on "GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens," I respectfully offer the perspective of the Air Line Pilots Association, International (ALPA).

For the past 80 years, ALPA has played a pivotal role in a wide variety of significant safety improvements in the airline industry. Today, we represent more than 53,000 pilots at 39 airlines in the US and Canada, and we are proud to have partnered with your Subcommittee to help make airline travel the safest mode of transportation in human history. Our commitment to unbiased, fact-based evaluation of airline safety and security issues has won ALPA an unrivaled reputation for excellence throughout the airline industry.

ALPA is a strong proponent of NextGen and supports its implementation to improve safety, increase capacity and efficiency, and reduce aviation's environmental footprint. The safety and efficiency of the aviation operations today are already heavily reliant on the invaluable position, navigation, and timing accuracy provided by GPS. GPS is now used for aircraft navigation, all-weather approaches and landings, surveillance, separation between aircraft, and pilot situational awareness. As NextGen initiatives continue to mature, there will be ever-increasing emphasis on the central role of GPS.

Unfortunately, a threat is being posed to the viability and usefulness of GPS from LightSquared (L^2), a privately held commercial enterprise which plans to deploy a network of 40,000 transmitters across the U.S. to provide broadband communications services. L^2 intends to use a frequency band immediately adjacent to that assigned to GPS, which uses a low-powered signal that will be disrupted by L^2's much higher-powered signal. The LightSquared system, if allowed to operate as requested in their license application, would cripple the ability of pilots to safely, accurately and efficiently operate in all conditions.

Since 1983, when President Reagan announced that the GPS system would be made available for civilian use, GPS has become a crucial element of the aviation industry. The aviation community has long recognized that the GPS signal is, by design, of very low power and is thus susceptible to interference. For this reason, use of the radio frequency spectrum next to that used by GPS has been limited to similar low-powered, satellite-based signals to ensure that the GPS signal is not adversely affected. In stark contrast, the LightSquared proposal to deploy 40,000 high-powered ground based transmitters would create interference, now validated by rigorous testing and analysis, that would disrupt GPS nation-wide.

Joint government and industry tests clearly show GPS-based operations would be unavailable over entire regions of the country at any normal operational aircraft altitude.

Reverting from GPS to exclusive use of ground-based navigation systems would constitute a huge and unacceptable leap backwards in technology and safety and would be highly impractical, if not impossible, to achieve. The National Airspace System (NAS) simply cannot return to pre-GPS operations. This is due to the fact that the FAA has been decommissioning ground-based navigational aids for the past several years. The FAA's decommissioning program was intended to further take advantage of the efficiency afforded by GPS by removing high-maintenance, technologically outdated equipment from the NAS. Such modernization efforts are appropriate, timely, and in the best interests of the traveling public and the country's economic health. As a result, allowing LightSquared to commence operations before acceptable, proven mitigations are developed to prevent interference should not be viewed as an option.

In 2007, the Federal Aviation Administration (FAA) began a $1.8 billion GPS-based Automatic Dependent Surveillance – Broadcast (ADS-B) program to replace radar-based surveillance of aircraft in the NAS. The GPS-enhanced aircraft position information, which is transmitted from the aircraft to air traffic controllers as well as other aircraft, is increasing capacity and efficiency both in the terminal and en route portions of the National Airspace System (NAS). ADS-B also provides radar-like surveillance coverage of mountainous and remote areas like Alaska and the Rocky Mountains – areas where radar is currently not available.

Without GPS there will be areas of the country without a way to navigate efficiently or, more importantly, land safely in bad weather. Most airports serviced by air carrier operations now have multiple GPS-based procedures. Many of these runways were not equipped for approaches using ground-based navigational aids during bad weather, which resulted in cancellations or delays. Now, using GPS, approaches are conducted in safety during all weather conditions at these locations.

Since 1994, the US commitment to provide GPS for aviation worldwide has been the key to GPS aircraft navigation and surveillance applications, which today support safer and more efficient aviation operations worldwide. Allowing L^2 to operate a system that interferes with the GPS signal would negate decades of advancements in operational safety and capacity. This is not acceptable to ALPA and we do not believe that it should be acceptable to Congress or the flying public.

L^2's system must not be approved or deployed in any manner unless and until the company demonstrates that is has fully protected the GPS systems relied on by millions of Americans for safe and efficient air travel.

Thank you for your oversight of this matter.

Sincerely,

Donald Lee Moak

Lee Moak, President
DLM:jc

AUVSI
ASSOCIATION FOR UNMANNED VEHICLE SYSTEMS INTERNATIONAL

Statement of the

Association for Unmanned Vehicle Systems International (AUVSI)

JOINT HEARING BEFORE THE HOUSE TRANSPORTATION AND INFRASTRUCTURE SUBCOMMITTEES ON AVIATION AND COAST GUARD AND MARITIME TRANSPORTATION

on

GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens

The Honorable Thomas E. Petri, Chairman
The Honorable Frank A. LoBiondo, Chairman
The Honorable Jerry Costello, Ranking Member
The Honorable Rick Larsen, Ranking Member

23 June 2011

Chairmen and members of the subcommittees, thank you for the opportunity for the Association for Unmanned Vehicle Systems International (AUVSI) to provide testimony for the official committee record. AUVSI is the world's largest non-profit organization devoted exclusively to advancing the unmanned systems community through communication, education, and leadership. AUVSI represents more than 6,000 members from industry, government, and academia, in the air, ground, and maritime domains.

As technology continues to evolve, the field of unmanned systems continues to grow. Currently, unmanned systems are performing tasks that just a few years ago could only be completed by a human hand, or by a human being present onboard a vehicle. Today, unmanned aircraft systems (UAS) are flying to defend our interests at home and abroad, unmanned underwater vehicles (UUV) are being used to track wildlife and cap underwater oil wells, and unmanned ground vehicles (UGV) are being used to defuse and dispose of bombs and cleanup radioactive materials. In the years to come, you will see unmanned systems doing many more tasks that were previously performed by humans.

Currently, the overarching technology that almost all of these systems use and rely on is our Global Positioning System (GPS). Without accurate, uninterrupted GPS signals, many unmanned systems cannot effectively operate.

For this reason, it is vital that the GPS frequency, which many consider to be a national and even international utility, be protected from possible interference and disruption.

On 26 January 2011, the Federal Communications Commission (FCC) issued a conditional waiver to a company known as LightSquared, to build thousands of high-powered terrestrial transmitters and use a radio frequency adjacent to the lower-powered GPS satellite frequency to build a new broadband wireless network. Because these frequencies are in the same radio spectrum range, the high-powered, terrestrial-based transmitters drown out or significantly interfere with the weaker satellite GPS signals and thereby, render GPS receivers in the nearby vicinity unusable.

The lack of a reliable GPS signal poses a serious threat to our public safety and national defense, and the potential cost of retrofitting or replacing affected GPS receivers would be cost prohibitive. Without GPS, the emerging field of unmanned systems will be stifled. That means firefighters that want to use UAS to monitor wildfires will no longer be able to do so, researchers will no longer be able to use UUVs to monitor fish migration, and farmers will not be able to use UGVs to monitor and harvest their crops.

For these reasons, on 12 April 2011, on behalf of the unmanned systems industry, AUVSI's President and CEO, Michael Toscano, wrote a letter to the Chairman of the FCC, voicing concern with the FCC's decision to grant LightSquared a conditional waiver. AUVSI asked the FCC to further study the issue and allow for more public comment.

In addition to sending a letter to the FCC, AUVSI also joined forces with dozens of other trade associations and individual corporations, by becoming a member of the Save Our GPS Coalition (www.SaveOurGPS.org).

AUVSI also notified its 6,000 members of this issue and encouraged them to contact their elected officials. The coalition's grassroots efforts have paid off. Members of Congress, in addition to other affected federal executive agencies, are beginning to take notice and ask the FCC to proceed with caution in this area.

Thankfully, in response to industry and government pressure, the FCC decided to establish a working group to examine the issue and report back with their findings on 15 June. Over objections from many in the GPS industry,

LightSquared did not release its findings on 15 June, instead asked for and was granted a two week extension. Media reports and preliminary findings indicate that GPS signals around LightSquared terrestrial towers do in fact significantly interfere with GPS receivers. On 21 June, LightSquared announced that they would be moving their frequency to a different spot on the spectrum to avoid interfering with GPS signals.

While AUVSI supports LightSquared's intention of increasing broadband wireless access across the country, AUVSI cannot support this new broadband system, or any other use for that matter, if it interferes with GPS signals. The GPS is simply too valuable a utility to jeopardize.

AUVSI appreciates Congress' interest in this matter, and hopes it will remain vigilant in its oversight of the FCC and the allocation of radio spectrum. If you have any questions, or need any additional information about how GPS is important to the unmanned systems industry, please contact AUVSI's Executive Vice President, Gretchen West at 703.845.9671 or West@auvsi.org. Thank you again for the opportunity to submit testimony for the record.

STATEMENT OF ED BOLEN

PRESIDENT AND CEO

NATIONAL BUSINESS AVIATION ASSOCIATION

JOINT HEARING

SUBCOMMITTEE ON AVIATION

SUBCOMMITTEE ON COAST GUARD AND MARITIME TRANSPORTATION

COMMITTEE ON TRANSPORTATION AND INFRASTRUCURE

U.S. HOUSE OF REPRESENTATIVES

JUNE 23, 2011

Statement of Ed Bolen
President and CEO
National Business Aviation Association

On behalf of the over 8,000 members of the National Business Aviation Association, I would like to commend the leaders and members of the House Aviation Subcommittee and the Coast Guard and Maritime Transportation Subcommittee for holding this important joint hearing on "GPS Reliability: A Review of Aviation Industry Performance, Safety Issues, and Avoiding Potential New and Costly Government Burdens."

First, we would like to acknowledge and thank Aviation subcommittee Chairman Petri and Ranking Member Costello for joining with over 60 Members of the House of Representatives in sending a letter to the Chairman of the Federal Communications Commission (FCC) expressing concerns about the possible interferences from the proposed LightSquared system on the Global Positioning System (GPS) frequencies. In addition, thirty-three Senators signed a similar letter to the FCC expressing their respective concerns on this issue.

General aviation operators were early adopters of Global Positioning Satellite (GPS) technologies. Prior to GPS availability aircraft operators were limited to navigation either by map reference--when the visibility was good enough--or, point- to-point electronic navigation using World War II ground-based navigation aids. These en route navigation aids (NAVAID), (non-directional radio beacons [NDBs], Very High Frequency Omni Directional Radio Ranges [VORs] and Distance Measuring Equipment [DMEs] and others) resulted in indirect air navigation routing. This early rudimentary system provided a high level of dependable but inefficient flight, with greater fuel burn and more time en route because aircraft had to pass over the same geological point in space above a NAVAID location.

GPS is now one of several international satellite-based navigation systems, either operating or in the process of implementation. They are known collectively and generically as Global Navigation Satellite Systems (GNSS).

When the GPS became available for civil use in the 1980s it was almost immediately recognized by the general aviation community as providing higher levels of safety, precision and efficiency. With time, the sophistication of on-board equipment evolved and provided even more accurate positioning. The technology allowed instrument approaches that were user friendly, and the adoption of GPS became more universal. Today, more than 60% of the 11,000 business aircraft operating in the US are equipped with various GPS capabilities required for instrument approaches at over 5000 airports in the US. Even more have en route GPS capability.

Following action earlier this year by the FCC to issue a waiver to LightSquared to permit the re-purposing of radio spectrum to deploy its wireless broadband initiative, NBAA joined with a diverse group of over 200 concerned parties to urge the FCC to carefully review and monitor progress on this issue to insure that there would be no adverse impact on current GPS users. This advocacy group includes local, state and federal agencies (including the Department of Defense, Department of Homeland Security, and Department of Transportation); first responders, agricultural users as well as members of the general public concerned about the potential impact on their auto and personal communication devices.

For more than three decades, the GPS, as administered by the U.S. Department of Defense (DOD), has been integral part of our nation's infrastructure. We have been carefully monitoring the field testing of the LightSquared system and initial results do indicate the potential for interference with the satellite transmissions to hundreds of millions of GPS receivers.

These concerns are highlighted in the FY2012 House Agriculture Appropriations legislation. The current bill expresses concern about the potential impact of the LightSquared technology on the GPS used by agricultural interests. It calls on the Department of Agriculture to collaborate with the Defense and Transportation Departments to further address the possible national impact on GPS usage.

In addition, both the House and Senate FY2012 Defense Authorization bills include language regarding potential GPS interference. Last week, the Senate Armed Services Committee included a provision directing the

Secretary of Defense "to review and access the ability of national security Global Position Systems (GPS) receivers to receive GPS signals without interruption or interference over the next 2 years."

We greatly appreciate these strong Congressional expressions of interest and concern about the safety and efficiency of the GPS network and the potential impacts of LightSquared on the nation's GPS safety and security infrastructure.

This concern extends beyond the U.S. The global aviation community has strong concerns over the potential impact on GPS signals from LightSquared. In a June 13 letter to U.S. officials, the International Civil Aviation Organization (ICAO) expressed the group's "grave concern" over the conditional waiver provided by the Federal Communications Commission to wireless provider LightSquared. ICAO went on to state that, "ongoing aviation developments, such as those being undertaken in the framework of United States NextGen programme and the European SESAR programme, will place even more emphasis on the central role of GPS and other satellite navigation systems in aviation operations."

Concerned about potential impact on aviation safety, the Federal Aviation Administration (FAA) recently warned pilots of possible GPS anomalies in areas where LightSquared testing is occurring and requested that any such events be reported directly to the FAA. In fact, a sub-group of the Radio Technical Commission for Aeronautics (RTCA)--the primary federal advisory panel on navigation and air-traffic management policy--recently issued a preliminary study finding that the LightSquared system is incompatible with GPS.

There are also initial indications that it could pose system integrity problems for the ongoing FAA deployment of the Automatic Dependent Surveillance-Broadcast (ADS-B) which serves as the foundation for the satellite-based Next Generation Air Transportation System. These obviously are concerns of vital importance to the safety and security of our national air transportation system, and we commend the Transportation and Infrastructure Committee for exercising the necessary Congressional oversight to address these concerns.

As previously noted, the general aviation community has historically been a leader in new navigation and communication technology. Obviously, the introduction of such technology enhancements has the potential to provide welcome and needed benefits to the public. Our members are not opposed to the development and deployment of new or improved technology systems like LightSquared—as long as it is conclusively proven that it WILL NOT result in radio interference with GPS systems or pose any threat to the global aviation transportation system.

We appreciate the opportunity to share these observations and concerns with both subcommittees. Again, our members thank you for holding this important hearing to examine this possible threat to the global GPS system. We look forward to working with you to preserve the integrity of our national GPS infrastructure.

Thank you.

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