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**Statement of**
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**before the**

**Committee on Science, Space and Technology**
**U.S. House of Representatives**

Good morning Chairman Hall, Ranking Member Johnson, and Members of the Committee. Thank you for inviting the National Aeronautics and Space Administration (NASA) to testify today on this very important issue concerning the potential impacts of the proposed LightSquared network on NASA's activities. My name is Victor Sparrow, and I am Director of the Spectrum Policy and Planning Division at NASA.

NASA recognizes the importance of maximizing the utility of the radio spectrum, and fully supports the President's Wireless Innovation Initiative and the Executive Memo setting a goal of 500 MHz for mobile broadband to achieve this end. This effort is needed to enable the continued growth of, and innovation in, wireless broadband capabilities and services. It is important to ensure, though, that projects being undertaken to pursue this initiative are compatible with the many Global-Positioning-System-dependent (GPS-dependent) systems that are also critical to the Nation. The capabilities, benefits, and innovation of the GPS utility should not be degraded or disrupted in the pursuit of increased wireless broadband access.

My testimony today will focus on some of NASA's GPS-dependent applications, and their significant vulnerability to interference from the network proposed by LightSquared and under consideration by the Federal Communications Commission (FCC). Impacted systems would include ground-based, airborne, and space-based receivers used to support activities such as: Earth Science research, weather forecasting, disaster monitoring, ground-truth calibration of instruments on orbit, precision navigation for aircraft and spacecraft, and search and rescue efforts. Research into the development of future aeronautical applications might be affected, as well.

The Administration believes that we must protect existing GPS users from disruption of the services they depend on today and ensure that innovative new GPS applications can be developed in the future. At the same time, recognizing the President's instruction to identify 500 MHz of new spectrum for innovative new mobile broadband services, we will continue our efforts at more efficient use of spectrum. Therefore, in the short run, we recommend further testing in order to assess the GPS interference concerns in the lower 10MHz of the band and to establish whether there are any feasible mitigation strategies. We also encourage commercial entities with interests to work with LightSquared toward a possible resolution,

though any proposed mitigation must be subjected to full testing. The Administration appreciates LightSquared's offer to not transmit in the upper 10MHz of its band, right next to GPS, and strongly supports efforts to identify alternative means of achieving the intended purpose of the signal that was planned there. The challenge of meeting the President's goal also depends on long-term actions by Federal agencies in the area of research and development, procurement practices that encourage spectrally-efficient applications, and new policy development.

**NASA Science-Related Uses of GPS Technology**

In addition to depending upon GPS to provide robust navigation services, NASA relies on GPS technology and capabilities to monitor and improve our understanding of Earth science, including climate change and solid Earth hazards, such as earthquakes and volcanic activity. This knowledge of our dynamic environment enhances resource management and protection, and environmental impact mitigation efforts. Some examples of the use of GPS-dependent space-based applications to improve our knowledge of the Earth include: determining the atmosphere's water content; improving the accuracy of weather forecasts; and enabling (as part of a multi-instrument suite) ocean topography measurements to determine currents and long-term changes in sea height. Ground-based GPS networks are also playing an increasingly prominent role in monitoring ground movement in order to identify potential conditions that may precede earthquakes and volcanic activity.

NASA also uses GPS data for ground-truth calibration measurements, often supported by field measurements. Precise knowledge of the location of these measurements is critical to enabling accurate calibration of instruments aboard orbiting spacecraft. This important procedure is completely dependent on the availability of the *in situ* GPS location data. Without ground-truth measurements, the resulting observations from spacecraft instruments, and interpretations of the data they collect, would be suspect. This application of the GPS system impacts many Earth Science missions.

In addition to data collected from satellites or *in situ* measurements on the ground, data are also collected using Unmanned Aerial Vehicles (UAVs) and crewed aircraft. For example, NASA's highly successful UAV Synthetic Aperture Radar project recently flew a sophisticated radar to study the Gulf of Mexico oil disaster and the impact of the Mississippi River floods on levees and farmland. These UAVs and other aircraft use GPS for navigation. Airborne science flights carrying lidars or altimeters rely on GPS data for all the science measurements they obtained.

Spacecraft also use GPS for highly precise navigation, using as many GPS satellites' signals as their receivers are able to acquire at one time. This may involve obtaining signals from very low angles, including those from just over the receiving spacecraft's "horizon." Based on testing and analysis of receivers used for a similar low look angle scenario ("radio occultation" measurements), NASA is concerned that powerful signals from a ground-based terrestrial network may cause disruption of those signals, degrading the precision of the spacecraft's orientation.

NASA uses GPS for weather sensing applications with a technique known as GPS radio occultation. This relies on the bending of GPS radio signals by the atmosphere as they travel from the GPS satellites in medium Earth orbit to a spacecraft in low Earth orbit (LEO). Specifically, this technique is used to estimate the temperature and water vapor content of the atmosphere by evaluating the minute changes in the GPS signal. These measurements define a vertical profile within the atmosphere. This technique, developed by NASA, is now being used operationally by the National Oceanic and Atmospheric Administration (NOAA) to improve its long-range weather forecasts.

**NASA Support for GPS-Based Search and Rescue (SAR) Efforts**

The worldwide Search and Rescue (SAR) community uses the 1544 MHz band for downlink messages. The effects of the LightSquared network on the global SAR capability have not yet been determined. It is

critical to test the compatibility of these systems before a final regulatory decision is made which might affect future Federal and international infrastructure plans. NASA is supporting the integration of a next-generation SAR capability onto the GPS satellites. The new system, the Distress Alerting Satellite System (DASS), is intended to succeed the existing COSPAS-SARSAT[1] system as it is decommissioned around 2016. DASS is expected to significantly enhance current SAR operations by providing near-instantaneous detection and location of emergency beacons (NASA's Goddard Space Flight Center currently hosts a prototype ground station for such applications).

**NASA Aeronautical Research and GPS**

NASA's aeronautics research supports the development of the FAA's NextGen air traffic system. NASA's work in this area may or may not be impacted, depending on the resolution of the GPS signals interference issue. If the spectrum is not protected for aviation uses, certain GPS-enabled capabilities would not be possible. These include advanced Flight Management Systems which would allow for precision positioning and navigation (e.g., area navigation and required navigation performance). Substantial operational efficiencies would be lost (such as improvements enabled by Automatic Dependent Surveillance-Broadcast, or ADS-B technologies), and the benefits of NASA's aeronautics research into NextGen applications that assume GPS-enabled precision would not be realized.

**Test and Analysis of LightSquared's Impacts**

NASA has participated in several efforts to analyze the potential impacts of the LightSquared proposal. The Agency was part of the industry-led Technical Working Group (TWG), which analyzed and tested GPS receiver performance in the presence of interfering signals representing LightSquared terrestrial broadcasts. Specifically, NASA led the work of the Space-Based Receiver (SBR) sub-group of the TWG, and participated in the work of the High Precision Receiver (HPR) sub-group.

NASA is also a member of the National Space-based Positioning, Navigation, and Timing (PNT) Systems Engineering Forum (NPEF), a Federal agency group that performed test and analysis work related to interference to GPS receivers.

Finally, NASA was involved in the test and analysis effort conducted by the RTCA (formerly the Radio Technical Commission for Aeronautics), an advisory body to the Federal Aviation Administration. The FAA chartered an RTCA committee to investigate the impact to aviation and NextGen of the LightSquared implementation plan. This team concluded that all three phases of the currently proposed LightSquared deployment plan are incompatible with aviation GPS operations. RTCA concluded that use of the upper 10 MHz band segment should not be allowed from an aviation perspective and that use of the Lower 10 MHz channel as a possible mitigation technique would require additional study.

Results of the TWG and NPEF test and analysis efforts indicate significant and harmful interference to terrestrial and space-based GPS receivers from the LightSquared network, were it to be deployed as originally intended. NASA's test results support the conclusion at this point that if the LightSquared network were to be deployed as originally intended, NASA's LEO and terrestrial-based science missions that are dependent on reliable GPS reception would be jeopardized. Similarly, analysis conducted on aviation-based scenarios in the RTCA effort showed significant disruption of GPS-based aviation systems, thereby impacting NASA aviation research missions.

[1] COSPAS-SARSAT is the international satellite search-and-rescue network. COSPAS is an acronym for the Russian words "Cosmicheskaya Sistyema Poiska Avariynich Sudov" ("Space System for the Search of Vessels in Distress"), and SARSAT for "Search And Rescue Satellite Aided Tracking."

**Mitigation Options**
Mitigation options for preventing the disruption of GPS by the deployment and operation of the LightSquared network, including a proposal to only use the lower 10 Megahertz (MHz) channel of the planned two-channel deployment, were identified in the TWG and NPEF Reports. However, none of these options have yet been demonstrated to be effective in mitigating potential interference to GPS. Although limited testing was conducted by the TWG on the susceptibility of some GPS devices to the use of only the lower 10 MHz LightSquared channel, limitations -- such as filters that have yet to be designed or are theoretical or speculative in nature -- prevented adequate testing of this mitigation approach. NASA believes it would be premature to allow the use of only the lower 10 MHz channel as a solution, until testing has been completed and it is established that there is no negative impact on GPS users.

**Conclusion**
Mr. Chairman, NASA has participated in the Federal agency and industry-led test and analysis efforts related to deployment of the LightSquared network and its potential impacts to GPS. At the conclusion of these efforts, it is clear to NASA that the FCC-imposed condition requiring resolution of GPS interference issues prior to commencing commercial operations has not been satisfied, including by LightSquared's modified plan of June 30, 2011. Impacts to NASA's GPS-dependent systems from interference created by the network would be substantial, impacting airborne and spaceborne science, as well as certain space operations. It is important to reiterate that NASA fully supports the Nation's efforts to increase wireless access, but those efforts should be implemented in such a way that our critical GPS assets, and the many worthwhile, innovative science and engineering applications they make possible, are not jeopardized.

I would like to thank this Committee for its continuing support of NASA and its programs. I would be pleased to respond to any questions you may have at this time.