

White Paper: GPS Threatened With Widespread Interference

In a highly unusual decision, the Federal Communications Commission (FCC) recently granted a conditional waiver allowing the dramatic expansion of terrestrial use of satellite spectrum *immediately neighboring that of the Global Positioning System (GPS)* – utilizing extremely high-powered ground-based transmissions that could potentially cause severe interference to millions of GPS receivers.

The conditional waiver was granted to a company called LightSquared. The FCC's decision has caused serious concern within the GPS industry and user community because LightSquared's planned use of the L-Band is fundamentally different from the "ancillary terrestrial component" of satellite based services that the FCC's rules permit – and, by every indication to date, is incompatible with existing GPS uses.

Initial technical analyses have shown that the distant, low-powered GPS signals would receive substantial interference from high-powered, close-proximity transmissions from LightSquared's planned network of 40,000 ground stations. The consequences of disruption to the GPS signals are far reaching: LightSquared's facilities could create 40,000 "dead spots" – each miles in diameter – throughout U.S. cities.

Therefore, it is imperative that the LightSquared system not be deployed unless it can be conclusively guaranteed that the GPS system – a national utility on which millions of Americans depend every day – is fully protected from radio interference. The problem LightSquared's plans pose and additional steps the FCC needs to take are explained below.

LightSquared plans to transmit radio signals that would be one billion or more times more powerful, as received on Earth, than GPS signals – potentially causing severe interference impacting millions of GPS users. This includes receivers used by U.S. federal agencies, state and local governments, first responders, airlines, industry, civil engineering, construction and surveying, agriculture, and everyday consumers in their cars and on hand-held devices.

- Initial technical analyses show that GPS signals, which are low-powered and emanate from distant satellites, would receive substantial interference from LightSquared's network of high-powered, close-proximity ground station transmissions.
- GPS satellites are solar powered and send signals using 50 or fewer watts, about what it takes to power a refrigerator light bulb. That signal then travels 12,000 miles, and the resulting amount of power received on Earth by a GPS receiver is extremely faint.
- Contrast that to LightSquared's planned ground transmissions powered with 1,500 watts of power transmitting as short a distance as a few hundred feet. This leads to a situation where the low powered, distant GPS signals are potentially "drowned out" by the nearby, high-powered transmissions in the immediately neighboring frequency band.
- LightSquared's planned use of these high-powered terrestrial networks in the frequency immediately adjacent to the GPS frequency is unproven and unprecedented and is almost certain to be found to be fundamentally incompatible with existing GPS uses when detailed studies are complete.

- Any technical arguments regarding the ability of the two systems to co-exist are unproven and require independent, authoritative, verified and thorough analysis and testing prior to any transmissions being made.

The usual FCC process is to conduct extensive testing followed by approvals. For LightSquared, the process was approve first, *then* test. The unusual waiver recently granted to LightSquared allows it to use its satellite spectrum for high-powered ground-based broadband transmissions *if* the company can demonstrate that harmful interference could be avoided.

- Issues of interference should have been addressed *before* the waiver was granted.
- The waiver was granted in just two months. Even with such a short window, the U.S. GPS Industry Council (USGIC), the National Telecommunications and Information Administration (NTIA) – along with some federal departments, concerned state and local governments, public safety authorities, and GPS commercial users – all voiced strong objection to LightSquared’s plan to reposition the spectrum.
- The FCC’s conditional waiver puts LightSquared in the conflicting position of assessing whether or not its own system will interfere with GPS transmissions.

GPS receivers are designed to be highly sensitive due to the very distant and very low-powered GPS satellite transmissions. The historical reliability of the system is due in part to the FCC’s long-established spectrum plan which reserves the frequencies adjacent to GPS for similar satellite communications uses. LightSquared’s proposal to turn this satellite spectrum into ground-based broadband spectrum appears to be driven more by LightSquared’s unilateral decision to buy the affected spectrum than by proper spectrum planning or allocation.

- LightSquared purchased inexpensive spectrum that for decades has been reserved for good reason by the FCC and International Telecommunications Union (ITU) for satellite use, apparently with the hope that it could turn the traditional satellite use into vastly more lucrative ground-based use. The construction of a high density, high-powered network of ground stations on a frequency immediately adjacent to a very low powered, space-based system is unprecedented. Millions of existing GPS users must be protected from interference and must not be forced to bear the costs or unintended consequences of such speculation.

The Global Positioning System, or GPS, was first launched more than 30 years ago and is now a critical and extremely reliable part of our national infrastructure. Millions use it routinely every day. If GPS is interfered with, critical private and public sector activity will be adversely affected, including:

- **Public Safety:** Public safety depends on GPS technology daily because first responders such as law enforcement, fire fighters, and emergency medical personnel rely on it day-in and day-out to provide critical instant location and route information. Disruptions to the GPS transmission pose a serious threat to public safety.
- **Homeland Security:** GPS equipment is widely used by the Departments of Defense, Interior, Transportation, Commerce and Homeland Security. Federal, state, and local government employees rely on GPS equipment in disaster response, public safety, and security and in the

management of our national assets and infrastructure, as do emergency services for rapid response, dispatch, and accident investigation.

- **Consumers:** Millions of Americans use GPS-enabled consumer devices in their cars and on their cell phones and other hand-held devices as vital, reliable every day navigational tools.
- **Aviation:** GPS receivers used in thousands of aircraft could be jammed within miles of LightSquared's transmissions. GPS, together with the Wide Area Augmentation System or WAAS (which will also be affected) has long been approved by the Federal Aviation Administration (FAA) for aircraft navigation and FAA-approved GPS instrument approaches now provide a landing system option at the many U.S. airports not equipped with land-based instrument landing systems. GPS also plays a critical role in the FAA Next Generation Air Transportation System, which will modernize air traffic control and address the nation's need for expanded air traffic capacity without compromising air safety.
- **Marine:** GPS is used for navigating the open seas as well as congested harbors, ports and waterways by commercial vessels, search and rescue operations and pleasure boating. Mariners and oceanographers also use GPS for underwater surveying, dredging, marine construction, buoy placement, and navigational hazard location and mapping. Commercial fishing fleets use GPS to navigate to optimum fishing locations, track fish migrations and ensure compliance with regulations. Electronic Chart Display and Information Systems (ECDIS) and Global Maritime Distress and Safety Systems (GMDSS) can also integrate GPS information. Some of the world's largest port facilities use GPS for automated container placement and management. In addition, GPS is part of the Automatic Identification System (AIS) transmissions for vessel traffic control around busy seaways. The service is not only vital for navigation, but is increasingly used for port and waterway security by providing governments with greater situational awareness of commercial vessels and their cargo.
- **Transportation:** GPS equipment is used in critical asset management activities for our national road and rail infrastructure, improving efficiency, lowering costs and enabling better decision making. The Federal Rail Administration's Positive Train Control mandate further drives the use of GPS to prevent train-to-train collisions, derailments, and casualties or injuries to railway workers. In addition, GPS is used to help fleets lower fuel consumption and improve their carbon footprint.
- **Agriculture:** Farmers use GPS to improve efficiency and crop yields, reduce environmental impact and comply with U.S. Agriculture reporting regulations.
- **Forestry:** The U.S. Forestry industry and Forest Service use GPS in forest land management and for Forest Automation Systems that improve logging efficiency and reduce environmental harm.
- **Engineering and Construction:** The U.S. building, construction, and civil engineering industry – one of the economic sectors most severely impacted by the recent recession – has made large investments in the use of GPS technology to modernize and automate construction sites, machines and processes. GPS is also used to monitor the movement of physical infrastructure such as bridges, dams, mines, and other natural and manmade structures. Disruption to this service could negatively impact positive economic and societal improvements.

- **Surveying, Mapping, and Land Management:** Interruption of the national geodetic infrastructure would disrupt surveying and mapping activities necessary for land title transactions, land development, building and civil engineering activity, and accident investigations. It would also disrupt the field creation, maintenance, and use of geographic information systems (GIS) databases that underpin our national digital mapping infrastructure.
- **Utilities:** Utility services nationwide including electricity, water, gas and telecommunications depend on GPS signals in a number of ways. This includes synchronizing utility networks and the power grid, maintaining and managing infrastructure and coordinating rapid responses to network outages and incidents – activities that are all essential to restoring disrupted services as quickly as possible.
- **Natural Resources:** Natural resources industries engaged in the exploration, production and distribution of energy and minerals rely on the GPS service throughout their operations.
- **Disaster Management and Scientific Research:** High-accuracy GPS networks are deployed along crustal faults and around volcanoes. In the U.S, the data is used to study and better understand the crustal movements that cause seismic hazards such as earthquakes and volcanic eruptions. In addition to disaster prevention and relief, GPS is also used for weather services and scientific research.

In recognition of the potential interference to GPS receivers, the FCC, as part of its January 26, 2011 modification order, required the establishment of a working group to bring together LightSquared and the GPS community. This working group will study the interference concerns, identify measures to prevent interference and produce a report for FCC review no later than June 15, 2011. The working group process will be complete once the FCC, in consultation with NTIA, concludes that “the harmful interference concerns have been resolved and sends a letter to LightSquared stating that the process is complete.”

The GPS industry is committed to work with LightSquared, FCC, NTIA and other interested parties in this working group process. However, we believe that additional safeguards are needed. We recommend:

1. The FCC must make clear, and the NTIA must ensure, that LightSquared's license modification is contingent on the outcome of the mandated study unequivocally demonstrating that there is no interference to GPS. The study must be comprehensive, objective, and based on correct assumptions about existing GPS uses rather than theoretical possibilities. Given the substantial pre-existing investment in GPS systems and infrastructure, and the critical nature of GPS applications, the results of studies must conclusively demonstrate that there is no risk of interference. If there is conflicting evidence, doubts must be resolved against the LightSquared terrestrial system. The views of LightSquared, as an interested party, are entitled to no special weight in this process.
2. The FCC should make clear that LightSquared and its investors are proceeding at their own risk in advance of the FCC's assessment of the working group's analysis. While this is the FCC's established policy, the Commission's International Bureau failed to make this explicit in its order.

3. Resolution of interference has to be the obligation of LightSquared, not the extensive GPS user community of millions of citizens. LightSquared must bear the costs of preventing interference emanating from their devices, and if there is no way to prevent interference, it should not be permitted to operate. GPS users or providers should not have to bear any of the consequences of LightSquared's actions.
4. This is a matter of critical national interest. There must be a reasonable opportunity for public comment of at least 45 days on the report produced by the working group and further FCC actions on the LightSquared modification order should take place with the approval of a majority of the commissioners, not at the bureau level.