Overview of GPS Adjacent Band Compatibility Assessment Plan

International Committee on GNSS (ICG)-9
Prague, Czech Republic

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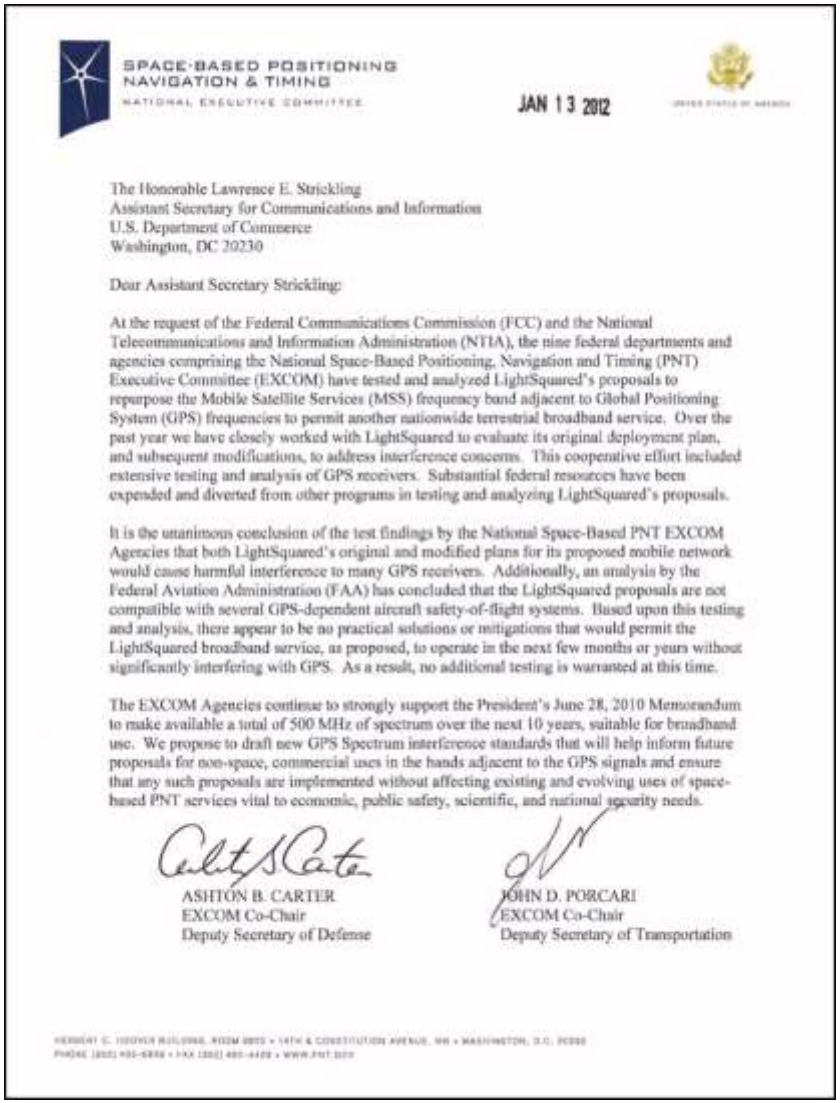
January 2012 Space-Based PNT EXCOM

January 13, 2012 National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee (EXCOM) co-chair letter to National Telecommunications and Information Administration (NTIA) proposed to draft new Global Positioning System (GPS) spectrum interference standards:

- Inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals.
- Ensure such proposals are implemented without affecting existing and evolving uses of space-based PNT that are vital to economic, public safety, scientific, and national security needs.



SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL EXECUTIVE COMMITTEE

JAN 13 2012

The Honorable Lawrence E. Strickling
Assistant Secretary for Communications and Information
U.S. Department of Commerce
Washington, DC 20230

Dear Assistant Secretary Strickling:

At the request of the Federal Communications Commission (FCC) and the National Telecommunications and Information Administration (NTIA), the nine federal departments and agencies comprising the National Space-Based Positioning, Navigation and Timing (PNT) Executive Committee (EXCOM) have tested and analyzed LightSquared's proposals to repurpose the Mobile Satellite Services (MSS) frequency band adjacent to Global Positioning System (GPS) frequencies to permit another nationwide terrestrial broadband service. Over the past year we have closely worked with LightSquared to evaluate its original deployment plan, and subsequent modifications, to address interference concerns. This cooperative effort included extensive testing and analysis of GPS receivers. Substantial federal resources have been expended and diverted from other programs in testing and analyzing LightSquared's proposals.

It is the unanimous conclusion of the test findings by the National Space-Based PNT EXCOM Agencies that both LightSquared's original and modified plans for its proposed mobile network would cause harmful interference to many GPS receivers. Additionally, an analysis by the Federal Aviation Administration (FAA) has concluded that the LightSquared proposals are not compatible with several GPS-dependent aircraft safety-of-flight systems. Based upon this testing and analysis, there appear to be no practical solutions or mitigations that would permit the LightSquared broadband service, as proposed, to operate in the next few months or years without significantly interfering with GPS. As a result, no additional testing is warranted at this time.

The EXCOM Agencies continue to strongly support the President's June 28, 2010 Memorandum to make available a total of 500 MHz of spectrum over the next 10 years, suitable for broadband use. We propose to draft new GPS Spectrum interference standards that will help inform future proposals for non-space, commercial uses in the bands adjacent to the GPS signals and ensure that any such proposals are implemented without affecting existing and evolving uses of space-based PNT services vital to economic, public safety, scientific, and national security needs.

ASHTON B. CARTER
EXCOM Co-Chair
Deputy Secretary of Defense

JOHN D. PORCARI
EXCOM Co-Chair
Deputy Secretary of Transportation

DOT GPS Adjacent Band Compatibility Assessment

- DOT Deputy Secretary Tasking:
  - Collaborate to develop a spectrum protection plan which provides a framework to define the processes and assumptions for development of GPS spectrum protection criteria on behalf of GPS civil users.
- GPS Adjacent Band Compatibility Assessment will identify the processes for:
  - Deriving adjacent-band power limits, as a function of offset frequency, necessary to ensure continued operation of all applications of GPS services.
  - Determining similar levels for future GPS receivers utilizing modernized GPS and interoperable Global Navigation Satellite System (GNSS) signals.

Elements of the DOT Assessment Plan

- Develop assumptions on the type of application planned for deployment in the adjacent-band
  - Validate assumptions with NTIA and FCC

- Determine GPS receiver interference tolerance masks and use cases
  - Current GPS Receivers (Set 1 limits)
  - Modernized GPS/GNSS Receivers (Set 2 limits)

- Determine interaction scenario(s)

- Specify the adjacent-band application transmitter power limits

Approach to DOT GPS Adjacent Band Compatibility Assessment

- Develop an implementation plan, that incorporates aspects from the DOT Assessment plan, with a near term focus of current GPS/GNSS receivers
- FAA conducting effort for certified avionics in conjunction with RTCA SC-159
- Non Certified Aviation (everything else) effort being led by DOT/Volpe Center
- Open and transparent approach
- Identify forums and provide public outreach to make sure the plan, on going work, and assumptions are vetted and an opportunity to gain feedback

  - First workshop held Sept. 18th; Second to be held Dec. 4th
- Goal is to protect existing and evolving uses of space-based PNT

GPS Adjacent Band Compatibility Assessment Implementation Plan Outline

1. Document GPS use cases and list of current (representative) GPS receivers
2. Develop representative receiver masks for each application.
   A. Collect receiver specifications and available test data
   B. Develop a generic receiver model. Validate model against collected data and use it to Perform sensitivity analysis on receiver specs.
   C. Develop a plan for testing of GPS receivers
3. Conduct GPS receiver testing to validate Manufacturer provided test results
4. GPS Interaction scenarios and antenna characteristics
5. Collect future and multi-channel GNSS receiver specifications

Near-Term Focus

- Frequency Bands Adjacent to GPS L1 (1500-1700 MHz)
- Leverage Receiver Categories from TWG
  - Aviation
  - Cellular
  - General Location/Navigation
  - High Precision
  - Timing
  - Networks
  - Space

❖ Develop a set of curves demonstrating the maximum aggregate power level as a function of frequency offset from GPS

Document Use Cases

- Identify characteristics of use cases - for each application determine:
  - Most likely geographic and topographic characteristics
  - Range of heights for GPS receiver antenna
  - Typical GPS receiver antenna pattern(s)
  - Expected Range of antenna boresight inclinations from zenith
  - Mobility: Stationary vs. mobile (typical speeds)

- Solicit information on selection of representative receivers within each category

- Gather feedback on the use cases parameters

Develop Receiver Mask Data Collection

- Collect test data and specifications from GPS receiver manufacturers.
  - Define the type of test data needed as well as the most relevant receiver specs for the analysis (especially in absence of test data).
  - Involve the receiver manufacturers and industry stakeholders to update them on the current state of the analysis and obtain feedback
  - Collect data provided by GPS receiver and antenna manufacturers
  - Follow up and interact with manufacturers to obtain additional information as well as resources they are willing to contribute for future testing

Develop a Test Plan

- Review available information on previous receiver testing effort
- Expand on the previous testing approach to cover a wider frequency range and assess the level of assistance expected from manufacturers and stakeholders
- Outline the testing procedure and equipment needed.
  - Testing procedure and equipment needed for wired tests
  - Same for wireless tests (anechoic chambers test). Primarily for receivers for which the antenna input port is not accessible
- Identify and begin coordination with the testing facilities

Collect Future and Multi-Channel GNSS Receiver Specifications

- This effort is expected to be a combination of modeling and testing with more emphasis on the modeling and analysis in the absence of actual receivers to test.
- Obtain information from direct contact with receiver manufacturers and/or through workshops, as well as subject matter experts on the future of the receiver architecture, filtering, oscillators and antenna technology to guide the modeling-based assessment
- Extend the test plan and perform testing as these new receivers become available.

Next Steps

- Continue engagement with Industry
  - Public Workshop Information available on www.gps.gov
  - Next Workshop Dec. 4th in Los Angeles (Webex Capability)

- Effort being worked in conjunction with DOT Extended Pos/Nav Working Group, GPS Directorate, Aerospace Corporation, and Stansell Consulting