



DOT Positioning, Navigation, and Timing Update

*GPS Adjacent Band Compatibility and
Civil Signal Monitoring*

Space-Based PNT Advisory Board

December 10, 2014

January 2012 Space-Based PNT EXCOM Letter

- 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



UNITED STATES OF AMERICA

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

- GPS Adjacent Band Compatibility Assessment will:
 - Derive adjacent-band power limits, as a function of offset frequency, necessary to ensure continued operation of all applications of GPS services.
 - Determine similar levels for future GPS receivers utilizing modernized GPS and interoperable Global Navigation Satellite System (GNSS) signals.



Approach to DOT GPS Adjacent Band Certified Avionics Compatibility Assessment

- FAA refining necessary processes, assumptions and analyses to assess certified avionics compatibility in conjunction with RTCA in its Federal advisory capacity.
 - *FAA GPS Adjacent-Band Compatibility Study Methodology and Assumptions* document delivered to RTCA on Oct 7, 2014 with response requested by 31 Mar 2015.
 - Document proposes specific questions for RTCA to address.
 - RTCA SC-159 (GPS Subcommittee) conducting technical meetings to vet assumptions/methodologies and provide opportunity for feedback using open, transparent processes.
 - Other RTCA committees to provide perspectives on safety and operational aspects of “exclusion zones” in interaction scenarios.
- FAA will assess RTCA response and plan to address any unresolved topics and conduct follow-on activities.



Approach to DOT GPS Adjacent Band Compatibility Assessment

- Non Aviation Certified effort (all other applications) led by DOT/OST-R Volpe Center
 - GPS Directorate, Aerospace, and Mitre participation
 - Stansell Consulting
 - DOT Extended Pos/Nav Working Group (Civil Departments and Agencies)
- Identify forums and provide public outreach to ensure the plan, on going work, and assumptions are vetted and an opportunity to gain feedback
 - Public workshops held
 - Open and transparent approach
- Goal is to protect existing and evolving uses of space-based PNT



Near-Term Focus

- Frequency Bands Adjacent to GPS L1
 - Focus on LTE concept (Base stations below 1559 MHz; handsets above 1610 MHz)
- GPS/GNSS Receiver Categories:
 - 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



Overview of GPS Adjacent Band Compatibility Assessment Implementation Plan

Tentative Schedule

1. Document GPS/GNSS use cases and identify current (representative) receivers: July - December 2014
2. Develop representative receiver masks for each application: November 2014 - April 2015
 - A. Collect receiver and antenna specifications and available test data
 - B. Develop a plan for testing GPS/GNSS receivers
3. Conduct GPS/GNSS receiver testing: June - July 2015
4. Develop GPS interaction scenarios: August – December 2015
5. Collect future GPS/GNSS receiver specifications: FY'16 - FY'17



Issues to Address

- Agreement on definition of harmful interference to GPS/GNSS
- Achieving Balance between Open/Transparent Process and Need to Protect GPS/GNSS Receiver Proprietary Design Information
- Agreement on Assumptions for Adjacent Band Service(s)
 - Currently Assuming LTE (Base Stations/Handsets)
- Spectrum Protection for GPS/GNSS Augmentation Services in MSS Band (StarFire, OmniStar, etc.)
- Spectrum Protection for Foreign GNSS
 - Other Systems Operate Closer to Adjacent Band
- Sufficient Resources for Receiver Testing



Civil Signal Monitoring Performance Specification (CMPS)

- **Issued by DOT in December 2005, rev. April 2009**
 - Adopted by civil agencies as requirements for civil signal monitoring of GPS (193 requirements)
- **Two key categories of monitoring requirements**
 - Those that result in timely notification (minutes) of GPS operators to take action
 - Those that report GPS service performance levels against stated commitments, e.g. GPS Standard Positioning Service Performance Standard
- **Explanation of what civil signal performance monitoring means**
 - Metrics verification
 - Archive and retrieval of monitoring data and performance levels
 - Signal quality and navigation message monitoring
 - GPS Operator and Civil User notification
- ❖ **CMPS was an OCX contract reference document**
 - **Not a requirements document**



Civil Signal Monitoring Trade Study

Cost, effectiveness, & risk analysis of OCX/Non-OCX (Mar 2014)

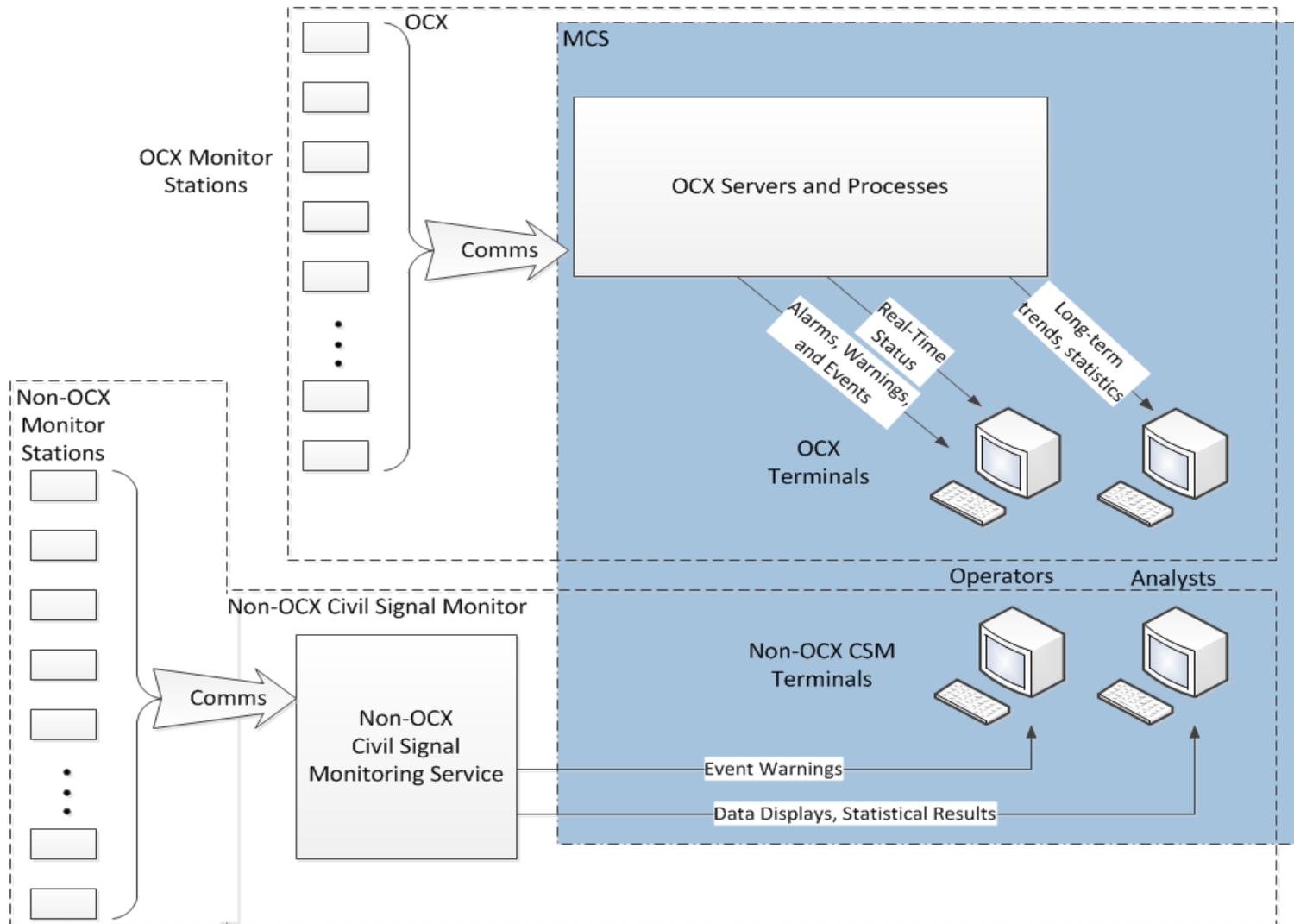
- **Three sources of study data**
 - OCX: ROM estimate on prioritized CMPS-defined requirements
 - Non-OCX: ROM estimate on full CMPS-defined requirements
 - GPS Operators: Current procedures, OCX OPSCON
- **Wide ranging study review team**
 - OST-R, FAA, 2SOPS, AFSPC/SMC/GP-GPC-GPE representatives
 - CMPS primary authors

Recommendations on Path Forward

- Pursue a dual implementation with OCX and Non-OCX elements
 - Incorporate high priority requirements into OCX contract
- Engage with USAF on integrating Non-OCX monitoring into GPS operations



Hybrid OCX/Non-OCX Architecture



Contact Information

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