

# DOT PNT Update

Civil GPS Service Interface Committee Meeting

Sept. 26, 2017



# Overview

- 2017 Federal Radionavigation Plan
- GPS Adjacent Band Compatibility Assessment
- GPS Civil Signal Monitoring

# 2017 FEDERAL RADIONAVIGATION PLAN

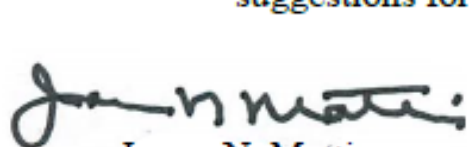


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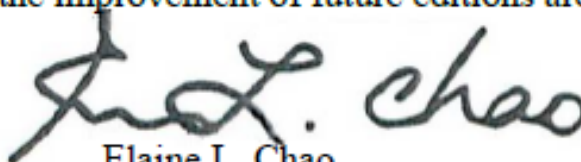
The Federal Radionavigation Plan (FRP) is the official source of positioning, navigation, and timing (PNT) policy and planning for the Federal Government. It is required by the National Defense Authorization Act for Fiscal Year (FY) 1998, as published under Title 10 United States Code, Section 2281, paragraph (c) (10 USC 2281(c)). The FRP is prepared jointly by the Departments of Defense (DoD), Homeland Security (DHS), and Transportation (DOT), with the assistance of other government agencies and published not less than every two years. This 2017 edition of the FRP reflects the policy and planning for present and future federally provided PNT systems, covering common-use PNT systems (i.e., systems used by both civil and military sectors). Exclusively military systems and policies are covered in the current version of the Chairman, Joint Chiefs of Staff Instruction 6130.01, the DoD Master Positioning, Navigation, and Timing Plan (MPNTP).

The FRP contains chapters covering Roles and Responsibilities, Policy, representative PNT User Requirements (while the FRP outlines the PNT performance requirements for various user groups, it is not a formal requirements document for the Federal Government), Operating Plans, and the National PNT Architecture, as well as appendices covering System Parameters and Descriptions, PNT Information Services, and Geodetic Reference Systems and Datums. It is updated biennially, allowing more efficient and responsive updates of policy and planning information. Your suggestions for the improvement of future editions are welcomed.



James N. Mattis  
Secretary of Defense

Date: SEP 20 2017



Elaine L. Chao  
Secretary of Transportation

Date: 4.5.2017



Elaine C. Duke  
Acting Secretary of Homeland Security

Date: 8-8-2017

# GPS Adjacent Radiofrequency Band Compatibility Assessment

- Identify adjacent band transmit power levels that can be tolerated by existing GNSS receivers for civil applications [excluding certified aviation applications - those are considered in a parallel FAA effort]
- Effort Led By DOT/OST-R/Volpe Center
- Accomplish this through:
  - GNSS Receiver and Antenna Testing – Radiated, Wired, and Antenna characterization
  - Development of 1 dB Interference Tolerance Masks (ITMs)
  - Development of generic transmitter (base station and handheld) scenarios
  - Inverse and propagation modeling / use case scenarios

# Major Milestones

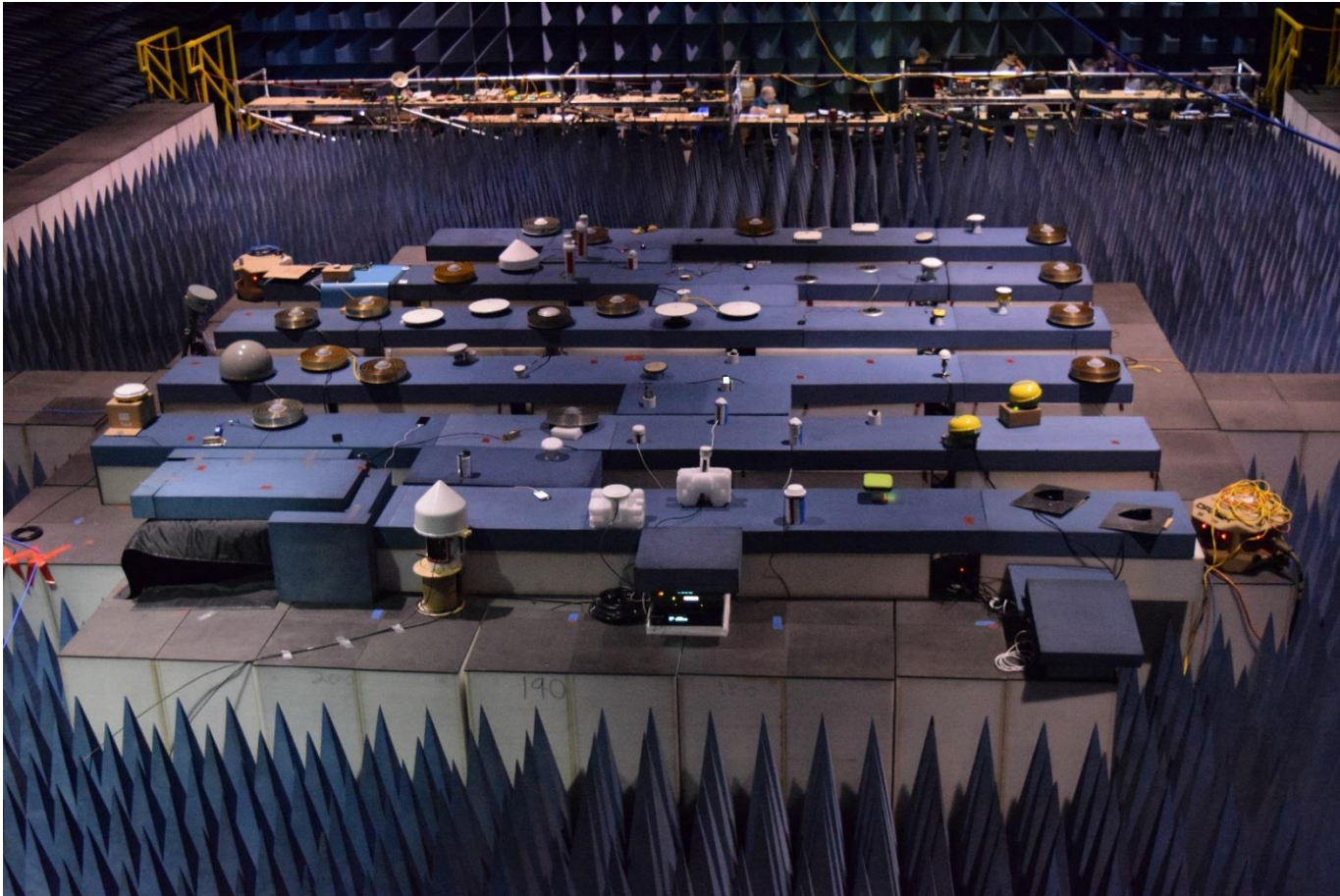
- Use case data collection effort with Federal Partners and Industry
- Released a public GNSS receiver test plan and developed an in depth GNSS receiver test procedure
- Carried out GNSS testing [OST-R/Volpe Center]
  - Radiated test data: Collected in an anechoic chamber [White Sands Missile Range (WSMR)]
  - Conducted test data: collected in a laboratory environment [Zeta Associates]
  - Antenna characterization data [The MITRE Corporation]
- Produced 1 dB Interference Tolerance Mask (ITM) results
- Developed Use Case Scenarios and Conducted Inverse Modeling to Determine Power Levels that can be Tolerated
- <http://www.gps.gov/spectrum/ABC/>



# Participants

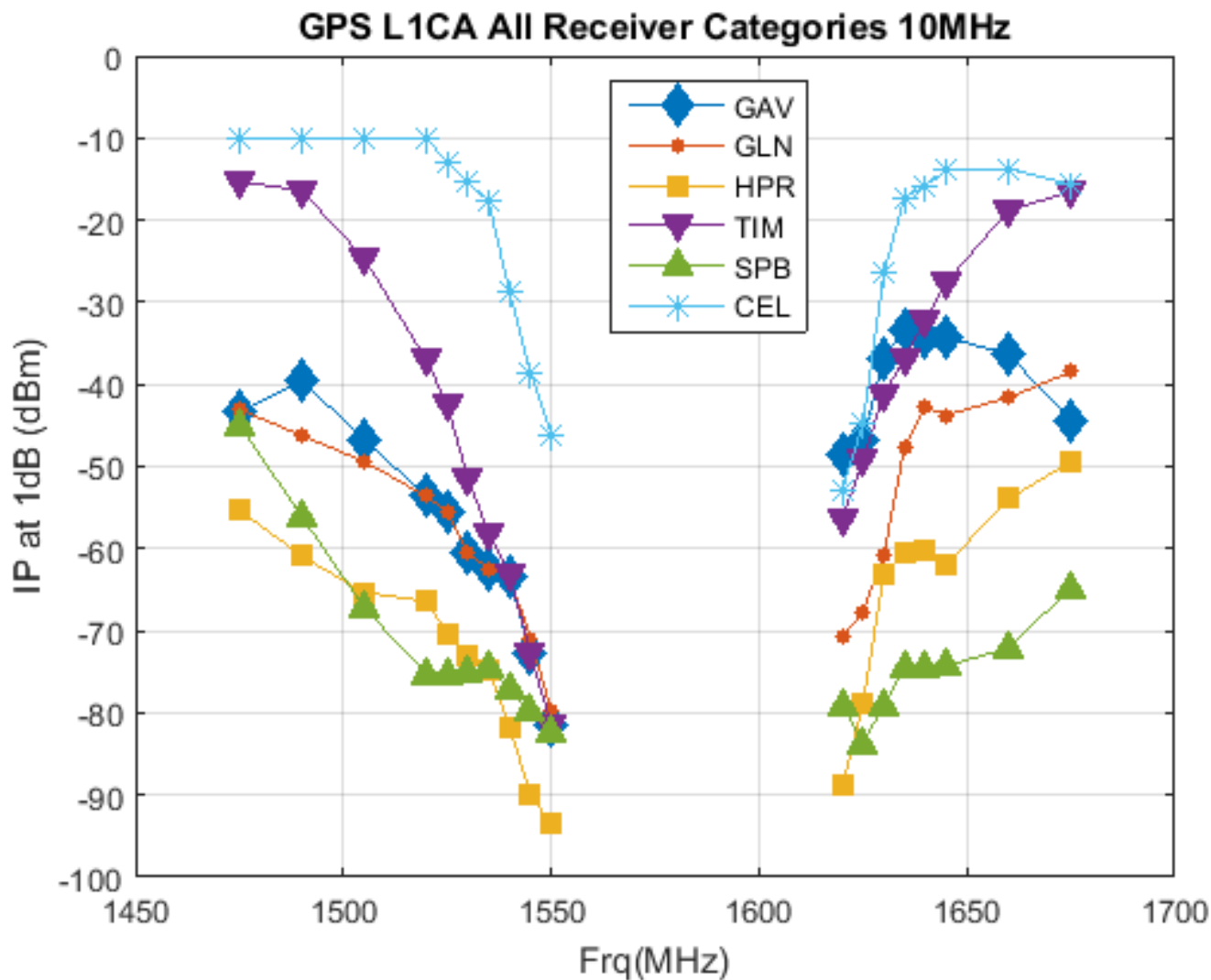
- United States Coast Guard (USCG)
- National Aeronautics and Space Administration (NASA)
- National Oceanic and Atmospheric Administration (NOAA)
- United States Geological Survey (USGS)
- Federal Aviation Administration (FAA)
- United States Department of Transportation (USDOT)
- General Motors (GM)
- u-blox
- NovAtel
- Trimble
- John Deere
- UNAVCO

# Chamber Test Grid and Setup



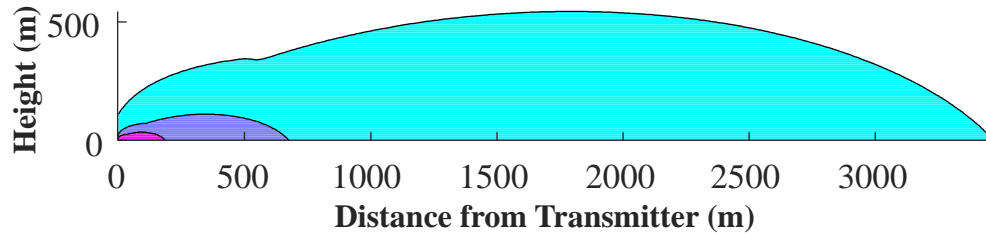


# Summary of 10 MHz Bounding Masks GPS L1 C/A

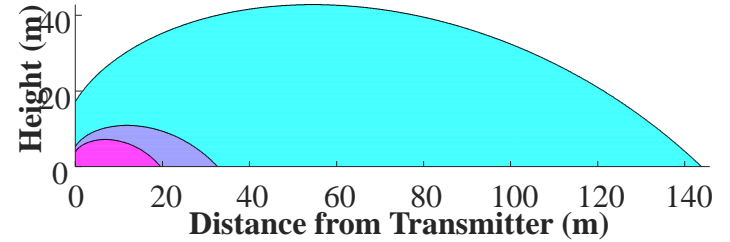


# Results: Region of Impact for ITU Recommended Power Levels

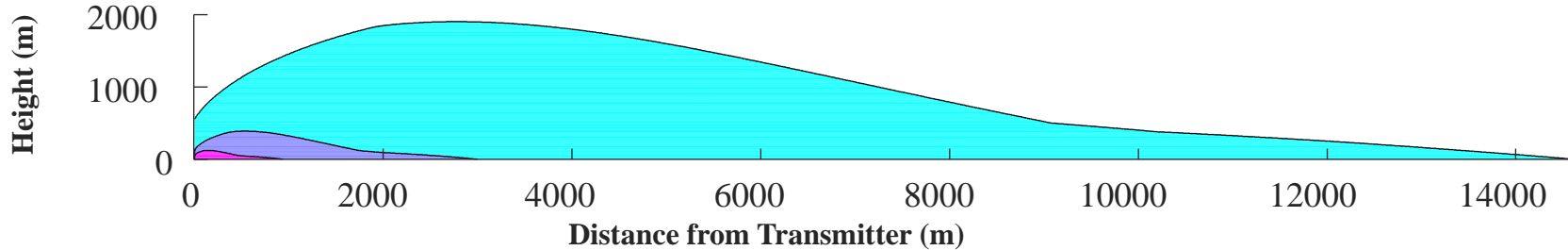
Micro urban base station (6m height, 40 dBm EIRP)






Handset (2m height, 23 dBm EIRP)

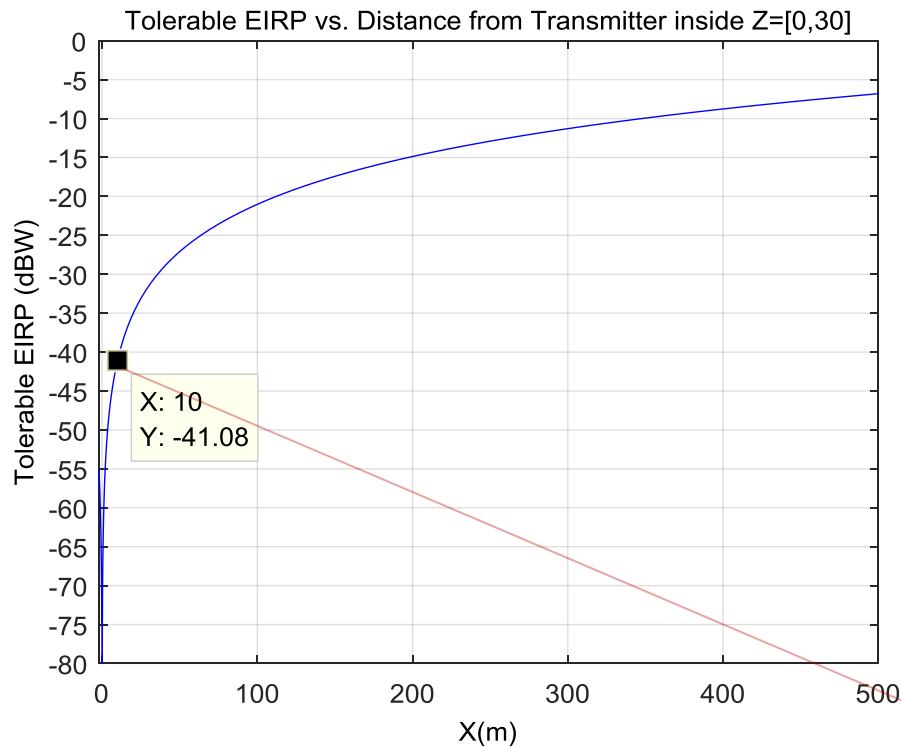


Macro urban base station (25m height, 59 dBm EIRP)

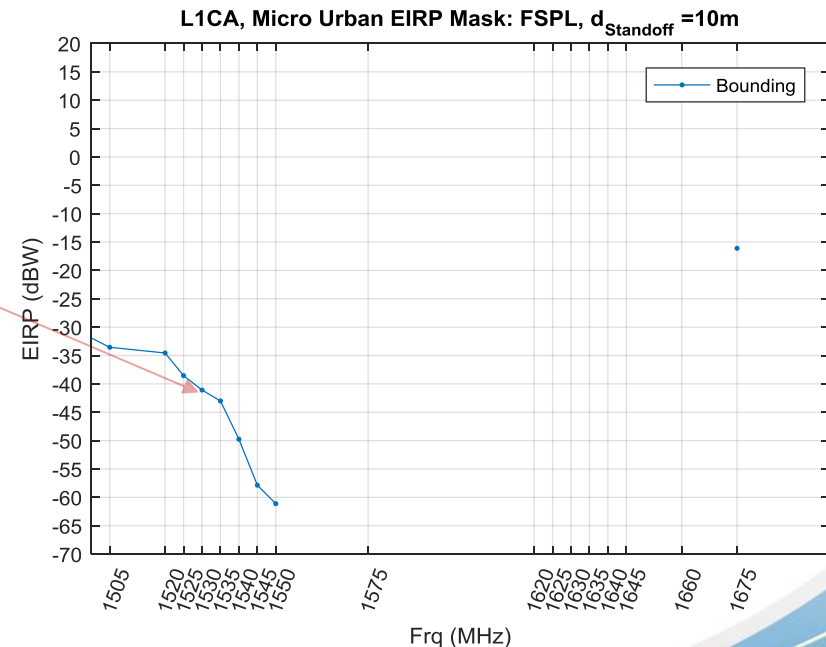


-   $\geq 1$  dB  $C/N_0$  degradation
-  Loss of lock of satellites with 10 dB attenuation
-  Loss of lock of all satellites with clear sky visibility

# Results: Tolerable EIRP Levels: Single Macros Urban Base Station Transmitter, FSPL



- For a 1530 MHz interference signal, the tolerable EIRP Levels are below 0.25 watts at a standoff distance of ½ km
- At 10m stand-off distance the tolerable EIRP ranges from 1  $\mu W$  to 1  $mW$  for interference for an interference signal with center frequency in the 1500 to 1550 frequency range
- For a 1675 MHz interference signal the tolerable EIRP is on the order of 30  $mW$  for the same 10m stand-off distance



# Maximum Tolerable Power Level for GPS/GNSS Receivers at 1530 MHz

Deployment	Stand off distance (m)	Max Tolerable EIRP (dBW)			
		GLN	HPR	TIM	CEL
Macro Urban	10	-31.0	-41.9	-20.6	10.9
	100	-11.0	-21.9	-0.6	31
Micro Urban	10	-29.8	-41.2	-20.1	10.7
	100	-9.8	-21.1	-0.1	30.8

Deployment	Stand off distance (m)	Max Tolerable EIRP			
		GLN	HPR	TIM	CEL
Macro Urban	10	0.8 mW	64 $\mu$ W	8.7 mW	12.3 W
	100	79.4 mW	6.5 mW	0.9 W	1.26 kW
Micro Urban	10	1 mW	76 $\mu$ W	9.8 mW	11.7 W
	100	104 mW	7.8 mW	1 W	1.2 kW

# Next Steps

- Coordinate DOT GPS Adjacent Band Compatibility Assessment Final Report within U.S. Government
  - Includes certified avionics and non certified receivers
- Issue Final Public Report



# CSM Status: OCX Development

## OCX Block 2

- RFP and Tech Eval completed (Aug '17)

## Monitoring Requirements Addressed

- Signal tracking L1 C/A, L1C, L2C, L5 (“P1” rqmts)
- Nav message L1 C/A, L1C, L2C, L5 (“P2” rqmts)
- Real-time AWE notification to operators
- Daily report (public release) to USCG NAVCEN

# USG Work on ICG-IGS Trial Project

- **Basis of Monitoring Requirements: Terms of Reference (ToR)**
  - US submitted proposal to ICG-IGS Trial Project at ICG-11 (Sochi)
  - Four monitored elements—UTC offset, PDOP, URE, Orbits (Clock & Ephemeris)
  - Initially monitor only US open signal (GPS L1 C/A)
- **Proposed US Monitoring Analysis Center (MAC)**
  - Leverage USG available data
  - Intermediate processing of raw observables for four data products
  - Data repository at USCG Navcen site
  - Publishing of data links to GPS.GOV and ICG web portal
- **Potential Expansion of Data Products in Later Phases**
  - Modernized GPS signals (L5, L2C, L1C)
  - GNSS open signals from other Service Providers BDS, GAL, GLN
  - Additional monitored elements if/when ToR is expanded
  - Internationally located tracking sites

**Thank You**