



SPACE-BASED POSITIONING  
NAVIGATION & TIMING  
NATIONAL COORDINATION OFFICE

# *GPS Modernization and Interoperability*

*Munich Satellite Navigation Summit 2015*

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# GPS Constellation Status



## **30 Operational Satellites (Baseline Constellation: 24+3)**

- Robust operational constellation
  - 3 GPS IIA – L1 C/A, L1 P(Y), L2 P(Y) signals
  - 12 GPS IIR – same signals as IIA
  - 7 GPS IIR-M – adds L2C, L1M, L2M signals
  - 8 GPS IIF – adds L5 signal
- 8 additional satellites in residual/test status
- Modified Battery Charge Control has extended GPS IIR and IIR-M life by 1-2 years per SV
- Global GPS civil service performance commitment met continuously since Dec 1993 (IOC)
  - Best performance 43.8 cm User Range Error (URE) 1 Jan 15; best weekly average 52.7 cm URE, 23 Nov 14
  - Performance improving as new satellites replace older satellites



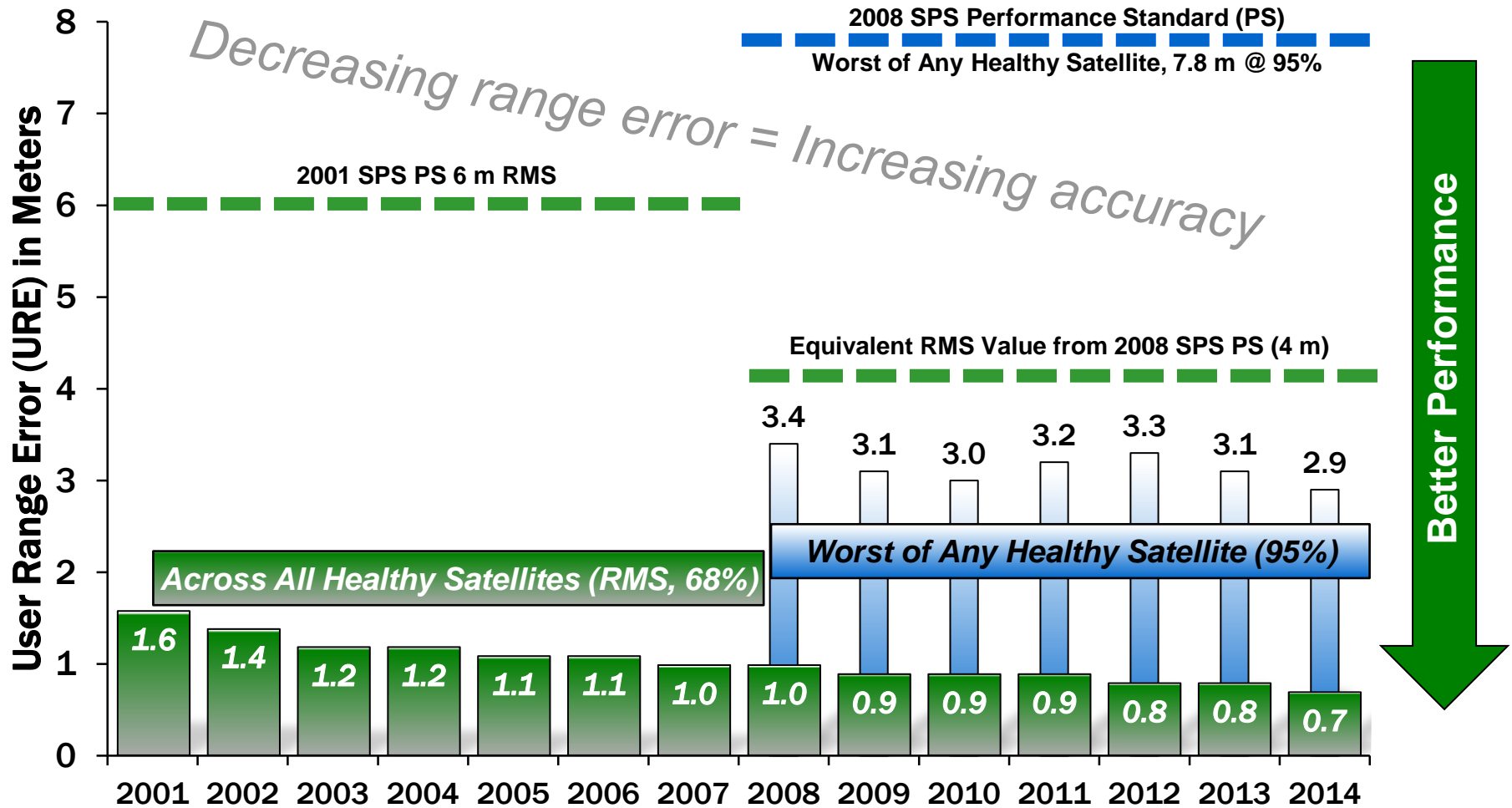


# Accuracy: Civil Commitments

## Standard Positioning Service Performance Standard



### Standard Positioning Service (SPS) Signal-in-Space Performance



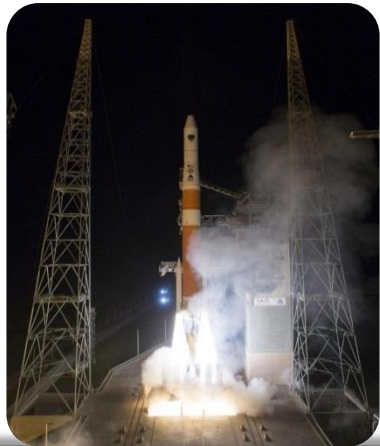
**System accuracy better than published standard**



# GPS IIF Status



- 4 successful GPS IIF launches in 2014
- 8 total GPS IIFs on-orbit
- 4 more GPS IIFs in the pipeline
  - Three GPS IIF launches planned 2015
  - SVs 10, 11, and 12 now in storage
  - SV-9 Launch Scheduled for 25 Mar 15



20 Feb: IIF-5



16 May: IIF-6



1 Aug: IIF-7



29 Oct: IIF-8

**Most GPS launches in a single year since 1993**



# GPS III Status



- Newest block of GPS satellites
  - 4 civil signals: L1 C/A, L1C, L2C, L5
    - First satellites to broadcast common L1C signal
  - 4 military signals: L1/L2 P(Y), L1/L2M
  - Three improved Rubidium atomic clocks
- SV07/08 contract awarded 31 Mar 14
- SV09/10 planned to be purchased under current Lockheed contract
- Navigation payload panel began space environment testing at Lockheed Martin's Colorado facility Sep 14
- GPS III Non-Flight Satellite Testbed accomplished launch processing at Cape Canaveral; reduced risk for integration & test and launch processing
- GPS III SV01 available for launch CY 2016



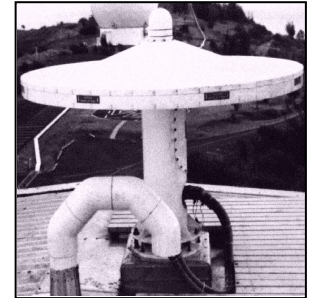
Lockheed-Martin (Waterton, CO) – Prime



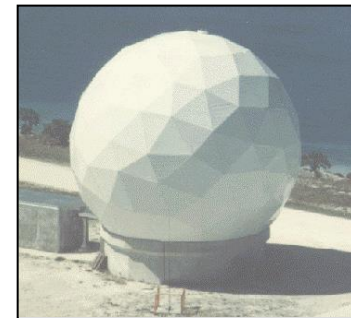
# Ground Segment Status



- Current system Operational Control Segment (OCS)
  - Flying GPS constellation on Architecture Evolution Plan (AEP) and Launch & early orbit, Anomaly, and Disposal Operations (LADO) software systems
  - Cyber security enhancements in progress
- Next Generation Operational Control System (OCX)
  - Modernized command & control system with M-Code, modern civil signal monitoring, info assurance infrastructure and improved PNT performance: Raytheon (Aurora, CO) - Prime
  - Successfully completed four GPS III launch exercises
  - OCX Block 0 supports launch & checkout for GPS III; currently in integration & test; delivery expected Jan 2016
  - OCX Block 1 supports transition from OCS in 2019
  - Civil Signal Performance Monitoring capability scheduled for OCX Block 2 in 2020



Monitor Station



Ground Antenna



# Now on the Air: Modernized Civil Signals

- The United States initiated continuous CNAV message broadcast (L2C & L5) on 28 Apr 14; began with twice-a-week uploads and moved to daily (nominal) uploads on 31 Dec 14
  - Position accuracy not guaranteed during pre-operational deployment
  - L2C message currently set “healthy”
  - L5 message set “unhealthy” until sufficient monitoring capability established
- User-Range Error (URE) CNAV Performance Post
  - Daily uploads consistent with or exceed LNAV performance\*
  - Inter-signal corrects enable single point positioning competitive with P(Y) receivers





# Assessment of Future of NDGPS



- **Joint U.S. Coast Guard & Department of Transportation Federal Register Notice 16 April 2013**
  - Assessment driven by many factors: from policy to technology
  - Asked how NDGPS is used, impact/alternatives if discontinued
  - Responses have been reviewed
- **Current Activity: Identify and assess options**
  - Site-by-site analysis
  - Continuation/partial decommission/transfer/hybrid
- **Decision timeline: No earlier than summer 2015**
  - Supports investment decisions in 2017
- **Continue uninterrupted NDGPS service to users as currently provided until future decision reached**
- **Public/user community information/ involvement in decision processes and next steps**





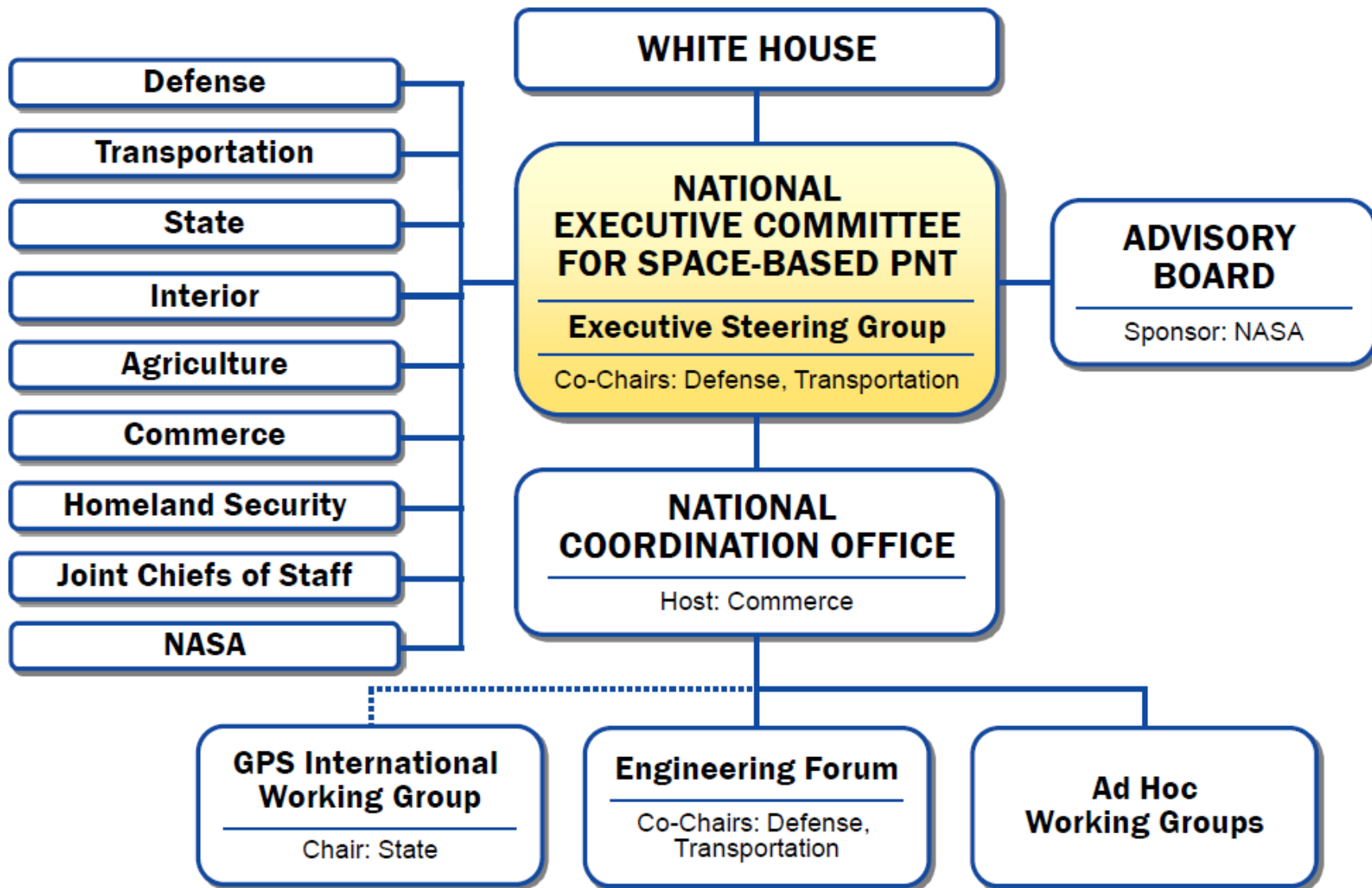
# Complementary PNT



- **EXCOM looked at need for complement to GPS**
  - Assessment driven by many factors: from policy to technology
  - U.S. coverage for GPS outage from natural or man-made events
- **Current Activity: Identify and assess alternatives**
  - Assessed a broad mix of terrestrial RF and autonomous PNT technologies
- **Decision timeline: No earlier than summer 2015**
  - Supports FY17 investment decisions
- ***Federal Register* Notice in development for public stakeholder engagement**



# National Space-Based PNT Organization





# Summary

- **The U.S. supports free access to civilian GNSS signals and all necessary public domain documentation**
- **GPS is a critical component of the global information infrastructure**
  - **Compatible with other satellite navigation systems and interoperable at the user level**
  - **Guided at a national level as multi-use asset**
  - **Acquired and operated by the Air Force on behalf of the USG**
- **The U.S. policy promotes open competition and market growth for commercial GNSS**
- **Modernization milestones: Multiple launches and new Civil Navigation messages broadcast**

***GPS: Continuous improvement,  
predictable, dependable performance***



# Thank You !

## Contact Information:

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**[www.gps.gov](http://www.gps.gov)**

**Official public resource for U.S. Government  
information about GPS and related topics**

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