



U.S. GPS Program and Policy Update



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Overview

- **U.S. Space-Based PNT Policy**
- GPS Program Status
- International Cooperation Activities
- Summary



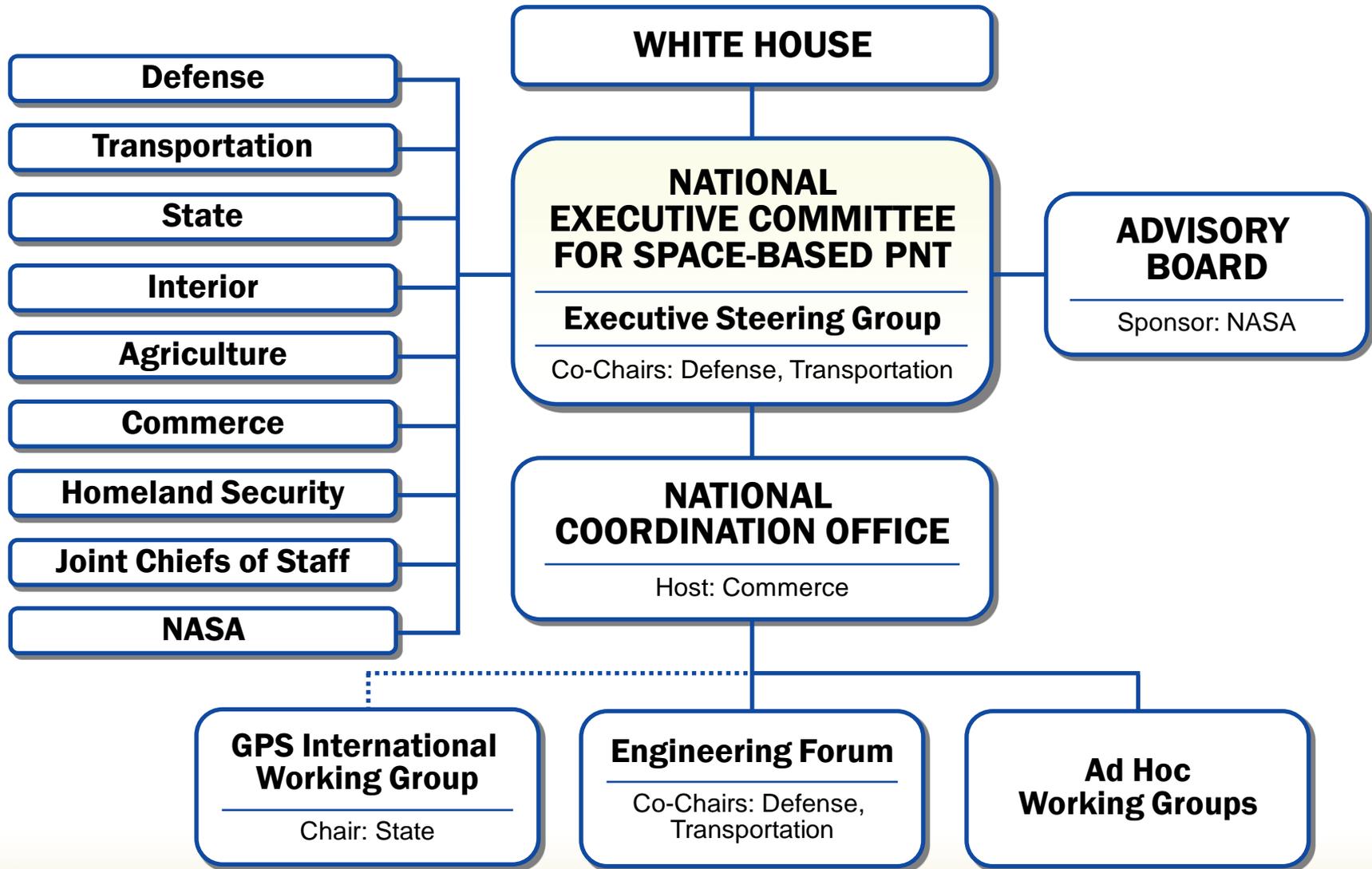
U.S. National Space Policy

Space-Based PNT Guideline: Maintain leadership in the service, provision, and use of GNSS

- Provide civil GPS services, free of direct user charges
 - Available on a continuous, worldwide basis
 - Maintain constellation consistent with published performance standards and interface specifications
 - Foreign PNT services may be used to complement services from GPS
- Encourage global ***compatibility*** and ***interoperability*** with GPS
- Promote transparency in civil service provision
- Enable market access to industry
- Support international activities to detect and mitigate harmful interference



U.S. Space-Based PNT Organization Structure





U.S. Policy Promotes Global Use of GPS Technology

- No direct user fees for civil GPS services
 - Provided on a continuous, worldwide basis
- Open, public signal structures for all civil services
 - Promotes equal access for user equipment manufacturing, applications development, and value-added services
 - Encourages open, market-driven competition
- Global compatibility and interoperability with GPS
- Service improvements for civil, commercial, and scientific users worldwide
- Protection of radionavigation spectrum from disruption and interference



Economic Benefits of GPS in U.S.

*Excerpted from NDP Consulting report commissioned by the
"Save Our GPS Coalition" in 2011*

- "We estimate that the value to the U.S. economy of the productivity gains and input cost reductions alone amounts to between \$68 billion and \$122 billion per year, or 0.5 to 0.9 percent of annual U.S. gross domestic product."
- The report estimates **\$67.6 billion in direct economic benefits** due to annual productivity increases and cost savings in precision agriculture (\$19.9 billion), engineering construction (\$19.9 billion), transportation (\$28.2 billion), and other commercial GPS uses (\$28.2 billion).
- "In addition, GPS technology creates direct and indirect positive spillover effects, such as emission reductions from fuel savings, health and safety gains in the work place, time savings, job creation, higher tax revenues, and improved public safety and national defense.
- Today, there are **more than 3.3 million jobs that rely on GPS technology**, including approximately 130,000 jobs in GPS manufacturing industries and 3.2 million in the downstream commercial GPS-intensive industries."



GPS Offers Enormous Value to Developing Nations

- Obviates need to develop local infrastructure for positioning, navigation, and timing
 - Example: Availability of GPS time eliminates need to build terrestrial time distribution networks
- Supports a wide range of sustainable development activities including:
 - Surveying, mapping, GIS
 - Construction, mining
 - Agriculture
 - Timing for telecom, banking, power grid management
 - Disaster management
 - Environmental stewardship



Overview

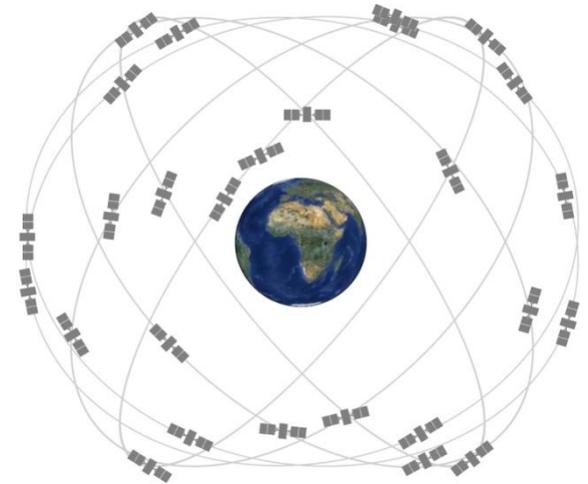
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GPS Constellation Status

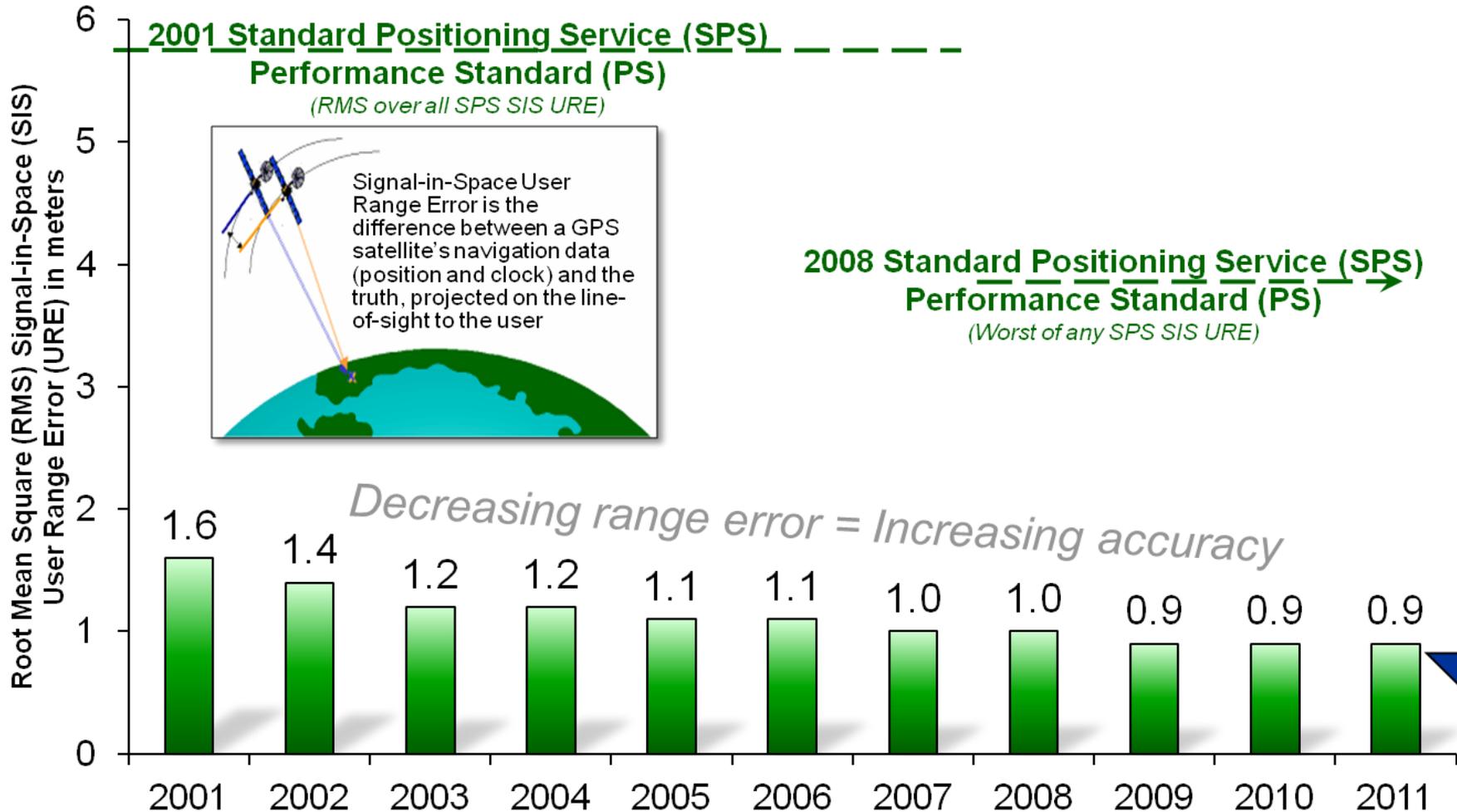
31 Operational Satellites **As of April 2013**

- “Expandable 24” configuration (27 slots)
- 9 Block IIA (1 set unhealthy)
- 12 Block IIR
- 7 Block IIR-M
- 3 Block IIF
- 4 residuals on orbit
- Continuously assessing constellation health to determine launch need





GPS SPS Signal in Space Performance

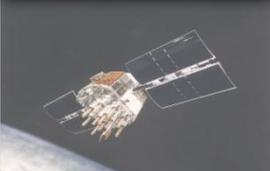
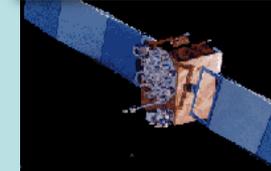


Better Performance

Global GPS service performance commitment met continuously since December 1993



GPS Program Evolution

1978 - 1985	1989 - 1997	1997- 2004	2005 - 2009	2010 - Present	2014 - 2024
					
Block I	Block II/IIA	Block IIR	Block IIR-M	Block IIF	Block III
11 (10) Satellites	28 Satellites	13 (12) Satellites	8 Satellites	12 Satellites	32 Satellites
Demonstration system	Basic GPS Provides Initial Navigation Capabilities	IIA/IIR Capabilities "Plus"	IIR -M Capabilities "Plus"	IIF Capabilities "Plus"	
<ul style="list-style-type: none"> • L1 (CA) Navigation signal • L1 & L2 (P Code) Navigation Signal • 5 Year Design Life 	<ul style="list-style-type: none"> • Standard Service <ul style="list-style-type: none"> • Single Frequency (L1) • C/A code Navigation • Precise Service • Two Frequencies (L1 & L2) • P (Y) -Code Navigation • 7.5 Year Design Life 	<ul style="list-style-type: none"> • 2nd Civil Signal L2 (L2C) • Earth Coverage M-Code on L1/L2 • L5 Demo • Anti-Jam Flex Power • 7.5 Year Design Life 	<ul style="list-style-type: none"> • 3rd Civil Signal L5 • Reprogrammable Nav Processer • Increased Accuracy Requirement • 12 Year Design Life 	<ul style="list-style-type: none"> SV 1-8 • Increased Accuracy • Increased Earth Coverage Power • 15 Year Design Life • 4th Civil Signal (L1C) TBD • Near-Real-Time Commanding • DASS • Navigation Integrity • Spot Beam for AJ 	
Increasing Space System Capabilities – Increasing Military/Civil User Benefits 					



Status of GPS III and OCX

- GPS Block III, Satellites 1-8
 - Non-Flight Satellite Testbed completed testing
 - First 4 satellites now in production
- GPS Block III, Satellites 9+
 - On track to add search and rescue payload (SAR-GPS) and satellite laser retroreflectors
 - Studying options for dual launch and other cost savings
- Next Generation Operational Control System (OCX)
 - Block 0 (GPS III launch and checkout): 2014
 - Block 1 (CNAV for L2C and L5): 2016
 - Block 2 (L1C and M-Code): 2017



New Civil GPS Signals

Signal	Benefits	# of Satellites Broadcasting Now	Availability on 24 Satellites
L2C	Meets commercial needs for ionospheric correction, higher effective power, etc.	10	~2018
L5	Meets requirements for safety-of-life transportation; enables triple-frequency positioning techniques	3	~2021
L1C	GNSS interoperability; performance improvements in challenged environments	Will start with GPS III in 2015	~2026

Testing of new Civil Signal Navigation Message (CNAV) to begin this summer



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Planned GNSS

- Global Constellations
 - **GPS (24+)**
 - GLONASS (30)
 - Galileo (27+3)
 - Compass (27+3 IGSO + 5 GEO)



- Regional Constellations
 - QZSS (4+3)
 - IRNSS (7)
- Satellite-Based Augmentations
 - **WAAS (3)**
 - MSAS (2)
 - EGNOS (3)
 - GAGAN (2)
 - SDCM (3)



U.S. Objectives in Working with Other GNSS Service Providers

- Ensure **compatibility** — ability of U.S. and non-U.S. space-based PNT services to be used separately or together without interfering with each individual service or signal
 - Radio frequency compatibility
 - Spectral separation between M-code and other signals
- Achieve **interoperability** – ability of civil U.S. and non-U.S. space-based PNT services to be used together to provide the user better capabilities than would be achieved by relying solely on one service or signal
- Promote fair competition in the global marketplace

Pursue through Bilateral and Multilateral Cooperation



Bilateral Cooperation

- **Japan:** Joint statement signed in 1998; cooperation focuses on compatibility and interoperability between GPS and Japan's Quasi-Zenith Satellite System (QZSS)
- **Russia:** GPS-GLONASS discussions ongoing since 1996; Joint Statement issued Dec. 2004; discussions underway regarding monitoring of GLONASS/SDCM from United States territory
- **China:** On going discussions with China (CSNO & CNAGA) on the margins of multilateral international meetings
- **India:** Joint statement on GNSS cooperation signed 2007; continuing discussions under the Joint Civil Space Cooperation Working Group
- **European Union:** GPS-Galileo Agreement signed in 2004, ratified by EU in December 2011



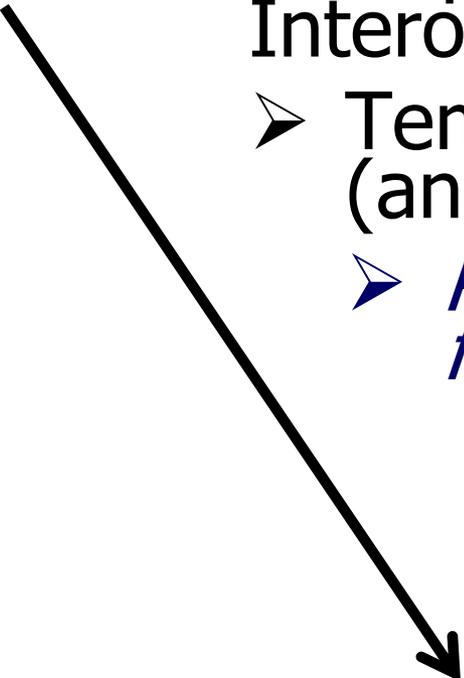
International Committee on Global Navigation Satellite Systems (ICG)

- Emerged from 3rd UN Conference on the Exploration and Peaceful Uses of Outer Space July 1999
 - Promote the use of GNSS and its integration into infrastructures, particularly in developing countries
 - Encourage compatibility and interoperability among global and regional systems
- Members include:
 - **GNSS Providers (U.S., EU, Russia, China, India, Japan)**
 - Other Member States of the United Nations
 - International organizations/associations





Progress in GNSS Service Provision

- ✓ Providers Forum
 - ✓ Providers Forum System Report
 - ✓ Principles of Compatibility, Interoperability, and Transparency
 - Template for Performance Standards (and ICDs)
 - *Postulated Performance Standards for future services*
 - Service Assurances or Commitments
 - *Monitoring of service performance*
 - *Interference monitoring*
- 



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Summary

- GPS performance is better than ever and will continue to improve
 - Testing new civil GPS signals this summer
 - More space and control segment upgrades coming
- U.S. policy encourages worldwide GPS use
 - International cooperation is a priority
 - Bilateral and Multilateral cooperation is ongoing



For Additional Information...

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Official U.S. Government information about the Global Positioning System (GPS) and related topics

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U.S. and UK Reach Understanding on GPS Patents

The United States and United Kingdom successfully reached an understanding on intellectual property rights that will ensure GPS civil signals remain free and openly available for users worldwide.

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Multilingual Content

To improve global understanding about GPS, we are pleased to offer key portions of this website in multiple languages. Please note that some pages link back to English content.

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GPS Cooperation with Other Nations

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- [Russia](#)
- [United Kingdom](#)
- [International Committee on GNSS](#)
- [Other International](#)

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THANK YOU!

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ICG Providers Forum

- Six space segment providers listed previously are members
- Purpose:
 - Focused discussions on **compatibility and interoperability**, encouraging development of complimentary systems
 - Exchange detailed information on systems & service provision plans
 - Exchange views on ICG work plan and activities
- Providers have agreed that all GNSS signals and services must be compatible and open signals and services should also be interoperable to the maximum extent possible
 - Working definition of **compatibility** includes respect for spectral separation between each system's authorized service signals and other systems' signals
 - **Interoperability** definition addresses signal, geodetic reference frame realization, and system time steering considerations