U.S. GPS Policy, Program and International Update

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Overview

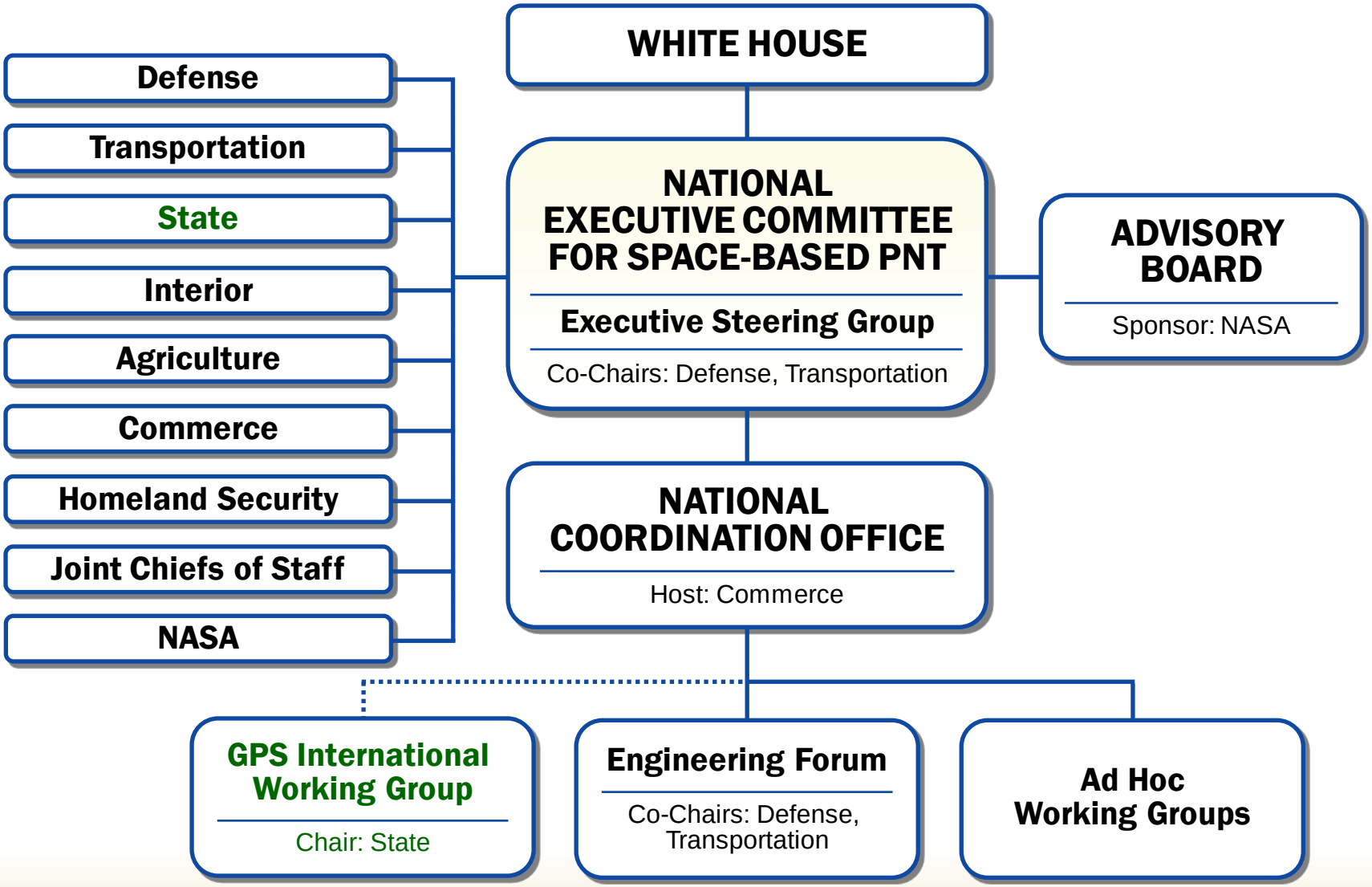
- **U.S. Space-Based PNT Policy**
- GPS Program Status
- International Cooperation Activities
- Summary

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.“

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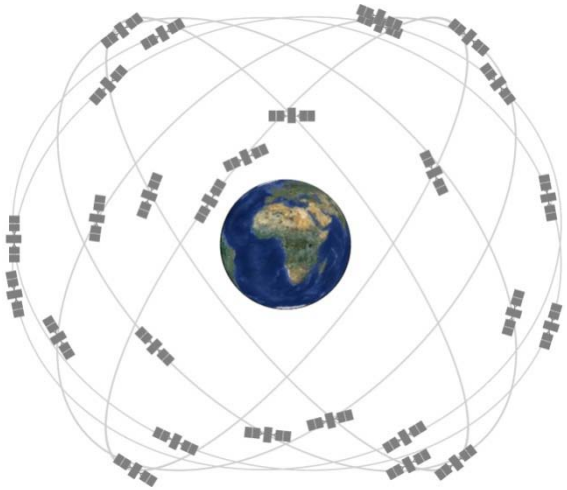
GPS Constellation Status

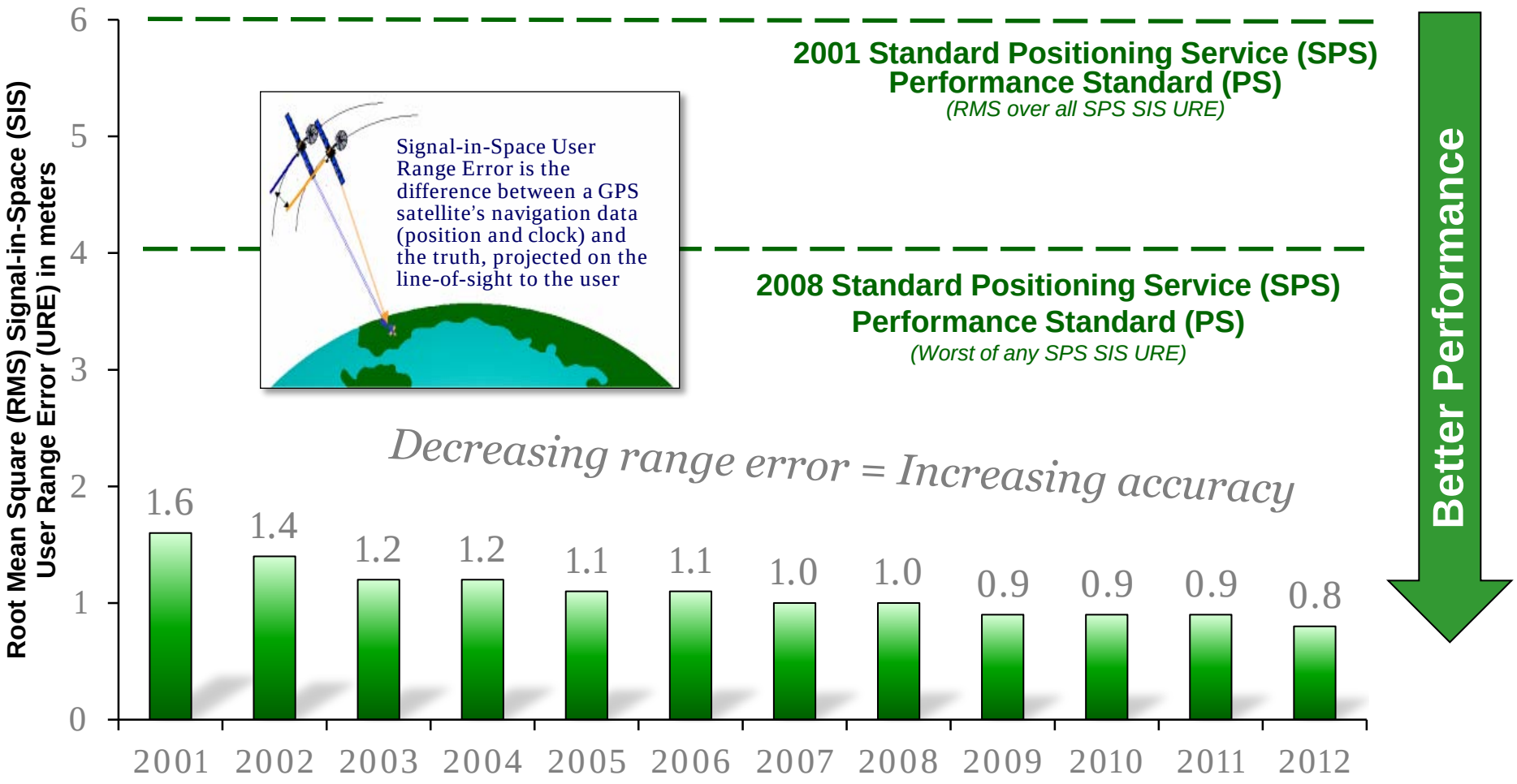
30 Operational Satellites
As of May 9, 2013

- "Expandable 24" configuration (27 slots)
- 8 Block IIA
- 12 Block IIR
- 7 Block IIR-M
- 3 Block IIF
- 4 residuals on orbit
- Continuously assessing constellation health to determine launch need



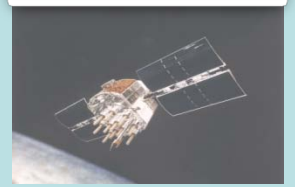
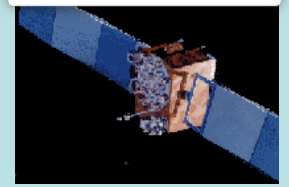
Next GPS IIF Launch planned for TODAY! (May 15)

GPS SPS Signal in Space 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"**	
• L1 (CA) Navigation signal • L1 & L2 (P Code) Navigation Signal • 5 Year Design Life	• Standard Service • Single Frequency (L1) • C/A code Navigation • Precise Service • Two Frequencies (L1 & L2) • P (Y) -Code Navigation • 7.5 Year Design Life	• 2nd Civil Signal L2 (L2C) • Earth Coverage M-Code on L1/L2 • L5 Demo • Anti-Jam Flex Power • 7.5 Year Design Life	• 3rd Civil Signal L5 • Reprogrammable Nav Processer • Increased Accuracy Requirement • 12 Year Design Life	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

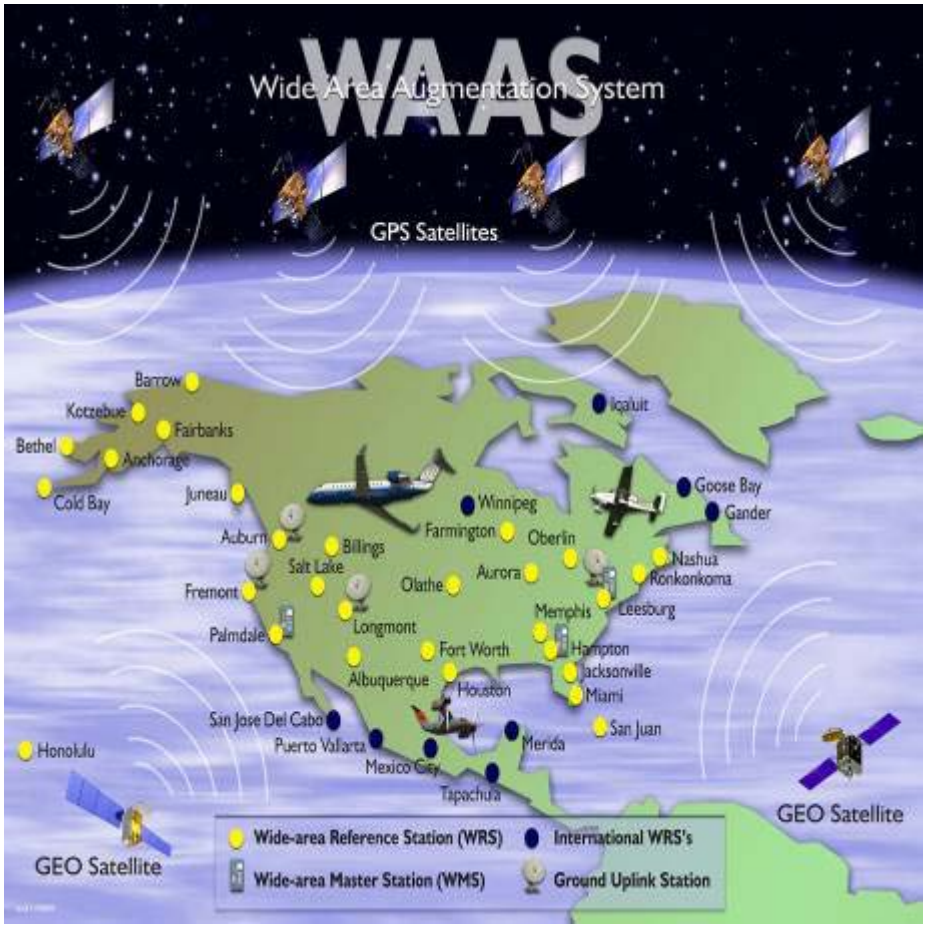
- GPS Block III, Satellites 1-8
  - Non-Flight Satellite Testbed completed testing
  - First 4 satellites now in production
- GPS Block III, Satellites 9+
  - On track to add search and rescue payload (SAR-GPS) and satellite laser retro-reflectors
  - Studying options for dual launch and other cost savings
- 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

Wide Area Augmentation System (WAAS) Architecture



38 Reference Stations

3 Master Stations

6 Ground Earth Stations

3 Geostationary Satellite Links

2 Operational Control Centers

WAAS Status

- **Phase III: Full LPV-200 Performance (2009 – 2013)**
  - **Development, modifications, and enhancements to include tech refresh**
  - **Steady state operations and maintenance**
  - **Transition to FAA performed 2nd level engineering support**
  - **Begin GPS L5 transition activities**
- **Phase IV: Dual Frequency (L1, L5) Operations (2014 – 2028)**
  - Complete GPS L5 transition
  - Will significantly improve availability and continuity during severe solar activity
  - Will continue to support single frequency users
  - Steady state operations and maintenance

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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

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

U.S. Bilateral Cooperation with China

- Operator-to-operator coordination under ITU auspices for GPS & Beidou/Compass was completed in September 2010
- Successful Workshop on GNSS conducted by the Chinese Academy of Engineering and U.S. National Academy of Engineering immediately following CSNC 2011
- Bilateral meeting between the CAAC (中国民用航空局) and U.S. FAA focused on aviation satellite navigation issues also occurred following CSNC 2011
- On going discussions with China Satellite Navigation Office (CSNO) and China National Administration of GNSS and Applications (CNAGA), on the margins of multilateral international meetings
- On going cooperation through the International Committee on GNSS (ICG)

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

http://www.icgsecretariat.org

ICG-7 Outcomes

- Endorsement of two Workshops (just held in Honolulu, HI, USA)
  - Second Workshop on Interference Detection and Mitigation, following a successful first Workshop in June 2012
  - Interoperability Workshop focused on industry feedback regarding signal design and parameters
- Multi-GNSS monitoring: Tasks and a Work Plan for the ICG International GNSS Monitoring and Assessment (IGMA) Subgroup were approved
  - Identify what service parameters should be monitored
  - Define the level and methods for carrying out the monitoring
- ICG adopt the International Terrestrial Reference System (ITRS) as the theoretical reference system for the alignment of GNSS terrestrial reference frames
- Consensus that achieving a fully interoperable GNSS space service volume would provide significant performance benefits that no single system could provide on its own

ICG-8 will be hosted by the UAE in Dubai, November 2013

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- 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…

www.gps.gov

谢谢

THANK YOU!

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