

# Update on GPS and International Activities

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Space-Based PNT

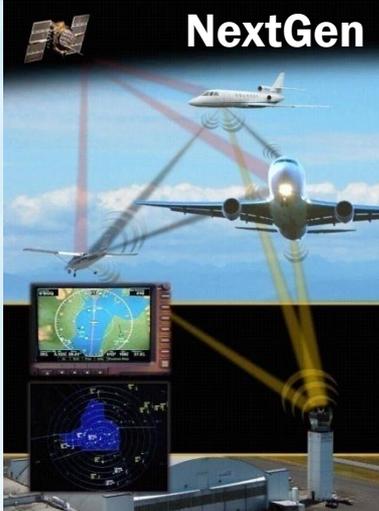
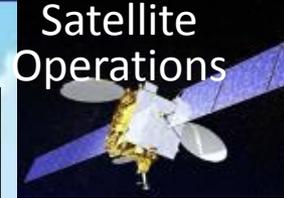
United States of America



## Overview

- **GPS Applications and Benefits**
- U.S. Space-Based PNT Policy
- International Implementation Activities
- Summary

## GPS enables a diverse array of applications



## Surveying, Mapping, GIS



- Surveying is essential to any new development

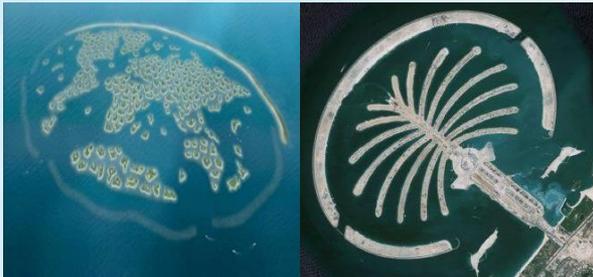
Electrification

Telecom tower placement

Pipeline installation

Dam construction

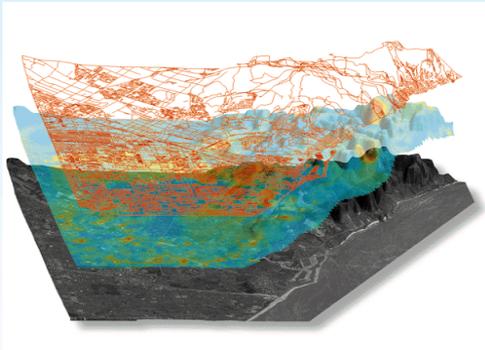
Port dredging



GPS enables 2-5 cm real-time positioning accuracy

Mm-level accuracy possible with post-mission data processing

- 100%-300% savings in time, cost, labor  
Stakeless, paperless surveys



## Construction, Mining

- Faster site preparation
- Enhanced management of assets, equipment
  - More efficient asset utilization
- Precise machine control
  - Up to 70% increased job site productivity
  - Saves time, fuel, and emissions
  - Reduces maintenance
  - Prevents accidents
- Automated, wireless job tasking
  - Smaller, more empowered workforce – no foreman



## Environmental Stewardship

- Climate monitoring
  - Sea level rise measurements
  - Ice sheet change observations
  - Atmospheric moisture profiles
- Reduced greenhouse gas emissions
  - Efficient routing of aircraft, trucks, and other vehicles
  - Reduction of vehicle fleet idle times
- Oil and chemical spill cleanup
  - Positioning, modeling of spills to guide remediation efforts
- Commercial fishing
  - Enforcement of fishery boundaries
- Forestry
  - Monitoring of illegal deforestation



## Disaster Management

- Assists in disaster planning efforts such as flood plain mapping
- Helps relief workers navigate disaster areas devoid of landmarks
- Facilitates containment and management of wildfires
- Enables disaster warning systems
  - GPS-equipped buoys for tsunami warnings
  - GPS ground networks monitor crustal motion, earthquakes

## Aviation Benefits

- Safety Benefits in Aviation
  - SBAS and GBAS enable vertically guided approaches at increasing number of airports
- Economic Benefits
  - More direct enroute flight paths – reduced fuel costs
  - Synchronized arrivals will improve utilization of runway capability
  - Reduced separation standards which allow increased capacity in a given airspace without increased risk

## Timing

- GPS provides precise time needed to synchronize large networks
- Telecommunications
  - Wired and wireless
- Finance
  - Stock exchanges
  - ATMs
- Power grids
  - Load balancing
  - Fault detection, location



## 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."

# Improved U.S. Agricultural Productivity

(courtesy of John Deere 2011)

- **Yield Mapping – used by 80% of grain combine customers in U.S.**
  - Provides insight for precise seed placement, pesticides and fertilizers
- **Auto Guidance – used by 65% of the large agriculture producers in U.S.**
  - Reduced errors in overlap of tillage, seeding and spraying
  - Reduced operator fatigue
  - Opportunity to use local unskilled operators
- **Improved Output**
  - Reduced overlap = fewer passes through the field
  - Less compaction implies higher yield
  - Less tillage required – less fuel, less carbon release and lower food cost
- **Future Gains**
  - Additional advancements needed to feed a growing population



## Space-Based PNT Advisory Board Economic Impact Study

- NASA sponsors PNT Advisory Board
- Board provides independent advice on GPS-related policy, planning, program management and funding
- Conducting National GPS Economic Assessment
  - Survey existing data and studies
  - Collect data on direct and supporting economic activities
  - Estimate economic and social impacts of GPS on the U.S . economy (including applications of GPS technology and GPS-related manufacturing)

## Overview

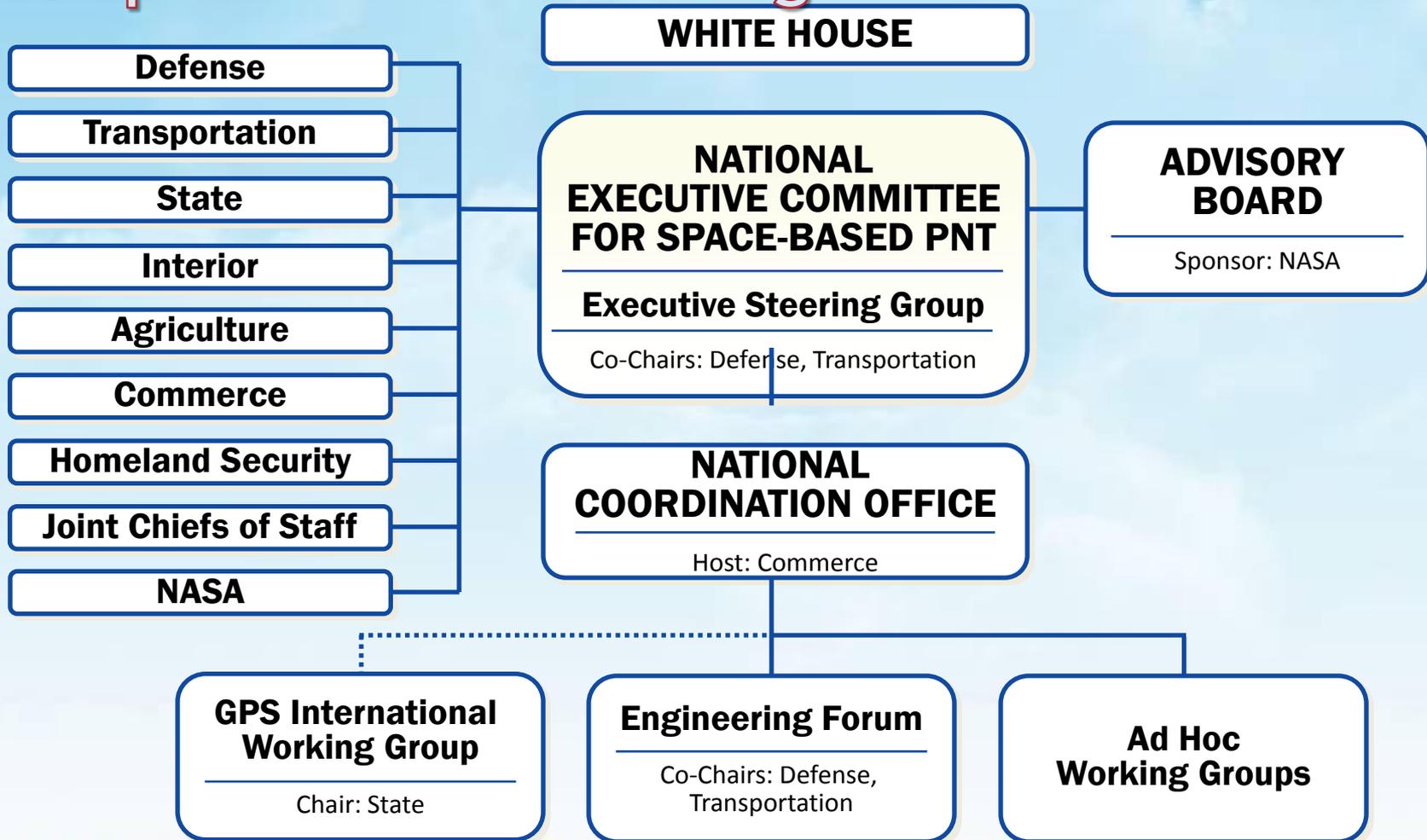
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## 2010 U.S. National Space Policy

*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
  - Non-U.S. 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



## National Risk Estimate

- DHS conducted National Risk Estimate on Risks to U.S. Critical Infrastructure from GPS Disruptions and released report in November, 2012
- Bottom Line: Numerous U.S. critical infrastructure sectors are increasingly at risk from a growing dependency on GPS for positioning, navigation, and timing (PNT) services.
- Such dependencies are not always apparent
- Interdependencies exist between critical infrastructure sectors that use GPS

## Critical Infrastructure Resilience

- Updated Policy Guidance
- February 2013 Presidential Policy Directive 21 on Critical Infrastructure Security and Resilience
- Consider role of GPS dependencies when examining 16 critical infrastructures
- On going interagency effort to address PNT Critical Infrastructure Resilience

## Federal Radionavigation Plan (FRP)

- Official source of radionavigation policy and planning for the Federal Government
  - Required by the National Defense Authorization Act for the Fiscal Year 1998 (10 USC 2281(c))
  - Jointly prepared by the Department of Defense (DoD), Homeland Security (DHS), and Transportation (DOT) with the assistance of other government agencies

- FRP issued biennially
- More emphasis on “planning”
- Incorporates civil PNT requirements (accuracy, availability, coverage, integrity)
- Incorporates National PNT Architecture concepts
- PNT Architecture Assessment and Evolution
  - FAA Alternative PNT
  - USCG CRADA on Timing Alternative to GPS
  - Interoperability and Compatibility with Foreign GNSS

2012  
FEDERAL  
RADIONAVIGATION  
PLAN



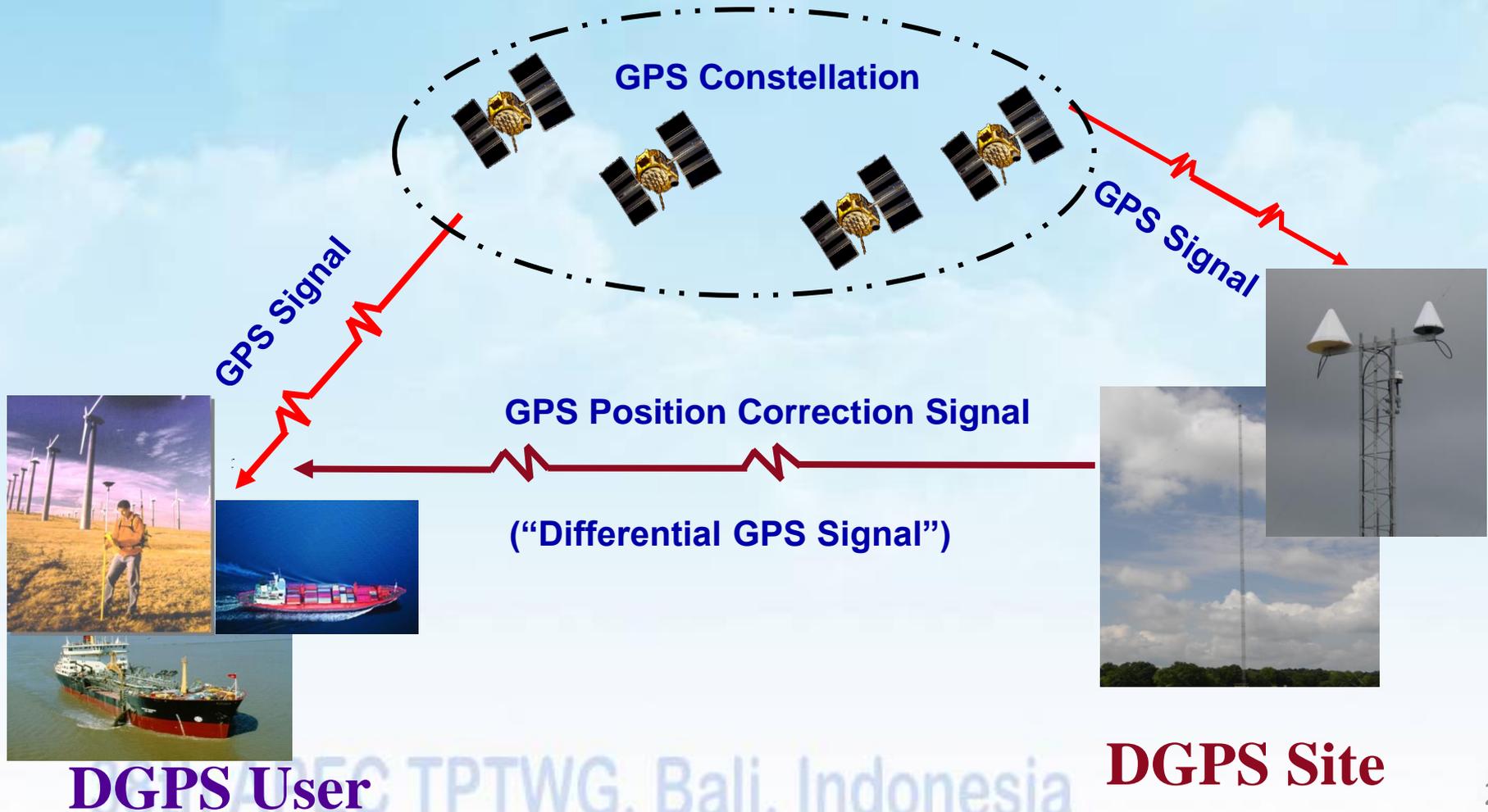
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## 2012 FRP Language on NDGPS

- The Department of Homeland Security, in coordination with the Department of Transportation, is analyzing the future requirements for the Nationwide Differential GPS (NDGPS) to support investment decisions beyond Fiscal Year 2016
- Future investment decisions might include:
  - Maintaining NDGPS as currently configured
  - Decommissioning NDGPS as currently configured
  - Developing alternate uses for the NDGPS infrastructure

# NDGPS Operation



**DGPS User**

**DGPS Site**

## National PNT Architecture Recommendation

“As GPS Modernization or other Methods Demonstrate New Operational Capabilities, Agencies should Transition or Divest US GNSS Augmentation Assets that are Unnecessarily Redundant to their Requirements.”

## Future of NDGPS Assessment

- Contributing Factors:
  - Lack of USCG requirements
    - ATON authorized to use GPS for positioning
    - Navigation Standards Manual updated to allow use of WAAS for Navigation
  - Discontinuation of Selective Availability
  - Continued GPS modernization
  - Reduced availability of consumer grade DGPS receivers
  - FRA has stated that there is no requirement for NDGPS to meet Positive Train Control

## Federal Register Notice

- Issued April 16, 2013
- Requests comments from Federal, state, and local agencies, as well as other interested members of the public:
  - Current and future usage of NDGPS
  - Need to retain NDGPS
  - Impact if NDGPS signals were not available
  - Alternatives to NDGPS
  - Alternative uses for the NDGPS infrastructure
- Full Federal Register Notice can be found at:  
<http://www.gpo.gov/fdsys/pkg/FR-2013-04-16/pdf/2013-08844.pdf>
- Comments are due by July 15, 2013

## Next Steps

- Spring-Fall 2013
  - Collect/Analyze user needs/inputs
  - Conduct public meetings
  - Coordinate with International Partner
- Information used to inform decision making process to continue/discontinue/develop alternate uses of NDGPS

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## International Cooperation

- U.S. goals for GNSS cooperation:
  - Compatibility and interoperability
  - Transparency in civil service provision
  - Market access
  - Detecting, mitigating, and increasing resiliency to harmful interference
- Bilateral relationships
  - Russia, Europe, Japan, India, Australia, China
- Multilateral engagement
  - ICG, APEC, ICAO, IMO, ITU



## Bilateral Cooperation

- **Russia:** GPS-GLONASS discussions ongoing since 1996; Joint Statement issued Dec. 2004; discussions underway regarding civil GLONASS service and SDCM monitoring stations 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); satellite-based augmentation systems (SBAS) Multi-Functional Satellite Augmentation System (MSAS) cooperation
- **China:** China Operator-to-operator coordination under ITU auspices for GPS & Beidou completed in September 2010; on going cooperation through the International Committee on GNSS (ICG)

## Bilateral Cooperation (continued)

- **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; SBAS GPS Aided Geo-Augmented Navigation System (GAGAN) cooperation

## International Committee on GNSS (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
- First meeting held November 2006 and then annually
- **ICG-7** was held in Beijing in November 2012, and **ICG-8** will take place in November 2013 in Dubai

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## Summary

- New applications for GPS every day
- Numerous critical infrastructures utilize and depend upon GPS
- U.S. is analyzing future requirements for NDGPS
- 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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For Students

**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.

**Español**

- Página Principal
- El Sistema de Posicionamiento Global
- Ampliaciones al GPS
- Aplicaciones del GPS

**中文**

- 首页
- 全球定位系统
- GPS的增强系统
- GPS的应用

**GPS Cooperation with Other Nations**

- Australia
- China
- Europe
- India
- Japan
- Russia
- United Kingdom
- International Committee on GNSS
- Other International