GPS Constellation, Modernization Plans and Policy

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Overview

• Introduction
• Global Positioning System
• Modernization Plans
• U.S. Policy
GPS enables a diverse array of applications
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GPS IIF-3 Launch

SVN-65, October 4, 2012
The Global Positioning System

- Baseline 24+3 satellite constellation in medium earth orbit
- Global coverage, 24 hours a day, all weather conditions
- Satellites broadcast precise time and orbit information on L-band radio frequencies
- Two types of signals:
  - Standard (free of direct user fees)
  - Precise (U.S. and Allied military)
- Three segments:
  - Space
  - Ground control
  - User equipment
GPS Constellation Status

35 Satellites (30 Operational) (Baseline Constellation: 24+3)

- 12 Block IIA
  - 3 on-orbit in residual status
- 12 Block IIR
- 8 Block IIR-M
  - Transmitting new second civil signal
  - 1 GPS IIR-M in on-orbit testing
- 3 Block IIF
  - SVN-65 operational late 2012
- Global GPS civil service performance commitment met continuously since December 1993
Standard Positioning Service (SPS) Signal-in-Space Performance

- System accuracy exceeds published standard

**2001 Standard Positioning Service (SPS) Performance Standard (PS)** (RMS over all SPS SIS URE)

- Signal-in-Space User Range Error is the difference between a GPS satellite's navigation data (position and clock) and the truth, projected on the line-of-sight to the user

**2008 Standard Positioning Service (SPS) Performance Standard (PS)** (Worst of any SPS SIS URE)

- Decreasing range error = Increasing accuracy

Root Mean Square (RMS) Signal-in-Space (SIS) User Range Error (URE) in meters

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Better Performance
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GPS Modernization Program

**Increasing System Capabilities** • **Increasing User Benefit**

**Block IIA/IIR**
- Basic GPS
  - Standard Service
    - Single frequency (L1)
    - Coarse acquisition (C/A) code navigation
  - Precise Service
    - Y-Code (L1Y & L2Y)
    - Y-Code navigation

**Block IIR-M, IIF**
- IIR-M – Basic GPS capability plus
  - 2nd civil signal (L2C)
  - M-Code (L1M & L2M)
- IIF – IIR-M capability plus
  - 3rd civil signal (L5)
  - 2 Rb + 1 Cs Clocks
  - 12 year design life

**Block III**
- Backward compatibility
- 4th civil signal (L1C)
- 4x better User Range Error than IIF
- Increased availability
- Increased integrity
- 15 year design life
GPS Modernization – New Civil Signals

• Second civil signal “L2C”
  • Designed to meet commercial needs
  • Available since 2005 without data message
  • Currently broadcasts from 9 satellites
  • Full capability: 24 satellites and full CNAV approximately 2018

• Third civil signal “L5”
  • Designed to meet transportation safety-of-life requirements
  • Currently broadcasts from 2 satellites
  • 24 satellites and full CNAV approximately 2021

• Fourth civil signal “L1C”
  • Designed for GNSS interoperability
  • Specification developed in cooperation with industry
  • Fully designed and in testing
  • Will be broadcast by GPS III
  • Available on 24 satellites approximately 2026

Improved performance in challenged environments
Ground Segment Status

- Current system Operational Control Segment (OCS)
  - Currently flying expanded 24+3 constellation of GPS Block II satellites
  - Provides worldwide ground antenna and monitor station with redundant coverage
- Next Generation Operational Control System (OCX) development continues
  - Will provide ability to fly GPS III and operate modernized GPS signals
  - OCX Block I deployment planned for 2016
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U.S. Policy History

- 1978: First GPS satellite launches
- 1983: President announces civilian access to GPS following KAL 007
- 1991: U.S. offers free civil GPS service to the International Community
- 1996: First U.S. GPS Policy establishes joint civil/military management
- 1997: U.S. law provides civil GPS access free of direct user fees
- 2000: President ends use of Selective Availability
- 2004: President issues U.S. Policy on Space-Based PNT
- 2004: Agreement signed on GPS-Galileo Cooperation
- 2007: Selective Availability eliminated from GPS III satellites
- 2010: National Space Policy provides high-level PNT guidance
The U.S. must maintain its leadership in the service, provision and use of Global Navigation Satellite Systems (GNSS)

- Provide continuous worldwide access to GPS for peaceful uses, free of direct user charges
- Encourage compatibility and interoperability with foreign GNSS services
- Operate and maintain constellation to satisfy civil and national security needs
  - Foreign PNT may be used to strengthen resiliency
- Invest in domestic capabilities and support international activities to detect, mitigate and increase resiliency to harmful interference
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
  – Primary focus on the common L1C and L5 signals

**Pursue through Bilateral and Multilateral Cooperation**
National Space-Based PNT Organization

WHITE HOUSE

NATIONAL EXECUTIVE COMMITTEE FOR SPACE-BASED PNT

Executive Steering Group
Co-Chairs: Defense, Transportation

NATIONAL COORDINATION OFFICE
Host: Commerce

GPS International Working Group
Chair: State

Engineering Forum
Co-Chairs: Defense, Transportation

Ad Hoc Working Groups

ADVISORY BOARD
Sponsor: NASA

Defense
Transportation
State
Interior
Agriculture
Commerce
Homeland Security
Joint Chiefs of Staff
NASA

DEFENSE
TRANSPORTATION
STATE
INTERIOR
AGRICULTURE
COMMERCE
HOMELAND SECURITY
JOINT CHIEFS OF STAFF
NASA

NATIONAL COORDINATION OFFICE FOR SPACE-BASED POSITIONING, NAVIGATION & TIMING
Summary

• GPS continues to meet or exceed our performance commitments to worldwide users.

• Modernization of all GPS segments on track.

• Striving to continually improve navigation and timing services while maintaining backward compatibility with legacy equipment.

• GPS is committed to open and transparent cooperation with the international GNSS community.
For Additional Information

- NCO maintains GPS.gov as a central public resource for official USG information about GPS and related topics.
Contact Information

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This presentation and other GPS information:
www.gps.gov

Thank You!