

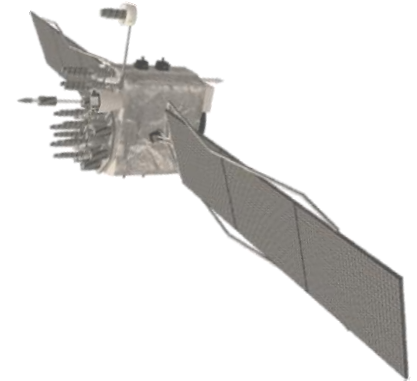
U.S. Space-Based Positioning, Navigation and Timing Policy and Program Update

7th International Committee on GNSS

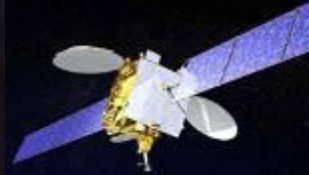
4 November 2012

*Anthony J. Russo
Director, National Coordination Office
United States of America*

*Bernard J. Gruber
Director, Global Positioning Systems Directorate
United States of America*



GNSS enables a diverse array of applications



Satellite Operation



Surveying & Mapping



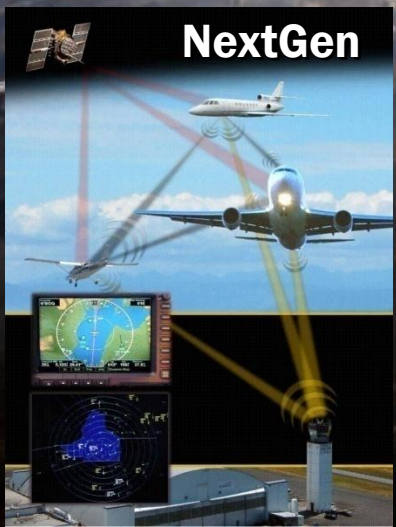
Power Grids



Precision Agriculture



Transit Operations



NextGen



Disease Control



Intelligent Vehicles



TeleComm



Trucking & Shipping



Personal Navigation



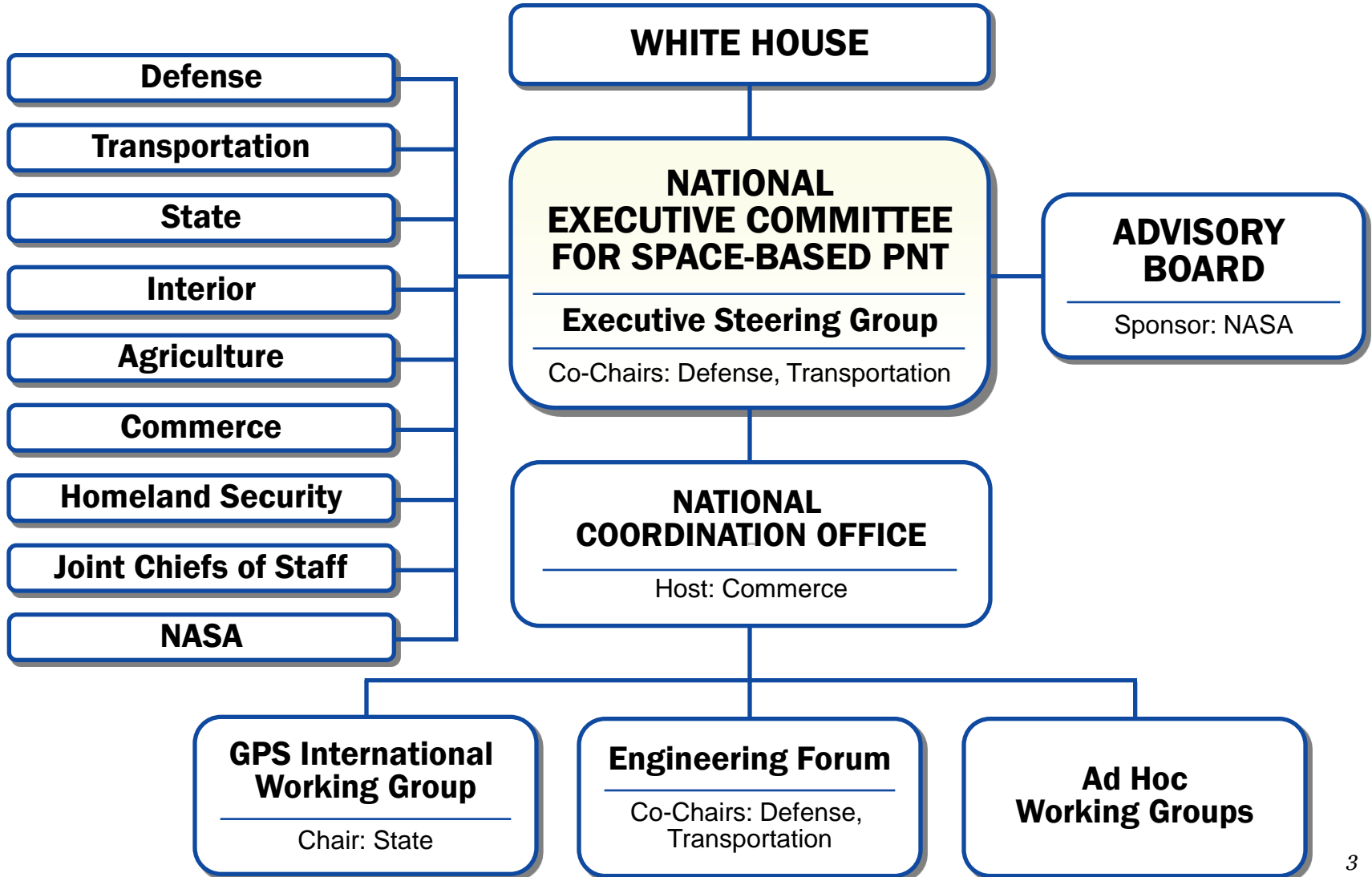
Oil Exploration



Fishing & Boating



National Space-Based PNT Organization





U.S. Policy



- Provide continuous worldwide access for peaceful uses, free of direct user charges
- Encourage compatibility and interoperability with foreign GNSS services and promote transparency in civil service provisioning
- Operate and maintain constellation to satisfy civil and national security needs
 - *Foreign PNT services may be used to complement services from GPS*
- 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
- Ensure a level playing field in the global marketplace

*Pursue through Bilateral
and Multilateral Cooperation*



Keys to Successful U.S. Program



- Policy Stability
- Transparency
- Program Stability
- Sustained Performance and Credibility
- Continuous Improvement

Policy stability and transparency improve industry confidence and investment



GPS IIF-3 Launch



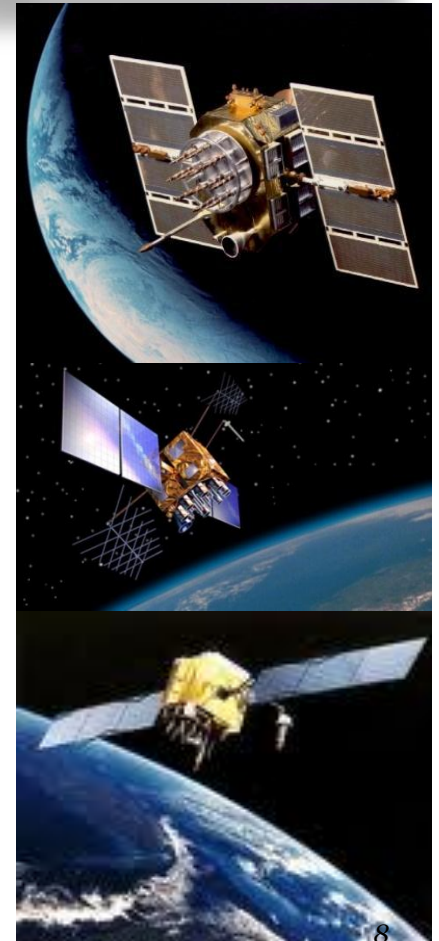
SVN-65 , October 4, 2012



GPS Constellation Status

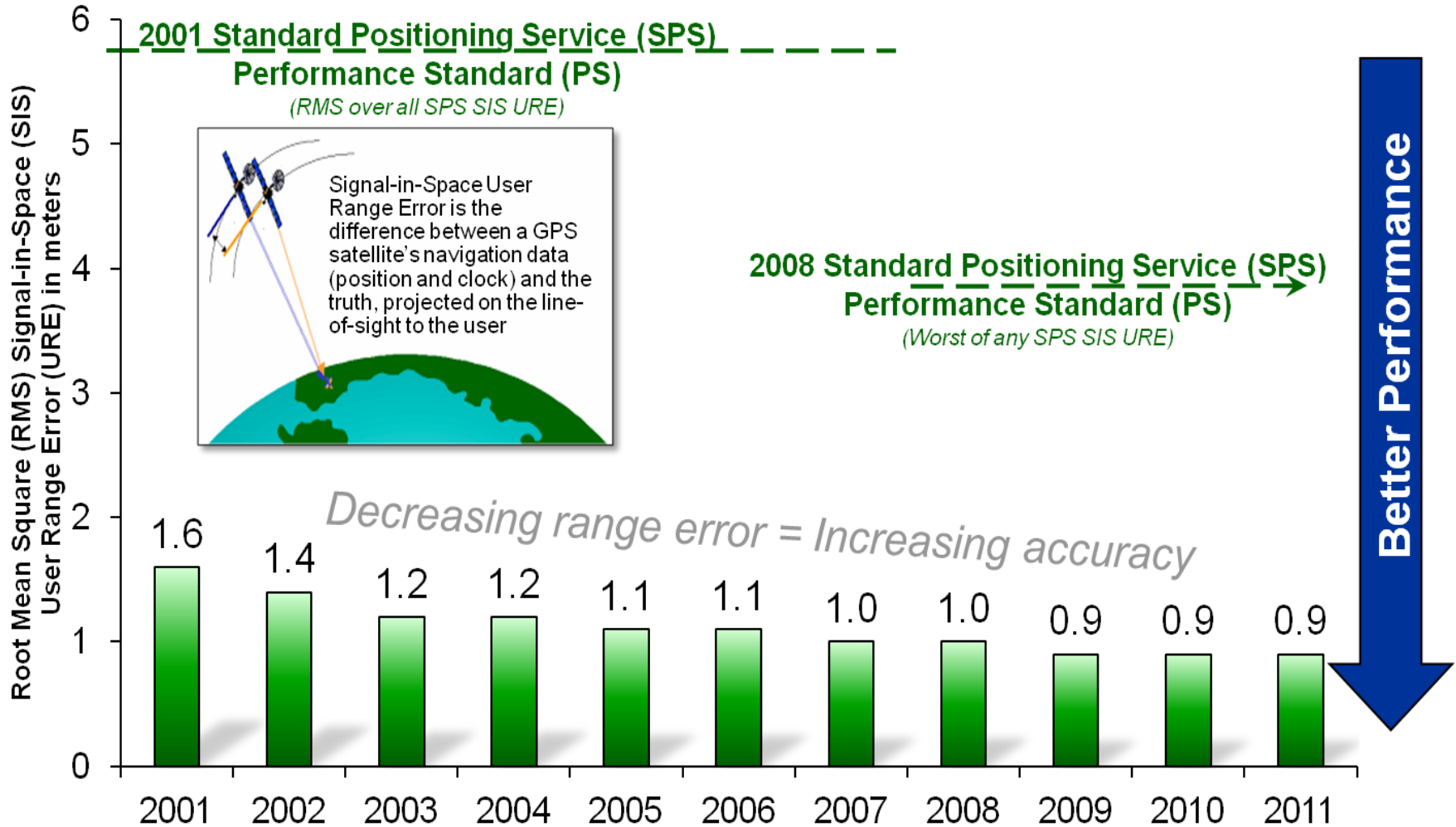
*35 Satellites (30 Operational)
(Baseline Constellation: 24+3)*

- 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

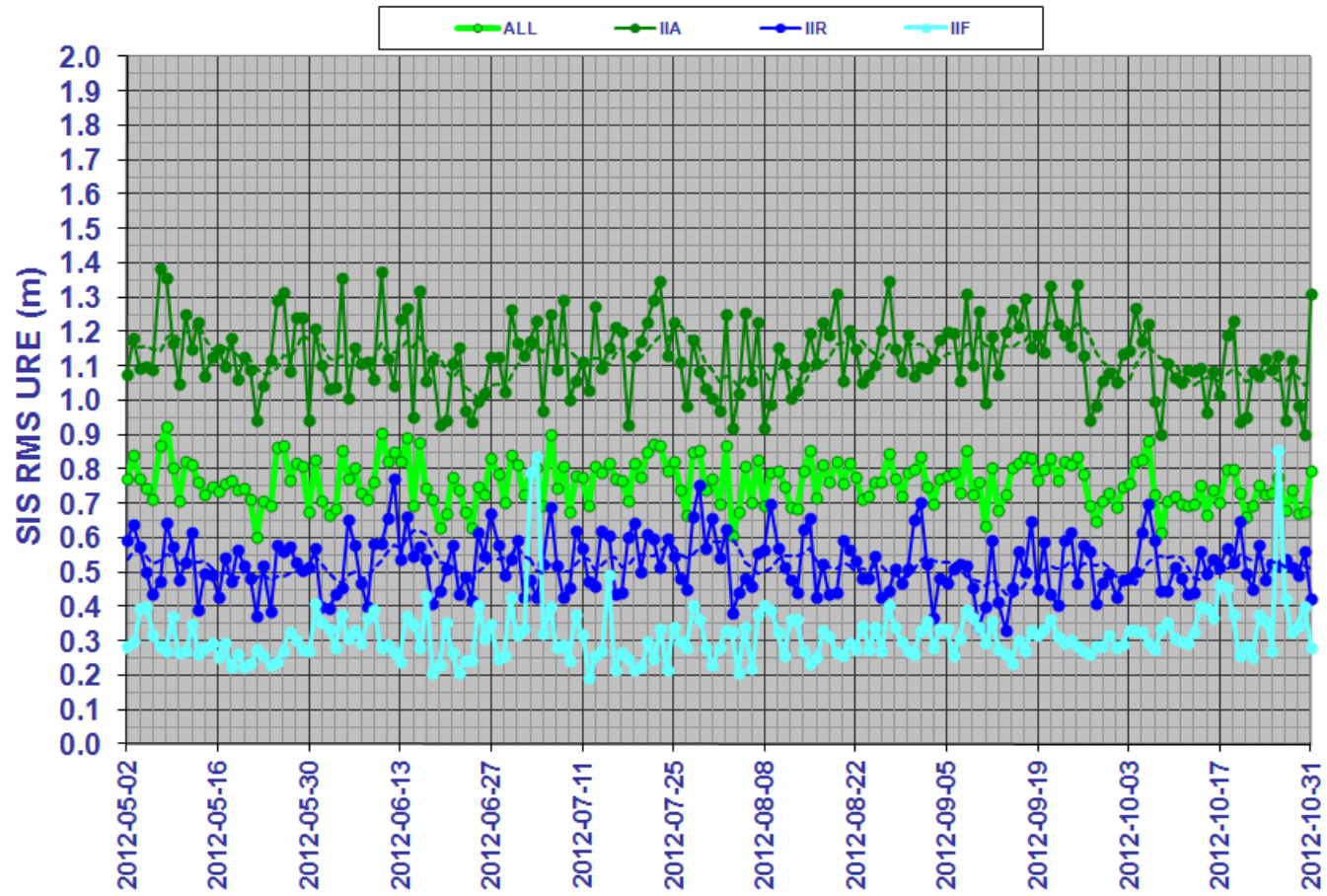


System accuracy exceeds published standard



GPS SIS Performance – Past 6 Months

As-Broadcast SIS vs JPL Real Time





GPS Modernization Program

Legacy Block IIA/IIR

- Single Frequency (L1)
- Coarse acquisition (C/A) code
- Y-Code (L1Y & L2Y)

Block IIR-M

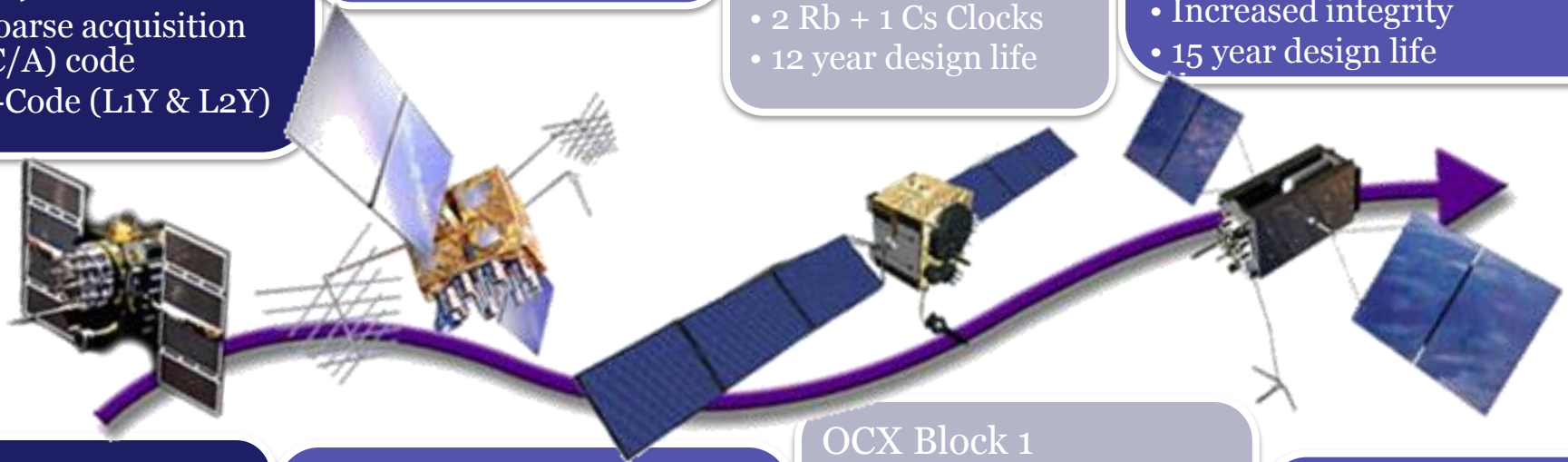
- 2nd Civil Signal (L2C)
- M-Code (L1M & L2M)

Block IIF

- 3rd civil signal (L5)
- 2 Rb + 1 Cs Clocks
- 12 year design life

Block III

- 4th civil signal (L1C)
- 4x better User Range Error than IIF
- Increased availability
- Increased integrity
- 15 year design life



Legacy OCS

- Mainframe system
- Command & Control
- Signal monitoring

AEP

- Distributed architecture
- Increased signal monitoring
- Security
- Accuracy
- Launch and disposal operations

OCX Block 1

- Fly constellation + GPS III
- Begin new signal control
- Upgraded information assurance

OCX Block 2+

- Control all signals
- Capability On-Ramps
- GPS III evolution

Increasing System Capabilities ♦ Increasing User Benefit



Modernized Civil GPS Capabilities

2nd Civil Signal (L2C)

Provide dual-frequency civil navigation and extend GPS availability in challenged environments



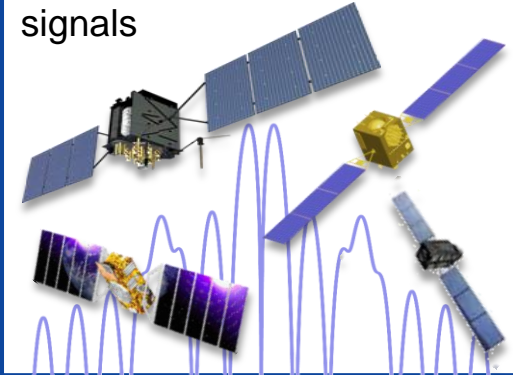
3rd Civil Signal (L5)

Provide dual-frequency and/or triple-frequency civil navigation and safety-of-life signals



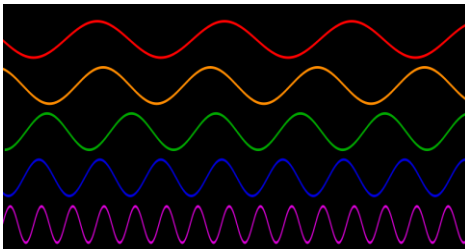
4th Civil Signal (L1C)

Provide internationally harmonized civil navigation signals



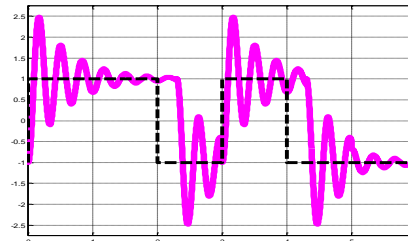
Precision Carrier-Phase Tracking

Dataless pilot channels for precision carrier phase lock loop tracking



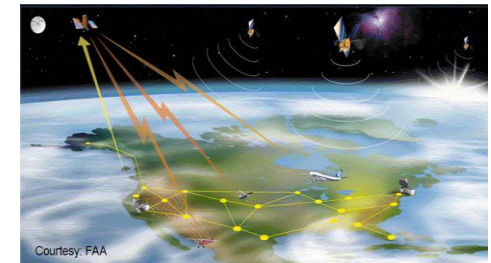
Monitored Integrity

On-board monitoring for clock anomalies, ground monitoring for signal malformation anomalies



External Augmentations

Extend GPS accuracy and integrity for safety-of-life applications



Courtesy, FAA



Summary

- The U.S. supports free access to civilian GNSS signals and all necessary public domain documentation
 - GPS.gov -- official public resource for official U.S. Government information about GPS and related topics
- 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 Air Force on behalf of the USG
- The U.S. policy promotes open competition and market growth for commercial GNSS

*GPS continues to provide
consistent, predictable, dependable performance*



BACKUP SLIDES





GPS.gov



- Migrated PNT.gov website to the new GPS.gov website
- GPS.gov is now a central public resource on Official U.S. Government information about GPS and related topics

The screenshot shows the GPS.gov website homepage. At the top, there is a navigation bar with links for HOME, WHAT'S NEW, SYSTEMS, APPLICATIONS, GOVERNANCE, MULTIMEDIA, and SUPPORT. The main content area features a large article titled "Lost Satellite Reception" with a sub-headline "FCC Steps Up Enforcement Against GPS Jammer Sales". To the left of this article is a sidebar with links for "For General Public", "For News Media", "For Congress", "For Internationals", and "For Professionals". Below the main article, there are three smaller sections: "Get Help with Incorrect Addresses, Maps, and Directions" with a map snippet; "Successful Launch of Third GPS IIF Satellite on Oct 4" with a video player showing a rocket launch; and "GPS User Support" with a "Common Questions" section listing topics like reporting GPS service problems, finding lost phones, and GPS accuracy. The website also includes a search bar and language selection options (English, Español, Français, 中文, العربية).



WAAS Architecture



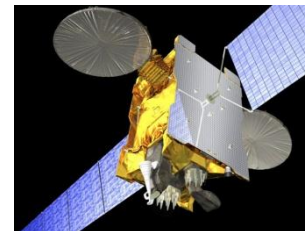
38 Reference Stations



3 Master Stations



6 Ground Earth Stations



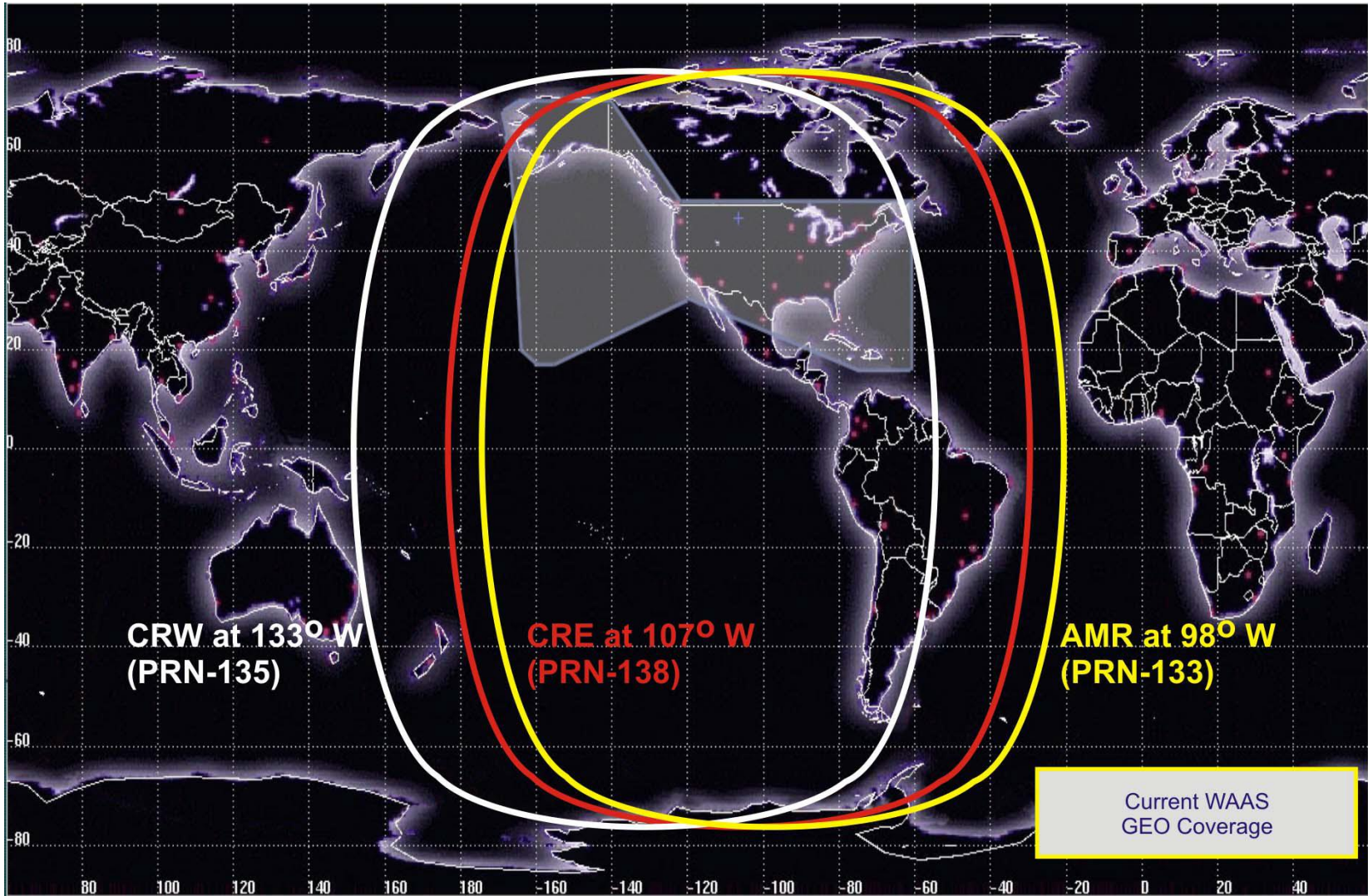
3 Geostationary Satellite Links



2 Operational Control Centers

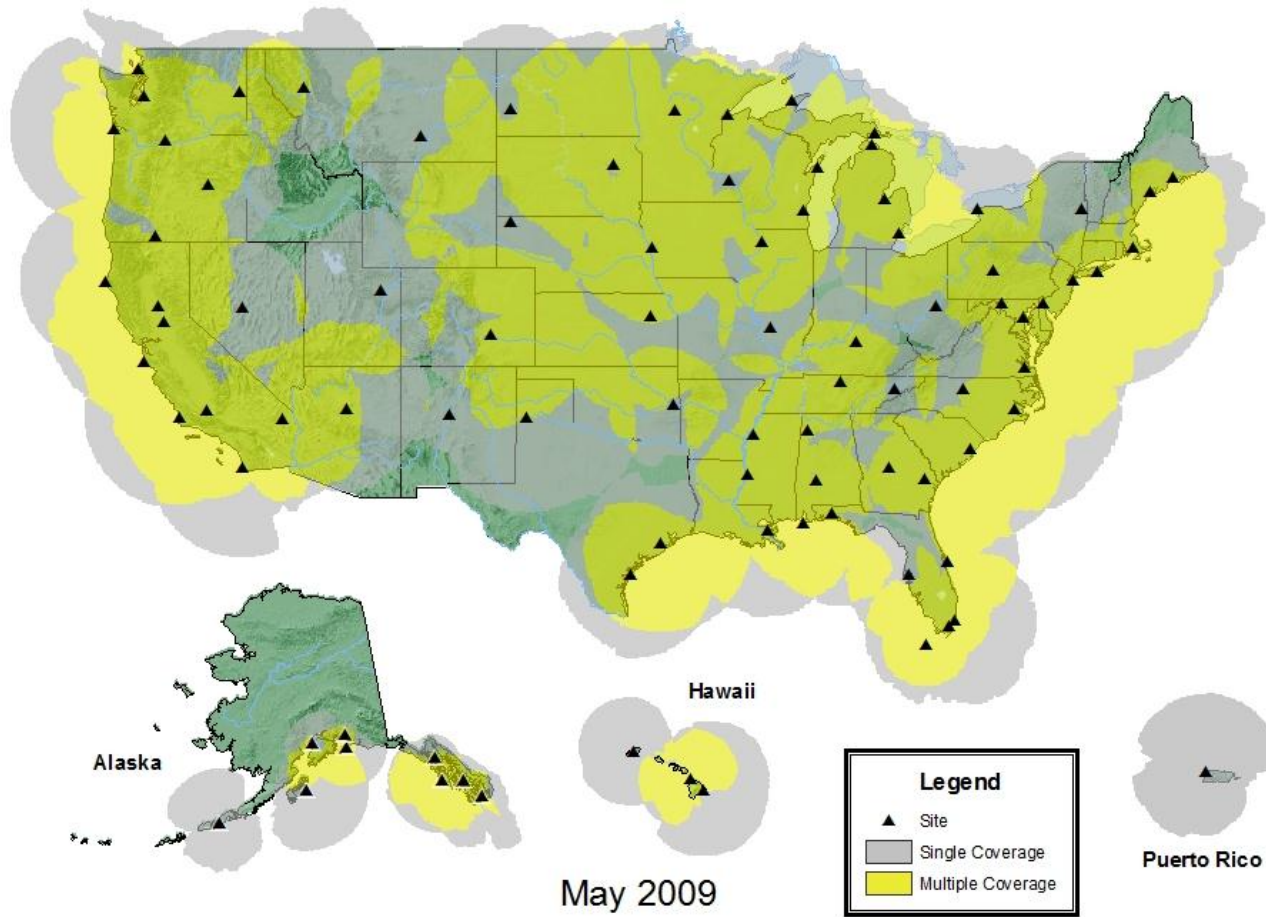


GEO Satellite Coverage Plot





National Differential GPS (NDGPS)



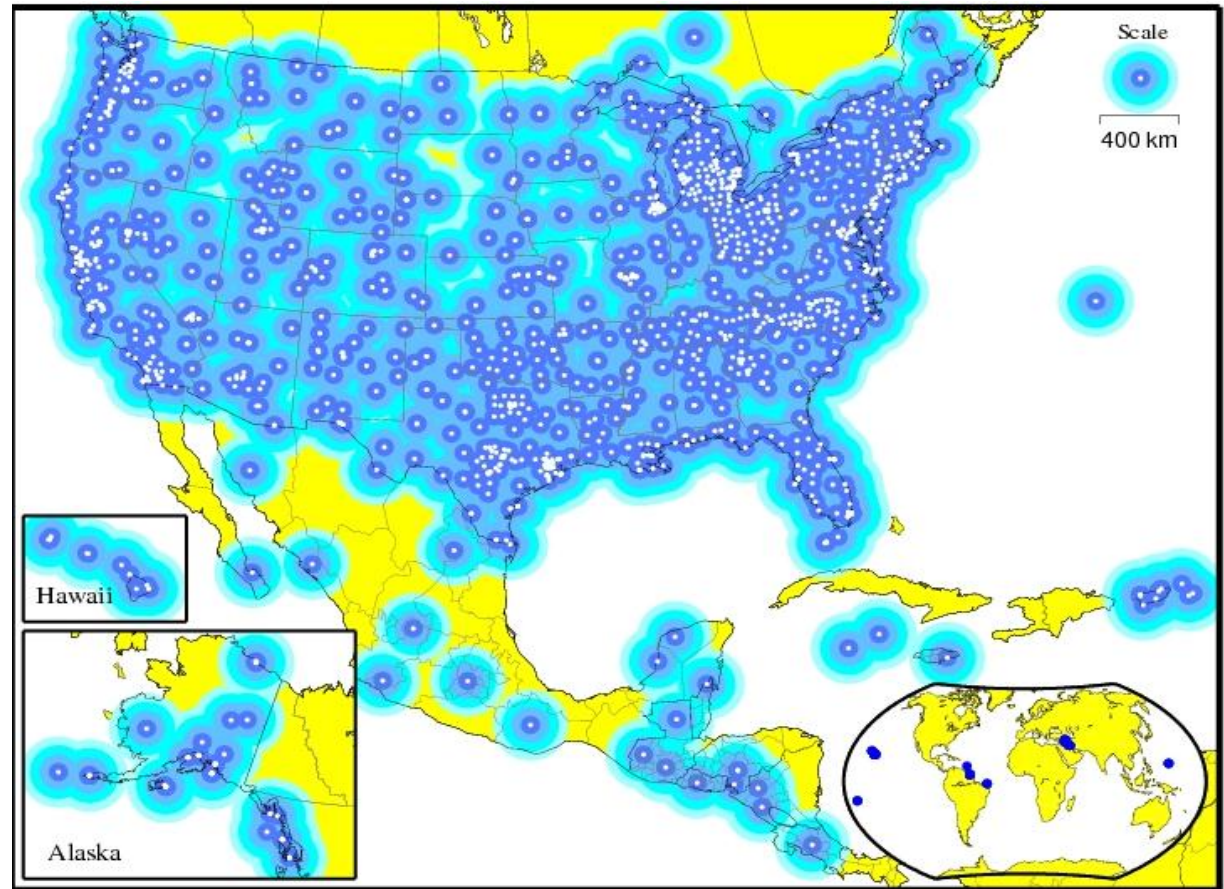


National Continuously Operating Reference Stations (CORS)



Sponsor: NOAA

- 1,900+ sites
- Operated by 200+ academic organizations
- Enables highly accurate, 3-D positioning





Global Differential GPS (GDGPS) and TDRSS Augmentation Service for Satellites (TASS)



Sponsor: NASA

GDGPS: More than 100 real-time tracking sites

- Real-Time Positioning, Timing, and Orbit-Determination

TASS: Future plans to disseminate GDGPS corrections to satellites for autonomous orbit determination and science missions

