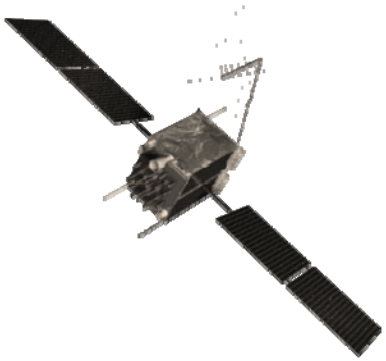
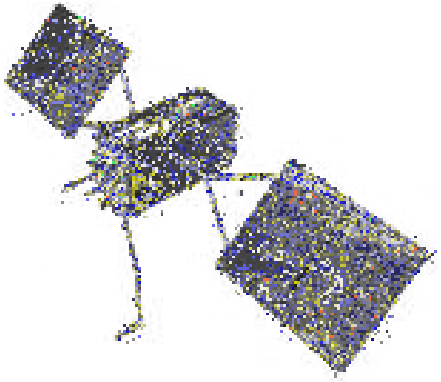
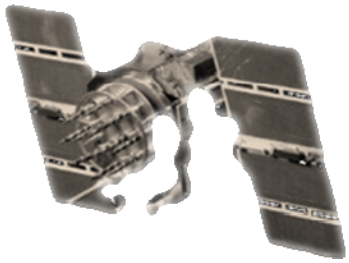


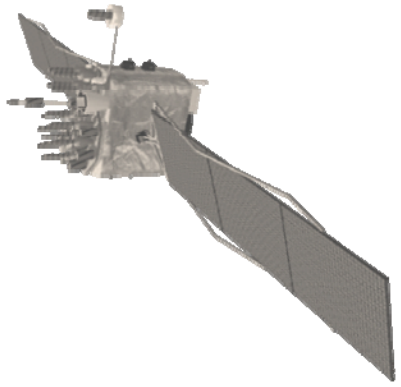




U.S. Space-Based Positioning, Navigation and Timing Policy and Program Update

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

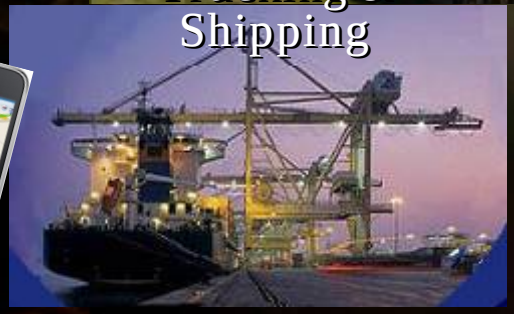
Disease Control

Intelligent Vehicles

TeleComm

Trucking & Shipping

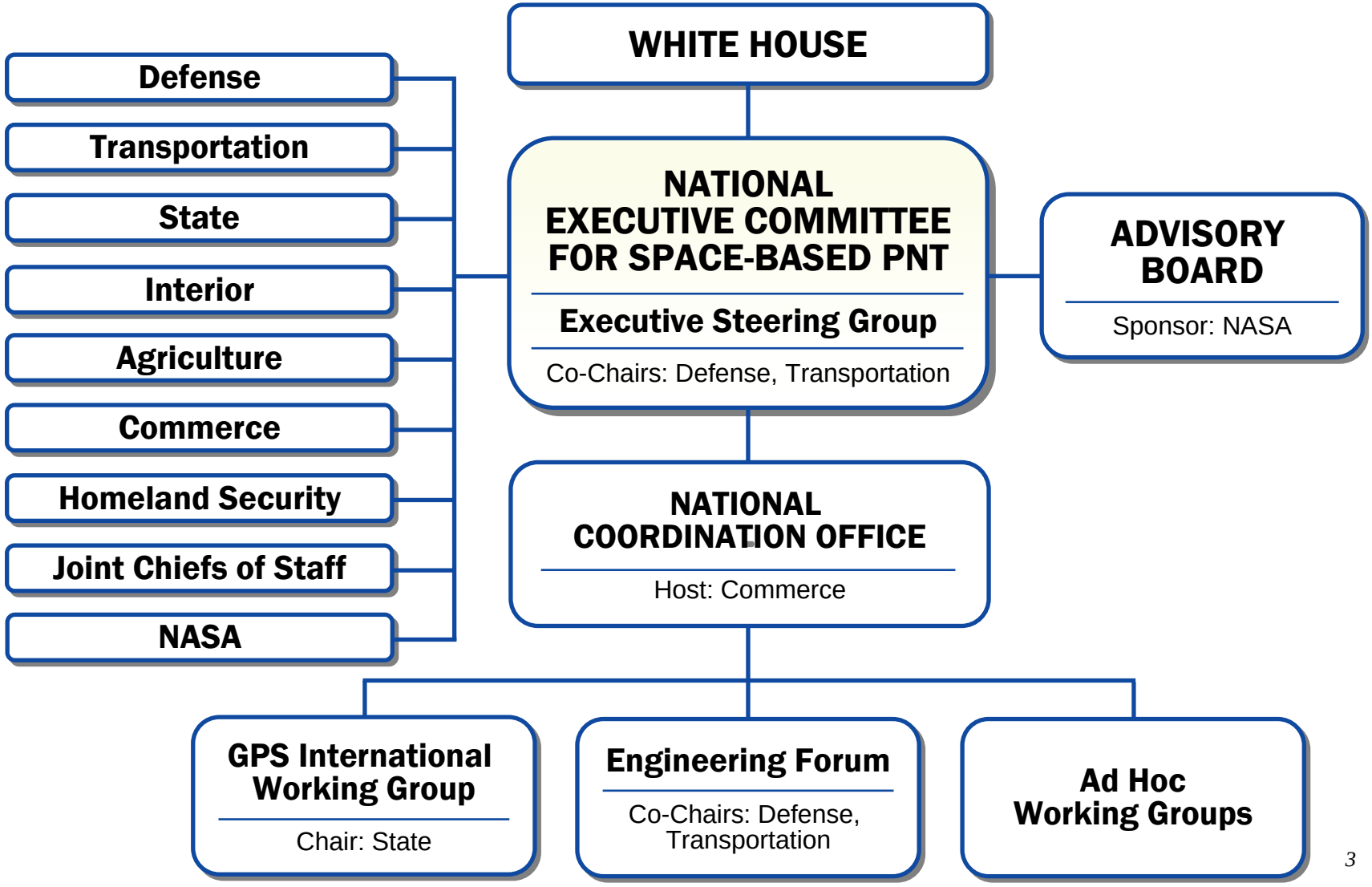
Personal Navigation



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

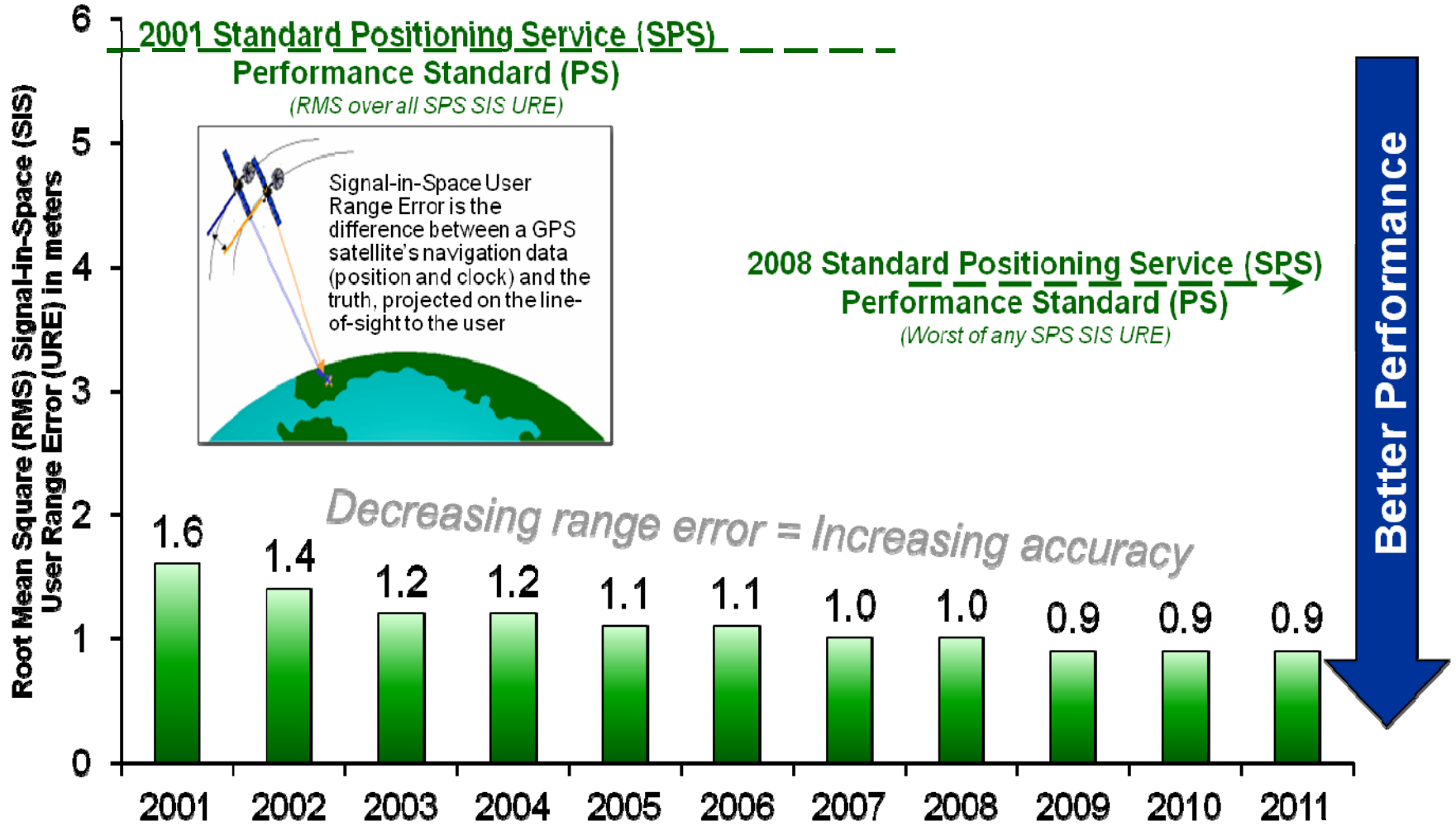
SVN–65 , October 4, 2012

GPS Constellation Status

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

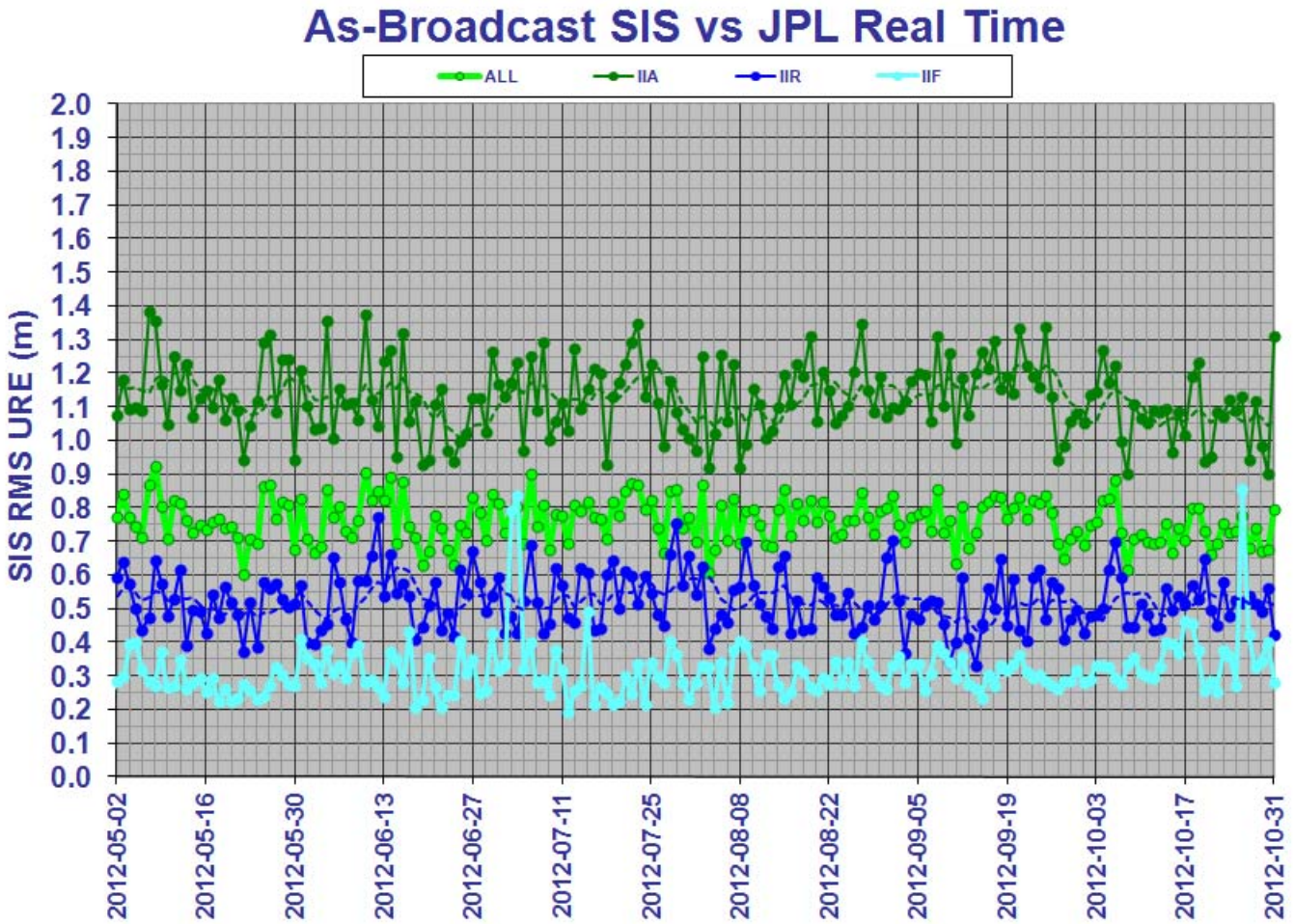
- 12 Block IIA
  - 3 on-orbit in residual status
- 12 Block IIR
- 8 Block IIR-M
  - Transmitting new second civil signal
  - 1 GPS IIR-M in on-orbit testing
- 3 Block IIF
  - SVN-65 operational late 2012
- Global GPS civil service performance commitment met continuously since December 1993

Standard Positioning Service (SPS) Signal-in-Space Performance



System accuracy exceeds published standard

GPS SIS Performance – Past 6 Months



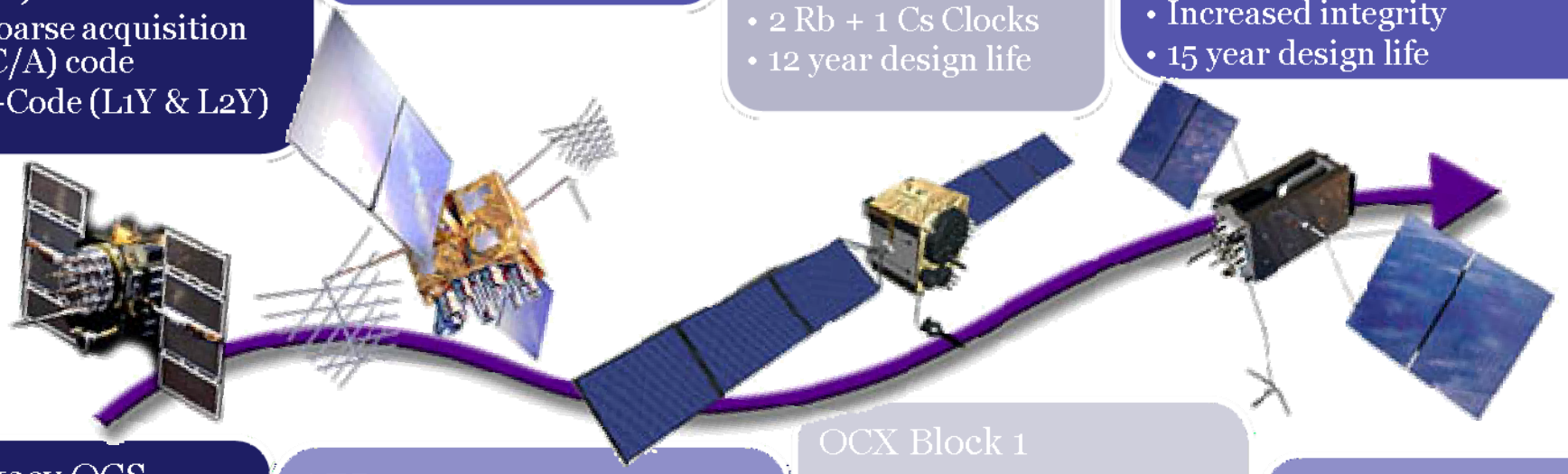
GPS Modernization Program

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)

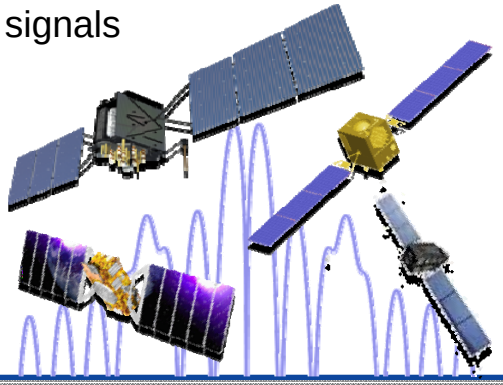
Provide dual-frequency civil navigation and extend GPS availability in challenged environments

3rd Civil Signal (L5)

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

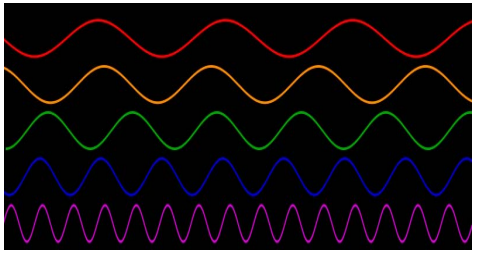
4th Civil Signal (L1C)

Provide internationally harmonized civil navigation signals



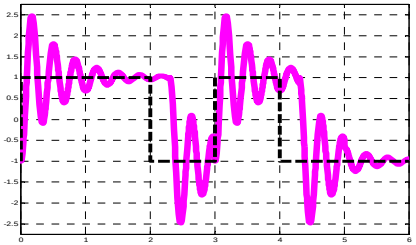
Precision Carrier-Phase Tracking

Dataless pilot channels for precision carrier phase lock loop tracking



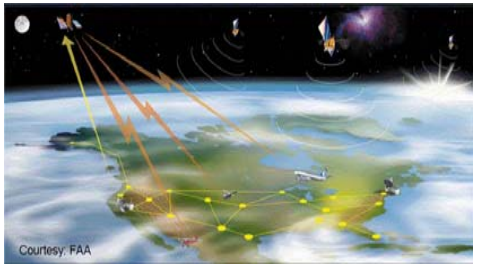
Monitored Integrity

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



External Augmentations

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



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

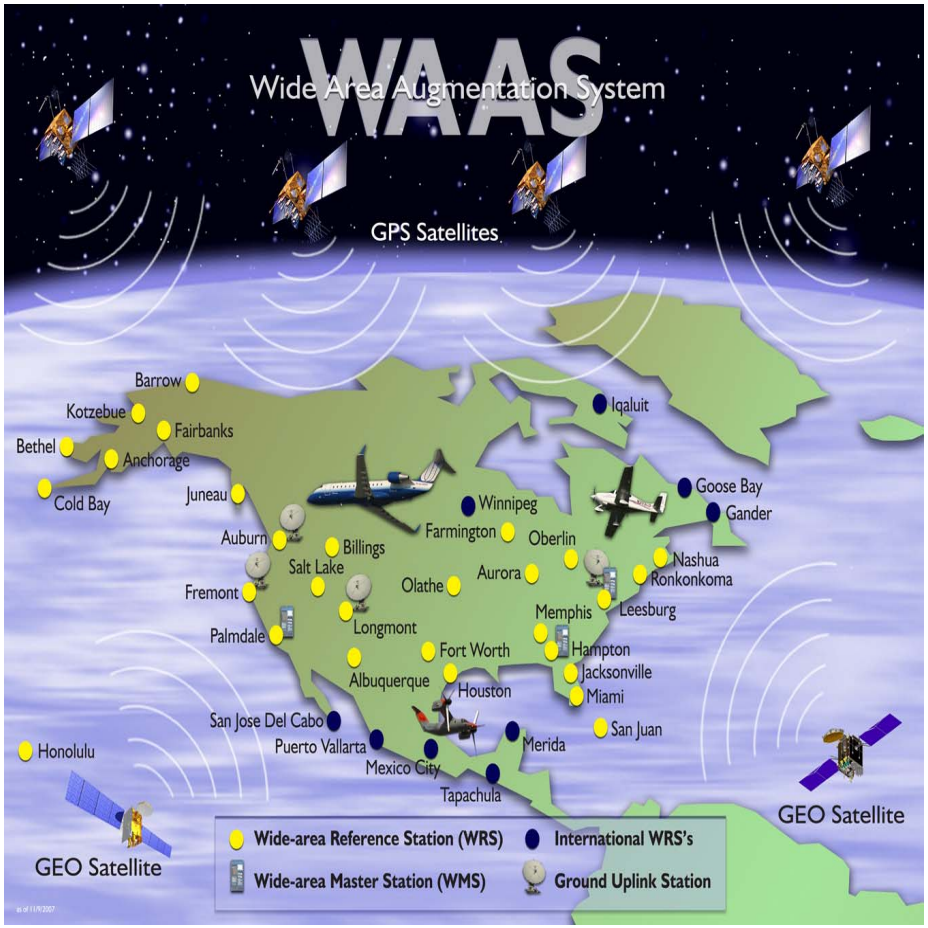
GPS continues to provide consistent, predictable, dependable performance

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

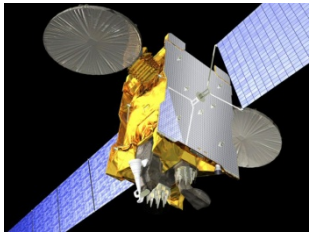
WAAS Architecture



38 Reference Stations

3 Master Stations

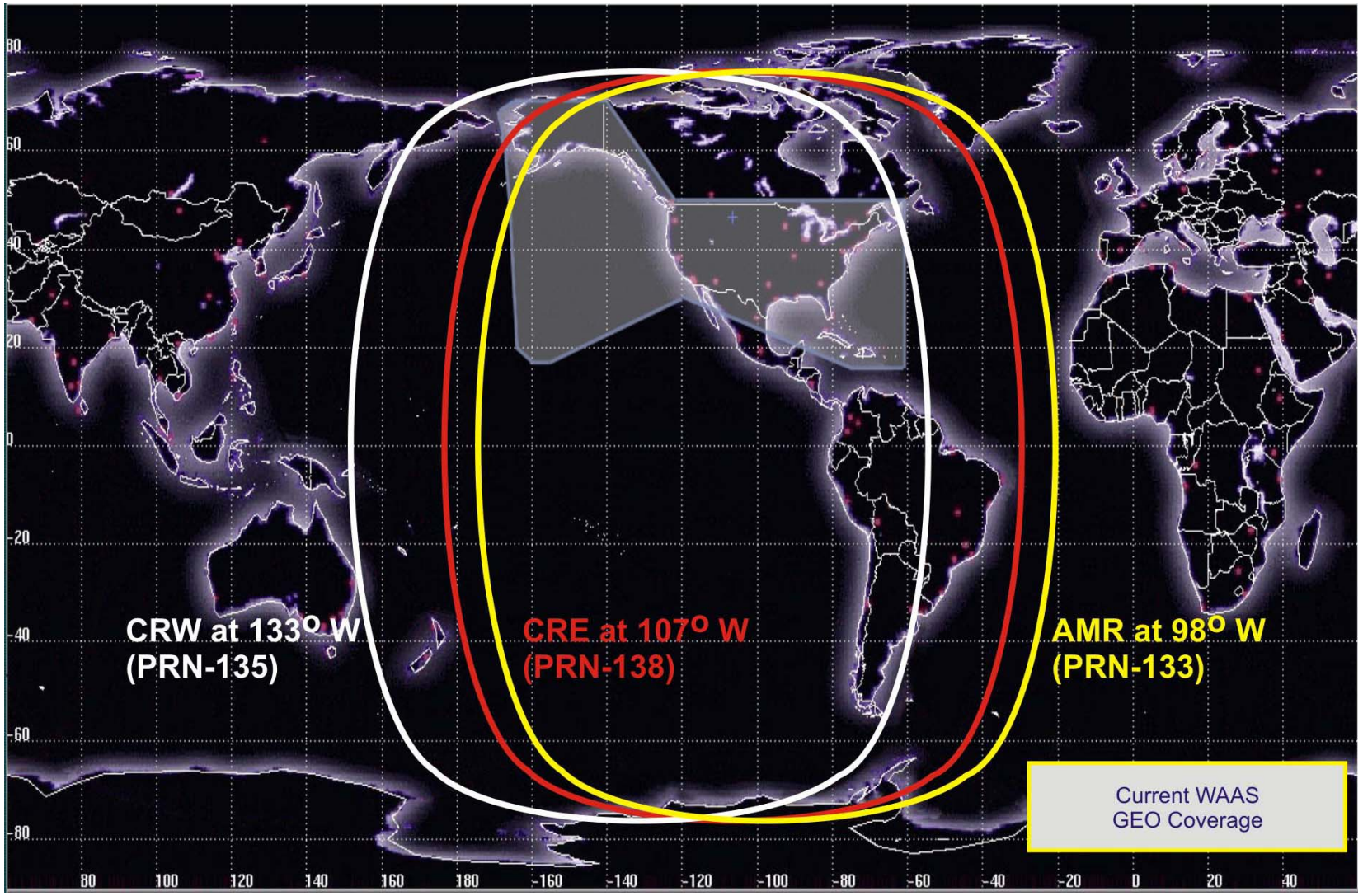
6 Ground Earth Stations



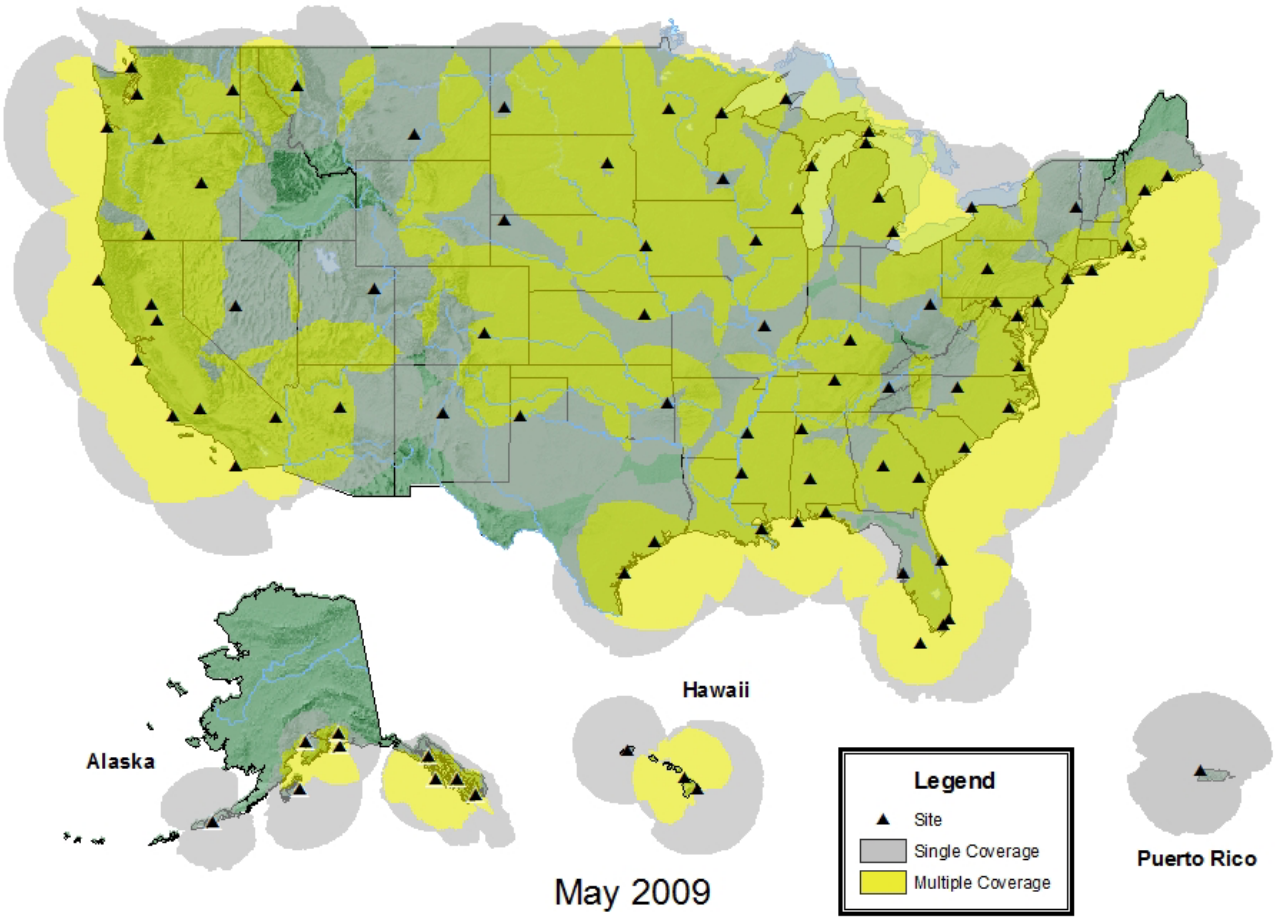
3 Geostationary Satellite Links

2 Operational Control Centers

GEO Satellite Coverage Plot



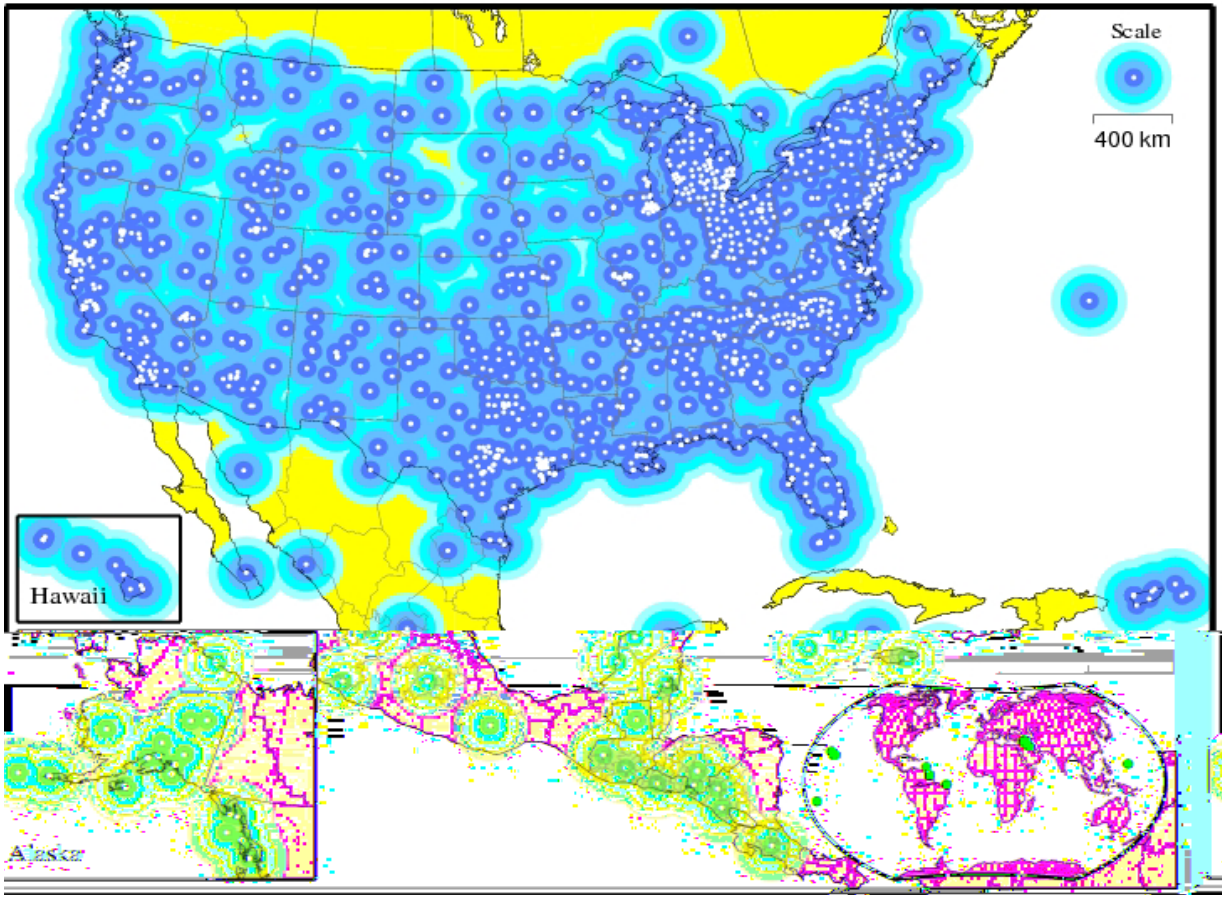
National Differential GPS (NDGPS)



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