

Global Positioning Systems Directorate

GPS Program Update to
8th Stanford PNT Symposium

30 Oct 2014



Col Matt Smitham
Deputy Director, GPS Directorate



Global Positioning Systems Directorate

SPACE AND MISSILE SYSTEMS CENTER

Mission:

Acquire, deliver and sustain reliable GPS capabilities to America's warfighters, our allies, and civil users



Col Bill Cooley



Deliver and Sustain Global Navigation and Timing Service

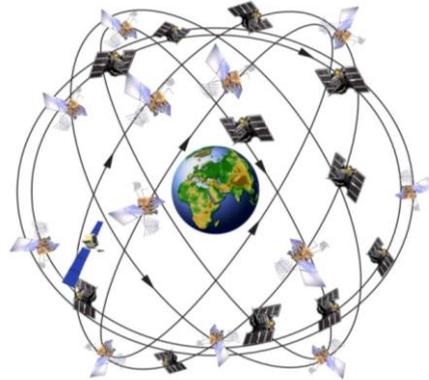


GPS Overview

SPACE AND MISSILE SYSTEMS CENTER

Civil Cooperation

- 1+ Billion civil & commercial users
- Search and Rescue
- Civil Signals
 - L2C (2nd Civil Signal)
 - L5 (Safety of Life)
 - L1C (International)



38 Satellites / 31 Set Healthy

Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age	Oldest
GPS IIA	5	20.5	23.9
GPS IIR	12	12.8	17.2
GPS IIR-M	7	7.2	9.1
GPS IIF	7	1.8	4.4
Constellation	31	10.3	23.9

AS OF 21 OCT 14

Department of Defense

- Services (Army, Navy, AF, USMC)
- Agencies (NGA & DISA)
- US Naval Observatory
- PNT EXCOMS
- GPS Partnership Council

Maintenance/Security

- All Level I and Level II
 - Worldwide Infrastructure
 - NATO Repair Facility
- Develop & Publish ICDs Annually
 - ICWG: Worldwide Involvement
- Update www.GPS.gov Webpage
- Load Operational Software on over 1 million SAASM Receivers
- Distribute PRNs for the World
 - Including 90 for GNSS

Spectrum

- World Radio Conference
- International Telecommunication Union
- Bilateral Agreements
- Adjacent Band Interference

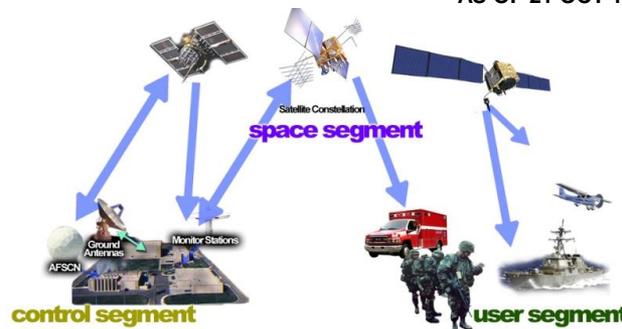


Department of Transportation

- Federal Aviation Administration

Department of Homeland Security

- U.S. Coast Guard



International Cooperation

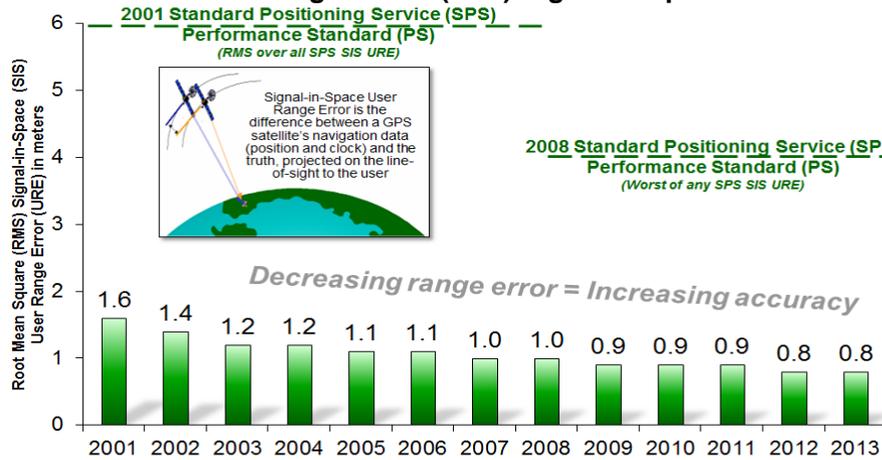
- 57 Authorized Allied Users
 - 25+ Years of Cooperation
- GNSS
 - Russia - GLONASS
 - Europe - Galileo
 - China - BeiDou
 - Japan - QZSS
 - India - IRNSS



GPS Signal-in-Space Performance

SPACE AND MISSILE SYSTEMS CENTER

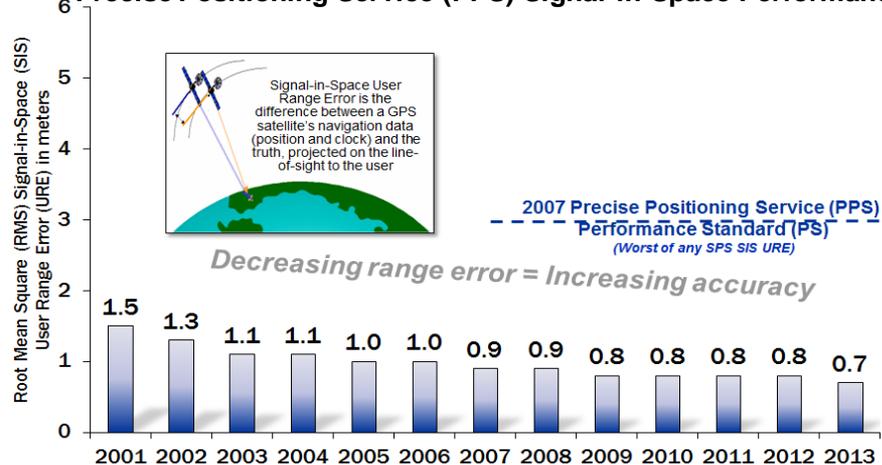
Standard Positioning Service (SPS) Signal-in-Space Performance



Better Performance



Precise Positioning Service (PPS) Signal-in-Space Performance



Better Performance



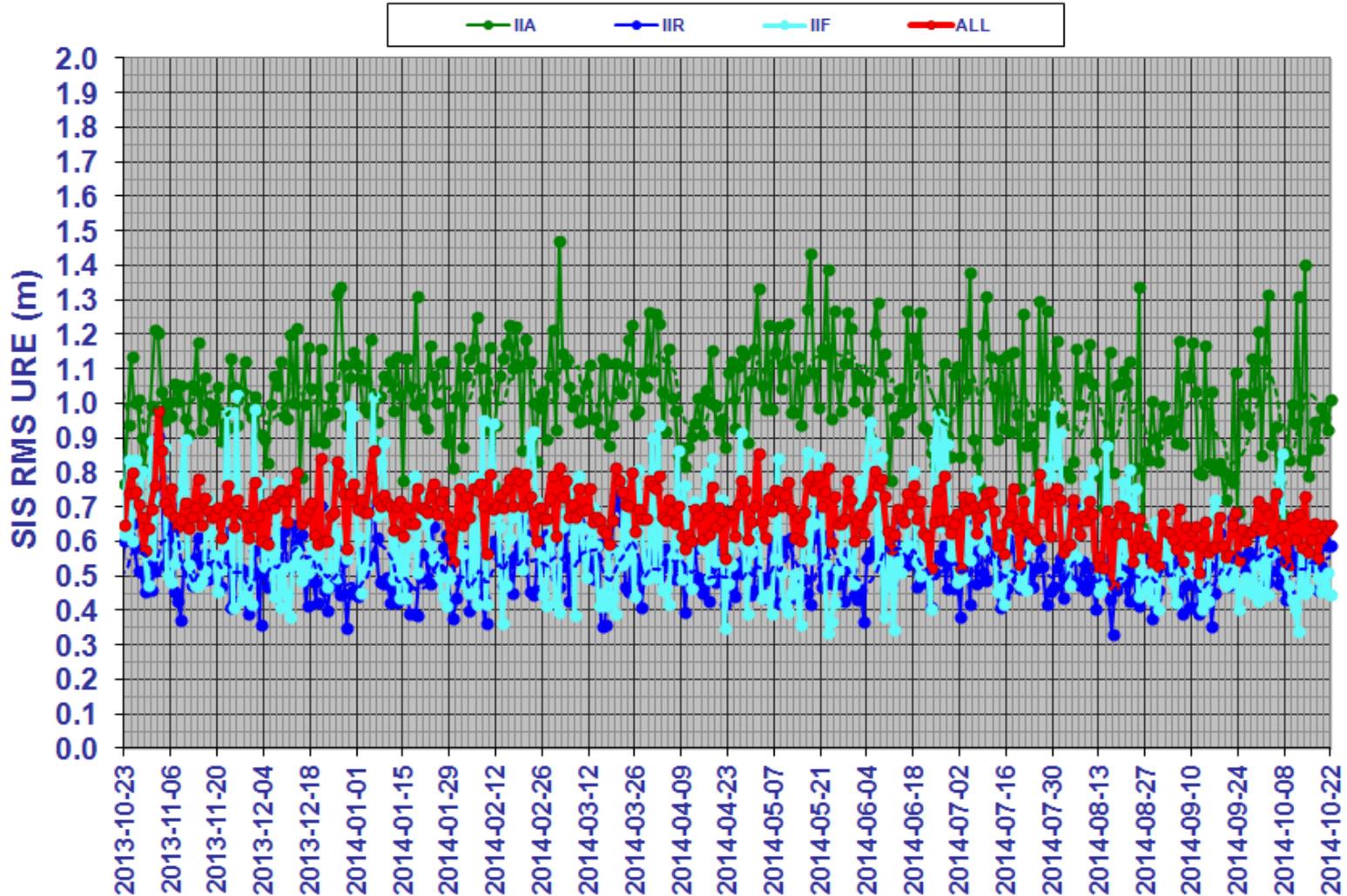
**Best performance 46.6 cm User Range Error (URE) 8 Jun 13;
best weekly average 58.7 cm URE 18 Aug 14!**



GPS Performance – Past 12 Months

SPACE AND MISSILE SYSTEMS CENTER

As-Broadcast SIS vs JPL Real Time





GPS III Status

SPACE AND MISSILE SYSTEMS CENTER

- Newest block of GPS satellites
 - 4 civil and 4 military signals:
L1 C/A, L1C, L2C, L5; L1/L2 P(Y), L1/L2M
 - First satellites to broadcast common L1C signal
 - Three improved Rubidium atomic clocks
- SV07/08 contract awarded 31 Mar 14
- Navigation payload panel began space environment testing at Lockheed Martin's Colorado facility Sep 2014
- GPS III Non-Flight Satellite Testbed accomplished launch processing at Cape Canaveral; reduced risk for integration & test and launch processing
- GPS III SV01 available for launch starting 2016



Lockheed-Martin (Waterton, CO) – Prime



Ground Segment Status

SPACE AND MISSILE SYSTEMS CENTER

- Current system Operational Control Segment (OCS)
 - Flying GPS constellation on Architecture Evolution Plan (AEP) and Launch & Early Orbit, Anomaly, and Disposal Operations (LADO) software systems
 - Cyber security enhancements in progress
- Next Generation Operational Control System (OCX)
 - Modernized command & control system with M-Code, modern civil, signal monitoring, info assurance infrastructure and improved PNT performance
 - OCX Block 0 supports launch & checkout for GPS III and is in integration & test; Raytheon (Aurora, CO) - Prime
 - OCX Block 1 supports transition from OCS in 2018
 - Successfully completed 3 GPS III launch exercises



Monitor Station



Ground Antenna



Now on The Air: Modernized Civil Signals

SPACE AND MISSILE SYSTEMS CENTER

- The United States Air Force initiated continuous CNAV message broadcast (L2C & L5) on 28 Apr 14
- CNAV Data message uploaded twice a week; daily by Dec 2014
- Position accuracy not guaranteed during pre-operational deployment
 - L2C message currently set “healthy”
 - L5 message set “unhealthy” until sufficient monitoring capability established
- Expected Performance for users:
 - During first 24 hours after upload, CNAV performs as LNAV
 - Expect divergence between CNAV & LNAV as CNAV data ages until next CNAV upload



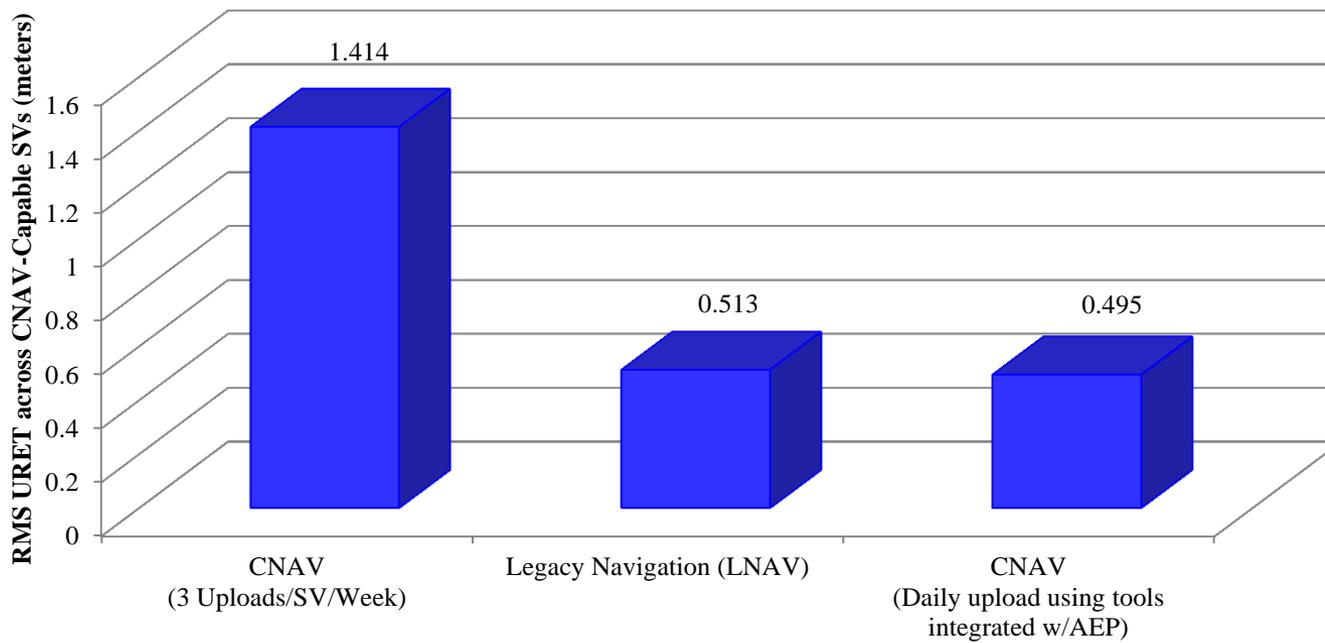


Effect of Upload Frequency on CNAV User Range Error

SPACE AND MISSILE SYSTEMS CENTER

- Improved tools reduce age of data & CNAV User Ranging Error (URE)
- Initial, twice-a-week upload (Apr 2014) drives high CNAV URE

RMS URE Driven by Upload Latency & Integration with AEP



Challenge to the world-wide community: What are you seeing? How are you using these signals? Do these signals impact your use of codeless access?



Questions?

SPACE AND MISSILE SYSTEMS CENTER

The screenshot shows the homepage of GPS.gov. At the top left is the "GPS.GOV" logo. To its right is the text "Official U.S. Government information about the Global Positioning System (GPS) and related topics" and a search box. Below this is a navigation bar with links: Home, What's New, Systems, Applications, Governance, Multimedia, and Support. On the left side, there is a vertical menu with links for "For General Public", "For News Media", "For Congress", "For Internationals", "For Professionals", and "For Education". The main content area features a large banner with a map background and the text "Get Help with Wrong Directions, Missing Locations, etc., on GPS Devices". To the right of the banner is a text block that reads: "Do GPS devices show your home or business in the wrong place? Do they send trucks through your neighborhood? Don't blame the GPS satellites... tell the device/map makers!" with a "GET HELP" button. Below the banner, there are two columns of content. The left column is titled "Feature Stories" and lists three items: "August 1: Third GPS Launch Success of 2014", "FCC Proposes \$34.9M Fine for Signal Jammer Manufacturer", and "Attention Truckers: Do Not Use Consumer GPS Devices". Below this list are links for "VIEW ALL NEWS", "Video Message", and "Common Questions". The right column is titled "New Additions to GPS.gov" and lists three items: "Oct 23: Mobile-friendly media homepage", "Sep 26: Bio of new NCO director", and "Sep 25: Satellite".

GPS.GOV Official U.S. Government information about the Global Positioning System (GPS) and related topics

Search

Home What's New Systems Applications Governance Multimedia Support

For General Public
For News Media
For Congress
For Internationals
For Professionals
For Education

Get Help with Wrong Directions, Missing Locations, etc., on GPS Devices

Do GPS devices show your home or business in the wrong place? Do they send trucks through your neighborhood? Don't blame the GPS satellites... tell the device/map makers!

GET HELP

Feature Stories

- August 1: Third GPS Launch Success of 2014
- FCC Proposes \$34.9M Fine for Signal Jammer Manufacturer
- Attention Truckers: Do Not Use Consumer GPS Devices

[VIEW ALL NEWS](#)
[Video Message](#)
[Common Questions](#)

New Additions to GPS.gov

- Oct 23: Mobile-friendly media homepage
- Sep 26: Bio of new NCO director
- Sep 25: Satellite

For more information, please visit our homepage at www.gps.gov