Global Positioning Systems Directorate

GPS Program Update to CGSIC 2011

20 September 2011

Col Bernard Gruber
Director
GPS Directorate

Global Positioning Systems Directorate

Mission:

Deliver sustained, reliable GPS capabilities to America's warfighters, our allies and civil users

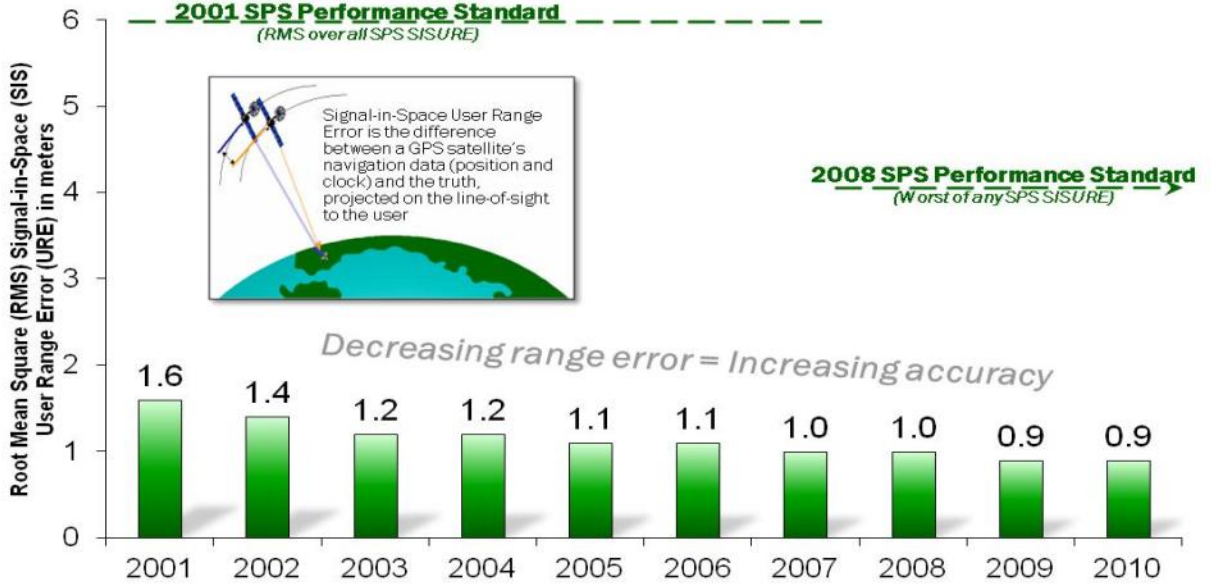
Col Bernie Gruber

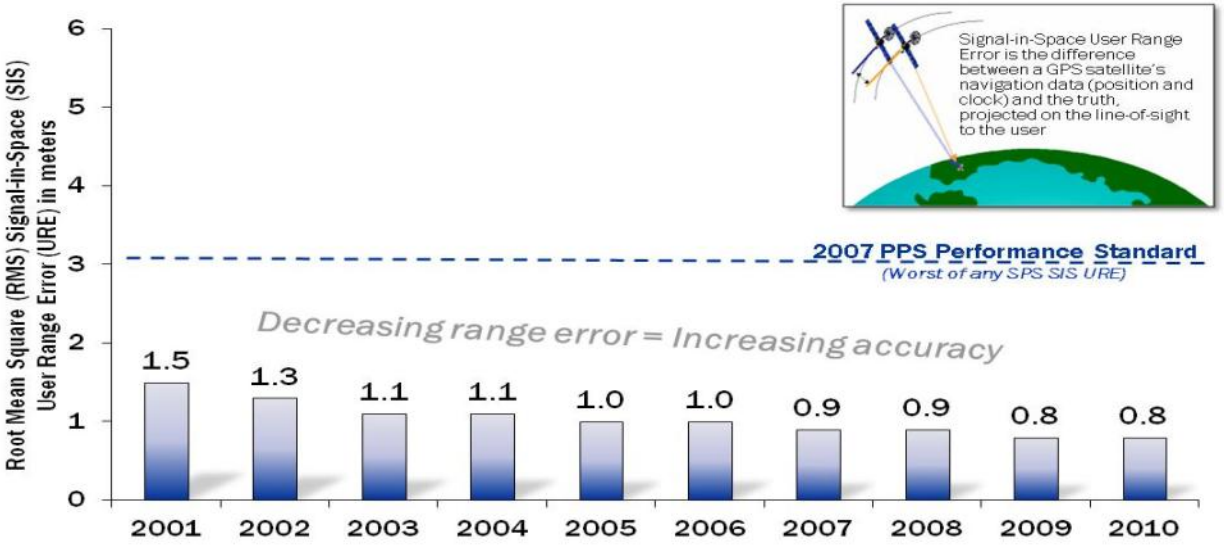
Deliver and Sustain Global Navigation and Timing Service

GPS Constellation

- **Very robust constellation**
  - 30 space vehicles currently in operation
    - 10 GPS IIA, 12 GPS IIR, 7 GPS IIR-M, 1 GPS IIF
  - 4 additional satellites in residual status
  - 1 IIF satellite in test/checkout
- **Extensive International and Civil Cooperation**
  - Agreements with 53 international customers
  - 1+ billion civil/commercial users
  - Countless applications…and growing
- **Global GPS civil service performance commitment met continuously since Dec 1993**

GPS Signal in Space Performance





Precision Agriculture

Mining and Construction

Aviation

Precision Navigation

GPS IIF Status

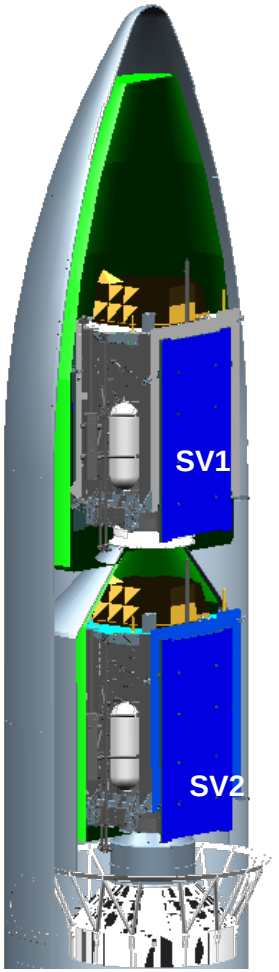
- **Launched GPS IIF-2 on 15 Jul 11**
  - SVN 63, PRN 1
  - Check out phase complete
  - Second operational L5
  - Increases the enhanced GPS clock performance coverage
- **Excellent on-orbit performance**
  - SIS URE of .30 meters (1 yr performance Jul 11)
- **10 more IIFs in the pipeline**
  - SVs 3-6 are in production
- **IIF-3 Initial Launch Capability in Feb 12**

GPS III Status

- **Newest block of GPS satellites**
  - First satellite to broadcast common L1C signal
  - Multiple civil and military signals; L1 C/A, L1 P(Y), L1M, L1C, L2C, L2 P(Y), L2M, L5
  - Three Rubidium clocks
- **Completed Critical Design Review**
- **Completed Independent Program Assessment (Milestone C)**
- **Prototype and engineering unit build/test underway**
  - Completed 54 of 59 Manufacturing Readiness Reviews
  - Completed 32 of 59 Test Readiness Reviews
- **GPS Nonflight Satellite Testbed (GNST) started 1 month early**
- **Manufacturing Readiness Review initiated**
- **Completed System Design Review and initiated Capability Insertion Program for SV-9+**

Dual Launch of GPS III Satellites

- **Dual launch of GPS III satellites could reduce launch costs of GPS III**
- **SMC is exploring the technical feasibility and cost implications of dual manifest launch,**
  - Two studies, a space vehicle (SV) study and a launch vehicle (LV) study, are expected to be complete by Jan 12
- **Initial results indicate dual launch on Atlas V possible with minor updates to GPS III and a new dual-payload adapter**



Notional Dual Launch Configuration on Atlas V 551

Ground Segment Status

Monitor Station

Master Control Stations at Schriever AFB,

Ground Antenna

- **Current system Operational Control Segment (OCS)**
  - Now flying Block IIA/IIR/IIR-M/IIF constellation
  - Added the capability for anomaly resolution and disposal ops for IIF
- **Next Generation Operational Control System (OCX) Phase B continues on track**
  - Integrated Baseline Review completed August 2010
  - Software Specification Review completed September 2010
  - Preliminary Design Review July 2011
  - Milestone B approval expected 1st Qtr 2012
  - OCX Block I deployment planned for 2015

GPS Modernization – New Civil Signals

- **Second civil signal "L2C"**
  - Designed to meet commercial needs
  - Available since 2005 without data message
  - Phased roll-out of CNAV message
  - Full capability: 24 satellites and full CNAV ~2016*

- **Third civil signal "L5"**
  - Designed to meet transportation safety-of-life requirements
  - Uses Aeronautical Radio Navigation Service band
  - 24 satellites and full CNAV ~2020*

- **Fourth civil signal "L1C"**
  - Designed for GNSS interoperability
  - Specification developed in cooperation with industry
  - Launches with GPS III in 2014
  - Available on 24 SVs ~ 2026*
  - Improved tracking performance

Urban Canyons

Improved performance in challenged environments

* FOC dates are based on our best estimate of launch schedule

GPS Program Partnership

- **Civil representatives integral members of GPS team**
  - Resident in the GPS Directorate – DOT (2), FAA (1), NASA (½)

- **Support program, Interface Control Document and Specification reviews**
  - Civil GPS Service Interface Committee (CGSIC)
  - Signal Monitoring Working Group (SMWG)
  - Interface Control Working Group (ICWG)
  - L1C Product Implementation Teams
  - Positioning Signal Integrity and Continuity Assurance (PSICA) Team
  - Interagency Forum for Operational Requirements (IFOR)
  - National Space-Based PNT Engineering Forum (NPEF)

DOT/FAA team critical to GPS modernization success!

GPS Metrics for Alternatives Assessment

- **Performance Metrics generated for multiple constellations**
  - Leveraging existing constellation management tool (GIANT) for our ongoing analysis efforts
- **Assessment in terms of GPS User in various scenarios at the Architecture level**
  - 1. Elevation Masking; 2. Jamming; 3. Precision Approach
- **Focusing on core metrics associated with:**
  - ✓ **Availability:** **How often is signal available to the user?**
  - ✓ **Accuracy:** **What 3-D position accuracy will the user achieve?**
  - ✓ **Robustness:** **What is the range to denied areas?**

	GPS Performance Metrics		
Scenarios	**Availability**	**Accuracy**	**Robustness**
Elevation Mask (5˚ & 30˚)			NA
Jammer Power (10W, 50W & 100W)	NA	NA	
Precision Approach	NA		NA

Approach provides a more universal way of assessing alternatives

Acquisition Opportunities

- **Released GPS Enterprise Modernization Research and Prototype Demonstration "Broad Agency Announcement" – 22 Aug 11**
  - Soliciting proposals for research and prototypes of GPS capabilities
  - Released thru Space and Naval Warfare Systems Center, Pacific
  - Specific areas of interest include:
    - Information Assurance
    - Advanced Integrity
    - Software Defined Radios
    - GPS Alternative Architectures

Resiliency / Affordability

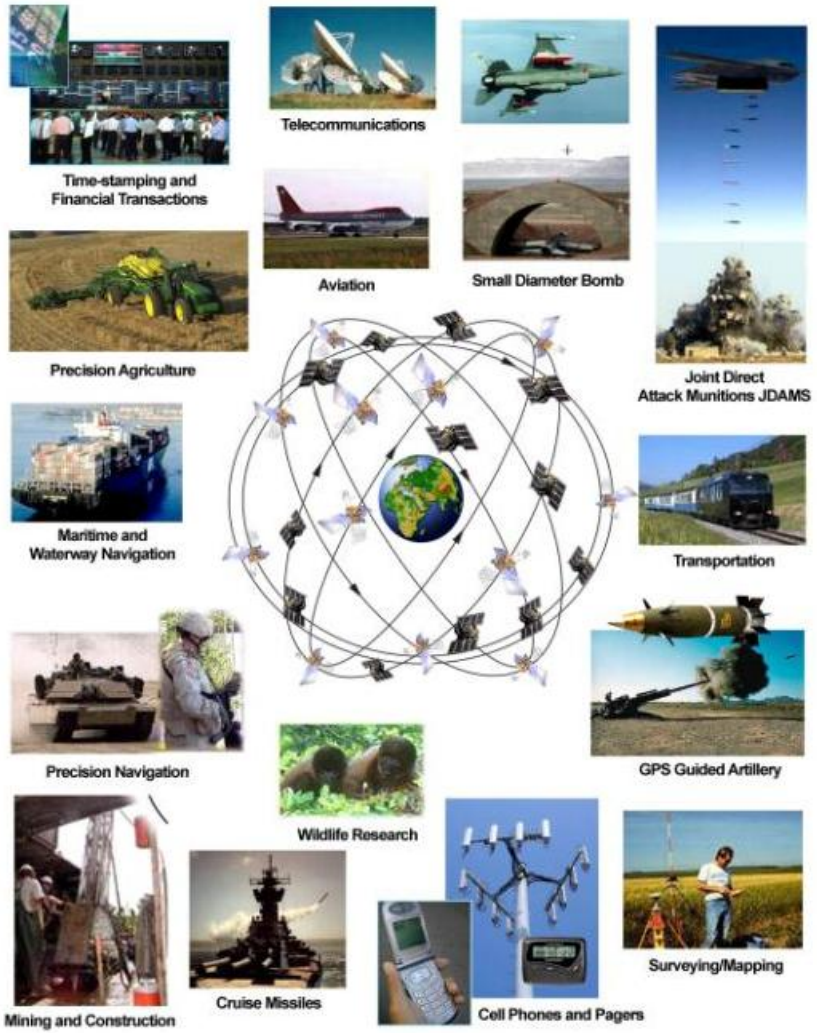
- **GPS Systems Engineering & Integration support**
  - Industry Day held Aug 11
  - Refining acquisition strategy
  - Targeting Industry comments on Draft Request for Proposal (RFP) 1QFY12
  - Estimated RFP release in 2QFY12

LightSquared (LSQ) Status

- **LSQ proposed open wireless broadband network adjacent to GPS L1**
  - Offering terrestrial 4G service – 34,000+ ATCs across the U.S.A.
- **FCC granted conditional waiver to LSQ – 26 Jan 11**
  - Required LSQ study GPS overload and interference prevention NLT 15 Jun 11
- **Supports National Broadband Plan – find 500 MHz for wireless broadband**
- **Numerous organizations conducted testing - all indicated interference**
  - National Space-Based PNT Engineering Forum Test Report - 1 Jun 11
  - Radio Technical Commission for Aeronautics Report - 26 May 11
  - Numerous separate filings with FCC by Industry
- **LSQ/GPS Industry Council Tech Working Group Report submitted - 30 Jun 11**
- **LSQ proposing "10 Low" implementation as alternative**
- **NTIA requesting additional testing be conducted by 30 Nov 11**
- **Directorate working with DoD and Civil agencies to develop execution plan**

Summary

- GPS has continuously met its commitments to all users
- GPS had multiple operational and acquisition successes in the past year
- Modernization of all GPS Segments is on track
- Striving to continually improve navigation and timing services while maintaining backward compatibility with legacy equipment



Maintaining And Improving GPS Services For All Users Is Job #1

Backup

New Certification Paradigm

- **2009 - Receiver problems experienced during segment upgrades**
  - Problems traced to non-ICD compliant User Equipment
    - Incorrect implementation/interpretation of interface specifications
- **Developing DoD "Performance Certification" strategy**
  - Will determine efficient "Mother of all Test Vector (MTV)" approach to verify Signal-in-Space ICDs
  - Final certifying authority will reside either within the directorate or be an independent 3rd party (Underwriter Laboratories construct) organization
  - Clarifying business case for both options
- **Implementing actions**
  - Seeking stakeholder feedback prior to final 'certification design'
  - Will result in new DoD-Instruction (possibly encompassing both security and performance certification)

ICD Compliance is Critical for GNSS Success

Military User Segment Status

- **Delivered 447,333 GPS handhelds receivers**
  - Accelerated fielding to US + allies (6 months ahead of schedule)
  - Program transitioning to sustainment
- **Fielded over 94,000 embedded GPS military receiver for US and allied nations**
- **Military GPS User Equipment (MGUE) Program**
  - 3 Prototypes complete; government testing underway
  - Ongoing ACAT 1D receiver program
  - Completed MGUE Industry Day




Performance Standard Update

- **Planning a draft update of the Open Access Service Performance (OAS PS) Standard by the end of CY11**
  - Name changed from "Standard Positioning Service Performance Standard" (SPS PS)
  - Addition of L2C signal to current L1 C/A signal
  - Same performance values
  - Draft update will be circulated for review & comment within U.S. Government
  - SPS PS update approval before Initial Operational Capability (IOC) declaration for L2C
- **Planning subsequent draft updates for L5 signal & for L1C signal**
  - Prior to each subsequent IOC declaration
- **Developing an updated set of performance metrics**
  - Include different user applications and terrain environments