



U.S. AIR FORCE

GPS Status and Modernization

***ICG WG-A
Vienna, Austria
30 July 2009***

Lt Col Pat Harrington, US Air Force



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Overview

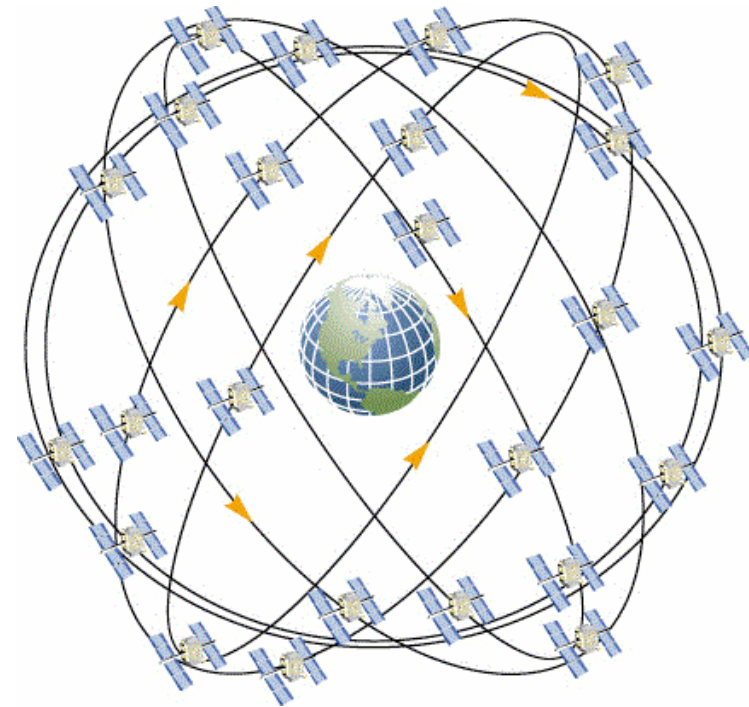
- **GPS Overview**
- **Recent Events**
- **Modernization Improvements**
- **Summary**



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GPS Constellation

- **Six planes**
- **55° inclination**
- **20,000 km altitude**
- **12-hour orbits**
- **Twenty-four primary slots**





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GPS Ground Segment



L-Band



S-Band



■ MCS at Schriever AFB, CO
& Alternate MCS at VAFB

● 16 Monitor Stations
6 OCS + 10 NGA

▲ 12 Ground Antennas
4 GPS + 8 AFSCN



■ MCS Master Control Station Schriever AFB	■ AMCS Alternate MCS Vandenberg AFB
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▲ GPS Ground Antennas
▲ AFSCN Remote Tracking Stations



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USG Commitment to GPS

- **24 Operational Satellites 95% (averaged over any day)**
- **21 of 24 Plane/Slot Positions Must Be Set Healthy and Transmitting a Navigation Signal With 98% Probability (averaged yearly)**
- **4 Meter User Range Error (URE)**
- **10⁻⁵ Integrity**

GLOBAL POSITIONING SYSTEM
STANDARD POSITIONING SERVICE
PERFORMANCE STANDARD



4th Edition

September 2008

Integrity - Service - Excellence

Distribution Statement A. Approved for public release; distribution is unlimited.



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GPS – Serving the World

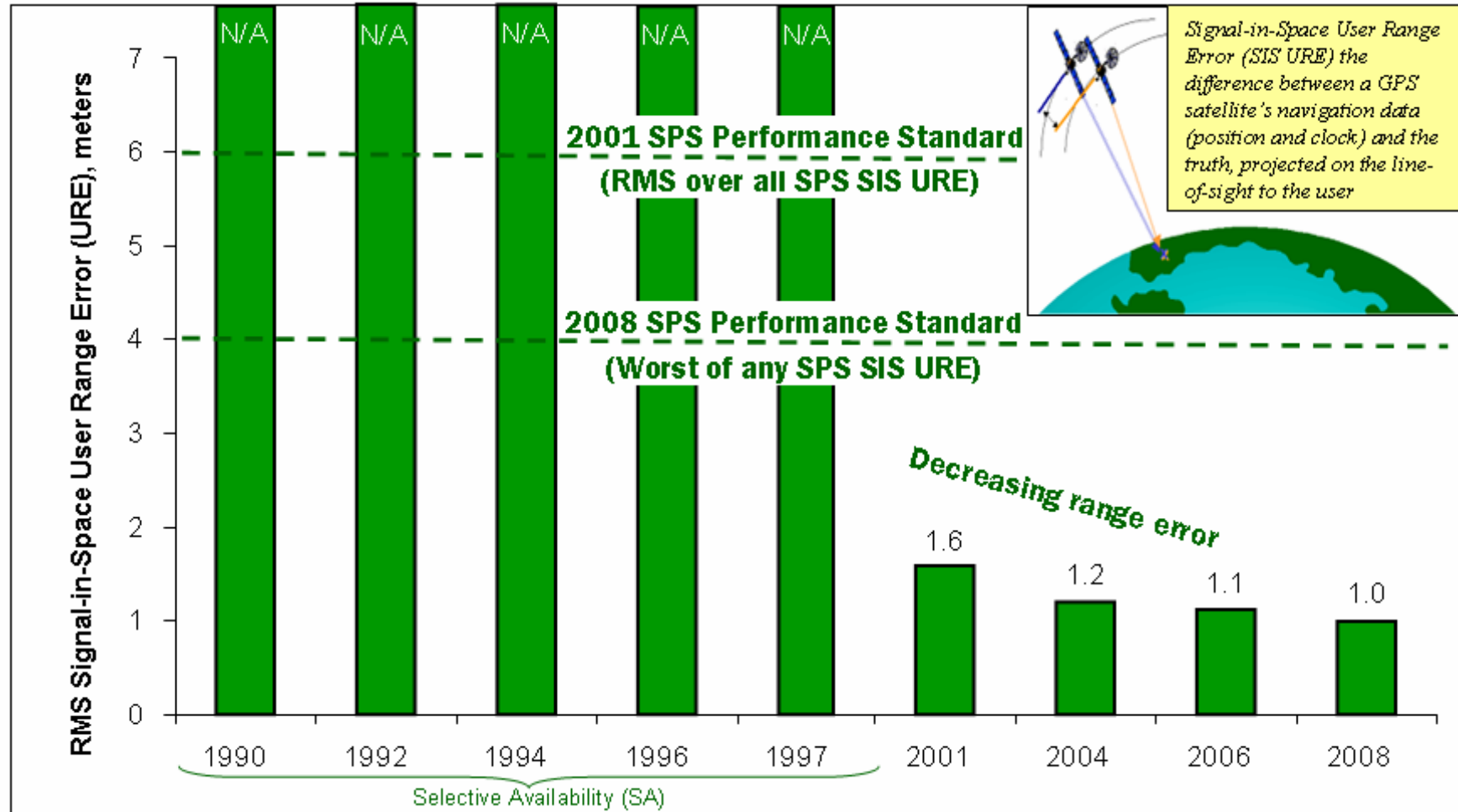
- **Constellation – the largest ever - 30 Healthy Satellites**
 - 12 Block IIA
 - 12 Block IIR
 - 6 Block IIR-M
- **Residual Satellites**
 - 3 Block IIA
- **Most Recent Launch**
 - IIR-20(M) or SVN 49– 7th modernized SV
 - Launched 24 Mar 09
 - First Transmission of L5, Apr 09
 - In on-orbit testing
- **Next Launches**
 - IIR-21(M) – Aug 09
 - IIF-1 – Early CY10





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SPS Signal in Space Performance

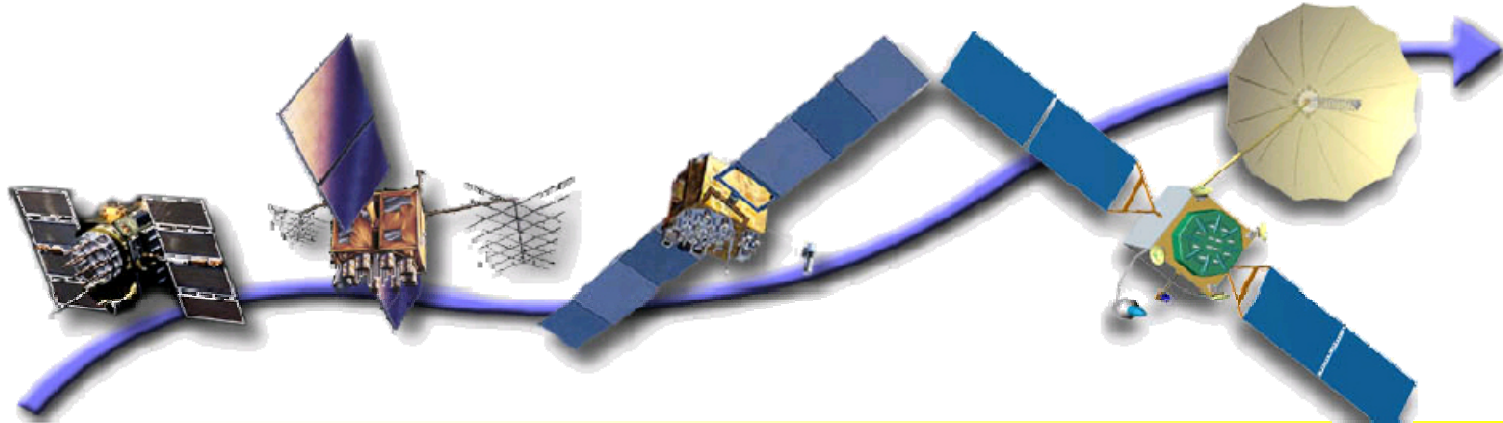


System accuracy exceeds published standard



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GPS Modernization Program



Increasing System Capabilities ♦ Increasing Defense / Civil 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: IIA/IIR capabilities plus

- 2nd civil signal (L2C)
- M-Code (L1M & L2M)

IIF: IIR-M capability plus

- 3rd civil signal (L5)
- 12 year design life

Block III

- Backward compatibility
- 4th civil signal (L1C)
- Increased availability of accuracy
- Increased integrity



GPS Modernization – New Civil Signals

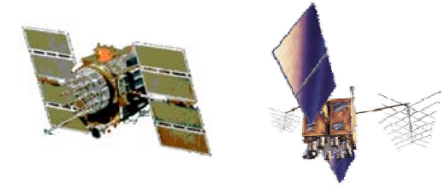
- **Second civil signal “L2C”**
 - **Designed to meet commercial needs**
 - **Higher accuracy through ionospheric correction**
 - **1st launch: Dec 2005 (GPS IIR-M); 24 satellites: ~2016**
- **Third civil signal “L5”**
 - **Designed to meet demanding requirements for transportation safety-of-life**
 - **Brought into use: 24 Mar 09 (IIR-M(20));**
 - **1st IIF launch: Early CY10; 24 satellites: ~2018**
- **Fourth civil signal “L1C”**
 - **Designed with international partners for GNSS interoperability**
 - **Begins with GPS Block III**
 - **1st launch: ~2014; 24 satellites: ~2021**



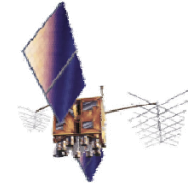
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GPS – Spectrum

Block IIA 1990 Block IIR 1997



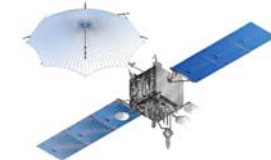
Block IIR-M, 2005



Block IIF, 2009

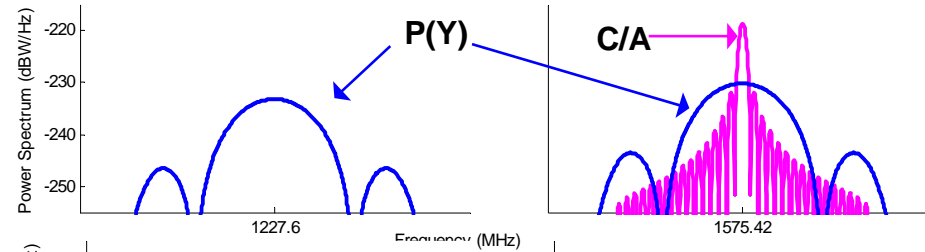


Block III, 2014

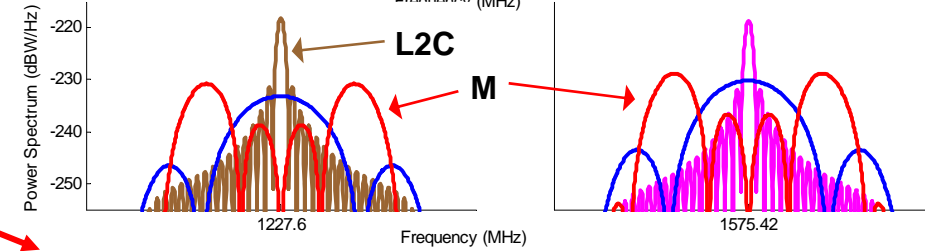


(artist's concept)

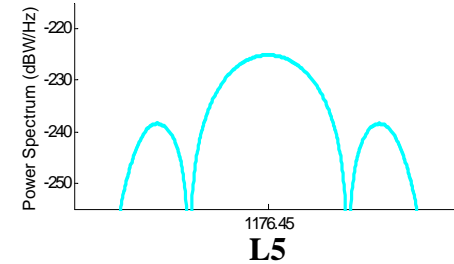
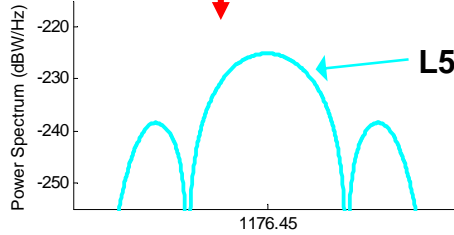
Previous



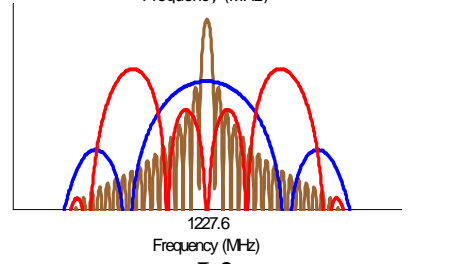
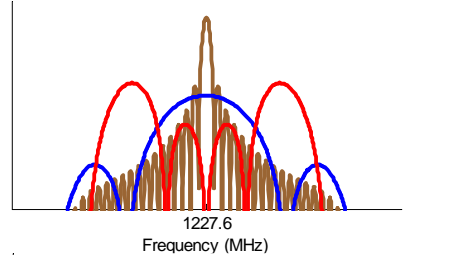
Since Dec 2005 (6 SVs)



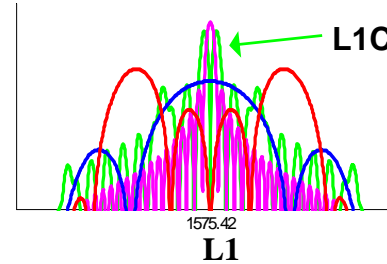
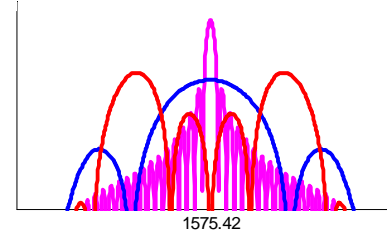
Planned



RNSS Band



RNSS Band



RNSS Band



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GPS Modernization – Ground

- **Architecture Evolution Plan (AEP)**
 - **Transitioned in 2007**
 - **Modern distributed system replaced 1970's era mainframe**
 - **Increased capacity for monitoring of GPS signals to 100% worldwide coverage (was 96.4%) and have 99.8% of world double covered**
 - **Increased worldwide commanding capability from 92.7% to 94.5% while providing nearly double the backup capability**

- **Next Generation Operational Control Segment (OCX)**
 - **Enables modernized navigation related messaging**
 - **Controls more capable GPS constellation**
 - **Monitors all GPS signals**
 - **Two development contracts awarded – Nov 07**
 - **Down select of contract in 2009**



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Summary

- **Largest constellation in history with best accuracy ever**
- **Modernized Command and Control System allows more signal monitoring and quicker satellite commanding than ever before**
- **And we're continuing to modernize and improve GPS even more!**

GPS – Serving the World