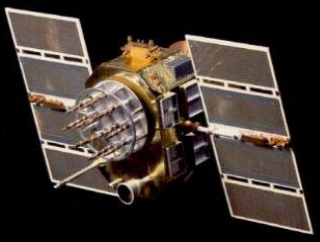


Global Positioning System
Policy and Modernization Status

UN/US International Meeting on
The Use and Applications of Global Navigation Satellite Systems

Vienna, Austria

December 13-17, 2004

David A. Turner
IGEB Executive Secretariat
U.S. Department of Commerce/NOAA

Overview

- **Policy**
- **System Status**
- **Modernization**
- **Summary**

Policy Principles

- **No direct user fees** for civil GPS services
- **Protect** the current radionavigation spectrum **from disruption and interference**
- **Open public signal structure** for all civil services
  - Promotes equal access for user equipment manufacture, applications development and value-added services
  - Ensures **open market** driven competition
- **Global compatibility & interoperability** of future systems with GPS
  - Use of GPS time, geodesy, and signal **standards**
- Recognition of **national and international security** issues and protecting against misuse

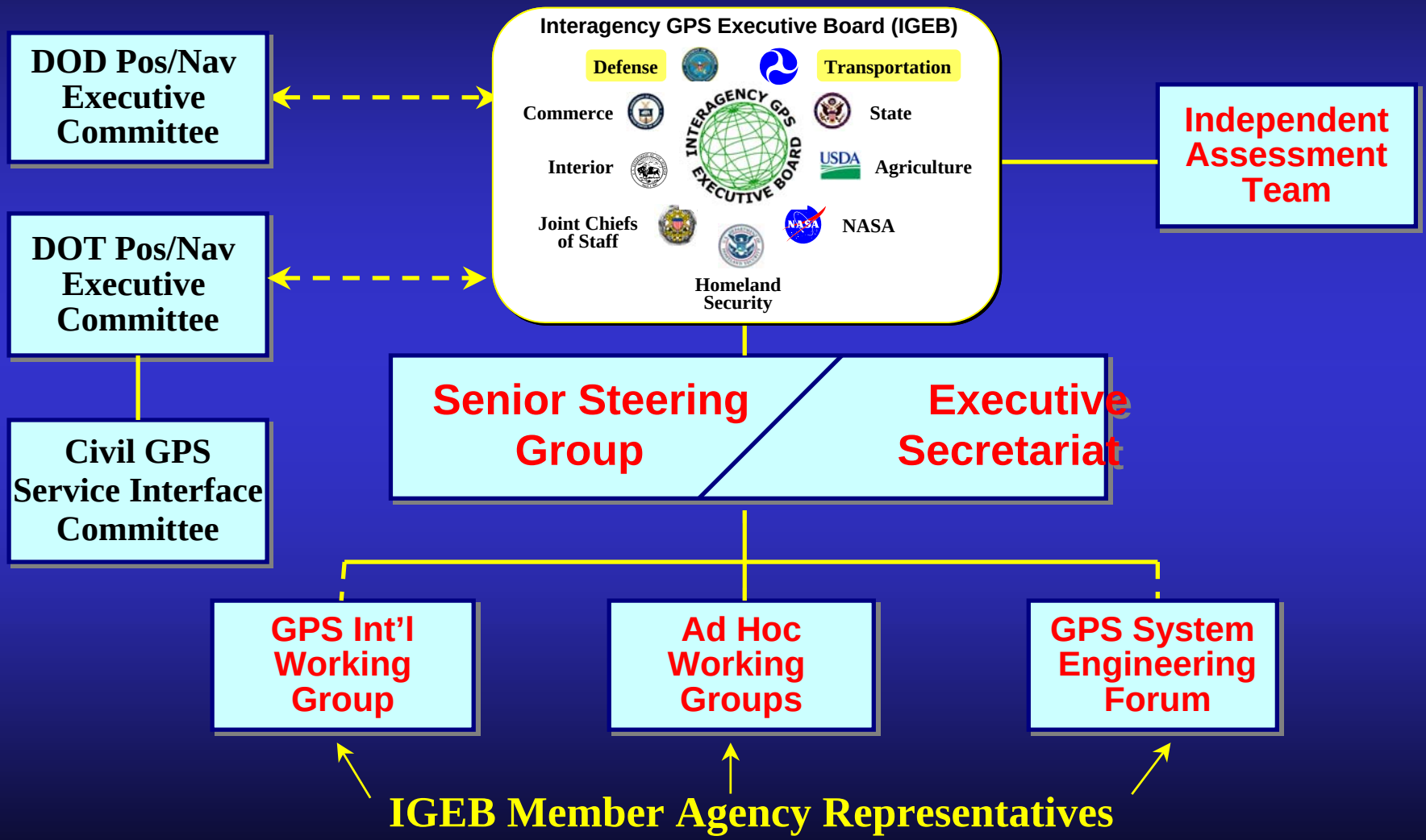
Sources of Policy

- **Executive** and **Legislative** Framework
  - Policy for GPS & augmentations
  - Federal Radionavigation Planning
    - Required by the INMARSAT Act of 1978
    - Joint Transportation & Defense Biennial Federal Radionavigation Plan
  - Annual Congressional Budgeting Acts

GPS Policy

- 1996 Policy
  - Standard Positioning Service (SPS) available for peaceful use, free of direct user charges
  - Interagency GPS Executive Board (IGEB) to manage GPS and its federal augmentations
    - DoD to take action to prevent hostile use without unduly degrading civil use
    - DOT lead civil agency on GPS matters
  - Discontinue Selective Availability within a decade
    - SA set zero in May 2000

GPS Management Structure



Federal Radionavigation Plan (FRP)

- **Biennial plan for common-use civil and military radionavigation systems**
  - **Outlines approach for implementing new and consolidating existing systems**
  - **Provides radionavigation policy, planning, system information, and schedules**
  - **Snapshot at time of publication**
- **Next FRP will use DOT Radionavigation Systems Task Force Report and DoD Master PNT Plan as foundation**
- **2003 FRP delayed awaiting updates on GPS Policy and LORAN continuation decision**

Policy Summary

- **Satellite Navigation policy in the U.S. provides institutional foundation for GNSS**
  - **Establishes a framework for public/private decision makers**
  - **Sets foundation for coordination of efforts**
  - **Creates basis for productive dialogue between service providers and end users**
  - **Allows for examination of current infrastructure to meet future needs**
  - **Defines government commitments to all stakeholders**

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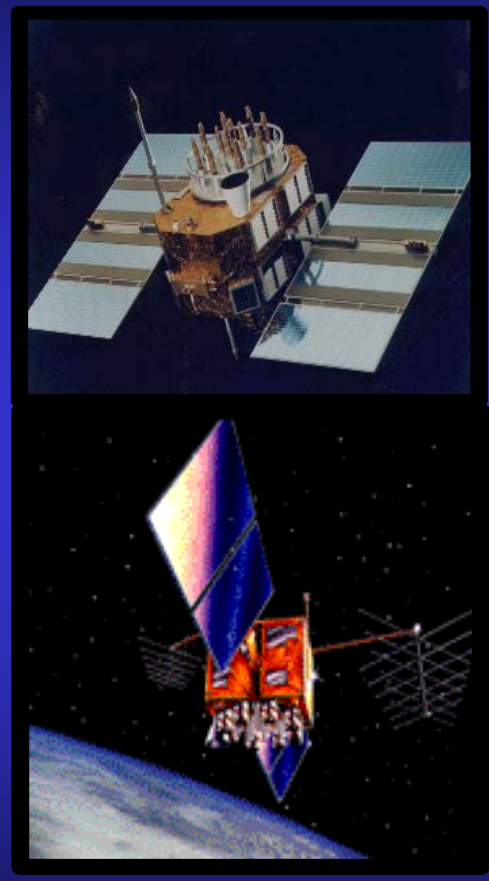
GPS Constellation Status

30 Operating Satellites
(to ensure 24)



- **18 Block II/IIA satellites operational**
- **12 Block IIR satellites operational**
  - 8 IIR satellites available for launch
  - Up to 8 satellites will be modified for new civil signal (L2C)
  - Most recent launch: Nov 04
- **Next launch is currently scheduled for Spring 05**
- **Continuously assessing constellation health to determine launch need**

Global GPS civil service performance commitment has been met continuously since Dec 93

Civil GPS Augmentations

- **Wide Area Augmentation System (WAAS)**
  - **Commissioned in July 2003**
  - **Service available for aviation use**
- **Local Area Augmentation System (LAAS)**
  - **CAT I contract focused only on integrity and safety**
  - **CAT II/III research and development**
- **Nationwide Differential GPS System (NDGPS)**
  - **Single station coverage in 2005**
  - **Dual station coverage in 2008**

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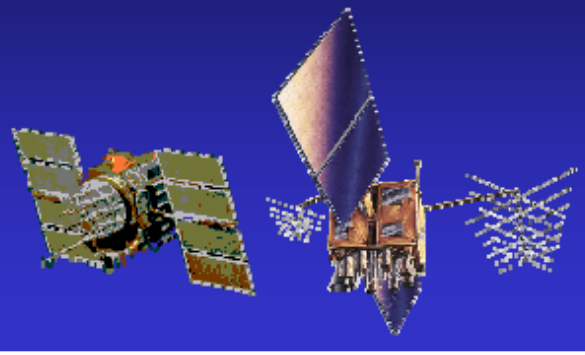
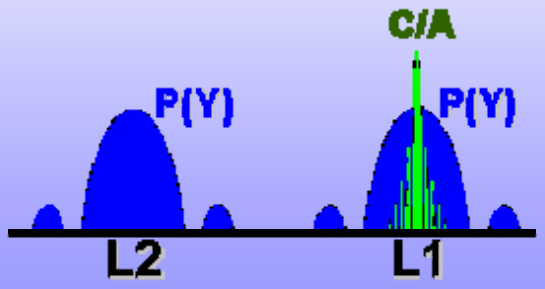
GPS Modernization Plan

Block IIA/IIR



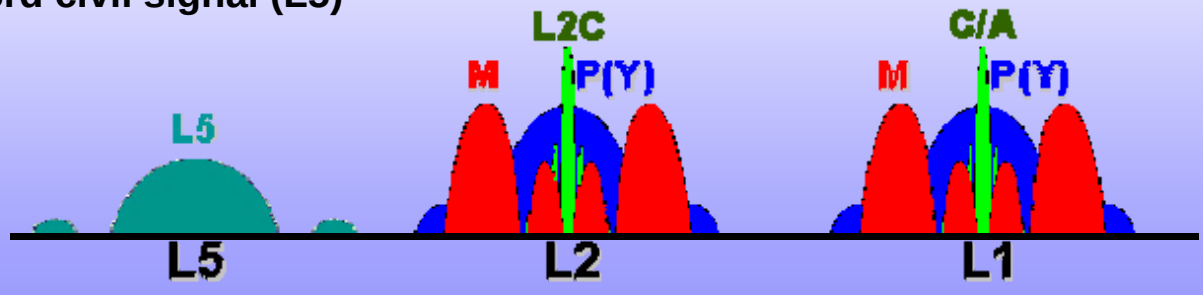
IIA / IIR: Basic GPS
- C/A civil signal (L1C/A)
- Std Service, 16-24m SEP
- Precise Service, 16m SEP
  - L1 & L2 P(Y) nav



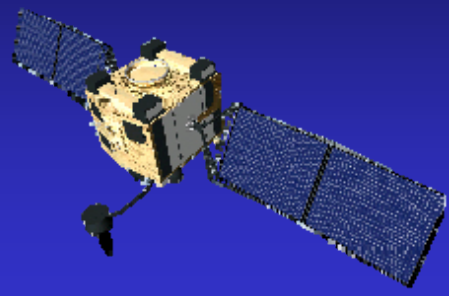
Block IIR-M, IIF

IIR-M: IIA/IIR capabilities &
- 2nd civil signal (L2C)
- New military code
- Flex A/J power (+7dB)

IIF: IIR-M capability plus
- 3rd civil signal (L5)



Block III



III: IIF capabilities &
- Improved civil signal (L1C)
- Increased accuracy (4.8-1.2m)
- Evaluating integrity improvements
- Navigation surety for military
  - Increased A/J power (+20 dB)

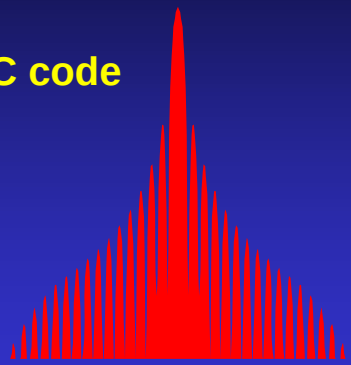
GPS modernization balances military and civil needs

Civil Benefits of GPS Modernization

- New signals provide
  - Reduced vulnerability to interference
  - Calculation of ionospheric corrections at user site
- Improvements in service performance in accuracy, availability, integrity, and reliability
  - Provide centimeter-level accuracy for scientific and survey applications
- New spectrally separated signals
  - Preserve civil use outside areas of military ops
- Opportunity for common & complementary signals/services with other global navigation satellite systems

New end-user opportunities should result

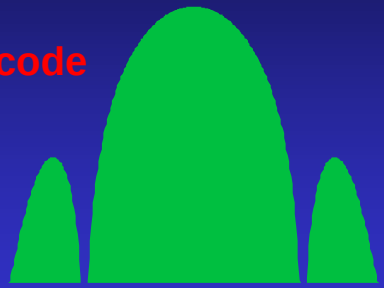
Second Civil Signal (L2C)



Begins with IIR-M sats
First launch: May 2005
24 Satellites: 2012

- **Benefits of L2C**
  - **Improves service for ~ 50,000 current scientific/commercial dual frequency users**
  - **Extends safety-of-life, single-frequency E-911 applications**
  - **Provides better protection (24 dB) than C/A against code cross correlation and continuous wave (CW) interference**
  - **L2C signal definition in ICD-GPS-200C**

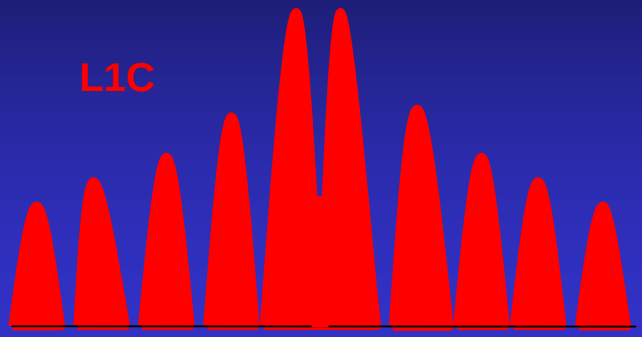
Third Civil Signal (L5)



Begins with IIF sats
First launch: 2006
24 Satellites: 2014

- **Benefits of L5**
  - **Improves signal structure for enhanced performance**
    - **Higher power (-154.9 dBW)**
    - **20 MHz (minimum) broadcast bandwidth**
  - **Aeronautical Radionavigation Services band**
    - **Co-primary allocation at WRC-2000 (1164-1215MHz)**
  - **L5 signal definition in IS-GPS-705**

New L1 Civil Signal (L1C)



Begins with GPS III
First launch: ~ 2012
24 Satellites: ~ 2017

- **Adds a modernized L1 civil signal**
  - **In addition to C/A code to ensure backward compatibility**
- **Enables greater civil interoperability with Galileo**
  - **Converges with Galileo L1 Open Service**

GPS III Status

- **Contracts awarded** in January 04
  - To Lockheed and Boeing for 12-month **requirements definition** effort
  - Leading to Systems Requirements Review
- **Decision** to enter next program/contract phase (Risk Reduction/Design Development) is currently scheduled for **Summer 2005**
- **First launch** currently projected for 2012

GPS III Civil Benefits

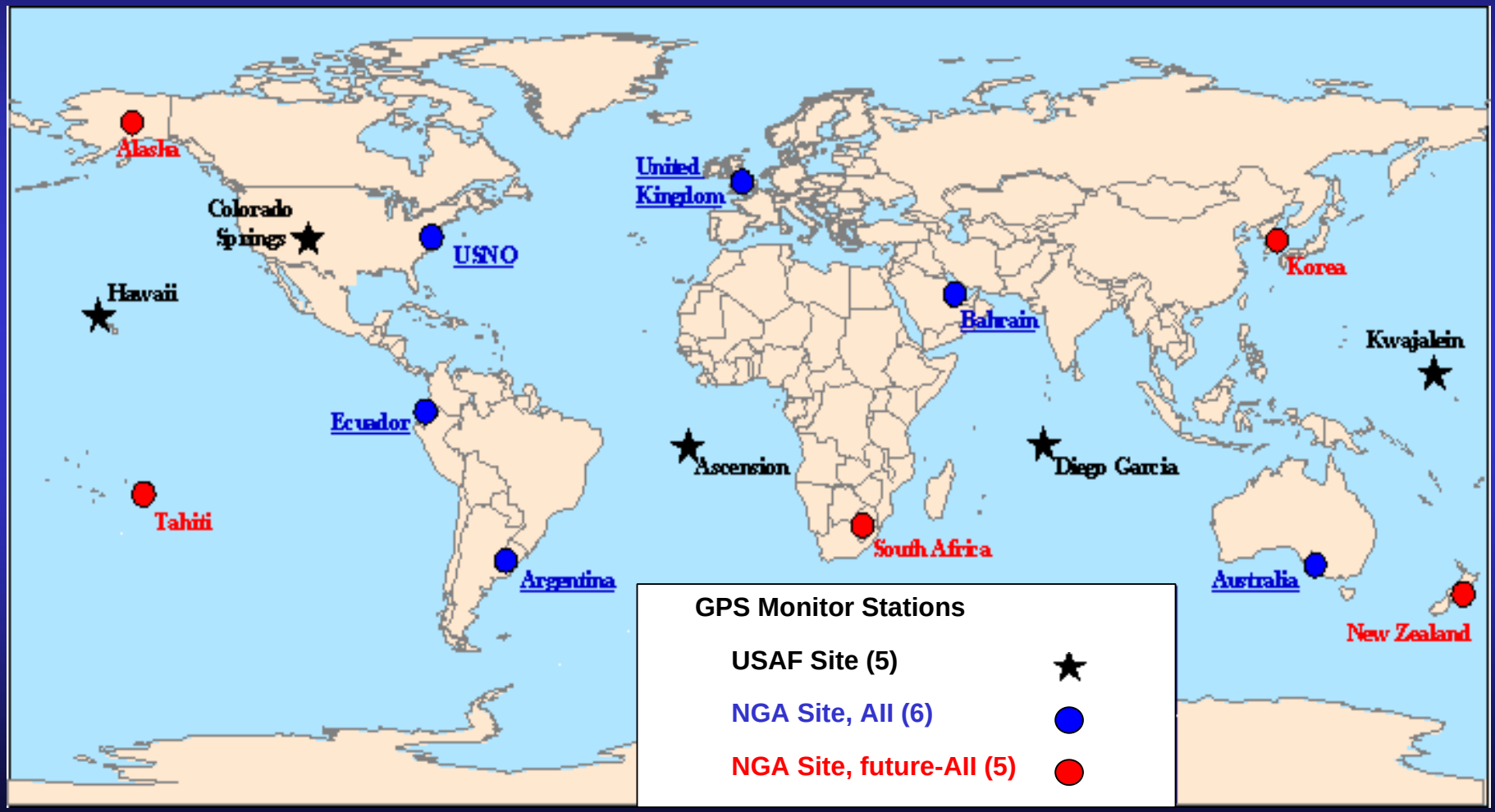
- Increase in system accuracy
- Improve robustness to interference
- Improve level of unaugmented integrity
- Improve availability of accuracy with integrity
- Backward compatibility with existing receivers
- Operational capability for L2C & L5
  - In combination with GPS IIR-M/IIF satellites
- Flexibility to respond to evolving requirements with limited programmatic impacts
- Opportunity to converge with Galileo Open Service

Legacy Improvements

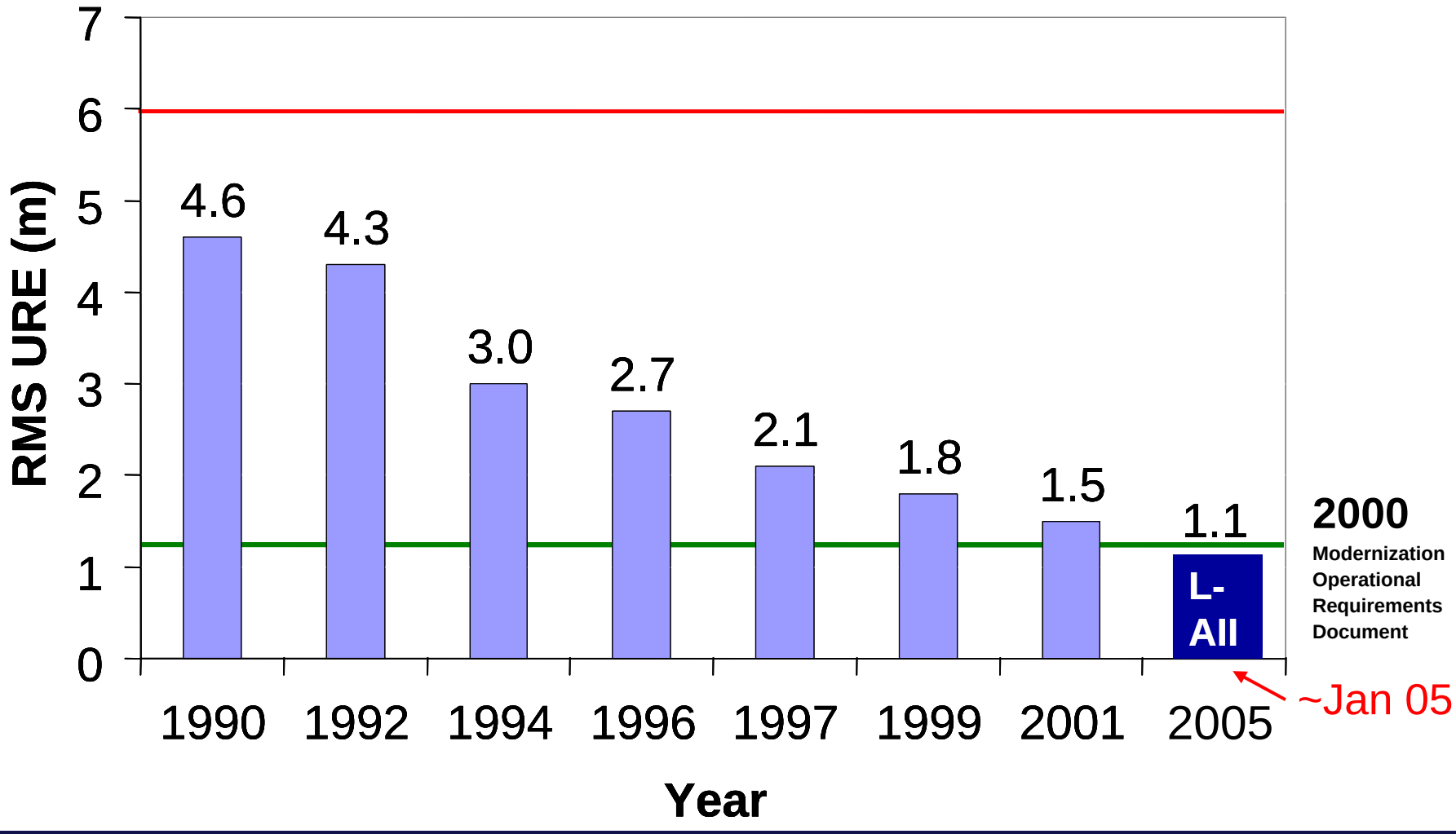
- Legacy **Accuracy Improvement Initiative** by US Air Force & National Geospatial-Intelligence Agency (NGA) in 2005
  - Objective is to **reduce "User Range Error"** (URE) produced by errors in GPS satellite orbital position and clock data transmitted to users in the GPS nav data message
  - **Combining USAF & NGA GPS satellite tracking data** results in better knowledge of GPS satellite orbits & clocks
- **Monitoring of Civil Signals**: Operational Control Segment Modernized Monitor Station Receiver Equipment (MMSRE) development ongoing
- Integrity Failure Modes and Effects Analysis (IFMEA): Knowledge of GPS failure modes required to design improved integrity monitoring systems
- Improvements to WAAS and NDGPS

Control Segment Tracking Stations

Accuracy Improvement Initiative (AII)



User Range Error Performance History



No user changes required to accomplish this!

Overview

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The Way Ahead

- Maintain **stable, consistent** GPS policy and service
- **Improve** GPS civil service through **modernization**
  - Second civil signal (L2C): First launch in 2005
  - Third civil signal (L5): First launch in 2006
  - Control Segment Improvements
  - GPS III to address future dual-use requirements
  - Continue augmentation development
- Build a logical **GNSS** architecture
  - Maintain international dialogue
  - **Maintain Spectral separation** of civil and military services
  - Establish **compatibility & Interoperability**
  - **Protect** GNSS spectrum