Partnering and Outreach:

Satellite Navigation Services for Application at Federal, State and Local Levels

National Rural ITS Conference 2006

16 Aug 06

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What is the National Coordination Office?

- Facilitates information sharing, coordination, and issue resolution regarding space-based positioning, navigation and timing (PNT) across the Departments of the U.S. Government
- Evaluates plans to modernize the U.S. space-based PNT infrastructure, i.e. GPS and its augmentations
- Conducts or oversees space-based PNT studies, analyses, and projects that have broad U.S. Government participation
- Represents the National Executive Committee on space-based PNT with Federal, State, local, and tribal governments
  - As well as with the private sector and representatives of foreign governments

Overview

- Background
- Satellite Navigation Applications
- GPS Modernization
- U.S. Policy

GPS Today

- Over the past decade, GPS has grown into a utility providing positioning, navigation and timing (PNT) throughout the Nation and the world
  - Consistent, predictable, dependable performance
  - Augmentations improve performance even further
- Like the Internet, GPS has grown into a critical component of the global information infrastructure
  - Scalable applications enabling new capabilities at the National, State, and local levels
  - Facilitating innovations in efficiency, safety, environmental, public security, and science

GPS as a Global "Public Service"

- Owned and operated by the U.S. Government
  - Paid for by U.S. taxpayers
  - Managed at a national level as multi-use asset
  - Acquired and operated by the U.S. Air Force on behalf of the U.S. Government
- GPS service is a one-way broadcast, like FM radio
  - Unlimited number of users
  - Access to civilian GPS signals is free of direct user charges
- Public domain documentation
  - Available on an equal basis to users and industry
  - Anyone in the world can develop GPS user equipment

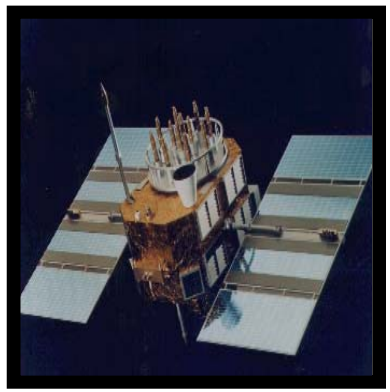
Global Positioning System (GPS)

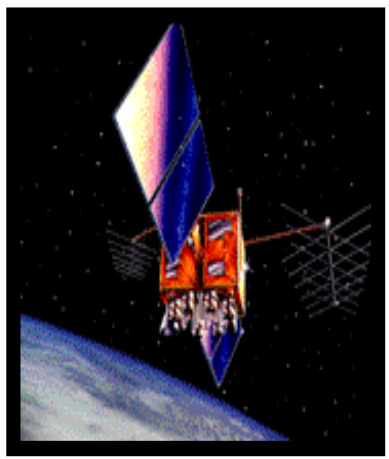
- Constellation of 24+ satellites in medium Earth orbit
- Global coverage, 24 hours a day, all weather conditions
- Satellites broadcast precise time and orbit information on L-band radio frequencies
- Two classes of signals
  - Civilian (free of direct user fees)
  - Military (encrypted for US/allies)
- Three components
  - Space
  - Ground control
  - User equipment

Current Constellation

29 Operational Satellites
(Baseline Constellation: 24)

- 16 Block II/IIA satellites operational
- 12 Block IIR satellites operational
  - Modernizing 8 remaining Block IIR satellites
- 1 Block IIR-M satellite operational
  - Transmitting new second civil signal (L2C)
- Continuously assessing constellation health to determine launch need
  - Next launch: September 2006
- Global GPS civil service performance commitment has been met continuously since December 2003





GPS Augmentations

- U.S. Government and other nations operate augmentations to enhance GPS performance, particularly for transportation safety
  - Space-based Augmentation Systems (e.g. WAAS)
  - Ground-based Augmentation Systems (Nationwide DGPS)
  - Continuously Operating Reference Stations (CORS), International GNSS Service (IGS), Global Differential GPS (GDGPS)
- GPS is an Open Architecture service
  - Where GPS alone does not fulfill user needs, it can be augmented (or added to)
  - Use reference stations to observe GPS satellites from known points on Earth
  - Differential corrections are broadcast and then applied to GPS information to improve accuracy to 1m or better
  - Also provides GPS integrity warnings for safety and other applications
- Commercial companies also offer local, regional, and global augmentation services and systems
  - Differential GPS, Sensor Integration (e.g. inertial), Cellular, etc.

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Commercial GPS Applications Span A Wide Range of Economic Activities

Satellite Operations

Power Grid Management

Personal Navigation

Surveying & Mapping

Trucking & Shipping

Aviation

Communications Network Synchronization

Recreation

Railroads

Fishing & Boating

Offshore Drilling

GPS Applications - Precision Agriculture

- Maximize use of resources
  - Optimize plowing of crop rows
  - Tailor applications of seeds, fertilizer, water, pesticides
  - Improve management of land, machinery, personnel, time
  - Greater crop yields
  - Net benefit: $5-14 per acre

- Minimize environmental impacts
  - Localize identification and treatment of distressed crops that reduces chemical use
  - Precisely level fields to prevent fluid runoff

This grain combine can be outfitted with a GPS receiver, yield monitor, and electronic sensors to track crop production based on location. These data can be transferred to a geographic information system to create a yield map and subsequently used to analyze the field and make site-specific management decisions.

GPS Applications – Automatic Vehicle Location

- Cargo Fleet Tracking
  - Improves safety and security
- Fleet Control/Dispatch
  - Increases fuel savings
  - Improves asset management
- Emergency Operations
  - Reduces response times
  - Reduces injury and property loss
- Road Maintenance
- In Vehicle Navigation
  - Determines accurate position
  - Reduces air pollution

States and Localities - Public Services

A GPS-based automated toll system keeps traffic on Germany's increasingly crowded highways.

- City planning
- Emergency response
  - Law Enforcement
  - Fire Fighting
  - Search and Rescue
  - Paramedics
  - Disaster Relief
- Transportation Infrastructure
  - Road billing network
  - Public road inventory
  - Snowplow guidance

Snow Plow Video

GPS Applications – Improving Highway Operations

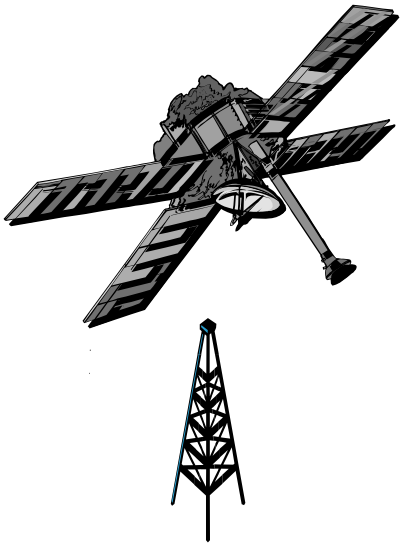
Vehicle Infrastructure Integration (VII)

- Improving safety and reducing congestion will require more efficient management of the roadway system
- Vehicle-highway information exchange is key to improved management and operation of the transportation network
  - Provide information on traffic conditions, crashes, adverse weather and road conditions, etc.

VII Initiative

- Vehicle Infrastructure Integration (VII) Program
  - Cooperative program with DOT-FHWA-NHTSA, auto industry, states and other key stakeholders
- Preliminary architecture defined to include GPS
- 110 public and private use cases have been developed
- Standards nearing completion
- DSRC (Dedicated Short-Range Communications) prototype development underway
- Implementation beyond 2010

VII Range of Applications



Work Zone Management

Traveler Information

Intersection Collision Avoidance

Weather Sensing

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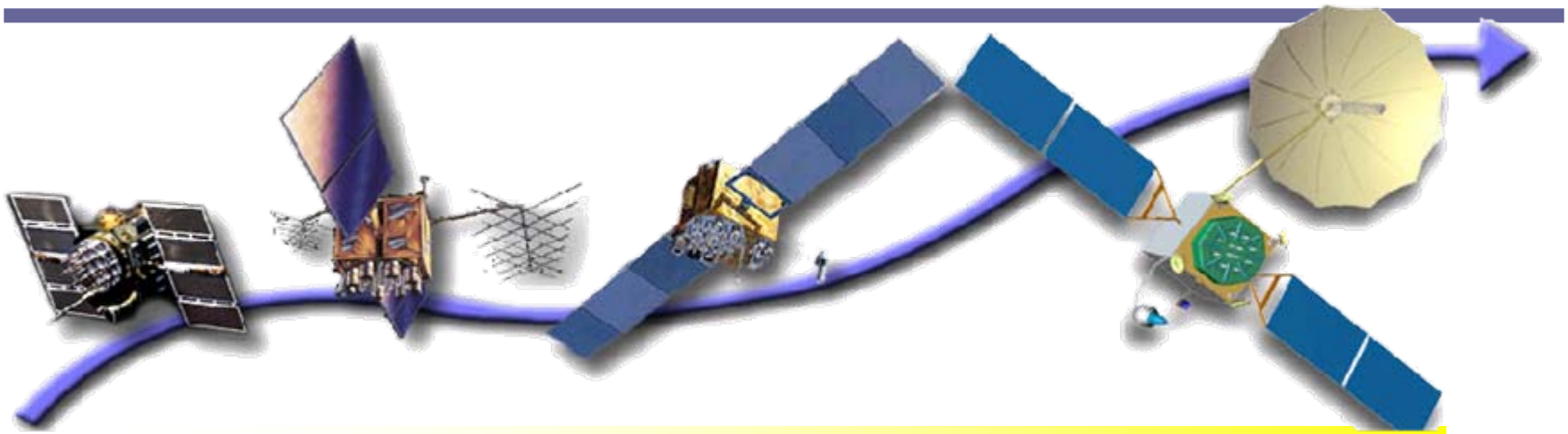
Benefits of GPS Modernization

- For all users: System-wide improvements in accuracy, availability, integrity, and reliability
  - Higher standalone accuracy
    - Augmentations likely will still remain
  - More robust against interference
  - Improved indoor, mobile, and urban use
  - Interoperability with other GNSS constellations
- Also maintains international competitiveness

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 and L2Y)
  - – Y-Code navigation

Block IIR-M

IIR-M: IIA/IIR capabilities plus

- **2nd civil signal (L2C)**
- M-Code (L1M and L2M)
- **Currently being launched**

Block, IIF

IIF: IIR-M capability plus

- **3rd civil signal (L5)**
- Anti-jam flex power
- **Begin launch 2009**

Block III

- Backward compatibility
- **4th civil signal (L1C)**
- Increased accuracy
- Increased anti-jam power
- Assured availability
- Increased security
- System survivability
- **Begin launch 2011-2013**

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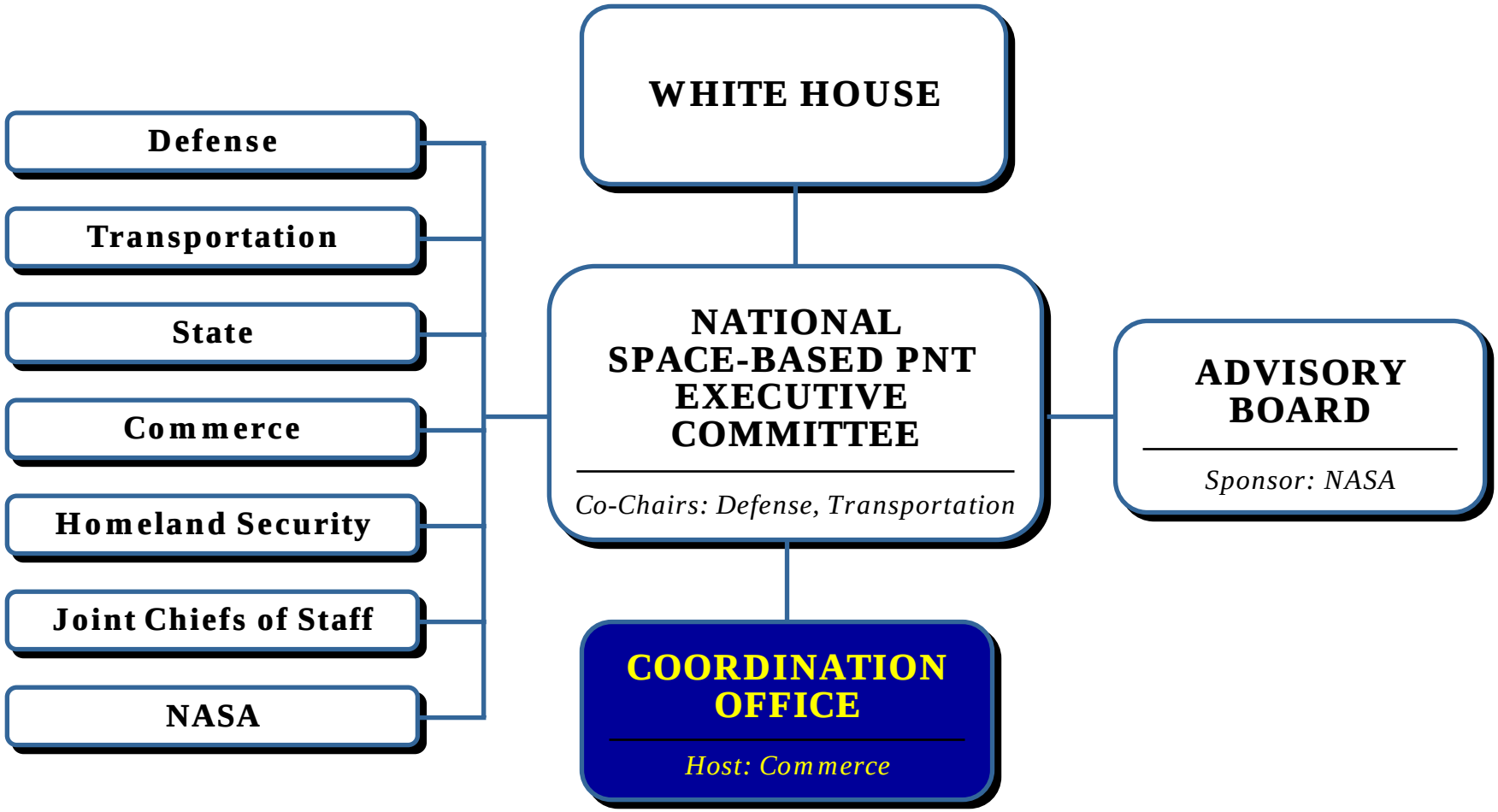
2004 U.S. Policy Objectives

- Provide civil GPS and its augmentations free of direct user fees on a continuous, worldwide basis
- Provide open, free access to information needed to use civil GPS and its augmentations
- Improve performance of GPS and its augmentations
  - Meet or exceed international systems
  - Improve resistance to interference for civil, commercial, homeland security, and scientific users worldwide
- Work to ensure that international GNSS services are interoperable with GPS and its augmentations
  - Or, at a minimum, are compatible

2004 U.S. Policy Summary

- Demonstrates U.S. Government commitment to space-based PNT for all stakeholders
- Provides framework for public/private decision makers
- Improves ability to coordinate efforts across the various agencies of the U.S. Government
- Creates basis for meaningful dialogue between service providers and end users
- Promotes common standards for worldwide interoperability

U.S. Space-based PNT Organizational Structure



Summary

- U.S. policy encourages and promotes worldwide use of civil GPS and augmentations
- GPS performance is better than ever and will continue to improve
  - Augmentations enable high performance today
  - New GPS signal now available
  - Many additional upgrades scheduled
- International cooperation is essential
  - Other nations of the world are also implementing satnav systems
  - Compatibility and interoperability are critical
- Expanding outreach to States and Localities

Outreach - States and Localities

- Coordinated by a Subcommittee of the Civil GPS Service Interface Committee (CGSIC)
  - Open forum for civil user information exchange concerning use of GPS
  - Identifies common user needs for GPS capabilities by State and Local Governments

Next meeting is September 25-26 is
in Fort Worth, TX immediately prior to the
Institute of Navigation (ION) GNSS 2006 Conference

Contact Information

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Presentation and additional information available:
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BACKUPS

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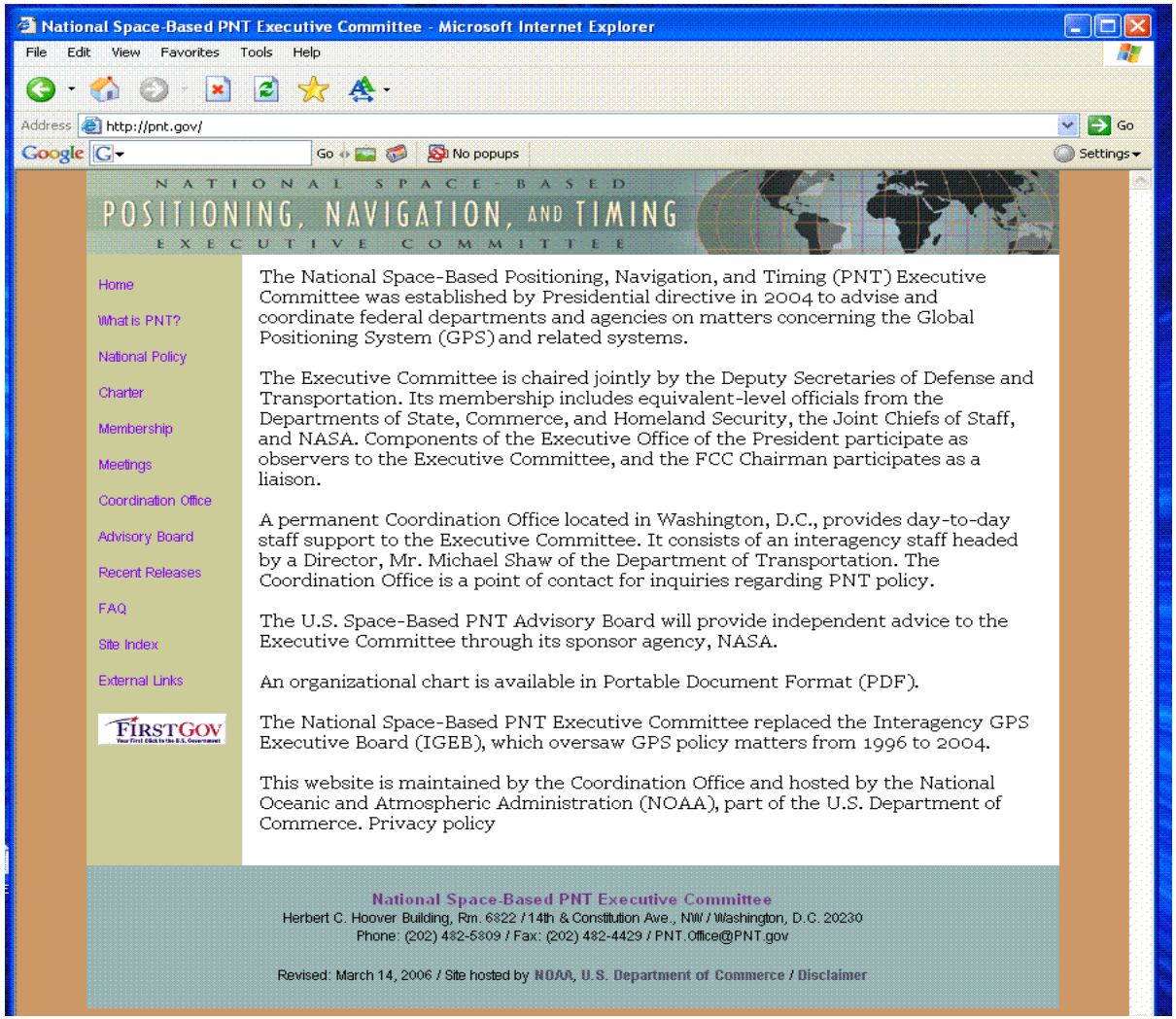
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FIRSTGOV
The National Space-Based Positioning, Navigation, and Timing (PNT) Executive Committee was established by Presidential directive in 2004 to advise and coordinate federal departments and agencies on matters concerning the Global Positioning System (GPS) and related systems.
The Executive Committee is chaired jointly by the Deputy Secretaries of Defense and Transportation. Its membership includes equivalent-level officials from the Departments of State, Commerce, and Homeland Security, the Joint Chiefs of Staff, and NASA. Components of the Executive Office of the President participate as observers to the Executive Committee, and the FCC Chairman participates as a liaison.
A permanent Coordination Office located in Washington, D.C., provides day-to-day staff support to the Executive Committee. It consists of an interagency staff headed by a Director, Mr. Michael Shaw of the Department of Transportation. The Coordination Office is a point of contact for inquiries regarding PNT policy.
The U.S. Space-Based PNT Advisory Board will provide independent advice to the Executive Committee through its sponsor agency, NASA.
An organizational chart is available in Portable Document Format (PDF).
The National Space-Based PNT Executive Committee replaced the Interagency GPS Executive Board (IGEB), which oversaw GPS policy matters from 1996 to 2004.
This website is maintained by the Coordination Office and hosted by the National Oceanic and Atmospheric Administration (NOAA), part of the U.S. Department of Commerce. Privacy policy
National Space-Based PNT Executive Committee
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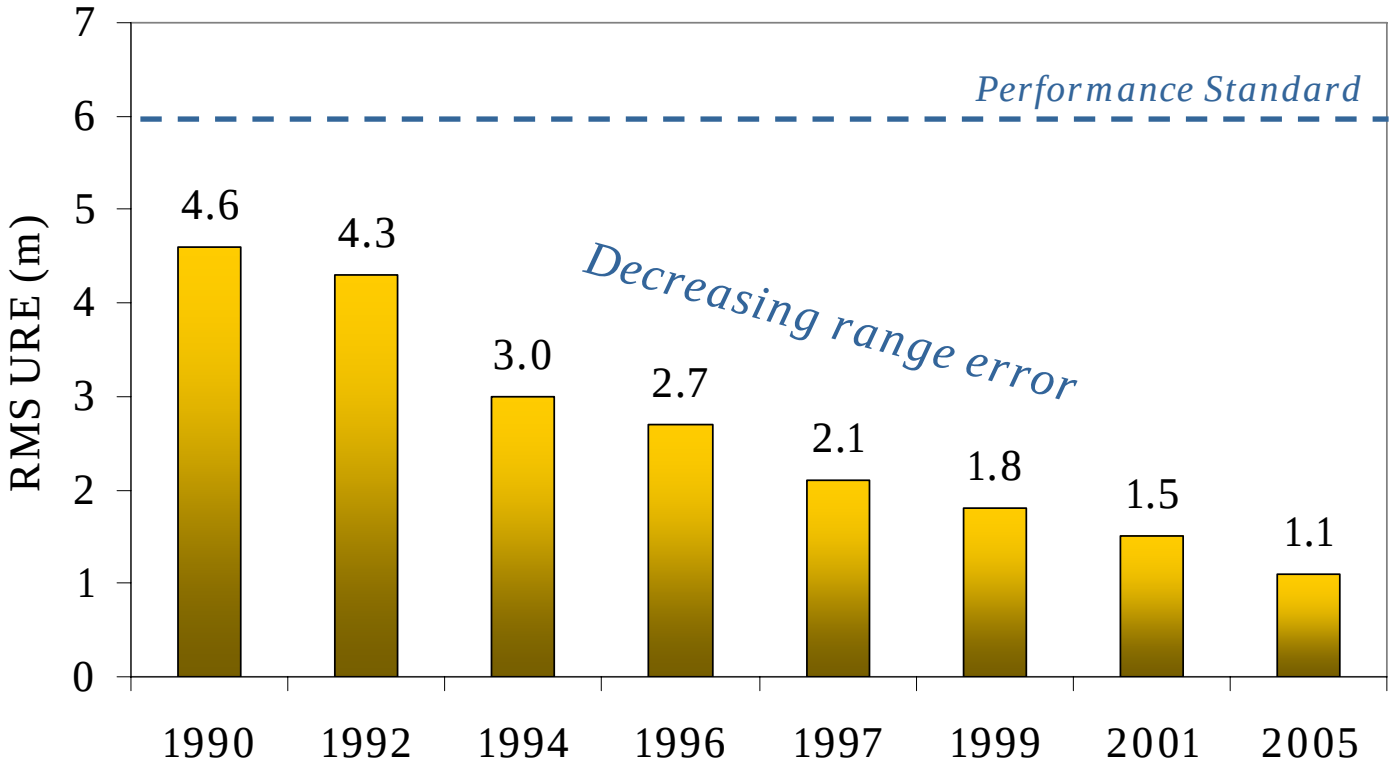
GPS Vehicle Applications

- Accuracy and integrity values for vehicle applications
  - Early estimates
    - Which Lane – 1.5 meters
    - Error includes positioning and map error (2 sigma)
    - Where in Lane – 0.5 Meters
    - Integrity – not addressed
    - Availability – loss of lock to reacquire below 30 seconds
  - Early applications
    - Car probe data for Traveler Information Systems/511 and weather
    - Lane departure warning
    - Extended emergency brake lights
    - Intersection collision warnings
    - Electronic payment for services
    - Dynamic route guidance

GPS Signal in Space Performance



Signal in Space RMS URE: Root Mean Square User Range Error

System accuracy far exceeds current standard