



# ***GPS and Galileo – Progress through Partnership***



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and Exhibition  
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# Overview

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- GPS System and Performance
- GPS Modernization
- International Cooperation



# Global Positioning System

- Baseline 24 satellite constellation 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
  - 3 dimensional position worldwide
- Two types of services
  - Civil (free of direct user fees)
  - Military (U.S. and Allied military)
- Three system elements
  - Space
  - Ground control
  - User equipment

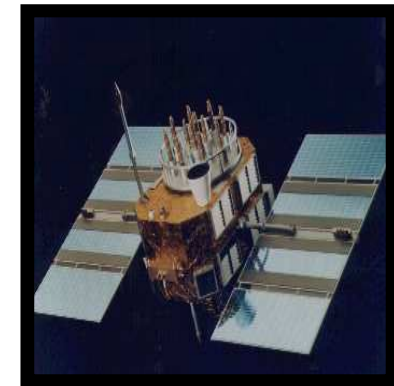




# Current Constellation

## 29 Operational Satellites (Baseline Constellation: 24)

- 28 Block II/IIA/IIR satellites operational
- 1 Block IIR-M satellite operational
  - Transmitting new second civil signal (L2C)
- Continuously assessing constellation health to determine launch need
  - New IIR-M satellite launched – September 2006
  - 6 remaining Block IIR-M satellites
  - Next launch: November 2006
- Global U.S. GPS civil service performance commitment met continuously since Dec 1993

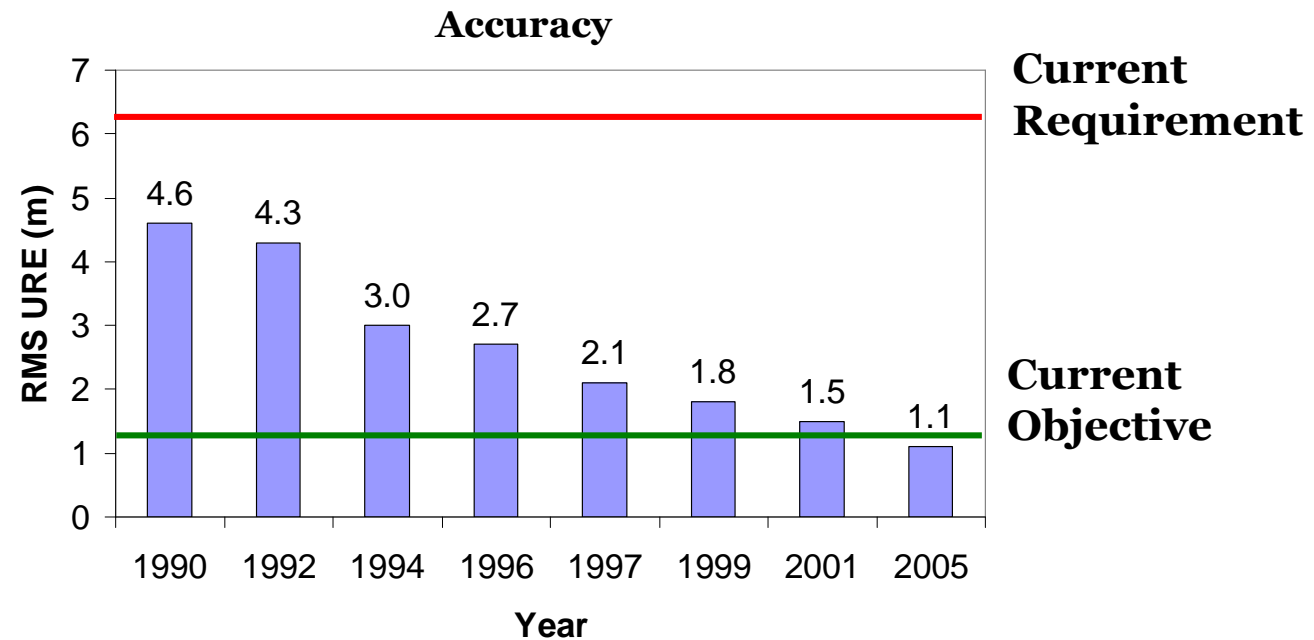




# Continuous Performance Improvement

## Key Measures of Effectiveness to evaluate GPS services

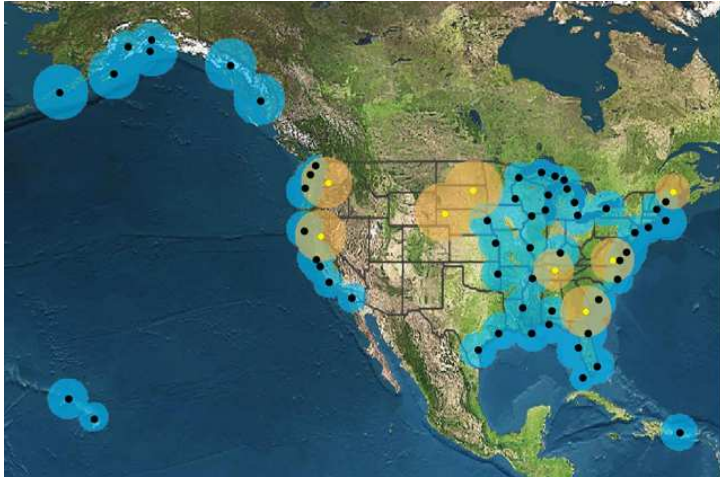
- *Accuracy*
- *Bounded inaccuracy*
- *Assured Availability*
- *Integrity*
- *Resistance to RF Interference/Jamming*



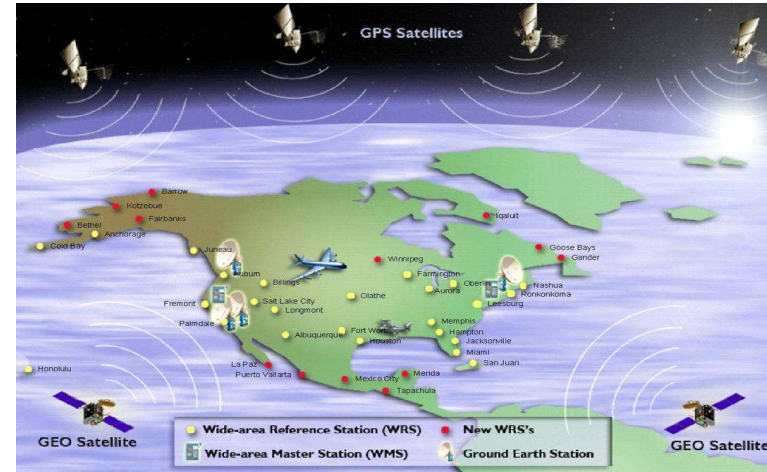
National Coordination Office for Space-Based PNT, USA



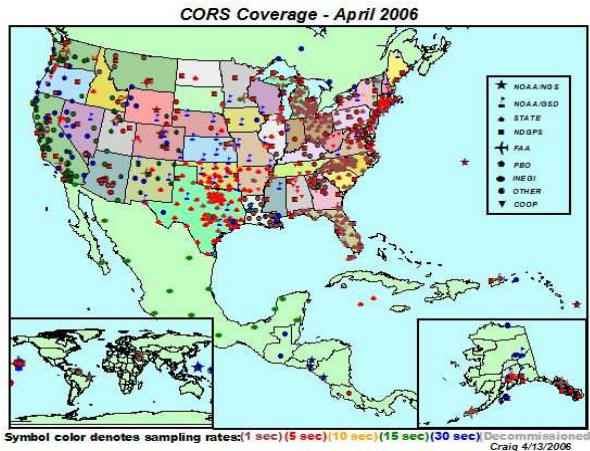
# U.S. Augmentations



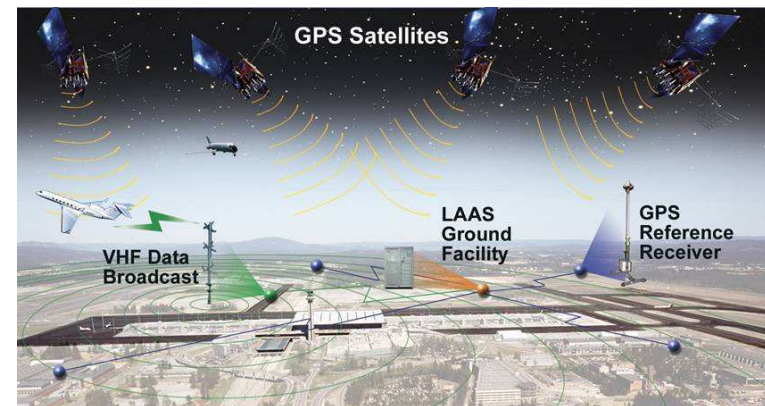
**Nationwide Differential GPS**



**Wide Area Augmentation System**



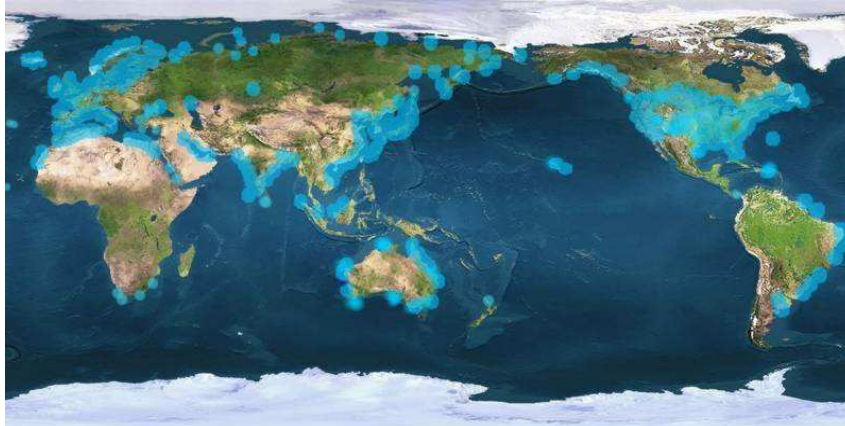
**Continuously Operating Reference Stations**



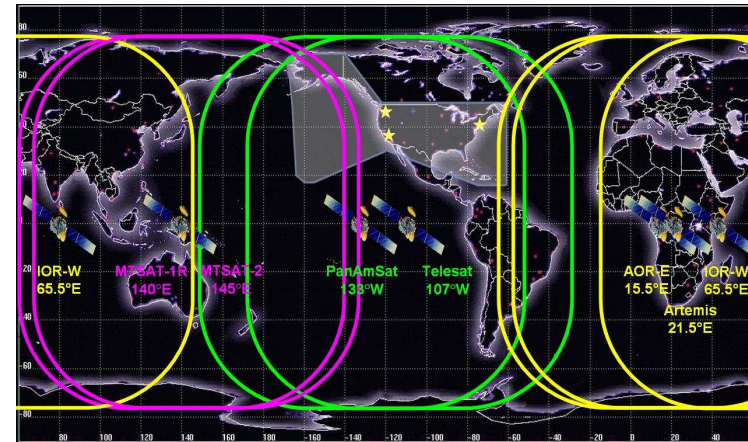
**Local Area Augmentation System**



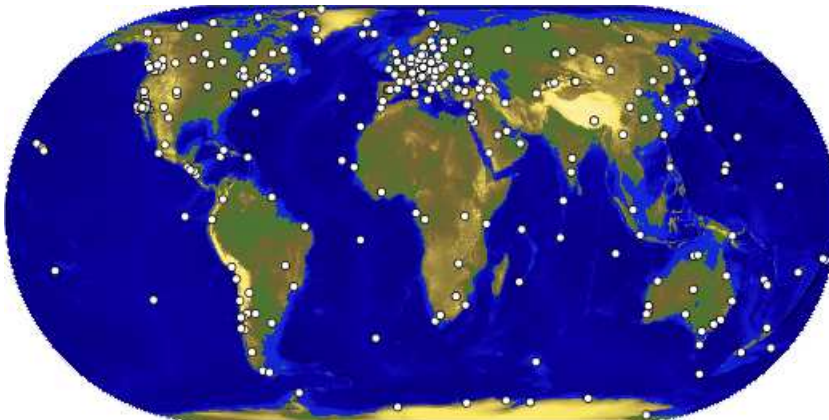
# International Augmentations



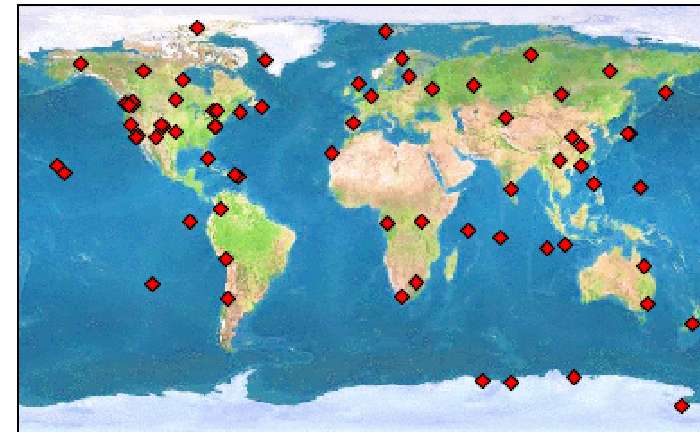
**Differential GPS Networks**



**Space-Based Augmentation Systems**



**International GNSS Service**



**Global Differential GPS System**



# Overview

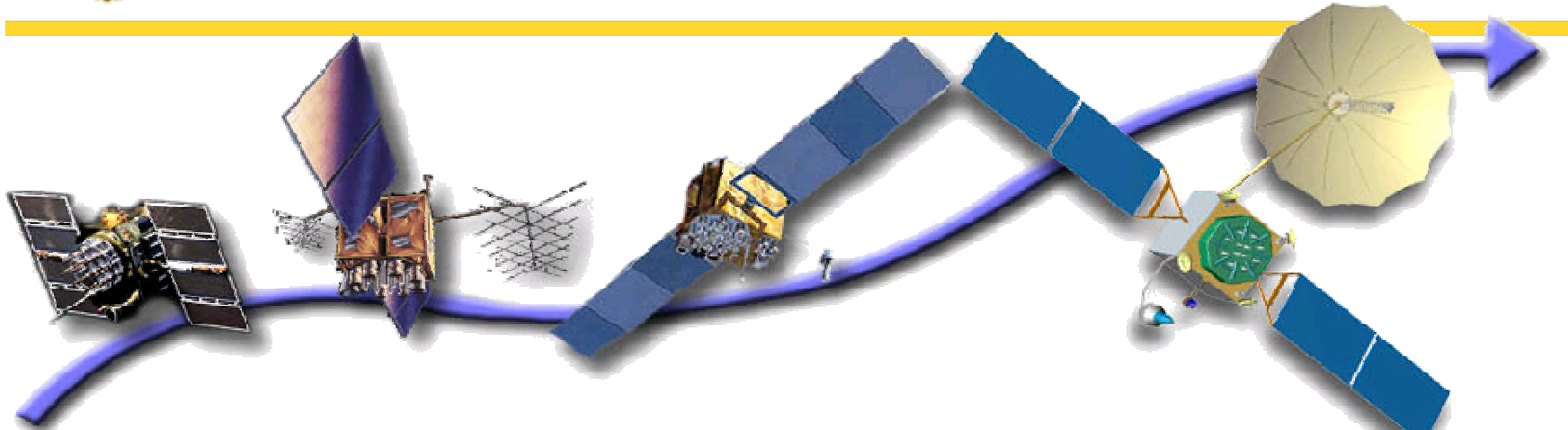
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# GPS Modernization



*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)**
- Anti-jam flex power

## **Block III**

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



# Modernized GPS – Civil Signals

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- Second civil signal (“L2C”)
  - Designed to meet commercial needs
    - Higher accuracy through ionospheric correction
    - Higher effective power and improved data structure reduce interference
  - Began with GPS Block IIR-M in **Sep 2005**; 24 satellites projected in: **~2014**
- Third civil signal (“L5”)
  - Designed to meet demanding requirements for transportation safety-of-life
    - Uses protected Aeronautical Radio Navigation Service (ARNS) frequency
  - Higher Power
  - Begins with GPS Block IIF
  - First launch: **~2008**; 24 satellites projected in : **~2016**
- Fourth civil signal (“L1C”)
  - Designed with international partners to enable GNSS interoperability
  - Begins with GPS Block III
  - First launch: **~2013**; 24 satellites projected in : **~2021**



## International Growth in Global Navigation Satellite Systems (GNSS)

- Europe: Galileo, EGNOS
- Russia: GLONASS
- Japan: MSAS, QZSS
- India: GAGAN, IRNS
- Australia: GRAS
- China: Beidou, Compass
- Canada: CWAAS
- Mexico: WAAS
- Multilateral: International GNSS Service
- Most major nations: Differential GPS\*, geodetic reference networks
- Galileo partners: Canada, Mexico, India, Ukraine, Israel, China, Morocco, South Korea; discussions ongoing with Brazil, others

*\*50 nations operate beacon-type DGPS services like the U.S. Nationwide DGPS services*



# Overview

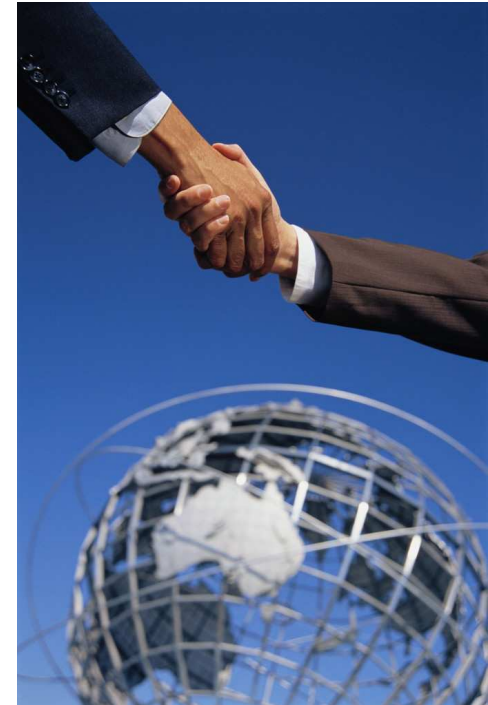
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# U.S. International Cooperation

- U.S. Government has pursued formal cooperative arrangements with Europe, Japan, and Russia since 1996
  - To ensure compatibility (non-interference) and interoperability with foreign systems
  - To maintain and promote a level playing field in the global market
- Additional efforts ongoing with Australia, India, Brazil, and others
- Multilateral cooperation established through U.N. International Committee on GNSS
  - As well as ICAO, IMO, and NATO





# GPS-Galileo Agreement

- In 2004, United States and European Community signed agreement on **GPS-Galileo cooperation**
  - Recognizing importance of compatibility and interoperability for all parties
  - Agreed to spectrally separate signals for military, civilian, and public regulated services
- Agreed to implement a **common, open, civil signal on both Galileo and GPS III, free of direct user fees**
- Working groups established to continue cooperation:
  - Compatibility and Interoperability
  - Trade and Commercial Applications
  - Next-Generation GNSS
  - Security Issues



June 26, 2004, press conference at U.S.-EU Summit in Ireland (U.S. Sec. of State Colin Powell, Irish Foreign Minister Brian Cowen, EU Vice-President Loyola De Palacio)



## U.S. International Cooperation

*Outlined in 2004 U.S. National Policy on Space-Based Positioning, Navigation, and Timing (PNT)*

- Provide civil GPS and augmentations free of direct user fees on a continuous, worldwide basis
- Provide open, free access to information needed to develop equipment
- Improve performance of civil GPS and augmentations to meet or exceed that of international systems
- Encourage international development of PNT systems based on GPS
- Seek to ensure international systems are interoperable with civil GPS and augmentations
  - Or at a minimum, are compatible
- Address mutual security concerns with international providers to prevent hostile use



# International Committee on GNSS

- Multilateral group chartered through United Nations
  - First meeting: December 2005
  - Next meeting: November 2006
- Purpose: Promote use of GNSS to improve efficiency and security of transport, search and rescue, geodesy, etc., particularly in developing countries
  - Coordination among GNSS providers to ensure both compatibility and interoperability
  - Assistance to developing countries in use of PNT services
  - Focal point for international information exchange
  - Forum for addressing future user needs

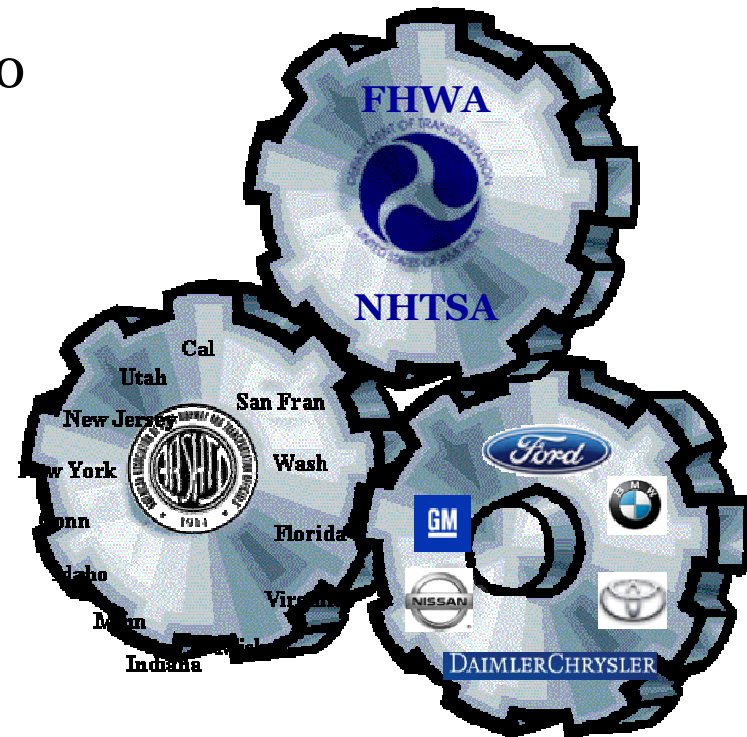






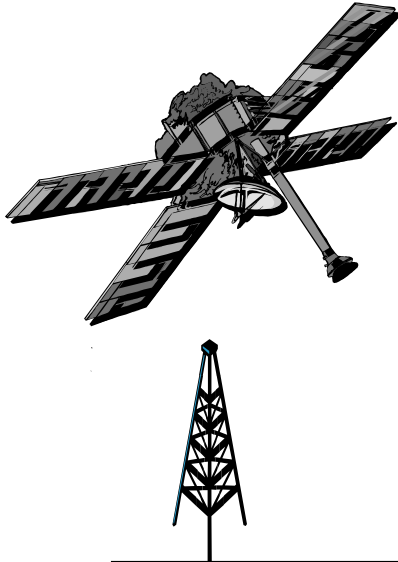
## Vehicle Infrastructure Integration (VII) Program

- Improving safety and reducing congestion will require more efficient management of the roadway system
- Cooperative program with DOT-FHWA-NHTSA, auto industry, states and other key stakeholders
- Preliminary architecture defined to include GPS/GNSS
- 110 public and private use cases have been developed
- Standards nearing completion
- Prototype development underway
- Implementation beyond 2010





# VII Range of Applications



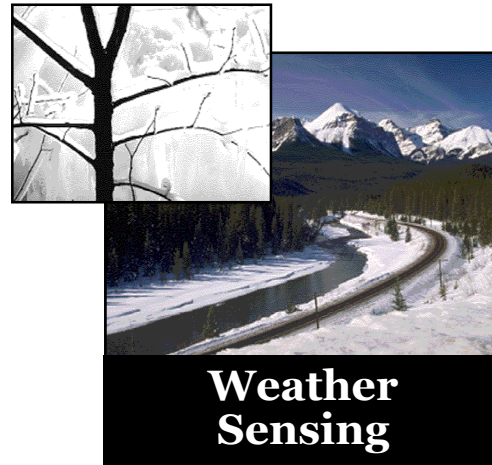
**Work Zone Management**



**Traveler Information**



**Intersection Collision Avoidance**



**Weather Sensing**



## Summary

- U.S. policy promotes worldwide use of civil GPS and augmentations, and its interoperability/compatibility with other GNSS systems, specifically Galileo
- GPS is getting better and will continue to improve
  - Augmentations enable high performance today
  - New GPS signal now available
- International cooperation - a priority for all nations
  - Interoperability/compatibility are critical
  - Ever improving performance for applications worldwide

**GPS and Galileo: Progress through Partnership**



## Web-based Information

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- **PNT.gov** established to disseminate information on the U.S. National Executive Committee
  - Contains [recent public presentations](#) as well as information on Membership, Policy, the Advisory Board, and “frequently asked questions”
- **GPS.gov** established to disseminate information on GPS applications
  - Brochure on GPS applications available for download
    - Copies available upon request
  - Contains additional links to various other websites



## Contact Information

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Presentation and other GPS information available:

**[PNT.gov](http://PNT.gov)**