SPACE-BASED POSITIONING NAVIGATION & TIMING

NATIONAL COORDINATION OFFICE

# *Introduction to GPS and US PNT Policy*

*USTTI Seminar: GPS Applications for Disaster Management*

*October 13, 2015*

National Coordination Office
United States of America

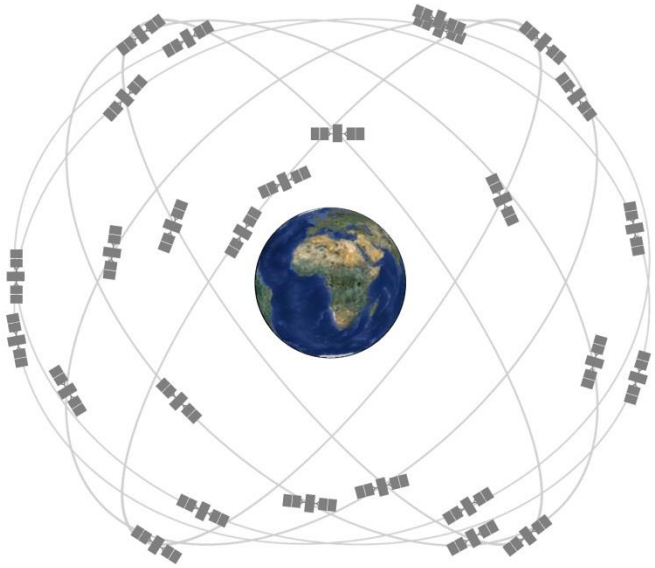
# Overview

- Global Positioning System
- GPS Applications
- U.S. Policy

# The Global Positioning System

- Baseline constellation of 27 satellites in medium earth orbit
- Global coverage, 24 hours a day, all weather conditions
- Satellites broadcast precise time and orbit information

- Two types of signals:
  - Standard (free of direct user fees)
  - Precise (U.S. and Allied military)
- Three segments:
  - Space
  - Ground control
  - User equipment



# GPS Modernization Program

**Legacy GPS IIA/IIR**
- Single Frequency (L1)
- Coarse acquisition (C/A) code
- Y-Code (L1Y & L2Y)

**GPS IIR-M**
- 2nd Civil Signal (L2C)
- M-Code (L1M & L2M)

**GPS IIF**
- 3rd civil signal (L5)
- 2 Rb + 1 Cs Clocks
- 12 year design life

**GPS III**
- 4th civil signal (L1C)
- 4x better User Range Error than GPS IIF
- Increased availability
- Increased integrity
- 15 year design life

**Legacy Operational Control Segment (OCS)**
- Mainframe system
- Command & Control
- Signal monitoring

**Architecture Evolution Plan (AEP)**
- Distributed architecture
- Increased signal monitoring
- Security
- Accuracy
- Launch and disposal ops

**Next Generation Operational Control System (OCX) Block 0**
- Launch & On-Orbit Checkout of GPS III

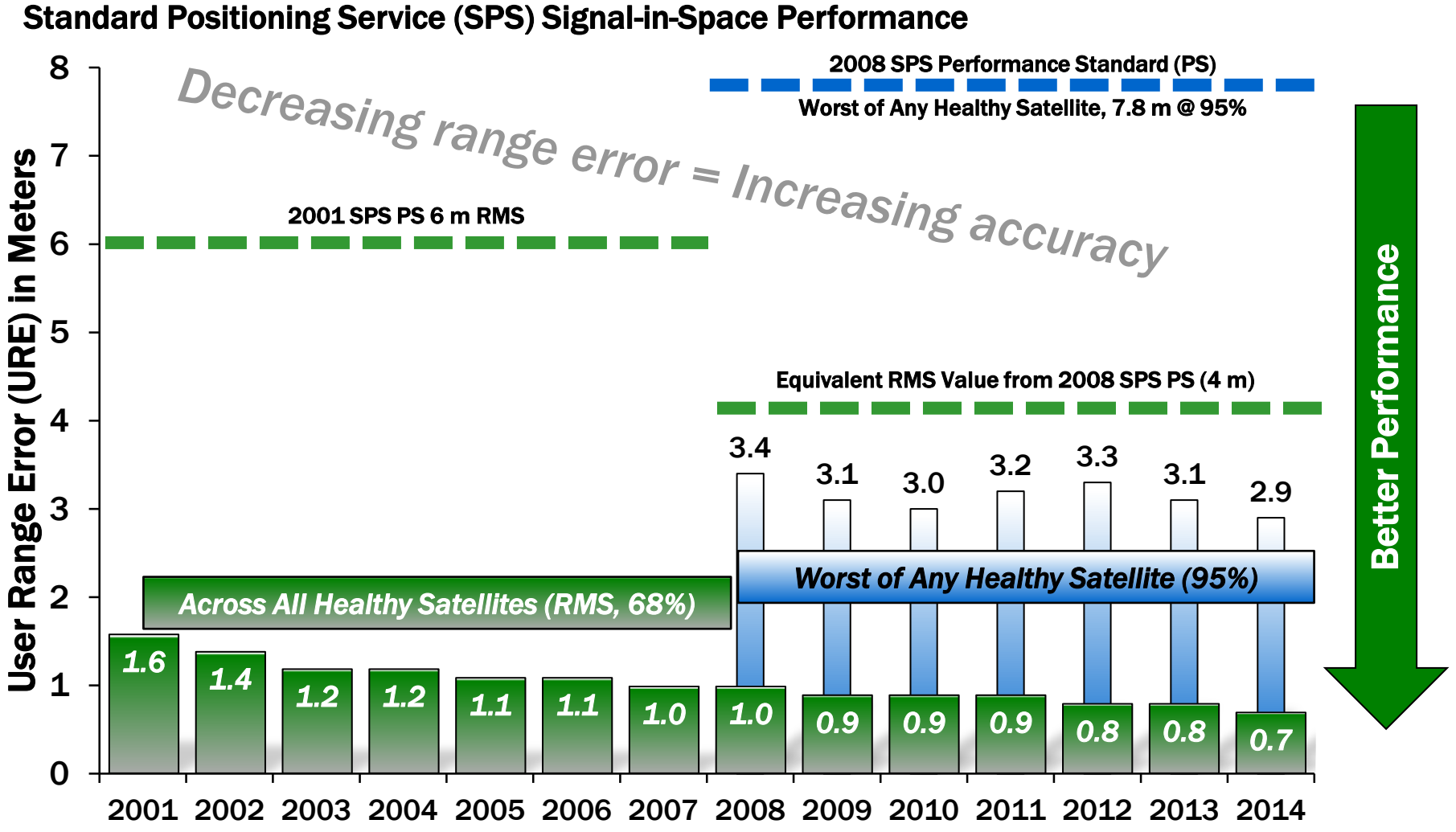
**OCX Block 1**
- Transition to OCX for all GPS command and control operations

***Increasing system capabilities - Increasing user benefit***

# Modernized Civil Signals

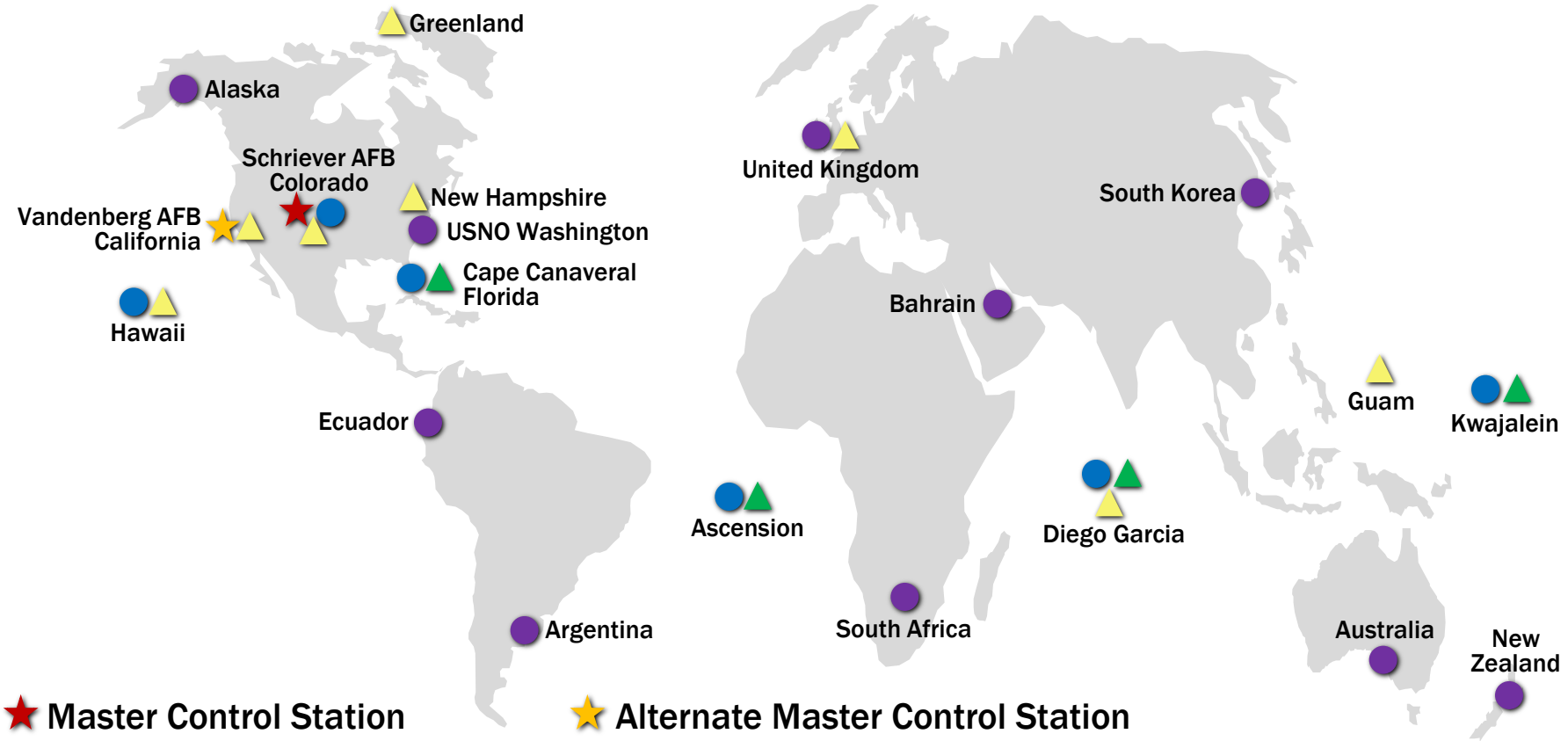
- The U.S. initiated continuous civil navigation message broadcast (L2C & L5) on 28 Apr 14
- L2C and L5 should continue to be considered pre-operational and should be employed at the user's own risk
  - Position accuracy not guaranteed during pre-operational deployment
  - L2C message currently set “healthy”
  - L5 message set “unhealthy” until sufficient monitoring capability established

# Accuracy: Civil Commitments
## Standard Positioning Service Performance Standard




**System accuracy better than published standard**

# GPS Control Segment




- Master Control Station
- Alternate Master Control Station
- Ground Antenna
- AFSCN Remote Tracking Station
- Air Force Monitor Station
- NGA Monitor Station

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# GPS Enables a Diverse Array of Applications

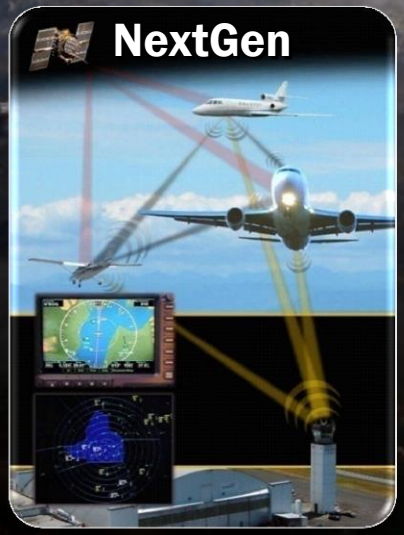
Space Applications

Surveying and Mapping

Power Grids

Precision Agriculture

Transit Operations



NextGen

Disease Control Mapping

Intelligent Vehicles

TeleComm

Trucking

Personal Navigation

Shipping

Oil Exploration

Fishing and Boating

# GPS Offers Enormous Value

- Supports a wide range of sustainable development activities including:
  - Agriculture
  - Environmental stewardship
  - Disaster management
  - Surveying & mapping
  - Timing

# Agriculture

- Optimized placement of crop rows, seeds, and nutrients
- Plant-specific applications of water, fertilizer, pesticides, herbicides
- Greater crop yields, profit margins
- Environmental benefits
- Enhanced monitoring of crop yields and soil fertility
- Automated, 24-hour operations using lighter equipment, less fuel, less labor

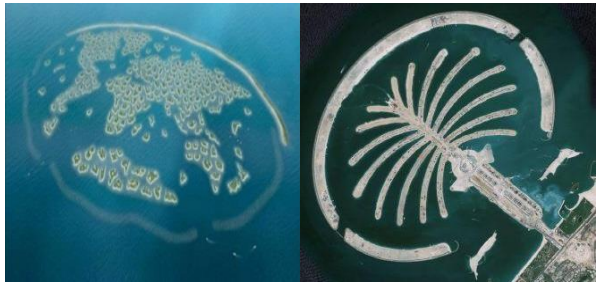
# Environmental Stewardship

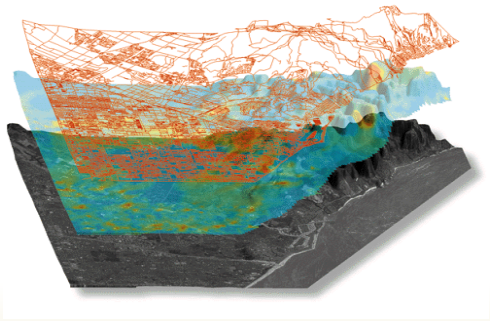
- Climate monitoring
  - Tidal tracking
  - Atmospheric moisture profiles
- Oil and chemical spill cleanup
  - Positioning, modeling of spills to guide remediation efforts
- Commercial fishing
  - Enforcement of fishery boundaries
- Forestry
  - Improves use of fire fighting resources
  - Support efforts to combat illegal deforestation

# Disaster Management

- Assists in disaster planning efforts such as flood plain mapping
- Helps relief workers navigate disaster areas devoid of landmarks
- Facilitates containment and management of wildfires
- Enables disaster warning systems
  - GPS-equipped buoys for tsunami warnings
  - GPS ground networks monitor crustal motion, earthquakes

# Surveying, Mapping, GIS





- Surveying is essential to development
  - Real estate
  - Power lines, telecom towers, pipelines
  - Dams and bridges
  - Port dredging
- GPS enables 2-5 cm real-time positioning accuracy
  - Accuracy possible with post-mission data processing
- Significant savings in time, cost, labor

# Timing

- GPS provides precise time needed to synchronize large networks
- Telecommunications
  - Wired and wireless
- Finance
  - Stock exchanges
  - ATMs
- Power grids
  - Load balancing
  - Fault detection, location

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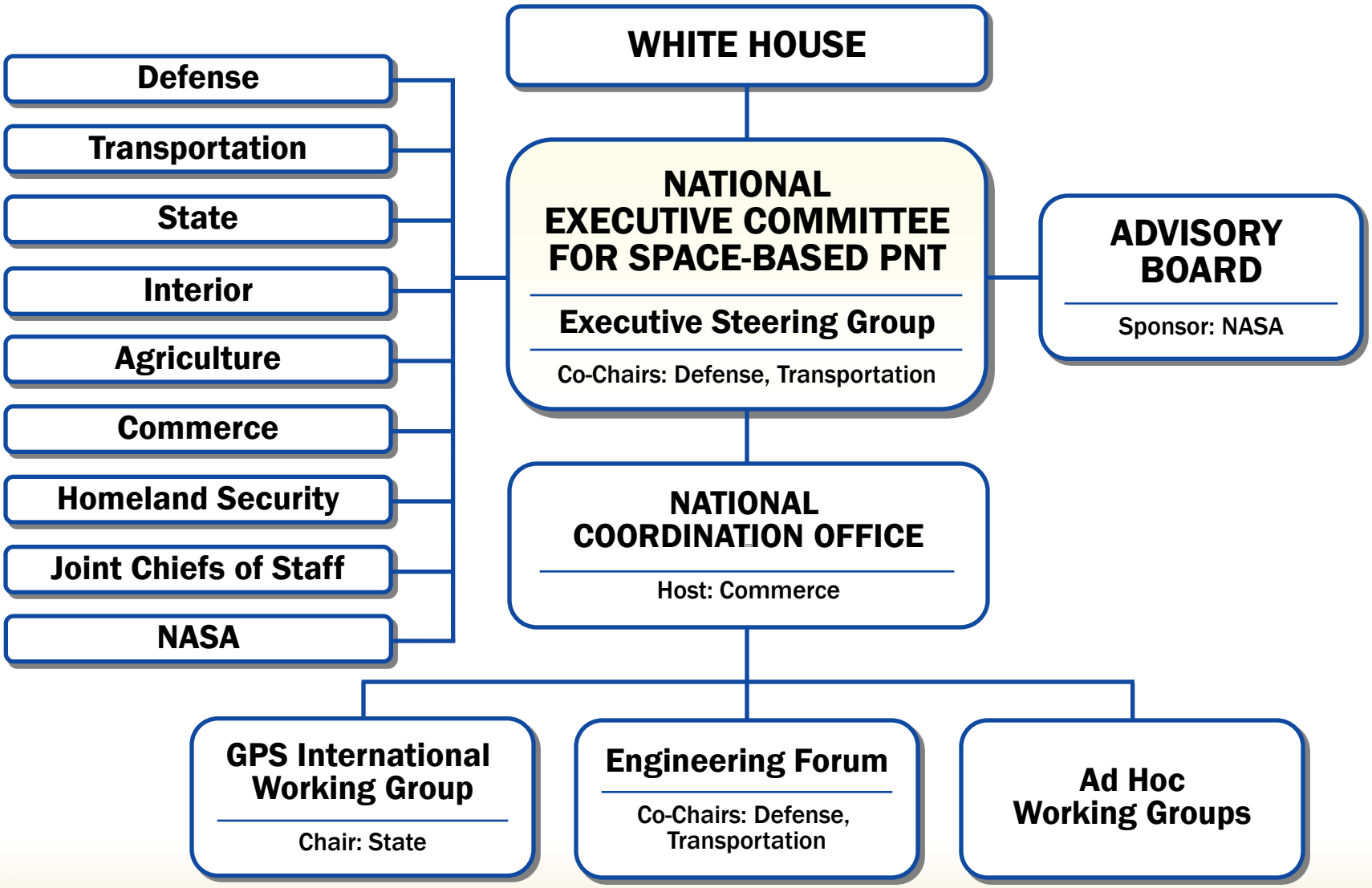
# U.S. Policy

- Continuous, worldwide, free of direct user fees
- Encourage compatibility and interoperability with foreign GNSS services and promote transparency in civil service provisioning
- Operate and maintain constellation to satisfy civil and national security needs
  - Foreign PNT services may be used to augment and strengthen the resiliency of GPS
- Invest in domestic capabilities and support international activities to detect, mitigate and increase resiliency to harmful interference

# Governance Structure



# Summary

- GPS performance is better than ever and will continue to improve
- GPS enables many applications that support sustainable development
- U.S. policy provides a stable foundation for international GPS use, trust, and cooperation

# For More Information


**www.gps.gov**