



SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL COORDINATION OFFICE

Introduction to GPS and U.S. GPS Policy

Maps Camp
UN Headquarters New York
July 9, 2016

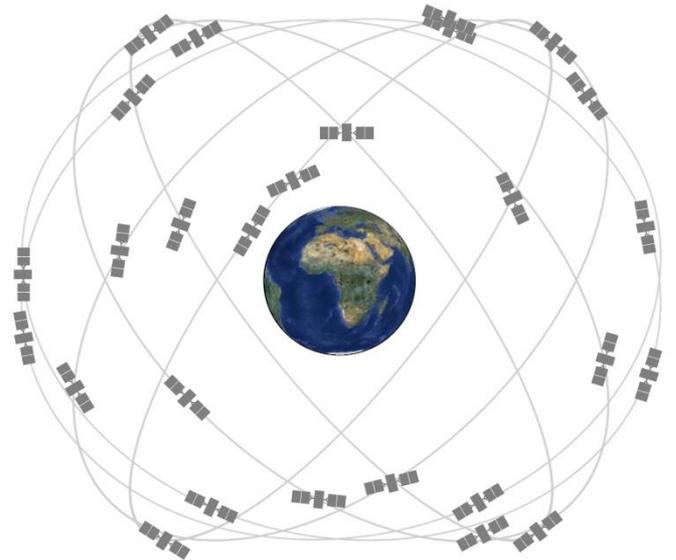
Jason Y. Kim
Senior Advisor



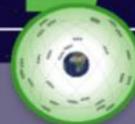
The Global Positioning System



- **Baseline 24+3 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**
- **Two types of signals:**
 - Standard (free of direct user fees)
 - Precise (U.S. and Allied military)
- **Three segments:**
 - Space
 - Ground control
 - User equipment



HOW GPS WORKS



GPS
IS A CONSTELLATION OF 24 OR MORE SATELLITES FLYING 20,350 KM ABOVE THE SURFACE OF THE EARTH. EACH ONE CIRCLES THE PLANET TWICE A DAY IN ONE OF SIX ORBITS TO PROVIDE CONTINUOUS, WORLDWIDE COVERAGE.

1 GPS satellites broadcast radio signals providing their locations, status, and precise time $\{t_s\}$ from on-board atomic clocks.

2 The GPS radio signals travel through space at the speed of light $\{c\}$, more than 299,792 km/second.

3 A GPS device receives the radio signals, noting their exact time of arrival $\{t_r\}$, and uses these to calculate its distance from each satellite in view.

To calculate its distance from a satellite, a GPS device applies this formula to the satellite's signal:
distance = rate x time
where **rate** is $\{c\}$ and **time** is how long the signal traveled through space.

The signal's travel **time** is the difference between the time broadcast by the satellite $\{t_s\}$ and the time the signal is received $\{t_r\}$.

4 Once a GPS device knows its distance from at least four satellites, it can use geometry to determine its location on Earth in three dimensions.

The GPS Master Control Station tracks the satellites via a global monitoring network and manages their health on a daily basis.

Ground antennas around the world send data updates and operational commands to the satellites.



The Air Force launches new satellites to replace aging ones when needed. The new satellites offer upgraded accuracy and reliability.

How does GPS help farmers? Learn more about the Global Positioning System and its many applications at

WWW.GPS.GOV

This poster is a product of the National Coordination Office for Space-Based Positioning, Navigation and Timing, an official body of the United States Government. Rocket image courtesy of JPLA.



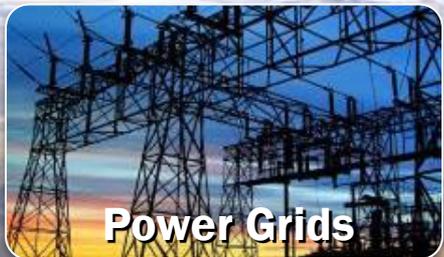
U.S. Economic Benefits of GPS Use Exceed \$55B/Year



Space Applications



Surveying and Mapping



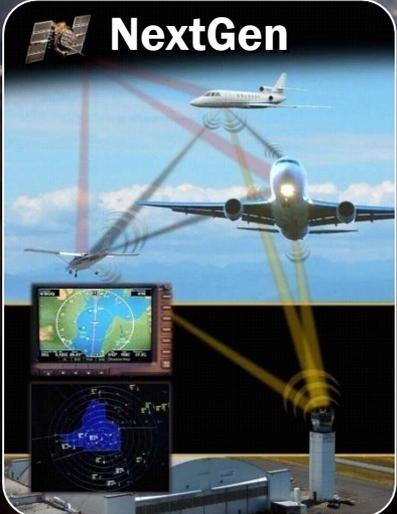
Power Grids



Precision Agriculture



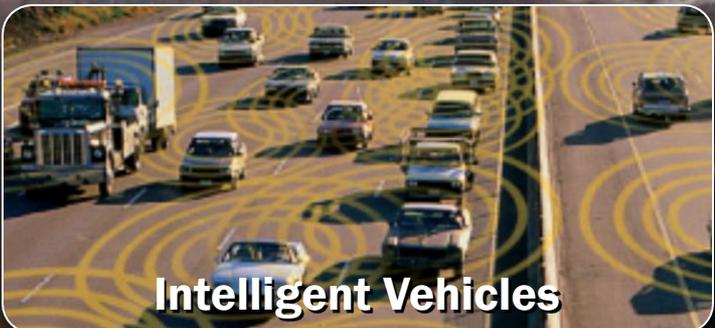
Transit Operations



NextGen



Disease Control Mapping



Intelligent Vehicles



TeleComm



Trucking



Personal Navigation



Shipping



Oil Exploration



Fishing and Boating



System Status



- **31 operational satellites**
 - **12 Block IIR**
 - **7 Block IIR-M (adds L2C)**
 - **12 Block IIF (adds L5)**
- **System accuracy better than published standard**
 - **38.2 cm User Range Error observed Apr 25, 2016**
 - **Global GPS civil service performance commitment met continuously since Dec 1993**
 - **Performance improving as new satellites replace older satellites**



GPS Block IIF



- Final satellite in the series launched Feb 5, 2016
- Available to users since Mar 9, 2016

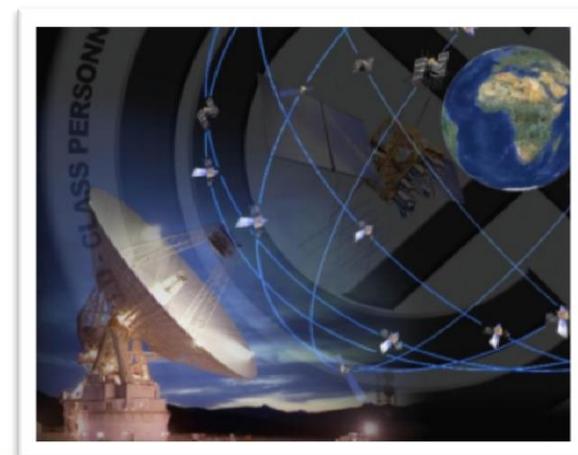
Courtesy ULA



The Future: GPS III & OCX



- **GPS III**
 - Next generation satellite design
 - 4 civil & 4 military signals
 - First 8 satellites on contract
 - First satellite expected to be available for launch this year
- **Next Generation Operational Control System (OCX)**
 - GPS III command & control
 - M-Code
 - Robust cyber security infrastructure
 - Modern civil signals & monitoring
 - Improved PNT performance





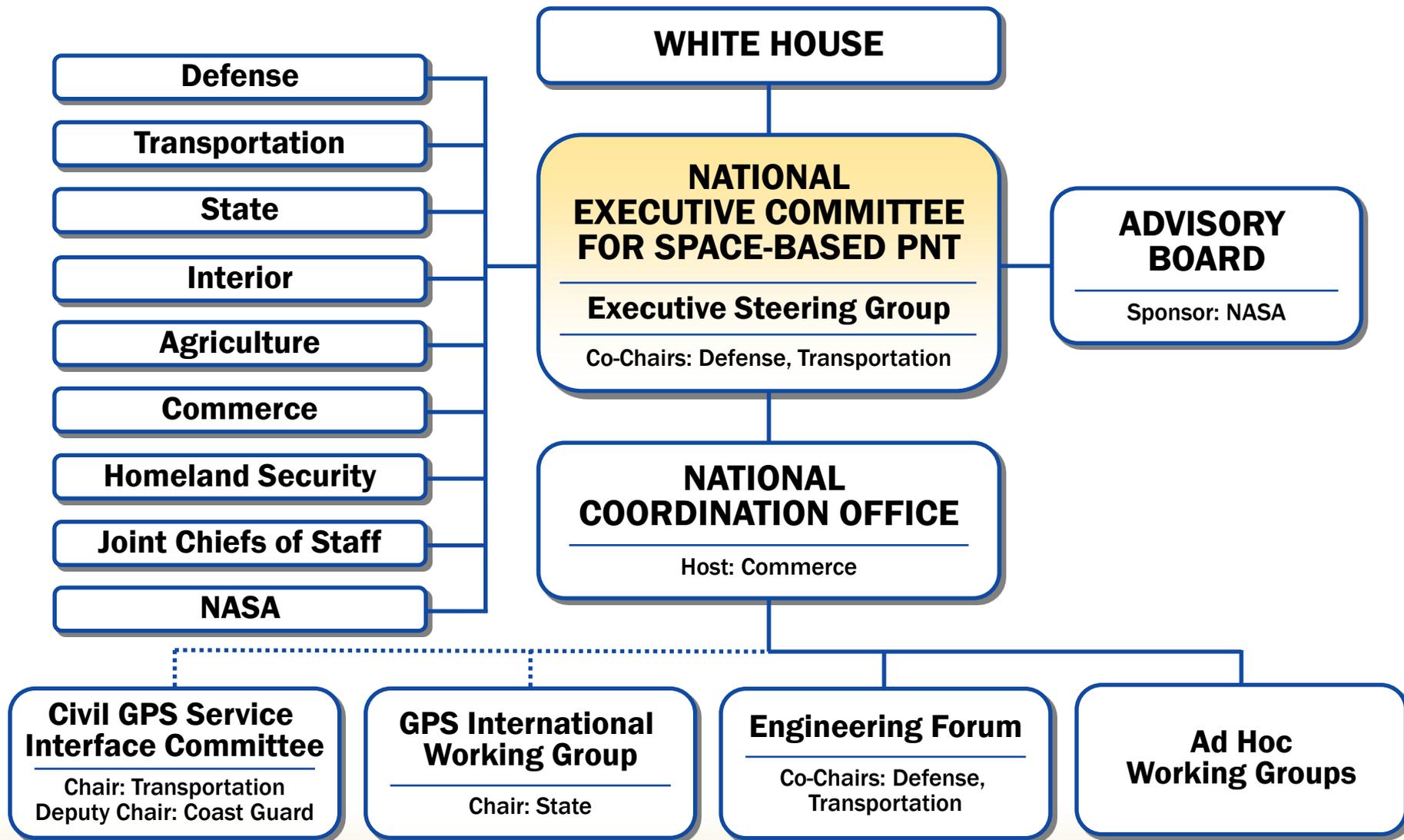
U.S. Policy Promotes Civilian GPS Use



- **No direct user fees for civil GPS services**
 - Provided on a continuous, worldwide basis
- **Open, free access to information necessary to use civil GPS and augmentations**
 - Anyone can develop applications, user equipment, and value-added services
 - Encourages market-driven competition
- **Global compatibility and interoperability with GPS**
- **Service improvements for civil, commercial, and scientific users worldwide**
- **Protection of radionavigation spectrum from disruption and interference**



Organization Structure





Strategic Focus Areas



- **GPS Sustainment and Modernization**
- **International Cooperation**
- **Spectrum Management**
- **Critical Infrastructure**
- **PNT Resilience**
- **Outreach**



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Official U.S. Government information about the Global Positioning System (GPS) and related topics

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Get Help with Map Problems

Do GPS devices show your home or business in the wrong place? Don't blame the GPS satellites... contact the map providers!

[LEARN HOW](#)

Feature Stories

Feb 5: Final GPS IIF Satellite Launched into Space

Air Force: 'GPS did not get you lost' (af.mil)

Attention Truckers: Do Not Use Consumer GPS Devices

[VIEW ALL NEWS](#)

New Additions to GPS.gov

- Jun 7: Proposed ICD changes
- Jun 6: Prague Space Security Conference presentation
- May 18: Advisory board



Summary



- **GPS is a radio beacon service enabling many applications**
- **GPS performance is better than ever and will continue to improve**
- **U.S. policy upholds longstanding commitments to free, continuous, worldwide GPS access**
- **GPS receives National-level attention and guidance**