



SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL COORDINATION OFFICE

Program and Policy Update

*14th Meeting
of the
International Committee on GNSS
Bangalore, India
9 December 2019*

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GPS Constellation Status



SPACE AND MISSILE SYSTEMS CENTER

35 Satellites • 30 Set Healthy
Baseline Constellation: 24 Satellites



Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIA	(2*)	25.9	26.0
GPS IIR	11	17.8	22.3
GPS IIR-M	7 (1*)	12.1	14.1
GPS IIF	12	5.8	9.5
GPS III	(2*)	0.6	0.9

*Ops capable; not set healthy

As of 13 Nov 19

GPS Signal in Space (SIS) Performance

From 14 Nov 18 to 13 Nov 19

Average URE*	Best Day URE	Worst Day URE
51.4 cm	36.2 cm (21 Sep 19)	66.6 cm (13 Oct 19)

*All User Range Errors (UREs) are Root Mean Square values



GPS Modernization



SPACE AND MISSILE SYSTEMS CENTER

Space Segment

SV families provide L-Band broadcast to User Segment

GPS IIA/IIR

- Basic GPS
- Nuclear Detonation Detection System (NDS)

GPS IIR-M

- 2nd Civil Signal (L2C)
- New Military Signal
- Increased Anti-Jam Power

GPS IIF

- 3rd Civil Signal (L5)
- Longer Life
- Better Clocks

GPS III (SV01-10)

- Accuracy & Power
- Increased Anti-Jam Power
- Inherent Signal Integrity
- 4th Civil Signal (L1C)
- Longer Life
- Better Clocks

GPS IIIF (SV11-32)

- Unified S-Band Telemetry, Tracking & Commanding
- Search & Rescue (SAR) Payload
- Laser Retroreflector Array
- Redesigned NDS Payload

Control Segment

TT&C of Space Segment assets & distribution of data to user interfaces

Legacy (OCS)

- Mainframe System
- Command & Control
- Signal Monitoring

Architecture Evolution Plan (AEP)

- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security
- Accuracy

OCX Block 0

- GPS III Launch & Checkout System

GPS III Contingency Ops (COps)

- GPS III Mission on AEP

M-Code Early Use (MCEU)

- Update OCS to operationalize Core M-Code

OCX Block 1

- Fly Constellation & GPS III
- Begin New Signal Control
- Upgraded Information Assurance

OCX Block 2+

- Control all signals
- Capability On-Ramps
- GPS IIIF Evolution

User Segment

Applies Space and Control Segment data for PNT applications

Continued support to an ever-growing number of applications

- Annual Public Interface Control Working Group (ICWG)
- Standard Positioning Service (SPS) Performance Standard Updates
- Sustained commitment to transparency
- Visit GPS.gov for more info

Modernized Civil Signals

- L2C (Various commercial applications)
- L5 (Safety-of-life, frequency band protected)
- L1C (Multi-GNSS interoperability)



WAAS Current Status



Current WAAS provides high availability service to aviation user in North America

- 4031 Localizer Performance with Vertical Guidance (LPV) approaches in the NAS
 - Over 1000 LPVs are LPV-200's which provides CAT I equivalent instrument approach performance

Preparing WAAS to take advantage of Dual Frequency service that will be provided by GPS

- To continue high availability of WAAS vertical service during ionospheric disturbances

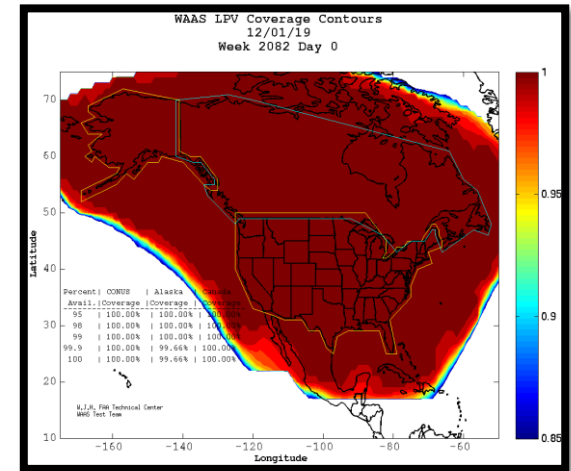
GEO Sustainability

- Currently maintaining 3 GEO's (Anik F1R [CRE], Eutelsat 117 WB [GEO 5], SES-15 [GEO 6])
- Developing future GEO's 7/8/9 to replace legacy GEO's upon lease expiration
 - GEO 7 is Intelsat at 125 West

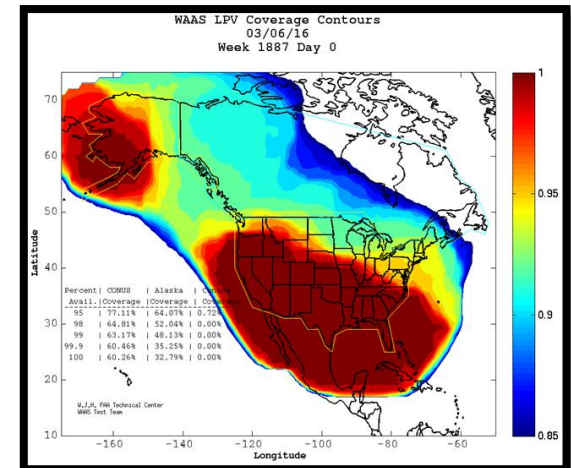
WAAS Modernization Efforts

- Dual Frequency Multi-Constellation (DFMC)
- Advanced Receiver Integrity Monitoring (ARAIM)

Current WAAS LPV Coverage



WAAS LPV Coverage March 6, 2016 Iono event





WAAS Avionics Equipage Status



- **Over 130,000 WAAS equipped aircraft in the NAS**
 - WAAS receivers provided by companies such as:
Garmin, Universal, Rockwell Collins, Honeywell, Avidyne,
Innovative Solutions & Support (IS&S), Thales and
Genesys Aerosystem (Chelton)
- **Since 2006, aircraft equipage rates have increased each year**
- **All classes of aircraft are served in all phases of flight**
- **Enabling technology for NextGen programs**
 - Automatic Dependent Surveillance Broadcast (ADS-B)
 - Performance Based Navigation (PBN)





U.S. Policy



The U.S. must maintain its leadership in the service, provision, and use of Global Navigation Satellite Systems (GNSS)

- **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**



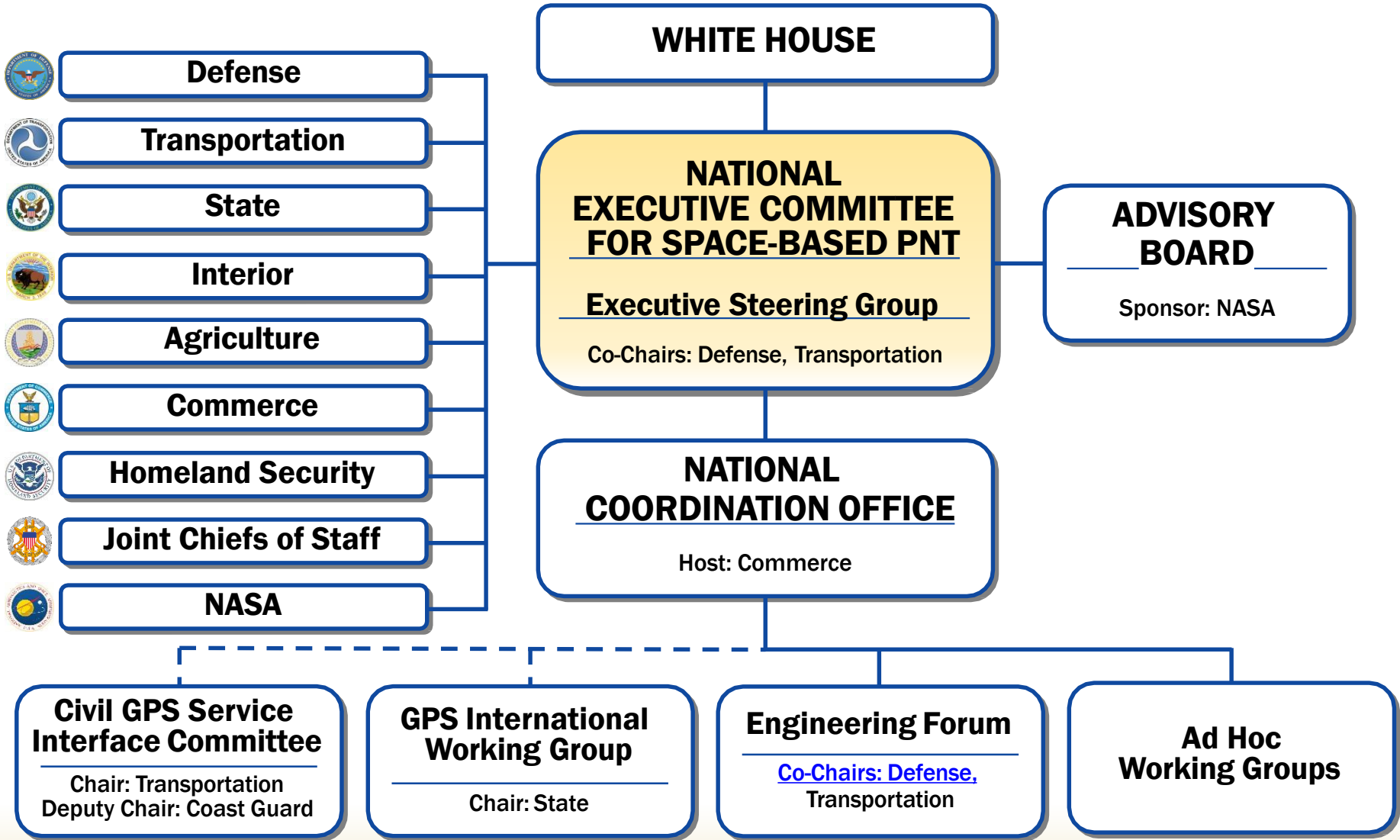
U.S. Policy



- **NSPD-39, the Space-Based Positioning, Navigation, and Timing Policy from 2004, is in the process of being updated by the National Space Council**
- **Remarks by DOT General Counsel at the 6th Meeting of the National Space Council:**
 - **Under National Security Presidential Directive 39, issued in December 2004, the United States is committed to developing, maintaining and a modernizing the global positioning system, or GPS, and other satellite-based navigation systems, including backup capability in the event of a disruption of GPS.**
 - **...”Working closely with the Commerce Department, NTIA, and the FCC,” DOT’s adjacent band compatibility study “shows we need strong, consistent policies to ensure protection for satellite-based navigation.”**



National Space-Based PNT Organization





Thank You



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GPS: Accessible, Accurate, Interoperable