SPACE-BASED POSITIONING
NAVIGATION & TIMING
NATIONAL COORDINATION OFFICE

U.S. Space-Based Positioning, Navigation and Timing (PNT) Status and Policy Update

ICG16
10 October 2022

Harold W. Martin III
Director
National Coordination Office

GPS Status

37 Satellites • 31 Set Healthy
Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIR	12 (5*)	20.7	25.1
GPS IIR-M	8 (1*)	14.9	16.9
GPS IIF	12	8.6	12.3
GPS III	5	2.4	3.7

*Not set healthy

As of 27 Aug 22

GPS Signal in Space (SIS) Performance

Week ending on 3 Sept 22

Average URE*	Best Day URE	Worst Day URE
49.1 cm	31.5 cm (20 Apr 21)	64.8 cm (20 May 22)

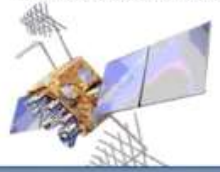
*All User Range Errors (UREs) are Root Mean Square values

GPS Modernization

SPACE SEGMENT (SATELLITES)

Legacy (GPS IIA/IIR)
- Basic GPS
- NUDET (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
- Improved Clocks

GPS IIIF (SV11-32)
- Unified S-Band Telemetry, Tracking, & Commanding
- Search & Rescue (SAR) Payload
- Laser Retroreflector Array
- Redesigned NDS Payload
- Regional Military Protect (RMP)

CONTROL SEGMENT (GROUND)

Legacy (OCS)
- Mainframe System
- Command & Control
- Signal Monitoring

Architecture Evolution Plan (AEP)
- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security & Accuracy
- Launch And Disposal Operations

OCX Block 0
- GPS III Launch & Checkout

GPS III Contingency Ops (COps)
- GPS III Mission on AEP

M-Code Early Use (MCEU)
- Update OCS to operationalize Core M-Code on AEP

OCX Blocks 1 and 2
- Fly GPS IIR/-M, GPS IIF, GPS III
- Modernize Cyber Architecture
- Operationalize Civil Signals (L1C, L2C, L5)
- Full M-Code

OCX Block 3F
- Incorporates GPS IIIF Command & Control
- Integrates new capabilities

USER SEGMENT (RECEIVERS)

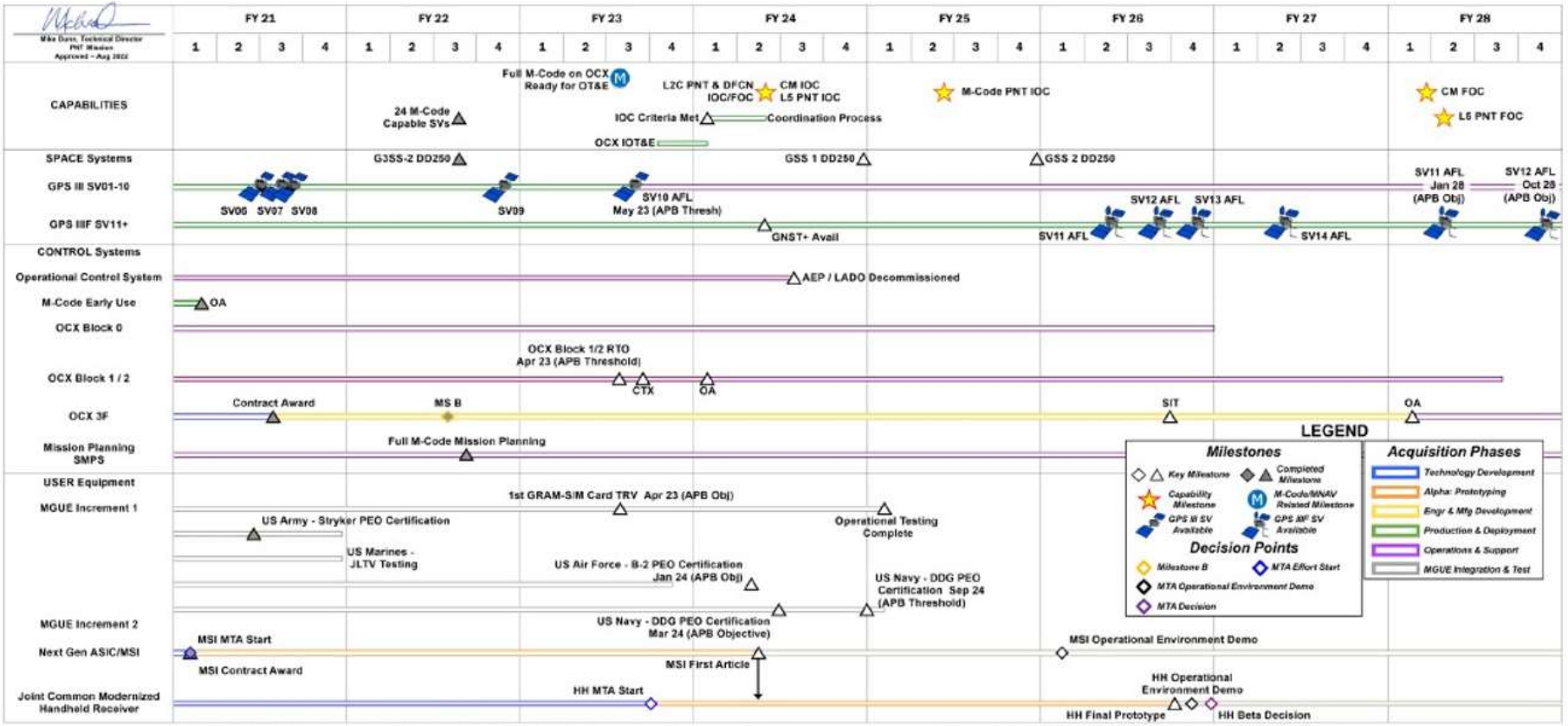
Legacy (PLGR/GAS-1/MAGR)
- First Generation System

Visit GPS.gov for more info

SAASM-era User Equipment
- Anti-Jam capability
- Electronic Protection

Military GPS User Equipment
- M-Code Receivers
- Common GPS Modules
- Increased Access Power w/ M-Code
- Increased Accuracy
- Increased Availability
- Increased Anti-Tamper Anti-Spoof
- Increased Acquisition in Jamming

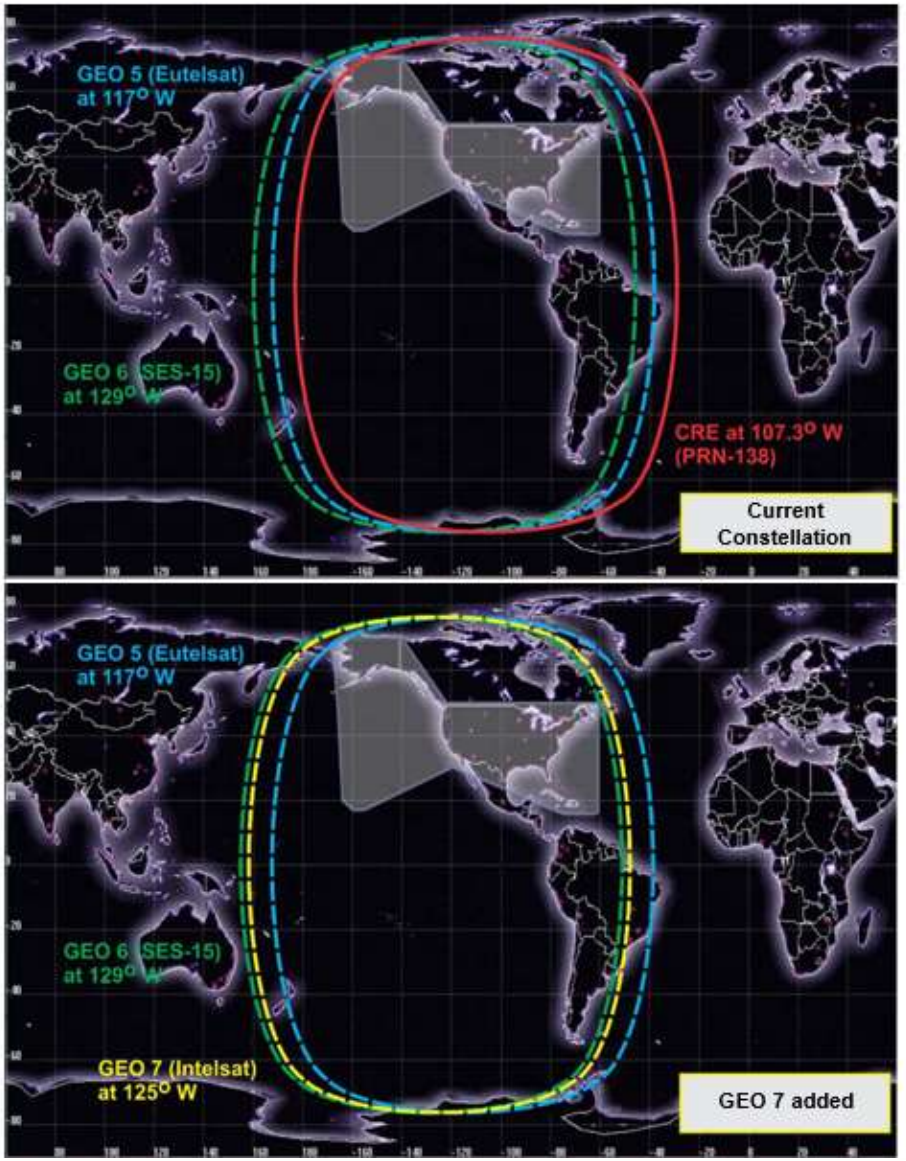
GPS Roadmap



AEP	Architecture Evolution Plan	DFCN	Dual-Frequency Civil Navigation	HH	Handheld	MNAV	Military Navigation	PEO	Program Executive Officer
AFL	Available for Launch	FOC	Full Operational Capability	IOC	Initial Operating Capability	MS	Milestone	PNT	Positioning, Navigation & Timing
APB	Acquisition Program Baseline	GRAM-S/M	GPS Receiver Application Module – Standard Elec Module/Modernized	IOT&E	Initial Operational Test & Evaluation	MSI	Miniature Serial Interface	RTO	Ready for Transition to Ops
ASIC	Application-Specific Integrated Circuit			JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	SMPS	SAASM Mission Planning System
CM	Constellation Management	G3SS	GPS III Satellite Simulator	LADO	Launch, Anomaly, and Disposal Operations	OA	Operational Acceptance	SIT	System Integration Test
CTX	Constellation Transfer	GNST+	GPS IIF Non-Flight Satellite Testbed	M-Code	Military Code	OCX	Next Gen Operational Control System	SV	Space Vehicle
DDG	Arleigh Burke Guided Missile Destroyer	GSS	GPS Satellite Simulator	MGUE	Military GPS User Equipment	OT&E	Operational Test and Evaluation	TRV	Technical Requirements Verification

WAAS Status 1

- GEO 5 (Eutelsat 117WB) - Operational March 2018
- GEO 6 (SES-15) - Operational July 2019
- GEO 7 (Intelsat G-30) – Operational April 2022
- GEO 7 Integration (integration of ground segment with the GEO) occurred in June 22



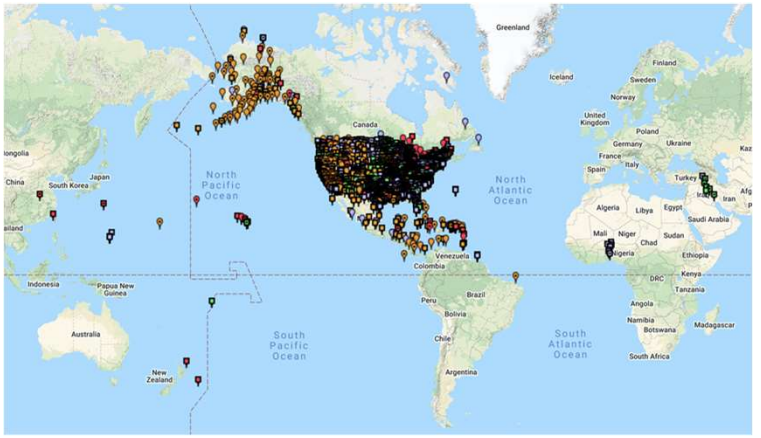
WAAS Status 2

- As of Sept 2022 there are currently 1,612 ILS procedures while WAAS has 4,825 LPV/LP procedures published

- Most of the airports throughout the National Airspace System contain WAAS Procedures

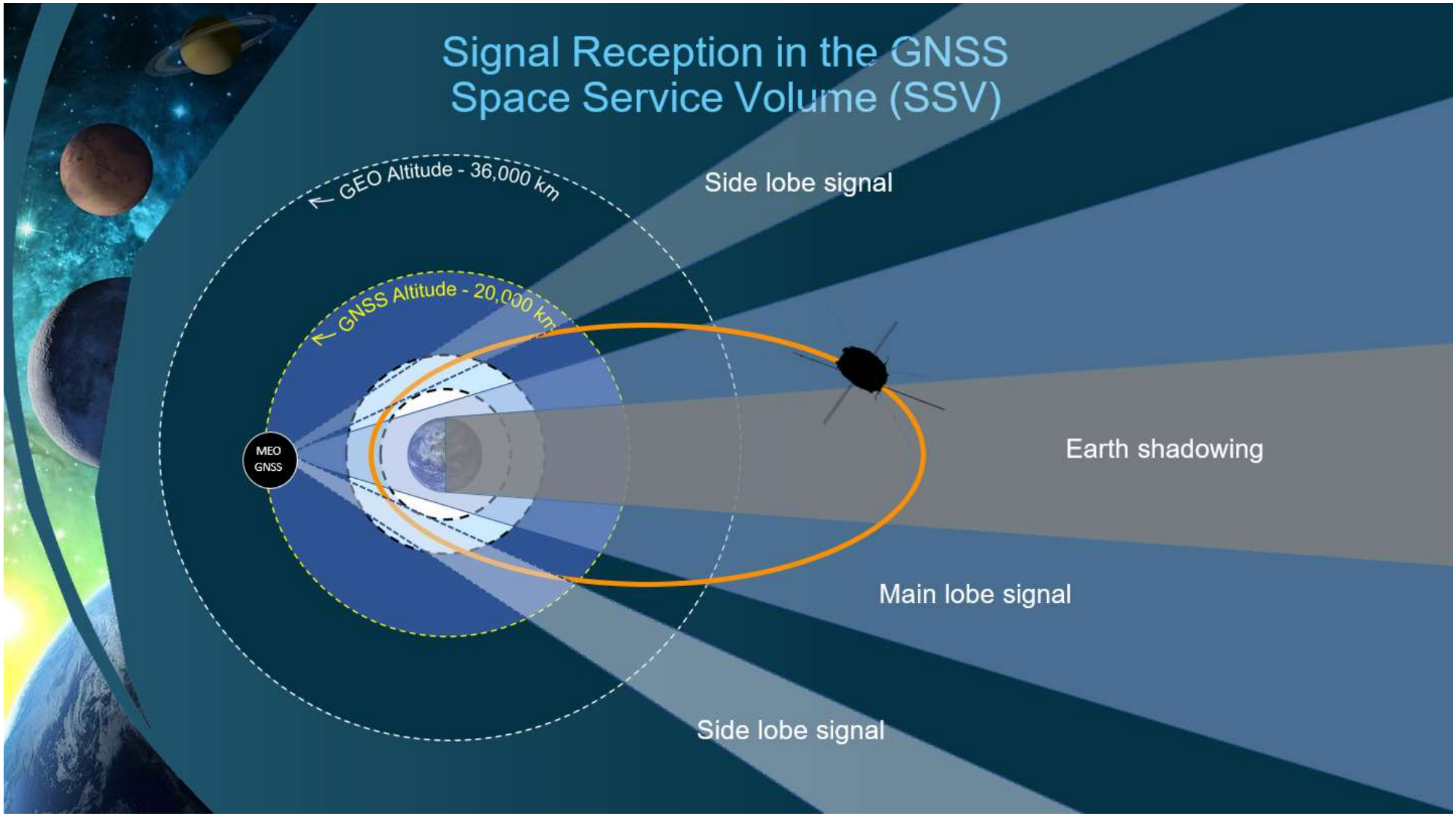
NOAA CORS Network (NCN)

- 1,887 Continuously Operating GNSS Reference Stations
  - 239 government, academic & private partners
  - Managed by National Geodetic Survey
  - Provides GNSS data supporting National Spatial Reference System, high precision 3D positioning, meteorology, space weather, other geophysical applications



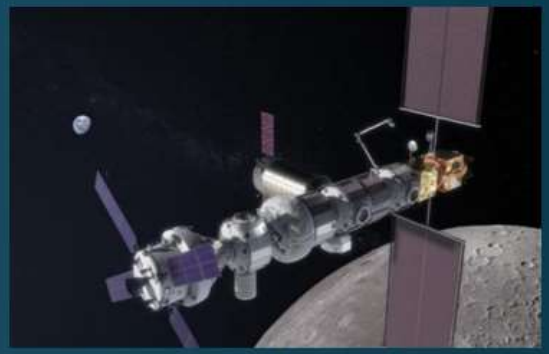
- Installing multiple GNSS stations and InSAR corner reflectors at each NRAO VLBA radio telescope
  - In collaboration with National Geospatial-Intelligence Agency
  - Will greatly improve ties between space geodetic techniques
  - Critical for defining terrestrial reference frame and tracking Earth's center of mass

GPS SSV


Signal Reception in the GNSS
Space Service Volume (SSV)
GEO Altitude - 36,000 km
GNSS Altitude - 20,000 km
MEO
GNSS
Side lobe signal
Earth shadowing
Main lobe signal
Side lobe signal

NASA Cislunar

Lunar Surface Operations, Robotic Prospecting,& Human Exploration



Human-tended Lunar Vicinity Vehicles (Gateway)

Robotic Lunar Orbiters, Resource & Science Sentinels

Earth, Astrophysics, & Solar Science Observations

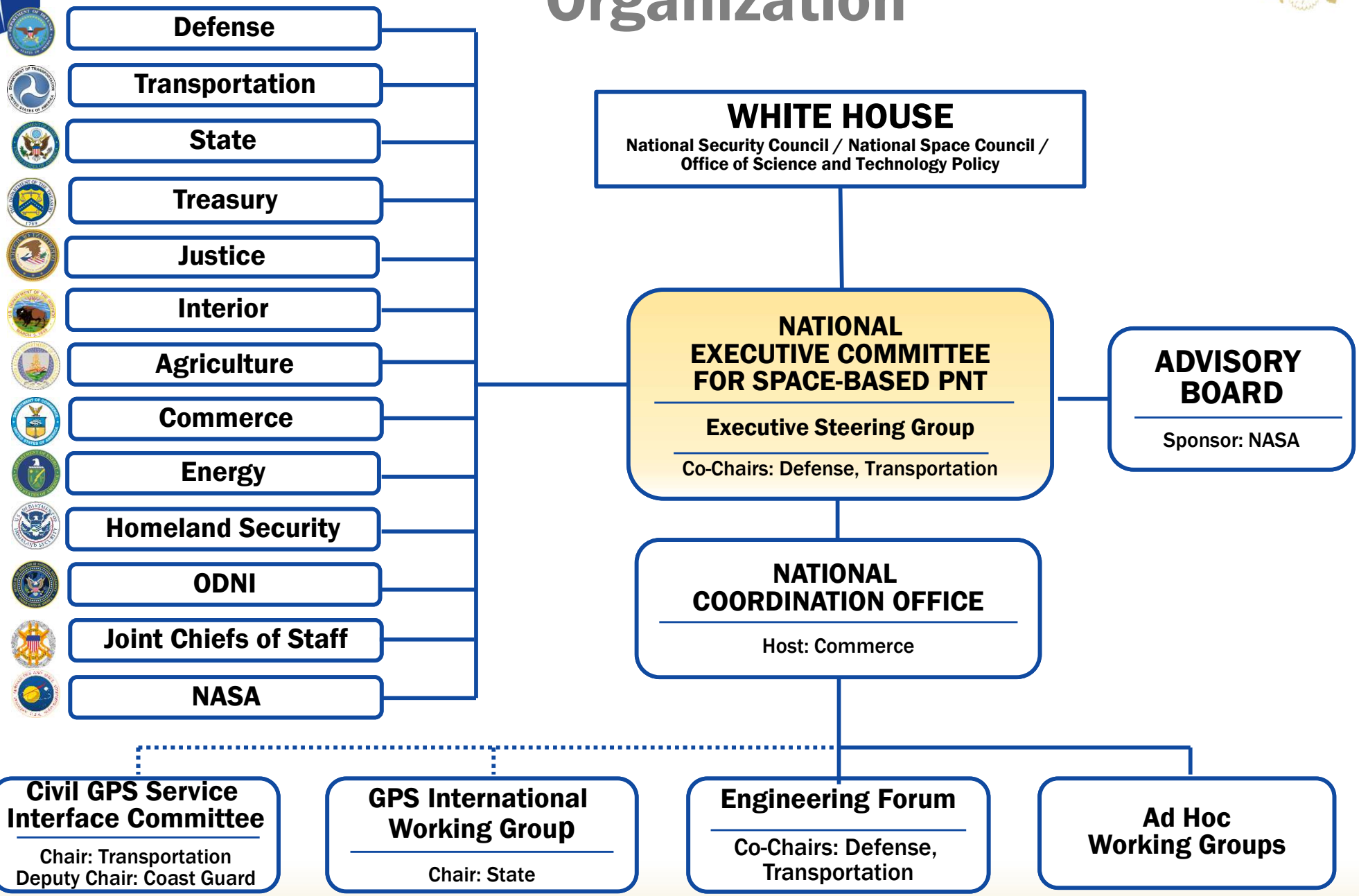
Satellite Servicing

Lunar Exploration Infrastructure

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*

National Space-Based PNT Organization



U.S. Policy

The goal of [SPD-7] is to maintain United States leadership in the service provision, and responsible use of global navigation satellite systems (GNSS), including GPS and foreign systems.

- Provide continuous, worldwide service free of direct user fees
- Encourage compatibility and interoperability with like-minded nations, promote transparency in civil service provisioning and enable market access for the United States industry
- Operate and maintain constellation to satisfy civil and national security needs and equip and train for the responsible use of GPS
  - Foreign PNT services may augment and strengthen the resiliency of GPS; however, the US Government does not assure the reliability or authenticity of foreign PNT services
- Invest in domestic capabilities and support international activities to detect, mitigate and increase resiliency to harmful interference
- Improve the cybersecurity of GPS, its augmentations, and United States Government-owned GPS-enabled devices, and foster private sector adoption of cyber-secure GPS-enabled systems

Space Policy Directive 7 (SPD-7)
of 15 January 2021

Updates and replaces U.S. Space-Based PNT Policy of 2004

- Increased focus on protecting GPS and denying hostile use
- Incorporated principles of Responsible Use of GPS in Executive Order (EO) 13905
- Consistent guidance across the PNT policy ecosystem: SPD-7, SPD-5, EO 13905, National Space Policy
- Expanded EXCOM Membership
  - Added Departments of Treasury, Justice, Energy, and the Office of the Director of National Intelligence
- New direction: Protect the spectrum environment that is currently used by GPS and its augmentations

SPD-7 Cont.

Describes EXCOM structure and tasks

- The EXCOM is the interagency body responsible for guiding and preserving whole-of-government interests in the provision of space-based PNT services, augmentations, and space-based alternatives
- The EXCOM shall make recommendations on sustainment, modernization, and policy matters regarding the United States space-based PNT services to its member agencies and the President (through the Executive Office of the President (EOP)
- Ensure that national security, homeland security, and civil requirements receive full and appropriate consideration in the decision-making process
- Review PNT spectrum management and protection issues in coordination with the Department of Commerce

Spectrum Protection: Background

- FY21 NDAA chartered National Academy of Sciences, Engineering, and Medicine (NASEM) technical review of FCC order 2021
- NASEM issued notice on 16 Aug 2022 that it would release the report on 9 Sep 2022
- NASEM released a Study report on 9 Sep 2022
- National Telecommunications and Information Administration (NTIA) issued a press release on NASEM Study 9 Sep 2022
- The Department of Defense (DoD) issued a press release on NASEM Study 9 Sep 2022
- EXCOM issued a statement on NASEM Study 9 Sep 2022

EXCOM Statement on NASEM Study

Slide 1 of 2

September 9, 2022

The National Space-Based Positioning, Navigation, and Timing Executive Committee (EXCOM) appreciate the study by the National Academies of Science, Engineering and Medicine (NASEM) committee on the important topic of interference to GPS capabilities, including those critical to national, homeland, and economic security.

The EXCOM, co-chaired by the Deputy Secretaries of the Departments of Defense (DoD) and Transportation (DOT), and with membership from over a dozen Departments and Agencies, supports the stated National Policy goal to protect the spectrum environment that GPS currently uses and its augmentations, including critical systems for Federal Government, the men and women of our Military Services, the economy, scientific advancements, and U.S. Critical Infrastructure.

EXCOM Statement on NASEM Study

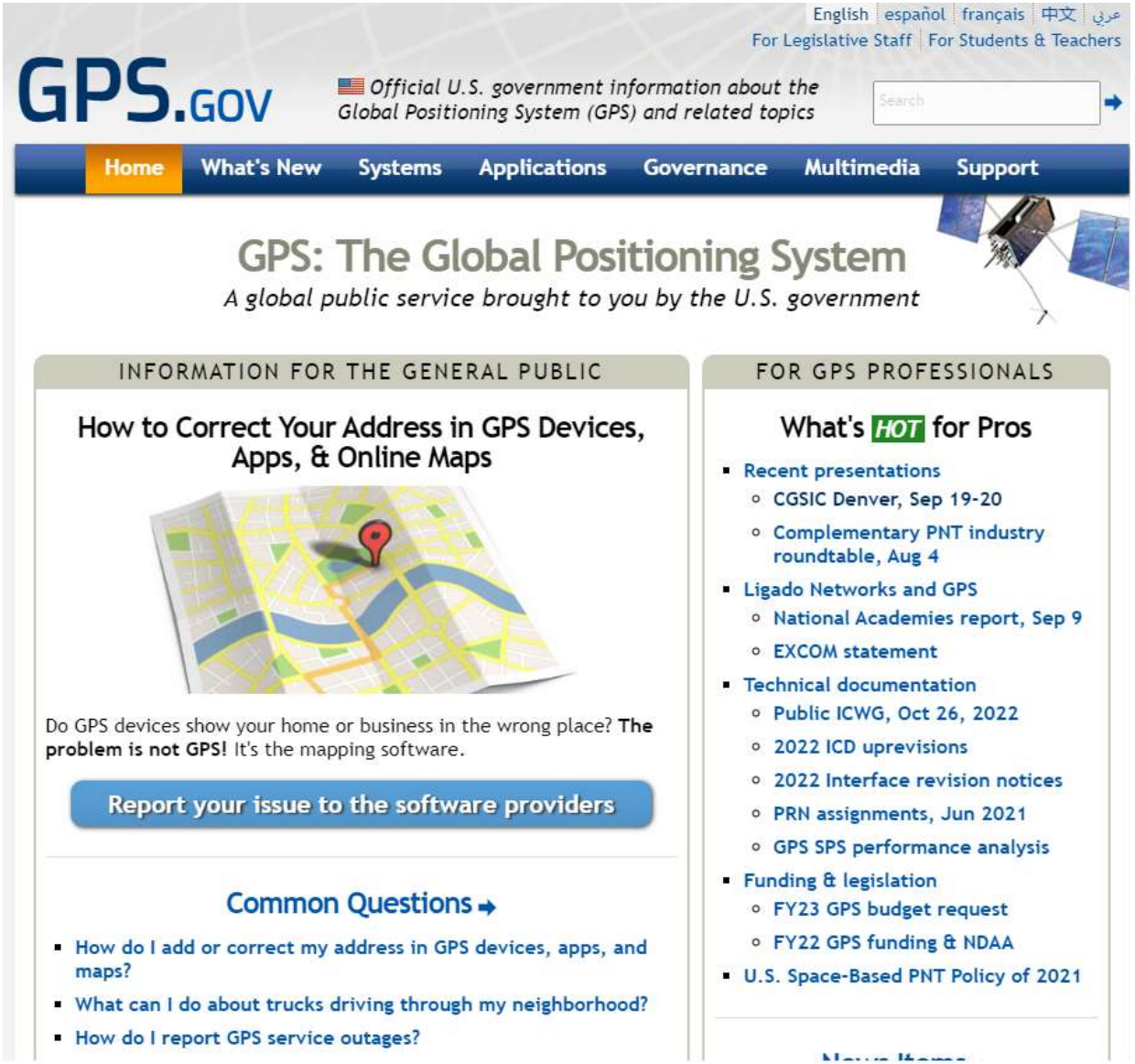
Slide 2 of 2

The EXCOM agrees with the statements by DoD and the NTIA about the NASEM study.

The EXCOM will review this lengthy study more carefully but agrees with the statements that our Nation requires a solution that ensures continued operations of critical systems. The study confirms that the GPS interference testing approach used by DoD and DOT, base the d on the signal-to-noise ratio, is more comprehensive and informative when done properly. In addition, the EXCOM agrees with NASEM's assessment that the proposed mitigation and replacement measures are impractical, cost prohibitive, and possibly ineffective.

The EXCOM looks forward to continuing to work with Departments and Agencies across America on this complex and important issue.

www.GPS.gov


English español français 中文 عربي
For Legislative Staff For Students & Teachers
GPS.GOV
Official U.S. government information about the Global Positioning System (GPS) and related topics
Search
Home What's New Systems Applications Governance Multimedia Support
GPS: The Global Positioning System
A global public service brought to you by the U.S. government
INFORMATION FOR THE GENERAL PUBLIC
How to Correct Your Address in GPS Devices, Apps, & Online Maps
Do GPS devices show your home or business in the wrong place? The problem is not GPS! It's the mapping software.
Report your issue to the software providers
Common Questions
How do I add or correct my address in GPS devices, apps, and maps?
What can I do about trucks driving through my neighborhood?
How do I report GPS service outages?
FOR GPS PROFESSIONALS
What's HOT for Pros
Recent presentations
CGSIC Denver, Sep 19-20
Complementary PNT industry roundtable, Aug 4
Ligado Networks and GPS
National Academies report, Sep 9
EXCOM statement
Technical documentation
Public ICWG, Oct 26, 2022
2022 ICD uprevisions
2022 Interface revision notices
PRN assignments, Jun 2021
GPS SPS performance analysis
Funding & legislation
FY23 GPS budget request
FY22 GPS funding & NDAA
U.S. Space-Based PNT Policy of 2021