

Department of the Air Force

GPS Program Update



Capt Max Butler
Space Systems Command
21 March 2023



Position, Navigation, and Timing Policy

“Maintain United States leadership in the service provision, and responsible use of global navigation satellite systems, including GPS and foreign systems.”



Free Civilian Use



GPS as a National Asset



GPS Modernization



International Cooperation



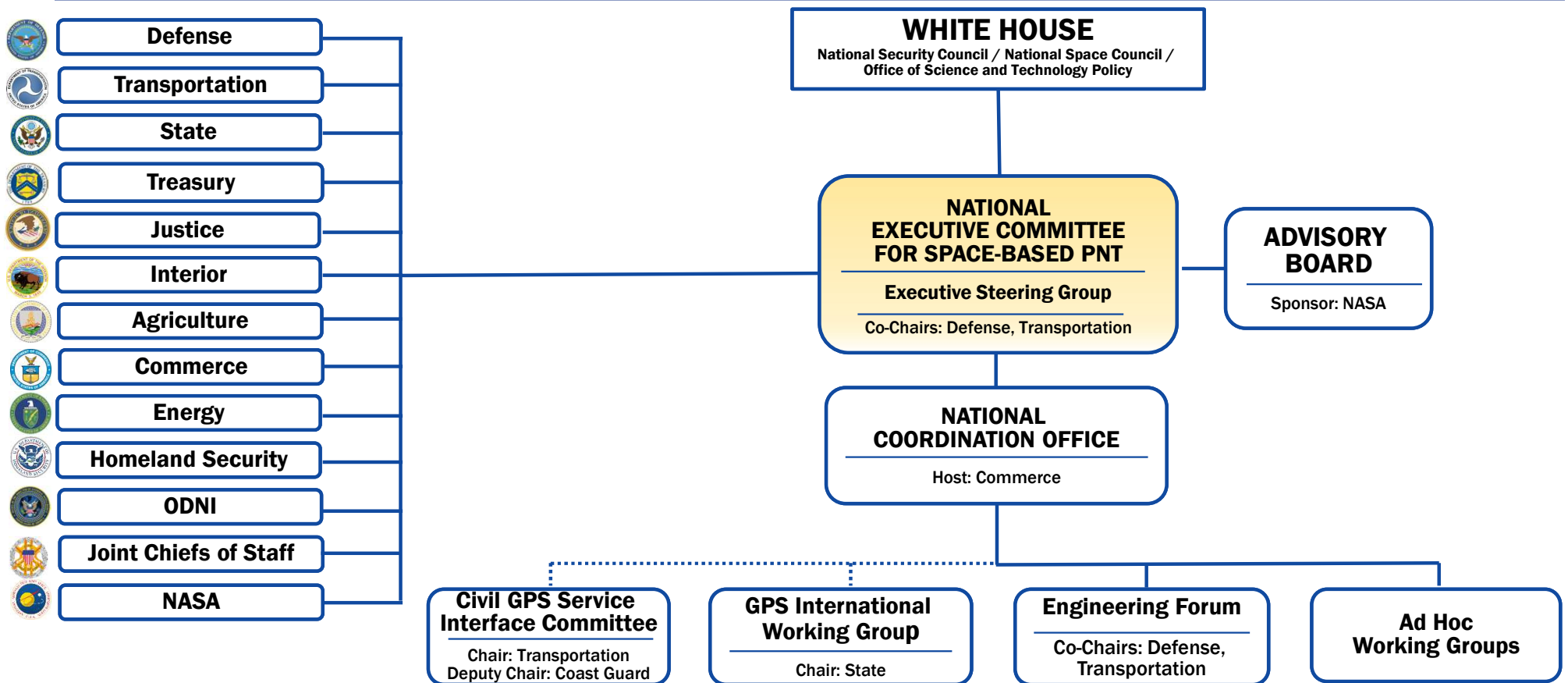
Deny Hostile Use



Spectrum Protection

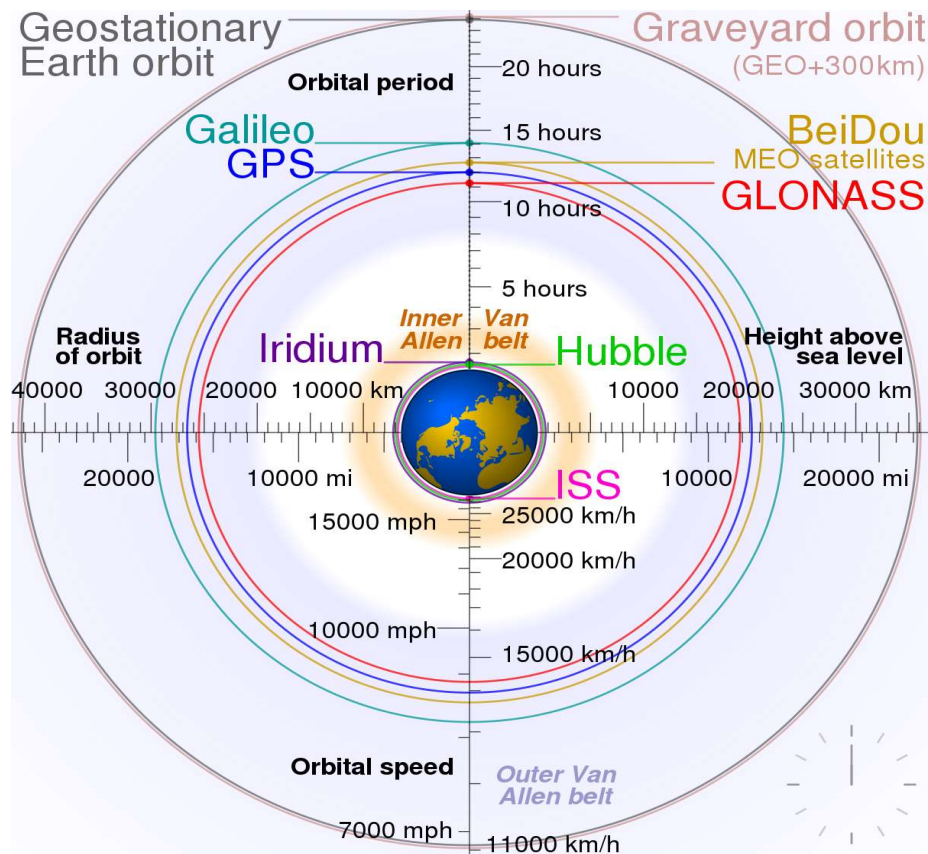


National Space-based PNT Governance





Brief Overview and History



- Timation & Transit
- Secor
- AF 621B
- GPS I
- KAL Flight 007
- GPS Block II/IIA
- End of Selective Availability



GPS Constellation 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)

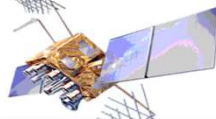
Legacy (GPS IIA/IIR)

- 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 Block 1

- Fly Constellation & GPS III
- Control New Signals
- Upgrade Cyber Security

OCX Block 2

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

OCX Block 3F

- Incorporates GPS IIIF Command & Control
- Integrates new capabilities



USER SEGMENT (RECEIVERS)

Continued Support to growing number of applications

Visit [GPS.gov](https://www.gps.gov) for more info



Sustained commitment to transparency



Modernized Civil Signals

- L2C, Commercial applications
- L5, Safety of life, band protected
- L1C, Multi-GNSS interoperability





Improved Civil Signals

Three New Navigation Signals Designed for Civilian Use:

- Civilian L2 (L2C)
- Safety of Life (L5)
- New Civilian L1 (L1C)





GPS Enables Infrastructure

MUNICIPAL SERVICES

GPS can be used for real-time tracking of **garbage trucks, snowplows, and buses**, leading to substantial savings in **dollars, fuel, and time**.

In Niles, IL, the Department of Public Works used GPS to optimize the routing of snowplows, leading to:³

40%

Reduction in the use of salt

700+

Tons of salt saved

TRANSPORTATION

GPS is at the heart of the FAA's Next Generation Air Transportation System. GPS enabled optimized flight paths can reduce:



Autonomy



Public Safety



AGRICULTURE

By **2030**, GPS-enabled precision agriculture can save **180 billion cubic meters of water**.¹



The use of GPS guidance systems on 10% of planted acres in the U.S. each year would reduce:²



Fuel use by **16 million gallons**



Herbicide use by **2 million quarts**



Insecticide use by **4 million pounds**

CONSTRUCTION

High-precision GPS is used to support the building of roads, bridges, and other infrastructure projects.

Projects utilizing GPS can:



Reduce wetland impacts



Reduce impact to sensitive species



Reduce landslide risks



Reduce residential displacement



Minimize impact on existing utilities

Finance





Global Perspective

- **Global Constellations**

- **GPS (24+6)**
- **GLONASS (24+)**
- **GALILEO (24+3)**
- **BDS/BEIDOU (27+3 IGSO + 3 GEO)**

- **Regional Constellations**

- **QZSS (4+3)**
- **IRNSS/NAVIC (7)**
- **Korea – KPS (7)**

- **Plus Satellite-based Augmentation Systems**





16th International Committee on GNSS



- Held in hybrid format with both in-person and virtual participation
 - More than 200 people participated
 - All 6 GNSS Providers, as well as other members and observers
- Agenda included:
 - Meeting of the Providers' Forum
 - System Provider Updates
 - Applications and Experts Session
 - Meeting of all four Working Groups





Thank You!

