

# *Department of the Air Force*

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## 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



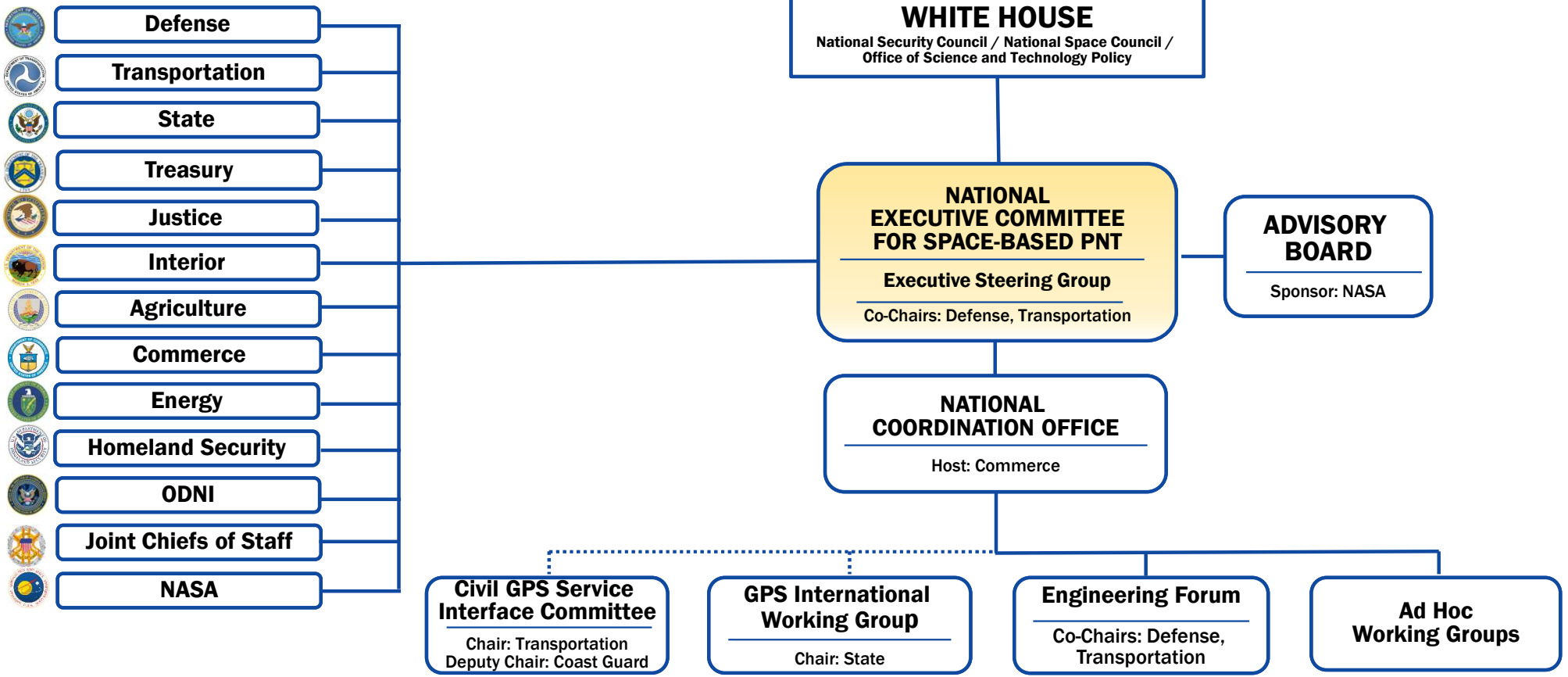
Deny Hostile Use



Spectrum Protection

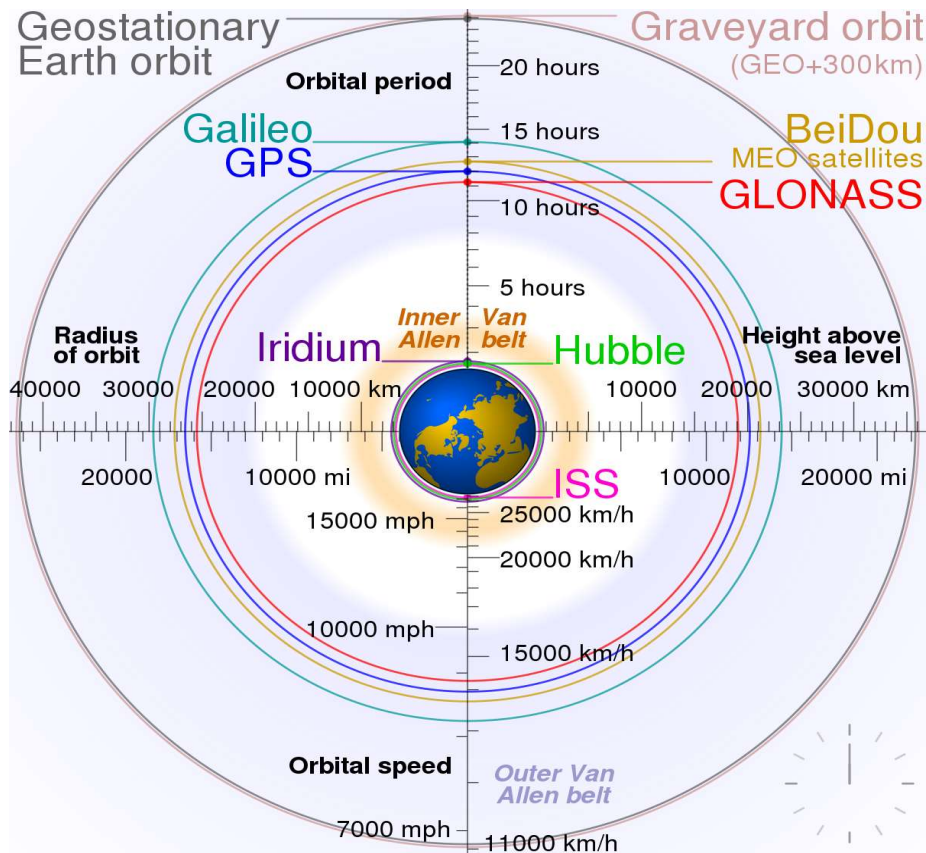


# National Space-based PNT Governance





# 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)

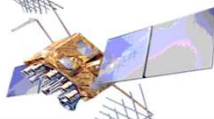
### Legacy (GPS IIA/IIR)

- 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](http://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:<sup>2</sup>

**40%**

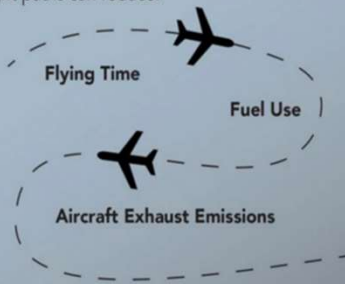
Reduction in the use of salt

**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**.<sup>1</sup>



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

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**





# 16<sup>th</sup> 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!***

