



# ***GPS Policy and Program Update***

***ION Pacific PNT  
Honolulu, HI***

***U.S. Department of State  
and  
GPS Directorate***

***08 April 2019***



# *Outline*

- U.S. PNT Policy
- GPS Program Update
- International Cooperation Update



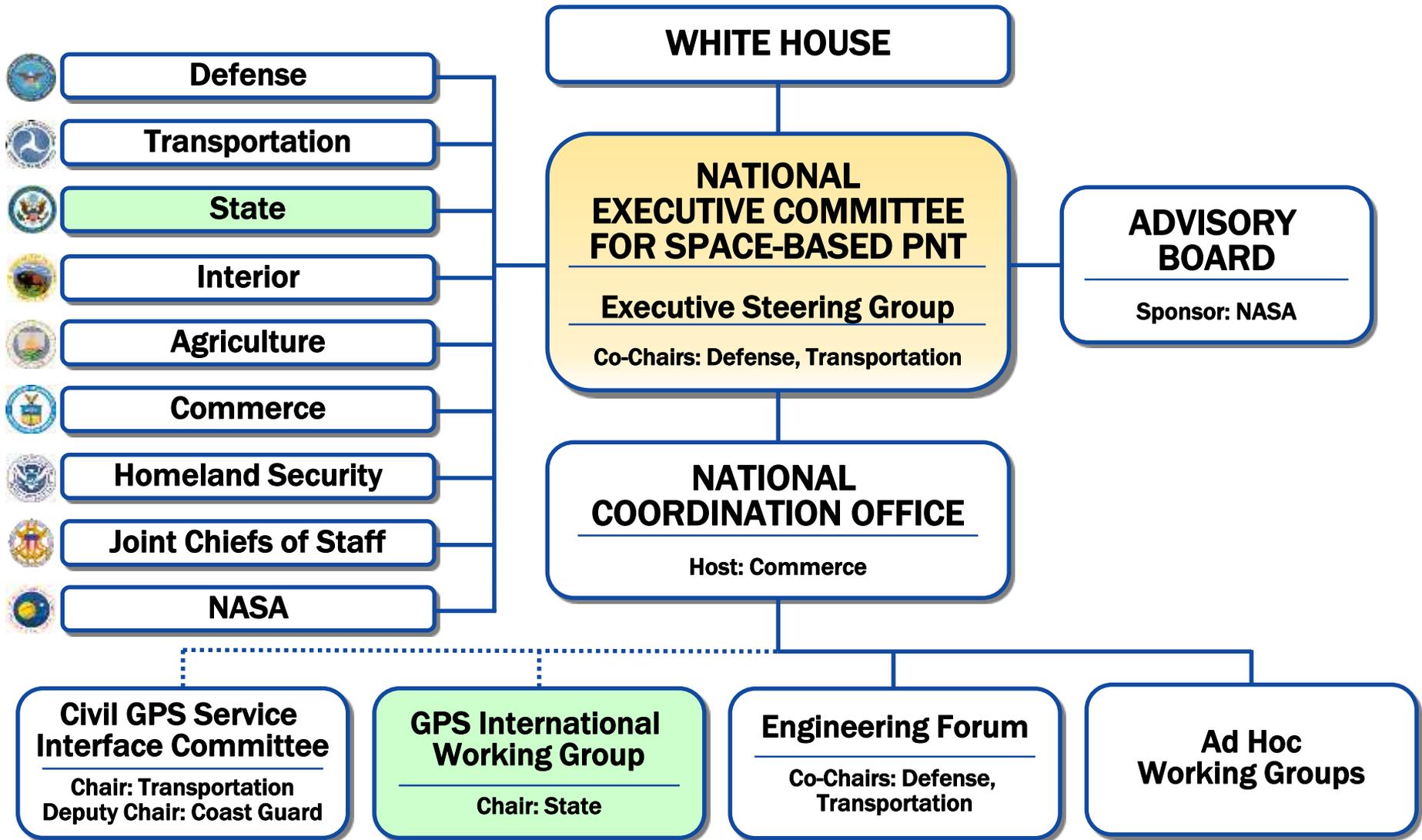
# *U.S. National Space Policy*

## ***Space-Based PNT Guideline: Maintain leadership in the service, provision, and use of GNSS***

- Provide civil GPS services, free of direct user charges
  - Available on a continuous, worldwide basis
  - Maintain constellation consistent with published performance standards and interface specifications
  - Foreign PNT services may be used to augment and strengthen the resiliency of GPS
- Encourage global *compatibility* and *interoperability* with GPS
- Promote *transparency* in civil service provision
- Enable *market access* to industry
- Support international activities to detect and mitigate harmful interference



# National Space-Based PNT Organization





# GPS Overview

## Civil Cooperation

- 3+ Billion civil & commercial users worldwide
- Search and Rescue
- Civil Signals
  - L1 C/A (Original Signal)
  - L2C (2<sup>nd</sup> Civil Signal)
  - L5 (Aviation Safety of Life)
  - L1C (International)



## Spectrum

- World Radio Conference
- International Telecommunication Union
- Bilateral Agreements
- Adjacent Band Interference



## Department of Transportation

- Federal Aviation Administration

## Department of Homeland Security

- U.S. Coast Guard

## 34 Satellites / 31 Set Healthy Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age	Oldest
GPS IIA	1	25.4	25.4
GPS IIR	11	17.1	21.6
GPS IIR-M	7	11.6	13.4
GPS IIF	12	5.1	8.8
Constellation	31	11.5	25.4

AS OF 6 MAR 19



## Department of Defense

- Services (Army, Navy, AF, USMC)
- Agencies (NGA & DISA)
- US Naval Observatory
- PNT EXCOM
- GPS Partnership Council

## Maintenance

- Develop & Publish ICDs Annually
  - Public ICWG: Worldwide Involvement
  - Materials Available at: [gps.gov/technical/icwg](http://gps.gov/technical/icwg)
- Update GPS.gov Webpage
- Distribute PRNs for the World
  - 120 for US and 90 for GNSS

## International Cooperation

- 57 Authorized Allied Users
  - 25+ Years of Cooperation
- GNSS
  - Europe - Galileo
  - China - Beidou
  - Russia - GLONASS
  - Japan - QZSS
  - India - NAVIC



# GPS SIS Performance Scoreboard

## GPS SIGNAL IN SPACE (SIS) PERFORMANCE (CM) (VS. JPL, RMS, URE, CM)

**BEST WEEK \***

**BEST DAY \***

**WORST DAY \***

**ENDING**

**URE**

**ENDING**

**URE**

**ENDING**

**URE**

**ROLLING YEAR**

**8 DEC 18**

**45.7**

**14 MAR 18**

**37.5**

**27 AUG 18**

**73.2**

**BEST WEEK EVER**

**29 NOV 16**

**44.1**

*\*ROLLING YEAR*





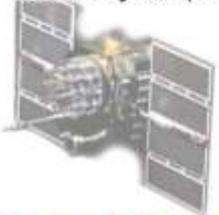
# GPS Modernization

## Space Segment

SV families provide L-Band broadcast to User Segment

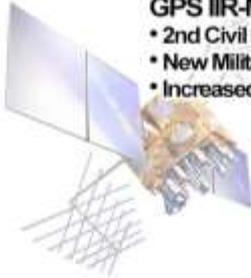
### Legacy (GPS IIA/IIR)

- Basic GPS
- NUDET (Nuclear Detonation) Detection System (NDS)



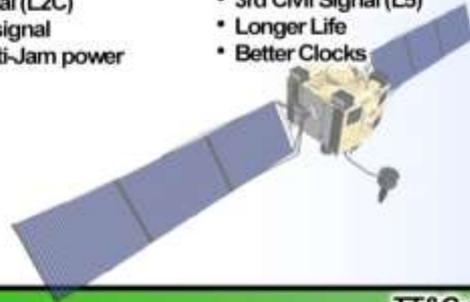
### GPS IIR-M

- 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
- Common L1C Signal
- Longer Life



### GPS III (SV11+)

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



## Ground Segment

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

### Legacy (OCS)

- Mainframe System
- Command & Control
- Signal Monitoring

### AEP

- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security
- Accuracy
- Launch And Disposal Operations



### OCX Block 1

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

### OCX Block 2+

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

### OCX Block 0

- GPS III Launch & Checkout

### GPS III Contingency Ops (COps)

- GPS III Mission on AEP

## User Segment

Applies Space and Control Segment data for PNT applications

### Modernized Civil Signals

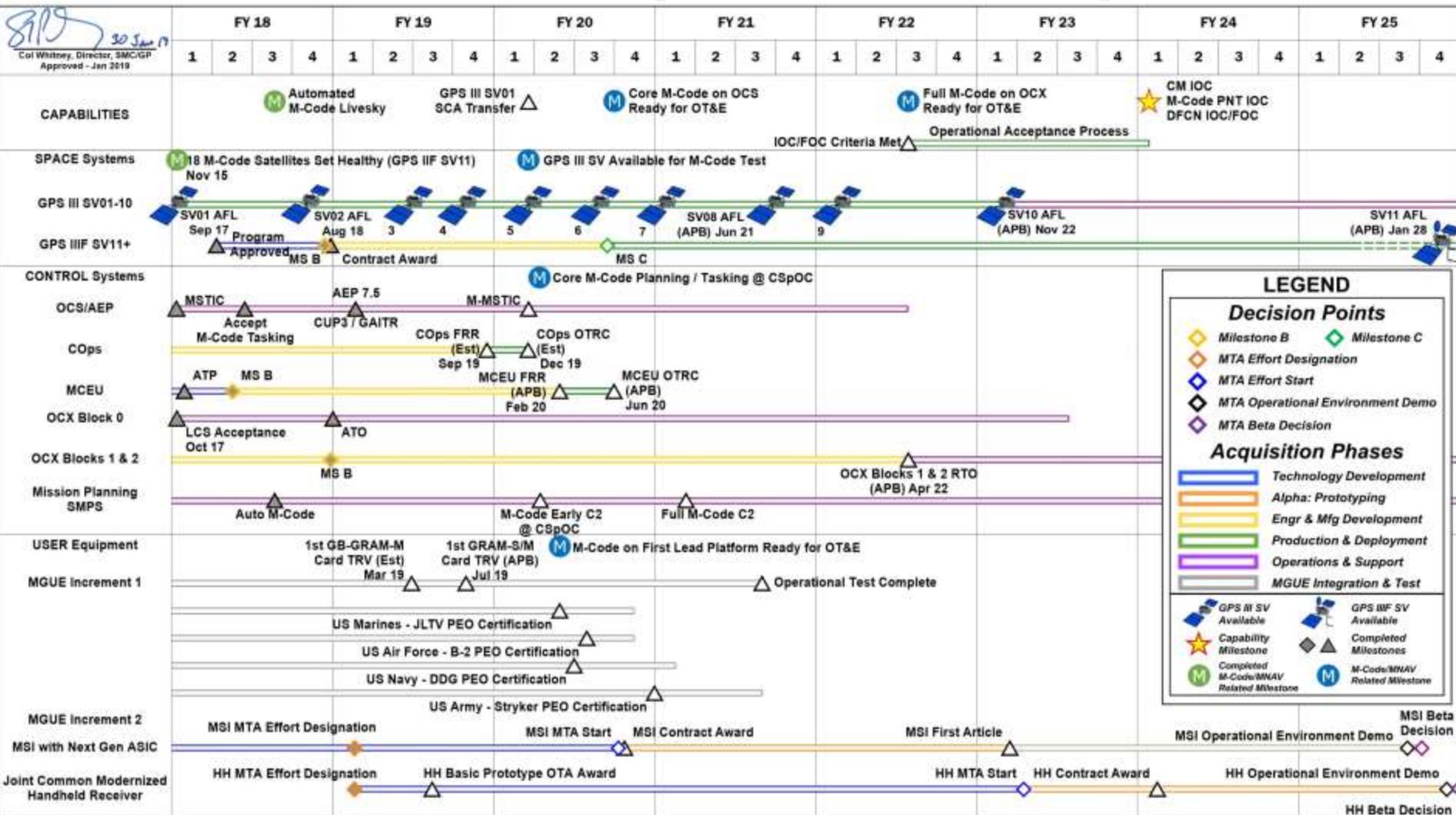
- L1C
- L2C
- L5



### Continued support to an ever-growing number of applications

- Annual Public Interface Control Working Group
- Imminent update of SPS Performance Standard
- Sustained commitment to transparency, renew focus on agility

# GPS Enterprise Roadmap



AEP	Architecture Evolution Plan	CSpOC	Combined Space Operations Center	GB-GRAM-M	Ground Based GPS Receiver Application Module - Modernized	MGUE	Military GPS User Equipment	OT&E	Operational Test and Evaluation
AFL	Available for Launch	CUP	COTS Upgrade Project	GRAM-S/M	GPS Receiver Application Module - Standard Elec Module/Modernized	M-MSTIC	Modernized-Monitor Station Tech Improvement & Capability	OTRC	Ops Test Readiness Certification
APB	Acquisition Program Baseline	DDG	Arleigh Burke Guided Missile Destroyer	HH	Handheld	MS	Milestone	PEO	Program Executive Officer
ASIC	Application-Specific Integrated Circuit	DFCN	Dual-Frequency Civil Navigation	IOC	Initial Operating Capability	MSI	Miniature Serial Interface	PNT	Positioning, Navigation & Timing
ATO	Authority to Operate	Est	Forecast Estimate	JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	RTO	Ready for Transition to Ops
ATP	Authority to Proceed	FOC	Full Operational Capability	LCS	GPS III Launch & Checkout System	OCX	Operational Control System	SCA	Spacecraft Control Authority
C2	Command & Control	FRR	Fielding Readiness Review	MCEU	M-Code Early Use	OCX	Next Gen Operational Control System	SMPS	SAASM Mission Planning System
CM	Constellation Management	GAITR	Ground Antenna Interface Technical Refresh			OTA	Other Transaction Agreement	SV	Space Vehicle
COps	GPS III Contingency Operations							TRV	Technical Requirements Verification

# GPS Firsts!

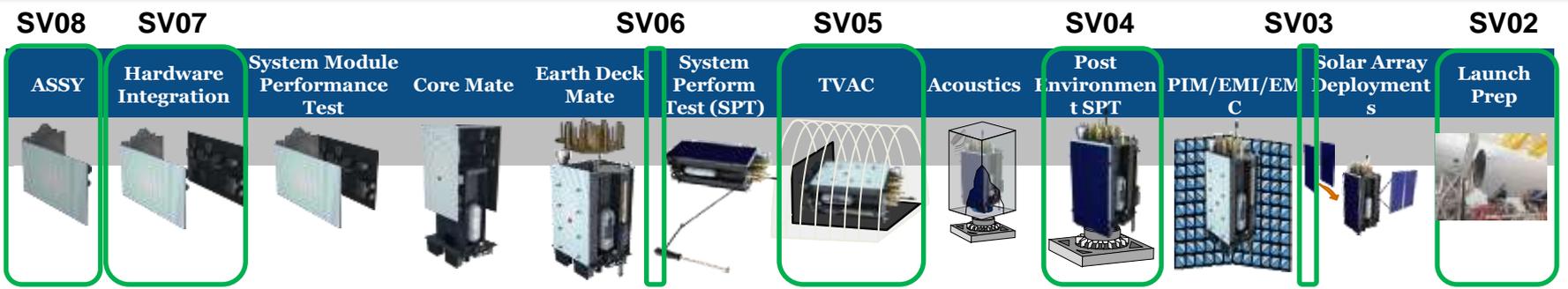
GPS III SV01 successful launch on a Falcon 9 on Dec 23, 2018

Next Generation Operational Control System (OCX) Block 0 performed nominally during the successful launch of GPS III SV01



# GPS III Space Vehicles (SVs)

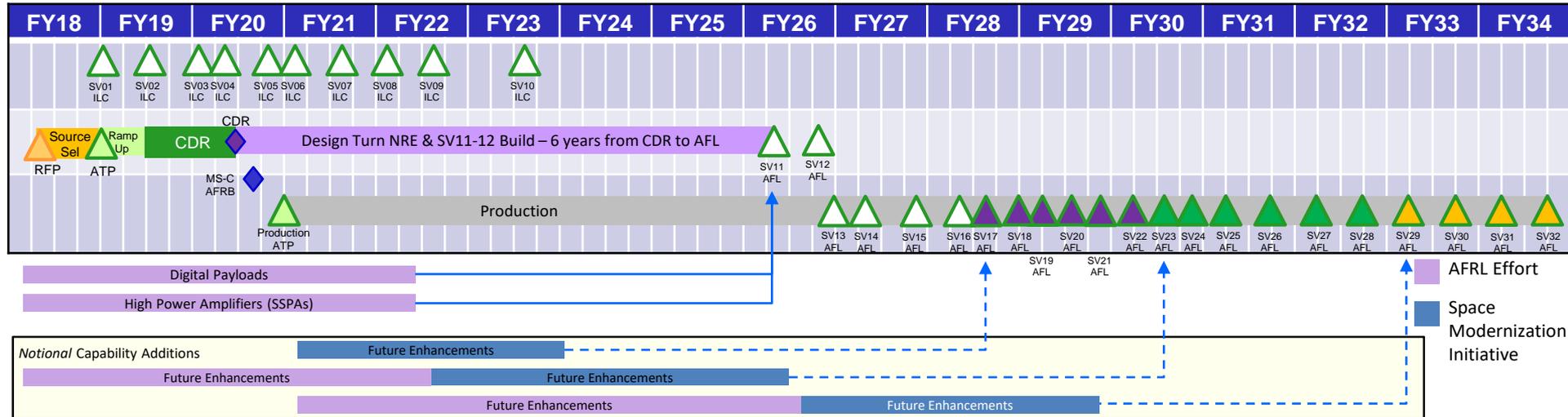
- Modernized civil signals
- Longer design life
- Increased accuracy
- Improved anti-jam





# GPS IIIIF Acquisition Strategy

## Modernization, Recapitalization, and Resiliency



- Focused on ability to deliver capability with high production maturity
- Continued partnerships with AFRL for technology insertion and path to flight
  - Digital Payloads
  - High Power Amplifiers
  - Advanced Clocks
  - Near Real-Time Commanding/Crosslinks
  - Signal Upgradeability

AFL – Available for Launch  
 ATP – Authority to Proceed  
 CDR – Critical Design Review  
 ILC – Initial Launch Capability  
 NRE – Non-recurring Engineering  
 RFP – Request for Proposal  
 SV – Space Vehicle

**Ensuring the Gold Standard today and into the future**



# *Next Generation Operational Control System (OCX)*

- Incremental Development
  - Block 0 Launch and Checkout System (LCS)
  - Block 1/2 Operational Control System
- Current Status
  - LCS supported GPS III SV01 launch on 23 Dec 18
    - Continues to function nominally during SV01 on-orbit checkout and testing (OOCT)
    - Preparing to support SV02 launch in 4QFY19
  - Block 1/2 development continues to meet milestones
    - Ready to Transition to Operations: 2Q 2022
- Enhanced command and control capability
- Modernized, agile architecture



***OCX program continues to execute and meet schedule***



# ***GPS III Contingency Operations (COps)***

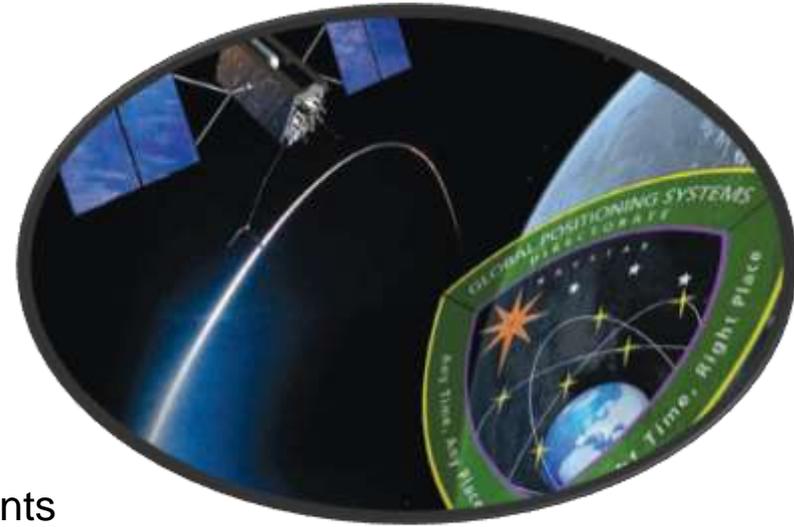
- Limited operations for GPS III SVs until OCX Block 1/2 delivery
  - Provides legacy and modernized civil signal operations
  - Uses OCX Block 0 for GPS III launch, major anomaly, & disposal capabilities
- Software Development
  - Risk reduction modification to current control system
  - Four incremental software builds
- Current Status
  - Software development completed Jun 2018
  - Operational Acceptance: Apr 2020

***COps is a critical bridge, enabling sustainment of legacy signals for GPS III***



# *GPS Director's Perspectives*

- GPS is the Global Utility
  - Committed to maintaining reliable service
  - “The Gold Standard”
- Continue to enhance GPS resiliency by:
  - Addressing near-term needs with current efforts
  - Identifying opportunities for resiliency improvements
  - Maturing technical needs for future use
- Appreciate the need for alternative PNT sources, and challenge the community (labs, industry, others) to propose & explore solutions
- Exploring & expanding multi-GNSS potential





# Global Perspective

- Global Constellations

- **GPS (24+3)**
- GLONASS (24+)
- GALILEO (24+3)
- BDS/BEIDOU (27+3 IGSO + 5 GEO)



- Regional Constellations

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

- Satellite-Based Augmentations

- **WAAS (3)**
- MSAS (2)
- EGNOS (3)
- GAGAN (3)
- SDCM (3)
- BDSBAS (3)
- KASS (2)
- **Australia SBAS**



# *U.S. Objectives in Working with Other GNSS Service Providers*

- Ensure **compatibility** — ability of U.S. and non-U.S. space-based PNT services to be used separately or together without interfering with each individual service or signal
  - Radio frequency compatibility
  - Spectral separation between M-code and other signals
- Achieve **interoperability** – ability of civil U.S. and non-U.S. space-based PNT services to be used together to provide the user better capabilities than would be achieved by relying solely on one service or signal
- Promote fair competition in the global marketplace

***Pursue through Bilateral and Multilateral Cooperation***



# *Bilateral Cooperation*

## Europe

- GPS-Galileo Cooperation Agreement signed in 2004
- Working Group on Next Generation GPS/Galileo Civil Services meets twice per year
- EU waiver of FCC Part 25 rules discussed by Working Group on Trade & Civil Applications – see next slide
- On-going PRS access negotiations

## Japan

- Comprehensive Dialogue held in Tokyo, July 2018
- Civil Space Dialogue held in Washington, May 2017
- Technical Working Group (TWG) discusses GPS and QZSS compatibility and interoperability
  - ITU coordination is ongoing – Most recent meeting in February 2019



# ***U.S. Federal Communications Commission (FCC) Part 25 Rules – Galileo Waiver Request***

- FCC rules require licensing of receive-only Earth stations (receivers) operating with Non-U.S. Licensed Space Stations
- NTIA (on behalf of Executive Branch) has outlined criteria it will apply in recommending waiver of these rules (2011)
- EU Waiver Request Submitted to State in 2013
  - NTIA submitted the EC's request to the FCC, on behalf of the Executive Branch, **in 2015** and recommended granting the request
- FCC issued a public notice in January 2017 inviting interested parties to comment on the waiver request
- On November 15, 2018 the **Commissioners approved a waiver authorizing the use of Galileo signals in the United States** within two frequency bands

## **Chairman Pai's Statement:**

*<https://docs.fcc.gov/public/attachments/FCC-18-158A2.pdf>*



# *Bilateral Cooperation (continued)*

## China

- GNSS Plenary meeting held May 2018 in Harbin, China
- Working Groups meet as needed
  - Public Joint Statement on Civil Signal Compatibility and Interoperability signed in November 2017

## India

- U.S.–India Joint statement signed in 2007
- U.S.-India Civil Space Joint Working Group (CSJWG) met October 2017 in Washington
  - Agenda included GNSS discussions
- Next meeting scheduled to occur before the end of 2019 in Bangalore



# ***Additional Bilateral Dialogues***

- *Canada:* Civil GNSS meeting held in Washington, D.C. - March 21, 2019
- *Australia:* Joint Delegation Statement on Cooperation in the Civil Use of GPS in 2007
  - Regular discussions about Australia’s plans for SBAS
  - U.S.-Australia Civil Space Dialogue held on November 30, 2018
  - Australia became a member of the ICG at the 13<sup>th</sup> meeting
- *Republic of Korea:* 2nd bilateral Civil Space Dialogue held in Seoul – April 2016
  - Discussion about Korea’s development of their SBAS
  - Planning underway for discussions related to KPS in 2019
- *Indonesia:* 1<sup>st</sup> Civil Space Dialogue April 4, 2019 in Washington, D.C. – GNSS applications discussed



# *International Committee on Global Navigation Satellite Systems (ICG)*

- Emerged from 3rd UN Conference on the Exploration and Peaceful Uses of Outer Space July 1999
  - Promote the use of GNSS and its integration into infrastructures, particularly in developing countries
  - Encourage compatibility and interoperability among global and regional systems
- Members include:
  - **GNSS Providers:** (U.S., EU, Russia, China, India, Japan)
  - Other Member States of the United Nations
  - International organizations/associations



<http://www.unoosa.org/oosa/en/ourwork/icg/icg.html>



# ***13<sup>th</sup> Meeting of the International Committee on GNSS (ICG)***



***Xi'an, China: 4-9 November 2018***

- More than 200 participants
  - Representatives from 27 countries/organizations
  - Representation from all 6 GNSS Providers
- Agenda included:
  - Meeting of the Providers' Forum
  - System Provider Updates
  - Applications and Experts Session
  - Meeting of all four Working Groups
- New Membership approval: Australia





# ***GNSS Interference and Spectrum Protection***

## Core Area of Focus of the ICG

- Primarily discussed within the Working Group on Systems, Signals and Services (WG-S)
- Subgroup on Compatibility and Spectrum Protection established in 2010
- Task Force on Interference Detection and Mitigation (IDM) established in 2013
- IDM Workshops have been held since 2012 – organized by the ICG
  - 7th IDM Workshop took place May 2018 as part of Baska GNSS Conference in Croatia
- Spectrum Protection Educational Seminars organized by ICG Experts – Focused on the importance of protecting GNSS spectrum
  - 3<sup>rd</sup> Seminar held March 2018 in Argentina



# *Interoperability and Service Standards*

## Timing Workshop held in June 2018 – Focus on GNSS time offsets

- ICG is considering several technical proposals and discussing ways to test multi-GNSS time interoperability
- ICG is looking at ways to improve GNSS time synchronization with UTC

## Performance Standard Template

- Workshop held in May 2018 hosted by Galileo Reference Center in Noordwijk, Netherlands
- “Guidelines” document being developed as a template for all providers to consider when developing their performance standard

## International GNSS Monitoring and Assessment (IGMA)

- IGMA Workshop held in May 2018 in Noordwijk, Netherlands
- Discussions focused on the multi-GNSS monitoring trial project established in 2016 between the ICG and IGS



# *Other Important ICG Activities*

## Space Service Volume

- **United Nations booklet “The Interoperable GNSS SSV” – prepared by GNSS Providers through WG-B – published in early 2018 and highlighted at ICG-13**

[http://www.unoosa.org/res/oosadoc/data/documents/2018/stspace/stspace75\\_0.html/stspace75E.pdf](http://www.unoosa.org/res/oosadoc/data/documents/2018/stspace/stspace75_0.html/stspace75E.pdf)

- Outreach efforts continue on benefits of an interoperable space service volume and development of space-based user equipment

## Search and Rescue

- Discussion about compatibility and interoperability of MEOSAR systems

## Precise Point Positioning (PPP)

- Workshop proposed by WG-D focused on multi-GNSS PPP based on plans by regional and global service providers



# Summary

- U.S. policy encourages the worldwide use of civil GPS services and cooperation with other GNSS providers
  - **Compatibility, interoperability, and transparency in civil service provision** are priorities
  - Pursued through bilateral and multilateral dialogues
- GPS performance exceeds commitments while modernization efforts continue
  - First GPS III satellite launched in 2018
  - Progress on modernized ground segment to meet future needs
- The ICG, with strong U.S. participation, continues to pursue a **Global Navigation Satellite System-of-Systems** to provide civil GNSS services that benefit users worldwide



# THANK YOU !

English | español | français | 中文 | العربية  
For Legislative Staff | For Students & Teachers

## GPS.GOV

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

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 map 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?
- Can GPS help me find my lost phone?
- How does GPS work?
- How accurate is GPS?
- How vulnerable is GPS to malicious jamming?

#### FOR GPS PROFESSIONALS

##### What's **HOT** for Pros

- Recent presentations
  - APEC TPT-WG46, Oct 16
  - CGSIC Miami, Sep 24-25
- Adjacent band compatibility
  - Aug 10 Advisory board letter regarding Ligado (PDF)
  - Advisory board topic papers
  - Advisory board telecon slides
- Technical documentation
  - Updated PRN code assignments
  - New GPS ICDs
  - Sep 12 ICWG meeting
  - AF memo on GPS control segment software change
- Funding & legislation
  - FY 2019 GPS budget bills

#### News Items →

- Sep 25: Presentations from 58th CGSIC Meeting
- Sep 14: AF Announces Selection of GPS III Follow-On Contract
- Aug 23: GPS III Space Vehicle No. 1

- Stay up to date: [www.gps.gov](http://www.gps.gov)
- Providing information pertinent to GPS:
- Including Systems, Applications, Governance, and Multimedia
  - You can also find information related to: Frequency Asked Questions, Technical Documentation, Service Reports, International Cooperation, etc.
  - Available in: English, Spanish, French, Chinese and Arabic
  - Archival information back to 2009

