



Global Positioning System Program Status

**Civil GPS Service Interface Committee
September 17, 2019**

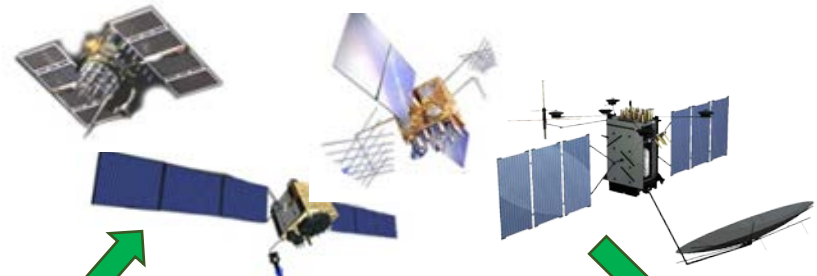
**Lieutenant Colonel Ken McDougall
Chief, GPS Integration Branch
Space and Missile Systems Center**

GPS Overview



SPACE AND MISSILE SYSTEMS CENTER

Space Segment



Broadcasting since 1978

Control Segment



20 monitoring and control stations worldwide

User Segment



Reaching over 4 billion users every second



Committed to Cooperation

Department of Defense • Army • Navy • Air Force • USMC • NGA • DISA • USNO • PNT EXCOM
Department of Transportation • Federal Aviation Administration • Department of Homeland Security • U.S. Coast Guard
International Telecommunication Union • International Committee on GNSS • International Civil Aviation Organization
Global Navigation Satellite Systems (GNSS) • Galileo • Beidou • GLONASS • QZSS • NAVIC



GPS Constellation Status

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36 Satellites • 31 Set Healthy
Baseline Constellation: 24 Satellites



Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIA	1 (2*)	25.9	25.9
GPS IIR	11	17.6	22.1
GPS IIR-M	7 (1)	5.6	9.3
GPS IIF	12	11.9	25.8
GPS III	(2*)	0.4	0.7

*Ops capable; not set healthy

As of 10 Sep 19

GPS Signal in Space (SIS) Performance

From 1 Sep 18 to 31 Aug 19

Average URE*	Best Day URE	Worst Day URE
51.9 cm	36.6 cm (4 Dec 18)	70.4 cm (5 Oct 18)

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



GPS Modernization

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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

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

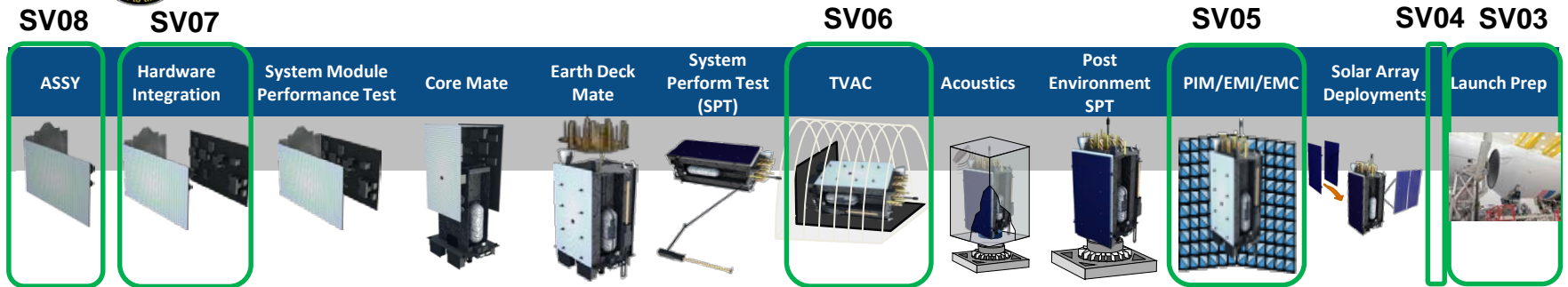
Modernized Civil Signals

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



GPS III Space Vehicles (SVs)

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- GPS III features
 - Increased accuracy and power
 - Inherent signal integrity
 - New L1C civil signal
 - Longer design life (15 years)
- SV01 launched 23 Dec 18; completed on-orbit check out
 - Expected to be added to constellation mission operations in early 2020
- SV02 successfully launched 22 Aug 19; completed on-orbit check out
- SV03 ships to Cape Canaveral in Oct 2019; Launch planned Jan 2020
- SV04 Available for Launch Sep 2019
- SV05 – 10 are in various phases of production



Second GPS III satellite successfully launched in Aug 2019



GPS III Follow-On (GPS IIIF)

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- GPS IIIF additional features
 - Search-and-Rescue (SAR) payload - faster detection and location of distress signals (International Partnership w/Canada)
 - Laser Retroreflector Array
 - Redesigned Nuclear Detonation Detection System (NDS)
- Partnering with Air Force Research Laboratory (AFRL) for technology opportunities
 - Digital Payloads
 - Near Real-Time Commanding/Crosslinks
- Program strategy allows for technology insertion to remain aligned with future requirements
- SV11 launch forecasted for 2026



The GPS IIIF team is committed to maintaining the Gold Standard of PNT



Next Generation Operational Control System (OCX)

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- OCX uses Incremental Development for:
 - GPS III Launch and Checkout System (LCS) – OCX Block 0
 - OCX Operational Control System – Blocks 1 and 2
- Current Status
 - LCS supported GPS III SV01 and SV02 Launch and Checkout
 - OCX Block 1 software development completed – 12 Aug 19
 - 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)

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- Upgrade to current control system that enables limited operations on GPS III vehicles until OCX Block 1/2 delivery
 - Provides legacy and modernized signal (M-Code, L2C, L5) 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 an important bridge, enabling sustainment of legacy signals for GPS III



Preparing for Next Generation GPS

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- GPS Week Rollover Event – 6 Apr 19
 - 10-bit GPS Week Number rollover from 1023 back to 0
 - GPS constellation signal unaffected by control system reset
 - Multiple reports of civilian receiver malfunctions due to non-ICD compliant GPS receivers
- Many improvements are coming to GPS over the next year
 - All changes remain ICD compliant and within specification/standards
 - Communicating these changes to the Civil User Community and manufacturers early and often is accomplished through many forums

Critical for civil users to ensure their receivers are ICD compliant



global utility
uninterrupted service
strength through partnership
gold standard

GPS