



Global Positioning System Program Status

PNT Advisory Board
November 20-21, 2019

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GPS Overview

SPACE AND MISSILE SYSTEMS CENTER

Space Segment

Control Segment

User Segment

Broadcasting since 1978

20 monitoring and
control stations worldwideReaching 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 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

M-Code Early Use (MCEU)

- Update OCS to operationalize Core M-Code

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 Constellation Status

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35 Satellites • 30 Set Healthy
Baseline Constellation: 24 Satellites



Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIA	(2*)	25.9	26.0
GPS IIR	11	17.8	22.3
GPS IIR-M	7 (1*)	12.1	14.1
GPS IIF	12	5.8	9.5
GPS III	(2*)	0.6	0.9

*Ops capable; not set healthy

As of 13 Nov 19

GPS Signal in Space (SIS) Performance

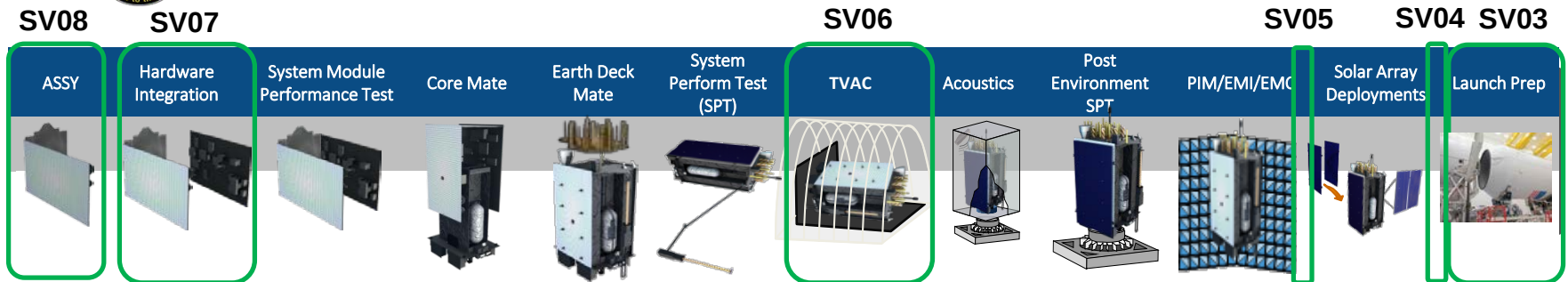
From 14 Nov 18 to 13 Nov 19

Average URE*	Best Day URE	Worst Day URE
51.4 cm	36.2 cm (21 Sep 19)	66.6 cm (13 Oct 19)

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

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
 - Integrated System Test (IST) 2-5 Phase 2 completed on 8 Nov 19
 - Expected to be added to constellation mission operations in early 2020
- SV02 successfully launched 22 Aug 19; completed on-orbit check out
- SV03 ready for shipment to Cape Canaveral; Launch forecast Mar 2020
- SV04 declared Available for Launch 10 Sep 19; Launch forecast 3Q 2020
- 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
 - Regional Military Protection (RMP) - delivers higher-power/jam resistant military signal to the warfighter
 - Search-and-Rescue (SAR) payload - faster detection and location of distress signals (International Partnership w/Canada)
 - Laser Retroreflector Array (LRA) - provides more precise ranging data
 - 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
- Currently in detailed design phase; Space Vehicle Critical Design Review planned for Feb 2020
- 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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- Next-generation command, control and cyber-defense for GPS
 - Worldwide, 24 hr/day, all weather, Positioning, Navigation, and Timing (PNT) source for military and civilian users
 - Enhanced command and control capability
 - Modernized architecture
 - Robust information assurance and cyber security
- Incremental Development
 - OCX Block 0: Launch and Checkout System (LCS) for GPS III
 - OCX Blocks 1 and 2: Operate and manage modernized GPS constellation, control and monitor modernized signals
- Current Status
 - LCS successfully supported GPS III SV01 and SV02 Launch and Checkout
 - Exceeding operational requirements for availability and dependability
 - OCX Block 1 software coding complete – 12 Aug 19
 - System Integration and Verification ongoing
 - Ready to Transition to Operations: 2Q22



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 test, L2C, L5) operations
 - Uses OCX Block 0 for GPS III launch, major anomaly, & disposal capabilities
- Software Development
 - Risk reduction modification to current operational control system
 - Formal Qualification Test of the software builds completed 20 May 19
- Current Status
 - Integrated System Test (IST) 2-5 Phase 2 completed on 8 Nov 19
 - IST is an evaluation of COps software and the GPS III Space Vehicle
 - Operational Test and Evaluation of COps is scheduled to complete in Feb 2020
 - COps Operational Acceptance: Apr 2020

COps is an important bridge, enabling sustainment of legacy signals for GPS III



GPS Military Code Early Use (MCEU)

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- Description
 - Provide early use of GPS M-Code signal from 2020 until OCX Block 1 Ready for Transition to Operations
 - Enable and operate M-Code messaging on capable satellites, including GPS IIR-M, GPS IIF, and GPS III (at a GPS IIF performance level)
 - Process Combined Space Operations Center (CSPOC) M-Code directives and monitor M-Code message sets
- Software Development
 - Updates to current Operational Control System (OCS)
 - Integration of M-Code Keying and Modernized Monitoring Stations
- Current Status
 - Software Development and Integration Complete
 - Currently conducting Factory Qualification Test: Dec 2019
 - Operational Acceptance: Nov 2020

MCEU is operationalizing Core M-Code in 2020



Military GPS User Equipment (MGUE)

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- Competitive market-driven acquisition approach
- MGUE Increment 1 involves three vendors developing modernized receiver cards
 - Ground form factor
 - Aviation/maritime form factor
- MGUE Increment 2 addresses GPS receiver card obsolescence issue, and extends M-Code to space receivers, Precision-Guided Munitions, and a joint, common modernized Handheld receiver
- Current Status:
 - Increment 1 on track to support Core M-Code Operations in 2020
 - Government qualified first card in Mar 2019
 - Increment 2 Acquisition Strategy approved in Nov 2018 as two Middle Tier Acquisition rapid prototyping efforts:
 - Miniature Serial Interface (MSI) receiver card w/ Next Generation Application-Specific Integrated Circuit (ASIC)
 - Joint Modernized Handheld receiver



Modernizing to provide accurate and resilient PNT to military users



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