Global Positioning System
Status and Modernization
Civil GPS Service Interface Committee (GSIC)

Tuesday, 22 Sep
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Space and Missile Systems Center
Portfolio Architect’s
Senior Materiel Leader, Spectrum Warfare
GPS Overview

Space Segment

Broadcasting since 1978

User Segment

20 monitoring and control stations worldwide

Reaching over 4 billion users every second

Committed to Cooperation

Department of Defense • Army • Navy • Air Force • Space Force • USMC • NGA • DISA • USNO • NSA • PNT EXCOM

National Nuclear Security Administration (NNSA) • Department of Transportation • Federal Aviation Administration

Department of Homeland Security • U.S. Coast Guard • International Civil Aviation Organization

Global Navigation Satellite Systems • Galileo • Beidou • GLONASS • QZSS • NAVIC

International Committee on GNSS • International Telecommunication Union

Space Starts Here
Global Impact of GPS

GPS is utilized across the world with +4B users!

GPS impacts almost every industry. Some of these industries include:
- Agriculture
- Maritime
- Public Safety
- Recreation
- Space
- Aviation
- Finance
- Telecommunications
- Telematics
- Oil/Gas

GPS economic benefit ~$1.4 Trillion*

GPS consistently met all technical performance commitments:
Accuracy, Integrity, Availability and Continuity

GPS Constellation Status

35 Satellites • 31 Set Healthy
Baseline Constellation: 24 Satellites

<table>
<thead>
<tr>
<th>Satellite Block</th>
<th>Quantity</th>
<th>Average Age (yrs)</th>
<th>Oldest</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS IIR</td>
<td>10 (2*)</td>
<td>18.6</td>
<td>23.1</td>
</tr>
<tr>
<td>GPS IIR-M</td>
<td>7 (1*)</td>
<td>12.9</td>
<td>14.9</td>
</tr>
<tr>
<td>GPS IIF</td>
<td>12</td>
<td>6.6</td>
<td>10.2</td>
</tr>
<tr>
<td>GPS III</td>
<td>2 (1*)</td>
<td>0.9</td>
<td>1.7</td>
</tr>
</tbody>
</table>

*Ops capable; not set healthy

As of 22 Aug 20

GPS Signal in Space (SIS) Performance
From 18 Aug 19 to 15 Aug 20

<table>
<thead>
<tr>
<th>Average URE*</th>
<th>Best Day URE</th>
<th>Worst Day URE</th>
</tr>
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<tbody>
<tr>
<td>52.2 cm</td>
<td>38.5 cm (1 Jun 20)</td>
<td>90.2 cm (26 Jul 20)</td>
</tr>
</tbody>
</table>

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

Space 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

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 1/2
- 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

Continued support to an ever-growing number of applications
- Annual Public Interface Control Working Group (ICWGW)
- Standard Positioning Service (SPS) Performance Standard Updates
- Precise Positioning Service (PPS) Enhancements
- 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)

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

SV families provide L-Band broadcast to User Segment

Applies Space and Control Segment data for PNT applications
GPS III

- SV01 Set healthy and available for use on 13 Jan 20
- SV02 Set healthy and available for use on 1 Apr 20
- SV03 Operationally accepted 27 Jul 20
- SV04 Launch scheduled for 29 Sep 20
  - Second NSSL mission on a recoverable Falcon 9
- SV05 Declared Available for Launch 7 May 20
- SV06 Available for Launch Spring 2021
- SV07 TVAC forecast completion Sep 2020
- SV08 Core Mate completed 15 Apr 20
- SV09-10 Component deliveries in progress

Fourth GPS III satellite launch scheduled 29 Sep
GPS III Follow-On (GPS IIIF)

- GPS IIIF additional features
  - Regional Military Protection (RMP) and redesigned Nuclear Detonation Detection System (NDS)
  - Search-and-Rescue (SAR) payload – faster detection and location of distress signals
  - Laser Retroreflector Array (LRA) – provides more precise ranging data
- Partnering with Air Force Research Laboratory (AFRL) for future technology opportunities
  - Digital Reprogrammable Payloads
  - Demo on Navigation Technology Satellite (NTS-3)
  - Near Real-Time Commanding/Crosslinks
- Status: Design Phase Completed 13 Jul 20; SV11 launch forecasted for 2026

Ensuring the Gold Standard today and into the future
Next Generation Operational Control System (OCX)

- Next-generation command, control and cyber-defense for GPS
  - 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: Controls and manages all GPS IIR, GPS IIR-M, GPS IIF, and GPS III spacecraft; and controls all legacy and new GPS signals

- Current Status
  - LCS successfully supported GPS III SV01, SV02, and SV03 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: 4QCY22

OCX program continues to execute and meet schedule
global utility
uninterrupted service
strength through partnership
gold standard

GPS