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

Control Segment

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
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>
</thead>
<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**

<table>
<thead>
<tr>
<th>SV families provide L-Band broadcast to User Segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS IIA/IIR</td>
</tr>
<tr>
<td>• Basic GPS</td>
</tr>
<tr>
<td>• Nuclear Detonation Detection System (NDS)</td>
</tr>
<tr>
<td>GPS IIR-M</td>
</tr>
<tr>
<td>• 2nd Civil Signal (L2C)</td>
</tr>
<tr>
<td>• New Military Signal</td>
</tr>
<tr>
<td>• Increased Anti-Jam Power</td>
</tr>
<tr>
<td>GPS IIF</td>
</tr>
<tr>
<td>• 3rd Civil Signal (L5)</td>
</tr>
<tr>
<td>• Longer Life</td>
</tr>
<tr>
<td>• Better Clocks</td>
</tr>
<tr>
<td>GPS III (SV01-10)</td>
</tr>
<tr>
<td>• Accuracy &amp; Power</td>
</tr>
<tr>
<td>• Increased Anti-Jam Power</td>
</tr>
<tr>
<td>• Inherent Signal Integrity</td>
</tr>
<tr>
<td>• 4th Civil Signal (L1C)</td>
</tr>
<tr>
<td>• Longer Life</td>
</tr>
<tr>
<td>• Better Clocks</td>
</tr>
<tr>
<td>GPS IIF (SV11-32)</td>
</tr>
<tr>
<td>• Unified S-Band Telemetry, Tracking &amp; Commanding</td>
</tr>
<tr>
<td>• Search &amp; Rescue (SAR) Payload</td>
</tr>
<tr>
<td>• Laser Retroreflector Array</td>
</tr>
<tr>
<td>• Redesigned NDS Payload</td>
</tr>
</tbody>
</table>

**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 IIF 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
- 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)
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 launched 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