Global Positioning System Status and Modernization

Civil GPS Service Interface Committee – 20 Sep 2022

Col Heather Anderson, SSC/CGX
Transition Director

APPROVED FOR PUBLIC RELEASE

GPS Overview

Global Positioning Satellites: Encompassing the DoD and Civil Industry Partners

- **GPS is utilized across the world with**
- **6B+ 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 Integrity, Availability and Continuity

GPS Constellation Status

37 Satellites • 31 Set Healthy
Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age (yrs)	Oldest
GPS IIR	12 (5*)	20.7	25.1
GPS IIR-M	8 (1*)	14.9	16.9
GPS IIF	12	8.6	12.3
GPS III	5	2.4	3.7

*Not set healthy

As of 27 Aug 22

GPS Signal in Space (SIS) Performance

Week ending on 3 Sept 22

Average URE*	Best Day URE	Worst Day URE
49.1 cm	31.5 cm (20 Apr 21)	64.8 cm (20 May 22)

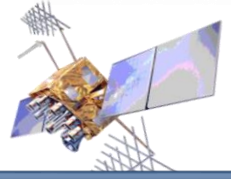
*All User Range Errors (UREs) are Root Mean Square values

GPS Modernization

SPACE SEGMENT (SATELLITES)

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
- 4th Civil Signal (L1C)
- Longer Life
- Improved Clocks

GPS IIIF (SV11-32)
- Unified S-Band Telemetry, Tracking, & Commanding
- Search & Rescue (SAR) Payload
- Laser Retroreflector Array
- Redesigned NDS Payload
- Regional Military Protect (RMP)

CONTROL SEGMENT (GROUND)

Legacy (OCS)
- Mainframe System
- Command & Control
- Signal Monitoring

Architecture Evolution Plan (AEP)
- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security & Accuracy
- Launch And Disposal Operations

OCX Block 0
- GPS III Launch & Checkout

GPS III Contingency Ops (COps)
- GPS III Mission on AEP

M-Code Early Use (MCEU)
- Update OCS to operationalize Core M-Code on AEP

OCX Blocks 1 and 2
- Fly GPS IIR/-M, GPS IIF, GPS III
- Modernize Cyber Architecture
- Operationalize Civil Signals (L1C, L2C, L5)
- Full M-Code

OCX Block 3F
- Incorporates GPS IIIF Command & Control
- Integrates new capabilities

USER SEGMENT (RECEIVERS)

Legacy (PLGR/GAS-1/MAGR)
- First Generation System

Visit GPS.gov for more info

SAASM-era User Equipment
- Anti-Jam capability
- Electronic Protection

Military GPS User Equipment
- M-Code Receivers
- Common GPS Modules
- Increased Access Power w/ M-Code
- Increased Accuracy
- Increased Availability
- Increased Anti-Tamper Anti-Spoof
- Increased Acquisition in Jamming

Benefits of Improved Civil Signals

Three New Navigation Signals designed for civilian use

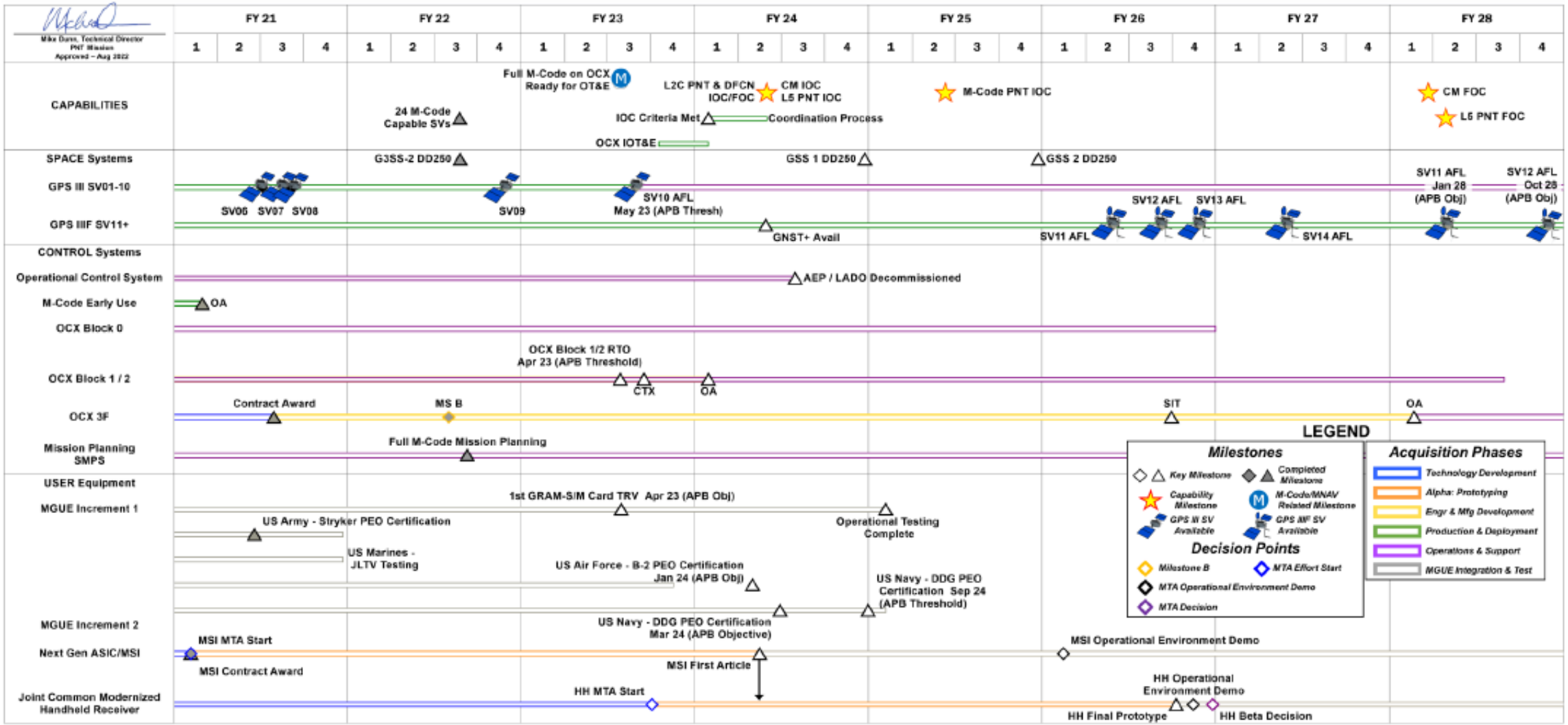
L1 (Legacy)

L2C – Commercial Needs –
enables ionospheric correction, improving accuracy

L5 – Safety-of-life transportation – compatible with the Federal Aviation Administration (FAA) Wide Area Augmentation System (WAAS) supporting Civil Aviation in the National Airspace

L1C – Interoperability between GPS and international satellite navigation systems

GPS Enterprise Roadmap



AEP	Architecture Evolution Plan	DFCN	Dual-Frequency Civil Navigation	HH	Handheld	MNAV	Military Navigation	PEO	Program Executive Officer
AFL	Available for Launch	FCC	Full Operational Capability	IOC	Initial Operating Capability	MS	Milestone	PNT	Positioning, Navigation & Timing
APB	Acquisition Program Baseline	GRAM-S/M	GPS Receiver Application Module – Standard Elec Module/Modernized	IOT&E	Initial Operational Test & Evaluation	MSI	Miniature Serial Interface	RTO	Ready for Transition to Ops
ASIC	Application-Specific Integrated Circuit			JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	SMPS	SAASM Mission Planning System
CM	Constellation Management	G3SS	GPS II Satellite Simulator	LADO	Launch, Anomaly, and Disposal Operations	OA	Operational Acceptance	SIT	System Integration Test
CTX	Constellation Transfer	GNST+	GPS IIF Non-Flight Satellite Testbed	M-Code	Military Code	OCX	Next Gen Operational Control System	SV	Space Vehicle
DDG	Arleigh Burke Guided Missile Destroyer	GSS	GPS Satellite Simulator	MGUE	Military GPS User Equipment	OT&E	Operational Test and Evaluation	TRV	Technical Requirements Verification

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 Set healthy and available for use on 1 Oct 20
- SV04 Set healthy and available for use on 2 Dec 20
- SV05 Set healthy and available for use on 25 May 22
- SV06 Launch scheduled for 18 Jan 23
- SV07 in storage – AFL 20 May 21; TLD May 2024
- SV08 in storage – AFL 10 Jun 21; TLD FY25
- SV09 in storage – AFL 23 Aug 22; TLD FY26
- SV10 in production - TLD FY26

Five GPS III satellites declared operational

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
  - OCX 3F: Adds support to OCX for GPS IIIF vehicle and new capabilities including Regional Military Protection
- Current Status
  - LCS successfully supported Launch and Checkout for GPS III SV01-SV05
  - OCX Block 1 completed factory integration and in Golden Dry Run for factory qualification
  - Constellation Transfer (CTX) 3QFY23; Operational Acceptance target 1QFY24

OCX program continues to execute and is nearing completion

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
    - Demo on Navigation Technology Satellite (NTS-3)
      - Digital Reprogrammable Payloads
      - Advanced Clocks
  - Status: Milestone C Completed 13 Jul 20; SV11 launch forecasted for FY2027

Ensuring the Gold Standard today and into the future


global utility
uninterrupted service
strength through partnership
gold standard
GPS