



# Military Communications & Positioning, Navigation, and Timing Overview & GPS Enterprise Update

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Deputy Program Executive Officer for MilComm & PNT



- GPS Enterprise Update



# 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)

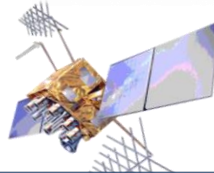
### Legacy (GPS IIA/IIR)

- 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](http://GPS.gov) for more info

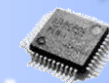
### SAASM-era User Equipment

- Anti-Jam capability
- Electronic Protection

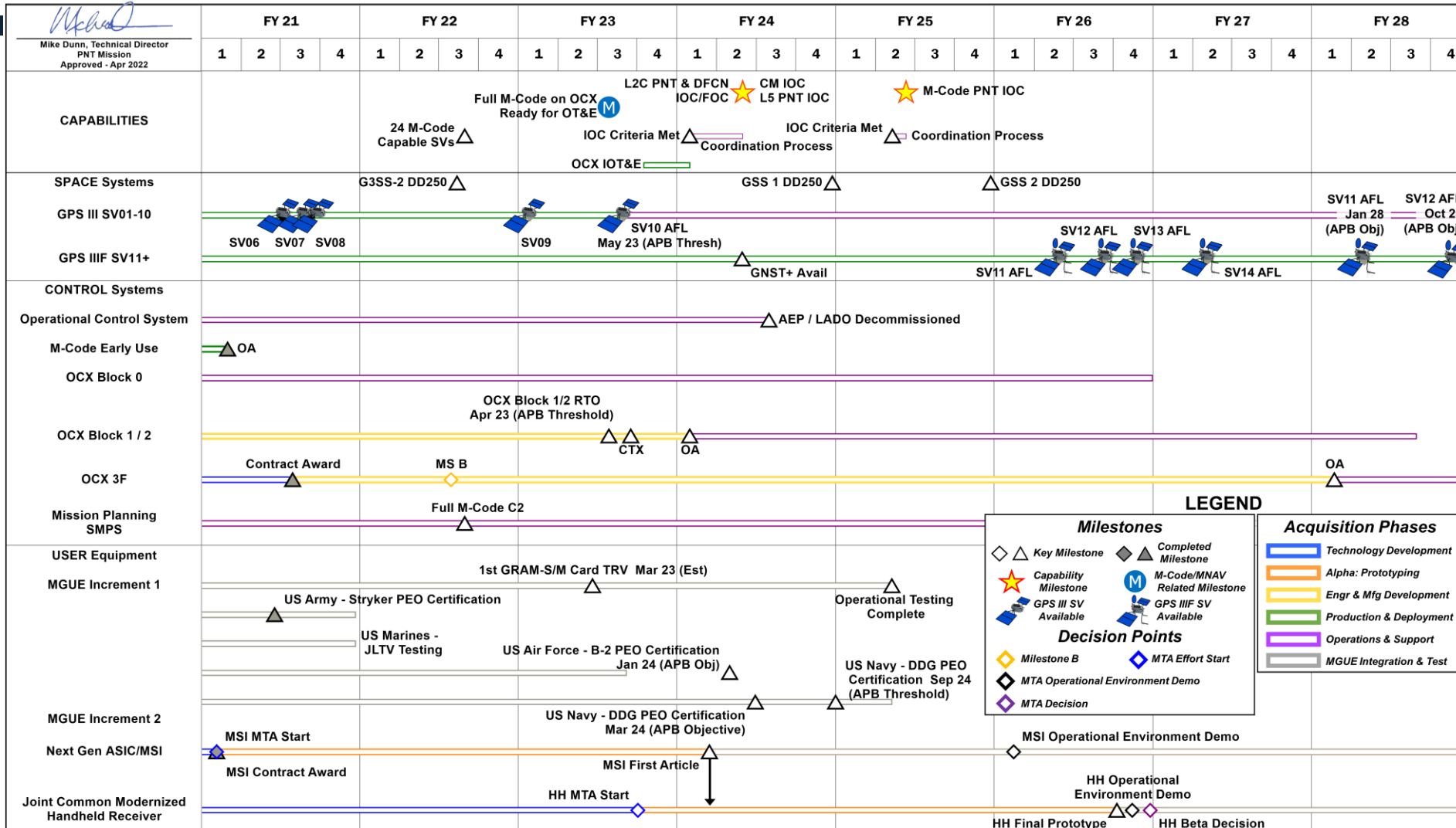


### Military GPS User Equipment

- 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



# GPS Enterprise Roadmap

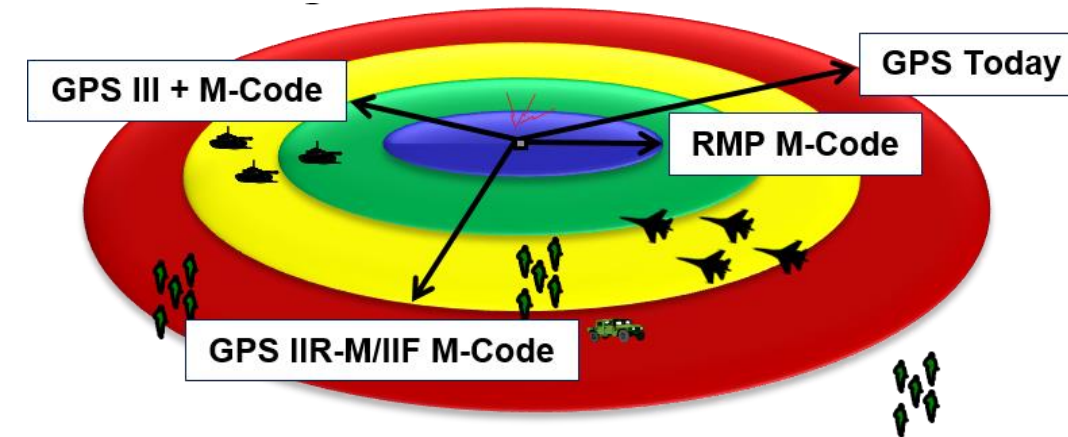


AEP	Architecture Evolution Plan	DDG	Arleigh Burke Guided Missile Destroyer	GSS	GPS Satellite Simulator	MGUE	Military GPS User Equipment	OT&E	Operational Test and Evaluation
AFL	Available for Launch	DFCN	Dual-Frequency Civil Navigation	HH	Handheld	MNAV	Military Navigation	PEO	Program Executive Officer
APB	Acquisition Program Baseline	FOC	Full Operational Capability	IOC	Initial Operating Capability	MS	Milestone	PNT	Positioning, Navigation & Timing
ASIC	Application-Specific Integrated Circuit	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
C2	Command & Control	G3SS	GPS III Satellite Simulator	JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	SMPS	SAASM Mission Planning System
CM	Constellation Management	GNST+	GPS IIIIF Non-Flight Satellite Testbed	LADO	Launch, Anomaly, and Disposal Operations	OA	Operational Acceptance	SV	Space Vehicle
CTX	Constellation Transfer			MCEU	M-Code Early Use	OCX	Next Gen Operational Control System	TRV	Technical Requirements Verification



# Benefits of Military Code

- A fully populated M-Code constellation increases the warfighters ability to receive PNT in a contested environment, specifically in regard to:
  - Jam-resistance
    - M-Code receivers do not rely on other signals.
    - M-Code military receiver can determine its position with the M-Code alone while with the P(Y) Code, the receiver has to acquire the C/A code first
  - Security and Anti-spoofing
    - The M-Code signals are encrypted and their receivers are able to detect and reject false signals
    - M-Code enables an over-the-air-rekey capability for the warfighter



Red – GPS Today  
 Yellow – M-Code  
 Green – M-Code with GPS III  
 Blue – GPS Regional Military Protection (RMP)



# 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





# 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 IIF 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



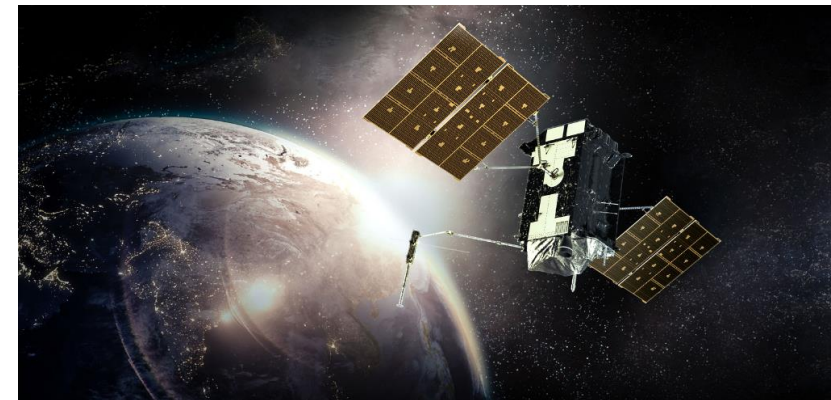
***OCX program continues to execute and is nearing completion***





# Next Generation Operational Control System (OCX) 3F

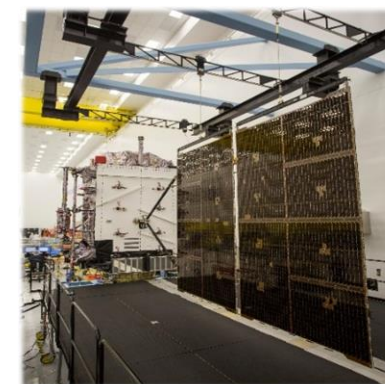
- Current Status
  - Awarded Next Generation Operational Control System (OCX) 3F Contract Award (\$234M, Apr 2021)
  - Startup Activities ongoing; program will modify adaptive architecture of OCX Blocks 1 and 2 software baseline to launch and control enhanced GPS IIF satellite capabilities
  - Delivered OCX 3F Development Readiness Review to the Space Systems Command on (Nov 2021)
  - Integrated Baseline Review (IBR) completed (Apr 2022)
- Upcoming Milestones
  - Milestone B (2QCY22)
  - OCX 3F Launch & Checkout s/w complete (1QCY24)
  - OCX 3F s/w Ready for Enterprise Int & Test (3QCY25)
  - Operational Acceptance (4QCY27)



*OCX 3F program continues to execute and meet schedule*



- 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***



# 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*



# User Equipment



**AIR FORCE B2 SPIRIT**



**NAVY DDG ARLEIGH BURKE**



**MGUE Inc 2**

## MGUE Inc 1




**MARINE CORPS JLTV**



**ARMY STRYKER**





**global utility**  
**uninterrupted service**  
**strength through partnership**  
**gold standard**

**GPS**



# Questions