

Space and Missile Systems Center

GPS Enterprise Status and Modernization

PNT Advisory Board

Col Steve Whitney

Director, GPS Directorate

5 Dec 2018

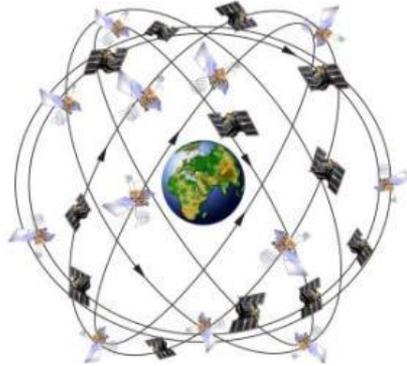




GPS Overview

Civil Cooperation

- 3+ Billion civil & commercial users worldwide
- Search and Rescue
- Civil Signals
 - L1 C/A (Legacy Signal)
 - L2C (2nd Civil Signal)
 - L5 (Aviation Safety of Life)
 - L1C (International)



Department of Defense

- Services (Army, Navy, AF, USMC)
- Agencies (NGA & DISA)
- US Naval Observatory
- PNT EXCOM
- GPS Partnership Council

Maintenance/Security

- All Level I and Level II
 - Worldwide Infrastructure
 - NATO Repair Facility
- Develop & Publish ICDs Annually
 - Public ICWG: Worldwide Involvement
 - Materials Available at: gps.gov/technical/icwg
- Update GPS.gov Webpage
- Load Operational Software on over 970,000 SAASM Receivers
- Distribute PRNs for the World
 - 120 for US and 90 for GNSS

Spectrum

- World Radio Conference
- International Telecommunication Union
- Bilateral Agreements
- Adjacent Band Interference

34 Satellites / 31 Set Healthy
Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age	Oldest
GPS IIA	1	25.0	25.0
GPS IIR	11	16.8	21.3
GPS IIR-M	7	11.3	13.1
GPS IIF	12	4.8	8.4
Constellation	31	11.2	25.0

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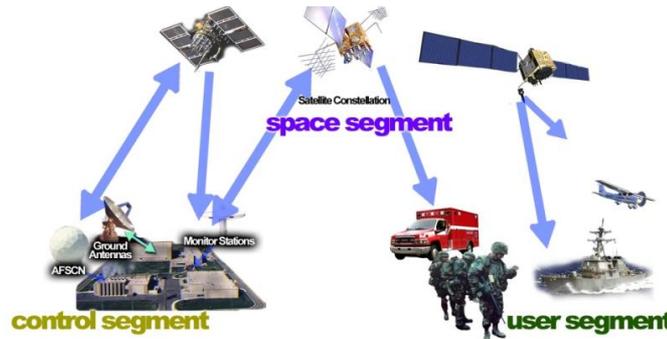


Department of Transportation

- Federal Aviation Administration

Department of Homeland Security

- U.S. Coast Guard



International Cooperation

- 57 Authorized Allied Users
 - 25+ Years of Cooperation
- GNSS
 - Europe - Galileo
 - China - Beidou
 - Russia - GLONASS
 - Japan - QZSS
 - India - NAVIC



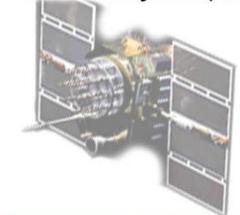
GPS Modernization

Space Segment

SV families provide L-Band broadcast to User Segment

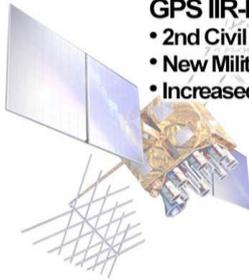
Legacy (GPS IIA/IIR)

- Basic GPS
- NUDET (Nuclear Detonation Detection System) (NDS)



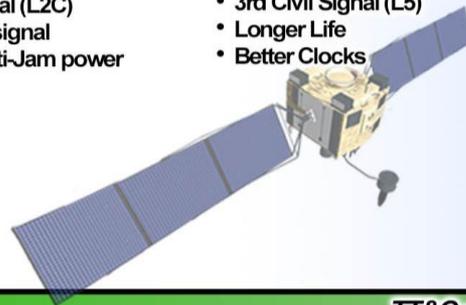
GPS IIR-M

- 2nd Civil signal (L2C)
- New Military signal
- Increased Anti-Jam power



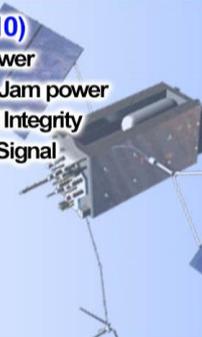
GPS IIF

- 3rd Civil Signal (L5)
- Longer Life
- Better Clocks



GPS III (SV01-10)

- Accuracy & Power
- Increased Anti-Jam power
- Inherent Signal Integrity
- Common L1C Signal
- Longer Life



GPS III (SV11+)

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



Ground Segment

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

Legacy (OCS)

- Mainframe System
- Command & Control
- Signal Monitoring

AEP

- Distributed Architecture
- Increased Signal Monitoring Coverage
- Security
- Accuracy
- Launch And Disposal Operations



OCX Block 1

- Fly Constellation & GPS III
- Begin New Signal Control
- Upgraded Information Assurance

OCX Block 2+

- Control all signals
- Capability On-Ramps
- GPS III Evolution

OCX Block 0

- GPS III Launch & Checkout

GPS III Contingency Ops (COPs)

- GPS III Mission on AEP

User Segment

Applies Space and Control Segment data for PNT applications

Modernized Civil Signals

- L1C
- L2C
- L5

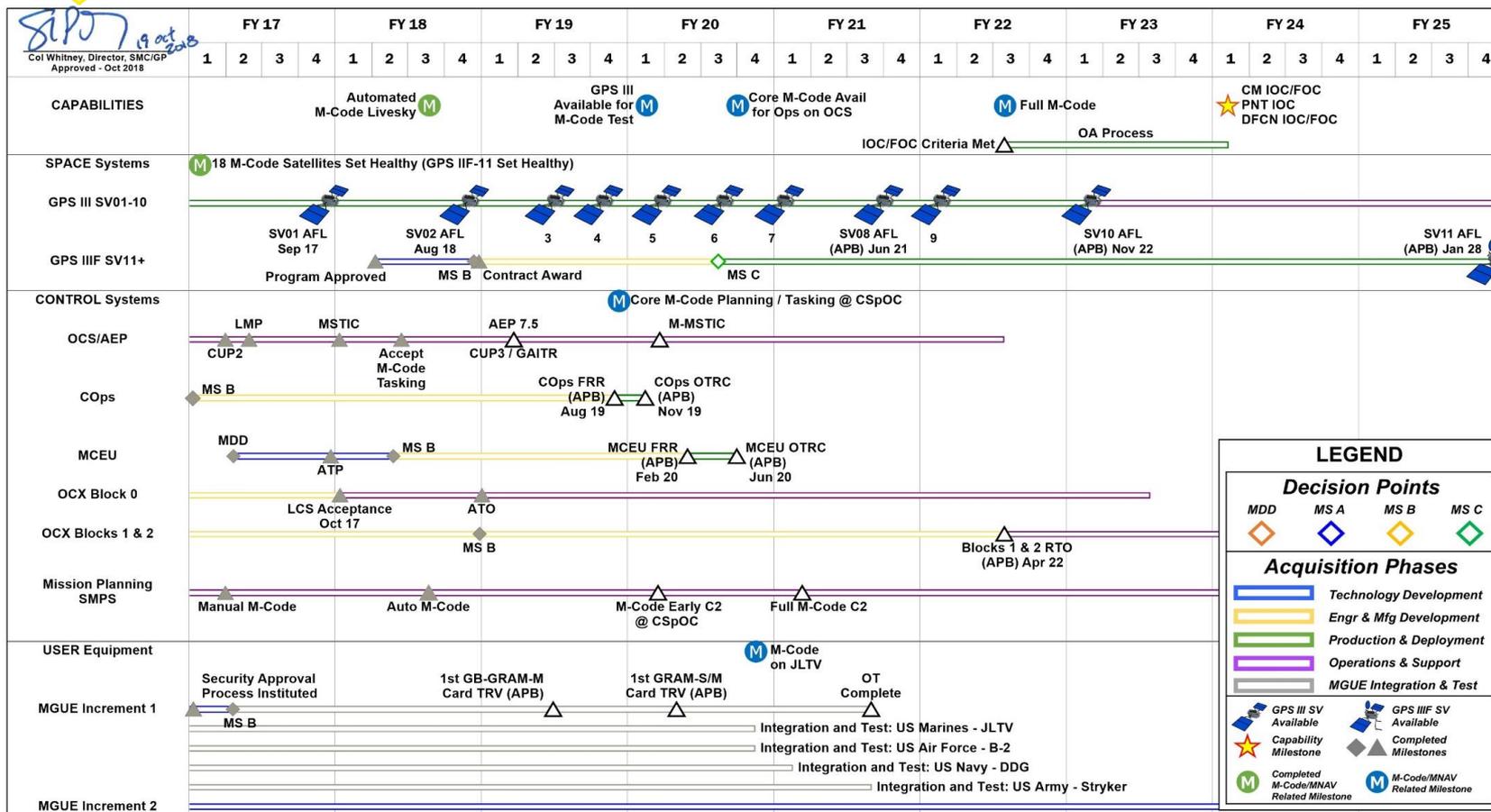


Continued support to an ever-growing number of applications

- Annual Public Interface Control Working Group
- Imminent update of SPS Performance Standard
- Sustained commitment to transparency, renew focus on agility



GPS Enterprise Roadmap



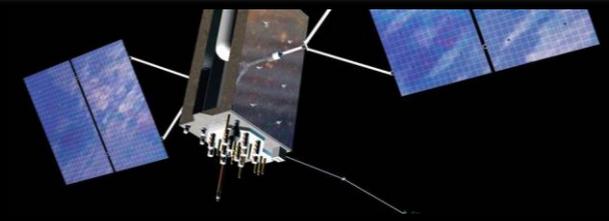
AEP Architecture Evolution Plan	CSpOC Combined Space Operations Center	GB-GRAM-M Ground Based GPS Receiver Application Module - Modernized	LMP LADO Modification Project	OCS Operational Control System
AFL Available for Launch	CUP COTS Upgrade Project	GPS IIF GPS III Follow On	MCEU M-Code Early Use	OCX Next Gen Operational Control System
APB Acquisition Program Baseline	DDG Guided Missile Destroyer	GRAM-S/M GPS Receiver Application Mode - Standard Elec Module/Modernized	MDD Materiel Development Decision	OT Operational Test
ATO Authority to Operate	DFCN Dual-Frequency Civil Navigation	IOC Initial Operating Capability	MGUE Military GPS User Equipment	OTRC Ops Test Readiness Certification
ATP Authority to Proceed	FOC Full Operational Capability	JLTV Joint Light Tactical Vehicle	M-MSTIC Modernized Monitor Station Tech Improvement & Capability	PNT Position, Navigation & Time
C2 Command & Control	FRR Fielding Readiness Review	LCS Launch & Checkout System	MS Milestone	RTO Ready for Transition to Ops
CM Constellation Management	GAITR Ground Antenna Interface Technical Refresh		OA Operational Acceptance	SMPS SAASM Mission Planning System
Cops Contingency Operations				TRV Technical Requirements Verification



GPS III Space Vehicles (SVs)

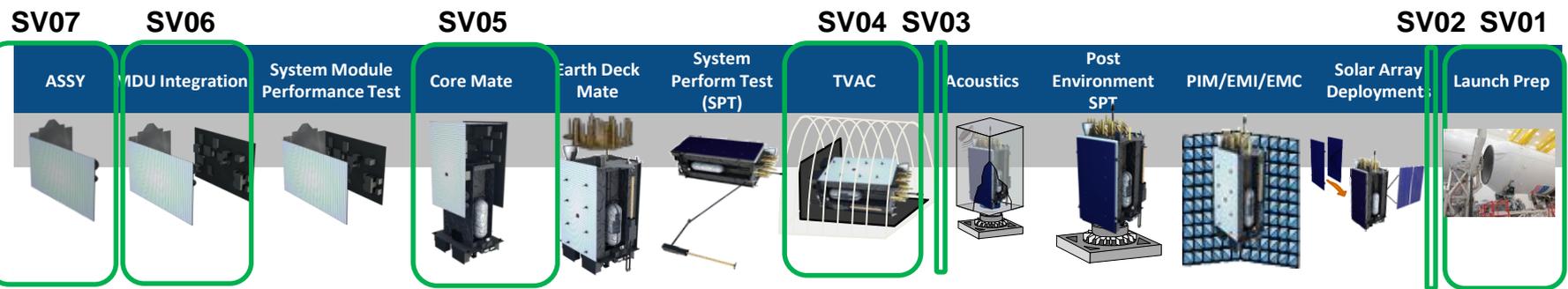


Gold Standard Since 1993



FINAL COUNTDOWN

- Modernized civil signals
- Longer design life
- Increased accuracy
- Improved anti-jam





GPS IIF Space Vehicles (SVs)

- Follow-on production of GPS III satellites
 - Modernization
 - Recapitalization
 - Resiliency
- Contract awarded to Lockheed Martin in Sep 2018
- Strategic on-ramps technology insertion
 - Digital Payloads
 - High Power Amplifiers
 - Advanced Clocks
 - Near Real-Time Commanding/Crosslinks

Ensuring the Gold Standard today and into the future



Next Generation Operational Control System (OCX)

- Incremental Development
 - Block 0 Launch and Checkout System (LCS)
 - Block 1/2 Operational Control System
- Current Status
 - LCS ready to support GPS III SV01 launch
 - Block 1/2 development continues to meet milestones
 - Ready to Transition to Operations: Apr 2022
- Enhanced C2 and cybersecurity
- Modernized, agile architecture

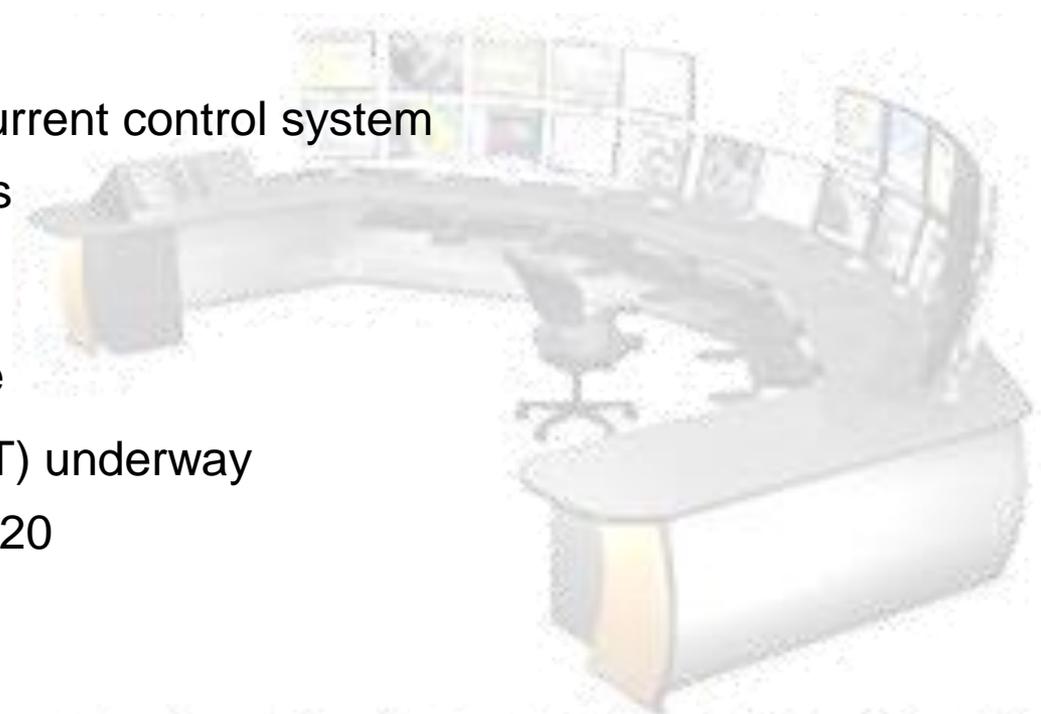


OCX program continues to execute and meet schedule



GPS III Contingency Operations (COps)

- Limited operations for GPS III SVs until OCX Block 1/2 delivery
 - Provides legacy (L1 C/A) and modernized (L2C & L5) civil signal operations
 - Uses OCX Block 0 for GPS III launch, major anomaly, & disposal capabilities
- Software Development
 - Risk reduction modification to current control system
 - Four incremental software builds
- Current Status
 - Software development complete
 - Component Integration Test (CIT) underway
 - Operational Acceptance: Jan 2020

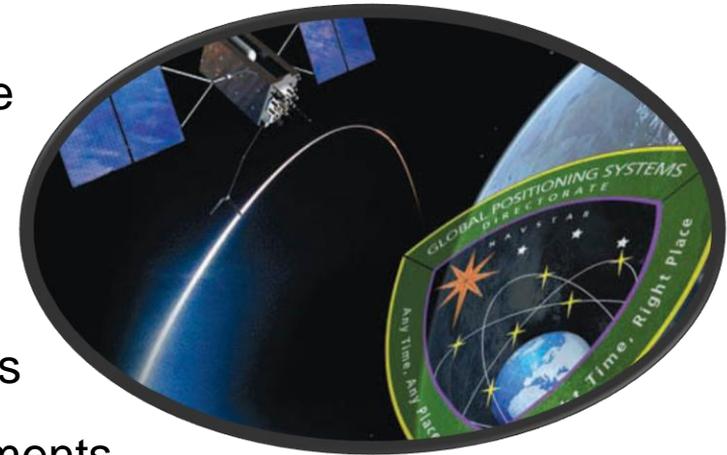


COps is a critical bridge, enabling sustainment of legacy signals for GPS III



GPS Director's Perspectives

- GPS is a global utility
 - Committed to maintaining uninterrupted service
 - Sustaining & advancing “The Gold Standard”
- Continue to enhance GPS resiliency
 - Addressing near-term needs with current efforts
 - Identifying opportunities for resiliency improvements
 - Maturing technical needs for future use
- Appreciate the need for alternative PNT sources, and challenge the community (labs, industry, others) to propose & explore solutions
- Exploring & expanding multi-GNSS potential



Deliver capabilities, execute with excellence, lead with transparency



the men and women of the
GLOBAL POSITIONING SYSTEMS DIRECTORATE

home of the gps green monsters



Acquisition professionals delivering the Gold Standard in Space-Based PNT & NDS Services