

Space & Missile Systems Center



GPS Enterprise Status and Modernization

PNT Advisory Board
6-7 Jun 2019

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SAF/AQS



GPS Overview

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Civil Cooperation

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



34 Satellites / 31 Set Healthy Baseline Constellation: 24 Satellites

Satellite Block	Quantity	Average Age	Oldest
GPS IIA	1	25.5	25.5
GPS IIR	11	17.3	21.8
GPS IIR-M	7	11.8	13.6
GPS IIF	12	5.3	8.9
Constellation	31	11.7	25.5

AS OF 7 MAY 19

Spectrum

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



Department of Transportation

- Federal Aviation Administration

Department of Homeland Security

- U.S. Coast Guard

Department of Defense

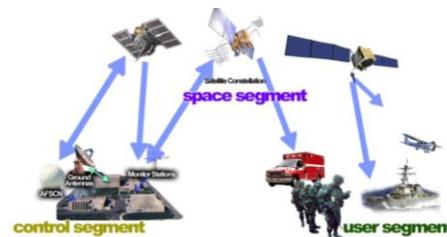
- Services (Army, Navy, Air Force, USMC)
- Agencies (NGA & DISA)
- US Naval Observatory
- PNT EXCOM
- GPS Partnership Council

Maintenance

- Develop & Publish ICDs Annually
 - Public ICWG available at: gps.gov/technical/icwg
- Update GPS.gov Webpage
- Distribute PRNs for the World
 - 120 for US and 90 for GNSS

International Cooperation

- 57 Authorized Allied Users
 - 25+ Years of Cooperation
- Global Navigation Satellite Systems (GNSS)
 - Europe - Galileo
 - China - Beidou
 - Russia - GLONASS
 - Japan - QZSS
 - India - NAVIC



Space Starts Here



GPS Modernization

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Space Segment

SV families provide L-Band broadcast to User Segment

Legacy (GPS IIA/IIR)

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



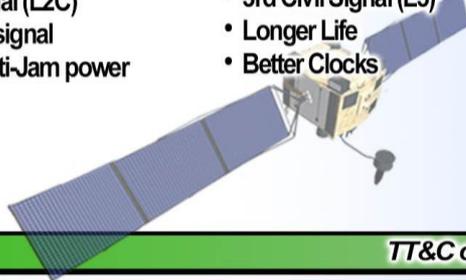
GPS IIR-M

- 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



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

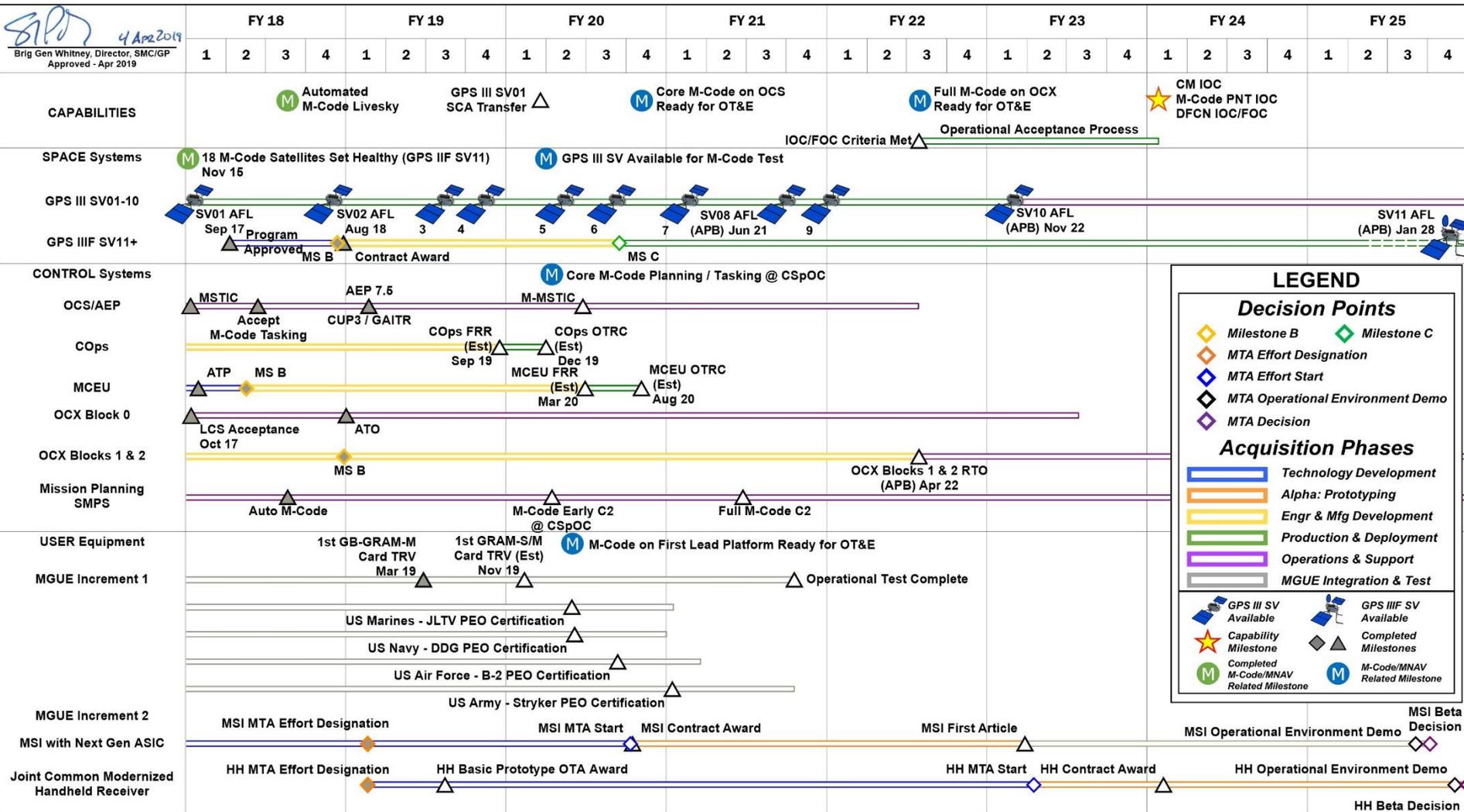


Continued support to an ever-growing number of applications

- Annual Public Interface Control Working Group
- Periodic update of SPS Performance Standard
- Sustained commitment to transparency

GPS Enterprise Roadmap

 4 Apr 2019
 Brig Gen Whitney, Director, SMC/GP
 Approved - Apr 2019

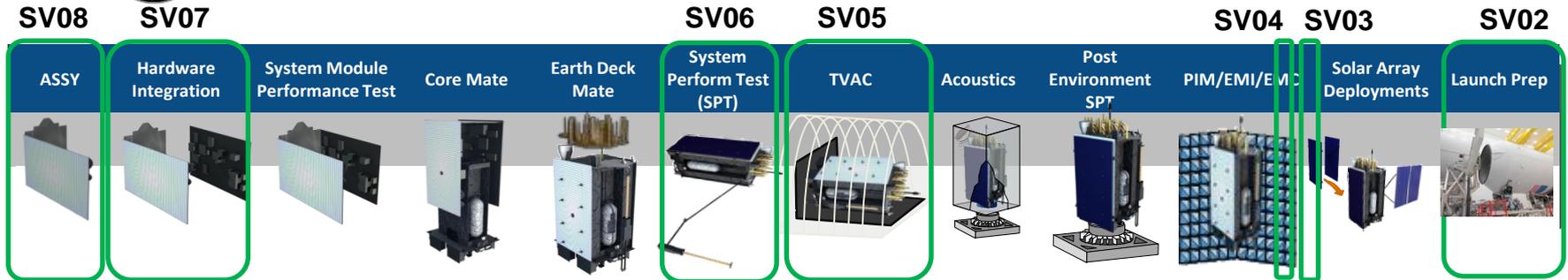


AEP	Architecture Evolution Plan	CSpOC	Combined Space Operations Center	GB-GRAM-M	Ground Based GPS Receiver Application Module – Modernized	MGUE	Military GPS User Equipment	OT&E	Operational Test and Evaluation
AFL	Available for Launch	CUP	COTS Upgrade Project	GRAM-S/M	GPS Receiver Application Module – Standard Elec Module/Modernized	M-MSTIC	Modernized-Monitor Station Tech Improvement & Capability	OTRC	Ops Test Readiness Certification
APB	Acquisition Program Baseline	DDG	Arleigh Burke Guided Missile Destroyer	HH	Handheld	MS	Milestone	PEO	Program Executive Officer
ASIC	Application-Specific Integrated Circuit	DFCN	Dual-Frequency Civil Navigation	IOC	Initial Operating Capability	MSI	Miniature Serial Interface	PNT	Positioning, Navigation & Timing
ATO	Authority to Operate	Est	Forecast Estimate	JLTV	Joint Light Tactical Vehicle	MTA	Middle Tier Acquisition	RTO	Ready for Transition to Ops
ATP	Authority to Proceed	FOC	Full Operational Capability	LCS	GPS III Launch & Checkout System	OCS	Operational Control System	SCA	Spacecraft Control Authority
C2	Command & Control	FRR	Fielding Readiness Review	MCEU	M-Code Early Use	OCX	Next Gen Operational Control System	SMPS	SAASM Mission Planning System
CM	Constellation Management	GAITR	Ground Antenna Interface			OTA	Other Transaction Agreement	SV	Space Vehicle
COps	GPS III Contingency Operations		Technical Refresh					TRV	Technical Requirements Verification



GPS III Space Vehicles (SVs)

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- GPS III features
 - Increased accuracy and power
 - Inherent signal integrity
 - New L1C signal
 - Longer design life (15 years)
- SV01 launched 23 Dec 18; currently undergoing on-orbit check out
 - Expected to be added to constellation mission operations in early 2020
- SV02 is in launch preparation; targeting a 25 Jul 19 launch date
- SV03 Available for Launch planned for summer 2019
- SV04 Available for Launch planned for late summer 2019
- SV05 – 10 are in various phases of production



First GPS III satellite successfully launched in Dec 2018



GPS III Follow-On (GPS IIIF)

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- GPS IIIF Contract awarded on 26 Sep 18
- Will leverage production maturity of GPS III SV01-10
- Partnering with Air Force Research Laboratory (AFRL) for technology opportunities:
 - Digital Payloads
 - High Power Amplifiers
 - Advanced Clocks
 - Near Real-Time Commanding/Crosslinks

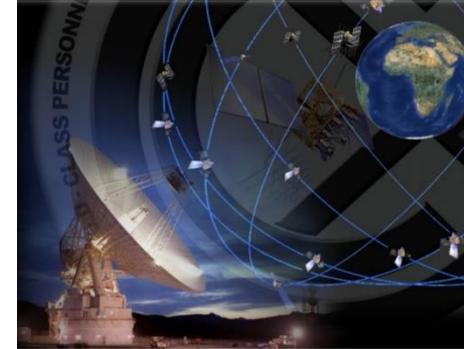
The GPS IIIF team are committed to maintaining the Gold Standard of PNT



Next Generation Operational Control System (OCX)

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- OCX uses Incremental Development for:
 - GPS III Launch and Checkout System (LCS) - OCX Block 0
 - OCX Operational Control System - Block 1/2
- Current Status
 - LCS completing Launch and Checkout for GPS III SV01
 - Preparing to support SV02 launch in 4QFY19
 - OCX Block 1/2 development continues to meet milestones
 - Ready to Transition to Operations: 2Q 2022
- Enhanced command and control capability
- Modernized, agile architecture



OCX program continues to execute and meet schedule



GPS III Contingency Operations (COps)

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- Limited operations for GPS III vehicles until OCX Block 1/2 delivery
 - Provides legacy and modernized 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 completed Jun 2018
 - Operational Acceptance: Apr 2020

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

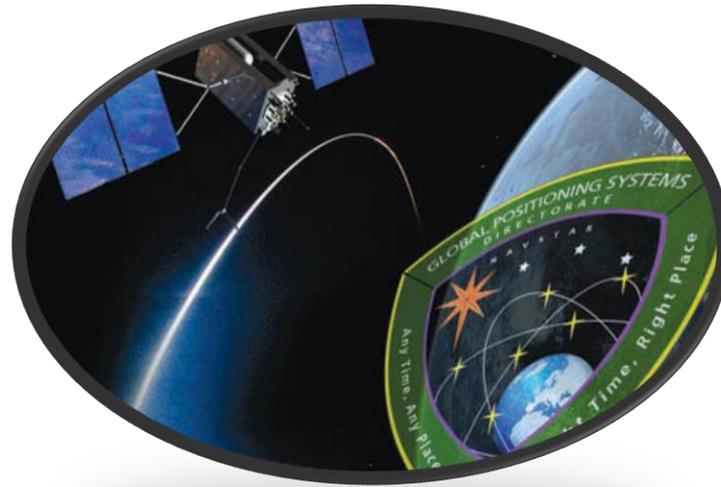


Preparing for Next Generation GPS

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- GPS Week Rollover Event – 6 Apr 19
 - 10-bit GPS Week Number rollover from 1023 back to 0
 - GPS constellation signal unaffected by control system reset
 - Multiple reports of civilian receiver malfunctions – NYC wireless network, Australian weather balloons, NOAA outages, grounded Boeing A/C, etc
 - **Root Cause:** non-ICD compliant GPS receivers
- GPS III/IIIF, OCX, COps – all implement design changes to GPS
 - All changes remain ICD compliant and within specification/standards
 - Communicating these changes to the Civil User Community and manufactures early and often is accomplished through many forums

Critical for civil users to ensure their receivers are ICD compliant



GPS continues the Global Utility

- “The Gold Standard”
- Committed to maintaining uninterrupted service
- Committed to maintaining domestic and international partnerships



Backup Slides

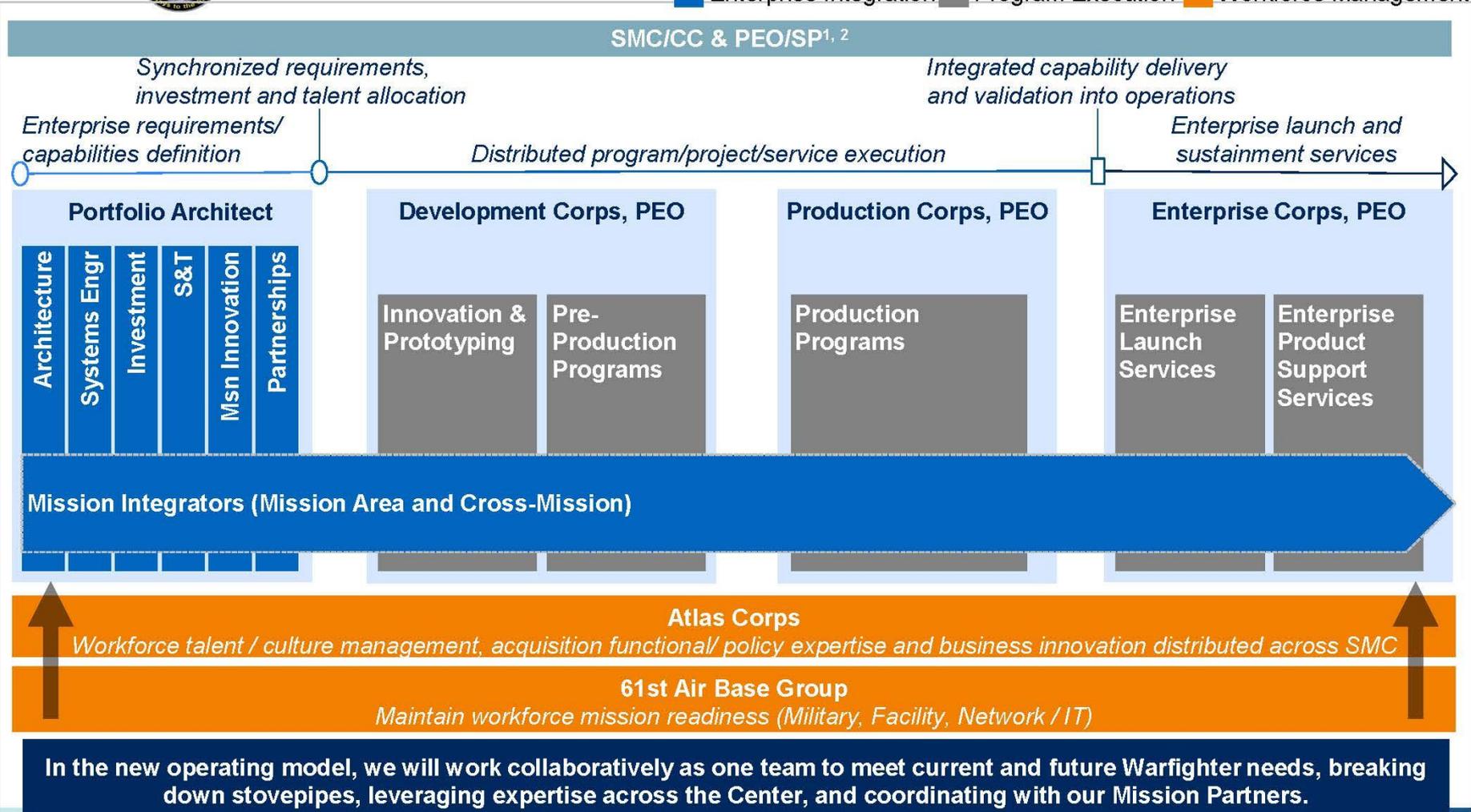
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SMC 2.0 operating model achieves speed and enterprise integration

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Enterprise Integration Program Execution Workforce Management



1 Special programs are managed similarly in the SMC 2.0 Operating Model as part of PEO Space's Portfolio

2 Cross-mission programs (Ground, Comms and Networks) will be managed similarly – org structure and alignment in work

Config Controlled SMC Program Portfolio Allocations

(Reallocation determinations must be approved at Leadership Council)

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Note: Chart below indicates where programs will go for decision authority beginning at IOC; chart does not indicate when billets move to Corps

Legend

Program of Record 804

Pacesetters In Bold**

In Discussion Underlined

Cross Mission Ground

	AFPEO/SP	PEO Development Corps	PEO Production Corps	PEO Enterprise Corps
ACAT I	<ul style="list-style-type: none"> Classified Programs+ FFRDC* GPS OCX (OT&E @ PC) ESBMC2 (OT&E @ EC) 	<ul style="list-style-type: none"> ESS PTS PTES Next Gen OPIR SBIRS Baseline Block 20 (OT&E @ EC) 	<ul style="list-style-type: none"> MGUE Inc 1 GPS III F EPS (incl EPS-R) AEHF 5-8 WSF EWS GPS-III MGUE Inc 2 MSI ACA (AEHF-Ground) SBIRS Block Buy SBIRS Baseline S2E2 WGS-11 Space Fence+ (OT&E @ HAFB) 	<ul style="list-style-type: none"> AEHF 1-4 NSSL Milstar DSCS GBS GPS NAVSTAR (Space/Ground) Fielded SBIRS Baseline element SBIRS HEO 3&4 JMS Inc 2 (MAIS) WGS 1-10
ACAT II	<ul style="list-style-type: none"> SILENTBARKER+ DARC+ 		<ul style="list-style-type: none"> USNDS-8 USNDS-7-ICADS-7 	<ul style="list-style-type: none"> MEECN USNDS LTRS AFSCN Sust
ACAT III	<ul style="list-style-type: none"> CCS B10P3I+ GBOSS+ 	<ul style="list-style-type: none"> LDPE A3M/PTSFD 	<ul style="list-style-type: none"> GPS III COps MCEU AFWET (OT&E @ HAFB) Sp Surv Telescope+ USNDS-7-SIGHTS MGUE Inc 2 HH WGS Anti-Jam/MAJE 	<ul style="list-style-type: none"> GMT AITG SWAFS GFPM SWFSRADX MEN WMN RCDM RBC RCF CCS-CACE JETSS C2 Mod GEODSS+ C-Band Radar+ Eglin Radar+ ORS-5+
Other	<ul style="list-style-type: none"> GSW+ NSDC Integrator+ CCS+ STTR+ 	<ul style="list-style-type: none"> Blackjack/CASINO QZSS Space Test Prog Tetra M-Code HP HPIU RALI ECP/REACH HoPS NTS-3 CPA Bus OPIR Demo/WFOV MILSATCOM SMI OPIR SMI SpEC OT MMSOC WCSE RDSMO SSAEM 	<ul style="list-style-type: none"> GPS UE FMS EWS-G GPS OCX Block 3 	<ul style="list-style-type: none"> RSLP IGS LTRS exemptions MARK IV-B SEON Standard Space Trainer R-spEC (DCO) EGS Next Gen OPIR- Ground (FORGE) Space Combat Cloud Wideband Studies Wideband Pathfinder DMSF Ground (DC3GS) SMPS AFSCN Network Modernization (APSS/AST/MBMM)

* AFPEO/CM for services; SMC/CC will exercise local organize/train/equip decisions.

** Pacesetter programs will complete their status as pacesetters by June 2019 as we move to execute all programs under SMC 2.0 operating model

+ OT&E with Special Programs