RCS: DD-A&T(Q&A)823-456

Next Generation Operational Control System (OCX)

As of FY 2021 President's Budget

Defense Acquisition Management
Information Retrieval
(DAMIR)

Table of Contents

Common Acronyms and Abbreviations for MDAP Programs

Acq O&M - Acquisition-Related Operations and Maintenance
ACAT - Acquisition Category
ADM - Acquisition Decision Memorandum
APB - Acquisition Program Baseline
APPN - Appropriation
APUC - Average Procurement Unit Cost
$B - Billions of Dollars
BA - Budget Authority/Budget Activity
Blk - Block
BY - Base Year
CAPE - Cost Assessment and Program Evaluation
CARD - Cost Analysis Requirements Description
CDD - Capability Development Document
CLIN - Contract Line Item Number
CPD - Capability Production Document
CY - Calendar Year
DAB - Defense Acquisition Board
DAE - Defense Acquisition Executive
DAMIR - Defense Acquisition Management Information Retrieval
DoD - Department of Defense
DSN - Defense Switched Network
EMD - Engineering and Manufacturing Development
EVM - Earned Value Management
FOC - Full Operational Capability
FMS - Foreign Military Sales
FRP - Full Rate Production
FY - Fiscal Year
FYDP - Future Years Defense Program
ICE - Independent Cost Estimate
IOC - Initial Operational Capability
Inc - Increment
JROC - Joint Requirements Oversight Council
$K - Thousands of Dollars
KPP - Key Performance Parameter
LRIP - Low Rate Initial Production
$M - Millions of Dollars
MDA - Milestone Decision Authority
MDAP - Major Defense Acquisition Program
MILCON - Military Construction
N/A - Not Applicable
O&M - Operations and Maintenance
ORD - Operational Requirements Document
OSD - Office of the Secretary of Defense
O&S - Operating and Support
PAUC - Program Acquisition Unit Cost

PB - President's Budget
PE - Program Element
PEO - Program Executive Officer
PM - Program Manager
POE - Program Office Estimate
RDT&E - Research, Development, Test, and Evaluation
SAR - Selected Acquisition Report
SCP - Service Cost Position
TBD - To Be Determined
TY - Then Year
UCR - Unit Cost Reporting
U.S. - United States
USD(AT&L) - Under Secretary of Defense (Acquisition, Technology and Logistics)
USD(A&S) - Under Secretary of Defense (Acquisition and Sustainment)

Program Information

Program Name

Next Generation Operational Control System (OCX)

DoD Component

Air Force

Joint Participants

Department of Transportation

This is a United States Space Force program.

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References

SAR Baseline (Development Estimate)

Defense Acquisition Executive (DAE) Approved Acquisition Program Baseline (APB) dated September 27, 2018

Approved APB

Defense Acquisition Executive (DAE) Approved Acquisition Program Baseline (APB) dated September 27, 2018

Mission and Description

The Global Positioning System (GPS) is a space based positioning, navigation, and timing distribution system, which operates through weather and electromagnetic environments (jamming, spoofing, etc.). GPS supports both civil and military users in air, space, sea, and land operations. GPS is a satellite-based radio navigation system that serves military and civil users worldwide. GPS users process satellite signals to determine accurate position, velocity, and time. GPS must comply with 10 United States Code (USC) Section 2281 which requires that the Secretary of Defense ensures the continued sustainment and operation of GPS for military and civilian purposes and 51 USC Section 50112, which requires that GPS complies with certain standards and facilitates international cooperation.

The GPS Next Generation Operational Control System (OCX) program develops and fields a modernized satellite command and control (C2) system which replaces the current ground control system for legacy and new GPS satellites. OCX implements a modern flexible architecture with built-in robust information assurance to address emerging cyber threats. The Air Force is taking a block approach to develop OCX with each block delivering upgrades as they become available.

The OCX program of record consists of 2 block deliverables: Block 1, and Block 2. OCX Block 0, a subset of Block 1, will allow OCX to support the launch and checkout of GPS III satellites. OCX Block 1 replaces the existing legacy GPS C2 system and fields the operational capability to control legacy satellites (GPS IIR, IIR-M, and IIF) and control existing signals (L1 C/A, L1P(Y), L2P(Y)). OCX Block 1 also adds the operational capability to command and control the GPS III satellites and the modernized civil signals (L2C and L5). OCX Block 2 adds operational control of the new international open/civil L1C signal in compliance with 2004 European Union-United States agreement and adds control of the modernized Military Code signal. With the restructuring of the program as a result of the Nunn-McCurdy process, Block 1 and Block 2 capabilities will be delivered concurrently. The majority of Block 2 capabilities were merged into the Block 1 delivery during the 2014 OCX restructure. Recent analysis found it would be cheaper to merge the remaining Block 2 capabilities into Block 1 than to deliver Block 2 after Block 1. This approach delivers Block 2 capabilities sooner and eliminates the impact to GPS operations from a transition from Block 1 to Block 2.

On December 20, 2019, the President of the United States established the United States Space Force which assumed the responsibility for all major space acquisition programs. This program is now a United States Space Force program.

Executive Summary

Program Highlights Since Last Report

Since the last SAR, Raytheon continues to execute to the program and contract schedule. On October 3, 2019, the tenth Deep Dive with USD(A&S) demonstrated the program has held to plan since the post-Nunn-McCurdy re-baseline established in April 2017. The large software-intensive program is performing well using metric driven decisions and remaining risks are typical of a complex software acquisition. At the Deep Dive, USD(A&S) also recognized the need to address the International Business Machines (IBM) hardware obsolescence replacement prior to transition to operations. In addition, in response to the FY 2019 National Defense Authorization Act Congressional directed follow-on study, the Air Force reviewed the MITRE findings and determined that OCX remained the most cost effective option to deliver a modernized command and control system with built-in information assurance controls capable of addressing emerging cyber threats.

The Global Positioning System (GPS) III Launch and Checkout System (LCS), also known as OCX Block 0, successfully supported the on-orbit checkout of GPS III Space Vehicle (SV)01 with no failures as well as supporting state-of-health operations until the SV was transitioned to the current operational ground system, Architecture Evolution Plan, in October 2019. LCS remains available as a backup for emergencies. Additionally, LCS supported the SV02 launch on August 22, 2019 and is currently executing checkout activities. Finally, LCS is on track to support the Spring 2020 launch of SV03.

OCX Blocks 1 & 2 development is complete. Code and unit test and software integration and checkout for the final software iteration completed in August 2019 with a 92% pass rate. As a result, the program has shifted focus to system integration, requirements verification, deployment, and transition to operations. This enables the software team to direct more resources to burn down the discrepancy reports backlog, as well as support integration and requirements sell-off (product test and formal qualification test). System integration is ongoing in an operationally relevant environment and hardware-in-the-loop-testing began in July 2019 enabling the team to begin exercising relevant data flows. The program completed production of all 34 OCX Monitoring Station Receiver Elements and received security accreditation for both unclassified and classified variants enabling the units to be integrated into the system for testing and shipping worldwide in CY 2020. The program completed the pilot phase for IBM obsolescence replacement of the monitoring stations in January 2019. This is ahead of schedule and enabled all IBM hardware to be replaced prior to shipment of equipment to the Monitoring Stations.

The program is currently executing within the APB, for cost, schedule, and performance, approved on September 27, 2018. Government acceptance of OCX Blocks 1 and 2 is contracted for June 2021, with a corresponding Ready to Transition to Operations (RTO) date of April 2022. The Air Force projects seven months risk to the RTO date.

This is a software-intensive program actively using Development Operations, with routine, low-level development and program execution issues worked day-to-day.

History of Significant Developments Since Program Initiation

History of Significant Developments Since Program Initiation	
Date	**Significant Development Description**
February 2007	The United States Air Force began the OCX program with a technology development phase (Phase A). Awarded Phase A contracts for $160M each to Northrop Grumman and Raytheon to produce competitive prototypes.
February 2010	OCX development contract awarded to Raytheon for $886M, with an option to begin preliminary work on Blocks 3 & 4 which are to provide additional capabilities to support follow-on, upgraded versions of GPS III satellites.
March 2012	OCX Program received Milestone B approval and was authorized to begin EMD. An updated APB was signed by the MDA, USD(AT&L).
June 2013	Raytheon conducted a Critical Design Review for the GPS III Launch and Checkout System (LCS)(Block 0). The design artifacts assessed by the Government team demonstrated that Raytheon's design and software architecture were adequate to meet requirements.
June 2014	Government completed Over Target Baseline (OTB) / Over Target Schedule (OTS). The result of the OTB/OTS resulted in revised milestone dates which required the program to submit a Program Deviation Report to USD (AT&L). As part of the OTB/OTS initiatives, Raytheon paused software development activities and focused its effort on completing the balance of Block 1 & Block 2 systems engineering.
February 2015	Program Office and Raytheon held a Deep Dive with USD(AT&L) which directed the development of a new APB and established new milestones to measure schedule and cost performance.
October 2015	A revised APB was signed on October 19, 2015.
December 2015	Second Deep Dive with USD(AT&L) was conducted resulting in OSD and the Air Force jointly agreeing to a 24-month replanto the schedule objectives for Milestone C, Block 1 Ready to Transition to Operations (RTO) and Block 2 RTO in the APB.
December 2015	Program Office reported a schedule breach against current baseline on December 23, 2015.
February 2016	Due to reported schedule delays, the Air Force awarded GPS III Contingency Operations to bridge capability between Block 0 and Block 1.
June 2016	The Secretary of the Air Force declared a critical Nunn-McCurdy breach on June 30, 2016.
July 2016	Raytheon completed Block 0 Factory Qualification Test (FQT) Golden Dry Run, demonstrating the maturity of Block 0 requirements to support LCS.
September 2016	Quarterly review conducted with USD(AT&L). Raytheon reported they met Block 0 LCS FQT Test Readiness Review key milestones. Raytheon also reported on improvements on implementing Development Operations processes, including increased automation in software development, platform deployment, and test as well as an updated configuration management and software development approach.
October 2016	OCX was recertified on October 12, 2016 and the Milestone B, original and current APBs were rescinded. The contract was restructured to reflect a 24-month plus six-month risk schedule extension. All Block 2 content was re-phased to deliver concurrently with Block 1.
March 2017	Program Office and Raytheon completed OTB/OTS process on March 28, 2017. Execution against the new baseline began on April 1, 2017.
June 2017	The DAB occurred on June 20, 2017, and USD(AT&L) agreed to approve OCX's new Milestone B certification and new APB objective dates of April 2021 for Milestone C and April 2022 for Block 1 and 2.

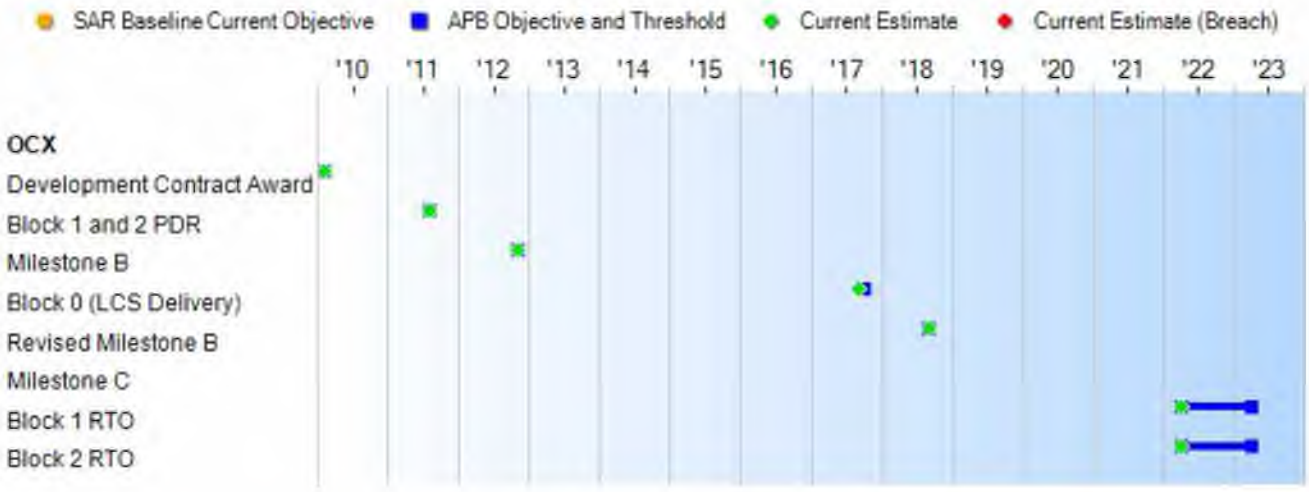
June 2017	GPS OCX CDD approved.
October 2017	The program office accepted Block 0 LCS delivery to support the first GPS III launch, which successfully occurred on December 23, 2018.
September 2018	USD(A&S) recertified Milestone B on September 27, 2018. The recertification established a new APB and revalidated the program funding to the SCP. The MDA remains with USD(A&S) and Milestone C was waived.
October 2018	LCS received Authority to Operate on October 2, 2018, which is valid for two years.
December 2018	LCS supported launch of first GPS III Space Vehicle (SV) 01 on December 23, 2018.
January 2019	Completed the pilot phase for monitoring station obsolescence.
March 2019	Completed production of all 34 OCX Monitoring Station Receivers and received security accreditation for both the unclassified and classified variants.
August 2019	LCS supported launch of the second GPS III SV02 on August 22, 2019.
August 2019	OCX Block 1 and 2 completed software development.

Threshold Breaches

APB Breaches		
Schedule		☐
Performance		☐
Cost	RDT&E	☐
	Procurement	☐
	MILCON	☐
	Acq O&M	☐
O&S Cost		☐
Unit Cost	PAUC	☐
	APUC	☐

Nunn-McCurdy Breaches		
Current UCR Baseline		
	PAUC	None
	APUC	None
Original UCR Baseline		
	PAUC	None
	APUC	None

Schedule



Schedule Events				
Events	**SAR Baseline Development Estimate**	**Current APB Development Objective/Threshold**		**Current Estimate**
Development Contract Award	Feb 2010	Feb 2010	Feb 2010	Feb 2010
Block 1 and 2 PDR	Aug 2011	Aug 2011	Aug 2011	Aug 2011
Milestone B	Nov 2012	Nov 2012	Nov 2012	Nov 2012
Block 0 (LCS Delivery)	Oct 2017	Oct 2017	Oct 2017	Sep 2017
Revised Milestone B	Sep 2018	Sep 2018	Sep 2018	Sep 2018
Milestone C	N/A	N/A	N/A	N/A
Block 1 RTO	Apr 2022	Apr 2022	Apr 2023	Apr 2022
Block 2 RTO	Apr 2022	Apr 2022	Apr 2023	Apr 2022

Change Explanations

None

Notes

OCX Block 1 RTO will be achieved when the Control Segment can support GPS III SV01-10 and operational Block II satellites, can monitor broadcast GPS navigation signals, and can support NAVWAR mission planning by JSpOC. At RTO, the system is turned over to the operational community.

Block 1 and 2 RTOs are the same due to contract change that re-phases the remaining Block 2 content to deliver concurrently with Block 1.

Revised Milestone B was added in the approved September 27, 2018 APB.

Acronyms and Abbreviations

GPS - Global Positioning System
JSpOC - Joint Space Operations Center
LCS - Launch and Checkout System
NAVWAR - Navigation Warfare
PDR - Preliminary Design Review
RTO - Ready to Transition to Operations
SV - Space Vehicle

Performance

Performance Characteristics				
SAR Baseline Development Estimate	**Current APB Development Objective/Threshold**		**Demonstrated Performance**	**Current Estimate**
Backward Compatibility				
All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS- GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB, Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifications for the Local Area Augmentation System, Wide Area Augmentation System, Nationwide Differential GPS, and Maritime Differential GPS.	All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS- GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB, Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifications for the Local Area Augmentation System, Wide Area Augmentation System, Nationwide Differential GPS, and Maritime Differential GPS.	(T=O) All modifications made to the existing GPS Space Segment and Control Segment shall allow the continued operation of existing IS-GPS-200, IS- GPS-700, IS-GPS-705 and SS-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB, Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifications for the Local Area Augmentation System, Wide Area Augmentation System, Nationwide Differential GPS, and Maritime Differential GPS.	TBD	All modifications made to the existing GPS SS and CS shall allow the continued operation of existing IS-GPS-200, IS-GPS-700, IS-GPS-705 and System Specifications-GPS-001 compliant UE and continued operation of legacy receivers (to include Federal augmentation system receivers) IAW performance meeting the APB Precise Positioning Service Performance Standard and GPS Positioning Service Performance Standard, and Federal augmentation system specifica -tions for the Local Area Augmenta-tion System, Wide Area Augmenta-tion System, Nationwide Differential GPS,

				and Maritime Differential GPS.
Availability of Position Accuracy a. b. Horizontal c.d. Vertical				
UEE = 0.8 m rms HORIZONTAL Note 1) a. 4.5 m (95%) @ 90% availability (any lat/long) b. 4.0 m (95%) @ 99.9% availability (global Average) VERTICAL (see Note 1) c. 7.0 m (95%) @ 90% availability (any lat/long) d. 7.0 m (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) HORIZONTAL (see Note 1) a. 11.5 m (95%) @ 90% availability (any lat/long) b. 11.5 m (95%) @ 99.9% availability (global average) VERTICAL (see Note 1) c. 17.7 m (95%) @ 90% availability (any lat/long) d. 17.7 m global average. (95%) @ 99.9% availability *Note 1: Availability of position accuracy is dependent on the GPS receiver's UEE.	UEE = 0.8 m rms HORIZONTAL Note 1) a. 4.5 m (95%) @ 90% availability (any lat/long) b. 4.0 m (95%) @ 99.9% availability (global Average) VERTICAL (see Note 1) c. 7.0 m (95%) @ 90% availability (any lat/long) d. 7.0 m (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) HORIZONTAL (see Note 1) a. 11.5 m (95%) @ 90% availability (any lat/long) b. 11.5 m (95%) @ 99.9% availability (global average) VERTICAL (see Note 1) c. 17.7 m (95%) @ 90% availability (any lat/long) d. 17.7 m global average. (95%) @ 99.9% availability *Note 1: Availability of position accuracy is dependent on the GPS receiver's UEE.	(T=O) UEE = 0.8 m rms HORIZONTAL Note 1) a. 4.5 m (95%) @ 90% availability (any lat/long) b. 4.0 m (95%) @ 99.9% availability (global Average) VERTICAL (see Note 1) c. 7.0 m (95%) @ 90% availability (any lat/long) d. 7.0 m (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) HORIZONTAL (see Note 1) a. 11.5 m (95%) @ 90% availability (any lat/long) b. 11.5 m (95%) @ 99.9% availability (global average) VERTICAL (see Note 1) c. 17.7 m (95%) @ 90% availability (any lat/long) d. 17.7 m global average. (95%) @ 99.9% availability *Note 1: Availability of position accuracy is dependent on the GPS receiver's UEE.	TBD	UEE = 0.8 m rms a. 4.5 m (95%) @ 90% availability any lat/long b. 4.0 m (95%) @ 99.9% availability global average c. 7.0 m (95%) @ 90% availability any lat/long d. 7.0 m (95%) @ 99.9% availability global average UEE = 2.6 m rms a. 11.5 m (95%) @ 90% availability any lat/long b. 11.5 m (95%) @ 99.9% availability global average c. 17.7 m (95%) @ 90% availability any lat/long d. 17.7 m (95%) @ 99.9% availability global average.
Position and Time Transfer Integrity				
The GPS III Enterprise shall not transmit Misleading SIS Information (MSI) to the user with a probability greater than 0.0001 per hour.	The GPS III Enterprise shall not transmit Misleading SIS Information (MSI) to the user with a probability greater than 0.0001 per hour.	(T=O) The GPS III Enterprise shall not transmit Misleading SIS Information (MSI) to the user with a probability greater than 0.0001 per hour.	TBD	GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour.
Net-Ready KPP				
Availability of Accuracy in the terrestrial Transfer Determination Capability; service volume with UE UEE = 0.8 m rms HORIZONTAL 4.5 m (95%)@ 90% availability	Availability of Accuracy in the terrestrial Transfer Determination Capability; service volume with UE UEE = 0.8 m rms HORIZONTAL 4.5 m (95%)@ 90% availability	(T=O) Availability of Accuracy in the terrestrial Transfer Determination Capability; service volume with UE UEE = 0.8 m rms HORIZONTAL 4.5 m	TBD	The system must fully support execution of joint critical operational activities and information

(any lat/long) 4.0 m (95%) @ 99.9% availability (global VERTICAL 7.0 m (95%) @ 90% availability (any lat/long) 7.0 m (95%) @ 99.9% availability (global average) UEE = 2.6m rms HORIZONTAL 11.5 m (95%)@ 90% availability (any lat/long) 11.5 m (95%)@ 99.9% availability (global average) VERTICAL 17.7 m (95%)@ 90% availability (any lat/long) 17.7 m (95%) @ 99.9% availability (global average) Availability of Dynamic and Static Time Transfer Accuracy with UE. UEE = 0.8 m rms 15 ns (95%)@90% availability (any lat/long) 15 ns (95%)@ 99.9% availability (global coverage) UEE = 2.6 m rms 40 ns (95%)@ 90% availability (any lat/long) 50 ns (95%)@ 99.9% availability (global coverage) Static Time Transfer Threshold=Objective 30ns (95%) @> 99.9% availability Note: This represents the cumulative threshold/objective achieved by the collective contributions of the space, control, and/or user segments. Availability of position accuracy is dependent on the GPS receiver's UEE. Note: Mission: Provide: Positioning, Navigation, and Time Transfer Determination Capability; Military Protection and Operations Capability; and Constellation	(any lat/long) 4.0 m (95%) @ 99.9% availability (global VERTICAL 7.0 m (95%) @ 90% availability (any lat/long) 7.0 m (95%) @ 99.9% availability (global average) UEE = 2.6m rms HORIZONTAL 11.5 m (95%)@ 90% availability (any lat/long) 11.5 m (95%)@ 99.9% availability (global average) VERTICAL 17.7 m (95%)@ 90% availability (any lat/long) 17.7 m (95%) @ 99.9% availability (global average) Availability of Dynamic and Static Time Transfer Accuracy with UE. UEE = 0.8 m rms 15 ns (95%)@90% availability (any lat/long) 15 ns (95%)@ 99.9% availability (global coverage) UEE = 2.6 m rms 40 ns (95%)@ 90% availability (any lat/long) 50 ns (95%)@ 99.9% availability (global coverage) Static Time Transfer Threshold=Objective 30ns (95%) @> 99.9% availability Note: This represents the cumulative threshold/objective achieved by the collective contributions of the space, control, and/or user segments. Availability of position accuracy is dependent on the GPS receiver's UEE. Note: Mission: Provide: Positioning, Navigation, and Time Transfer Determination Capability; Military Protection and Operations Capability; and Constellation	(95%)@ 90% availability (any lat/long) 4.0 m (95%) @ 99.9% availability (global VERTICAL 7.0 m (95%) @ 90% availability (any lat/long) 7.0 m (95%) @ 99.9% availability (global average) UEE = 2.6m rms HORIZONTAL 11.5 m (95%)@ 90% availability (any lat/long) 11.5 m (95%)@ 99.9% availability (global average) VERTICAL 17.7 m (95%)@ 90% availability (any lat/long) 17.7 m (95%) @ 99.9% availability (global average) Availability of Dynamic and Static Time Transfer Accuracy with UE. UEE = 0.8 m rms 15 ns (95%)@90% availability (any lat/long) 15 ns (95%)@ 99.9% availability (global coverage) UEE = 2.6 m rms 40 ns (95%)@ 90% availability (any lat/long) 50 ns (95%)@ 99.9% availability (global coverage) Static Time Transfer Threshold=Objective 30ns (95%) @> 99.9% availability Note: This represents the cumulative threshold/objective achieved by the collective contributions of the space, control, and/or user segments. Availability of position accuracy is dependent on the GPS receiver's UEE. Note: Mission: Provide: Positioning, Navigation, and Time Transfer Determination Capability; Military Protection and Operations Capability;		exchanges identified in the DoD Enterprise Architecture and solution architectures based on integrated DoD AF content, and must satisfy the technical requirements for transition to Net-Centric military operations to include: 1) Solution architecture products compliant with DoD Enterprise Architecture based on integrated DoD AF content, including specified operationally effective information exchanges 2) Compliant with Net-Centric Data Strategy, and Net -centric Services Strategy and the principles and rules identified in the DoD IEA, excepting tactical and non-IP communic-ations 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementa-tion guidance of GESPs necessary to

Management.	Management.	and Constellation Management.		meet all operational requirements specified in the DoD Enterprise Architecture and solution architecture views 4) Information assurance requirements including availability, integrity, authentica-tion, confidential-ity, and non-repudiation, and issuance of an IATO or ATO by the DAA, and 5) Support-ability requirements to include SAASM, Spectrum, and JTRS require-ments.
System Survivability				
The System Survivability KPP is satisfied by meeting the thresholds of the Availability of Position Accuracy KPP (SS and CS); Position and Time Transfer Integrity KPP (SS and CS); Availability of Time Transfer Accuracy KPP (SS and CS); PNT Determination KPP (User Segment); Accuracy KPP (User Segment); System Survivability - Cybersecurity KPP (CS); Integrity KPP (User Segment); Cryptography, Security Architecture, and Key Distribution KPP (User Segment); and External Augmentation KPP	The System Survivability KPP is satisfied by meeting the thresholds of the Availability of Position Accuracy KPP (SS and CS); Position and Time Transfer Integrity KPP (SS and CS); Availability of Time Transfer Accuracy KPP (SS and CS); PNT Determination KPP (User Segment); Accuracy KPP (User Segment); System Survivability - Cybersecurity KPP (CS); Integrity KPP (User Segment); Cryptography, Security Architecture, and Key Distribution KPP (User Segment); and External Augmentation KPP	(T=O) The System Survivability KPP is satisfied by meeting the thresholds of the Availability of Position Accuracy KPP (SS and CS); Position and Time Transfer Integrity KPP (SS and CS); Availability of Time Transfer Accuracy KPP (SS and CS); PNT Determination KPP (User Segment); Accuracy KPP (User Segment); System Survivability - Cybersecurity KPP (CS); Integrity KPP (User Segment); Cryptography, Security Architecture, and Key Distribution KPP (User Segment); and External Augmentation KPP		The System Survivability KPP is satisfied by meeting the thresholds of the Availability of Position Accuracy KPP (SS and CS); Position and Time Transfer Integrity KPP (SS and CS); Availability of Time Transfer Accuracy KPP (SS and CS); PNT Determination KPP (User Segment); Accuracy KPP (User Segment); System

(User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.	(User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.	(User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.		Survivability - Cybersecurity KPP (CS); Integrity KPP (User Segment); Cryptography, Security Architecture, and Key Distribution KPP (User Segment); and External Augmentation KPP (User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.
Sustainment				
The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP thresholds satisfies this KPP.	The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP thresholds satisfies this KPP.	(T=O) The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP thresholds satisfies this KPP.		The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP thresholds satisfies this KPP.
Availability of Time Transfer Accuracy				
UEE = 0.8 m rms (See Note 1) 15 nanoseconds (ns) (95%) @ 90% availability (any lat/long) 15 ns (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) 40 ns (95%) @ 90% availability (any lat/long) 50 ns (95%) @ 99.9% availability (global average) Static Time Transfer 3.0 ns (95%) @ >99.9% availability Note 1: Availability of time transfer accuracy	UEE = 0.8 m rms (See Note 1) 15 nanoseconds (ns) (95%) @ 90% availability (any lat/long) 15 ns (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) 40 ns (95%) @ 90% availability (any lat/long) 50 ns (95%) @ 99.9% availability (global average) Static Time Transfer 3.0 ns (95%) @ >99.9% availability Note 1: Availability of time transfer accuracy	(T=O) UEE = 0.8 m rms (See Note 1) 15 nanoseconds (ns) (95%) @ 90% availability (any lat/long) 15 ns (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) 40 ns (95%) @ 90% availability (any lat/long) 50 ns (95%) @ 99.9% availability (global average) Static Time Transfer 3.0 ns (95%) @ >99.9% availability Note 1: Availability of time transfer accuracy		UEE = 0.8 m rms (See Note 1) 15 nanoseconds (ns) (95%) @ 90% availability (any lat/long) 15 ns (95%) @ 99.9% availability (global average) UEE = 2.6 m rms (See Note 1) 40 ns (95%) @ 90% availability (any lat/long) 50 ns (95%) @ 99.9% availability (global average) Static Time

(dynamic) is dependent on the GPS receiver's UEE.	(dynamic) is dependent on the GPS receiver's UEE.	(dynamic) is dependent on the GPS receiver's UEE.		Transfer 3.0 ns (95%) @ >99.9% availability Note 1: Availability of time transfer accuracy (dynamic) is dependent on the GPS receiver's UEE.

Classified Performance information is provided in the classified annex to this submission.

Requirements Reference

GPS OCX CDD dated June 29, 2017.

Change Explanations

None

Notes

This performance baseline is for OCX and was derived from the system-level CDD requirements. The GPS III program will track cost, schedule, and performance separately in its own APB.

Performance characteristics System Survivability, Sustainment, and Availability of Time Transfer Accuracy were added in the approved September 27, 2018 APB.

Acronyms and Abbreviations

AF - Air Force
ATO - Authority To Operate
CS - Control Segment
DAA - Designated Approval Authority
GESP - GIG Enterprise Service Profiles
GIG - Global Information Grid
GPS - Global Positioning System
IATO - Interim Authority to Operate
IAW - In Accordance With
IEA - Information Enterprise Architecture
IP - Internet Protocol
IS - Interface Specifications
IT - Information Technology
JTRS - Joint Tactical Radio System
lat - Latitude
long - Longitude
m - meter
MSI - Misleading Signal in Space Information
ns - nanosecond
O - Objective
PNT - Positioning, Navigation, and Timing
rms - root-mean-square
SAASM - Selective Availability/Anti-Spoofing Module
SS - Space Segment
SV - Space Vehicle
T - Theshold
TV - Technical View
UE - User Equipment
UEE - User Equipment Error

Track to Budget

General Notes

In December 2019, the Office of Management and Budget directed the DoD to establish new Space Force RDT&E and procurement appropriations. Beginning in FY 2021, space-related RDT&E funding, formerly under 3600F (RDT&E, Air Force) is contained in 3620SF (RDT&E, Space Force) and space procurement funding formerly under 3021F (Space Procurement, Air Force) is contained in 3022SF (Procurement, Space Force).

RDT&E

Appn	BA	PE	
Air Force	07	0603421F	
Project		**Name**	
674993		GPS III	(Sunk)
Air Force	07	0603423F	
Project		**Name**	
67A021		INWS	(Sunk)
67A025		GPS Enterprise Integrator	(Sunk)
Air Force	07	1206423F	
Project		**Name**	
67A021		OCX	(Sunk)
67A025		GPS Enterprise Integrator	(Sunk)
Air Force	07	1206423SF	
Project		**Name**	
67A021		OCX	
67A025		GPS Enterprise Integrator	

Cost and Funding

Cost Summary

Total Acquisition Cost							
Appropriation	BY 2017 $M			BY 2017 $M	TY $M		
	SAR Baseline Development Estimate	Current APB Development Objective/Threshold		Current Estimate	SAR Baseline Development Estimate	Current APB Development Objective	Current Estimate
RDT&E	6030.4	6030.4	6633.4	6222.8	6016.9	6016.9	6253.8
Procurement	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Flyaway	--	--	--	0.0	--	--	0.0
Recurring	--	--	--	0.0	--	--	0.0
Non Recurring	--	--	--	0.0	--	--	0.0
Support	--	--	--	0.0	--	--	0.0
Other Support	--	--	--	0.0	--	--	0.0
Initial Spares	--	--	--	0.0	--	--	0.0
MILCON	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acq O&M	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	6030.4	6030.4	N/A	6222.8	6016.9	6016.9	6253.8

Current APB Cost Estimate Reference

SCP dated May 25, 2017; SAF/FMC GPS OCX 2017 SCP memo dated June 12, 2018

Cost Notes

No cost estimate for the program has been completed in the previous year.

Total Quantity			
Quantity	SAR Baseline Development Estimate	Current APB Development	Current Estimate
RDT&E	1	1	1
Procurement	0	0	0
Total	1	1	1

Cost and Funding

Funding Summary

Appropriation Summary FY 2021 President's Budget / December 2019 SAR (TY$ M)									
Appropriation	Prior	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	To Complete	Total
RDT&E	4504.9	445.3	482.0	406.1	290.9	124.6	0.0	0.0	6253.8
Procurement	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MILCON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acq O&M	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PB 2021 Total	4504.9	445.3	482.0	406.1	290.9	124.6	0.0	0.0	6253.8
PB 2020 Total	4522.8	445.3	487.4	406.3	291.1	125.9	0.0	0.0	6278.8
Delta	-17.9	0.0	-5.4	-0.2	-0.2	-1.3	0.0	0.0	-25.0

Funding Notes

The total funding requirement of the program is $6,265.2M with the Air Force and the Space Force funds part totaling to $6,253.8M shown in table above. Department of Transportation (DoT) funding in the amount of $11.4M (as of January 2020) is required and is critical to the development and delivery of the entire program.

Quantity Summary FY 2021 President's Budget / December 2019 SAR (TY$ M)										
Quantity	Undistributed	Prior	FY 2020	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	To Complete	Total
Development	1	0	0	0	0	0	0	0	0	1
Production	0	0	0	0	0	0	0	0	0	0
PB 2021 Total	1	0	0	0	0	0	0	0	0	1
PB 2020 Total	1	0	0	0	0	0	0	0	0	1
Delta	0	0	0	0	0	0	0	0	0	0

Cost and Funding

Annual Funding By Appropriation

Annual Funding 3600 | RDT&E | Research, Development, Test, and Evaluation, Air Force							
Fiscal Year	Quantity	TY $M					
		End Item Recurring Flyaway	Non End Item Recurring Flyaway	Non Recurring Flyaway	Total Flyaway	Total Support	Total Program
2007	--	--	--	--	--	--	96.1
2008	--	--	--	--	--	--	249.5
2009	--	--	--	--	--	--	289.6
2010	--	--	--	--	--	--	288.4
2011	--	--	--	--	--	--	353.4
2012	--	--	--	--	--	--	346.4
2013	--	--	--	--	--	--	316.7
2014	--	--	--	--	--	--	361.4
2015	--	--	--	--	--	--	373.8
2016	--	--	--	--	--	--	463.4
2017	--	--	--	--	--	--	382.1
2018	--	--	--	--	--	--	493.0
2019	--	--	--	--	--	--	491.1
2020	--	--	--	--	--	--	445.3
Subtotal	1	--	--	--	--	--	4950.2

Annual Funding 3600 | RDT&E | Research, Development, Test, and Evaluation, Air Force							
Fiscal Year	Quantity	BY 2017 $M					
		End Item Recurring Flyaway	Non End Item Recurring Flyaway	Non Recurring Flyaway	Total Flyaway	Total Support	Total Program
2007	--	--	--	--	--	--	110.7
2008	--	--	--	--	--	--	281.8
2009	--	--	--	--	--	--	322.8
2010	--	--	--	--	--	--	317.5
2011	--	--	--	--	--	--	381.8
2012	--	--	--	--	--	--	367.8
2013	--	--	--	--	--	--	330.7
2014	--	--	--	--	--	--	372.2
2015	--	--	--	--	--	--	381.1
2016	--	--	--	--	--	--	465.6
2017	--	--	--	--	--	--	376.2
2018	--	--	--	--	--	--	475.6
2019	--	--	--	--	--	--	464.7
2020	--	--	--	--	--	--	413.0
Subtotal	1	--	--	--	--	--	5061.5

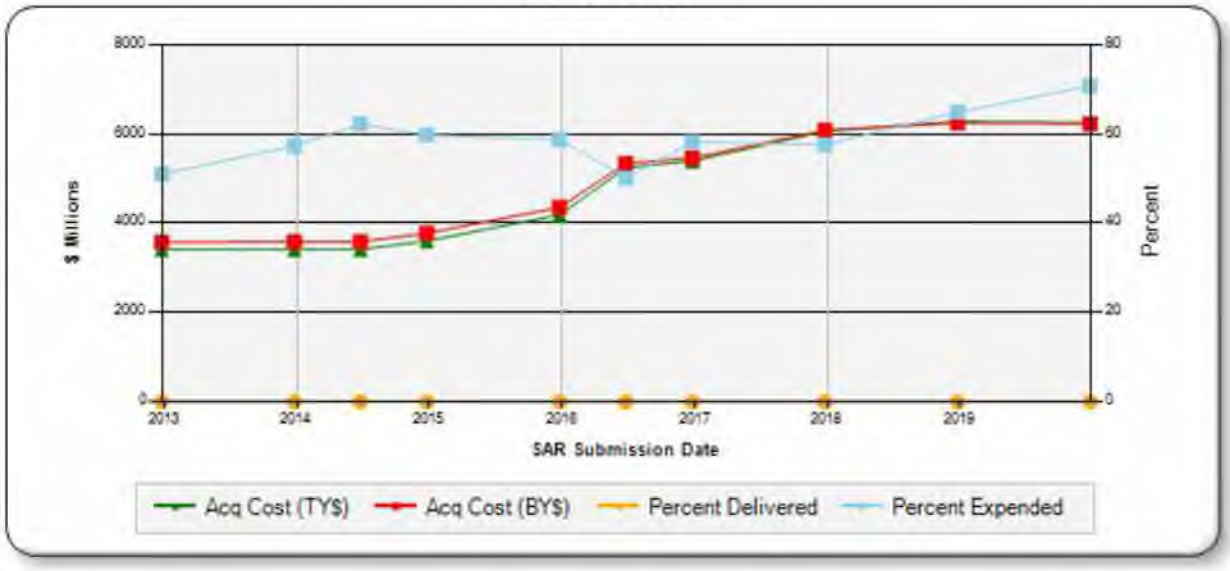
Annual Funding 3620 | RDT&E | Research, Development, Test, and Evaluation, Space Force, Air Force							
Fiscal Year	Quantity	TY $M					
		End Item Recurring Flyaway	Non End Item Recurring Flyaway	Non Recurring Flyaway	Total Flyaway	Total Support	Total Program
2021	--	--	--	--	--	--	482.0
2022	--	--	--	--	--	--	406.1
2023	--	--	--	--	--	--	290.9
2024	--	--	--	--	--	--	124.6
Subtotal	--	--	--	--	--	--	1303.6

Annual Funding 3620 | RDT&E | Research, Development, Test, and Evaluation, Space Force, Air Force							
Fiscal Year	Quantity	BY 2017 $M					
		End Item Recurring Flyaway	Non End Item Recurring Flyaway	Non Recurring Flyaway	Total Flyaway	Total Support	Total Program
2021	--	--	--	--	--	--	438.3
2022	--	--	--	--	--	--	362.0
2023	--	--	--	--	--	--	254.2
2024	--	--	--	--	--	--	106.8
Subtotal	--	--	--	--	--	--	1161.3

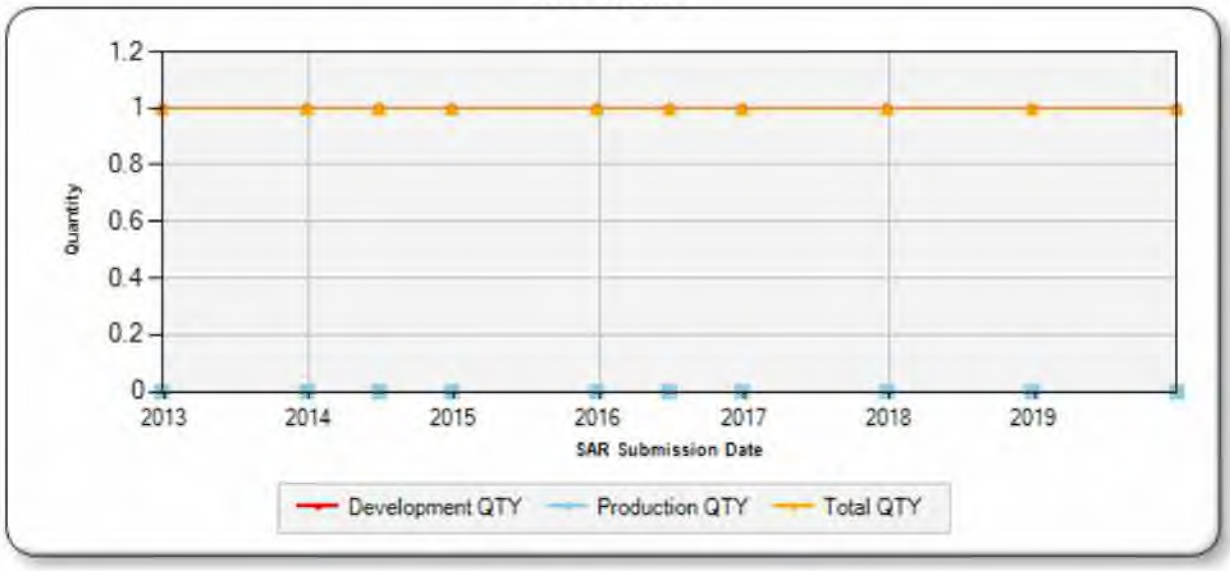
Charts

OCX first began SAR reporting in December 2012

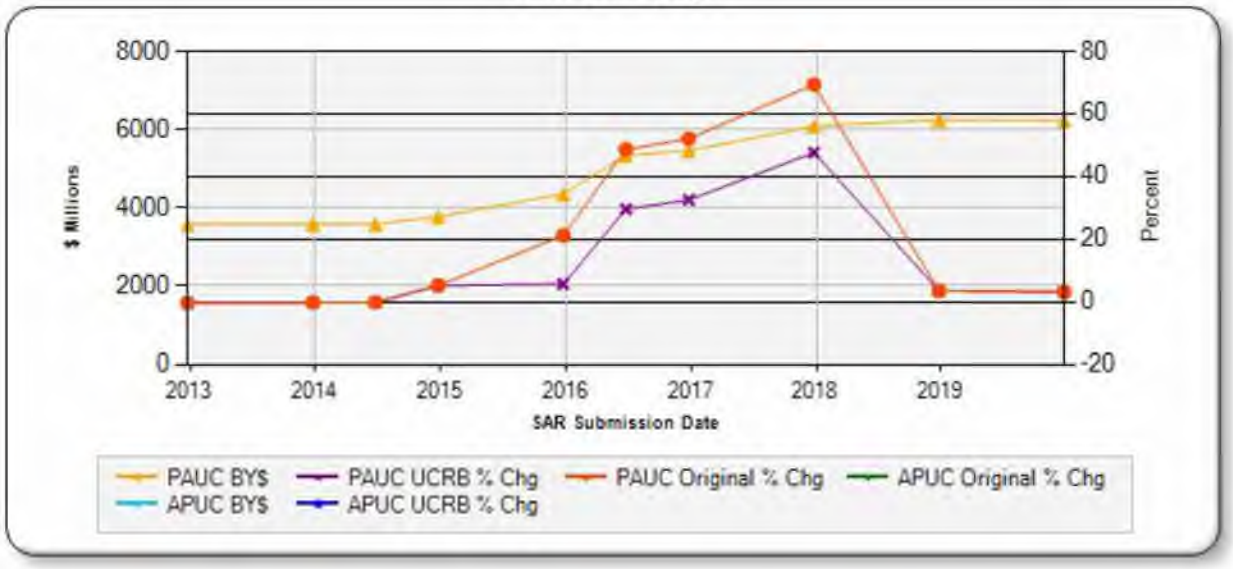
Program Acquisition Cost - OCX
Base Year 2017 $M



Quantity - OCX



Unit Cost - OCX
Base Year 2017 $M



Risks

Significant Schedule and Technical Risks

Significant Schedule and Technical Risks	
Milestone B (November 2012)	
1.	Information Assurance Requirement.
2.	Software Development Plan.
3.	Software Defects.
4.	Systems Engineering process discipline.
Revised Milestone B (September 2018)	
1.	Development Operations (DevOps) Adoption.
2.	Simulation Accreditation.
3.	Integration/Product test.
Current Estimate (December 2019)	
1.	Hardware/Software Obsolescence - International Business Machines (IBM) sold its blade server business to foreign company. The program office identified the need to address IBM obsolescence prior to Ready to Transition to Operations in order to mitigate impacts to operations.

Risks

Risk and Sensitivity Analysis

Risks and Sensitivity Analysis	
Current Baseline Estimate (September 2018)	
1.	Total Acquisition Cost - $6030.4M (BY 2017); PAUC - $6030.4M; Risks - Minimal efficiency gains in the final testing phase from the implementation of Development Operations (DevOps) and hardware/software obsolescence.
Original Baseline Estimate (November 2012)	
1.	Total Acquisition Cost - $3347.2M (BY 2012); PAUC - $3347.2M; Risks - Integrating and testing Block 0 on cyber-hardened infrastructure.
Revised Original Estimate (September 2018)	
1.	Total Acquisition Cost - $6030.4M (BY 2017); PAUC - $6030.4M; Risks - Minimal efficiency gains in the final testing phase from the implementation of DevOps and hardware/software obsolescence.
Current Procurement Cost (December 2019)	
1.	Total Acquisition Cost - $6,221.0M (BY 2017); PAUC - $6,221.0M; Risks - minimal efficiency gains in the final testing phase from the implementation of DevOps and hardware/software obsolescence

Low Rate Initial Production

Notes

There is no LRIP for this program.

Foreign Military Sales

None

Nuclear Costs

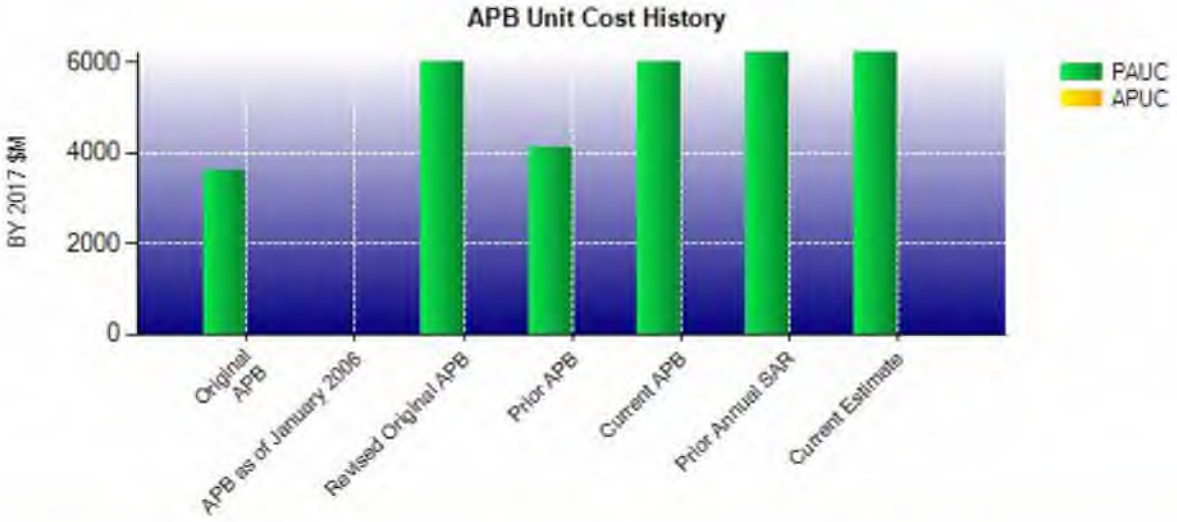
None

Unit Cost

Current UCR Baseline and Current Estimate (Base-Year Dollars)			
Item	BY 2017 $M Current UCR Baseline (Sep 2018 APB)	BY 2017 $M Current Estimate (Dec 2019 SAR)	% Change
Program Acquisition Unit Cost			
Cost	6030.4	6222.8	
Quantity	1	1	
Unit Cost	6030.400	6222.800	+3.19
Average Procurement Unit Cost			
Cost	0.0	0.0	
Quantity	0	0	
Unit Cost	--	--	--

Original UCR Baseline and Current Estimate (Base-Year Dollars)			
Item	BY 2017 $M Revised Original UCR Baseline (Sep 2018 APB)	BY 2017 $M Current Estimate (Dec 2019 SAR)	% Change
Program Acquisition Unit Cost			
Cost	6030.4	6222.8	
Quantity	1	1	
Unit Cost	6030.400	6222.800	+3.19
Average Procurement Unit Cost			
Cost	0.0	0.0	
Quantity	0	0	
Unit Cost	--	--	--

PAUC is based on RDT&E costs and quantities only. There is no APUC for this program because there are no procurement funds or quantities.



APB Unit Cost History					
Item	Date	BY 2017 $M		TY $M	
		PAUC	APUC	PAUC	APUC
Original APB	Nov 2012	3591.800	N/A	3413.000	N/A
APB as of January 2006	N/A	N/A	N/A	N/A	N/A
Revised Original APB	Sep 2018	6030.400	N/A	6016.900	N/A
Prior APB	Oct 2015	4119.900	N/A	3964.400	N/A
Current APB	Sep 2018	6030.400	N/A	6016.900	N/A
Prior Annual SAR	Dec 2018	6244.100	N/A	6278.800	N/A
Current Estimate	Dec 2019	6222.800	N/A	6253.800	N/A

SAR Unit Cost History

Current SAR Baseline to Current Estimate (TY $M)									
PAUC Development Estimate	Changes								PAUC Current Estimate
	Econ	Qty	Sch	Eng	Est	Oth	Spt	Total	
6016.900	23.000	0.000	0.000	0.000	213.900	0.000	0.000	236.900	6253.800

Current SAR Baseline to Current Estimate (TY $M)									
Initial APUC Development Estimate	Changes								APUC Current Estimate
	Econ	Qty	Sch	Eng	Est	Oth	Spt	Total	
0.000	--	--	--	--	--	--	--	--	0.000

An APUC Unit Cost History is not available, since no Initial APUC Estimate had been calculated due to a lack of defined quantities.

SAR Baseline History				
Item	SAR Planning Estimate	SAR Development Estimate	SAR Production Estimate	Current Estimate
Milestone A	N/A	N/A	N/A	N/A
Milestone B	N/A	Sep 2018	N/A	Sep 2018
Milestone C	N/A	N/A	N/A	N/A
IOC	N/A	N/A	N/A	N/A
Total Cost (TY $M)	N/A	6016.9	N/A	6253.8
Total Quantity	N/A	1	N/A	1
PAUC	N/A	6016.900	N/A	6253.800

Cost Variance

Summary TY $M				
Item	RDT&E	Procurement	MILCON	Total
SAR Baseline (Development Estimate)	6016.9	--	--	6016.9
Previous Changes				
Economic	+25.0	--	--	+25.0
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	--	--	--	--
Estimating	+236.9	--	--	+236.9
Other	--	--	--	--
Support	--	--	--	--
Subtotal	+261.9	--	--	+261.9
Current Changes				
Economic	-2.0	--	--	-2.0
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	--	--	--	--
Estimating	-23.0	--	--	-23.0
Other	--	--	--	--
Support	--	--	--	--
Subtotal	-25.0	--	--	-25.0
Total Changes	+236.9	--	--	+236.9
Current Estimate	6253.8	--	--	6253.8

Summary BY 2017 $M				
Item	RDT&E	Procurement	MILCON	Total
SAR Baseline (Development Estimate)	6030.4	--	--	6030.4
Previous Changes				
Economic	--	--	--	--
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	--	--	--	--
Estimating	+213.7	--	--	+213.7
Other	--	--	--	--
Support	--	--	--	--
Subtotal	+213.7	--	--	+213.7
Current Changes				
Economic	--	--	--	--
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	--	--	--	--
Estimating	-21.3	--	--	-21.3
Other	--	--	--	--
Support	--	--	--	--
Subtotal	-21.3	--	--	-21.3
Total Changes	+192.4	--	--	+192.4
Current Estimate	6222.8	--	--	6222.8

Previous Estimate: December 2018

RDT&E	$M	
Current Change Explanations	Base Year	Then Year
Revised escalation indices. (Economic)	N/A	-2.0
Revised estimate due to Air Force-wide funding adjustments. (Estimating)	-6.1	-6.8
Revised estimate due to Small Business Innovative Research in FY 2019. (Estimating)	-17.2	-18.2
Adjustment for current and prior escalation. (Estimating)	+1.1	+1.1
Funds transferred within program from Research, Development, Test, and Evaluation, Air Force to newly added Research, Development, Test, and Evaluation, Space Force. (Estimating)	-1161.3	-1303.6
Funds transferred within program from Research, Development, Test, and Evaluation, Air Force to newly added Research, Development, Test, and Evaluation, Space Force. (Estimating)	+1161.3	+1303.6
Revised estimate due to Air Force wide inflation adjustment. (Estimating)	+0.9	+0.9
RDT&E Subtotal	-21.3	-25.0

Contracts

Contract Identification

Appropriation: RDT&E
Contract Name: OCX Phase B Contract
Contractor: Raytheon (Intelligence and Information Systems)
Contractor Location: 16800 E Centre Tech Pkwy
Aurora, CO 80011
Contract Number: FA8807-10-C-0001
Contract Type: Cost Plus Incentive Fee (CPIF), Cost Plus Award Fee (CPAF)
Award Date: February 25, 2010
Definitization Date: February 25, 2010

Contract Price							
Initial Contract Price ($M)			Current Contract Price ($M)			Estimated Price At Completion ($M)	
Target	Ceiling	Qty	Target	Ceiling	Qty	Contractor	Program Manager
886.4	N/A	1	1269.1	N/A	1	3323.6	3438.6

Target Price Change Explanation

The difference between the Initial Contract Price Target and the Current Contract Price Target is due to recognized cost over-runs as a result of software development and systems engineering challenges. Engineering Change Proposals, Requests for Equitable Adjustments, contract modifications for the Master Control Station (MCS) Element, Monitor Station Legacy Ground Antenna, and engineering studies were also contributors.

Contract Variance		
Item	Cost Variance	Schedule Variance
Cumulative Variances To Date (12/31/2019)	-79.6	-53.4
Previous Cumulative Variances	-51.0	-23.9
Net Change	-28.6	-29.5

Cost and Schedule Variance Explanations

The unfavorable net change in the cost variance is due to MCS Software Integration and Checkout (SWIC) integration complexity, inefficiencies in Product Test and Development Operations activities and complexity and quantity of Discrepancy Report (DR) work-offs as well as System Engineering Integration and Test software test lab inefficiencies and Final Acceptance Test/Final Qualification Test environmental immaturity.

The unfavorable net change in the schedule variance is due to delays in Cycle 4 Design, Code Unit Test and SWIC, DR growth, and Final 3 Operational Control Segment Master Station Receiver Element manufacturing delays. The unfavorable change was partly offset by a $10M schedule variance improvement mainly due to the September 2019 approved re-plan.

Notes

For tracking purposes, initial contract price information is based on the initial monthly contractor's performance report ending March 28, 2010.

In past reports, the PM Estimated Price at Complete included costs of future contract obligations (FCOs). Going forward, the PM Estimated Price at Complete will include only effort that is currently on contract and will not include FCOs. This approach to remove FCOs from the PM Estimated Price at Complete, aligns to how the contractor is reporting its Contractor Estimated Price at Complete and leads to an accurate comparison of contractor and PM Estimated Price at Complete.

Deliveries and Expenditures

Deliveries				
Delivered to Date	Planned to Date	Actual to Date	Total Quantity	Percent Delivered
Development	0	0	1	0.00%
Production	0	0	0	--
Total Program Quantity Delivered	0	0	1	0.00%

Expended and Appropriated (TY $M)			
Total Acquisition Cost	6253.8	Years Appropriated	14
Expended to Date	4421.6	Percent Years Appropriated	77.78%
Percent Expended	70.70%	Appropriated to Date	4950.2
Total Funding Years	18	Percent Appropriated	79.16%

The above data is current as of February 10, 2020.

Operating and Support Cost

Cost Estimate Details

Date of Estimate:	May 25, 2017
Source of Estimate:	SCP
Quantity to Sustain:	1
Unit of Measure:	System
Service Life per Unit:	10.00 Years
Fiscal Years in Service:	FY 2024 - FY 2034

O&S costs includes operating, maintaining, and supporting the dedicated Master Control Station (MCS) located at Schriever Air Force Base (AFB), Colorado and the Alternate MCS (AMCS) located at Vandenberg AFB, California, both of which include connections to the ground antenna and monitoring stations which support the Global Positioning System III (GPS III) and GPS II legacy spacecraft. Also included are the costs of operating, maintaining, and supporting 17 monitoring stations, six controlled by the 50th Space Wing and 11 co-located at National Geo-spatial Intelligence Agency sites. Satellite operations at the MCS include mission planning, mission payload operations, and monitoring of satellite state of health. Monitor stations receive mission payload data and transfer this data to the MCS to ensure spacecraft are operating as desired.

The "system" to be supported will consist of the MCS, AMCS, Launch and Checkout System, Transition Support Facility, Data Storage and Archive System, GPS System Simulator, Standard Space Trainer software, four ground antennae elements, and 17 remote sites.

O&S cost estimate assumes OCX Block 1 is Ready To Operate in month end August 2022. Initial O&S activities start in August 2022 and continue until full O&S activities begin in May 2024. The system has a 10-year service life which will continue through May 2034. Manpower assumes a mixture of Air Force personnel performing organic work with assistance from contractor engineers.

Manpower, operations and maintenance is analogous to the currently operating GPS Operational Control System (OCS) with adjustments modeled to reflect the new OCX footprint.

Continuing system improvements are factored in as hardware modifications and software maintenance and modifications. The OCX hardware and software maintenance cost are based on OCS historical data and adjusted proportionally for the larger hardware profile and Software Lines of Code and cyber security differences between OCS and OCX.

In February 2016, the Air Force contracted with Lockheed Martin to modify the existing GPS OCS to support the GPS III satellite on-orbit command and control while delivering legacy capabilities. This effort is called Contingency Operations, and is not a part of the OCX system or its estimates.

Sustainment Strategy

Hardware depot maintenance will be 100% supported by Tobyhanna Army Depot while the Organizational Level maintenance will be Contractor Logistics Support (in alignment with operational unit's maintenance structure).

The estimate assumes organic depot hardware maintenance with 30% organic software maintenance and 70% contractor software maintenance. The cost estimate also includes Software Iteration 2.2 and the O&S requirements to support GPS III Space Vehicles on orbit.

Sustainment support is based on operator and non-operator training and sustainment engineering support is analogous to GPS OCS.

Antecedent Information

The antecedent system is GPS OCS. This system is the current operating control system and is limited to operating GPS II satellites. GPS OCS costs are derived from actual cost collected from the last GPS OCS official Cost Data Summary Report submission in 2011.

Annual O&S Costs BY2017 $M		
Cost Element	**OCX Average Annual Cost Per System**	**GPS OCS (Antecedent) Average Annual Cost Per System**
Unit-Level Manpower	9.248	12.100
Unit Operations	19.570	51.400
Maintenance	112.652	5.400
Sustaining Support	9.447	4.400
Continuing System Improvements	62.892	31.500
Indirect Support	3.882	0.500
Other	0.000	0.000
Total	217.691	105.300

The estimated GPS OCX average annual cost is higher than the GPS OCS actuals mainly due to the following significant cost drivers; OCX has a significantly more lines-of code (57% larger) to maintain, a significantly more complex and robust Information Assurance construct, and higher costs for hardware maintenance due to a larger hardware profile (76% larger).

Item	Total O&S Cost $M			
	OCX			GPS OCS (Antecedent)
	Current Development APB Objective/Threshold		Current Estimate	
Base Year	2303.2	2533.5	2303.2	N/A
Then Year	2955.1	N/A	2955.1	0.0

Estimate includes requirements for GPS IIF and GPS III and On-Orbit and Factory Support and updates Base Year from 2012 to 2017.

Equation to Translate Annual Cost to Total Cost

Average Annual Cost per System = Total OCX O&S Cost from FY 2024 through FY 2034 / number of service years

$217.69 = $2,176.90/ 10 Years

Total OCX O&S Cost from FY 2022 through FY 2034 = Total OCX O&S Cost in FY 2022 + Total OCX O&S Cost in FY 2023 + Total OCX O&S Cost from FY 2024 through FY 2034

$2,295.5M= $33.0M in FY2022 + $85.6M in FY 2023 + $2,176.9M in FY 2024 through FY 2034

O&S Cost Variance		
Category	**BY 2017 $M**	**Change Explanations**
Prior SAR Total O&S Estimates - Dec 2018 SAR	2303.2	
Programmatic/Planning Factors	0.0	
Cost Estimating Methodology	0.0	
Cost Data Update	0.0	
Labor Rate	0.0	
Energy Rate	0.0	
Technical Input	0.0	
Other	0.0	
Total Changes	0.0	
Current Estimate	2303.2	

Total Prior O&S cost BY dollars updated from BY 2012 to BY 2017 using FY 2017 inflation rates and applying the BY 2017 rates to the approved SCP.

Disposal Estimate Details

Date of Estimate: May 25, 2017
Source of Estimate: SCP
Disposal/Demilitarization Total Cost (BY 2017 $M): 7.7