PAIRS CASE 2022-C-0306

NEXT GENERATION OPERATIONAL CONTROL SYSTEM (OCX)

Selected Acquisition Report (SAR)

AS OF THE FY 2023 PRESIDENT'S BUDGET

U.S. AIR FORCE

Contents

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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 section 2281 of title 10, United States Code (USC), which requires that the Secretary of Defense ensures the continued sustainment and operation of GPS for military and civilian purposes and section 50112 of title 51, USC, which requires that GPS complies with certain standards and facilitates international cooperation.

The 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 two block deliverables: Blocks 1 and 2. OCX Block 0, a subset of the Block 1 delivery, allows 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), and 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 a 2004 European Union-United States agreement and adds control of the modernized Military Code signals (L1M and L2M). With the restructuring of the program as a result of the Nunn-McCurdy process, Blocks 1 and 2 capabilities will be delivered concurrently.

Executive Summary

Program Highlights Since Last Report

OCX remains a large software-intensive program that is performing well using metric driven decisions and its remaining technical risks are typical of a complex software acquisition. Since the last SAR the Government continues its plan to mitigate an unacceptable cyber risk caused by the sale of an International Business Machines product line to Lenovo, a foreign owned company, in a manner which saves the government $150M in future costs. This Hewlett-Packard (HP) Replacing IBM Project (HRIP) held Raytheon to its original contract commitment to qualify the OCX Block 1 and 2 mission software on IBM while separately directing them to build up the new HP environments in parallel.

The Raytheon and Government teams have also worked hard to mitigate major delivery delays since the onset of the COVID-19 pandemic. However, two separate and concurrent pandemic issues impacted OCX. First, site closures and mandatory Restrictions of Movement slowed equipment installation for the Monitor Stations (MS), and extended the deployment schedule by five months. The second issue happened concurrently with the MS five month schedule impact and was due to impacts on integration and testing in classified labs resulting from social distancing constraints and staff disruptions due to COVID-19 cases. In April 2021, Raytheon submitted a Request for Equitable Adjustment (REA) and in July 2021, the Government and Raytheon settled on a $13.5M price and schedule relief due to these impacts.

Due to other technical issues and delays not attributable to COVID-19, Raytheon has also consumed all of their remaining schedule margin and is estimating a July 2022 contract delivery. Taking into account potential technical issues and COVID-19 inefficiencies the government is projecting a later date of October 2022 for DD250. The Government estimates that six months of transition activities are required between the Raytheon contract delivery date and the Ready to Transition to Operations (RTO) milestone; therefore the government RTO estimate now stands at March 31, 2023. The Acquisition Program Baseline (APB) RTO threshold remains April 30, 2023, leaving one month margin.

The Launch and Checkout System (LCS), or OCX Block 0, is operating nominally. To date, LCS has supported the launch and checkout of five GPS III Space Vehicles (SV)s. Satellite control authority for GPS III SV 03, 04, and 05 was transferred to the 2nd Space Operations Squadron in July 2020, November 2020, and June 2021, respectively, and all vehicles are now operational. LCS remains available as a backup to the Operational Control System for GPS III emergencies, and is on-track to support a January 2023 SV06 launch.

OCX Block 1 and 2 concluded a major program element referred to as Certificate of Conformance (CoC) in December 2021. This event qualified much of the system's mission software on IBM with the completion of the Master Control Station (MCS) Formal Qualification Test (FQT) on December, 17, 2021. Also tied to the CoC event was completion of the GPS System Simulator Element, MS, Legacy Ground Antenna Element (LGAE), and Global Information Grid Automated Information System (GGA) qualification tests and installation of 17 worldwide Monitoring Stations.

On May 28, 2021 the HRIP team completed configuration of the HP baseline's core infrastructure, virtualization capabilities, and unclassified software factory pipeline. By September 1, 2021, the Segment Integration team began demonstrating HP-specific Integration Objectives and Capability Sequences; this work occurs both in the factory and also on fielded equipment. As of December 2021,

overall Segment Integration tasks (prior IBM-based and current HP-based) are 62% complete. As Segment Integration progresses, the program will begin formally testing remaining requirements through the HP FQT and Site Acceptance Test events, which are slated to begin in March and April 2022, respectively.

Additionally, in September 2021, the HRIP team secured the first of a series of cyber accreditations that allowed additional global HP deployments to proceed. By the end of December 2021, GGA, MCS, and Transition Support Facility were installed at Schriever Space Force Base (SFB) (SSFB). At Vandenberg Space Force Base, GGA and the unclassified portion of the Alternate Master Control Station (AMCS) were also installed. The remainder of the AMCS is being temporarily retained in the factory to support HP-based Segment Integration efforts. Three of the four LGAE interfaces were installed at Cape Canaveral Space Force Station, Ascension Island, and Diego Garcia in October, November, and December 2021, respectively. The last LGAE will be installed at Marshall Islands (Kwajalein) beginning in February 2022.

Live Sky data from the MSs continues to be collected at SSFB for tuning and checking OCX's navigation algorithms, and the program projects OCX will be able to meet its navigation and timing specifications.

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 Engineering and Manufacturing Development. An updated APB was signed by the Milestone Decision Authority (MDA), USD(AT&L).
June 2013	Raytheon conducted a Critical Design Review for the GPS III 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 replan to the schedule objectives for Milestone C, Block 1 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 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 Capability Development Document (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 SV01 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.
December 2019	SV01 satellite control authority transferred to Second Space Operations Squadron (2 SOPS).
March 2020	SV02 satellite control authority transferred to 2 SOPS.
March 2020	Hewlett Packard Enterprise Replacing International Business Machines Project contract modification definitized.
July 2020	GPS III SV 03 satellite control authority transferred to 2 SOPS on July 23, 2020 following LCS support of the launch on June 30, 2020.
September 2020	The Global MS deployment campaign began with the completion of the Schriever Air Force Base (SAFB) installation on September 4, 2020.
September 2020	GPS System Simulator Element FQT completed on September 8, 2020.
September 2020	The Product Test campaign completed on September 25, 2020, having assessed over 10,000 configuration item-level requirements.
November 2020	GPS III SV04 satellite control authority transferred to 2 SOPS on November 16, 2020 following LCS support of the launch on November 5, 2020.
November 2020	The primary GGA ("Rack 2") was integrated onto SIPRNet at SAFB on November 23, 2020.
June 2021	GPS III SV05 satellite control authority transferred to 2 SOPS on June 28, 2021 following LCS support of the launch on June 17, 2021.
July 2021	All 17 MS installations completed; the last site, Ecuador, finished installation on July 23, 2021.
October 2021	MCS installation began at SSFB on October 5, 2021.
October 2021	The AMCS installation began at Vandenberg Space Force Base on October 12, 2021.
October 2021	Global LGAE interface deployment began with Cape Canaveral Space Force Station, which was

	installed on October 26, 2021.
November 2021	The Transition Support Facility installation began at SSFB on November 9, 2021.
December 2021	The MCS Element FQT ended on December 16, 2021.
December 2021	On December 17, 2021 Government accepted Raytheon's IBM based CoC.

Schedule

Schedule Events

Schedule Events					
Events	**Development APB Objective**	**Current APB Development Objective/Threshold**		**Current Estimate/Actual**	**Deviation**
Development Contract Award	Feb 2010	Feb 2010	Feb 2010	February 25, 2010	
Block 1 and 2 PDR	Aug 2011	Aug 2011	Aug 2011	August 31, 2011	
Milestone B	Nov 2012	Nov 2012	Nov 2012	November 18, 2012	
Block 0 (LCS Delivery)	Oct 2017	Oct 2017	Oct 2017	September 29, 2017	
Revised Milestone B	Sep 2018	Sep 2018	Sep 2018	September 27, 2018	
Milestone C	N/A	N/A	N/A	N/A	
Block 1 RTO	Apr 2022	Apr 2022	Apr 2023	Mar 2023	
Block 2 RTO	Apr 2022	Apr 2022	Apr 2023	Mar 2023	

Schedule Notes

The Block 1 and 2 RTO current estimate changed from November 2022 to March 2023. The Government projects RTO milestone to March 31, 2023 versus the previous RTO of November 2022. This shift accounts for potential technical issues and COVID-19 inefficiencies that the government anticipates Raytheon will uncover. Therefore the government estimates DD250 to occur in October 2022 vice the current Contractor Integrated Master Schedule date of July 2022. The government estimates six months of transition/activities are required between the Raytheon contract delivery date and the APB RTO milestone. With RTO estimate now at March 31, 2023 leaving one month margin to the APB RTO schedule threshold of April 2023.

Significant Schedule Risks

Significant Schedule 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 2021)
1.	Risks emerged due to the international COVID-19 pandemic. Site closures and mandatory Restrictions of Movement placed the Monitor Station deployment schedule at risk. A separate and concurrent risk was due to impacts on integration and testing in classified labs resulting from social distancing constraints and staff disruptions due to COVID-19 cases. In addition, technical issues and schedule concurrency continue to place pressure on the DD250 delivery date. The government projects DD250 date of October 2022 with an 80% confidence level.

Significant Schedule Risks Notes

Milestone B schedule risks details cannot be provided due to how old the data is.

Performance

Performance Characteristics					
SAR Baseline Development Estimate	**Current APB Development Objective/Threshold**		**Demonstrated Performance**	**Current Estimate**	**Deviation**
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,	

Performance Characteristics					
SAR Baseline Development Estimate	Current APB Development Objective/Threshold		Demonstrated Performance	Current Estimate	Deviation
				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	The GPS III Enterprise shall not transmit Misleading	(T=O) The GPS III Enterprise shall not transmit Misleading	TBD	GPS III SV01-08 shall not transmit MSI to	

Performance Characteristics					
SAR Baseline Development Estimate	Current APB Development Objective/Threshold		Demonstrated Performance	Current Estimate	Deviation
SIS Information (MSI) to the user with a probability greater than 0.0001 per hour.	SIS Information (MSI) to the user with a probability greater than 0.0001 per hour.	SIS Information (MSI) to the user with a probability greater than 0.0001 per hour.		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 (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	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 (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	(T=O) 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 (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	TBD	The system must fully support execution of joint critical operational activities and information 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	

Performance Characteristics					
SAR Baseline Development Estimate	Current APB Development Objective/Threshold		Demonstrated Performance	Current Estimate	Deviation
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 Management.	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 Management.	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 Management.		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 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-	

Performance Characteristics					
SAR Baseline Development Estimate	**Current APB Development Objective/Threshold**		**Demonstrated Performance**	**Current Estimate**	**Deviation**
				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 (User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.	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 (User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.	(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 (User Segment).* See Table 5-1 OCX System Survivability – Cybersecurity (KPP) in approved CDD for GPS OCX.	TBD	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	

Performance Characteristics					
SAR Baseline Development Estimate	Current APB Development Objective/Threshold		Demonstrated Performance	Current Estimate	Deviation
				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.	TBD	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 (dynamic) is dependent on the GPS receiver's UEE.	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 (dynamic) is dependent on the GPS receiver's UEE.	(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 (dynamic) is dependent on the GPS receiver's UEE.	TBD	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	

Performance Characteristics					
SAR Baseline Development Estimate	Current APB Development Objective/Threshold		Demonstrated Performance	Current Estimate	Deviation
				Note 1: Availability of time transfer accuracy (dynamic) is dependent on the GPS receiver's UEE.	

Requirements Source

GPS OCX CDD dated June 29, 2017

Acquisition Budget Estimate

Total Acquisition Cost

		Development APB	APB Name (Current) Mm/dd/yyyy)		Budget Estimate PB 2023		
Category	Base Year	Objective (BY$)	Objective (BY$)	Threshold (BY$)	BY$	TY$	Deviation
RDT&E	2017	6,030.4	6,030.4	6,633.4	6,086.9	6,132.1	
Procurement	2017						
MILCON							
Acq. O&M							
Total	2017	6,030.4	6,030.4	N/A	6,086.9	6,132.1	
PAUC	2017	6,030.4	6,030.4	6,633.4	6,086.9		
APUC		N/A	N/A	N/A	N/A	N/A	

Total End Item Quantity

Quantity Category	Current APB Quantity	Current Estimate Quantity
Development	1	1
Procurement	0	0
Total	1	1

Budget Notes

Decrease in FY 2019 - 2023 RDT&E due to reprogramming for other Air Force and Space Force priorities, transfer of funds to Sustainment, Small Business Innovative Research, and removal of all the Acquisition Category II OCX 3 Follow-On (3F) program funding (FY 2021-2025). For increased transparency, the OCX 3F program funding was separated into its own Budget Program Activity Code starting in FY 2023.

Net increase in FY 2024 - 2025 RDT&E due to a decrease caused by the removal of OCX 3F program funding and an increase due to updated service cost estimate.

Risk and Sensitivity Analysis

Risks and Sensitivity Analysis	
Current Baseline Estimate (September 2018)	
1.	Total Acquisition Cost - $6,030.4M (BY 2017); PAUC - $6,030.4M; 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 - $3,347.2M (BY 2012); PAUC - $3,347.2M; Risks - Integrating and testing Block 0 on cyber-hardened infrastructure.
Revised Original Estimate (September 2018)	
1.	Total Acquisition Cost - $6,030.4M (BY 2017); PAUC - $6,030.4M; Risks - Minimal efficiency gains in the final testing phase from the implementation of DevOps and hardware/software obsolescence.
Current Procurement Cost (December 2021)	
1.	Total Acquisition Cost - $6,086.9M (BY 2017); PAUC - $6,086.900; Risks - COVID-19 REA: Raytheon submitted a REA on April 8, 2021. The REA addressed COVID-19-induced cost and schedule impacts due to concurrent Monitor Station installation delays and impacts to integration and test. The REA was definitized on July 19, 2021, for a $13.5M price and eight weeks of schedule margin impact. The Program Office is no longer reporting this as a significant schedule or technical risk, but is monitoring for changing conditions.

Unit Cost

Current Baseline Compared with Current Estimate

Category ($M)	Current APB	Current Estimate	% Change	NMC Breach
PAUC				
Cost	6,030.4	6,086.9	+0.94	-
Quantity	1	1	-	-
Unit Cost	6,030.400	6,086.9	+0.94	
APUC				
Cost	-	-	-	-
Quantity	-	-	-	-
Unit Cost	-	-	-	-

Original Baseline Compared with Current Estimate

Category ($M)	Original APB	Current Estimate	% Change	NMC Breach
PAUC				
Cost	6,030.4	6,086.9	+0.94	-
Quantity	1	1	-	-
Unit Cost	6,030.400	6,086.9	+0.94	
APUC				
Cost	-	-	-	-
Quantity	-	-	-	-
Unit Cost	-	-	-	-

Contracts

General Notes:

This program has no Major Contracts as defined by 10 USC 2432(a)(3). The following contract is more than 90% complete and is no longer reporting in the SAR: FA8807-10-C-0001 – Raytheon.

Technologies and Systems Engineering

Significant Technical Risks

Significant 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 2021)	
1.	There are no risks with this program at this time.

Significant Technical Risks Notes:

Milestone B and Revised Milestone B technical risks details cannot be provided due to how old the data is.

Deliveries and Expenditures

Deliveries

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

Expended and Appropriated (TY$)

Total Acquisition Cost: 6,132.1
Expended to Date: 5,343.3
Percent Expended: 87.14%
Total Funding Years: 19
Years Appropriated: 16
Percent Years Appropriated: 84.21%
Appropriated to Date: 5,430.6
Percent Appropriated: 88.56%

Low Rate Initial Production

There is no LRIP for this program.

Operating and Support Costs

Total Program O&S Cost Compared with Baseline

	Current APB Objective (BY$)	Current APB Threshold (BY$)	Current Estimate (BY$)	Current Estimate (TY$)	Deviation
Total O&S ($Millions)	2,303.2	2,533.5	2,215.12	2,938.6	

O&S Cost Breakdown

Category (BY$ Million)	OCX
Unit-Level Manpower	119.99
Unit Operations	85.75
Maintenance	939.35
Sustaining Support	170.06
Continued System Improvements	873.88
Other	26.09
Total O&S	2215.12

O&S Cost Notes:

Other costs consist of FY 2023 – FY 2035 costs, disposal costs and indirect support costs.

O&S costs includes operating, maintaining, and supporting the dedicated MCS located at SSFB Colorado and the AMCS located at Vandenberg SFB, California, both of which include connections to the ground antenna and monitoring stations which support the GPS III, GPS III Follow-On (GPS IIIF), 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 Blocks 1 & 2 will be RTO March 2023. Initial O&S activities start in August 2024. The estimate plans for a 10-year operational period. Manpower assumes a mixture of Space 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. Additional Source Lines of Code for GPS IIIF are incorporated to account for GPS IIIF functionality.

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.

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 SVs on orbit.

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