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## Selected Acquisition Report (SAR)

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



### Next Generation Operational Control System (OCX)

As of FY 2019 President's Budget

Defense Acquisition Management  
Information Retrieval  
(DAMIR)

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## Sensitivity Originator

No originator info Available at this time.

## 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)

## Program Information

**Program Name**

Next Generation Operational Control System (OCX)

**DoD Component**

Air Force

**Joint Participants**

Department of Transportation

## Responsible Office

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**Date Assigned:** July 8, 2015

## References

**SAR Baseline (Development Estimate)**

Defense Acquisition Executive (DAE) Approved Acquisition Program Baseline (APB) dated November 19, 2012

**Approved APB**

Defense Acquisition Executive (DAE) Approved Acquisition Program Baseline (APB) dated October 19, 2015



## 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 (M-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.



## Executive Summary

On June 30, 2016, the Secretary of the Air Force notified Congress of the critical GPS Next Generation Operation Control System (OCX) Nunn-McCurdy breach. OCX recertification occurred on October 12, 2016 and the Milestone B (MS-B), original, and current APBs rescinded. Following the recertification of OCX, a DAB occurred on June 20, 2017 as a step towards MS-B. As a result, this SAR reports against the rescinded APB and will do so until a new one is established at MS-B. The program MS-B is expected in Summer 2018 following the finalization of an ICE that is dependent on completion of an Integrated Baseline Review (IBR). The IBR is expected to complete April 2018.

Since the last SAR, the fourth, fifth, and sixth OCX quarterly reviews occurred. These reviews reported on the GPS III Launch and Checkout System (LCS) OCX Block 0 delivery and its support to the GPS III launch scheduled for 2018, Development Operations (DevOps) progress in preparation for the final iteration, progress on the Iteration (IT) 1.6 software development, the completion of the Over Target Baseline (OTB)/Over Target Schedule (OTS), and execution against the new baseline OTB/OTS since April 1, 2017. Future reviews are changed from quarterly to triannually.

The OCX program has participated in 73 independent reviews of the program since program inception; including the most recent FY 2017 National Defense Authorization Act section 1622 Independent Program Assessment led by the MITRE Corporation. The Air Force is also currently participating in a subsequent OCX/OCS 90-day review.

The current contract date for Government acceptance of Blocks 1&2 is June 2021, with a corresponding Ready to Transition to Operations date of January 2022. The Air Force projects seven months risk to this date. At this time, Raytheon's integrated master schedule shows Government acceptance in February 2021, holding four months margin to the contract delivery date. The Government established inchstones to track Raytheon schedule performance at the quarterly program reviews. Raytheon achieved all five inchstones briefed at the September review. The five inchstones that completed include, Block 0 ready for factory mission readiness testing, Raytheon prepared for LCS Acceptance, 1.6 Incremental Integration completion, delivery of Platform 6.0, and DevOps Phase 2 Adoption.

The Air Force accepted the LCS, also known as Block 0, on October 26, 2017 after successfully demonstrating 3,306 requirements. The LCS is now at Lockheed Martin's Waterton, CO facility to support preparation for launch of GPS III Space Vehicle (SV)01. LCS is performing nominally in launch rehearsals and is on track to support the first GPS III launch planned for 2018.

On Block 1, Raytheon restructured their software development organization to implement the Defense Digital Services recommended "DevOps" approach for integrated software design/coding/testing/quality assurance that is now industry standard for rapid, high-quality software development. Raytheon expanded its test capability with additional physical environments on site and using Amazon Web Service for cloud-based virtual platforms.

Raytheon completed the 1.5 Risk Reduction Test activity verifying that the Block 1 functionality developed as part of IT 1.5 was resolved. Raytheon completed IT 1.6 Code and Unit Testing while preliminary design for IT 1.7/2.1 completed in February 2018. At that time, IT 1.7/2.1 Design Cut and Unit Test Entrance will commence. Software and Hardware obsolescence are a risk, and is being addressed through commercial off the shelf upgrades and prototyping. The Government program office continues to manage the risks and programmatic issues.

## Threshold Breaches

APB Breaches		
Schedule		<input checked="" type="checkbox"/>
Performance		<input type="checkbox"/>
Cost	RDT&E	<input checked="" type="checkbox"/>
	Procurement	<input type="checkbox"/>
	MILCON	<input type="checkbox"/>
	Acq O&M	<input type="checkbox"/>
O&S Cost		<input checked="" type="checkbox"/>
Unit Cost	PAUC	<input checked="" type="checkbox"/>
	APUC	<input type="checkbox"/>

Explanation of Breach
The December 2015 SAR previously reported the schedule breach.
The June 2016 SAR previously reported the cost, unit cost, and Nunn-McCurdy breaches.
OCX recertification occurred on October 12, 2016 and the Milestone B rescinded. The Nunn-McCurdy certification ADM directed the Air Force to return for Milestone B by June 30, 2017. However, the new APB and Milestone B currently await CAPE ICE inputs.

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

O&S cost breach due to revised estimate to include new requirements for GPS IIF and GPS III and On-Orbit and Factory Support.
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## 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)	Nov 2014	Apr 2016	Oct 2016	Sep 2017 <sup>†</sup>	
Milestone C	Oct 2015	Jul 2018	Jan 2019	Apr 2021 <sup>†</sup>	(Ch-1)
Block 1 RTO	Oct 2016	Jul 2019	Jul 2020	Apr 2022 <sup>†</sup>	(Ch-1)
Block 2 RTO	Jun 2017	Jul 2020	Jul 2021	Apr 2022 <sup>†</sup>	(Ch-1)

<sup>†</sup> APB Breach

### Change Explanations

(Ch-1) Milestone C current estimate changed from January 2021 in the FY 2016 SAR to April 2021 in the FY 2017 SAR and Block 1 and Block 2 RTOs current estimate changed from January 2022 in the FY 2016 SAR to April 2022 in the FY 2017 SAR because OSD(AT&L) directed a 33-month objective and 45-month threshold extension to Government acceptance date of Block 1 at the June 20, 2017 DAB.

### 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.



**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 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.
Availability of Position Accuracy a. b. Horizontal c.d. Vertical				
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	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	a. 1.2 m (95%) @ 90% availability any lat/long b. 1.2 m (95%) @ 99.9% availability global average c. 1.9 m (95%) @ 90% availability any lat/long d. 1.9 m (95%) @ 99.9% availability global average Note: (a) and (c) values equal 1 m SEP Note:	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.	(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.	no UEE assumed for objective because requirement is stated in FCS ORD.		(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.
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#### Position and Time Transfer Integrity

GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour.	GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour.	GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0000001 per hour.	TBD	GPS III SV01-08 shall not transmit MSI to the user with a probability greater than 0.0001 per hour.
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#### Availability of Dynamic Time Transfer Accuracy

UEE = 0.8 m rms Any lat/long 15 nanoseconds (ns) (95%) @ 90% availability Global Average 15 ns (95%) @ 99.9% availability UEE = 2.6 m rms Any lat/long 40 ns (95%) @ 90% availability Global Average 50 ns (95%)	UEE = 0.8 m rms Any lat/long 15 ns (95%) @ 90% availability Global Average 15 ns (95%) @ 99.9% availability UEE = 2.6 m rms Any lat/long 40 ns (95%) @ 90% availability Global Average 50 ns (95%)	Any lat/long 4.5 ns (95%) @ 90% availability Global Average 4.5 ns (95%) @ 99.9% availability Note: no UEE assumed for objective because requirement is derived from the FCS ORD Objective SEP accuracy requirement	TBD	UEE = 0.8 m rms any lat/long 15 ns (95%) @ 90% availability Global Average 15 ns (95%) @ 99.9% availability UEE = 2.6 m rms any lat/long 40 ns (95%) @ 90% availability Global Average 50 ns (95%).
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#### Availability of Static Time Transfer Accuracy

3.0 ns (95%) @ > 99.9% availability	3.0 ns (95%) @ > 99.9% availability	1.0 ns (95%) @ > 99.9% availability	TBD	3.0 ns (95%) @ > 99.9% availability.
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#### Net-Ready KPP

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	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	The system must fully support execution of all operational activities and information exchanges identified in 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	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
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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 communications 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementation 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, authentication, confidentiality, and non-repudiation, and issuance of an IATO or ATO by the DAA, and 5) Supportability requirements to include SAASM, Spectrum, and JTRS requirements.	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 communications 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementation 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, authentication, confidentiality, and non-repudiation, and issuance of an IATO or ATO by the DAA, and 5) Supportability requirements to include SAASM, Spectrum, and JTRS requirements.	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 communications 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementation 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, authentication, confidentiality, and non-repudiation, and issuance of an ATO by the DAA, and 5) Supportability requirements to include SAASM, Spectrum and JTRS requirements.	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 communications 3) Compliant with GIG Technical Guidance to include IT Standards identified in the TV-1 and implementation 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, authentication, confidentiality, and non-repudiation, and issuance of an IATO or ATO by the DAA, and 5) Supportability requirements to include SAASM, Spectrum, and JTRS requirements.
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#### Sustainment--Material Availability

The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds.	The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds.	(T=O) The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds.	TBD	The achievement of the Availability of Position Accuracy KPP and Time Transfer Accuracy KPP Thresholds.
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**Requirements Reference**

GPS III CDD dated September 17, 2009

**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.

**Acronyms and Abbreviations**

AF - Air Force  
ATO - Authority To Operate  
DAA - Designated Approval Authority  
FCS - Future Combat System  
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  
rms - root-mean-square  
SAASM - Selective Availability/Anti-Spoofing Module  
SEP - Spherical Error Probable  
SS - System Specifications  
SV - Space Vehicle  
T - Threshold  
TV - Technical View  
UE - User Equipment  
UEE - User Equipment Error

Track to Budget

RDT&E			
Appn	BA	PE	
Air Force	3600	07	0603421F
	Project	Name	
	674993	GPS III	(Shared) (Sunk)
Air Force	3600	07	0603423F
	Project	Name	
	67A021	INWS	(Sunk)
	67A025	GPS Enterprise Integrator	(Sunk)
Air Force	3600	07	1206423F
	Project	Name	
	67A021	OCX	
	67A025	GPS Enterprise Integrator	

## Cost and Funding

### Cost Summary

Total Acquisition Cost							
Appropriation	BY 2012 \$M			BY 2012 \$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	3347.2	3839.3	4112.0	5667.4 <sup>1</sup>	3413.0	3964.4	6060.1
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	3347.2	3839.3	N/A	5667.4	3413.0	3964.4	6060.1

<sup>1</sup> APB Breach

#### Current APB Cost Estimate Reference

SCP dated November 10, 2014

#### Cost Notes

In accordance with Section 842 of the National Defense Authorization Act for FY 2017, which amended title 10 U.S.C. § 2334, the Director of Cost Assessment and Program Evaluation, and the Secretary of the military department concerned or the head of the Defense Agency concerned, must issue guidance requiring a discussion of risk, the potential impacts of risk on program costs, and approaches to mitigate risk in cost estimates for MDAPs and major subprograms. The information required by the guidance is to be reported in each SAR. This guidance is not yet available; therefore, the information on cost risk is not contained in this SAR.

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 2019 President's Budget / December 2017 SAR (TY\$ M)									
Appropriation	Prior	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	To Complete	Total
RDT&E	3515.3	510.9	513.2	402.1	411.2	432.7	274.7	0.0	6060.1
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 2019 Total	3515.3	510.9	513.2	402.1	411.2	432.7	274.7	0.0	6060.1
PB 2018 Total	3531.2	510.9	441.6	342.6	239.1	156.1	173.3	0.0	5394.8
Delta	-15.9	0.0	71.6	59.5	172.1	276.6	101.4	0.0	665.3

#### Funding Notes

The total funding requirement of the program is \$6105.1M with the Air Force part totaling to \$6,060.1M shown in table above. Department of Transportation (DoT) funding in the amount of \$45M (as of April 2017) is required and is critical to the development and delivery of the entire program. DoT currently committed to provide \$11.4M; a civil funding shortfall of this amount still exists.

Quantity Summary										
FY 2019 President's Budget / December 2017 SAR (TY\$ M)										
Quantity	Undistributed	Prior	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023	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 2019 Total	1	0	0	0	0	0	0	0	0	1
PB 2018 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	--	--	--	--	--	--	376.6
2018	--	--	--	--	--	--	510.9
2019	--	--	--	--	--	--	513.2
2020	--	--	--	--	--	--	402.1
2021	--	--	--	--	--	--	411.2
2022	--	--	--	--	--	--	432.7
2023	--	--	--	--	--	--	274.7
Subtotal	1	--	--	--	--	--	6060.1

Annual Funding							
3600   RDT&E   Research, Development, Test, and Evaluation, Air Force							
Fiscal Year	Quantity	BY 2012 \$M					
		End Item Recurring Flyaway	Non End Item Recurring Flyaway	Non Recurring Flyaway	Total Flyaway	Total Support	Total Program
2007	--	--	--	--	--	--	103.3
2008	--	--	--	--	--	--	262.8
2009	--	--	--	--	--	--	301.1
2010	--	--	--	--	--	--	296.1
2011	--	--	--	--	--	--	356.2
2012	--	--	--	--	--	--	343.1
2013	--	--	--	--	--	--	308.5
2014	--	--	--	--	--	--	347.3
2015	--	--	--	--	--	--	355.6
2016	--	--	--	--	--	--	434.6
2017	--	--	--	--	--	--	347.0
2018	--	--	--	--	--	--	463.0
2019	--	--	--	--	--	--	456.8
2020	--	--	--	--	--	--	351.0
2021	--	--	--	--	--	--	351.9
2022	--	--	--	--	--	--	363.1
2023	--	--	--	--	--	--	226.0
Subtotal	1	--	--	--	--	--	5667.4

## Low Rate Initial Production

There is no LRIP for this program.



## Foreign Military Sales

None

## Nuclear Costs

None

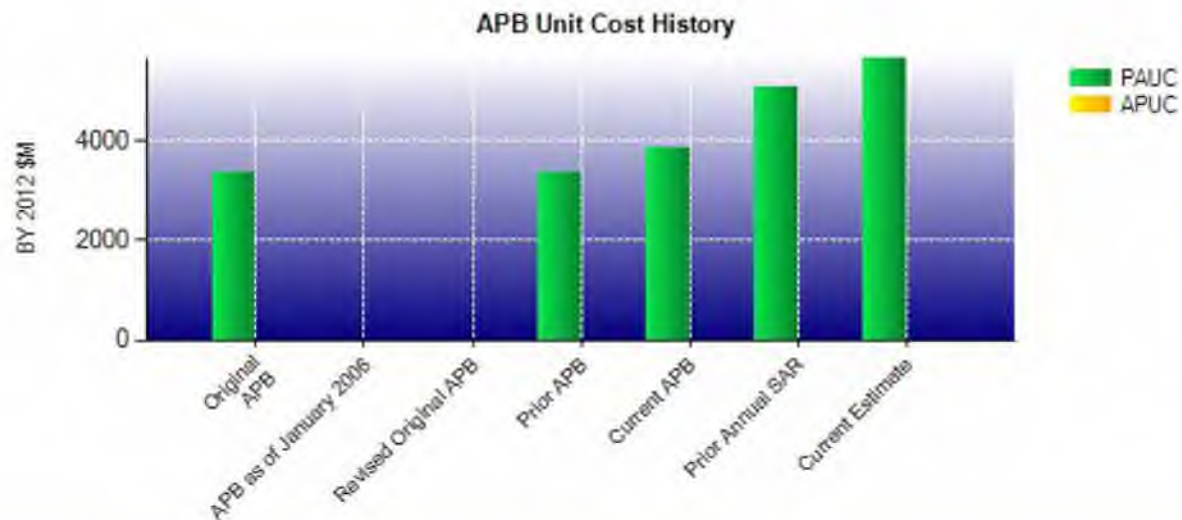
## Unit Cost

Current UCR Baseline and Current Estimate (Base-Year Dollars)			
Item	BY 2012 \$M	BY 2012 \$M	% Change
	Current UCR Baseline (Oct 2015 APB)	Current Estimate (Dec 2017 SAR)	
Program Acquisition Unit Cost			
Cost	3839.3	5667.4	
Quantity	1	1	
Unit Cost	3839.300	5667.400	+47.62
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 2012 \$M	BY 2012 \$M	% Change
	Original UCR Baseline (Nov 2012 APB)	Current Estimate (Dec 2017 SAR)	
Program Acquisition Unit Cost			
Cost	3347.2	5667.4	
Quantity	1	1	
Unit Cost	3347.200	5667.400	+69.32
Average Procurement Unit Cost			
Cost	0.0	0.0	
Quantity	0	0	
Unit Cost	--	--	--

<sup>1</sup> Nunn-McCurdy Breach

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 2012 \$M		TY \$M	
		PAUC	APUC	PAUC	APUC
Original APB	Nov 2012	3347.200	N/A	3413.000	N/A
APB as of January 2006	N/A	N/A	N/A	N/A	N/A
Revised Original APB	N/A	N/A	N/A	N/A	N/A
Prior APB	Nov 2012	3347.200	N/A	3413.000	N/A
Current APB	Oct 2015	3839.300	N/A	3964.400	N/A
Prior Annual SAR	Dec 2016	5088.700	N/A	5394.800	N/A
Current Estimate	Dec 2017	5667.400	N/A	6060.100	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	
3413.000	-34.300	0.000	0.000	212.300	2469.100	0.000	0.000	2647.100	6060.100

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	Nov 2012	N/A	Nov 2012
Milestone C	N/A	Oct 2015	N/A	Apr 2021
IOC	N/A	N/A	N/A	N/A
Total Cost (TY \$M)	N/A	3413.0	N/A	6060.1
Total Quantity	N/A	1	N/A	1
PAUC	N/A	3413.000	N/A	6060.100



**Cost Variance**

Summary TY \$M				
Item	RDT&E	Procurement	MILCON	Total
SAR Baseline (Development Estimate)	3413.0	--	--	3413.0
Previous Changes				
Economic	-17.4	--	--	-17.4
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	--	--	--	--
Estimating	+1999.2	--	--	+1999.2
Other	--	--	--	--
Support	--	--	--	--
Subtotal	+1981.8	--	--	+1981.8
Current Changes				
Economic	-16.9	--	--	-16.9
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	+212.3	--	--	+212.3
Estimating	+469.9	--	--	+469.9
Other	--	--	--	--
Support	--	--	--	--
Subtotal	+665.3	--	--	+665.3
Total Changes	+2647.1	--	--	+2647.1
CE - Cost Variance	6060.1	--	--	6060.1
CE - Cost & Funding	6060.1	--	--	6060.1

Summary BY 2012 \$M				
Item	RDT&E	Procurement	MILCON	Total
SAR Baseline (Development Estimate)	3347.2	--	--	3347.2
Previous Changes				
Economic	--	--	--	--
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	--	--	--	--
Estimating	+1741.5	--	--	+1741.5
Other	--	--	--	--
Support	--	--	--	--
Subtotal	+1741.5	--	--	+1741.5
Current Changes				
Economic	--	--	--	--
Quantity	--	--	--	--
Schedule	--	--	--	--
Engineering	+178.6	--	--	+178.6
Estimating	+400.1	--	--	+400.1
Other	--	--	--	--
Support	--	--	--	--
Subtotal	+578.7	--	--	+578.7
Total Changes	+2320.2	--	--	+2320.2
CE - Cost Variance	5667.4	--	--	5667.4
CE - Cost & Funding	5667.4	--	--	5667.4

Previous Estimate: December 2016

RDT&E		\$M	
Current Change Explanations		Base Year	Then Year
Revised escalation indices. (Economic)		N/A	-16.9
Increased funding for Regional Military Protection requirement. (Engineering)		+178.6	+212.3
Increase funding in FY 2019 through FY 2023 align with the SCP dated May 25, 2017. (Estimating)		+423.3	+496.8
Revised estimate to align with FY 2019 PB. (Estimating)		-13.4	-16.3
Revised estimate to reflect actuals. (Estimating)		-14.7	-15.9
Adjustment for current and prior escalation. (Estimating)		+4.9	+5.3
RDT&E Subtotal		+578.7	+665.3



## Contracts

Contract Identification	
<b>Appropriation:</b>	RDT&E
<b>Contract Name:</b>	OCX Phase B Contract
<b>Contractor:</b>	Raytheon (Intelligence and Information Systems)
<b>Contractor Location:</b>	16800 E Centre Tech Pkwy Aurora, CO 80011
<b>Contract Number:</b>	FA8807-10-C-0001
<b>Contract Type:</b>	Cost Plus Incentive Fee (CPIF), Cost Plus Award Fee (CPAF)
<b>Award Date:</b>	February 25, 2010
<b>Definitization Date:</b>	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	1112.8	N/A	1	3030.0	3687.0

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, and engineering studies were also contributors. However, the current target price doesn't include the Over Target Baseline/Over Target Schedule (OTB/OTS) value. The current target price decreased from last SAR as the FY 2016 SAR was incorrectly overstated.

Contract Variance		
Item	Cost Variance	Schedule Variance
Cumulative Variances To Date (12/31/2017)	-5.5	-32.8
Previous Cumulative Variances	-88.2	-37.3
Net Change	+82.7	+4.5

Cost and Schedule Variance Explanations
The favorable net change in the cost variance is due to the reset of Earned Value (EV) due to the OTB/OTS which occurred in March 2017 after a suspension of EV in October 2015.
The favorable net change in the schedule variance is due to the reset of EV due to the OTB/OTS which occurred in March 2017 after a suspension of EV in October 2015.

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

## 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	6060.1	Years Appropriated	12
Expended to Date	3488.8	Percent Years Appropriated	70.59%
Percent Expended	57.57%	Appropriated to Date	4026.2
Total Funding Years	17	Percent Appropriated	66.44%

The above data is current as of February 12, 2018.



## Operating and Support Cost

### Cost Estimate Details

<b>Date of Estimate:</b>	May 25, 2017
<b>Source of Estimate:</b>	SCP
<b>Quantity to Sustain:</b>	1
<b>Unit of Measure:</b>	System
<b>Service Life per Unit:</b>	10.00 Years
<b>Fiscal Years in Service:</b>	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), CO and the Alternate MCS (AMCS) located at Vandenberg AFB, CA, 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 BY2012 \$M		
Cost Element	OCX Average Annual Cost Per System	GPS OCS (Antecedent) Average Annual Cost Per System
Unit-Level Manpower	8.677	12.100
Unit Operations	18.361	51.400
Maintenance	105.691	5.400
Sustaining Support	8.863	4.400
Continuing System Improvements	59.006	31.500
Indirect Support	3.642	0.500
Other	0.000	0.000
Total	204.240	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	1321.0	1321.0	2153.6 <sup>1</sup>
Then Year	2066.1	N/A	2945.0

<sup>1</sup> APB O&S Cost Breach

Revised estimate to include new requirements for GPS IIF and GPS III and On-Orbit and Factory Support.

#### 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

$$\$204.24M = \$2,042.4M / 10 \text{ Years}$$

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

\$2,153.6M= \$30.9M in FY2022 + \$80.3M in FY 2023 + \$2,042.4M in FY 2024 through FY 2034

O&S Cost Variance		
Category	BY 2012 \$M	Change Explanations
Prior SAR Total O&S Estimates - Dec 2016 SAR	1307.2	
Programmatic/Planning Factors	0.0	
Cost Estimating Methodology	102.3	Revised manpower methodology for civilian and contractors to reflect actual manpower rates
Cost Data Update	120.5	Revised estimate to include Air Force Total Ownership Cost data from FY 2008 - FY 2016 as well as Adjustment for Current and Prior Inflation
Labor Rate	0.0	
Energy Rate	0.0	
Technical Input	623.6	Added requirement for GPS IIF and GPS III On-Orbit and Factory Support
Other	0.0	
Total Changes	846.4	
Current Estimate	2153.6	

#### Disposal Estimate Details

**Date of Estimate:** May 25, 2017  
**Source of Estimate:** SCP  
**Disposal/Demilitarization Total Cost (BY 2012 \$M):** Total costs for disposal of all System are 7.2