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Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Air Force **Date:** May 2021

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force I BA 7: Operational Systems Development</i>	R-1 Program Element (Number/Name) PE 1203265F / <i>GPS III Space Segment</i>
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COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	3,231.667	47.178	0.000	0.000	0.000	0.000	-	-	-	-	-	-
67A019: <i>GPS III</i>	3,231.667	47.178	0.000	0.000	0.000	0.000	-	-	-	-	-	-

Program MDAP/MAIS Code: 292

A. Mission Description and Budget Item Justification

In FY2021, PE 1203265F, GPS III Space Segment efforts were transferred to Appropriation 3620, Research, Development, Test & Evaluation, Space Force, PE 1203265SF GPS III Space Segment from Appropriation 3600, Budget Activity 7 due to the creation of a new Appropriation for Space Force.

The Global Positioning System (GPS) is a space-based navigation system that fills validated Joint Service requirements for worldwide, accurate, common-grid three-dimensional positioning/navigation for military aircraft, ships, and ground personnel. The consistent accuracy, unaffected by location or weather and available in real time, significantly improves effectiveness of reconnaissance, weapons delivery, mine countermeasures, and rapid deployment for all services. GPS must comply with Title 10 United States Code (USC) Sec. 2281, which requires that the Secretary of Defense ensure continued sustainment and operations of GPS for military and civilian purposes, and 51 USC Sec. 50112, which requires that GPS comply with certain standards and facilitate international cooperation.

The system is composed of three segments: User Equipment (funded under Program Element (PE) 1203164F), Space (funded under this PE and PE 1203269F) and a Control Network (funded under PE 1203165F and PE 1206423F). The satellites broadcast high-accuracy data using precisely synchronized signals that are received and processed by user equipment installed in military platforms. The user equipment computes the platform position and velocity and provides steering vectors to target locations or navigation waypoints. The control segment provides daily updates to the navigation messages broadcast from the satellites to maintain system precision in three dimensions to 16 meters (spherical error probable) worldwide. Additionally, GPS supports the United States Nuclear Detonation (NUDET) Detection System (USNDS) mission and provides strategic and tactical support to the following Department of Defense (DoD) missions: Joint Operations by providing capabilities for Positioning, Navigation, and Timing (PNT); Command, Control, Communications, and Intelligence (C3I); Special Operations; Military Operations in Urban Terrain (MOUT); Defense-Wide Mission Support; Air Mobility; and Space Launch Orbital Support.

GPS III is the next generation Space Vehicle (SV) supporting the GPS constellation and is funded in PE 1203265F. GPS III SVs will deliver significant enhancements, including a new international civil (L1C) Galileo-compatible signal, and enhanced anti-jam power. GPS III SVs 03-10 are in the Production and Deployment Phase.

PE 1203265F funds GPS III and supports the Research, Development, Test, and Evaluation (RDT&E) of GPS III SVs 01-02 and risk-reducing simulators through a systems engineering approach that matures and delivers SVs for launch. This PE includes SVs 01-02 engineering studies and analyses, trade studies, system development, test and evaluation efforts, integrated logistics support products, on-orbit support, and mission operations support for civil and military applications that protect United States (U.S.) military and allied use of GPS. The program also includes Contingency Operations (COps) as a bridge capability to fly GPS III SVs until the delivery of the GPS Next Generation Operational Control System (OCX).

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Starting in Fiscal Year (FY) 2019, PE 1203269F funded the RDT&E of GPS IIIF (SVs 11-12), which included Non-Recurring Engineering (NRE) support efforts. GPS IIIF includes design activity, risk-reducing simulators, and systems engineering associated with delivering the new capabilities required of GPS IIIF SVs, including backward compatibility, dual band Telemetry, Tracking, and Control (TT&C), integration of Government Furnished Equipment (GFE) hosted payloads, a new international civil (L1C) Galileo-compatible signal, and the Regional Military Protection (RMP) capability that provides the ability to deliver high-power regional Military Code (M-Code) signals in specific areas of intended effect.

Mission Readiness Campaign (MRC) activities include launch preparation, planning, mission readiness testing to validate space-ground-user interfaces, mission crew exercises and rehearsals, launch vehicle integration, and On-Orbit Checkout activities to validate performance prior to and after launch. Newly certified launch vehicles must be incorporated into the GPS III launch baseline. Integration requires the development of plans and procedures and procurement of special support equipment.

GPS supports the early deployment of Global M-Code to meet the congressional mandate limiting user equipment purchases to M-Code-capable receivers starting in FY 2017. Funds in this PE will cover the M-Code Early Use (MCEU) program and support development costs associated with the GPS control segment software to provide core M-Code capabilities to the warfighter, as well as the ability to command and control, process, and monitor the M-Code signal. MCEU mitigates delays with OCX, supports Military Global Positioning System User Equipment (MGUE) testing, and allows for early M-Code operations. M-Code provides greater security to protect navigation and timing in electronically contested environments.

Impacts of the M-Code deployment include:

- Compliance with The Air Force Space Command Commander's mandate to provide global monitoring necessary for early M-Code operational use and verification of Navigation Warfare (NAVWAR) effects.
- Direction to improve the resiliency of the GPS capability.
- Confirmation that Enterprise modernization efforts are integrated and properly deployed.
- Testing and Verification of M-Code capability on MGUE/GPS III solution and early M-Code use tied to MGUE fielding.

The feasibility studies and preliminary engineering analyses that are funded by this budget item will determine whether an initiative to host GPS M-Code augmentation payloads on other satellite systems is practical and beneficial. The primary goal is to provide additional mission assurance through redundant systems not directly connected with the current U.S. GPS satellite constellation.

Space acquisition must respond with speed and agility to emerging adversary threats. Space & Missile Systems Center (SMC) has transformed the organization and implementation of space acquisition to an enterprise approach, maximizing innovation and resiliency, leveraging international, commercial, and mission partnerships, and managing program/project priorities according to an integrated unclassified/classified enterprise space architecture. Expanding the appropriate acquisition authorities and contract mechanisms to deliver capability sooner, SMC will strategically execute experimentation, prototyping, risk reduction, and other efforts to develop new or repurpose capabilities.

This PE may include necessary civilian pay expenses required to manage, execute, and deliver GPS III Space Segment weapon system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in PEs 1206392F and 1206398F.

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This PE encompasses the GPS III (SVs 01-10), COps, MCEU, M-Code Hosted Payload, and prior to FY 2019, GPS III Follow-On (GPS IIIF) Production Readiness efforts.

This program is in Budget Activity 7, Operational System Development because this budget activity includes development efforts to upgrade systems that have been fielded or have received approval for full rate production and anticipate production funding in the current or subsequent fiscal year.

B. Program Change Summary (\$ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	42.440	0.000	0.000	0.000	0.000
Current President's Budget	47.178	0.000	0.000	0.000	0.000
Total Adjustments	4.738	0.000	0.000	0.000	0.000
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	6.012	0.000			
• SBIR/STTR Transfer	-1.274	0.000			
• Other Adjustments	0.000	0.000	0.000	0.000	0.000

Change Summary Explanation

FY2020 \$6.012M increase for GPS III Mission Readiness Campaign

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Exhibit R-2A, RDT&E Project Justification: PB 2022 Air Force										Date: May 2021		
Appropriation/Budget Activity 3600 / 7					R-1 Program Element (Number/Name) PE 1203265F / GPS III Space Segment				Project (Number/Name) 67A019 / GPS III			
COST (\$ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
67A019: GPS III	3,231.667	47.178	0.000	0.000	0.000	0.000	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

GPS III is the next-generation SV supporting the GPS constellation and is funded in PE 1203265F. GPS III SVs will deliver significant enhancements, including a new international civil (L1C) Galileo-compatible signal, and enhanced anti-jam power. GPS III SVs 04-10 are in the Production and Deployment Phase.

PE 1203265F funds GPS III and supports RDT&E of GPS III SVs 01-02 and risk-reducing simulators through a systems engineering approach that matures and delivers SVs for launch. This program includes SVs 01-02 engineering studies and analyses, trade studies, system development, test and evaluation efforts, integrated logistics support products, on-orbit support, and mission operations support for civil and military applications that protect U.S. military and allied use of GPS. The program also includes Contingency Operations (COps) as a bridge capability to fly GPS III SVs until the delivery of the GPS OCX program.

Mission Readiness Campaign (MRC) activities include launch preparation, planning, mission readiness testing to validate space-ground-user interfaces, mission crew exercises and rehearsals, launch vehicle integration, and On-Orbit Checkout activities to validate performance prior to launch and post launch. Newly certified launch vehicles must be incorporated into the GPS III launch baseline. Integration requires the development of plans and procedures and procurement of special support equipment.

GPS supports the early deployment of Global M-Code to meet a congressional mandate limiting user equipment purchase to M-Code capable receivers starting in FY 2017. The funds will cover the M-Code Early Use (MCEU) program and support development costs associated with the GPS control segment software to provide core M-Code capabilities to the warfighter, as well as the ability to command and control, process, and monitor the M-Code signal. MCEU mitigates delays with GPS OCX, supports MGUE testing, and allows for early M-Code operations. M-Code provides greater security to protect navigation and timing in electronically contested environments.

Impacts of the M-Code deployment include:

- Compliance with The Air Force Space Command Commander's mandate to provide global monitoring necessary for early M-code operational use and verification of NAVWAR effects.
- Direction to improve the resiliency of the GPS capability.
- Confirmation that Enterprise modernization efforts are integrated and properly deployed.
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Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 1203265F / GPS III Space Segment	Project (Number/Name) 67A019 / GPS III
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This PE encompasses the GPS III (SVs 01-10), COps, MCEU, M-Code Hosted Payload, and prior to FY2019, GPS III Follow-On (GPS IIIF) Production Readiness efforts.

B. Accomplishments/Planned Programs (\$ in Millions)	FY 2020	FY 2021	FY 2022
Title: GPS III SVs 01-02 Description: Development, test, and evaluation of GPS III SVs 01-02 and associated simulators, engineering studies and analyses, trade studies, system development, test and evaluation efforts, and integrated logistics support products.	29.588	-	-
Title: Architecture Evolution Plan (AEP) M-Code Monitoring Description: The M-Code Early Use (MCEU) program initiative will cover the development costs associated with updating the legacy control segment software, AEP, with additional capabilities needed to provide M-Code operations. MCEU will provide the Combined Space Operations Center (CSpOC) with command and control (C2), processing, and integrity monitoring for the M-Code signal. The development will also include the integration of modernized Monitor Station Technology Improvement Capability (MSTIC) receivers, which are being procured separately using Operations and Maintenance (O&M) funding as a Form-Fit- Functional replacement for the legacy Monitor Station Receiver Element (MSRE) Y-Code receivers. MCEU will add a software upgrade to MSTIC receivers to allow it to process M-Code signals. Prime contract was awarded to start software development and test activities; includes insertion of Legacy Hot Start, Demilitarized Zone, and Receiver Protection Profile requirements into the MCEU baseline.	17.590	-	-
Accomplishments/Planned Programs Subtotals	47.178	-	-

C. Other Program Funding Summary (\$ in Millions)

Line Item	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
• SPAF 01 Line Item GPS III: GPS III	34.845	-	-	-	-	-	-	-	-	-	-

Remarks

D. Acquisition Strategy

The GPS III next generation space segment (SV 01-10) rapidly and affordably responds to warfighter capability requirements. The acquisition approach utilizes a disciplined systems engineering approach which focuses on mitigating cost and schedule risk through a lower-risk incremental delivery of mature technologies. This approach focuses on mission success and on-time delivery. The GPS III SVs will have GPS IIF capabilities plus up to a 3x-8x increase in anti-jam signal power, 3x improved accuracy, 3+ year increased design life, a new international civil (L1C) signal compatible with the European Galileo system, and a satellite bus capable of supporting future SV capability additions.

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Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 1203265F / <i>GPS III Space Segment</i>	Project (Number/Name) 67A019 / <i>GPS III</i>
<p>RDT&E funding for SVs 11 and 12 is in PE 1203269F and PE 1203269SF, Project GPS IIIF. Procurement funding for SVs 13-32 is captured in PE 1203269F and PE 1203269SF, Project GPS IIIF.</p> <p>The AF is using its research laboratories to mature an On-Orbit Reprogrammable Digital Waveform Generator (ORDWG) which provide signal flexibility to change the signal form while the satellite is on-orbit. This effort is funded with AFRL's S&T funding and PE 1203265F to increase the number of alternate navigation payloads and inform future PNT architectures.</p> <p>On 19 July 2016, PEO Space approved the Acquisition Strategy Document (ASD) for the COps effort. The strategy enables contingency constellation sustainment capability for GPS III PNT. GPS III COps is needed because GPS OCX will not deliver in time to support initial GPS III SV operations. COps operates (post-launch and check-out) GPS III SVs at the capability level of GPS IIR-M or GPS IIF using the existing AEP control segment.</p> <p>On 21 Jan 2017, PEO Space approved the Acquisition Strategy for the MCEU program. The MCEU acquisition strategy enables the GPS Enterprise to provide core M-Code capabilities to the warfighter prior to GPS OCX delivery. MCEU will also support the scheduled operational testing of MGUE. MCEU will update the GPS control segment software, AEP, to allow for command and control, processing, and integrity monitoring of the M-Code signal. MCEU acquires this capability by using the existing GPS III prime contract vehicle to modify the operational AEP software.</p> <p>The Air Force approved reinstatement of a previously deferred Key Support Area (KSA) on 10 Feb 2016. The MSTIC receivers currently under development will get a software upgrade to process M-Code data. This \$7.96M project to procure the M-MSTIC receivers was funded through both O&M and SPAF funds in FY 2016-FY 2018. Performance monitoring, integration, and test will be conducted by the MCEU program and sustained under the Global Positioning Operations Support and Sustainment Division contract with Lockheed Martin.</p>		

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2022 Air Force **Date:** May 2021

Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 1203265F / GPS III Space Segment	Project (Number/Name) 67A019 / GPS III
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Product Development (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
GPS III Development	C/CPIF	Lockheed Martin : Denver, CO	2,463.786	3.190	Dec 2018	-		-		-		-	-	-	2,624.496
GPS III SV01-02 On Orbit Incentive Fee	C/CPIF	Lockheed Martin : Denver, CO	6.000	11.453	Jan 2020	-		-		-		-	-	-	22.500
GPS III Development 11+	C/Various	Lockheed Martin : Denver, CO	41.590	-		-		-		-		-	-	-	41.590
GPS III Development_COps	C/CPIF	Lockheed Martin : Denver, CO	125.171	-		-		-		-		-	-	-	128.863
GPS III Development_MCEU	C/CPIF	Lockheed Martin : Denver, CO	51.985	11.512	Oct 2019	-		-		-		-	-	-	72.157
GPS III Technical Mission Analysis	MIPR	Various : Various	30.494	6.504	Oct 2019	-		-		-		-	-	-	-
GPS III Enterprise SE&I	C/CPAF	TASC : El Segundo, CA	99.080	1.073	Oct 2019	-		-		-		-	-	-	100.823
GPS III Launch Support	RO	45th : Cape Canaveral, FL	80.369	7.241		-		-		-		-	-	-	-
GPS III Production SMI	C/CPFF	Various : Various	36.156	-		-		-		-		-	-	-	-
GPS III Enterprise Ground Service	C/CPAF	N/A : N/A	7.500	-		-		-		-		-	-	-	7.500
Subtotal			2,942.131	40.973		-		-		-		-	-	-	N/A

Test and Evaluation (\$ in Millions)				FY 2020		FY 2021		FY 2022 Base		FY 2022 OCO		FY 2022 Total	Cost To Complete	Total Cost	Target Value of Contract
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost			
GPS III T&E	Various	Various : TBD	36.124	-		-		-		-		-	-	-	-
Subtotal			36.124	-		-		-		-		-	-	-	N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2022 Air Force **Date:** May 2021

Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 1203265F / GPS III Space Segment	Project (Number/Name) 67A019 / GPS III
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	FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025				FY 2026			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4

GPS III	
GPS III SV01/02 On-Orbit Engineering Support/Performance Validation	
COps/MCEU	
COps Fielding Readiness Review (FRR)	
COps Operational Test Readiness Certification	
MCEU Fielding Readiness Review	

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Exhibit R-4A, RDT&E Schedule Details: PB 2022 Air Force **Date:** May 2021

Appropriation/Budget Activity 3600 / 7	R-1 Program Element (Number/Name) PE 1203265F / GPS III Space Segment	Project (Number/Name) 67A019 / GPS III
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
GPS III				
GPS III SV01/02 On-Orbit Engineering Support/Performance Validation	1	2020	4	2020
COps/MCEU				
COps Fielding Readiness Review (FRR)	2	2020	2	2020
COps Operational Test Readiness Certification	3	2020	3	2020
MCEU Fielding Readiness Review	4	2020	4	2020

Note

GPS III SV 02 was launched on 22 August 2019
 GPS III SV01/SV02 will perform on-going on-orbit engineering support and performance validation through FY 2025
 COps/MCEU schedule milestones adjusted to match approved Acquisition Program Baseline threshold dates