Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force											Date: April 2022	
Appropriation/Budget Activity 3620F: *Research, Development, Test & Evaluation, Space Force* / BA 7: *Operational Systems Development*					R-1 Program Element (Number/Name) PE 1203109SF / *Narrowband Satellite Communications*							
COST ($ in Millions)	**Prior Years**	**FY 2021**	**FY 2022**	**FY 2023 Base**	**FY 2023 OCO**	**FY 2023 Total**	**FY 2024**	**FY 2025**	**FY 2026**	**FY 2027**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	0.000	110.012	165.892	0.000	165.892	277.713	521.579	671.276	587.324	1,405.633	3,739.429
673109: *SATCOM MUOS*	0.000	0.000	110.012	165.892	0.000	165.892	277.713	521.579	671.276	587.324	1,405.633	3,739.429
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		
Program MDAP/MAIS Code: 345												

Note

In FY 2022, Program Element (PE) 1203109N, Satellite Communications (SPACE), efforts were transferred to PE 1203109SF, Narrowband Satellite Communications, in order to meet the intent of Space Policy Directive-4 and to align with Office of the Under Secretary of Defense (OUSD) direction to transfer the Mobile User Objective System (MUOS) from the Department of the Navy to the United States Space Force (USSF).

A. Mission Description and Budget Item Justification

Mobile User Objective System (MUOS) provides a worldwide, multi-service population of mobile and fixed-site terminal users with Ultra High Frequency (UHF) Narrowband, beyond line of sight satellite communications (SATCOM). MUOS significantly increases performance and capacity in support of critical Combatant Command SATCOM priorities. MUOS is the replacement system for the UHF Follow-on (UFO) system, which is currently beyond its design life.

MUOS is comprised of Space, Ground, and User Entry Segments. The Space Segment consists of five geosynchronous satellites, which includes an on-orbit spare. Each satellite provides both a legacy UHF payload backward compatible with UFO and a Wideband Code Division Multiple Access (WCDMA) payload, which provides 3G cellular-like capability. MUOS reached full operational capability in October 2019.

The Ground Segment consists of four world-wide Radio Access Facilities (RAFs) and two satellite control facilities. Each RAF includes three 60 ft. antennas and numerous equipment racks. The RAFs in Hawaii and Virginia each include a Switching Facility (SF), and the RAF in Hawaii includes a Network Management Facility (NMF). The User Entry Segment consists of the MUOS waveform that is ultimately integrated into MUOS-capable terminals which are fielded by the services. In addition to providing UHF SATCOM for the Department of Defense, the USSF has the overall responsibility to deliver the End-to-End (E2E) MUOS capability to the warfighter. This responsibility involves systems engineering, integration, and test management of all MUOS system-of-system activities.

In accordance with a Department of Defense Chief of Information Office assessment, anticipated narrowband satellite communication losses led to the recommendation by Office of Under Secretary of Defense (OUSD) Acquisitions & Sustainment and OUSD Cost Assessment and Program Evaluation (CAPE) direction for Navy to initiate MUOS Service Life Extension (SLE) to acquire and launch two additional MUOS satellites (without legacy payloads). The SLE is projected to extend the 70% constellation availability for the WCDMA capability to at least 2034 and extend the ground segment service life to support satellites to at least 2039.

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
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This PE funds systems optimization and modernization to address the dynamic, worldwide electromagnetic and cybersecurity environment in which MUOS operates. Efforts also include Service Life Extension early design and risk reduction for MUOS 6 and 7, as well as MUOS ground modernization. The PE includes a MUOS Baseline effort, a Service Life Extension effort, and an Analysis of Alternatives effort led by USSF in FY22-23.

The US Space Force will continue the narrowband analysis of alternatives as required to determine the narrowband solution beyond the MUOS system.

Space acquisition must respond with speed and agility to emerging adversary threats. Space Systems Command (SSC) 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, SSC will strategically execute experimentation, prototyping, risk reduction, and other efforts to develop new or repurpose capabilities.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver the MUOS system capability. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 1206392SF and 1206398SF.

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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	0.000	112.012	0.000	0.000	0.000
Current President's Budget	0.000	110.012	165.892	0.000	165.892
Total Adjustments	0.000	-2.000	165.892	0.000	165.892
• Congressional General Reductions	0.000	-5.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	3.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.000	0.000	165.892	0.000	165.892

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Project: 673109: *SATCOM MUOS*		
Congressional Add: *L-Band Communications*	0.000	3.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
Appropriation/Budget Activity 3620F: *Research, Development, Test & Evaluation, Space Force I* BA 7: *Operational Systems Development*	**R-1 Program Element (Number/Name)** PE 1203109SF *I Narrowband Satellite Communications*

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2021	FY 2022
Congressional Add Subtotals for Project: 673109	0.000	3.000
Congressional Add Totals for all Projects	0.000	3.000

Change Summary Explanation

FY 2023: +$165.892M; the FY 2022 President's Budget submittal did not reflect FY 2023 through FY 2026 funding. Therefore, an explanation of the change between the two budget positions for FY 2023 cannot be made in a relevant manner.

C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Title: Mobile User Objective System (MUOS) Baseline Upgrade	0.000	70.133	44.980
Description: System optimization and modernization to address the dynamic, worldwide electromagnetic and cybersecurity environment in which MUOS operates. ***FY 2022 Plans:*** Continue migration of MUOS ground infrastructure to Advanced Cryptographic Capability (ACC) from Enhanced FireFly Communications Security (COMSEC) which includes changes to MUOS waveform software and artifacts, software updates to existing KG-175 devices, and updates to MIL-STD-188-187A and associated terminal certification program. Continue system optimization and electro-magnetic interference mitigation efforts to ensure capacity is available to the end user. Continue E2E MUOS Usability Enhancements and improvements to over-the-air provisioning and profile portability. Pending a successful JCTD demonstration and military utility assessment in CY 2021, implement an operationally relevant and viable UHF Legacy Extension (ULX) system to mitigate Legacy UHF communications shortfalls. ***FY 2023 Plans:*** Complete migration of MUOS ground infrastructure from Enhanced Firefly COMSEC to ACC, which includes changes to MUOS waveform software and artifacts, software updates to existing KG-175 devices, and updates to MIL-STD-188-187A and associated terminal certification program. Continue system optimization and electro-magnetic interference mitigation efforts to ensure capacity is available to the end user. Continue E2E MUOS Usability Enhancements. Continue to investigate alternatives to mitigate Legacy UHF communications shortfalls. Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to studies, technical analysis, experimentation, and interoperability and integration efforts with other DoD systems (e.g., Integrated Broadcast Service (IBS), Combat Survivor Evader Locator (CSEL), etc.). ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 decreased due to completion and delivery of MUOS ground and waveform changes to support ACC in early FY 2023.			
Title: Mobile User Objective System (MUOS) Service Life Extension (SLE)	0.000	29.879	120.912

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
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C. Accomplishments/Planned Programs ($ in Millions)	FY 2021	FY 2022	FY 2023
Description: MUOS Service Life Extension (SLE) to acquire and launch two additional MUOS satellites (without legacy payloads) and extend the ground segment service life. ***FY 2022 Plans:*** Initiate Risk Reduction Design studies for MUOS 6 and 7 Service Life Extension (SLE) satellites. Address emerging cybersecurity requirements to ensure continued system security and availability. Perform ground life extension studies and initiate migration efforts to a digital processing ground system that is more resilient and responsive to mitigating emerging threats. ***FY 2023 Plans:*** FY 2023 is the second year of a ramp-up in SLE effort across the MUOS Space and Ground segments. Continue ramp-up in SLE effort across the MUOS Space and Ground segments. Funding request required to award two fixed-price satellite early design and risk reduction contracts. Conduct system requirements review, prototyping, modelling, and simulation. Conduct ground SLE studies and further migration efforts to a digital processing that is more resilient and responsive to mitigating emerging threats. Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Activities may include, but are not limited to program office support, studies, technical analysis, experimentation, prototyping, etc. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 increased due to initiation of early design activities and studies, ground modernization, and ramp-up of systems engineering and program management necessary to support MUOS Service Life Extension (SLE) effort.			
Title: Narrowband Analysis of Alternatives ***Description:*** Conduct analysis of alternatives for narrowband communications beyond MUOS. ***FY 2022 Plans:*** Begin studies bounding the expected solutions regarding requirements definition and technology maturity. Conduct analysis of alternatives to provide narrowband SATCOM capabilities to the joint warfighter beyond the MUOS system. ***FY 2023 Plans:*** Narrowband AoA is a FY 2022-funded activity expected to extend into FY 2023 ***FY 2022 to FY 2023 Increase/Decrease Statement:*** FY 2023 decreased due to utilization of FY 2022 funds to complete the Narrowband Analysis of Alternatives study.	0.000	7.000	0.000
Accomplishments/Planned Programs Subtotals	0.000	107.012	165.892

	FY 2021	FY 2022
Congressional Add: L-Band Communications	0.000	3.000

Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Air Force	Date: April 2022
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	FY 2021	FY 2022
FY 2021 Accomplishments: N/A ***FY 2022 Plans:*** Complete directed L-band communications study or work.		
Congressional Adds Subtotals	0.000	3.000

D. Other Program Funding Summary ($ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• SPSF 01 BA01 MUOS00: *Mobile User Objective System*	-	45.371	46.833	-	46.833	47.169	49.266	50.238	51.547	728.615	1,019.039

Remarks

E. Acquisition Strategy

The program awarded the Ground and User Entry Segment contracts. The Space Force will use existing requirements in order to develop two operationally-similar SLE satellites. The program awarded competitive risk reduction and system engineering contracts in FY 2022 to determine required non-recurring engineering design changes. Up to two vendors will be awarded competitive contracts in FY 2023 to conduct early design activities for MUOS 6 and 7. One contractor will be selected in FY 2025 for the final design and build contract.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3620F / 7	**R-1 Program Element (Number/Name)** PE 1203109SF / *Narrowband Satellite Communications*	**Project (Number/Name)** 673109 / *SATCOM MUOS*

Product Development ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
MUOS SLE Ground Engineering Contract	SS/ Various	General Dynamics : Scottsdale, AZ	0.000	-		7.842	Nov 2021	2.886	Nov 2022	-		2.886	673.165	683.893	-
MUOS SLE Risk Reduction Design Studies	C/FFP	TBD : TBD	0.000	-		13.273	Oct 2021	-		-		-	0.000	13.273	-
MUOS SLE Early Design Activities	C/FFP	TBD : TBD	0.000	-		-		104.458	Jan 2023	-		104.458	56.411	160.869	-
MUOS SLE Crypto Replacement Plans and Interfaces	MIPR	NSA : Fort Meade, MD	0.000	-		0.553	Nov 2021	-		-		-	0.000	0.553	-
MUOS SLE TMA	RO	Aerospace : El Segundo, CA	0.000	-		-		1.433	Oct 2022	-		1.433	21.654	23.087	-
MUOS SLE Final Design and Production	C/CPAF	TBD : TBD	0.000	-		-		-		-		-	2,436.977	2,436.977	-
MUOS Baseline Ground Engineering Contracts	SS/ Various	Various : Various	0.000	-		64.174	Nov 2021	41.915	Nov 2022	-		41.915	40.790	146.879	-
MUOS Baseline Space Engineering Contract	SS/ Various	Lockheed Martin : Sunnyvale, CA	0.000	-		-		1.431	Nov 2022	-		1.431	0.000	1.431	-
MUOS Baseline Electromagnetic Interference	SS/CPFF	Adaptive Dynamics Inc : San Diego, CA	0.000	-		4.284	Nov 2021	0.861	Nov 2022	-		0.861	0.000	5.145	-
L-Band Communications	TBD	Various : Various	0.000	-		3.000	Apr 2022	-		-		-	0.000	3.000	-
MUOS Narrowband Analysis of Alternatives (AoA)	TBD	Various : Various	0.000	-		7.000	Feb 2022	-		-		-	0.000	7.000	-
		Subtotal	0.000	-		100.126		152.984		-		152.984	3,228.997	3,482.107	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
MUOS SLE FFRDC	RO	Aerospace : El Segundo, CA	0.000	-		3.252	Oct 2021	2.865	Oct 2022	-		2.865	42.395	48.512	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3620F / 7	**R-1 Program Element (Number/Name)** PE 1203109SF / *Narrowband Satellite Communications*	**Project (Number/Name)** 673109 / *SATCOM MUOS*

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2021 Cost	FY 2021 Award Date	FY 2022 Cost	FY 2022 Award Date	FY 2023 Base Cost	FY 2023 Base Award Date	FY 2023 OCO Cost	FY 2023 OCO Award Date	FY 2023 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
MUOS SLE A&AS	C/CPFF	Various : Various	0.000	-		4.207	Jan 2022	4.599	Mar 2023	-		4.599	110.040	118.846	-
MUOS SLE Other Support	Various	Various : Various	0.000	-		0.752	Oct 2021	4.671	Oct 2022	-		4.671	82.093	87.516	-
MUOS Baseline A&AS	C/CPFF	Various : Various	0.000	-		0.693	Jan 2022	0.250	Mar 2023	-		0.250	0.000	0.943	-
MUOS Baseline Other Support	Various	Not specified. : TBD	0.000	-		0.982	Oct 2021	0.523	Oct 2022	-		0.523	0.000	1.505	-
		Subtotal	0.000	-		9.886		12.908		-		12.908	234.528	257.322	N/A

Remarks

Increase from FY22 to FY23 is due to the ramp up of staff necessary to support MUOS SLE efforts.

	Prior Years	FY 2021		FY 2022		FY 2023 Base		FY 2023 OCO		FY 2023 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	-		110.012		165.892		-		165.892	3,463.525	3,739.429	N/A

Remarks

Exhibit R-4, RDT&E Schedule Profile: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3620F / 7	**R-1 Program Element (Number/Name)** PE 1203109SF / *Narrowband Satellite Communications*	**Project (Number/Name)** 673109 / *SATCOM MUOS*

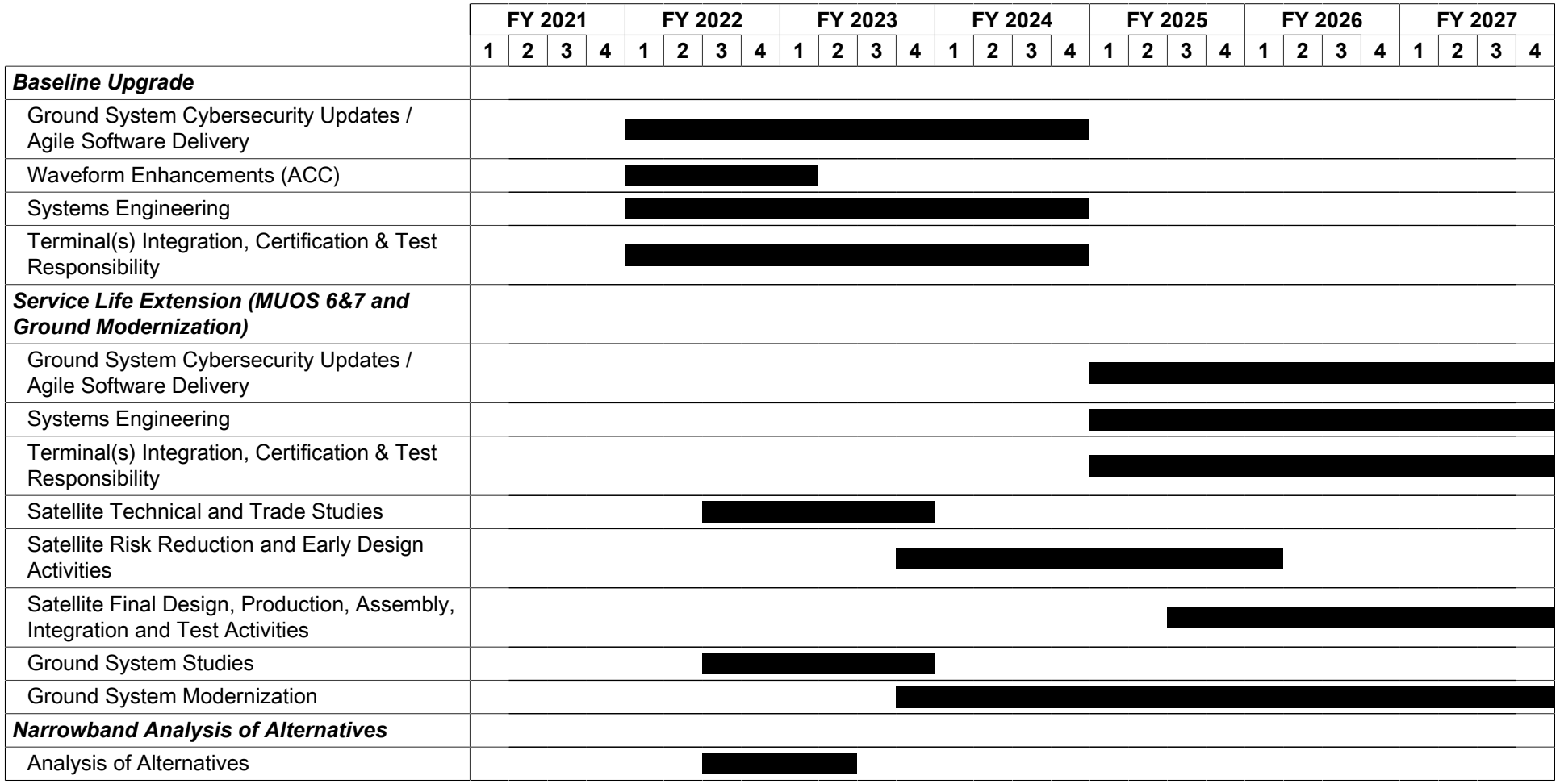

Exhibit R-4A, RDT&E Schedule Details: PB 2023 Air Force		Date: April 2022
Appropriation/Budget Activity 3620F / 7	**R-1 Program Element (Number/Name)** PE 1203109SF / *Narrowband Satellite Communications*	**Project (Number/Name)** 673109 / *SATCOM MUOS*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Baseline Upgrade				
Ground System Cybersecurity Updates / Agile Software Delivery	1	2022	4	2024
Waveform Enhancements (ACC)	1	2022	1	2023
Systems Engineering	1	2022	4	2024
Terminal(s) Integration, Certification & Test Responsibility	1	2022	4	2024
Service Life Extension (MUOS 6&7 and Ground Modernization)				
Ground System Cybersecurity Updates / Agile Software Delivery	1	2025	4	2027
Systems Engineering	1	2025	4	2027
Terminal(s) Integration, Certification & Test Responsibility	1	2025	4	2027
Satellite Technical and Trade Studies	3	2022	4	2023
Satellite Risk Reduction and Early Design Activities	4	2023	1	2026
Satellite Final Design, Production, Assembly, Integration and Test Activities	3	2025	4	2027
Ground System Studies	3	2022	4	2023
Ground System Modernization	4	2023	4	2027
Narrowband Analysis of Alternatives				
Analysis of Alternatives	3	2022	2	2023

Note

Narrowband AoA is a FY 2022-funded activity expected to extend into FY 2023.