Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force											Date: March 2023	
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 2022**	**FY 2023**	**FY 2024 Base**	**FY 2024 OCO**	**FY 2024 Total**	**FY 2025**	**FY 2026**	**FY 2027**	**FY 2028**	**Cost To Complete**	**Total Cost**
Total Program Element	0.000	110.493	110.142	230.785	0.000	230.785	435.486	595.552	676.140	604.844	Continuing	Continuing
673109: *SATCOM MUOS*	0.000	110.493	110.142	230.785	0.000	230.785	435.486	595.552	676.140	604.844	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		
Program MDAP/MAIS Code: 345												

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, network management, and test management of all MUOS system-of-system components.

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.

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 (AoA) effort led by USSF in FY 2022-2023.

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

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force	Date: March 2023
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*

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 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total
Previous President's Budget	110.012	165.892	277.713	0.000	277.713
Current President's Budget	110.493	110.142	230.785	0.000	230.785
Total Adjustments	0.481	-55.750	-46.928	0.000	-46.928
• Congressional General Reductions	0.000	-55.750			
• 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	0.000	0.000			
• SBIR/STTR Transfer	0.000	0.000			
• Other Adjustments	0.481	0.000	-46.928	0.000	-46.928

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2022	FY 2023
Project: 673109: *SATCOM MUOS*		
Congressional Add: *L-Band Communications*	3.000	-
Congressional Add Subtotals for Project: 673109	3.000	-
Congressional Add Totals for all Projects	3.000	-

Change Summary Explanation

FY 2024 : -109.500M; transferred to Space Procurement, Space Force BA01 MUOS00, to address hardware and software obsolescence and cybersecurity vulnerabilities.
FY 2024: -1.825M; to realign funding to APPN 3410, PE 1207804SF (SAG 13C), for fiscal policy compliance as Space Systems Command (SSC) establishes Headquarters functions and a Chief Information Office (CIO) for integrated cybersecurity.
FY 2024: +8.000M: Adjustment to demonstrate an alternative waveform to support Legacy Integrated Broadcast Service users.

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force	Date: March 2023
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*

FY 2024: +55.500M: transferred from Space Procurement, Space Force BA01 MUOS00, to conduct design review campaign with two vendors towards Final Design approval
FY 2024: +0.857M; inflation

C. Accomplishments/Planned Programs ($ in Millions)	FY 2022	FY 2023	FY 2024
Title: Mobile User Objective System (MUOS) Baseline Upgrade	75.088	59.812	43.110
Description: System optimization and modernization to address the dynamic, worldwide electromagnetic and cybersecurity environment in which MUOS operates. ***FY 2023 Plans:*** Complete migration of MUOS ground infrastructure from Enhanced Firefly communication security to Advanced Cryptographic Capability (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 increase 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 (Integrated Broadcast Service (IBS), Combat Survivor Evader Locator (CSEL), etc.). ***FY 2024 Plans:*** Continue systems engineering, system optimization, cybersecurity updates, and electro-magnetic interference (EMI) mitigation efforts to ensure capacity is available to the end user, including the development and fielding of EMI mitigation solutions and inclination control and eclipse contingency studies for the space segment. Rapidly respond to implement system resiliency and situational awareness necessary to operate in the contested space domain. Continue E2E MUOS usability enhancements including terminal certification, integration, and test. Continue to investigate and begin development of alternatives to mitigate Legacy UHF communications shortfalls. Activities may include, but are not limited to studies, technical analysis, experimentation, and interoperability and integration efforts with other DoD systems (Integrated Broadcast Service (IBS), Combat Survivor Evader Locator (CSEL), etc.). ***FY 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 decreased due to completion and delivery of MUOS ground and waveform changes to support ACC in early FY 2023. Remaining activities include system optimization efforts, electro-magnetic interference mitigation, and IBS development efforts.			
Title: Mobile User Objective System (MUOS) Service Life Extension (SLE)	26.435	50.330	187.675
Description: MUOS Service Life Extension SLE to acquire and launch two additional MUOS satellites without legacy payloads and extend the ground segment service life.			

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force	Date: March 2023
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*

C. Accomplishments/Planned Programs ($ in Millions)	FY 2022	FY 2023	FY 2024
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 2024 Plans:*** Continue systems engineering to support space, ground, and waveform segments. Continue satellite design and risk reduction activities for up to two vendors. Activities include spacecraft design, interface control document development, and preparing and conducting systems requirements and tailored design reviews. Initiate ground system modernization across all four radio access facilities, with associated laboratory equipment and associated program office support, through migration to an extensible digital processing architecture. Ground activities include interface testing & verification, and architecture updates. 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 2023 to FY 2024 Increase/Decrease Statement:*** FY 2024 increased to conduct design review campaign with two vendors towards Final Design approval and production activities to start in FY 2025.			
Title: Narrowband Analysis of Alternatives ***Description:*** Conduct analysis of alternatives for narrowband communications beyond MUOS. ***FY 2023 Plans:*** Narrowband AoA is a FY 2022-funded activity expected to extend into FY 2023 ***FY 2024 Plans:*** N/A ***FY 2023 to FY 2024 Increase/Decrease Statement:*** N/A	5.970	0.000	0.000
Accomplishments/Planned Programs Subtotals	107.493	110.142	230.785

Exhibit R-2, RDT&E Budget Item Justification: PB 2024 Air Force	Date: March 2023
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*

	FY 2022	FY 2023
Congressional Add: L-Band Communications	3.000	-
FY 2022 Accomplishments: Complete directed L-band communications study or work.		
Congressional Adds Subtotals	3.000	-

D. Other Program Funding Summary ($ in Millions)

Line Item	FY 2022	FY 2023	FY 2024 Base	FY 2024 OCO	FY 2024 Total	FY 2025	FY 2026	FY 2027	FY 2028	Cost To Complete	Total Cost
• SPSF 01 BA01 MUOS00: *Mobile User Objective System*	45.371	46.833	100.484	-	100.484	48.578	49.485	50.692	51.706	0.000	393.149

Remarks

FY 2024 figure does not include +109.500M ZBT transferred from RDT&E, SF, PE 1203109SF, to address hardware and software obsolescence and cybersecurity vulnerabilities.
FY 2024: -55.500M: transferred to RDT&E, SF, PE 1203109SF, to conduct design review campaign with two vendors towards Final Design approval.

E. Acquisition Strategy

The program previously 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 technical and trade studies contracts in FY 2022 to determine required non-recurring engineering design changes. The Service Acquisition Executive approved the program's acquisition strategy in 14 Sep 2022 as a Major Capability Acquisition pathway, post-Milestone C program, and the program is executing to plan. Up to two vendors will be awarded competitive contracts in FY 2023 to conduct design and risk reduction activities for MUOS SVs 6 and 7. One contractor will be selected in FY 2025 for the final design and production contract.

Exhibit R-3, RDT&E Project Cost Analysis: PB 2024 Air Force		Date: March 2023
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 2022 Cost	FY 2022 Award Date	FY 2023 Cost	FY 2023 Award Date	FY 2024 Base Cost	FY 2024 Base Award Date	FY 2024 OCO Cost	FY 2024 OCO Award Date	FY 2024 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
SLE Ground Engineering Contract	SS/ Various	General Dynamics : Scottsdale, AZ	0.000	7.842	Nov 2021	16.643	Nov 2022	43.382	Nov 2023	-		43.382	Continuing	Continuing	-
SLE Technical and Trade Studies	C/FP	Various : Various	0.000	13.273	Oct 2021	-		-		-		-	Continuing	Continuing	-
SLE Satellite Design and Risk Reduction Activities	C/FP	TBD : TBD	0.000	-		23.000	Aug 2023	109.000	Nov 2023	-		109.000	Continuing	Continuing	-
SLE Crypto Replacement Plans and Interfaces	MIPR	NSA : Fort Meade, MD	0.000	0.553	Nov 2021	-		-		-		-	Continuing	Continuing	-
SLE Technical Mission Analysis	RO	Aerospace : El Segundo, CA	0.000	-		1.335	Oct 2022	2.968	Nov 2023	-		2.968	Continuing	Continuing	-
Baseline Ground Engineering Contracts	SS/ Various	Various : Various	0.000	65.685	Nov 2021	36.287	Nov 2022	35.841	Nov 2023	-		35.841	Continuing	Continuing	-
Baseline Space Engineering Contract	SS/ Various	Lockheed Martin : Sunnyvale, CA	0.000	-		4.403	Nov 2022	0.970	Nov 2023	-		0.970	Continuing	Continuing	-
Baseline Electromagnetic Interference	SS/CPFF	Adaptive Dynamics Inc : San Diego, CA	0.000	4.284	Nov 2021	0.600	Nov 2022	0.800	Nov 2023	-		0.800	Continuing	Continuing	-
L-Band Communications	C/FFP	CesiumAstro : Austin, TX	0.000	3.000	Apr 2022	-		-		-		-	Continuing	Continuing	-
SBIR/STTR	Various	Not specified. : TBD	0.000	-		-		8.045		-		8.045	Continuing	Continuing	-
Narrowband Analysis of Alternatives (AoA)	TBD	Various : Various	0.000	5.970	Feb 2022	-		-		-		-	Continuing	Continuing	-
		Subtotal	0.000	100.607		82.268		201.006		-		201.006	Continuing	Continuing	N/A

Management Services ($ in Millions)

Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	FY 2022 Cost	FY 2022 Award Date	FY 2023 Cost	FY 2023 Award Date	FY 2024 Base Cost	FY 2024 Base Award Date	FY 2024 OCO Cost	FY 2024 OCO Award Date	FY 2024 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
SLE FFRDC	RO	Aerospace : El Segundo, CA	0.000	3.252	Oct 2021	3.200	Oct 2022	4.988	Oct 2023	-		4.988	Continuing	Continuing	-
SLE A&AS	C/CPFF	Various : Various	0.000	4.207	Jan 2022	14.591	Mar 2023	15.854	Nov 2023	-		15.854	Continuing	Continuing	-
SLE Other Support	Various	Various : Various	0.000	0.752	Oct 2021	4.671	Oct 2022	6.666	Oct 2023	-		6.666	Continuing	Continuing	-

Exhibit R-3, RDT&E Project Cost Analysis: PB 2024 Air Force		Date: March 2023
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 2022 Cost	FY 2022 Award Date	FY 2023 Cost	FY 2023 Award Date	FY 2024 Base Cost	FY 2024 Base Award Date	FY 2024 OCO Cost	FY 2024 OCO Award Date	FY 2024 Total Cost	Cost To Complete	Total Cost	Target Value of Contract
Baseline A&AS	C/CPFF	Various : Various	0.000	0.693	Jan 2022	1.297	Mar 2023	1.548	Nov 2023	-		1.548	Continuing	Continuing	-
Baseline Other Support	Various	Not specified. : TBD	0.000	0.982	Oct 2021	4.115	Oct 2022	0.723	Oct 2023	-		0.723	Continuing	Continuing	-
		Subtotal	0.000	9.886		27.874		29.779		-		29.779	Continuing	Continuing	N/A

Remarks

Increase from FY23 to FY24 is to support design and risk reduction activities for two vendors, ground system modernization, and Final Design and Production contract preparation including supporting draft and final request for proposals.

	Prior Years	FY 2022		FY 2023		FY 2024 Base		FY 2024 OCO		FY 2024 Total	Cost To Complete	Total Cost	Target Value of Contract
Project Cost Totals	0.000	110.493		110.142		230.785		-		230.785	Continuing	Continuing	N/A

Remarks

Cost to Complete and Total Cost columns show continuing due to the Service Cost Position (SCP) estimated completion date of 4QFY2023.

Exhibit R-4, RDT&E Schedule Profile: PB 2024 Air Force		Date: March 2023
Appropriation/Budget Activity 3620F / 7	**R-1 Program Element (Number/Name)** PE 1203109SF / *Narrowband Satellite Communications*	**Project (Number/Name)** 673109 / *SATCOM MUOS*

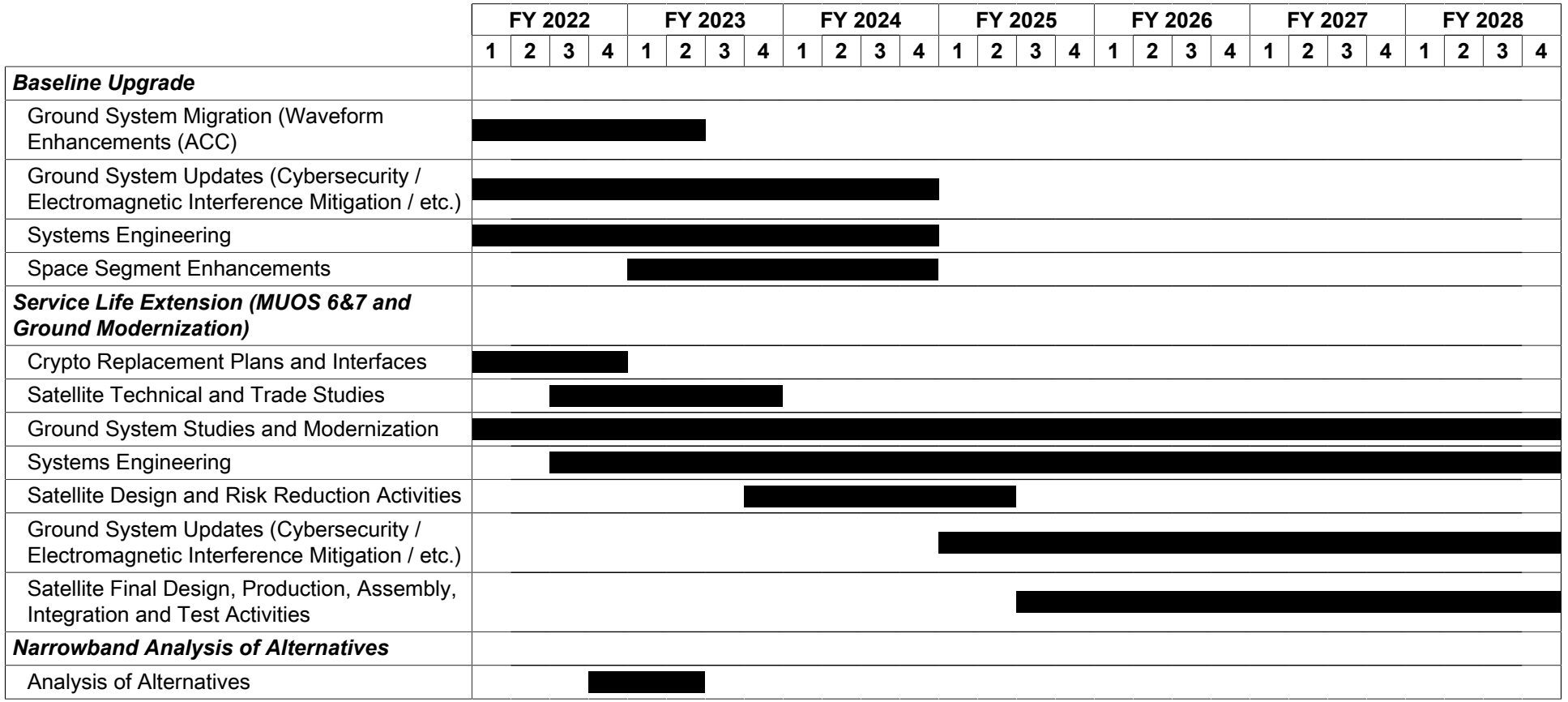

Exhibit R-4A, RDT&E Schedule Details: PB 2024 Air Force		Date: March 2023
Appropriation/Budget Activity 3620F / 7	**R-1 Program Element (Number/Name)** PE 1203109SF / *Narrowband Satellite Communications*	**Project (Number/Name)** 673109 / *SATCOM MUOS*

Schedule Details

	Start		End	
Events by Sub Project	**Quarter**	**Year**	**Quarter**	**Year**
Baseline Upgrade				
Ground System Migration (Waveform Enhancements (ACC)	1	2022	2	2023
Ground System Updates (Cybersecurity / Electromagnetic Interference Mitigation / etc.)	1	2022	4	2024
Systems Engineering	1	2022	4	2024
Space Segment Enhancements	1	2023	4	2024
Service Life Extension (MUOS 6&7 and Ground Modernization)				
Crypto Replacement Plans and Interfaces	1	2022	4	2022
Satellite Technical and Trade Studies	3	2022	4	2023
Ground System Studies and Modernization	1	2022	4	2028
Systems Engineering	3	2022	4	2028
Satellite Design and Risk Reduction Activities	4	2023	2	2025
Ground System Updates (Cybersecurity / Electromagnetic Interference Mitigation / etc.)	1	2025	4	2028
Satellite Final Design, Production, Assembly, Integration and Test Activities	3	2025	4	2028
Narrowband Analysis of Alternatives				
Analysis of Alternatives	4	2022	2	2023