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

<b>Appropriation/Budget Activity</b> 3600: <i>Research, Development, Test &amp; Evaluation, Air Force I BA 4: Advanced Component Development &amp; Prototypes (ACD&amp;P)</i>	<b>R-1 Program Element (Number/Name)</b> PE 0604003F / <i>Advanced Battle Management System (ABMS)</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	-	139.203	158.492	203.849	0.000	203.849	-	-	-	-	-	-
640141: <i>Advanced Battle Management System (ABMS)</i>	-	139.203	158.492	203.849	0.000	203.849	-	-	-	-	-	-
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-	-	-

**A. Mission Description and Budget Item Justification**

ABMS is the top modernization priority for the Department of the Air Force (DAF) and its primary contribution to provide decision superiority and meet the Joint All-Domain Command and Control (JADC2) requirements. JADC2 requires that individual military activities not simply be deconflicted, but be integrated - activities in one domain must enhance the effectiveness of those in other domains and compensate for vulnerabilities. ABMS will connect sensors, systems, and weapons across both the U.S. Space Force and U.S. Air Force. ABMS is not a platform or sensor, but instead will be the essential data network that connects and empowers current and future platforms to fight and win in the modern era as defined by the National Defense Strategy and Joint All-Domain Operations Department of Defense directives. Legacy and future sensors from a variety of programs and sources produce data that needs to be made available to those people and systems that need it most. Multi-level secure processing occurs on global distributed clouds, tactical edge nodes, infrastructure, platforms, and end user devices where operators interface with the data and applications at the required classification level. For information to flow, the network must be enabled by a combination of government and commercial connectivity pathways to move data to and through a suite of cloud and local edge-based applications that make sense of the environment and apply advanced algorithms aided by artificial intelligence and machine learning. Strategic, operational, and tactical operators use these applications to manage and direct the desired effects using machine-to-machine connections.

On 24 Nov 2020, the DAF Rapid Capabilities Office (DAF RCO) became the ABMS Integrating Program Executive Office (PEO) in a deliberate transition to start acquiring enduring ABMS capability through focused acquisition efforts and investments in robust digital infrastructure. The DAF RCO will build on the DAF Chief Architect Office (CAO) efforts to mature technology across product lines previously identified as Open, Networked, Extendible (ONEs) and through Onramp demonstration activities. The DAF RCO will build the digital infrastructure and work in tight partnership across the DAF acquisition community to ensure DAF systems have seamless interoperability and compatibility to meet the JADC2 operational requirements.

ABMS, as an acquisition effort managed by the DAF RCO, will pursue two parallel, symbiotic investment strategies under PE 0604003F: enduring digital infrastructure investments and Capability Releases (CRs) focused on closing kill-chains and delivering immediate operational capability to the warfighter. Instead of continuing to proliferate ONEs, DAF RCO will focus ABMS investments on six capabilities as part of digital infrastructure and CRs:

1. Secure Processing: The hardware and software for processing and storage through multi-level security globally and edge enabling a full range of military operations.

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<p>2. Connectivity: Maturation and integration of open software-defined radios and networks, government-owned waveform libraries, and wideband multi-function RF systems. This element also includes the integration and standards required to leverage advances in commercial technology such as Open Communications Standards (OCS), 5G networks, and connections through multi-orbit satellite communications.</p> <p>3. Data Management: Cloud-based data libraries, data feeds, data wrappers, software-defined data management, and content routing to improve data discoverability and information sharing across the joint force for legacy and future platforms and programs.</p> <p>4. Applications: Cloud-based applications to provide User Interface/User Experience (UI/UX) capabilities that will position warfighters "on the loop" to provide robust and dynamic battle management, command and control (BMC2) functionality, improved timing, and enhanced decision advantage.</p> <p>5. Sensor Integration: ABMS will develop government-owned standards and provide open and reusable capabilities, to ensure interoperability with the ABMS digital infrastructure for existing and future military systems.</p> <p>6. Effects Integration: ABMS will develop government-owned standards to ensure the successful integration of DAF and Joint effects capabilities into the ABMS digital infrastructure for existing and future military systems.</p> <p>Capability Release #1 (Airborne Edge Node): Leveraging the enduring digital infrastructure investments in Secure Processing, Connectivity, and Data Management, ABMS Capability Release #1 will deliver to the warfighter the first, secure tactical edge node — leveraging government reference architecture solutions connecting 5th Gen Tactical Air fighter platforms through a KC-46 tanker to operational C2 nodes. This "Airborne Edge Node" will allow for secure, resilient communications between the F-22 and F-35 and will extend the sharing of situational awareness across the globe in near-real time through satellite communications to and from command and control nodes such as Air Operations Centers (AOC) and Common Mission Control Center (CMCC). In addition to serving the tactical customers (fighter aircraft), the KC-46 C2 node will also provide data and information to operational and strategic customers while providing improved strategic awareness to the KC-46 crew. CR#1 constitutes a first edge node on the ABMS network and provides the example for other platforms to connect.</p> <p>ABMS funding provides for program management support, operational concept development and demonstration, hardware development and integration, and software development and integration. The funding will also enable the limited transition of mature and ready capabilities to appropriate programs of record in synchronization with planned modernization activities.</p> <p>Previous categories of Digital Architecture, Standards, and Concepts and Architecture Experimentation and Evaluation cut across all Department of the Air Force programs and are not exclusive to a single program. Starting in FY22 those activities are re-aligned to a Department-wide budget independent of ABMS, PE 0604006F.</p> <p>This program element may include necessary civilian pay and National Guard/Reserve Duty expenses required to manage, execute, and deliver ABMS capability. This program element may include necessary civilian pay expenses required to manage, execute, and deliver weapon system capability. The use of such programs funds would be in addition to the civilian pay expenses budgeted in program element 0605831F. In FY20 3.770M and in FY21 0.900M was expended for civilian pay expenses in this program element.</p>		

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This effort is in Budget Activity 4, Advanced Component Development and Prototypes (ACD&P), because efforts are necessary to evaluate integrated technologies, representative modes or prototype systems in a high fidelity and realistic operating environment.

<b>B. Program Change Summary (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022 Base</b>	<b>FY 2022 OCO</b>	<b>FY 2022 Total</b>
Previous President's Budget	8.000	302.323	449.290	0.000	449.290
Current President's Budget	139.203	158.492	203.849	0.000	203.849
Total Adjustments	131.203	-143.831	-245.441	0.000	-245.441
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	-143.831			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	0.000			
• Congressional Directed Transfers	0.000	0.000			
• Reprogrammings	131.496	0.000			
• SBIR/STTR Transfer	-0.293	0.000			
• Other Adjustments	0.000	0.000	-245.441	0.000	-245.441

**Change Summary Explanation**

FY 2020: Above Threshold Reprogramming realigned 131.496M into PE 0604003F, Advanced Battle Management System (ABMS), Project 640141, ABMS, for greater transparency, tracking, and execution purposes. OSD approved Internal Reprogramming action (DOD Serial No: FY 20-25 IR) action reprogrammed 34.308M from PE 0604003F, Advanced Battle Management System (ABMS), Project 67411L, Advanced Battle Management System, and 97.188M from PE 0304115F, Multi Domain Command and Control (MDC2), Project 673380, MDC2. SBIR/STTR Transfer of 0.293M as of Sep 2020.

FY 2021: Program reduced -143.831M in total due to unjustified growth (-50.000M) poor justification materials (-15.000M), excess to need (-0.290M) and forward financing of digital architecture, sensor integration, data, secure processing , connectivity, applications, effects integrations and onramps (-78.541M).

FY 2022: Program reduced 245.441M to better reflect amounts appropriate for FY 2022 objectives.

<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>	<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<b>Title:</b> Digital Infrastructure	0.000	43.922	57.203
<b>Description:</b> The first three ABMS capabilities (secure processing, connectivity, and data management) are considered the core digital infrastructure and the emphasis of future investments to ensure the ability to connect the joint force and allow decision making superiority at the tactical, operational, and strategic levels faster than the adversary.			

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<p>Secure Processing: Represents the physical infrastructure DAF RCO intends to procure in the initial phase. Investments focus on hybrid commercial and tactical edge multi-level security, multi-cloud environments resulting in secure compute and storage capability. Solutions will provide tactical edge secure processing environments and tools enabling remote operations as well as 'on the move' when disconnected from the broader network and global environment. These secure processing solutions will host critical services such as robust data management solutions, zero-trust multi-level security applications, Artificial Intelligence (AI) algorithms and Machine Learning (ML) capabilities.</p> <p>Connectivity: Delivers capabilities to enable resilient, robust communications and the transport of data globally, to the edge, and through space. This will include the software-defined networking and routing layer to enable content routing across connected nodes through government as well as commercial communication paths. ABMS will integrate into existing and future connectivity solution efforts in order to bridge gaps across existing and future platforms. ABMS will leverage Open Communications Standard (OCS) software-defined radios for integration onto platforms, enabling competitive rapid upgrading and the addition of new waveforms over time. Leveraging OCS for legacy and non-native platforms will allow communication through translation and relay. The software-defined radio solution intended for Capability Release #1 builds on OCS technology in partnership with other PEOs across the DAF. Lastly, ABMS will leverage the rapidly advancing commercial satellite ecosystem to ensure robust and resilient connectivity for the Joint Force.</p> <p>Data Management: Technologies and solutions will expose data through widely used commercial best practices and techniques such as Application Program Interfaces (APIs), and standardized data fabric solutions. This capability includes the capability for machine-assisted tagging of data across the DAF to enable rapid exploitation and processing. These techniques enable data to rapidly and securely move across multiple security levels and support decision making. Other high priority data management solutions include critical investments in zero-trust multi-level security applications, Artificial Intelligence (AI) applications, and Machine Learning (ML) capabilities.</p> <p><b>FY 2021 Plans:</b></p> <ul style="list-style-type: none"> <li>• Deploy OCONUS cloud prototype(s) and conduct demonstrations to store and transfer data between clouds, operate with and without cloud connectivity, move existing applications into the clouds, and develop security solutions.</li> <li>• Conduct technical analysis and prototyping for data management, including data tagging, data hosting and metadata.</li> </ul> <p><b>FY 2022 Plans:</b></p> <ul style="list-style-type: none"> <li>• Continue maturing CONUS and OCONUS clouds by adding more data types, data transfers across classification levels, establishing data and network management standards and tools, and developing and hosting cloud-native applications.</li> <li>• Mature connections between CONUS, OCONUS, and existing clouds.</li> </ul>				

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<ul style="list-style-type: none"> <li>Begin data architecture, data tagging and data orchestration design solutions and prototypes that enable available data to be exposed, processed and transferred amongst multi-level security ABMS cloud environments.</li> </ul> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> FY21 Congressional Marks</p>				
<p><b>Title:</b> Capability Releases</p> <p><b>Description:</b> Capability Releases (CRs) deliver operational capability by leveraging and/or supplementing digital infrastructure investments, while making targeted investments in the remaining three ABMS capabilities of Applications, Sensor Integration, and Effects Integration areas.</p> <p>Title: Capability Release #1 (Airborne Edge Node) Description: Based off of CSAF and CSO requirements and technical maturity, CR #1 will focus on the Edge Network to enable sharing of information across 5th Gen Tac Air and provide situational awareness to KC-46 and C2 nodes, enabling better operational decisions to deliver effects faster than the adversary is able to respond. This initial node will inform future platform integration and proliferation to establish the edge network.</p> <p>Title: Cloud-based C2 in support of NORAD/NORTHCOM Description: Investment in cloud-based C2 specifically in support of N/NC requirements with some investments in Applications, Sensor Integration, and Effects Integration.</p> <p><b>FY 2021 Plans:</b></p> <ul style="list-style-type: none"> <li>Capability Release #1 (Airborne Edge Node):                             <ul style="list-style-type: none"> <li>Continue development of open architecture, non-vendor locked, Radio and Aperture hardware and software that provides connectivity to current and future networks for C2 communications.</li> <li>Prototype Radio and Apertures and conduct laboratory and testbed risk-reduction activities</li> <li>Initiate design of pod and pylon sets for integration on the KC-46 outer wing stations</li> <li>Initiate pod, radio and aperture integration design activities.</li> <li>Initiate development of an Edge Node and Situational Awareness tool for KC-46 integration</li> <li>Conduct test planning and preparations</li> </ul> </li> </ul> <p><b>FY 2022 Plans:</b></p>		0.000	68.406	146.646

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<ul style="list-style-type: none"> <li>• Capability Release #1 (Airborne Edge Node)               <ul style="list-style-type: none"> <li>- Complete open architecture radio, aperture, pod/pylon, edge node and Situational Awareness (SA) tool designs</li> <li>- Develop Applications that will provide Sensor and Effects Integration capabilities through the SA tool</li> <li>- Complete builds of completed designs for integration onto the KC-46</li> <li>- Install podded system and SA Tool onto KC-46 and initiate test activities</li> <li>- Begin build of additional podded systems to meet approved quantity requirements</li> <li>- Develop Technical Data Package to enable potential follow-on development and/or procurement activities</li> </ul> </li> <li>• Cloud-based C2 in support of N/NC:               <ul style="list-style-type: none"> <li>- Initiate design activities focused on developing a scalable and extensible data-cloud architecture that leverages artificial intelligence/machine learning (AI/ML) applications and produces a common operating picture.</li> <li>- Develop shared visualization of multiple sources: automated &amp; fused 2D/3D representation of air domain</li> <li>- Ingest, fuse, and analyze data from military, government, and commercial sources to multi-classification cloud environments unlimited by compute &amp; store</li> <li>- Develop automated and operator-selectable tasking of assets, voice, data and C2</li> </ul> </li> </ul> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> The increase is due to planned program execution schedule.</p>				
<p><b>Title:</b> Digital Architecture, Standards, and Concepts</p> <p><b>Description:</b> This line of effort develops and continually advances the integrated U.S. Air Force and U.S. Space Force digital architecture in order to enable current and future platforms and systems to operate as an ecosystem, or family of capabilities, in concert with the other Services, the Intelligence Community, and our allies and partners - as one joint and combined team. Open architectures coupled with open standards and a digital engineering ecosystem is critical to all Department of the Air Force programs because they provide the foundation for agility and adaptability over time as well as enabling the modular approach to development and integration across a family of systems. This activity also evaluates the technical and operational feasibility of new technical concepts that may be brought into the architecture through the science, technology, research, and development and experimentation enterprise. Finally, this effort creates and manages the family-of-systems trade space lying between traditional requirements and acquisition roles, turning warfighter requirements into potential integrated architecture level designs "horizontally" across all Program Executive Office "vertically" managed portfolios.</p> <p><b>FY 2021 Plans:</b></p> <ul style="list-style-type: none"> <li>• Complete digital engineering development environment in the cloud and Platform One.</li> <li>• Complete incorporation of initial platform level system representation.</li> <li>• Identify open standard limitations.</li> </ul>		118.612	15.374	0.000

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<b>C. Accomplishments/Planned Programs (\$ in Millions)</b>		<b>FY 2020</b>	<b>FY 2021</b>	<b>FY 2022</b>
<ul style="list-style-type: none"> <li>Conduct analysis of U.S. Air Force and U.S. Space Force architectures.</li> </ul> <p><b>FY 2022 Plans:</b></p> <ul style="list-style-type: none"> <li>N/A</li> </ul> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> FY 2022 funding decreased compared to FY 2021 by 15.374M. Funding decreased to realign resources within Department of the Air Force to provide better visibility into funding to support ABMS versus other open architecture efforts. Starting in FY 2022 these activities are realigned to PE 0604006F.</p>				
<p><b>Title:</b> Architecture Experimentation and Evaluation</p> <p><b>Description:</b> Department of Defense needs an agile approach to capability development, integration, and delivery that is both rapid and continuous. Therefore, the program also develops the digital architecture for the Air Force and Space Force via regularly recurring Department of the Air Force Architecture Demonstration and Evaluation events alongside other Services in partnership with one or more operational Commanders. This engine of architecture demonstration and integration affords the opportunity for commanders and operators to shape Minimum Viable capabilities and requirements for operational use. These evaluations and warfighter feedback shape subsequent Department of the Air Force wide architecture activities. The necessity to conduct test and analysis at the architecture level and the speed required by the operational needs require enhanced approaches to traditional test and analysis capabilities, namely new, innovative and sufficiently resourced test and analysis infrastructure, networks, and core subject matter expertise to include employment of military, civilian, reserve, and contractor capabilities.</p> <p><b>FY 2021 Plans:</b> Conduct two Department of the Air Force Architecture Demonstration and Evaluation events.</p> <p><b>FY 2022 Plans:</b> N/A</p> <p><b>FY 2021 to FY 2022 Increase/Decrease Statement:</b> FY 2022 funding decreased compared to FY 2021 by 30.790M. Funding decreased to realign resources with objectives since this line of effort demonstrates and evaluates many different capabilities and architectures rather than within a single program. Starting in FY 2022 these activities are realigned to PE 0604006F.</p>		20.591	30.790	0.000
<b>Accomplishments/Planned Programs Subtotals</b>		139.203	158.492	203.849
<b>D. Other Program Funding Summary (\$ in Millions)</b>				
N/A				

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<b>D. Other Program Funding Summary (\$ in Millions)</b>		
<b>Remarks</b>		
<b>E. Acquisition Strategy</b>		
<p>ABMS will build to a portfolio of acquisition efforts and should not be viewed as a monolithic program. The first acquisition effort is an ACAT III, Capability Release #1 (CR #1). The Department of the Air Force Rapid Capabilities Office (DAF RCO) matured the CR #1 (Airborne Edge Node) Acquisition Strategy and will be briefing the Service Acquisition Executive (SAE) in 3QFY21.</p> <p>The ABMS agile acquisition strategy and development approach is modeled after the path of commercial innovation and internet of things technology practices. The acquisition strategy breaks capabilities - that might traditionally be developed as a monolith in the government - up into modular components and then integrates them through open standards and an open architecture. Modularity and openness enable increased competition and continuous innovation, as well as more rapid upgrade of product capabilities. Software development and hardware development can both follow this path—a proven, successful model that is employed in the commercial world as well as in agile government entities.</p> <p>The iterative nature of technology and speed of technical obsolescence in the 21st century digital age mandate an agile approach to capability development, integration, and delivery that is both rapid and continuous. The DAF RCO will make targeted investments in select areas and technologies to expedite the delivery of warfighter capability and close operational gaps.</p> <p>To enable the speed and agility required by this acquisition strategy, the ABMS acquisition efforts have developed a contracting strategy that is agile. Though the program employs the full range of contracting authorities, ABMS has established the following three primary Broad Agency Announcements: (1) JADC2 Multi-Award, Multi-Level Security (MA-MLS) Indefinite Delivery/Indefinite Quantity (ID/IQ) vehicle; (2) Open Call, and (3) a Cooperative Research and Development Agreement (CRADA); and (4) already existing contract vehicles where ABMS acquisition efforts are within scope. More information about these calls may be found on <a href="https://beta.sam.gov">https://beta.sam.gov</a>.</p>		

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

<b>Appropriation/Budget Activity</b> 3600 / 4	<b>R-1 Program Element (Number/Name)</b> PE 0604003F / <i>Advanced Battle Management System (ABMS)</i>	<b>Project (Number/Name)</b> 640141 / <i>Advanced Battle Management System (ABMS)</i>
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<b>Product Development (\$ in Millions)</b>				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			
DAF RCO - Digital Infrastructure	Various	DAF RCO : Various	-	-		43.922	Oct 2020	57.203	Apr 2022	-		57.203	-	-	-
DAF RCO - Capability Releases	Various	DAF RCO : Various	-	-		68.406	Nov 2020	146.646	Apr 2022	-		146.646	-	-	-
Digital Architectures, Standards, and Concept Development	Various	CAO - Product Line Owners : Various	-	7.506	May 2020	15.374	Oct 2020	-		-		-	-	-	-
Sensor Integration	Various	CAO - Product Line Owners : Various	-	8.808	Jun 2020	-		-		-		-	-	-	-
Multi-Domain Command Data Management	Various	CAO -Product Line Owners : Various	-	9.676	Jul 2020	-		-		-		-	-	-	-
Multi-Domain Secure Processing	Various	CAO - Product Line Owners : Various	-	17.921	Jun 2020	-		-		-		-	-	-	-
Multi-Domain Connectivity	Various	CAO - Product Line Owners : Various	-	25.246	Jun 2020	-		-		-		-	-	-	-
Multi-domain Applications	Various	CAO - Product Line Owners : Various	-	48.455	May 2020	-		-		-		-	-	-	-
Effects Integration	Various	CAO -Product Line Owners : Various	-	1.000	Oct 2020	-		-		-		-	-	-	-
<b>Subtotal</b>			-	118.612		127.702		203.849		-		203.849	-	-	N/A

<b>Test and Evaluation (\$ in Millions)</b>				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			
DAF Architecture Experimentation & Evaluation	Various	Product Line Product Owners : Various	-	20.591	May 2020	30.790	Oct 2020	-		-		-	-	-	-
<b>Subtotal</b>			-	20.591		30.790		-		-		-	-	-	N/A





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<b>Exhibit R-4A, RDT&amp;E Schedule Details:</b> PB 2022 Air Force		<b>Date:</b> May 2021
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<b>ABMS</b>				
Digital Architecture, Standards, and Concepts (CAO)	2	2020	4	2021
Digital Infrastructure (DAF RCO)	3	2020	4	2026
Capability Releases (DAF RCO)	4	2021	4	2026
<b>FY21 Milestones</b>				
FY21 Experimentation & Evaluation #4	2	2021	2	2021
FY21 Experimentation & Evaluation #5	3	2021	4	2021