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Exhibit R-2, RDT&E Budget Item Justification: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3600: <i>Research, Development, Test & Evaluation, Air Force</i> / BA 4: <i>Advanced Component Development & Prototypes (ACD&P)</i>	R-1 Program Element (Number/Name) PE 0604003F / <i>Advanced Battle Management System (ABMS)</i>
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COST (\$ in Millions)	Prior Years	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total	FY 2022	FY 2023	FY 2024	FY 2025	Cost To Complete	Total Cost
Total Program Element	-	0.000	8.000	302.323	0.000	302.323	449.290	590.878	1,087.601	832.229	Continuing	Continuing
640141: <i>Advanced Battle Management System (ABMS)</i>	-	0.000	8.000	302.323	0.000	302.323	449.290	590.878	1,087.601	832.229	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note
 ABMS FY20 total budget request was \$185.6M between PE 0604003F BA 07 and MDC2 PE 0304115F BA 07. Of that request, \$143.6M was enacted for FY20. The enacted funding for FY20 in this BPAC only reflects an \$8M Congressional add. See Section D, Other Program Funding, for a total summation of enacted funds for FY20 ABMS requirements still held in legacy PEs and BPACs.

A. Mission Description and Budget Item Justification

The Advanced Battle Management System (ABMS) portfolio develops the digital infrastructure and tools required for the joint force to provide operationally relevant and fieldable capabilities in support of the National Defense Strategy (NDS). ABMS addresses gaps in interoperability and information sharing for air, land, sea, space, and cyberspace domains. The ABMS lines of effort accelerate the development, integration, transition, and fielding of technologies that enable Joint All-Domain Command and Control.

ABMS investments are divided into seven categories of activities.

Digital Architectures, Standards, and Concept Development: This includes digital engineering and analysis, model-based systems engineering, and related analyses and exploration in support of potential investments in the other six categories.

Sensor Integration: This includes the development, test, and integration of open architecture sensor system. These systems will be based on government-owned standards and provide open and reusable capabilities, initially focused on air and ground moving target indication (AMTI, GMTI).

Multi-Domain Data Management: This includes cloud-based data libraries, data feeds, data wrappers, and data management to improve data discoverability and information sharing across the joint force.

Multi-Domain Secure Processing: This includes hardware and software for multi-level security as well as edge hardware to enable a full range of military operations

Multi-Domain Connectivity: This includes maturation and integration of open software-defined radios and networks, government-owned waveform libraries, and wideband multi-function RF systems. This category also includes the integration and standards required to leverage advances in commercial technology such as 5G networks and proliferated low-earth orbit satellite communications.

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Multi-Domain Applications: This includes cloud-based applications to process sensor data, fuse sensor data from multiple platforms across different domains, combine data into a common multi-domain operating picture, and provide battle management, command, and control (BMC2) functionality.

Effects Integration: This includes development and integration of open smart munitions that enable dynamic kill webs, attritable aircraft that generate combat mass and distributed effects, and real-time updates to mission data files to improve electronic warfare system performance.

The ABMS approach is not a traditional systems acquisition. Instead of acquisition of platforms, ABMS is moving to acquisition of capabilities that are open, available, deployable, and reconfigurable for installation on or use by multiple systems across multiple domains. These capabilities increase the effectiveness and survivability of Air Force, joint, and coalition partners across permissive and contested environments, in all warfighting domains, and at multiple classification levels. ABMS will leverage existing and emerging technology with emphasis on commercial technology and those at technology readiness levels that will enable rapid transition. The innovations from ABMS will augment new and ongoing initiatives aligned with service multi-domain operational priorities.

ABMS funding provides for 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.

This program element may include necessary civilian pay expenses required to manage, execute, and deliver JADC2 capabilities. The use of such program funds would be in addition to the civilian pay expenses budgeted in program elements 0605826F, 0605827F, 0605828F, 0605829F, 0605830F, 0605831F, 0605832F, and 0605898F.

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. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	0.000	0.000	0.000	0.000	0.000
Current President's Budget	0.000	8.000	302.323	0.000	302.323
Total Adjustments	0.000	8.000	302.323	0.000	302.323
• Congressional General Reductions	0.000	0.000			
• Congressional Directed Reductions	0.000	0.000			
• Congressional Rescissions	0.000	0.000			
• Congressional Adds	0.000	8.000			
• 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	302.323	0.000	302.323

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Change Summary Explanation

The ABMS effort was executed in FY20 under BA07 in PE 0604003F and PE 0304115F. In FY21 the funding for both PEs was aligned under BA04 in PE 0604003F for overall efficiency and effort clarity. This is not a New Start. See Section D, Other Program Summary to trace all funds.

C. Accomplishments/Planned Programs (\$ in Millions)

	FY 2019	FY 2020	FY 2021
<p>Title: Advanced Battle Management System</p> <p>Description: ABMS leverages and complements ongoing efforts and emerging technologies across services, agencies, laboratories, and industry partners. The hardware development approach is based on continuous integration and delivery of incremental capability improvement over time, with emphasis on open and modular systems that can be rapidly transitioned and widely deployed. Software will be deployed using a development/security/operations (DevSecOps) approach with multiple partners. Key points of emphasis include open and reusable software, cloud deployments for scaling and data management, and cyber resiliency. The DevSecOps approach directed by DoD facilitates integration efforts by traditional and non-traditional software providers, with or without prime contractor involvement.</p> <p>ABMS executes onramp events with a COCOM sponsor every four months. These events show proposed technical solutions across the ABMS product lines, demonstrate capabilities being developed in an operationally-relevant scenario, and have the potential to generate leave-behind capabilities if requested. The participating platforms and COCOMs will vary from event to event. Capabilities developed in the ABMS portfolio will be presented at onramp events as they become ready for demonstration, with multiple capabilities being demonstrated at each event. Each event informs the next development sprint as well as future events while also reducing technology risk. This approach also facilitates rapid integration by making the technology visible and performing initial operationally-relevant testing for a broad COCOM audience. Specific event costs are contained in the JADC2 PE 3040115F (BPAC 673380), formerly known as MDC2, while development costs are contained in the ABMS PE.</p> <p>FY 2020 Plans: Develop airborne gateway technology for rapid connection and information sharing between existing platforms. The first successful demonstration of communications between F-22 and F-35 using gateways was in December 2019. Test new sensor mesh networks including connection to proliferated low-earth orbit (LEO) commercial satellite communications. The first successful demonstration of this multi-domain mesh network was in December 2019. Additional hardware-related activities in FY 2020 include design of a radar testbed, continued capability improvements to gateways, test of a multi-level secure tablet, continued capability improvements to sensor mesh networks, and initial development of advanced radios and apertures.</p> <p>Develop cloud-based tools for processing of sensor data, fusion of data across platforms and domains, combining data into a multi-domain common operating pictures, and battle management, command, and control (BMC2). The first successful demonstration of this software suite was in December 2019. Additional software-related activities in FY 2020 include creation of</p>	-	8.000	302.323

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C. Accomplishments/Planned Programs (\$ in Millions)		FY 2019	FY 2020	FY 2021
<p>a radar mode library, waveform upgrades to gateways, and initial tests of software tools and cloud access on a multi-level secure tablet.</p> <p>The first on ramp event was held in December 2019 at Eglin AFB and was led by NORAD and USNORTHCOM. This ABMS onramp included Air Force, Army, and Navy system with key first in the areas of connectivity between platforms, mesh networking, and cloud-based battle management. The next FY2020 events will be held in April 2020 and August 2020.</p> <p>FY 2021 Plans: Continue airborne gateway technology development with initial installation on XQ-58 Valkyrie unmanned aircraft. Start development of gateway hardware for KC-46 tanker. First test of radar testbed, expansion of multi-level secure tablet to additional security levels, first operational test of edge processing hardware for disconnected/disadvantaged operations, laboratory test of wideband radios and apertures, initial design of sensor payloads for attritable aircraft, additional technology development and integration based on emerging technology and warfighter needs</p> <p>Continue development, small-scale deployment, and test of cloud-based tools for data processing, data fusion, common operating pictures, and BMC2. Begin using digital systems engineering model to evaluate trades across multiple systems. Continue gateway testing, including new waveform upgrades. Continue testing software tools and cloud access on a multi-level secure tablet. Pursue additional software development, deployment, and scaling based on emerging technology and warfighter needs.</p> <p>The ABMS portfolio will continue to advance concepts and capabilities based on lessons learned from FY2020 events. FY2021 efforts will also include integration of event data with the digital system model. It is important to note that there is no pre-defined or realized objective system. Capabilities are introduced in a rapid fashion building on previous development sprints and events with consistent transition to the field. FY2021 events are planned for December 2020, April 2021 and August 2021 with smaller-scale test events between the planned events.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: FY20 (\$144.491M, see Section D for totals including other program funding) to FY21 (\$302.323M) delta is \$157.832M. Additional funds enable continued development of FY20 accomplishments and cumulative integration and incorporation into FY21 objectives.</p>				
Accomplishments/Planned Programs Subtotals		-	8.000	302.323

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

<u>Line Item</u>	<u>FY 2019</u>	<u>FY 2020</u>	<u>FY 2021</u> <u>Base</u>	<u>FY 2021</u> <u>OCO</u>	<u>FY 2021</u> <u>Total</u>	<u>FY 2022</u>	<u>FY 2023</u>	<u>FY 2024</u>	<u>FY 2025</u>	<u>Cost To</u> <u>Complete</u>	<u>Total Cost</u>
• RDTE 07 0604003F: <i>Advanced Battle Management System (ABMS)</i>	27.883	35.611	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	63.494
• RDTE 07 0304115F: <i>Multi Domain Command and Control (MDC2)</i>	0.000	100.880	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	100.880

Remarks

Beginning in FY21 the MDC2 PE 0304115F (also known as Joint All Domain Command and Control, JADC2), provides non-RDT&E operations and infrastructure support elements for Joint All Domain Command and Control. All MDC2 (JADC2) technology development (RDT&E) is executed through the ABMS PE.

E. Acquisition Strategy

ABMS will provide capability through existing program office, program executive officers, service labs, services or agencies, programs of record, and their respective contracts and agreements. ABMS is not a single program of record. Many lines of effort will be horizontally integrated by the USAF Chief Architect and partner organizations. Program execution (cost, schedule, and performance) will be managed by the Chief Architect Integration Office and the appropriate program office.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Air Force **Date:** February 2020

Appropriation/Budget Activity 3600 / 4	R-1 Program Element (Number/Name) PE 0604003F / <i>Advanced Battle Management System (ABMS)</i>	Project (Number/Name) 640141 / <i>Advanced Battle Management System (ABMS)</i>
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Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 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			
ABMS HW, SW & On Ramps	Various	Product Line Owners : Various	-	-		8.000		302.323		-		302.323	Continuing	Continuing	-
Subtotal			-	-		8.000		302.323		-		302.323	Continuing	Continuing	N/A
Project Cost Totals			-	-		8.000		302.323		-		302.323	Continuing	Continuing	N/A

Remarks
 In FY20 this effort was held in MDC2 PE 0304115F BA 07 (now known as JADC2) and ABMS PE 0604003F BA 07; the two PEs were merged under the ABMS PE 0604003F BA 04 in FY21.

 Please see section D: Other Program Funding Summary to see comprehensive level of funding for FY21.

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Air Force		Date: February 2020
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	FY 2019				FY 2020				FY 2021				FY 2022				FY 2023				FY 2024				FY 2025			
	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

ABMS Execution	
Software Development and Integration	[Redacted]
Hardware Maturation and Demonstration	[Redacted]
Demonstration/On Ramp Events	[Redacted]
FY21 Milestones	
FY21 On Ramp 1	[Redacted]
FY21 On Ramp 2	[Redacted]
FY21 On Ramp 3	[Redacted]

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Air Force		Date: February 2020
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Schedule Details

Events by Sub Project	Start		End	
	Quarter	Year	Quarter	Year
<i>ABMS Execution</i>				
Software Development and Integration	1	2020	4	2025
Hardware Maturation and Demonstration	1	2020	4	2025
Demonstration/On Ramp Events	1	2020	4	2025
<i>FY21 Milestones</i>				
FY21 On Ramp 1	1	2021	1	2021
FY21 On Ramp 2	3	2021	3	2021
FY21 On Ramp 3	4	2021	4	2021