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

Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 4: Advanced Component Development & Prototypes (ACD&P)</i>	R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</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	-	44.743	52.980	26.482	0.500	26.982	0.500	0.000	0.000	0.000	Continuing	Continuing
FG9: <i>Air and Missile Defense (AMD) Electronic Warfare</i>	-	44.743	52.980	26.482	0.500	26.982	0.500	0.000	0.000	0.000	Continuing	Continuing

Note

Beginning in FY 2020, the Army Long-Range Persistent Surveillance (ALPS) system efforts transition to Program Element 0604741A, Project 126.

A. Mission Description and Budget Item Justification

Funding in this program supports Cyber and Electromagnetic Activities (CEMA) efforts to conduct operational realistic assessments of Army Integrated Fires performance, identify system vulnerabilities, and develop mitigations against threats across the Cyber and Electromagnetic spectrum. Army radars and sensors, integrated air and missile defense mission command and fire control, Radio Frequency (RF) data and voice networks, and Positioning, Navigation, and Timing (PNT) technology will be assessed against current and postulated threat systems and techniques. Potential solutions developed by the Army, other Services, and Defense agencies (for example Missile Defense Agency) to close identified gaps will be demonstrated and assessed in live and simulated CEMA environments. Assessment events will be conducted approximately every two years. Implementation of potential solutions will occur between events using system-specific funding. The proposed solutions will then be assessed at the next event after implementation.

Included in this line are funds to plan and execute periodic CEMA activities with Army Integrated Fires systems, to include other Service and other Agency radar and sensor systems as appropriate. Upon completion of CEMA demonstration analyses, funding will facilitate initial recommendations for potential mitigations and solutions to Army sensors, C2, and RF data link vulnerabilities. Efforts in this program will also develop tools for use by Army radar and sensor systems to improve overall system performance in contested environments, to include effects-based CEMA Modeling and Simulation (M&S) to assess Army CEMA concepts in Hardware-In-The-Loop (HWIL) environment. Additionally, virtual models of critical hardware and software are being developed and implemented to allow for destructive testing with advanced CEMA threats in a lab environment. There will be continual interface with intelligence communities to maintain cognizance of emerging CEMA threats and incorporate these threats in future CEMA demonstrations. These activities follow a time-phased roadmap that identifies the investments needed to improve the resiliency of Army radar and sensors, C2, and RF data and voice networks in contested CEMA environments.

FY 2021 base funding of \$26.482 million will be used to plan and execute the FY 2021 Survivability Exercise to assess the performance of the Army Integrated Fires architecture, with Joint participants, in a live, tactically relevant, contested CEMA environment. Funds will be used to analyze the performance data of the FY 2021 Survivability Exercise participant weapon systems, identify vulnerabilities, and develop rapid mitigation concepts. Additionally, the funds will be used to execute Cyber Table Tops, continue the development of virtualized critical hardware and software, conduct destructive cyber vulnerability assessments, and integrate artificial intelligence and machine learning into weapon systems to mitigate current and future CEMA threats. FY 2021 OCO funding of \$.500 million will be used to complete operational assessment of ALPS prototype systems in support of a Combatant Commander.

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Appropriation/Budget Activity 2040: <i>Research, Development, Test & Evaluation, Army / BA 4: Advanced Component Development & Prototypes (ACD&P)</i>	R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</i>
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B. Program Change Summary (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Previous President's Budget	46.231	15.648	27.008	-	27.008
Current President's Budget	44.743	52.980	26.482	0.500	26.982
Total Adjustments	-1.488	37.332	-0.526	0.500	-0.026
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-7.668			
• Congressional Rescissions	-	-			
• Congressional Adds	-	45.000			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-1.488	-			
• SBIR/STTR Transfer	-	-			
• Adjustments to Budget Years	-	-	-0.526	0.500	-0.026

Congressional Add Details (\$ in Millions, and Includes General Reductions)

Project: FG9: *Air and Missile Defense (AMD) Electronic Warfare*
 Congressional Add: *Interoperability of integrated air and missile defense.*
 Congressional Add: *Artificial Intelligence and Machine Learning*
 Congressional Add: *Cyber and Supply Chain Resiliency*

	FY 2019	FY 2020
	20.000	15.000
	-	25.000
	-	5.000
Congressional Add Subtotals for Project: FG9	20.000	45.000
Congressional Add Totals for all Projects	20.000	45.000

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army										Date: February 2020		
Appropriation/Budget Activity 2040 / 4					R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</i>				Project (Number/Name) FG9 / <i>Air and Missile Defense (AMD) Electronic Warfare</i>			
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
FG9: <i>Air and Missile Defense (AMD) Electronic Warfare</i>	-	44.743	52.980	26.482	0.500	26.982	0.500	0.000	0.000	0.000	Continuing	Continuing
Quantity of RDT&E Articles	-	-	-	-	-	-	-	-	-	-		

Note

Beginning in FY 2020, the Army Long-Range Persistent Surveillance (ALPS) system efforts transition to Program Element 0604741A, Project 126.

A. Mission Description and Budget Item Justification

Funding in this program supports Cyber and Electromagnetic Activities (CEMA) efforts to conduct operational realistic assessments of Army Integrated Fires performance, identify system vulnerabilities, and develop mitigations against threats across the Cyber and Electromagnetic spectrum. Army radars and sensors, integrated air and missile defense mission command and fire control, Radio Frequency (RF) data and voice networks, and Positioning, Navigation, and Timing (PNT) technology will be assessed against current and postulated threat systems and techniques. Potential solutions developed by the Army, other Services, and Defense agencies (for example Missile Defense Agency) to close identified gaps will be demonstrated and assessed in live and simulated CEMA environments. Assessment events will be conducted approximately every two years. Implementation of potential solutions will occur between events using system-specific funding. The proposed solutions will then be assessed at the next event after implementation.

Included in this line are funds to plan and execute periodic CEMA activities with Army Integrated Fires systems, to include other Service and other Agency radar and sensor systems as appropriate. Upon completion of CEMA demonstration analyses, funding will facilitate initial recommendations for potential mitigations and solutions to Army sensors, C2, and RF data link vulnerabilities. Efforts in this program will also develop tools for use by Army radar and sensor systems to improve overall system performance in contested environments, to include effects-based CEMA Modeling and Simulation (M&S) to assess Army CEMA concepts in Hardware-In-The-Loop (HWIL) environment. Additionally, virtual models of critical hardware and software are being developed and implemented to allow for destructive testing with advanced CEMA threats in a lab environment. There will be continual interface with intelligence communities to maintain cognizance of emerging CEMA threats and incorporate these threats in future CEMA demonstrations. These activities follow a time-phased roadmap that identifies the investments needed to improve the resiliency of Army radar and sensors, C2, and RF data and voice networks in contested CEMA environments.

FY 2021 base funding of \$26.482 million will be used to plan and execute the FY 2021 Survivability Exercise to assess the performance of the Army Integrated Fires architecture, with Joint participants, in a live, tactically relevant, contested CEMA environment. Funds will be used to analyze the performance data of the FY 2021 Survivability Exercise participant weapon systems, identify vulnerabilities, and develop rapid mitigation concepts. Additionally, the funds will be used to execute Cyber Table Tops, continue the development of virtualized critical hardware and software, conduct destructive cyber vulnerability assessments, and integrate artificial intelligence and machine learning into weapon systems to mitigate current and future CEMA threats. FY2021 OCO funding of \$.500 million will be used to complete operational assessment of ALPS prototype systems in support of a Combatant Commander.

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army			Date: February 2020		
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering	Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare			
B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
<p>Title: Advanced Electronic Protection Enhancements</p> <p>Description: Provides Cyber and Electromagnetic Activities (CEMA) planning, conducts CEMA demonstrations and post-mission analysis.</p> <p>FY 2020 Plans: Funding will be provided for continued system analysis to identify and recommend rapid mitigation concepts following the P-12 event; initial planning and preparation activities for P-13; conduct a CEMA lab event (C Series) with a virtualized AIAMD systems of systems architecture to measure system and mission performance against advanced destructive cyber and electromagnetic threats; continue development of algorithm based solutions to identify, characterize, and mitigate performance impacts of CEMA threats; update the Cyber and Electromagnetic Activities (CEMA) roadmap and strategy to ensure coordination and execution of prioritized goals; and to continue virtualization of additional AIAMD sensors, launchers, C2, and supporting architecture.</p> <p>FY 2021 Base Plans: Funds will be used to plan and execute the FY 2021 Survivability Exercise to assess the performance of the Army Integrated Fires architecture, with Joint participants, in a live, tactically relevant, contested CEMA environment. Funds will be used to analyze the performance data of the FY 2021 Survivability Exercise participant weapon systems, identify vulnerabilities, and develop rapid mitigation concepts. Additionally, the funds will be used to execute Cyber Table Tops, continue the development of virtualized critical hardware and software, conduct destructive cyber vulnerability assessments, and integrate artificial intelligence and machine learning into weapon systems to mitigate current and future CEMA threats.</p> <p>FY 2021 OCO Plans: Funds will be used to continue an operational assessment of ALPS prototype systems in support of a Combatant Commander identified need.</p> <p>FY 2020 to FY 2021 Increase/Decrease Statement: The funding decreases from FY 2020 to FY 2021 due to completion of Artificial Intelligence/Machine Learning and Cyber and Supply Chain Resiliency efforts.</p>	24.743	7.641	26.482	0.500	26.982
<p>Title: FY 2020 SBIR/STTR Transfer</p> <p>Description: Funding transferred in accordance with Title 15 USC ?638</p> <p>FY 2020 Plans:</p>	-	0.339	-	-	-

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Exhibit R-2A, RDT&E Project Justification: PB 2021 Army	Date: February 2020
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Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering	Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare
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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2019	FY 2020	FY 2021 Base	FY 2021 OCO	FY 2021 Total
Funding transferred in accordance with Title 15 USC ?638					
<i>FY 2020 to FY 2021 Increase/Decrease Statement:</i>					
Funding transferred in accordance with Title 15 USC ?638					
Accomplishments/Planned Programs Subtotals	24.743	7.980	26.482	0.500	26.982

	FY 2019	FY 2020
<i>Congressional Add:</i> Interoperability of integrated air and missile defense.	20.000	15.000
<i>FY 2019 Accomplishments:</i> Interoperability of integrated air and missile defense.		
<i>FY 2020 Plans:</i> Interoperability of integrated air and missile defense.		
<i>Congressional Add:</i> Artificial Intelligence and Machine Learning	-	25.000
<i>FY 2020 Plans:</i> Artificial Intelligence and Machine Learning		
<i>Congressional Add:</i> Cyber and Supply Chain Resiliency	-	5.000
<i>FY 2020 Plans:</i> Cyber and Supply Chain Resiliency		
Congressional Adds Subtotals	20.000	45.000

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

N/A

Remarks

D. Acquisition Strategy

Assessment events will be conducted approximately every two years in live and simulated CEMA environments. In addition to Government planning and conduct of assessments, funding will also be provided through various contracts for subject matter expertise.

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Exhibit R-3, RDT&E Project Cost Analysis: PB 2021 Army												Date: February 2020			
Appropriation/Budget Activity 2040 / 4				R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering						Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare					
Management Services (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Government Program Management	Various	Various : Various	2.831	1.688	Nov 2018	0.907	Nov 2019	0.926	Nov 2020	-		0.926	Continuing	Continuing	Continuing
FY 2020 SBIR/STTR Transfer	TBD	Various : Various	-	-		0.339		-		-		-	0.000	0.339	-
Subtotal			2.831	1.688		1.246		0.926		-		0.926	Continuing	Continuing	N/A
Product Development (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
System Integration Assessment	Various	Various : Various	1.538	2.840	Nov 2018	2.673	Nov 2019	2.934	Nov 2020	-		2.934	Continuing	Continuing	Continuing
Interoperability of Integrated AMD	SS/CPFF	Various : Various	15.000	20.000	Feb 2019	14.957	Feb 2020	-		-		-	0.000	49.957	-
Cyber and Supply Chain Resiliency	Various	Various : Various	-	-		3.273	Mar 2020	-		-		-	0.000	3.273	-
Artificial Intelligence and Machine Learning	Various	Various : Various	-	-		14.667	Feb 2020	-		-		-	0.000	14.667	-
ALPS Development/ Integration	Various	Various : Various	28.831	7.495	Jan 2019	0.458	Jan 2020	0.000		0.500	Jan 2020	0.500	0.000	37.284	-
Subtotal			45.369	30.335		36.028		2.934		0.500		3.434	Continuing	Continuing	N/A
Support (\$ in Millions)				FY 2019		FY 2020		FY 2021 Base		FY 2021 OCO		FY 2021 Total			
Cost Category Item	Contract Method & Type	Performing Activity & Location	Prior Years	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Award Date	Cost	Cost To Complete	Total Cost	Target Value of Contract
Component Assessments & Research and Trade Studies	Various	Various : Various	12.512	5.850	Feb 2019	10.982	Feb 2020	12.801	Feb 2021	-		12.801	Continuing	Continuing	Continuing
Subtotal			12.512	5.850		10.982		12.801		-		12.801	Continuing	Continuing	N/A

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Exhibit R-4, RDT&E Schedule Profile: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0603327A / Air and Missile Defense Systems Engineering	Project (Number/Name) FG9 / Air and Missile Defense (AMD) Electronic Warfare

Event Name	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
P-11 Analysis Efforts, Trade Studies, and Implementation	█																											
P-12 Demonstration Planning Efforts	█	█	█	█																								
P-12 Demonstration								█																				
P-12 Analysis Efforts, Trade Studies, and Implementation								█																				
FY21 Survivability Exercise Planning Efforts												█																
FY21 Survivability Exercise																█												
FY21 Survivability Exercise Analysis and Trade Studies																				█								
FY 21 Survivability Exercise Report and Implementation																												
Air and Missile Defense Systems Hardware Virtualization																												
Interoperability of Integrated Air and Missile Defense (Congress																												

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Exhibit R-4A, RDT&E Schedule Details: PB 2021 Army		Date: February 2020
Appropriation/Budget Activity 2040 / 4	R-1 Program Element (Number/Name) PE 0603327A / <i>Air and Missile Defense Systems Engineering</i>	Project (Number/Name) FG9 / <i>Air and Missile Defense (AMD) Electronic Warfare</i>

Schedule Details

Events	Start		End	
	Quarter	Year	Quarter	Year
P-11 Demonstration	2	2018	3	2018
P-11 Analysis Efforts, Trade Studies, and Implementation	3	2018	1	2019
P-12 Demonstration Planning Efforts	4	2018	4	2019
P-12 Demonstration	4	2019	1	2020
P-12 Analysis Efforts, Trade Studies, and Implementation	1	2020	4	2020
FY21 Survivability Exercise Planning Efforts	4	2020	2	2021
FY21 Survivability Exercise	2	2021	3	2021
FY21 Survivability Exercise Analysis and Trade Studies	3	2021	1	2022
FY 21 Survivability Exercise Report and Implementation	2	2022	4	2022
Air and Missile Defense Systems Hardware Virtualization	2	2019	4	2022
Interoperability of Integrated Air and Missile Defense (Congressional Adds)	4	2018	2	2021